NEUTRON USERS IN EUROPE:

Facility-Based Insights and Scientific Trends

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FOREWORD

Supported by a strong network of complementary facilities, Europe has led the field of neutron scattering for several decades. Many reports have been published in the past highlighting the scientific research carried out by European neutron scatterers, their position in the international arena and the future outlook of the community. However, a consolidated document providing a thorough insight into technical capacity of neutron sources and current scientific trends in neutron scattering in Europe had been missing. This report fills the gap.

Results of the pan-European survey presented in this report provide a useful source of information to help ESS to plan a tailored user service that matches scientific trends in Europe, and address the needs of a diverse user community. We hope and believe that the insights in the report will also prove to be useful for other facilities and European users too. The neutron sources are showcased in individual annexes and the data that had been aggregated from their answers is also presented in a wider European context.

In order to meet the challenges of our age and uncover the fundamental secrets of nature, we are increasingly dependent on the understanding of the properties and behaviour of matter at the atomic and molecular level. The research areas that benefit from neutron scattering are as diverse as science itself, covering physics, chemistry, geology, biology and medicine. The data collected in the survey demonstrate the applicability of science carried out at neutron sources and its relevance for society at large.

This report is the outcome of a collaborative effort between ESS, BrightnESS partners, and 15 neutron sources which provided data in the pan-European survey. We would like to take this opportunity to express gratitude to all facilities for teaming up with us, contributing to the development of the survey questionnaire, submitting their answers and working hard to make this happen. We wish to thank the European Commission for supporting the publication of this report through BrightnESS, a project funded under the EU Framework Programme for Research and Innovation, Horizon 2020.

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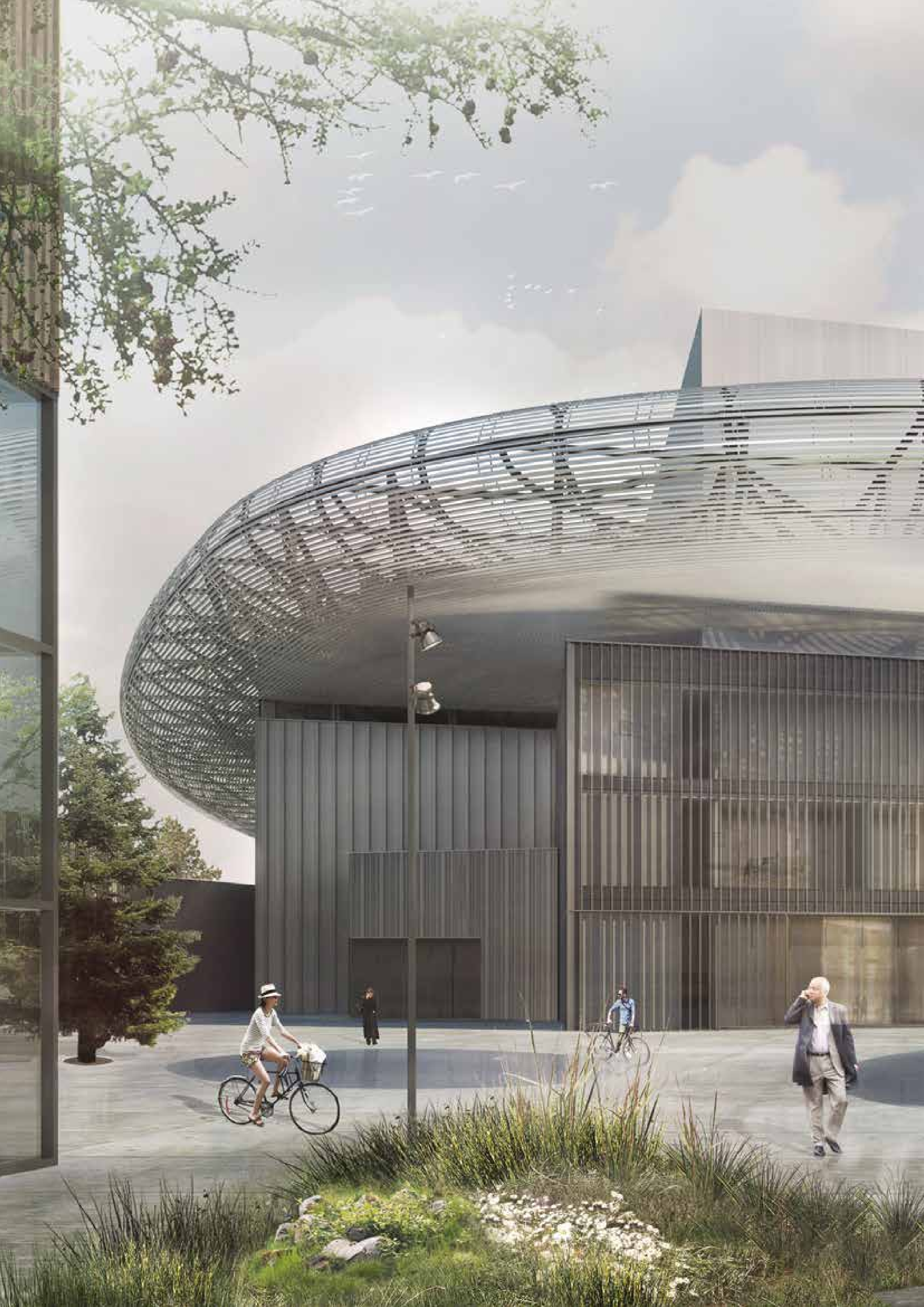

PREFACE

The European Spallation Source (ESS) is a partnership of 13 Founding Member and two Founding Observer countries committed to the goal of building and operating the world-leading facility for research using neutrons. The research infrastructure is under construction in Lund, Sweden, while the ESS Data Management and Software Centre (DMSC) is located in Copenhagen, Denmark. A total of 15 instruments will be built during the Construction Phase to serve the neutron user community, with more instruments built during Operations. The suite of ESS instruments will gain 10-100 times over current performance, enabling neutron methods to study real-world samples under real-world conditions. Generating neutron beams for science will add value to a broad range of research, from life sciences to engineering materials, heritage conservation to magnetism, and particle physics. The foreseen start of the ESS user programme is in 2023.

Acknowledging the relevance of ESS in the European science landscape, the European Union financially supports ESS through BrightnESS.[1] The three-year project implemented by 18 European partners aims to ensure that key challenges are met in order to build a European research infrastructure that can deliver high-impact scientific and technological knowledge.

In its INFRADEV-3-2015 call, the European Commission recognised the challenges and difficulties faced by new pan-European infrastructures such as ESS in the process of becoming fully operational, when technologies, services, and procedures need to be finalised and users' trust and awareness must be built. As a response to the appeal from the European Commission on research infrastructures to give specific attention to interactions with end-users, one of the strategic goals of BrightnESS is to gain the trust of future users of ESS from science and industry, and to understand the role of key players in the innovation ecosystem that ESS will foster. To this end, the BrightnESS team, within the framework of Work Package 6, entitled "Collaboration, Communication, and Dissemination", and Work Package 3, entitled "Organisational Innovation", designed and carried out activities with the aim of acquiring a profound understanding of target groups relevant for ESS and its partners. In 2016, BrightnESS launched three parallel initiatives, aimed at identifying the needs and expectations of:

- Scientific and academic users,
- Industrial users,
- Players in innovation ecosystems.

The ultimate goal of the set of activities was not only to gain a deeper insight into each of the groups, but also to use the findings to develop tailored outreach and engagement strategies, and to shape ESS policies for access and innovation. Each group was assessed through a custom-made approach which best conformed to the group specifics.

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[1] BrightnESS is an EU-funded project in support of ESS within the European Commission's Horizon 2020 Research and Innovation programme, under the INFRADEV-3 call. It is a partnership of 18 European institutes and universities from 11 countries, with a total budget of almost 20 MEUR and a duration of three years.

European survey of scientific and academic users

- The future users of ESS from science and academia were assessed through a survey of existing neutron research infrastructures in Europe. The development of the survey questionnaire was a collaborative effort of BrightnESS partners and research facilities participating in the survey. In March 2016, the final version of the electronic questionnaire was distributed to neutron sources across Europe. 15 out of 17 neutron sources invited to take part in the survey provided answers. While Demokritos and Joint Research Centre opted out, their absence did not affect the results of the survey due to the relatively small size of these facilities.
- The aim of the activity was to collect consolidated information on users of neutron sources in Europe, and identify scientific trends in the European neutron scattering community.
- The results are presented in the report you are reading. The document serves as a compendium of 15 neutron sources in Europe, and provides the scientific community with a detailed and up-to-date overview of their technical capacity, user community, and the usage of instruments across scientific disciplines, among others. The report also includes a consolidated section, which presents the collected data in a pan-European context.

Regional focus groups and one-on-one interviews with industrial users

- The future users of ESS from industry were assessed through focus groups and one-on-one interviews carried out by BrightnESS partner institutes in six different regional hubs in Europe, which were specifically created to maximise the geographical impact of engagement and outreach activities conducted within the framework of the project.
- The aim of the activity was to gather information about past experiences from industrial users, ideally representing R&D departments, who have already conducted measurements at research facilities using neutrons and/or X-rays, and to find out what needs and expectations they have regarding future services provided by ESS.
- The results are presented in a separately published consolidated report summarising the main findings from each hub. The report provides a qualitative analysis of the potential industrial user community in Europe, and also includes detailed hub-specific sections.

Mapping of the innovation ecosystem of ESS

- Players in the innovation ecosystem of ESS were assessed through a mapping exercise supported by a thorough desk research, a benchmarking analysis, and assessment of the overall competitiveness of regions similar to the one where ESS is based, as well as qualitative interviews with innovation experts and technology transfer officers in the selected regions.
- The aim of the activity was to identify key players and assess the potential of the innovation ecosystem surrounding ESS.
- The results are presented in a separately published report that compares the scientific capacity of the region where ESS is based to other regions in Europe, identifies key players in the innovation ecosystem of ESS, and recommends which actions and mechanisms adopted by research facilities elsewhere could be successfully replicated for the benefit of ESS, its region, and Europe at large.

EXECUTIVE SUMMARY

On behalf of the consortium of partners of the EU-funded project BrightnESS, in Spring 2016 the European Spallation Source ERIC (ESS) started to systematically collect consolidated information about the technical capacity of 15 neutron sources in Europe in order to identify scientific trends in the European neutron scattering community. The primary objective of the activity was to provide ESS and its partners with data relevant for the development of tailored outreach and engagement strategies, the establishment of vital relations with academia and science, and the drafting of ESS policies for innovation and access. The electronic survey questionnaire, developed in collaboration with the BrightnESS partners and participating facilities, was distributed to Heads of Research Infrastructures and/or the Heads of Users Offices across Europe. Key conclusions and observations from the survey are summarised below.

THE NEUTRON LANDSCAPE IN EUROPE

Facilities

Based on the technical specifications of the facilities, their user bases, and scientific activities, this report introduces **three categories of neutron sources** to describe the European landscape:

- **Category A: Large-scale facilities:** Neutron sources in this category have a large user base comprising of 450–1600 unique users. Principal Investigators who carry out research at these facilities are affiliated with institutes based in a variety of countries, in and outside Europe. The facilities have between 20-37 instruments deployable over 8-10 different experimental methods. Neutron sources in Category A include ISIS, ILL, MLZ-FRM II, LLB, and SINQ.
- **Category B: Medium-scale facilities:** Neutron sources in this category have a medium-sized user base comprising of 50–350 unique users. Principal Investigators who carry out research at these facilities are affiliated with institutes based in a variety of countries, in and outside Europe. The facilities have between 8-15 instruments deployable over 7-9 different experimental methods. Neutron sources in Category B include BER II, BNC, and NPL.
- **Category C: Small-scale facilities:** Neutron sources in this category have a small user base comprising of up to 50 unique users. The group of Principal Investigators who carry out research at these facilities is less international than that of facilities in Categories A and B. The institutes they are affiliated with are based in a limited number of mostly European countries. The facilities have between 1-9 instruments deployable over 1-5 different experimental methods. Neutron sources in Category C include TRIGA JGU, JEEP II, TRIGA JSI, RPI, ATI, MARIA, and RID.

User Base

The neutron scattering community in Europe is stable and comprises 5777 unique users (see figures 2.1, 2.2, and 2.3). The total number of unique users of neutron sources in Europe was calculated as a sum of unique users who performed experiments in a given year at 15 facilities participating in the survey. Since neutron users can access more than one facility per year, some of them might have been counted more than once. The international character of the community is revealed by the fact that Principal Investigators (PIs) come from 31 different European countries (see figure 2.12, double counting unaccounted for as inherent to the method used to collect data) and there is also a significant proportion (11%) of non-European PIs who carry out research at neutron sources in Europe. Almost 69% of PIs come from countries which host large-scaled facilities of Category A, i.e. Germany, the United Kingdom, France, and Switzerland. The majority of PIs (89%) carry out research at neutron sources in Category A. Considering the home country of institutes the Principal Investigators are affiliated with, we can conclude that facilities in Category A and B have a diverse international user base. The user base of Category C is less international and dominated by internal neutron users (see figure 2.9). **As the world's most powerful neutron source, the European Spallation Source, with its at least 22 instruments of world leading performance will be a facility of Category A. As such it can be expected to serve a diverse European community. This will stimulate the neutron scattering community in Europe by elevating research using neutrons to a new level.**

Importance of Small- and Medium-Scale Neutron Sources

Small- and medium-scale neutron sources of Category B and C play an important role in the European landscape. In alignment with the technical performance of their respective instrument suites, facilities in Category C specialise in a few scattering techniques, such as small angle neutron scattering, powder-liquid diffraction, and imaging (see figures 3.4, 3.8 and 3.12). They have a strong position in non-scattering activities related to isotopes and activation analysis, and thus offer instrumentation and methods which are complementary to the instrumentation at Category A and have a wide variety of applications among industrial users. Together with medium-scale neutron sources, they not only serve as focal points for local, regional, and international user communities, but also provide a much-needed scientific environment to train future neutron users and prepare PhD students for advanced techniques at facilities of Category A. Neutron sources in Category B and C collectively generate approximately one third of all beam days (see figures 3.5, 3.7 and 3.8) available to users in Europe per year. Their scientific expertise in a specific area of science makes them an invaluable focus point for a specific community. Taken together, this demonstrates the **importance of small- and medium-scale research facilities in terms of unleashing the scientific potential and productivity of the European neutron scattering community.**

INNOVATION AND FUNDING STREAMS

Innovation Potential

As much as 85% of beam time available in Europe is used by academia (see figure 2.10) to do basic and applied science research that pushes the boundaries of knowledge. More than 40% of the overall research carried out at neutron sources in Europe aims to address major societal challenges identified in Horizon 2020, as well as the Europe 2020 strategy (see figure 3.14). These include research related to energy (14%), climate and environment (10%), health (10%), food and water (5%), transport (1%), and soft security challenges (1%). In that sense, neutron sources help to drive innovation and deploy science for the benefit of society. The percentage of research carried out by industry alone or in collaboration with academia (15% combined, see figure 2.10) proves the relevance of neutron scattering for industrial R&D. These numbers indicate **the innovation potential of ESS in strengthening the knowledge transfer from basic science to applied research, and accelerating the development of novel products and services.**

Funding Streams

Neutron sources in Europe operate on a diversified set of funding streams, which represent a healthy mixture of classic research budgets, national and international grant schemes, as well as revenues from proprietary research. The overview of a variety of funding sources presented in figure 2.11 provides a useful **guideline for ESS in preparing for its Operations Phase.**

ESS INSTRUMENT SUITE

Neutron users currently have access to 195 instruments (see figure 3.1) at 15 different neutron sources in Europe. The highest number of scattering instruments is available for powder/liquid diffraction (28), small angle neutron scattering (27), and spectroscopy (45), including cold/thermal triple axis spectroscopy (20), cold/thermal time-of-flight spectroscopy (13), high-resolution spectroscopy (10), and vibrational spectroscopy (2). 15 instruments are used for nuclear and particle physics. When deciding on the composition of its instrument suite, ESS has adopted an approach similar to the pattern observed at large-scale facilities in Category A. These facilities provide users with the opportunity to utilise a full range of neutron scattering techniques (see figure 3.2). In the same fashion, the instrument suite at ESS will meet the cardinal needs of the user community in Europe and beyond. It will allow users from academia, science, and industry to deploy the most frequently used methods to carry out their research, including diffraction, spectroscopy, small angle neutron scattering, reflectometry, and imaging. Proportionally, neutron users presently use these methods 32%, 25%, 16%, 12%, and 8% of the beam time respectively (see figure 3.17). The table on the next page gives a detailed overview of 15 approved instruments, which will be made available to users at ESS, and also the prospective usage of these instruments across science fields. In addition to that, by the end of the decade, ESS will have seven more instruments designed to meet special needs of particular scientific communities, including those that focus on particle physics, and increase the overall capacity of the facility. In this respect, the total of 22 instruments at ESS will play a crucial role in providing the user community in Europe with stable access to a variety of neutron scattering techniques. LLB, with 23 instruments[1], and BER II, with 13 instruments (10 in user operation from 2016 onwards), will be decommissioned by the end of the decade. **The European Spallation Source will, in a balanced way, serve a wide community of neutron users from various scientific areas. From the start of the user programme, the instrumentation at ESS will exceed the performance of instruments which are currently available at other neutron sources in Europe, and the facility will allow for further improvements later in operation.**

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[1] The total number of instruments at LLB is 23. Out of these, 21 were counted in the total number of instruments in Europe, as data for the other two are not available. See the LLB annex for details.

ESS INSTRUMENTS

The table presents an overview of ESS instruments, instrument classes, and use areas. Darker shades in the left column indicate approved instruments.

LARGE-SCALE STRUCTURES	ODIN Multi-Purpose Imaging	Life Sciences; Soft Condensed Matter; Magnetism & Superconductivity; Engineering & Geo Sciences; Archaeology & Heritage Conservation
LARGE-SCALE STRUCTURES	SKADI General Purpose SANS	Chemistry of Materials; Soft Condensed Matter; Magnetism & Superconductivity; Energy Research
LARGE-SCALE STRUCTURES	LoKI Broadband SANS	Life Sciences; Soft Condensed Matter
LARGE-SCALE STRUCTURES	Surface Scattering	Life Sciences; Soft Condensed Matter; Chemistry of Materials; Magnetism & Superconductivity
LARGE-SCALE STRUCTURES	FREIA Liquids Reflectometer	Life Sciences; Soft Condensed Matter; Chemistry of Materials
LARGE-SCALE STRUCTURES	ESTIA Focusing Reflectometer	Magnetism & Superconductivity; Chemistry of Materials; Energy Research; Soft Condensed Matter
DIFFRACTION	HEIMDAL Hybrid Diffractometer	Chemistry of Materials; Energy Research; Engineering & Geo Sciences; Magnetism & Superconductivity
DIFFRACTION	DREAM Bispectral Powder Diffractometer	Magnetism & Superconductivity; Chemistry of Materials; Energy Research; Engineering & Geo Sciences
DIFFRACTION	Monochromatic Powder Diffractometer	Chemistry of Materials; Energy Research; Magnetism & Superconductivity
DIFFRACTION	BEER Engineering Diffractometer	Engineering & Geo Sciences; Chemistry of Materials; Energy Research
DIFFRACTION	Extreme Conditions Diffractometer	Energy Research; Engineering & Geo Sciences; Magnetism & Superconductivity; Chemistry of Materials
DIFFRACTION	MAGiC Magnetism Single Crystal Diffractometer	Magnetism & Superconductivity; Chemistry of Materials
DIFFRACTION	NMX Macromolecular Crystallography	Life Sciences; Magnetism & Superconductivity
SPECTROSCOPY	CSPEC Cold Chopper Spectrometer	Life Sciences; Soft Condensed Matter; Chemistry of Materials; Magnetism & Superconductivity
SPECTROSCOPY	Broadband Spectrometer	Life Sciences; Soft Condensed Matter; Chemistry of Materials; Magnetism & Superconductivity
SPECTROSCOPY	T-REX Bisprectral Chopper Spectrometer	Magnetism & Superconductivity; Chemistry of Materials; Energy Research
SPECTROSCOPY	BIFROST Extreme Environment Spectrometer	Magnetism & Superconductivity; Chemistry of Materials; Energy Research; Engineering & Geo Sciences
SPECTROSCOPY	VESPA Vibrational Spectrometer	Magnetism & Superconductivity; Chemistry of Materials; Energy Research
SPECTROSCOPY	MIRACLES Backscattering Spectrometer	Life Sciences; Soft Condensed Matter; Chemistry of Materials
SPECTROSCOPY	High-Resolution Spin-Echo	Life Sciences; Soft Condensed Matter; Chemistry of Materials; Energy Research
SPECTROSCOPY	Wide-Angle Spin-Echo	Life Sciences; Soft Condensed Matter; Magnetism & Superconductivity; Energy Research
	Particle Physics Instrument	Particle Physics

LIFE SCIENCES
SOFT CONDENSED MATTER
CHEMISTRY OF MATERIALS
ENERGY RESEARCH
MAGNETISM & SUPERCONDUCTIVITY
ENGINEERING & GEO SCIENCES
ARCHAEOLOGY & HERITAGE CONSERVATION
PARTICLE PHYSICS

INTRODUCTION

The European Spallation Source is a multi-disciplinary research centre based on what will be the world's most powerful neutron source. This new facility, currently under construction in Lund and with its Data Management and Software Centre in Copenhagen, will provide gains of 10-100 times over the current performance at today's leading facilities, enabling new opportunities for researchers in the fields of life sciences, energy, environmental technology, cultural heritage, and fundamental physics. Acknowledging the relevance of ESS in the European science landscape, EU decided to financially support ESS through BrightnESS. The three-year project, implemented by 18 European partners, aims to ensure that key challenges are met in order to build an ESS that can deliver high-impact scientific and technological knowledge. This includes the challenge of strengthening and expanding the ESS community and network.

Objectives

One of the strategic goals of BrightnESS is to gain trust of future scientific and academic users of ESS. With that in mind, the BrightnESS team initiated a pan-European survey of existing neutron sources to collect consolidated information on the user community in Europe, and to identify scientific trends. The findings presented in this report will be used to develop tailored outreach and engagement strategies, to establish vital relations with academia and science, and to shape ESS policies for innovation and access. To this end, the collected information provide ESS and its partners with the opportunity to:

- Take into consideration an up-to-date overview of existing neutron sources in Europe,
- Assess the size, geographic distribution, access modes, and affiliation of the European neutron user base,
- Map the usage of neutron sources according to their instrument suite and type of scientific activities carried out at the respective research infrastructures.

In this respect, it is important to note that the BrightnESS survey was not initiated with the aim of providing an exhaustive overview of the European neutron scattering landscape. Its sole purpose is to serve ESS and its partners and provide them with fact-based information to be utilised for the development of tailored engagement activities, and the drafting of relevant policies and strategies. Because of this, the survey did not inquire about data related to scientific publications, scientific productivity of users, the cost of neutron research projects, etc.

Methodology

The development of the survey questionnaire was a collaborative effort of BrightnESS partners and research facilities participating in the survey. Consisting of 25 questions, the survey was broken down into four sections. The aim of the first section was to gather facts and general information about participating facilities. The second section focused on data related to science, methods, and challenges. The third targeted user programmes, and the last section was dedicated to users. In March 2016, the final version of the electronic questionnaire was distributed to the Heads of Research Infrastructures and/or the Heads of Users Offices at 17 neutron sources across Europe; 15 of them provided answers.

The data provided by participating facilities is first presented in a European context, and then also as stand-alone annexes showing detailed information about each of the neutron sources, such as technical capacity, user base, the usage of instruments across scientific disciplines, etc. The figures in the European overview were calculated either as a sum or average of all relevant entries provided by individual facilities and, where appropriate, weighted over the number of beam days or the number of experiments. Consequently, these figures were cross-checked with data in the 2016 report of the ESFRI Physical Sciences and Engineering Strategy Working Group, and Neutron Landscape Group (NLG) entitled *Neutron Scattering Facilities in Europe: Present Status and Future Perspectives* (hereafter referred to as the ESFRI Report), and also with data available in the *ESF/ENSA Survey 2005 of the Neutron Scattering Community in Europe*. Given that the BrightnESS survey questionnaires were completed by representatives of neutron sources and not by neutron users themselves, the figures related to the size of neutron user community and Principal Investigators (PIs) might be affected by double-counting. Nevertheless, these figures are similar to those presented in the latest ESFRI and ENSA reports mentioned above.

Participants

15 out of 17 neutron sources invited to take part in the survey provided answers. The list of facilities was generated from the information presented in the *Neutrons for Science and Technology* brochure (see page 12 of the brochure) published by the European Neutron Scattering Association (ENSA) in 2015. While Demokritos in Greece and Joint Research Centre in the Netherlands opted out, their absence does not affect the results of the survey due to the relatively small size of these facilities. Data presented in this report[2] was supplied by the following facilities, based in 12 different European countries:

- Budapest Neutron Centre (BNC), Hungary
- Forschungs-Neutronenquelle Heinz Maier-Leibnitz Zentrum (MLZ FRM II), Germany
- Helmholtz-Zentrum Berlin – BER II, Germany
- Institute for Energy Technology – JEEP II, Norway
- Institut Laue-Langevin (ILL), France
- ISIS Neutron and Muon Source, United Kingdom
- Jožef Stefan Institute TRIGA Mark II Research Reactor (TRIGA JSI), Slovenia
- Laboratoire Léon Brillouin (LLB – ORPHÉE), France
- National Centre for Nuclear Research – MARIA, Poland
- Nuclear Physics Laboratory (NPL), Czech Republic
- Portuguese Research Reactor (RPI), Portugal
- Reactor Institute Delft (RID), Netherlands
- Swiss Spallation Neutron Source (SINQ), Switzerland
- TRIGA User Facility, Johannes Gutenberg-Universität Mainz (TRIGA JGU), Germany
- TU Wien, Atominstitut (ATI), Austria

[2] *All participating facilities reviewed and approved this report, as well as the data in the respective annexes.*

Timeframe

Neutron sources participating in the survey were asked to provide data referring to one of the following timeframes: 1) single year 2015, 2) single year 2014, 3) average over 2013-2015, and also to identify any irregularities in operation of their facility. The option to choose one of these timeframes was provided in order to collect data about the most representative year at each facility. As a result, the information presented in this report does not refer to a specific year. Rather, the information helps to get a general understanding of activities at neutron sources in Europe during any given ordinary year between 2013-2015. The timeframe selected by each facility is indicated in the respective annexes.


SPALLATION SOURCE
NUCLEAR REACTOR
JEEP II
(KJELLER)
ISIS
(DIDCOT)
RID
(DELFT)
BER II
(BERLIN)
MARIA
(OTWOCK-ŚWIERK)
NPL
(ŘEŽ)
TRIGA JGU
(MAINZ)
LLB
(GIF-SUR-YVETTE)
ATI
(VIENNA)
MLZ FRM II
(GARCHING)
SINQ
(VILLIGEN)
BNC
(BUDAPEST)
TRIGA JSI
(LJUBLJANA)
ILL
(GRENOBLE)
RPI
(BOBADELA)

EUROPEAN OVERVIEW

1. OVERVIEW OF NEUTRON SOURCES

This section provides an overview of European neutron sources. It presents up-to-date and consolidated information about each of the 15 facilities participating in the BrightnESS survey. The data refers to the type and scientific capacity of the source. Based on the technical specifications of the neutron sources, their user bases, and scientific activities, this report introduces three categories of neutron sources. The categories are used in this and the following sections of the report to better describe the European neutron sources landscape, taking into account the diverse, and sometimes complementary, mandates of the individual facilities.

European Neutron Sources Landscape
The European landscape of neutron sources presented in this report consists of 15 facilities, out of which 13 are nuclear reactors and two are spallation sources. These facilities serve a community of 5777 unique users and 3559 Principal Investigators coming from Europe and beyond. They offer a total of 195 instruments, which are available for 2694 operational days per year. The users carry out 4788 experiments per year, and the facilities jointly generate 24,398 beam days per year.

The 2016 ESFRI Report states that the instruments at neutron sources in Europe provide 32,469 instrument days for science (see page 60 of the ESFRI Report). The total number of beam days in the BrightnESS report is somewhat lower. However, it is important to note that the group of neutron sources considered for the ESFRI Report is different from that of the BrightnESS survey. The ESFRI Report provides information about instrument days at 13 neutron sources, out of which 11 overlap with that of the BrightESS survey. In addition, while the ESFRI report counts nominal days, entries in the BrightnESS survey either refer to the number of actual beam days during a specific year or to the average number of beam days per year. It should also be taken into consideration that as LLB and BER II move closer to their foreseen closure, these facilities are reducing their number of instruments and thus also the number of beam days (BER II from 2016 on: 10 instruments in user service, 170 beam days). RPI participated in the survey and was closed down in 2017.

Taking into consideration the size of their user base, as well as the number of instruments and methods available, the neutron sources participating in the BrightnESS survey were divided into three categories:

- **Category A: Large-scale facilities:** Neutron sources in this category have a large user base comprising of 450–1600 unique users. Principal Investigators who carry out research at these facilities are affiliated with institutes based in a variety of countries, in and outside Europe. The facilities have between 20-37 instruments deployable over 8-10 different experimental methods. Neutron sources in Category A include ISIS, ILL, MLZ-FRM II, LLB, and SINQ.
- **Category B: Medium-scale facilities:** Neutron sources in this category have a medium-sized user base comprising of 50–350 unique users. Principal Investigators who carry out research at these facilities are affiliated with institutes based in a variety of countries, in and outside Europe. The facilities have between 8-15 instruments deployable over 7-9 different experimental methods. Neutron sources in Category B include BER II, BNC, and NPL.

Category C: Small-scale facilities: Neutron sources in this category have a small user base comprising of up to 50 unique users. The group of Principal Investigators who carry out research at these facilities is less international than that of facilities in Categories A and B. The institutes they are affiliated with are based in a limited number of mostly European countries. The facilities have between 1-9 instruments deployable over 1-5 different experimental methods. Neutron sources in Category C include TRIGA JGU, JEEP II, TRIGA JSI, RPI, ATI, MARIA, and RID.

	Facility	Number of unique users	Number of instruments *	Number of experiments/ year	Power	Thermal neutron flux at 1.5 Å (neutron.cm^{-2}s^{-1})	Operational days/year
Large-Scale Facilities	ISIS	1580	31/31	850	200 kW	4.5×10^{15} (peak)	150
	ILL	1433	32/37	848	58.3 MW	1.5×10^{15}	200
	MLZ FRM II	965	26/26	832	20 MW	8×10^{14}	240
	LLB	637	20/23	403	14 MW	3×10^{14}	120
	SINQ	477	13/20	485	1 MW	4.1×10^{14}	195
Medium-Scale Facilities	BER II	302	13/17 ***	201	10 MW	2×10^{14}	200
	BNC	145	15/15	127	10 MW	2.1×10^{14}	120
	NPL	54	8/8	30	10 MW	1×10^{14}	189
Small-Scale Facilities	TRIGA JGU	44	4/4	9	100 kW	1×10^{12}	200
	JEEP II	43	5/6	65	2 MW	3×10^{13}	200
	TRIGA JSI	41	8/8	**	250 kW	5.107×10^{12}	150
	RPI	28	0/1	10	1 MW	1×10^{13}	150
	ATI	15	5/5	6	250 kW	5×10^{12}	200
	MARIA	13	4/6	46	30 MW	1×10^{14}	180
	RID ****	0	9/9	**	2 MW	3×10^{12}	200

While the primary characteristic of the three categories of neutron sources introduced in this report is the size of their respective user base, the table above indicates that, with a few exceptions, research facilities in the same category are essentially neutron sources of comparable power and flux.

* *Number of instruments available to external users/total number of instruments*
** *Facility carries out experiments using non-scattering methods only*
*** *From 2016 onwards: 10 instruments in user service*
**** *RID is not a user facility and does not run any user programme*

2. USER COMMUNITY

This section of the survey report provides a description and analysis of the neutron user community in Europe. The aim is to acquire a quantitative distribution of users and Principal Investigators according to the research infrastructure where they carry out their research, the affiliation of users, and funding mechanisms. The data refers to the overall European landscape and, in some cases, to the three categories of neutron sources.

NUMBER OF UNIQUE USERS

The total number of unique users in each category of neutron sources was calculated as a sum of unique users at all facilities belonging to the same category. Given that neutron users sometimes access more than one facility throughout the year, some of them might have been counted more than once. According to the data collected in the BrightnESS survey, the total number of unique users in Europe is 5777 (double counting not accounted for). This is the number of users who perform experiments at neutron sources in Europe per year. The number of distinct users at neutron scattering facilities in Europe stated in the 2016 ESFRI report mentioned earlier, is 5469 (source duplication unaccounted for, see page 60 of the ESFRI Report). The ESFRI Report counts the users of 13 facilities, out of which 11 overlap with those participating in the BrightnESS survey.

Results of the survey indicate that neutron sources in Category A attract a significant proportion (88%) of all unique users conducting research in Europe. These facilities also have the highest number of instruments (119 out of 195) and are thus equipped for diverse scientific activities. Neutron sources in Category B attract 9% of all unique users, and neutron sources in Category C serve the remaining 3%.

ISIS has the highest number of unique users (1580) per year among all facilities in Category A. It is closely followed by ILL, which hosts 1433 unique users. The facility with the highest number of unique users (302) in Category B is BER II. Many of the neutron sources in Category C do not run programmes for external users. In that sense, they are not typical user facilities and mostly serve in-house users. TRIGA JGU had the highest number of unique users (44) among all facilities in Category C. RID does not have any user programme and thus the number of users appears as zero.

Fig 2.1 Category A: Number of unique users per facility

Total number of unique users per year at all facilities in this category: 5092

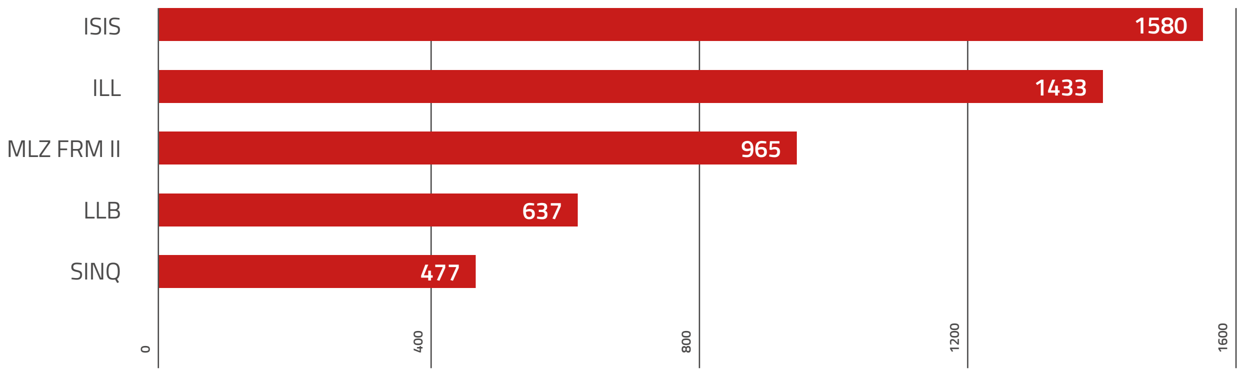


Fig 2.2 Category B: Number of unique users per facility

Total number of unique users per year at all facilities in this category: 501

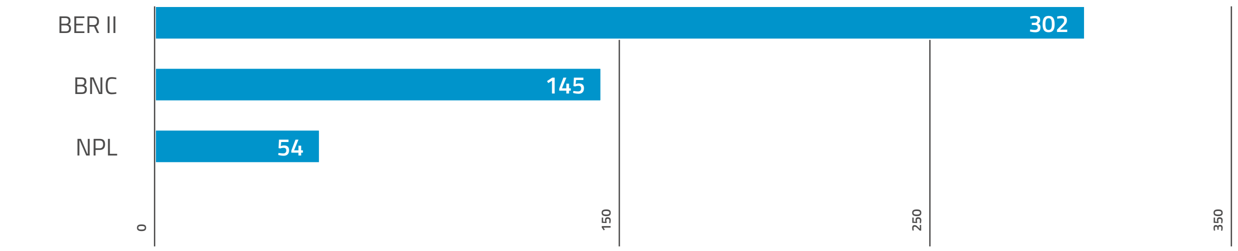


Fig 2.3 Category C: Number of unique users per facility

Total number of unique users per year at all facilities in this category: 184

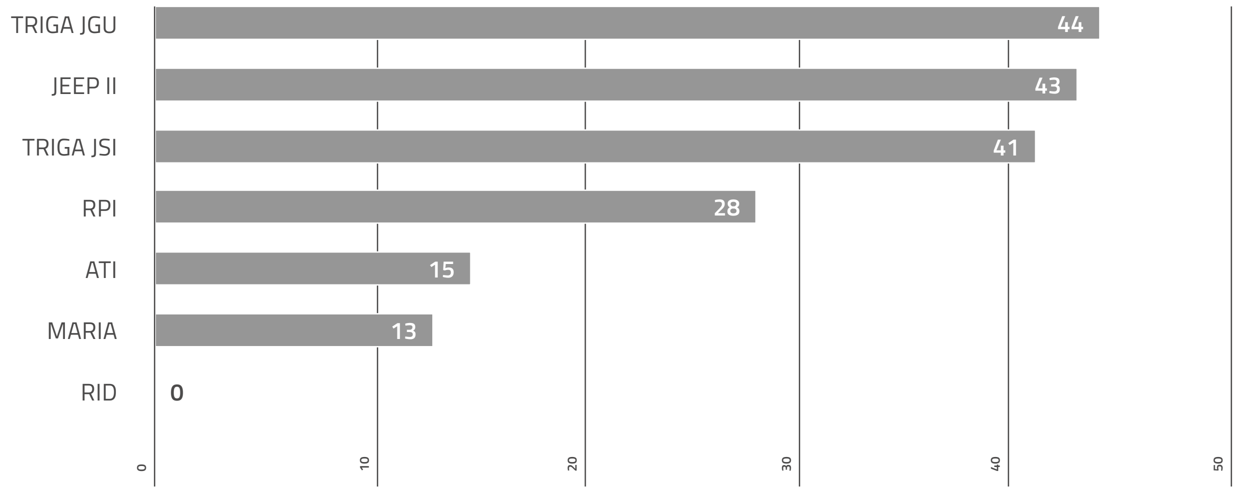
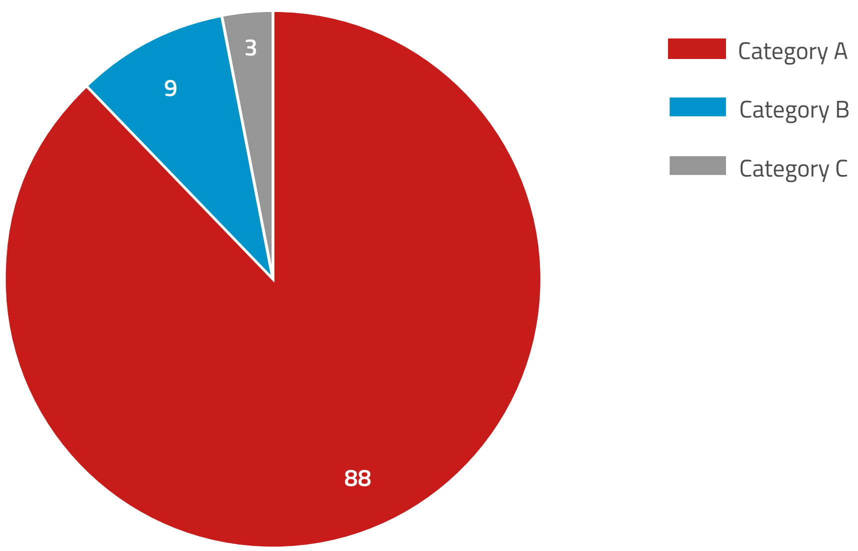


Fig 2.4 Europe: Percentage of unique users according to three categories of neutron sources



UNIQUE USERS ACCORDING TO DURATION OF VISIT AND PROXIMITY TO FACILITY

The participating facilities were asked to divide their users into several groups based on their geographical proximity to the facility and the duration of their visits. In the charts below, local users represent a group that does not need accommodation when visiting any given facility, but at the same time is distinct from in-house and remote users. Individual visitors were defined as users who come in for a few days. In each of the three categories of neutron sources, several entries presented in figures 2.5 – 2.8 were grouped in order to create figure 2.9. In figure 2.9, internal users include local users, in-house users, and PhD students. External users include individual visitors, long-term visitors, and remote users.

The majority of users (73%) are in need of accommodation when conducting research at neutron sources in Europe. Their home institute is usually geographically far from the respective facility. 27% of neutron users across Europe do not require accommodation to carry out their research. This group includes local users based in the vicinity of the facility, in-house staff, and also remote users who opt for mail-in service. The duration of most visits to research facilities is short. Long-term visitors who stay in for more than a few days only account for 6%.

The BrightnESS survey indicates that facilities in Category A and Category B have a different user base from that of Category C when it comes to duration of visit and users' geographical proximity to the facility. While external users, including individual visitors coming in for a few days, long-term visitors, and remote users, represent 75% of all users at large-scale facilities, and 65% at medium-scale facilities, this group only accounts for 34% at small-scale facilities.

Fig 2.5 Europe: Distribution of unique users according to duration of visit and proximity to facility

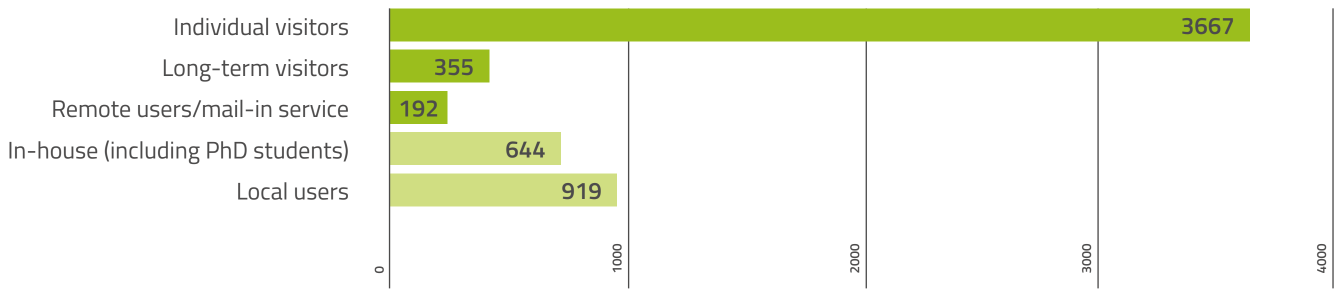


Fig 2.6 Category A: Distribution of unique users according to duration of visit and proximity to facility

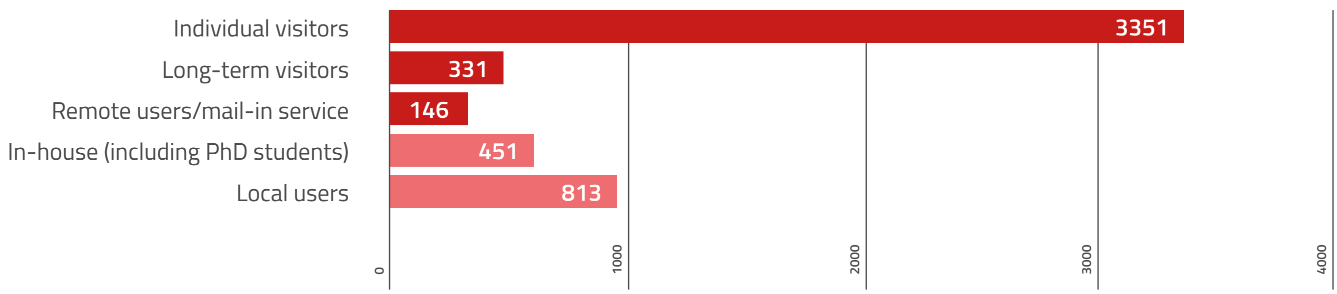


Fig 2.7 Category B: Distribution of unique users according to duration of visit and proximity to facility

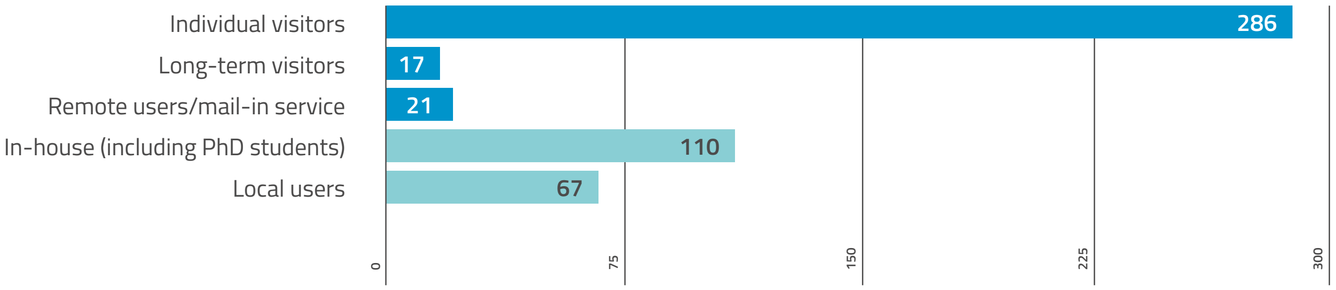


Fig 2.8 Category C: Distribution of unique users according to duration of visit and proximity to facility

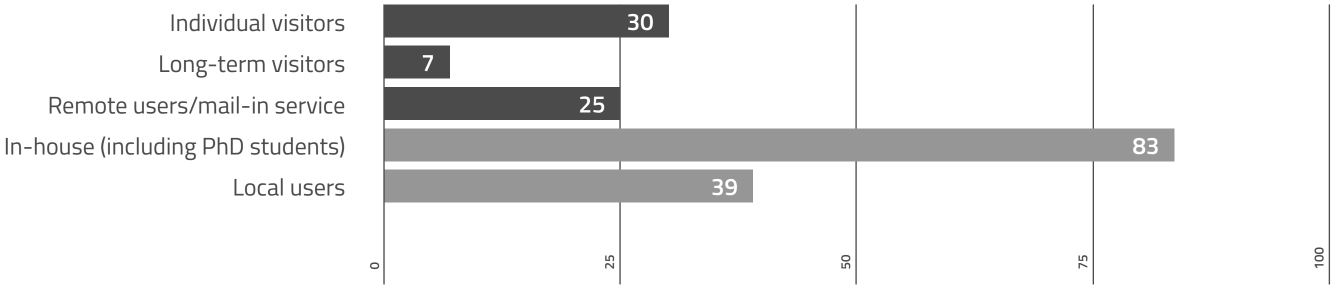
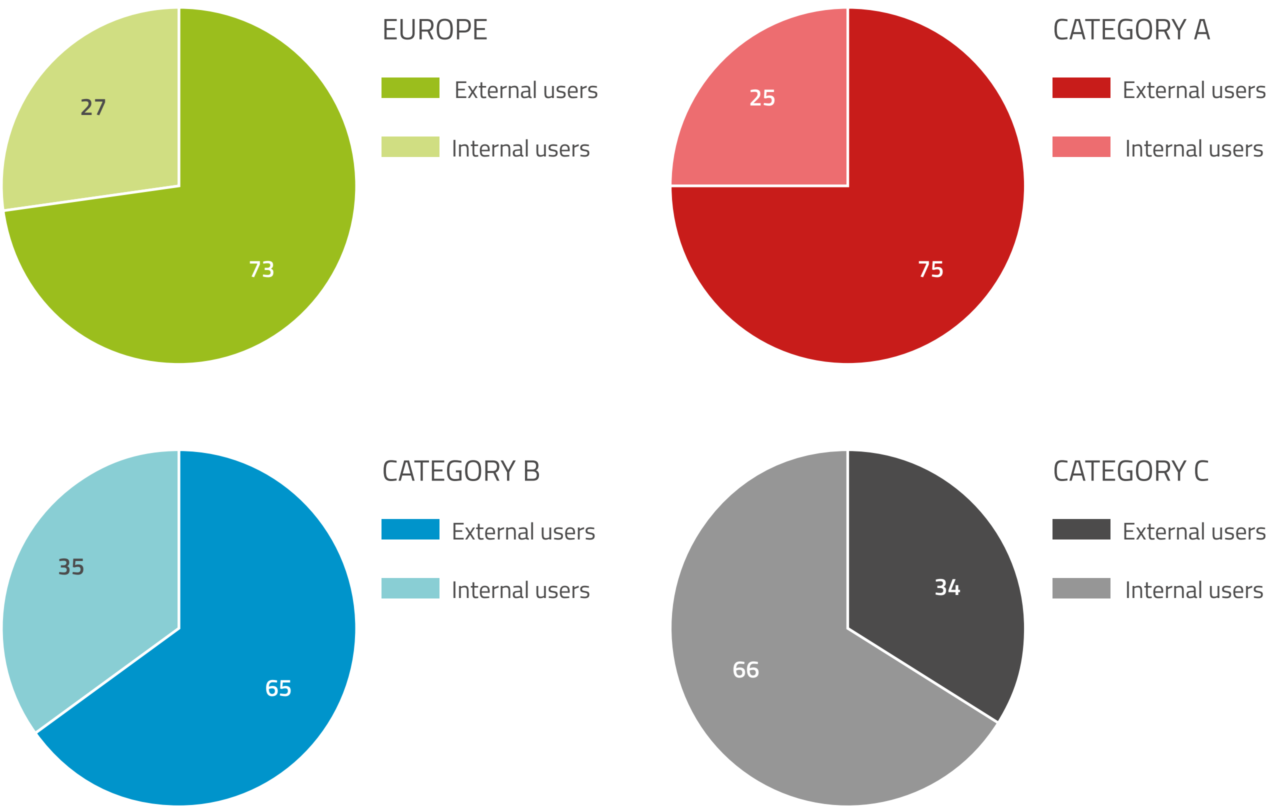


Fig 2.9 Percentage of external and internal users in Europe and in each of the three categories

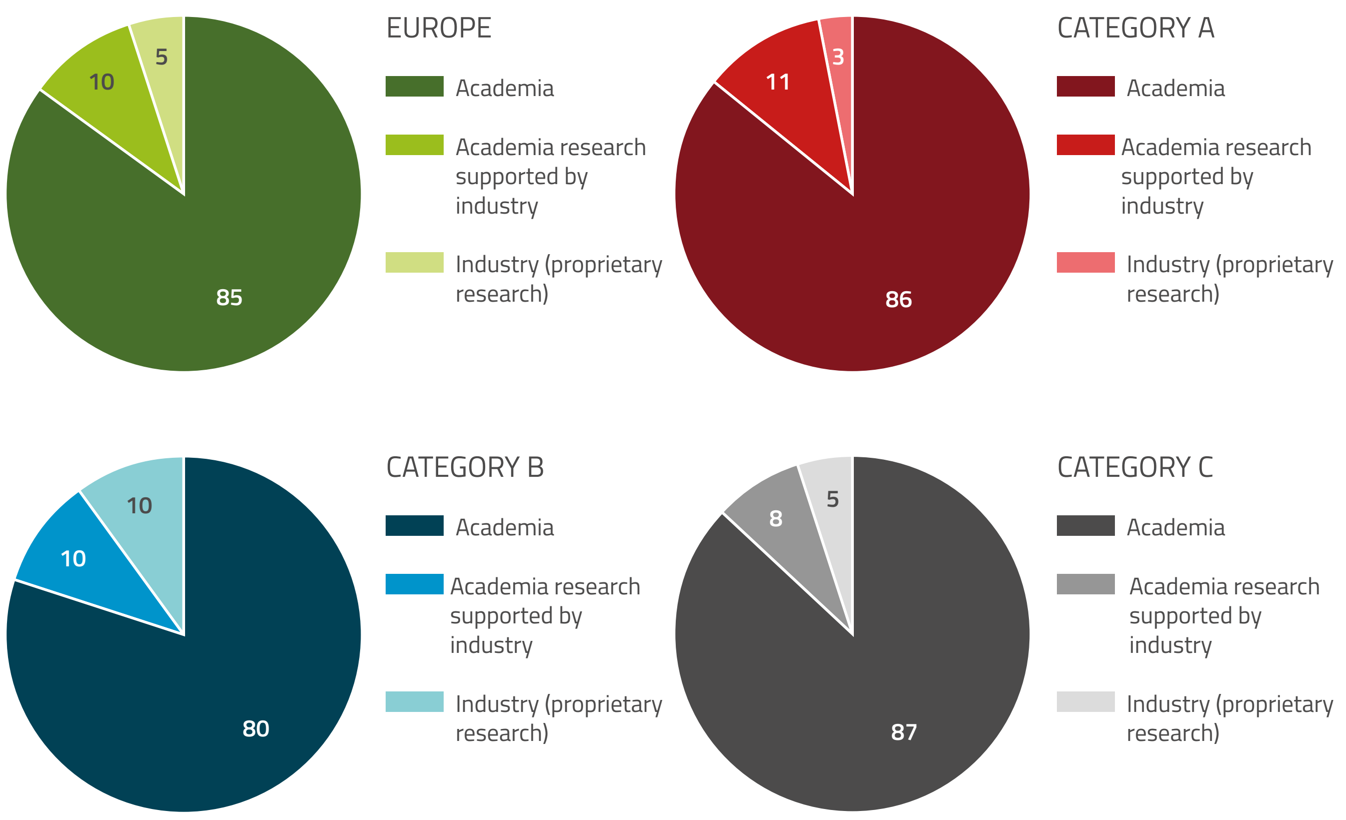


brightness

USER DISTRIBUTION ACCORDING TO AFFILIATION: ACADEMIA, PARTNERSHIPS, AND INDUSTRY

Facilities participating in the BrightnESS survey were asked to provide information about their type of users (academia, industry, and partnerships of academia and industry) expressed as a percentage of beam time. In order to calculate the distribution of users in each category of neutron sources, the collected data was weighted over the number of beam days at each facility. The results show that users from academia comprise the most active group at all three categories of neutron sources. The fraction of beam time they use fluctuates between 80-87% (see figure 2.10). As a result, academics also use the largest proportion of beam time (85%) on a European level. In addition to this, 10% of research at European neutron sources is carried out as partnerships of academia and industry. The proportion taken up by partnerships at each category is very similar, and ranges from 8% at Category C, to 10% at Category B, and 11% at Category A.

Fig 2.10 Distribution of users in Europe and in each of the three categories according to affiliation expressed as percentage of beam time



FUNDING FOR ACADEMIA, PARTNERSHIPS, AND INDUSTRY

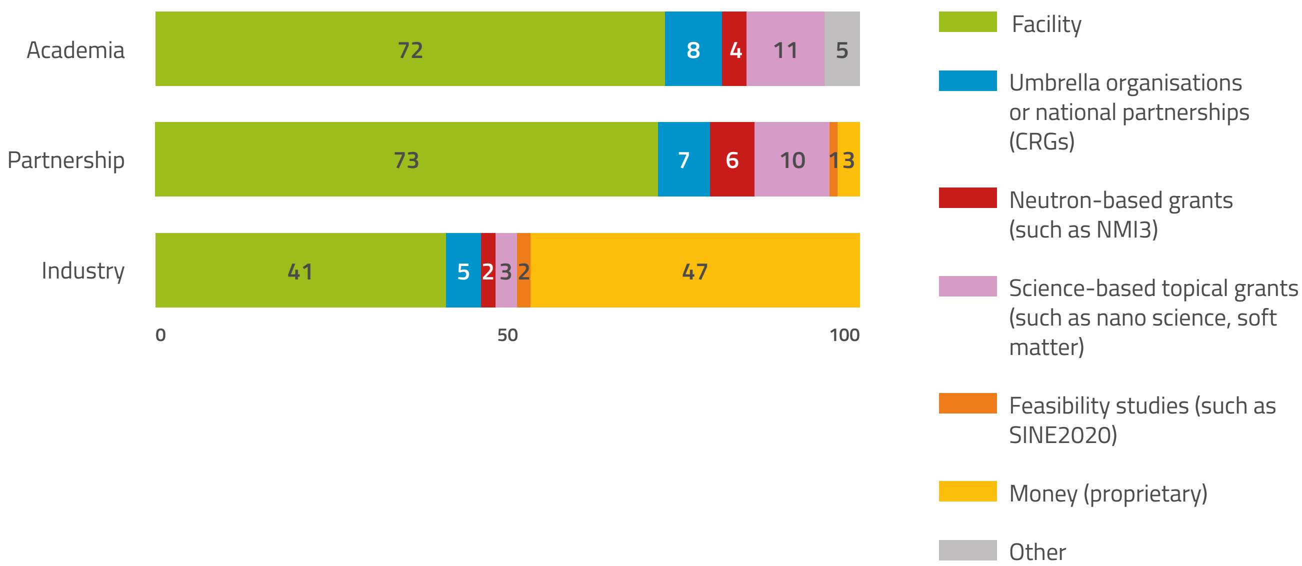
Facilities participating in the BrightnESS survey were asked to identify the means of funding for programmes they run for users from academia, industry, and partnerships of academia and industry. The collected data was weighted over the number of beam days at each facility. Figure 2.11 gives an overview of the variety of funding sources utilised by neutron research facilities across Europe.

European facilities have access to a diversified set of funding streams, which represents a healthy mixture of classic research budgets, national and international grant schemes, as well as revenues from proprietary research. This demonstrates the existence of synergies and common interests among a variety of players, including scientists, industry, science policy makers in the European Union (EU), innovation managers, entrepreneurs, etc.

There is a rich portfolio of funding opportunities put forth via grants (**neutron-based**, science-based, **feasibility studies**) by public institutions, including the EU. Academia funds 15% of its research through science- and neutron-based grants (such as NMI3, nano science, soft matter etc.). While public grants contribute to only 7% of the research carried out by industry, the number rises to 17% in case of research that is conducted as a partnership of academia and industry.

While academia and partnerships use a similar mixture of funding streams (see the bar chart below), the funding mix used by industry is different. Approximately one half (47%) of the research carried out by industry is funded by industry itself. However, the contribution of facilities to industrial research is also significant and accounts for 41%. Facilities support more than 70% of their research programmes for academia and partnerships, mainly based on proposal schemes.

Fig 2.11 Europe: Proportionate distribution of funding for Academia, Partnerships and Industry (%)



NUMBER OF PRINCIPAL INVESTIGATORS PER COUNTRY

Facilities participating in the survey were asked to provide the number of Principal Investigators (first proposer) from countries in Europe who have submitted proposals or performed experiments at their respective facilities, and also to indicate how many Principal Investigators come from non-European countries. The nationality of Principal Investigators is determined by the home country of the institute they are affiliated with. The BrightnESS survey did not inquire about the nationality of all users due to technical liminations.

According to data collected in the BrightnESS survey, the total number of PIs who carried out research at European neutron sources in a single calendar year is 3559. This number is approximately 1.6 times smaller than the number of users (5777). Out of these, 3152 conducted research at facilities in Category A. This represents 89% of all active PIs in Europe. There were 332 PIs at facilities in Category B, and 75 PIs at facilities in Category C. The distribution of PIs across the three different categories of neutron sources is shown in figures 2.13 and 2.14. European countries which are not shown in these two figures have less than 10 PIs and include Belgium, Slovakia, Greece, Finland, Ireland, Estonia, Luxembourg, Turkey, Croatia, Latvia, Moldova and Serbia. The respective number of PIs for each of these countries is presented in figure 2.12.

The national distribution of PIs at neutron sources in Category A is comparable to the overall distribution of PIs on a European level. The highest number of PIs at facilities in Category A comes from Germany (939), the United Kingdom (688), and France (510). These three countries have the largest number of PIs in Europe. The facilities in Category A host a significant number (350) of non-European PIs. This represents 90% of all non-European PIs who conduct their research at neutron sources in Europe.

The national distribution of PIs at neutron sources in Category B is also broad. The highest number of PIs in this group comes from Germany (101), the Czech Republic (40), and Russia (28). Medium-scale neutron sources also host 36 PIs from non-European countries.

Category C has a less international distribution of PIs. The highest number of PIs in this group comes from Germany (15), Norway (12), Poland (10), and Portugal (10).

Fig 2.12 Europe: Total number of Principal Investigators per country (Total: 3559)

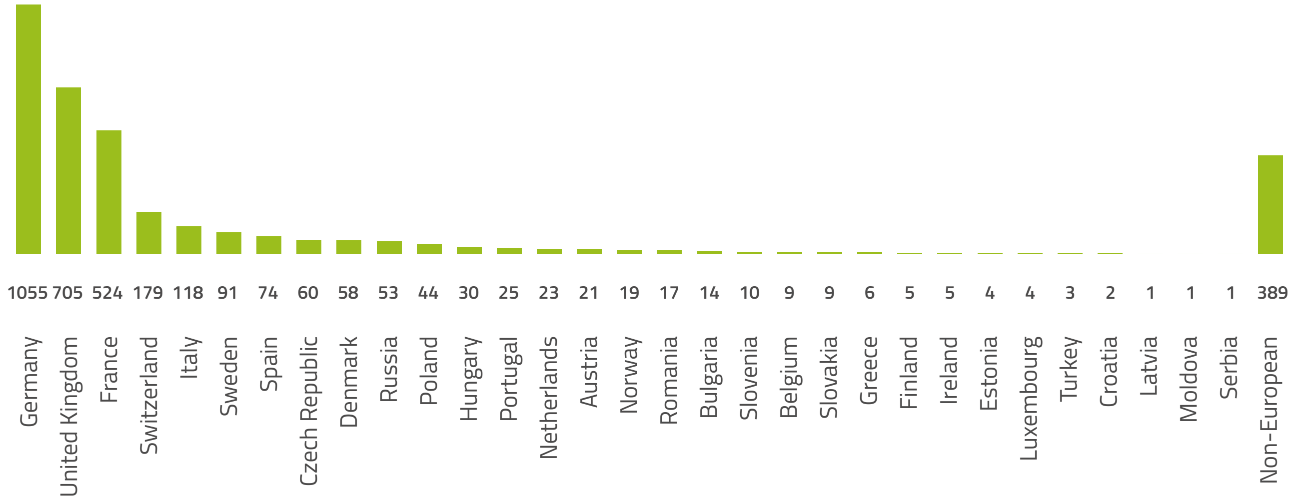


Fig 2.13 Distribution of PIs across categories of neutron sources in countries with more than 100 PIs

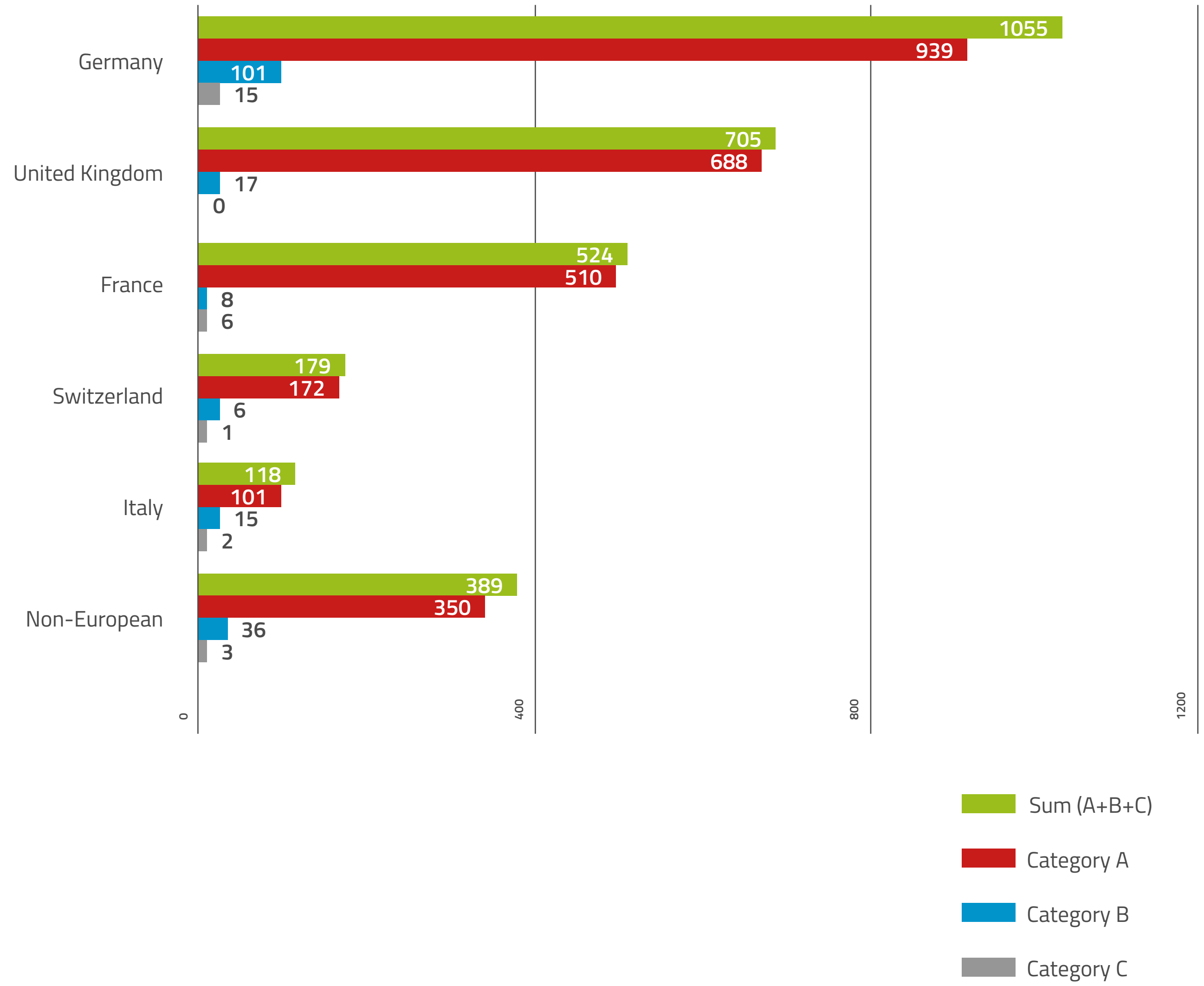
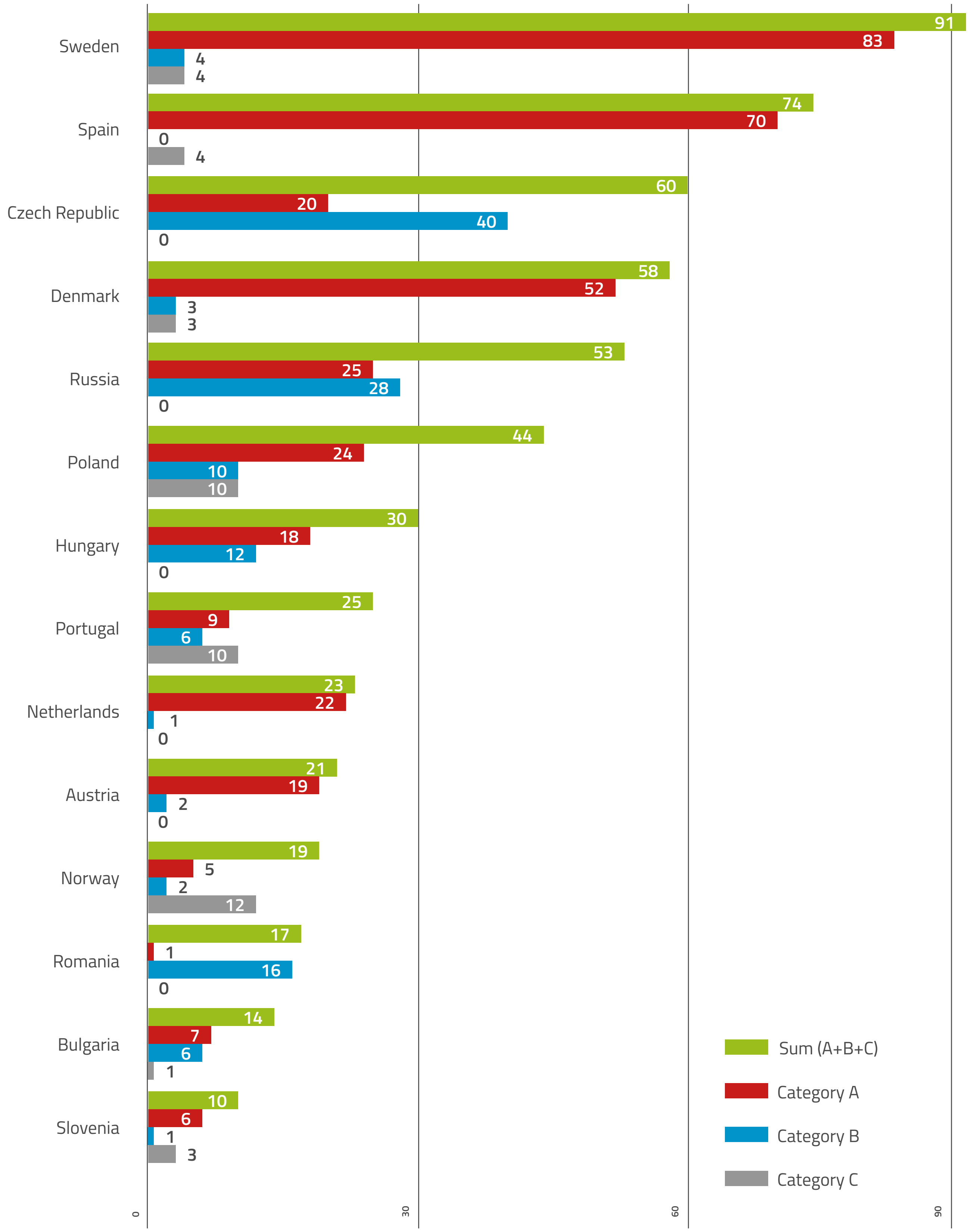


Fig 2.14 Distribution of PIs across categories of neutron sources in countries with 10-100 PIs



3. SCIENCE AND METHODS

This section provides detailed information about the scientific activities carried out at European neutron sources by correlating the usage of instruments and methods with scientific fields. The section includes quantitative information related to the needs of specific infrastructures, such as sample environment equipment and laboratories. A link between scientific activity and Horizon 2020 challenges is also established. The data refers to the overall European outlook, and in some cases to the three categories of neutron sources. You will notice that some charts in this section use abbreviations when referring to specific methods. Please see the table below to find out full name of method and correlating abbreaviation.

METHOD	ABBREVIATION
Small Angle Neutron Scattering	SANS
Reflectometry	REFL
Powder/Liquid Diffraction	POW-LI DIFF
Single Crystal Diffraction	SI-CRY DIFF
Engineering Diffraction	ENGIN DIFF
Imaging	IMAGING
High-Resolution Spectroscopy	HIGH-RES SPEC
Cold/Thermal Triple Axis Spectroscopy	CT TAS
Cold/Thermal Time-of-Flight Spectroscopy	CT TOF
Vibrational Spectroscopy	VIBR SPEC
Nuclear & Particle Physics	N&P PHYSICS
Other (Non-Scattering Methods)	OTHER

NUMBER OF INSTRUMENTS PER METHOD

According to the collected data, the total number of instruments at neutron sources in Europe is 195. Of these, 19 are used for non-scattering research and methods such as depolarisation analysis, INAA, positron analysis, etc. Detailed information about the usage of non-scattering instruments can be found in the individual annexes. More than half (61%) of all instruments available in Europe are found at facilities in Category A.

Figure 3.1 shows the distribution of instruments across methods on a European level. The graph shows that the highest number of instruments are available for powder/liquid diffraction (28), small angle neutron scattering (27), cold/thermal triple axis spectroscopy (20), single crystal diffraction (18), and reflectometry (17). The graph showing the distribution of instruments across methods at neutron sources in Category A (see figure 3.2) corresponds with the pattern observed on an overall European level (see figure 3.1). The only two methods for which neutron sources in Category A have the same or smaller number of instruments than neutron sources in Category B and C respectively is nuclear and particle physics, and non-scattering methods.

Generally speaking, the distribution at neutron sources in Category B corresponds with that of Category A and Europe. However, facilities in Category B have a lower number of instruments or no instruments for techniques which require higher neutron intensity, i.e. single-crystal diffraction (3), cold/thermal triple axis spectroscopy (3), cold/thermal time-of-flight spectroscopy (1), high-resolution spectroscopy (0), and vibrational spectroscopy (0).

Neutron sources in Category C show a different pattern than facilities in Categories A and B (see figure 3.4). When combined, instruments at neutron sources in Category C cover all methods except for engineering diffraction, high-resolution spectroscopy, cold/thermal time-of-flight spectroscopy, and vibrational spectroscopy. It is important to note that neutron sources in this category mostly have instrument suites that specialise in a few methods. In this respect, they are different from neutron sources in Category A and B, which have instruments that can be used over a variety of methods. For example TRIGA JSI and RPI have one imaging instrument each, and JEEP II has three instruments for powder/liquid diffraction, one instrument for small angle neutron scattering, and one instrument for imaging. The majority (79%) of all non-scattering instruments available at neutron sources in Europe are based at facilities in Category C. They are mostly used for various analytical methods or particle physics, thus serving two different communities. Analytical methods have a wide variety of applications among industrial users. The only facility in Category A that offers instruments, beam days, and methods for this type of analytical research is MLZ FRM II.

Fig 3.1 Europe: Number of instruments per method
Total: 195 (176 + 19 non-scattering instruments)

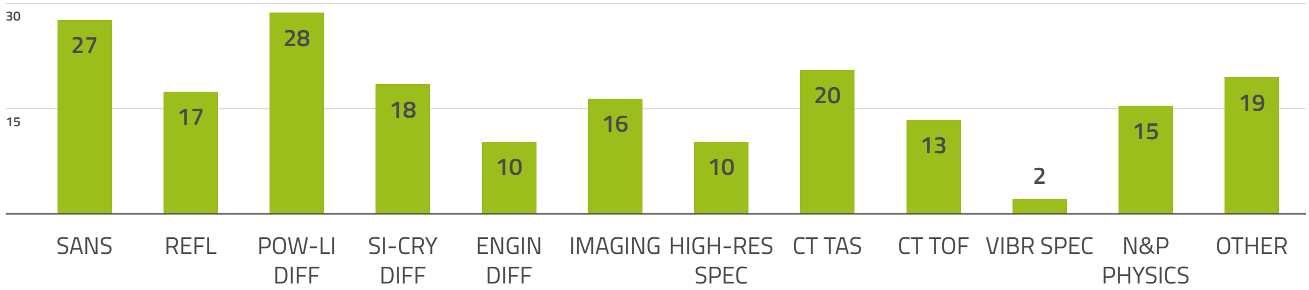


Fig 3.2 Category A: Number of instruments per method
Total: 119 (117 + 2 non-scattering instruments)

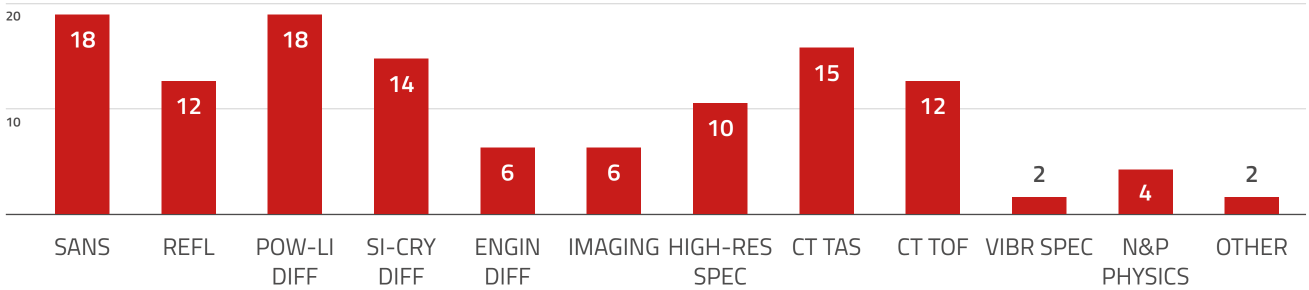


Fig 3.3 Category B: Number of instruments per method
Total: 38 (34 + 4 non-scattering instruments

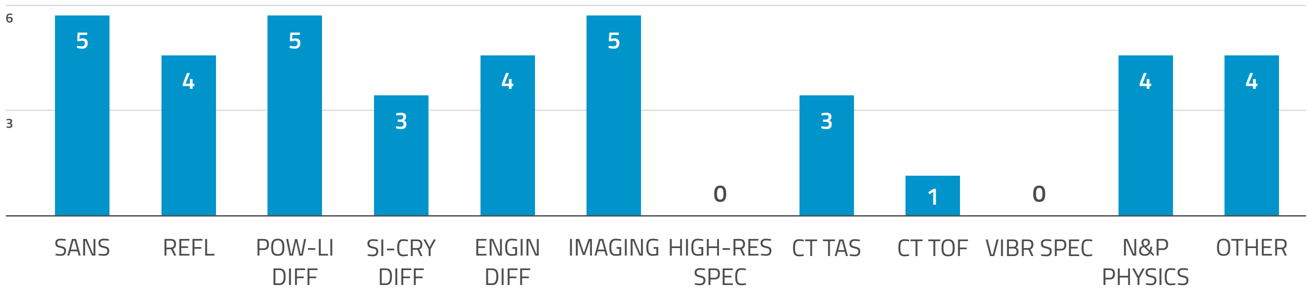
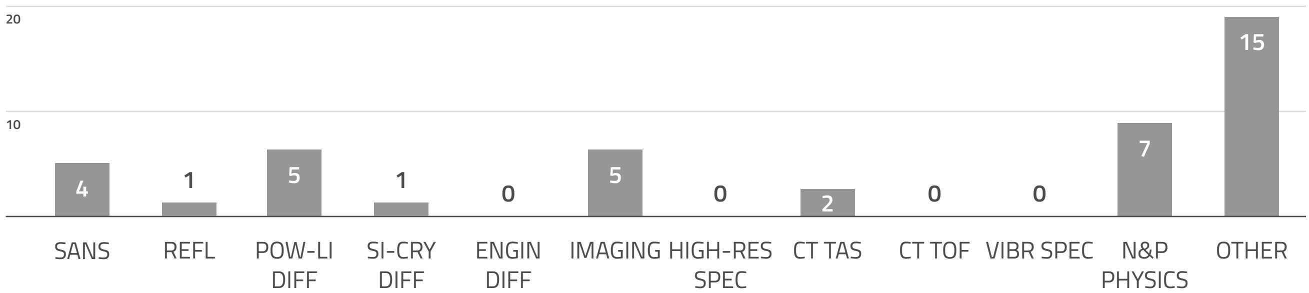


Fig 3.4 Category C: Number of instruments per method
Total: 38 (25 + 13 non-scattering instruments)



NUMBER OF BEAM DAYS AVAILABLE TO USERS

According to data collected in the BrightnESS survey, neutron sources in Europe collectively offer 24,398 beam days per year to their users (see figure 3.5). Out of these, 1872 are available for research and measurements requiring non-scattering methods.

Approximately 66% of all beam days are generated by neutron sources in Category A (see figure 3.6). The two methods, which take up the highest number of beam days at large-scale facilities, correspond with the methods for which these neutron sources offer the highest number of instruments, i.e. powder/liquid diffraction (2575 beam days across 18 instruments), and small angle neutron scattering (2394 beam days across 18 instruments). The graphical outlook in figures 3.5 and 3.6 indicates that the usage of beam days across methods at neutron sources in Category A corresponds with the overall usage of beam days in Europe. However, the number of beam days available for non-scattering methods (277) is higher at neutron sources in Category B (430) and is more than four times as high at neutron sources in Category C (1165).

Neutron sources in Category B provide a similar number of beam days for nuclear and particle physics as neutron sources in Category A, i.e. 440 vs. 462 beam days. Medium-scale facilities also generate 43% of beam days available for engineering diffraction, and 32% of beam days available for imaging. Medium-scale neutron sources offer no beam days for research methods which require neutron flux of higher intensity, such as high-resolution spectroscopy, cold/thermal time-of-flight spectroscopy and vibrational spectroscopy.

The graph showing beam days at neutron sources in Category C (see figure 3.8) is distinct from the graphs for Categories A and B, and corresponds with the individual specialisations of small-scale facilities. The number of beam days offered by small-scale facilities for non-scattering methods is significantly high (1165) and represents 62% of all beam days available for these methods in Europe. Neutron sources in Category C also generate 25% of beam days available for imaging.

NUMBER OF EXPERIMENTS PER METHOD

According to data collected in the BrightnESS survey, 4788 experiments are carried out per year at neutron sources in Europe. This number includes 876 non-scattering experiments. The highest number of experiments are performed using small angle neutron scattering (903 experiments, of which 738 were performed at neutron sources in Category A), and powder/liquid diffraction (809 experiments, of which 697 were performed at neutron sources in Category A). The number of non-scattering experiments performed at small-scaled facilities is significantly high (740) and represents 84% of all experiments carried out in Europe in this category.

Fig 3.5 Europe: Number of beam days available to users per year per method
Total: 24,398 (22,526 + 1872 beam days for non-scattering methods)

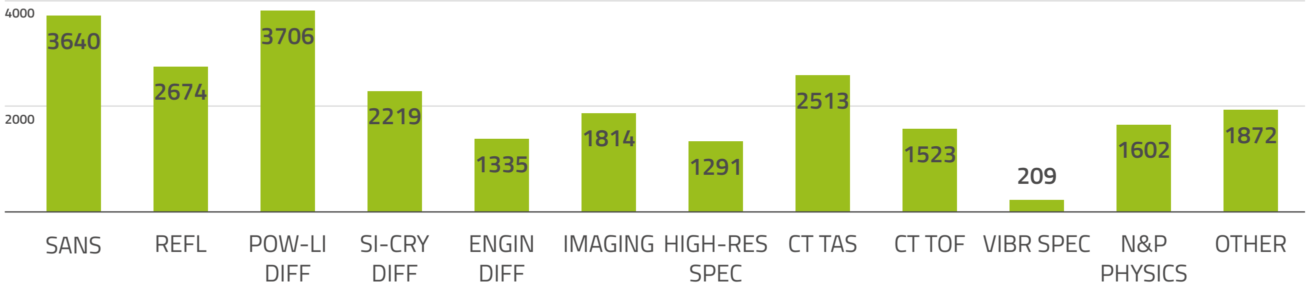


Fig 3.6 Category A: Number of beam days available to users per year per method
Total: 16,190 (15,913 + 277 beam days for non-scattering methods)

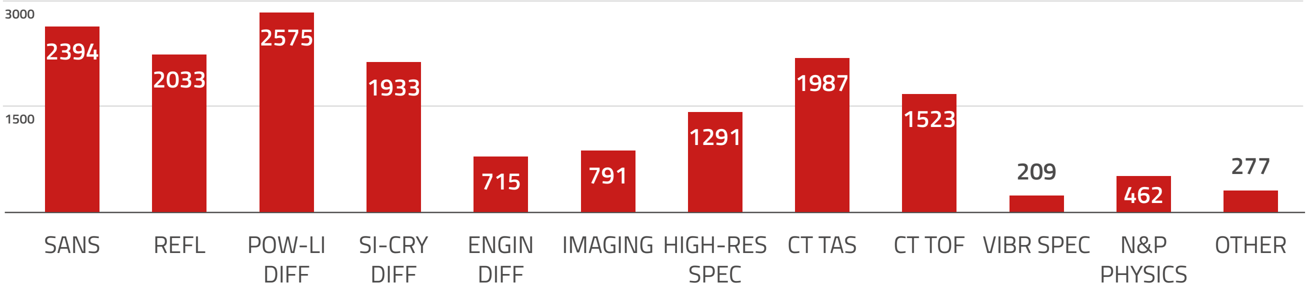


Fig 3.7 Category B: Number of beam days available to users per year per method
Total: 4393 (3963 + 430 beam days for non-scattering methods)

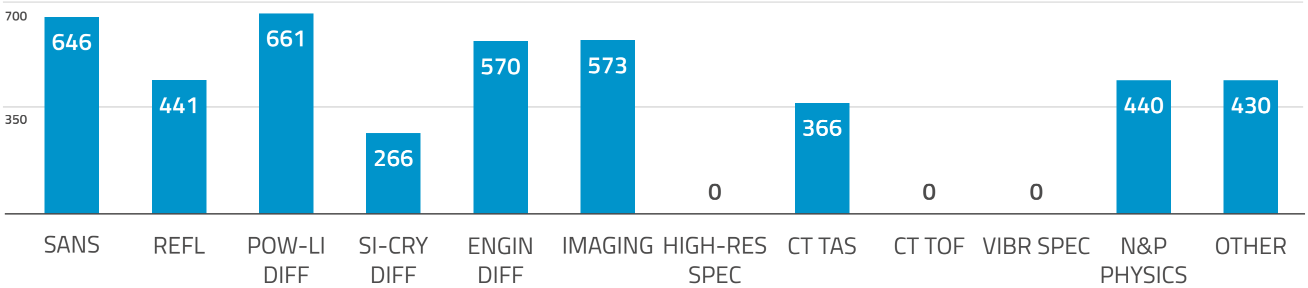


Fig 3.8 Category C: Number of beam days available to users per year per method
Total: 3815 (2650 + 1165 beam days for non-scattering methods)

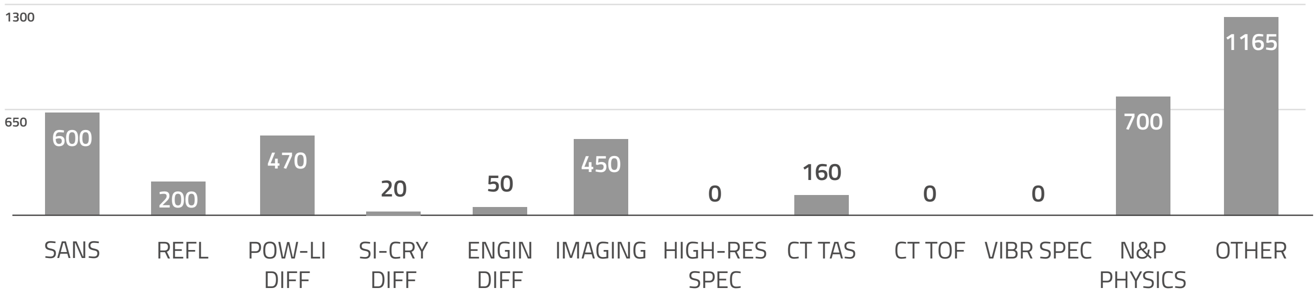


Fig 3.9 Europe: Number of experiments per year per method

Total: 4788 (3912 + 876 non-scattering experiments)

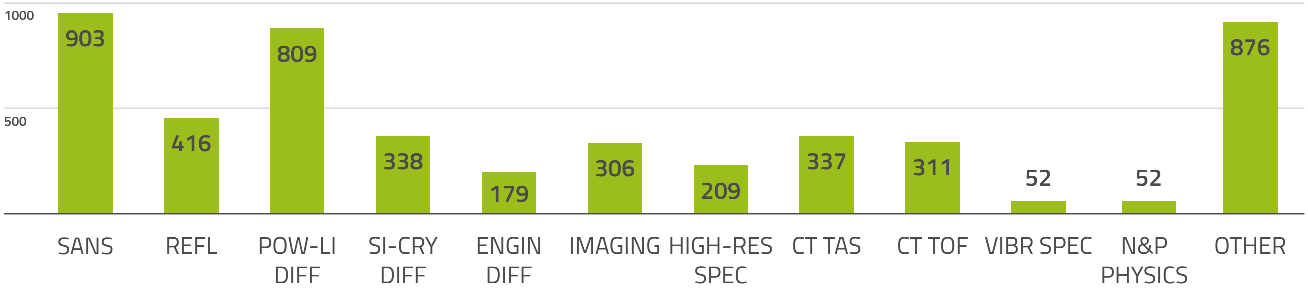


Fig 3.10 Category A: Number of experiments per year per method

Total: 3523 (3418 + 105 non-scattering experiments)

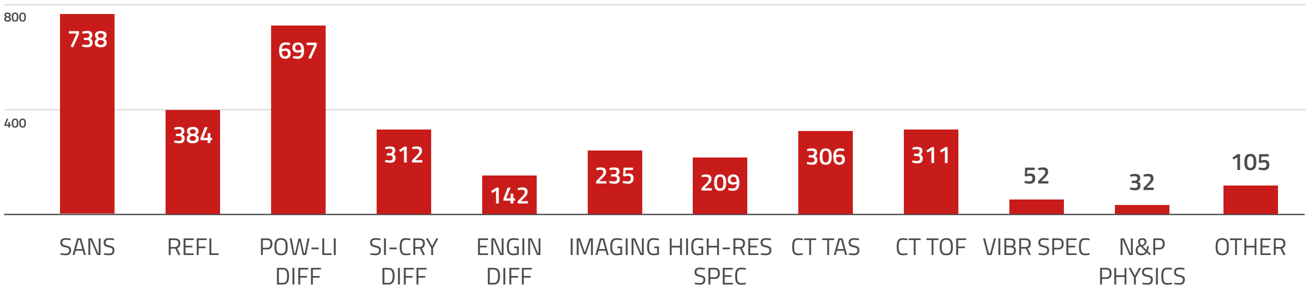


Fig 3.11 Category B: Number of experiments per year per method

Total: 389 (358 + 31 non-scattering experiments)

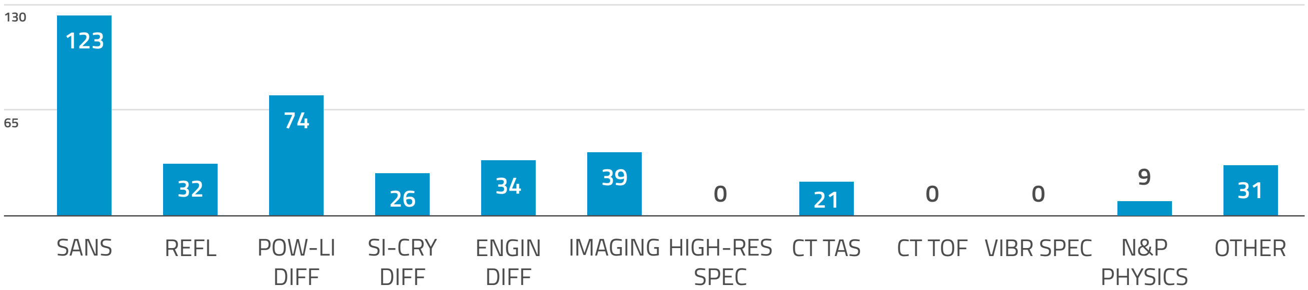
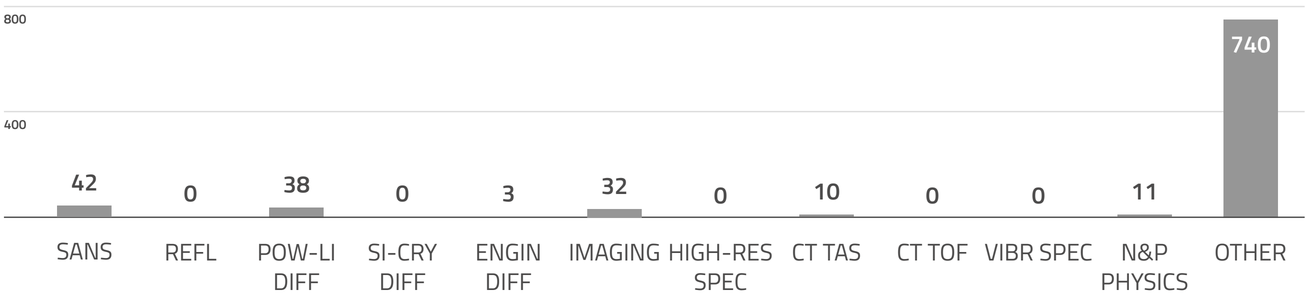


Fig 3.12 Category C: Number of experiments per year per method

Total: 876 (136 + 740 non-scattering experiments)

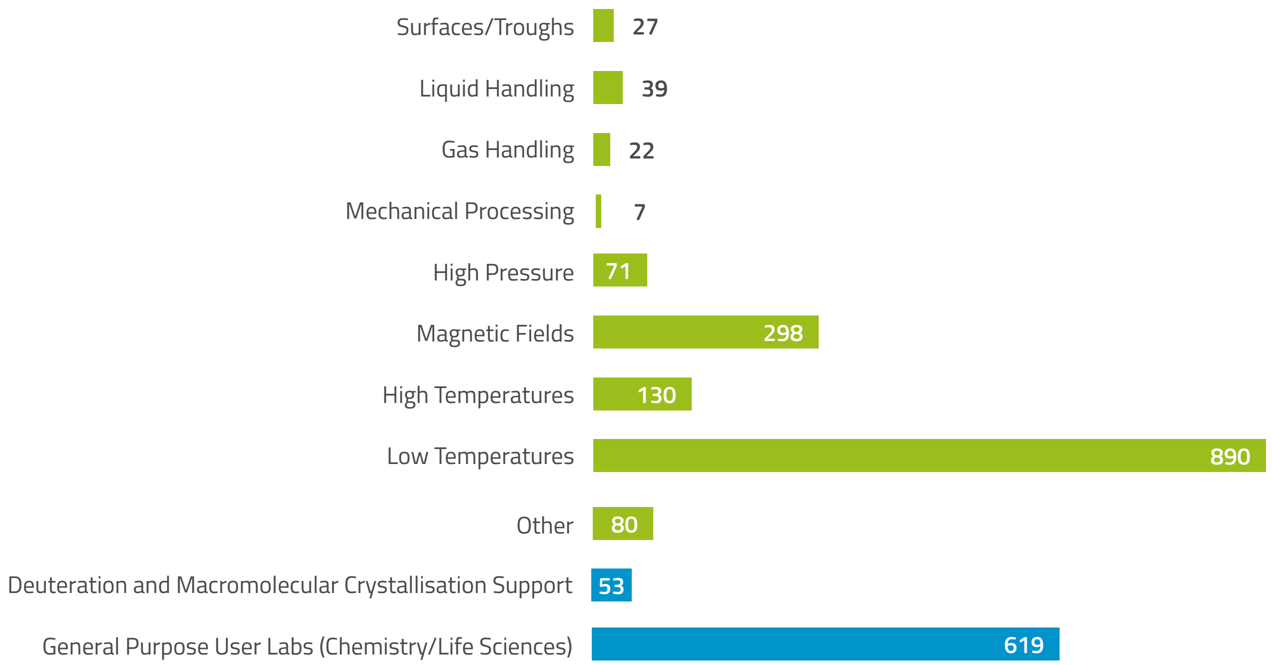


NUMBER OF EXPERIMENTS PER SAMPLE ENVIRONMENT EQUIPMENT AND LABORATORY

Figure 3.13 shows the number of experiments requiring specific sample environment equipment and laboratory facilities. The graph includes data from all facilities except ISIS (data not available), RID (question not applicable), and TRIGA JSI (no scattering experiments carried out). The reference base for this question (3175 experiments) is the total of all experiments carried out at 12 facilities, which provided data relevant for this graph.

The requirements for sample environment equipment and laboratory facilities shown in the graph below indicate what expectations future users might have of ESS. A high number of experiments (890) are performed using low temperature sample environment, and the demand for access to general purpose user laboratories is also high (619). A significant number of experiments requires magnetic fields (298).

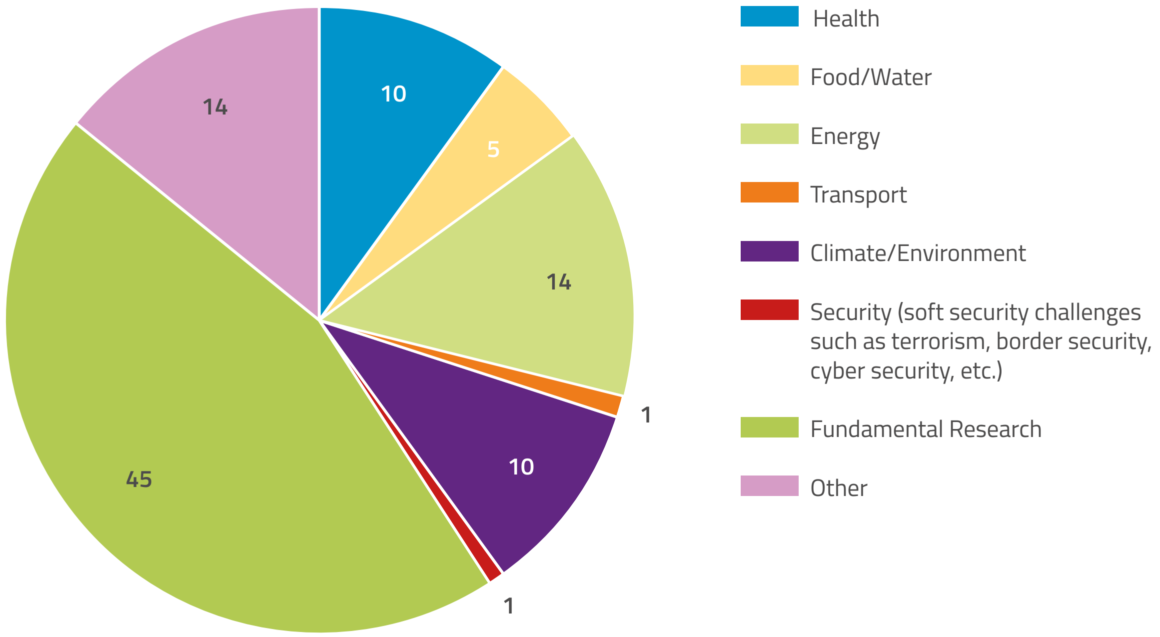
Fig 3.13 Europe: Number of experiments requiring the following sample environment equipment and laboratories. Base: 3175 experiments



RESEARCH FOCUSING ON HORIZON 2020 TOPICS AND CHALLENGES

Data collected in the BrightnESS survey indicates that research carried out at neutron sources in Europe focuses on topics and societal challenges identified by Horizon 2020, a financial instrument of the European Commission implementing the Innovation Union, which is a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. Apart from fundamental research, which has a dominant position and accounts for 45% of the overall research, energy (14%), climate/environment (10%), and health (10%) are the three societal challenges which get the most attention.

Fig 3.14 Europe: Horizon 2020 topics and challenges expressed as a percentage of research, averaged over all participating neutron sources



SCIENCE FIELDS PER METHOD

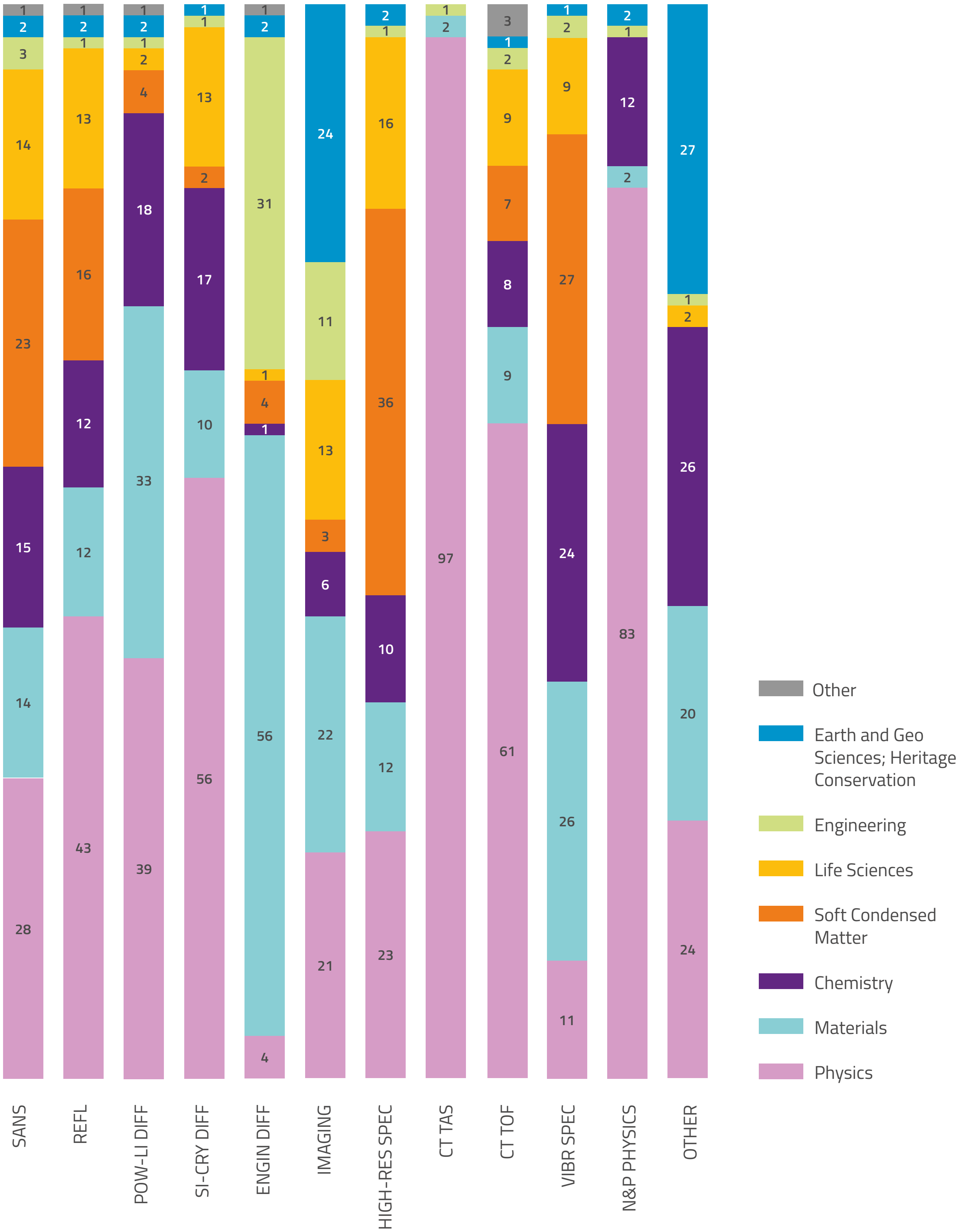
Neutron sources participating in the BrightnESS survey were asked to indicate how the facility allocates beam time across 11 different methods and seven different science fields. Methods included small angle neutron scattering, reflectometry, powder/liquid diffraction, single crystal diffraction, engineering diffraction, imaging, high-resolution spectroscopy, cold/thermal triple axis spectroscopy, cold/thermal time-of-flight spectroscopy, vibrational spectroscopy, and nuclear and particle physics. Science fields included physics, materials, chemistry, soft condensed matter, life science, engineering, earth and geo sciences, and heritage conservation.

The participating facilities provided data on the proportionate representation of science fields in each of the above-mentioned methods. This was expressed as a percentage of beam time. In order to get a European outlook, the inputs were correlated with the number of experiments carried out at each facility with the given methods. The results are shown in figure 3.15. The graph indicates that physics and materials science jointly take up more than half of experiments carried out with seven different methods (between 55-99% per method). These methods include cold/thermal triple axis spectroscopy (99%), nuclear and particle physics (85%), powder/liquid diffraction (72%), cold/thermal time-of-flight spectroscopy (70%), single crystal diffraction (66%), engineering diffraction (60%), and reflectometry (55%). Physics alone accounts for 97% of experiments using cold/thermal triple axis spectroscopy, and materials for 56% of experiments using engineering diffraction.

Experiments in chemistry are most widely represented using non-scattering methods (26%), so are earth and geo sciences, and heritage conservation (27%). The non-scattering analytical methods are marked as “Other” in figure 3.15 and have a significant industrial use. The majority of instruments, beam days, and experiments related to these methods come from neutron sources in Category C (see figures 3.4, 3.8 and 3.12). The only facility in Category A that offers instruments, beam days, and methods for this type of analytical research is MLZ FRM II.

Experiments in soft-condensed matter and life sciences are carried out mainly with the help of the following four techniques: high-resolution spectroscopy (52%), small angle neutron scattering (37%), vibrational spectroscopy (36%), and reflectometry (29%).

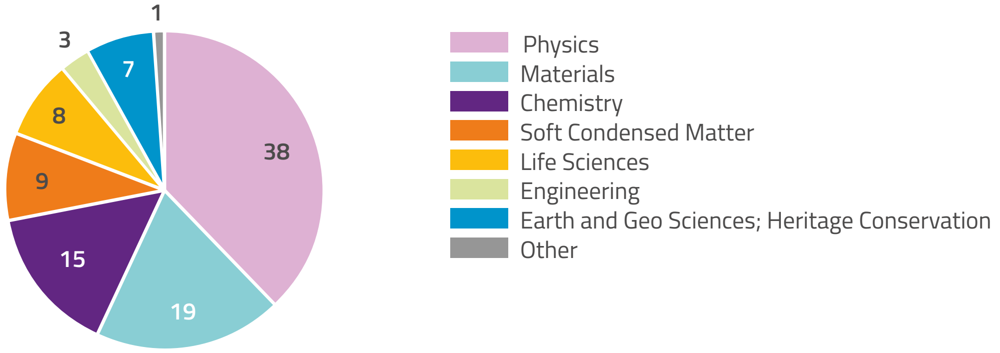
Fig 3.15 Europe: Science fields per method expressed as a percentage of experiments



SCIENCE FIELDS AND EXPERIMENTS

Figure 3.16 shows what percentage of experiments is dedicated to each science field. The graph was created by correlating data from figure 3.15 (science fields per method expressed as a percentage of experiments) with figure 3.5 (number of experiments carried out per year using each method). It is important to note that particle physics is included in the physics category in figure 3.16. Data in the pie chart below confirm significant dominance of experiments related to physics (38%) and materials (19%), closely followed by chemistry (15%). A similar percentage of experiments are dedicated to soft condensed matter (9%), life sciences (8%), and earth and geo sciences and heritage conservation (7%). Engineering experiments represent 3% of all experiments carried out at neutron sources in Europe.

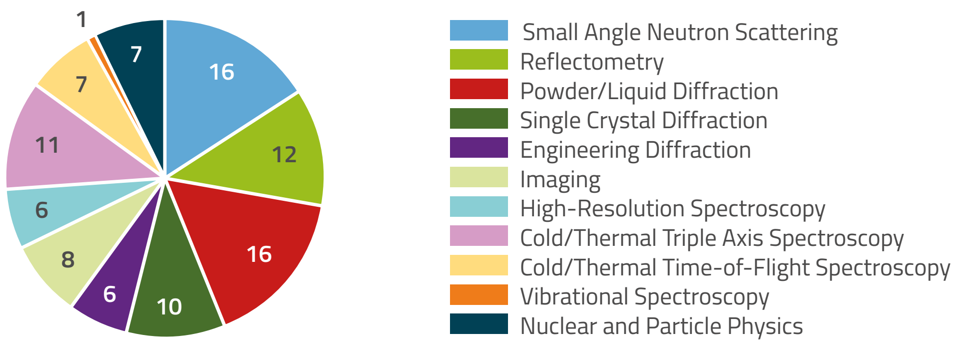
Fig 3.16 Europe: Science fields expressed as a percentage of experiments



USE OF METHODS

Figure 3.17 shows the proportionate distribution of beam days across methods and is based on data from figure 3.5. (22,526 beam days in total). The number of beam days used for non-scattering methods (1872) is not included. The distribution shows that small angle neutron scattering and powder/liquid diffraction each account for 16% of beam days. Looking at instrument classes, the chart shows that diffraction (powder/liquid diffraction, single crystal diffraction, and engineering diffraction) account for approximately one third of beam days (32%). Large-scale structures (small angle neutron scattering and reflectometry) follow closely behind with 28%. Spectroscopy (high-resolution spectroscopy, cold/termal triple axis spectroscopy, cold/thermal time-of-flight spectroscopy, and vibrational spectroscopy) account for 25% of beam days. Imaging accounts for 8% and nuclear and particle physics 7% of beam days at neutron sources in Europe.

Fig 3.17 Europe: Use of methods expressed as a percentage of beam days



ANNEXES

ISIS Neutron and Muon Source

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:

FACTS AND GENERAL INFORMATION

Type of facility	Spallation source
Power	200 kW
Thermal neutron flux at 1.5 Å (nominal peak)	4.5 x 10^{15} n/cm²/s
Cold neutron flux at 5 Å (average)	10^6 – 10^7 neutrons per second per instrument, counted at the sample position
Operational days per year	150
Total number of instruments	31
Number of instruments available to external users	31
Location	Didcot, United Kingdom

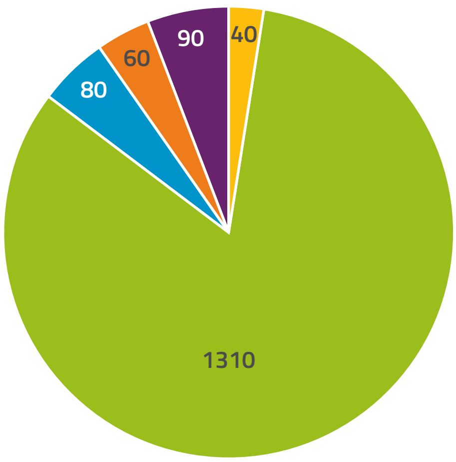
PROFILE OF THE FACILITY

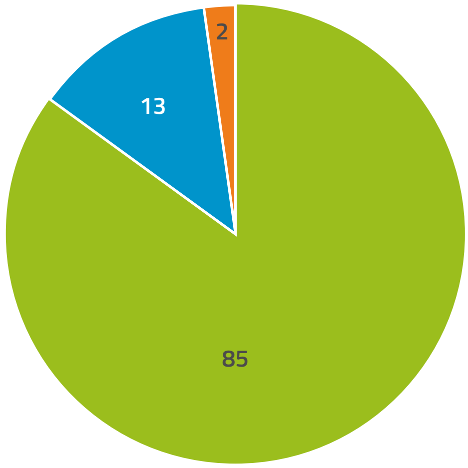
In addition to neutron scattering, ISIS is also a pulsed muon source for condensed matter and molecular studies, with five muon spectrometers. The facility also has a wide variety of other physical measurement characterisation techniques, chemistry and bio-laboratories, sample preparation labs, a deuteration facility, and a small crystal growth facility. ISIS is a part of the Rutherford Appleton Laboratory in Oxfordshire and is owned and operated by the Science and Technology Facilities Council.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

2015

USER COMMUNITY





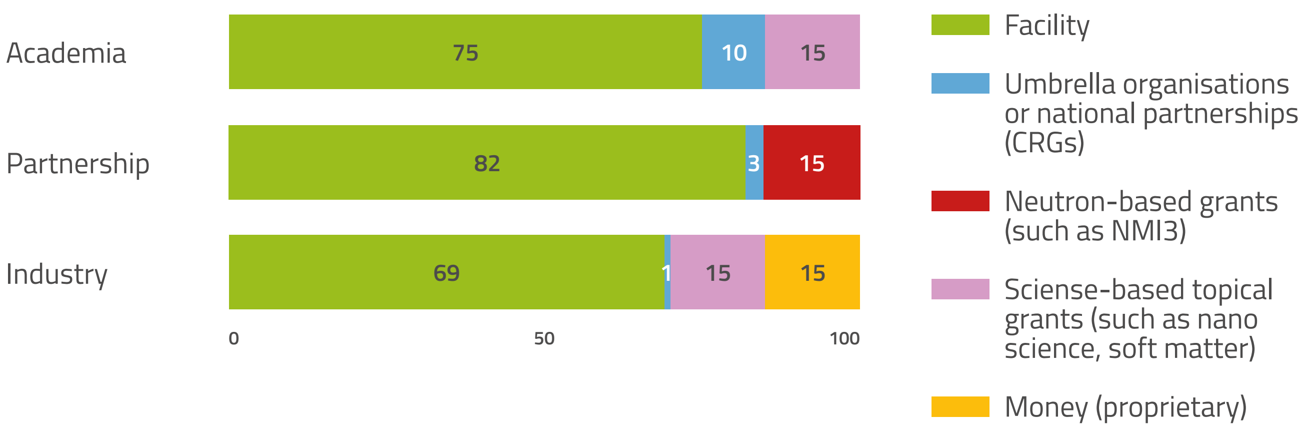
Number of unique users per year: 1580 (Q23)

- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)
- Remote users/mail-in service

User type expressed as a percentage of beam time (Q15)

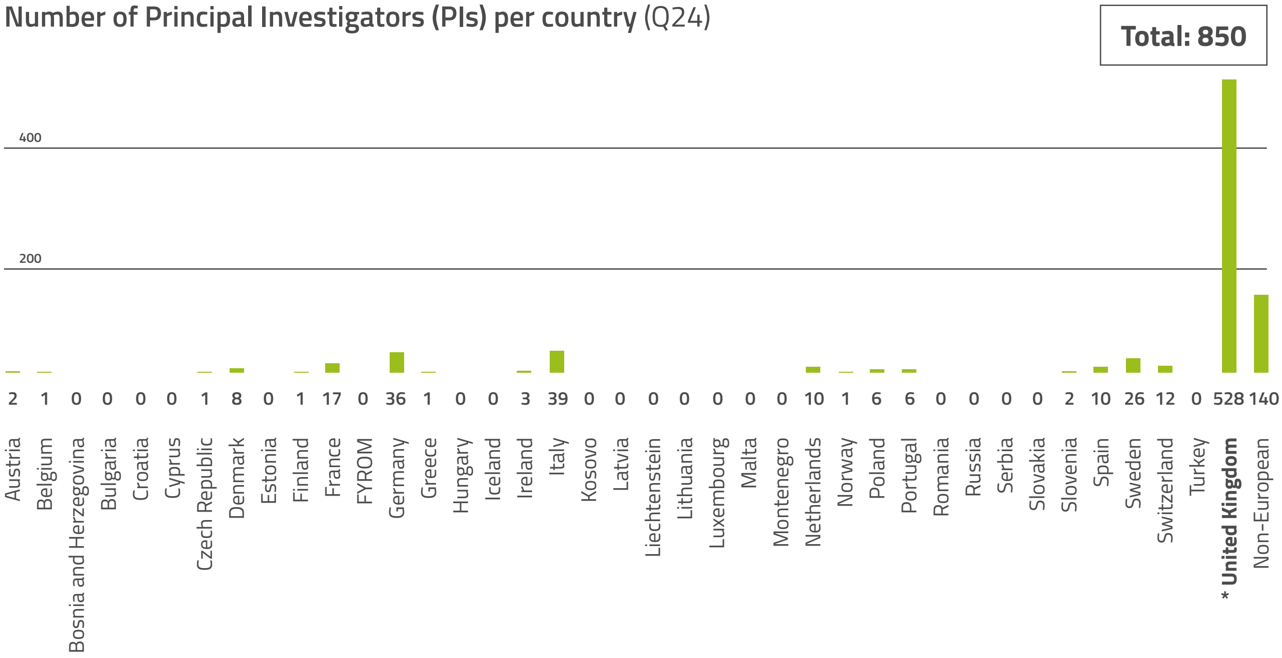
- Academia
- Partnership (public research of academia but supported by industry)
- Industry (proprietary research)

Funding of user programme for academia, partnership, and industry* (Q20, Q21, Q22)



** For example, for academia, the facility is free to use at the point of access, so it could be concluded that ISIS funds a very large fraction (75% or more) of this research as the cost of using the facility is not met by the user. However, the vast majority of users have grants which support their research programme, e.g. 50% of UK ISIS users have a grant from a UK research council to support their research. Facility costs are not met by users directly, but almost all have grants from UK or overseas research councils supporting their research.*

Number of Principal Investigators (PIs) per country (Q24)



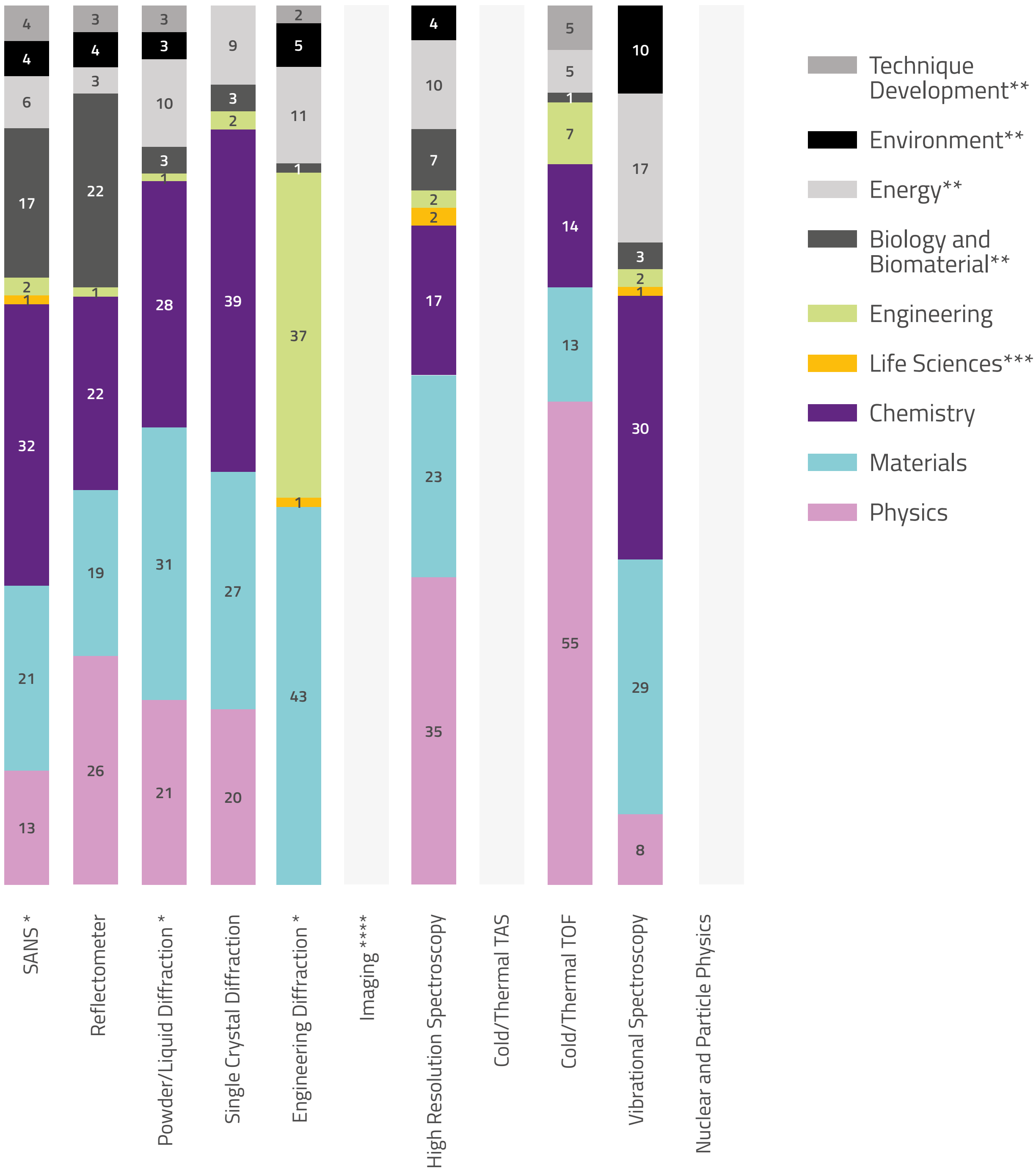
Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

Data not available

** Country where the facility is located. Figure includes ISIS staff.*

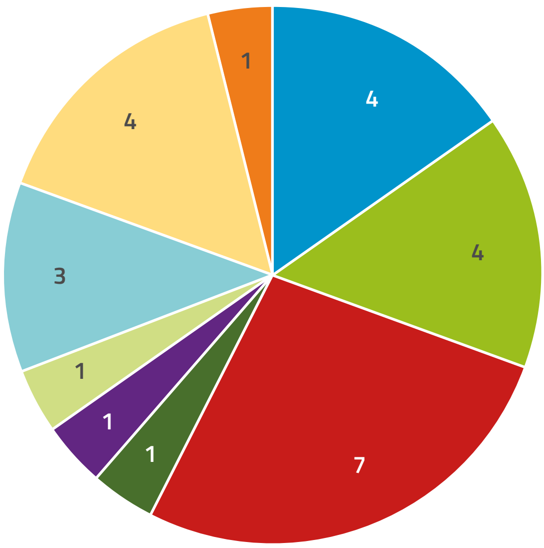
SCIENCE AND METHODS

Science fields per method expressed as a percentage of beam time (Q14)

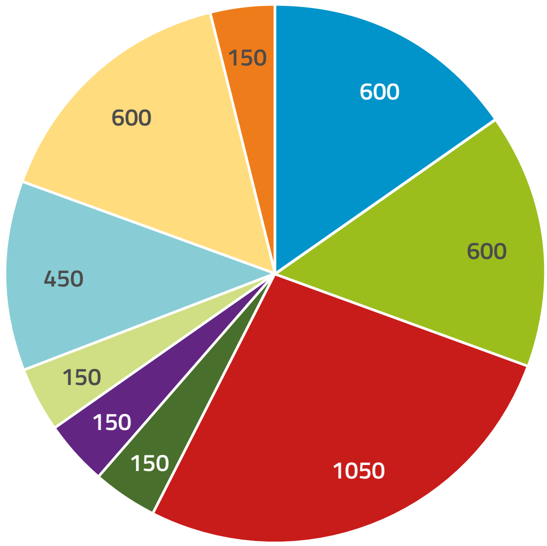


** Methods with the highest industrial use (Q16)*
*** Extra category added by the facility*
**** ISIS calls this category "Medicine"*
***** Data not available for imaging*

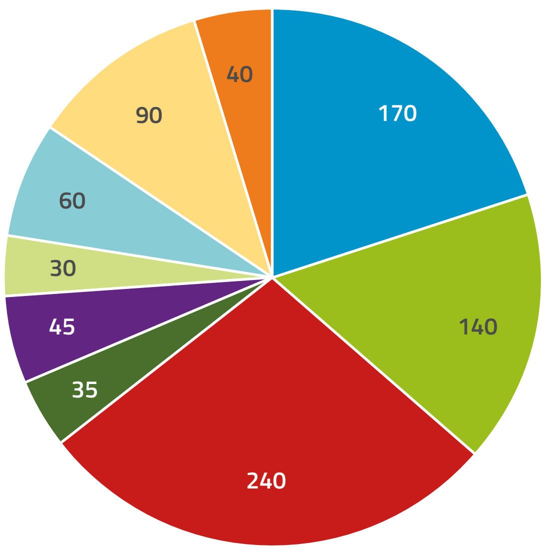
Number of instruments available for each method.* Total: 26 (Q11)



Number of beam days available to users per method per year. Total: 3900 (Q12)

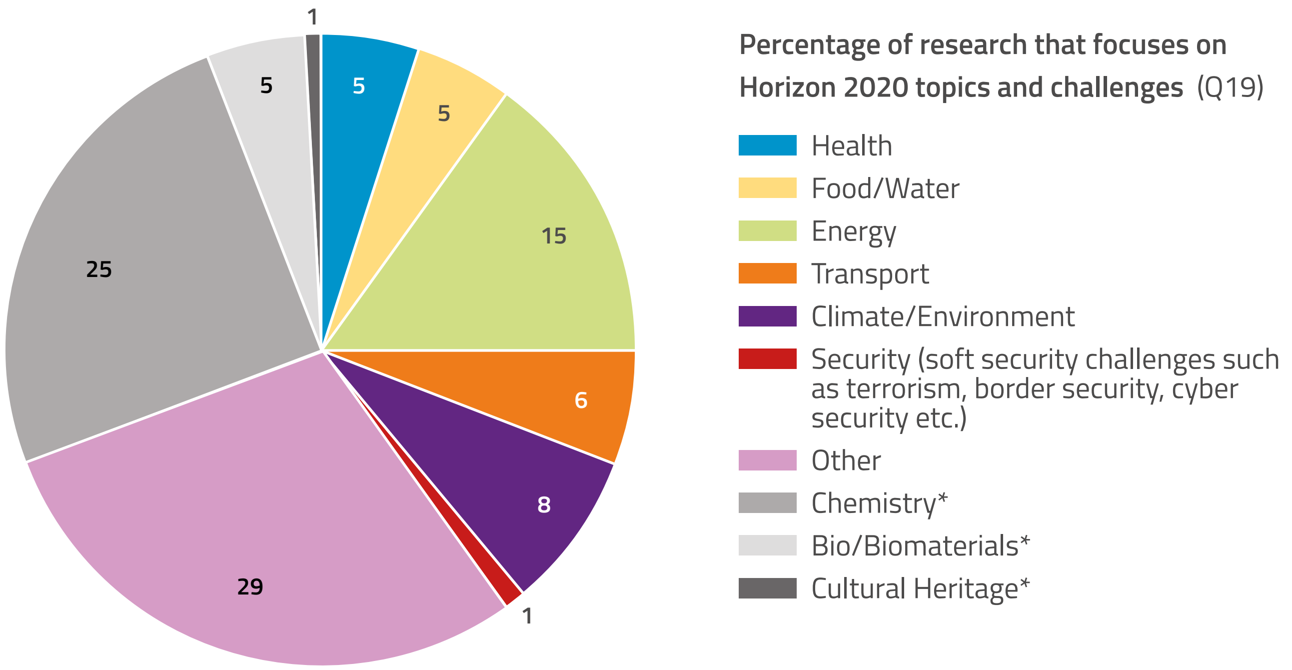


Number of experiments conducted per year using each method. Total: 850 (Q13)



- Small Angle Neutron Scattering
- Reflectometry
- Powder/Liquid Diffraction
- Single Crystal Diffraction
- Engineering Diffraction
- Imaging
- High Resolution Spectroscopy
- Cold/Thermal Time-of-Flight Spectroscopy
- Vibrational Spectroscopy

** In addition to the instruments presented in this chart, ISIS also has five muon spectrometers available for users*



Number of experiments requiring the following sample environment equipment and laboratories. (Q18)

Data not available

** Extra category added by the facility*

Q23

ISIS hosted 1580 unique users in 2015. Approximately 83% (1310) of them were individual visitors coming in for a few days. Remote users (90) who opted for the mail-in service were the second largest group. There were 80 long-term visitors, 60 in-house users, including PhDs, and 40 local users who did not need accommodation.

Q15

As much as 85% of overall beam time at ISIS was used by an academia. An additional 13% of beam time was used by academia for public research sponsored by industry. The remaining 2% was used by industry for proprietary research.

Q20, Q21, Q22

ISIS significantly contributed towards the costs covering its user programmes in 2015. The user programme for academia was funded by the facility (75%), science-based topical grants (15%), and umbrella organisations or national partnerships (10%). In this respect, it is important to note that, for example, for academia, the facility is free to use at the point of access, so it could be concluded that ISIS funds a very large fraction (75% or more) of this research as the cost of using the facility is not met by the user. However, the vast majority of users have grants which support their research programme, e.g. 50% of UK ISIS users have a grant from a UK research council to support their research. Facility costs are not met by users directly, but almost all have grants from UK or overseas research councils supporting their research. Up to 82% of the user programme for partnership was sponsored by the facility. In addition, 15% of the programme for partnership was funded by neutron-based grants and the remaining 3% was funded by umbrella organisations or national partnerships (CRGs). The user programme for industry was also mostly funded by the facility (69%). Science-based topical grants and money for proprietary research each covered 15% of programme costs. The remaining 1% was funded by umbrella organisations or national partnerships (CRGs).

Q24

850 principal investigators performed experiments at ISIS in 2015. 528 (62%) of them were from the United Kingdom, i.e. the country where ISIS is located, and included ISIS staff. The other two largest groups were Italy, with 39 PIs, and Germany, with 36 PIs. In addition, a rather large number (140) of non-European PIs carried out experiments at ISIS.

Q25

Data not available.

Q14

Engineering diffraction, SANS, and powder diffraction were the three methods with the highest industrial use. ISIS does not have any instruments for cold-thermal TAS or nuclear and particle physics. Data illustrating the use of the imaging instrument across science fields is not available. 32% of beam time using SANS was dedicated to research in chemistry. The second largest science field using SANS was materials, which took up 21% of beam time. Reflectometers were mostly used for physics (26%), chemistry (22%), and biology and biomaterial (22%). Physics, materials, and chemistry were the most dominant science fields using powder/liquid diffraction, as well as single crystal diffraction. More specifically, research in materials took up 31%, chemistry 28%, and physics 21% of the beam time using powder/liquid diffraction. 39% of the beam time using single crystal diffraction was used for research in chemistry, 27% in materials research and 20% in physics. Materials (43%) and engineering (37%) were dominant science fields using engineering diffraction. 35% of the beam time using high resolution spectroscopy was dedicated to physics, and 23% was used for materials research. Physics (55%) took up more than half of the beam time available for cold-thermal TOF. The two largest science fields using vibrational spectroscopy were chemistry (30%) and materials (29%).

Q11, Q12, Q13

The highest number of instruments (7) and beam days (1050) was available for powder/liquid diffraction. Likewise, the highest number of experiments (240) were conducted with this method.

Q19

Research carried out at ISIS addressed all Horizon 2020 topics and challenges. In 2015, 15% of the research conducted at the facility focused on energy. Chemistry (25%) together with energy (15%) were the most dominant fields.

Q18

Data not available.

Institut Laue-Langevin (ILL)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

INSTITUT LAUE-LANGEVIN (ILL)

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	58.3 MW
Thermal neutron flux at 1.5 Å (average)	1.5 x 10^{15} n/cm²/s
Cold neutron flux at five Å (average and peak)	2 x 10^{13} n/cm²/s at 1.5 Å
Operational days per year	200 (on average)
Total number of instruments	28 + 9 CRGs
Number of instruments available to external users	31.7
Location	Grenoble, France

PROFILE OF THE FACILITY

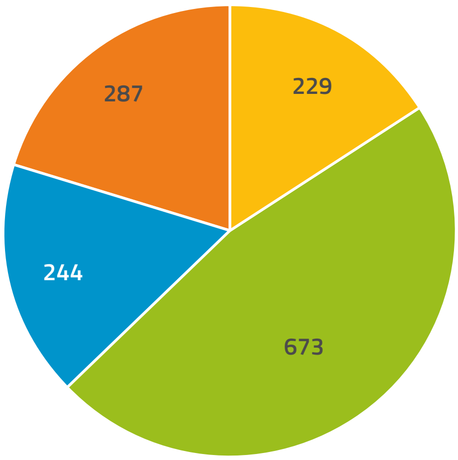
Institut Laue-Langevin (ILL) is an international centre for research in the field of neutron science and technology. Neutrons are used at the ILL to probe the structure and dynamics of a broad range of materials at a molecular, atomic and nuclear level. As a world-leading centre for neutron science, the ILL provides scientists with a very high flux of neutrons feeding some 40 state-of-the-art instruments, which are constantly being developed and upgraded. ILL offers sample preparation and characterisation with the PSB, PSCM, D-Lab and IRT nanolec.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

2015 (three cycles, 158 days of operation)* unless stated otherwise.

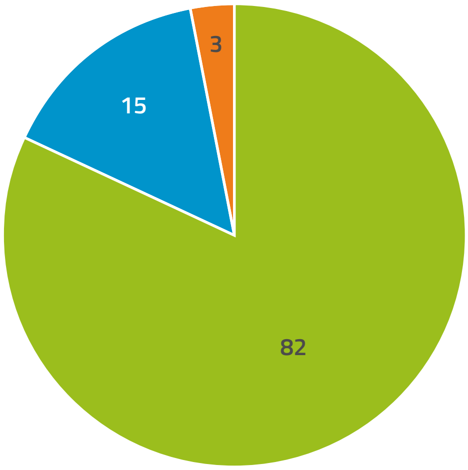
** The ILL operates four cycles (200 days) per year in normal conditions. However, since Fukushima, the amount of work imposed by the French nuclear authorities to comply with the new security regulation was such that as a consequence, longer shutdown periods were needed and the reactor operation has been rather hectic over the past years: 2011: 4 cycles, 2012: 3 cycles, 2013: 3 cycles, 2014: 2.5 cycles, 2015: 3 cycles.*

USER COMMUNITY



Number of unique users per year: 1433* (Q23)

- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)



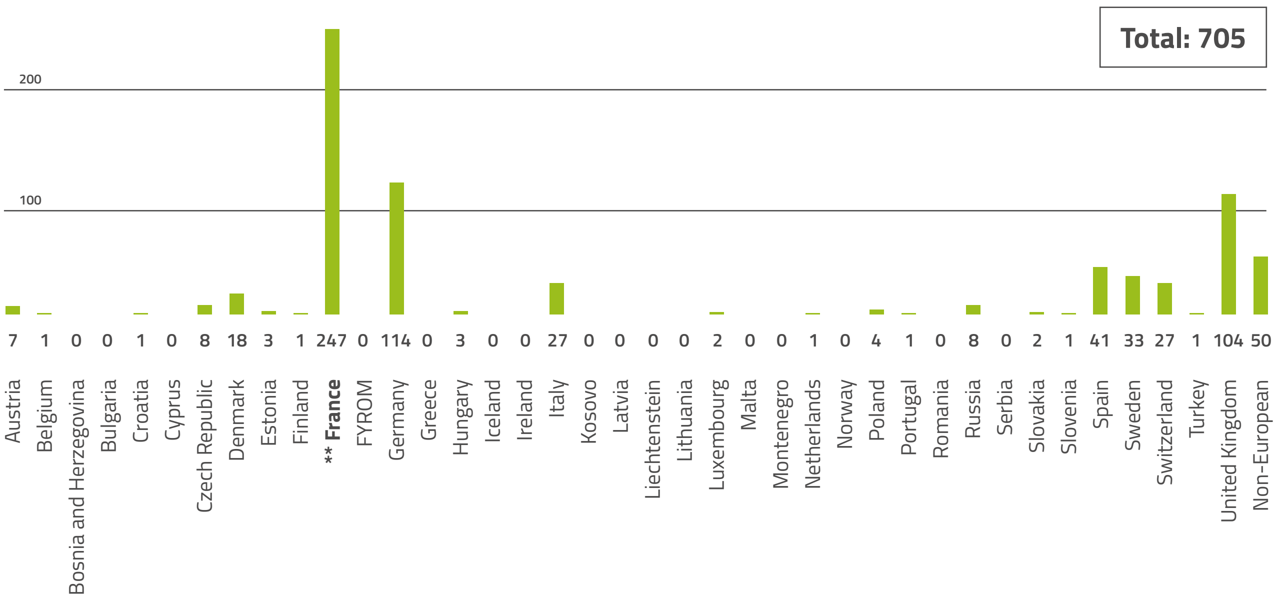
User type expressed as a percentage of beam time (Q15)

- Academia
- Partnership (public research of academia but supported by industry)
- Industry (proprietary research)

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)

** Average number of unique users per year*

Number of Principal Investigators (PI) per country* (Q24)



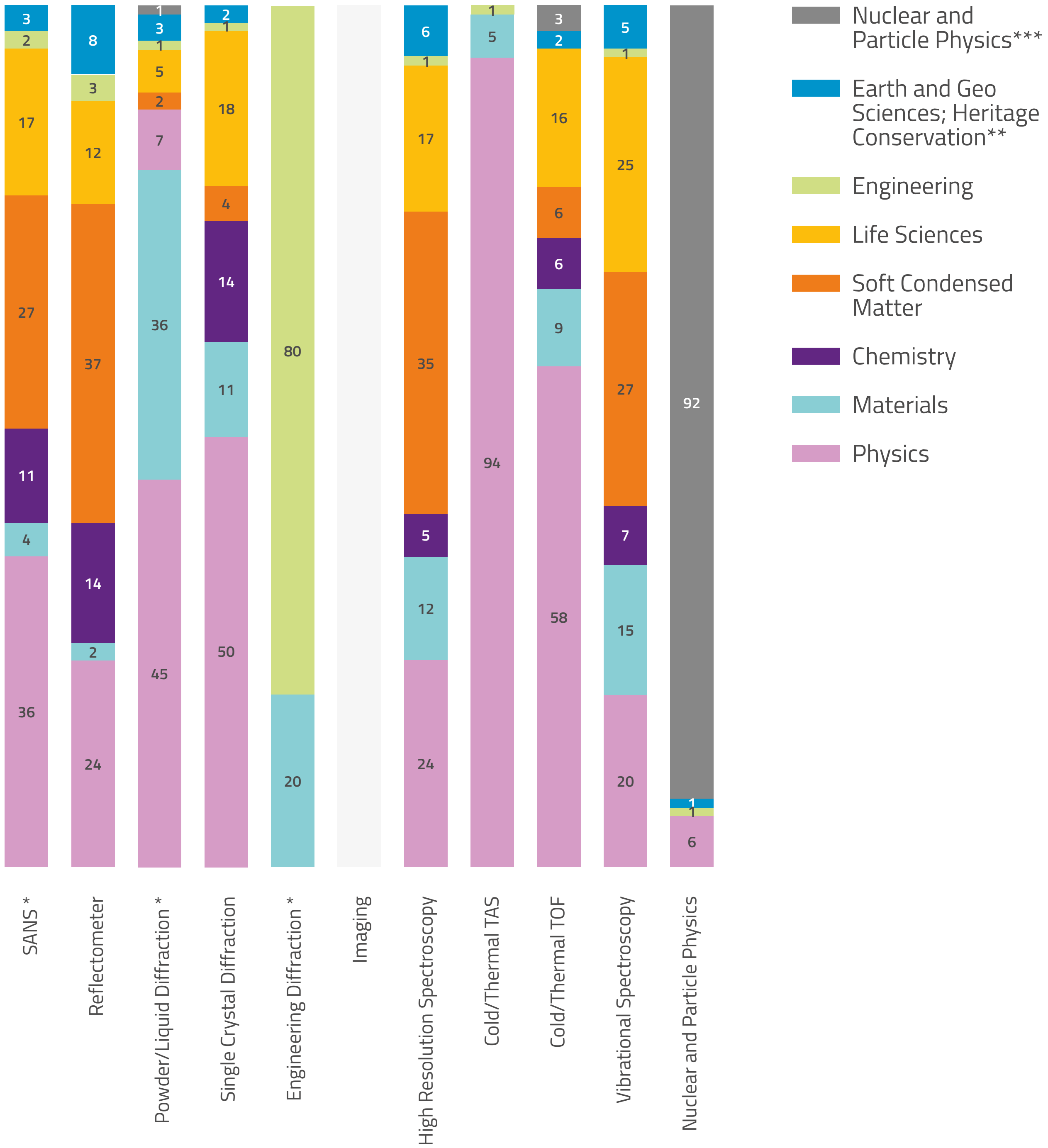
Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

	Regular	Emerging	No users
France	Physics Materials Chemistry Soft Condensed Matter Life Sciences[1] Nuclear and Particle Physics[2]	Engineering Earth/Geo/Heritage[3]	
Germany	Physics Materials Chemistry Soft Condensed Matter Nuclear and Particle Physics[2]	Life sciences[1] Engineering Earth/Geo/Heritage[3]	
United Kingdom	Physics Materials Chemistry Soft Condensed Matter Life Sciences[1]	Engineering Earth/Geo/Heritage[3] Nuclear and Particle Physics[2]	

** Average number of unique PIs per accepted experiments per year*
*** Country where the facility is located. Figure includes ILL staff.*
[1] ILL calls this category "Biology"
[2] Extra category added by the facility
[3] ILL tracks entries in this category as "Other"

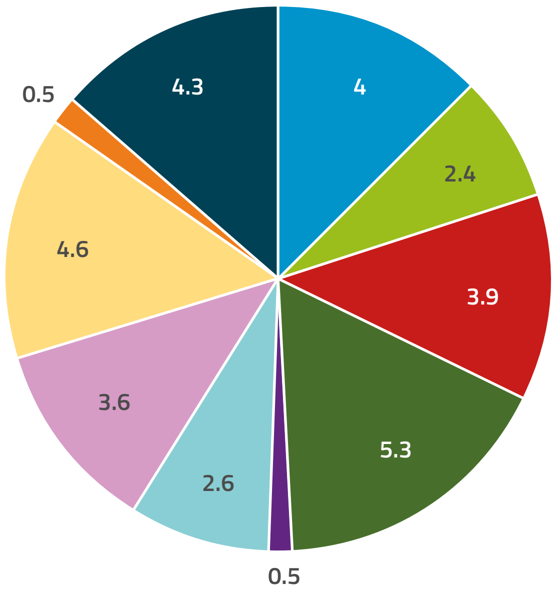
SCIENCE AND METHODS

Science fields per method expressed as a percentage of beam time (Q14)

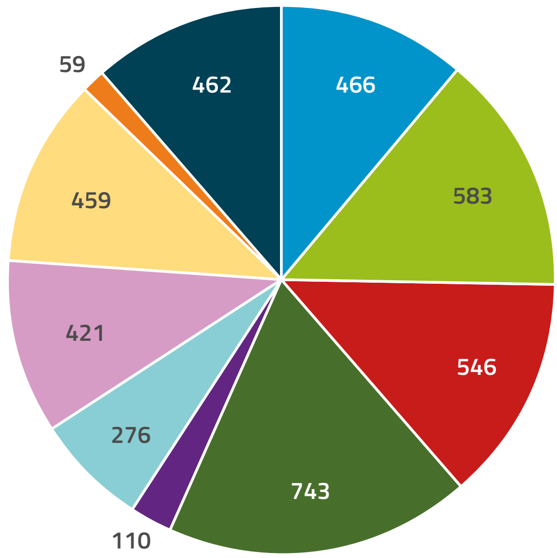


** Methods with the highest industrial use (Q16)*
*** ILL tracks entries in this category as "Other". Statistics for geo sciences are not available.*
**** Extra category added by the facility*

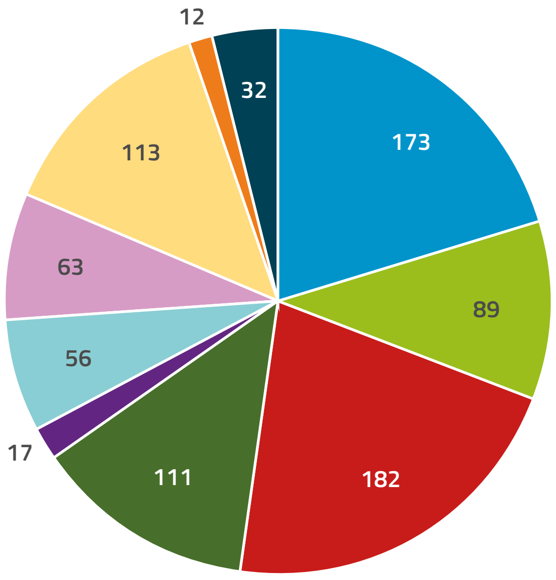
Number of instruments available for each method. Total: 31.7 (Q11)



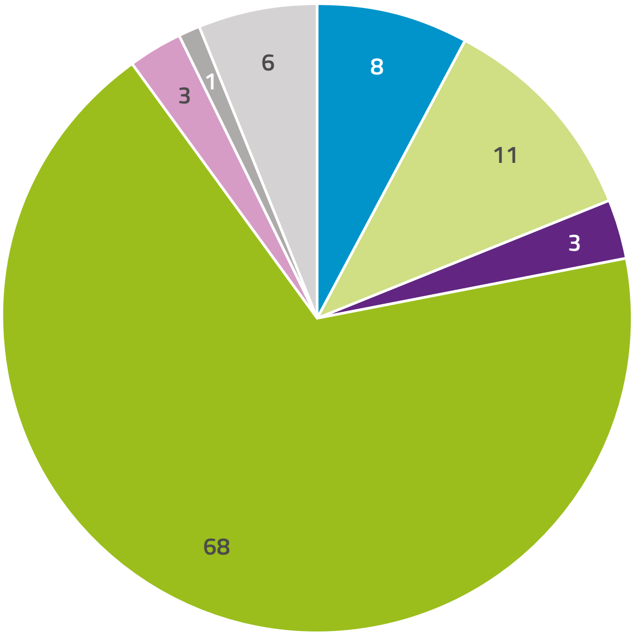
Number of beam days available to users per method per year. Total: 4125 (Q12)



Number of experiments conducted per year using each method. Total: 848** (Q13)

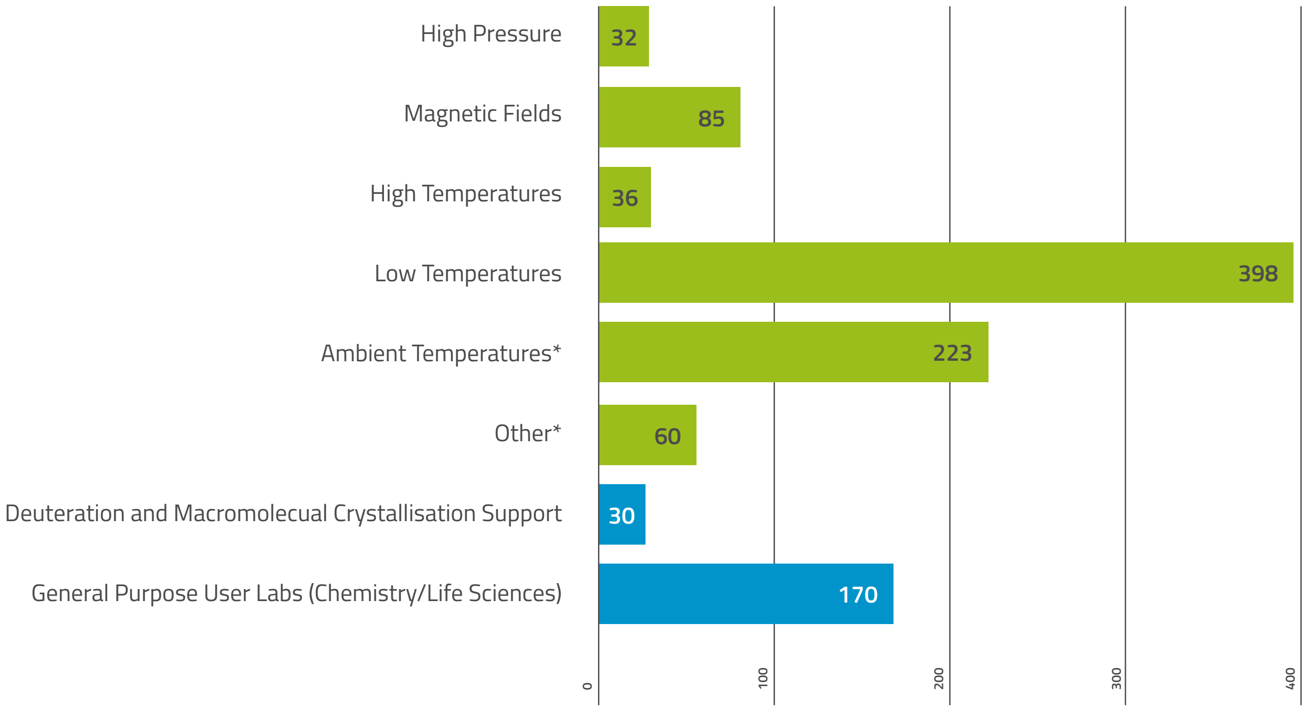


** Non-scattering method, where neutrons are used as a sample and not as a probe*
*** Average number of experiments per year*



Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 848**



** Extra category added by the facility*
*** This is the average number of experiments. The total number of experiments in 2015 was 825.*

Q23

On average, ILL hosts 1433 unique users per year. Almost 50% (673) of them are individual visitors who come to ILL for a few days. In-house users (287), including PhD students, are the second largest group. There are similar numbers of long-term visitors (244) and local users who do not need accommodation (229). Out of 244 long-term visitors, 100 stay for more than 15 days, 54 for more than 20 days, 41 for more than 25 days, 27 for more than 30 days, and 20 for more than 50 days. ILL has no remote users.

Q15

As much as 82% of overall beam time at ILL was used by academia in 2015. An additional 15% of beam time was used by academia for public research sponsored by industry. The remaining 3% was used by industry for proprietary research.

Q20, Q21, Q22

ILL sponsored a significant proportion of its user programmes in 2015. The user programme for partnership was fully sponsored by the facility. ILL also sponsored up to 93% of the user programme for academia and 84% of the user programme for industry. Umbrella organisations and national partnerships (CRGs) covered 7% of the costs of the user programme for academia. Feasibility studies, such as SINE2020, and money for proprietary research each funded 8% of the user programme for industry.

Q24

On average, 705 unique principal investigators perform experiments at ILL every year. 247 (35%) of them come from France, i.e. the country where ILL is located, and include ILL staff. The other two largest groups are Germany, with 114 PIs, and the United Kingdom, with 104 PIs. There is also a rather large number (50) of non-European PIs who perform experiments at ILL.

Q25

At ILL, the three countries with the highest number of PIs, i.e. France, Germany and the United Kingdom, are all strongly represented in physics, materials, chemistry, and soft condensed matter. While France and the United Kingdom are also strongly represented in biology (life sciences), Germany is only emerging in this field. On the other hand, Germany and France are strongly represented in nuclear and particle physics, while the United Kingdom is emerging here. All three countries are emerging in engineering and earth/geo/heritage.

Q14

SANS, powder/liquid diffraction, and engineering diffraction were the three methods with the highest industrial use. ILL does not have any imaging instruments. SANS was mostly used for research in physics (36%) and soft condensed matter (27%). Reflectometry also primarily served these two science fields, with soft condensed matter taking up 37% and physics 24% of the beam time. Physics (45%) and materials (36%) were the most frequent science fields using powder/liquid diffraction. 50% of beam time offered for single crystal diffraction was used for physics. Engineering occupied 80% of the beam time offered for engineering diffraction. High resolution spectroscopy was mostly used for soft condensed matter (35%) and physics (24%). Physics dominated cold/thermal TAS with 94%. Physics is also the most frequent science field (58%) researched using cold/thermal TOF. Soft condensed matter (27%) and life science (25%) are the two most frequent science fields researched using vibrational spectroscopy. Nuclear and particle physics (92%) was mostly researched using the nuclear and particle physics method.

Q11, Q12, Q13

In 2015, the highest number of instruments (5.3) was available for single crystal diffraction. Single crystal diffraction was also the method which offered the highest number of beam days (743) to users. On average, the highest number of experiments (182) per year are performed using powder/liquid diffraction.

Q19

Fundamental research was the dominant field at ILL and accounted for 68% of the overall research. Horizon 2020 challenges with the highest representation were energy (11%), health (8%), and climate/environment (3%).

Q18

In 2015, 170 experiments were performed on the instruments at ILL using general purpose user laboratories for sample preparation. 398 experiments required a low temperature sample environment.

FRM II
Forschungs-Neutronenquelle
Heinz Maier-Leibnitz

Forschungs-Neutronenquelle Heinz Maier-Leibnitz Zentrum (MLZ FRM II)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:

COURTESY OF FORSCHUNGS-NEUTRONENQUELLE HEINZ MAIER-LEIBNITZ ZENTRUM

FORSCHUNGS-NEUTRONENQUELLE HEINZ MAIER-LEIBNITZ ZENTRUM (MLZ FRM II)

FRM II
Forschungs-Neutronenquelle
Heinz Maier-Leibnitz

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	20 MW
Thermal neutron flux at 1.5 Å (average)	8×10^{14} $n_{th}/(cm^2\ s)$
Cold neutron flux at 5 Å (average)	3×10^{13} $n/(cm^2\ s)$
Operational days per year	240 (4 x 60 days at full power)
Total number of instruments	26*
Number of instruments available to external users	26
Location	Garching, Germany

PROFILE OF THE FACILITY

The Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II) is a multi-purpose research reactor designed to provide neutrons for scientific experiments, as well as for industrial and medical applications. The FRM II is equipped with cold, thermal, hot, and fast fission neutron sources and covers a broad range of applications, including experiments with positrons. An ultra-cold neutron source is under construction. Today, 26 instruments are operational. Furthermore, seven irradiation systems for isotope production, silicon doping, and analytical purposes are in service. An irradiation facility for the production of the medical isotope Mo-99 is under construction.

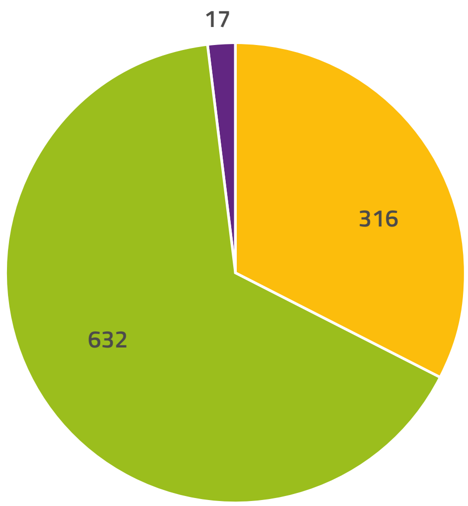
The FRM II is a user facility which is organised under the name of the "Heinz Maier-Leibnitz Zentrum (MLZ)". The MLZ represents the scientific cooperation between the Technische Universität München (TUM) and two research centres of the Helmholtz Association, namely Forschungszentrum Jülich and Helmholtz-Zentrum Geesthacht (HZG), to exploit the scientific use of the FRM II, and is strengthened by collaborating groups from the Max Planck Society and nine further universities.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

Average over 2013-2015 (unless stated otherwise)

**MLZ FRM II currently has 26 operational instruments. An additional six instruments are under construction.*

USER COMMUNITY*



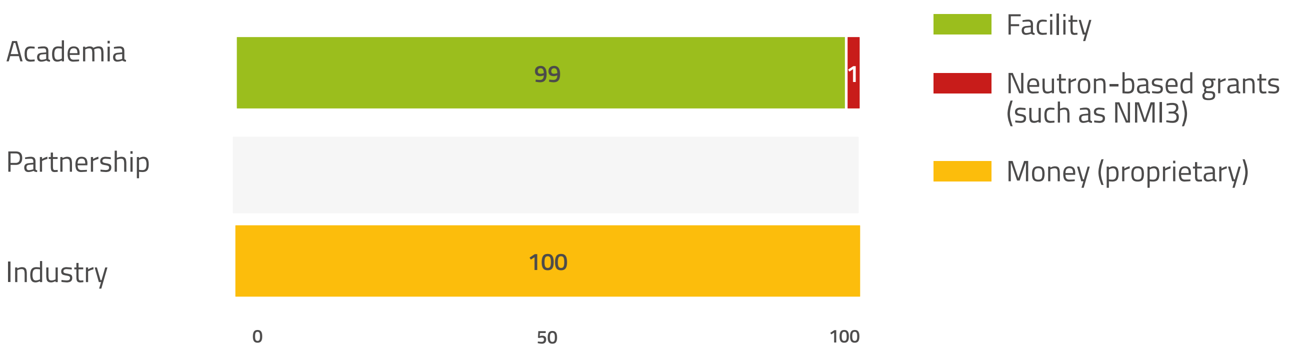
Number of unique users per year: 965** (Q23)

- Local users (no accommodation)***
- Individual visitors (coming for a few days)
- Remote users/mail-in service

User type expressed as a percentage of beam time (Q15)

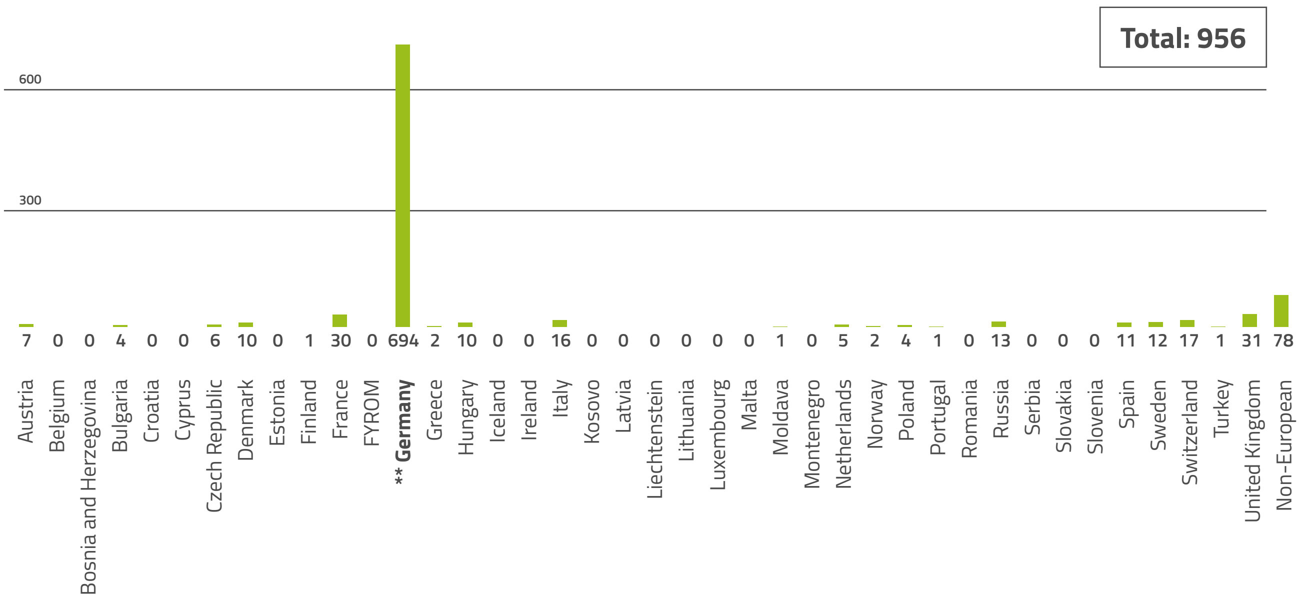
Not relevant for MLZ FRM II****

Funding of user programme for academia, partnership, and industry***** (Q20, Q21, Q22)



** Please note that the irradiation systems at MLZ FRM II are not counted as instruments in this document*
*** The number of operational days varied between 2013-2015 due to longer maintenance breaks in 2014 and 2015. The facility only had full four cycles in 2013. The figures provided in this question do not refer to the average over the three years, as this would not reflect the number of unique users in a standard year of operation. The figure refers to the year of 2013. MLZ FRM II has about 1400 visiting scientists per year (965 unique users in 2013).*
**** The number of in-house users and PhD students is included in the figure "local users (no accomodation)"*
***** The division of users into three categories (academia, partnerships, and industry) is not relevant for the user structure of MLZ FRM II. However, 30% of the neutrons used at MLZ FRM II go in the direction of industry and medicine. This includes production of isotopes, Si doping, paid beam time by industry, and cancer therapy.*
****** The budget of MLZ FRM II includes contributions from the Bavarian government, BMBF via Helmholtz, direct contribution by Helmholtz, BMBF funding of instrument construction, contributions from university groups which operate instruments, DFG funding, and EU funding, such as NMI3 or SINE2020. The order roughly represents the importance of the funding.*

Number of Principal Investigators (PIs) per country* (Q24)

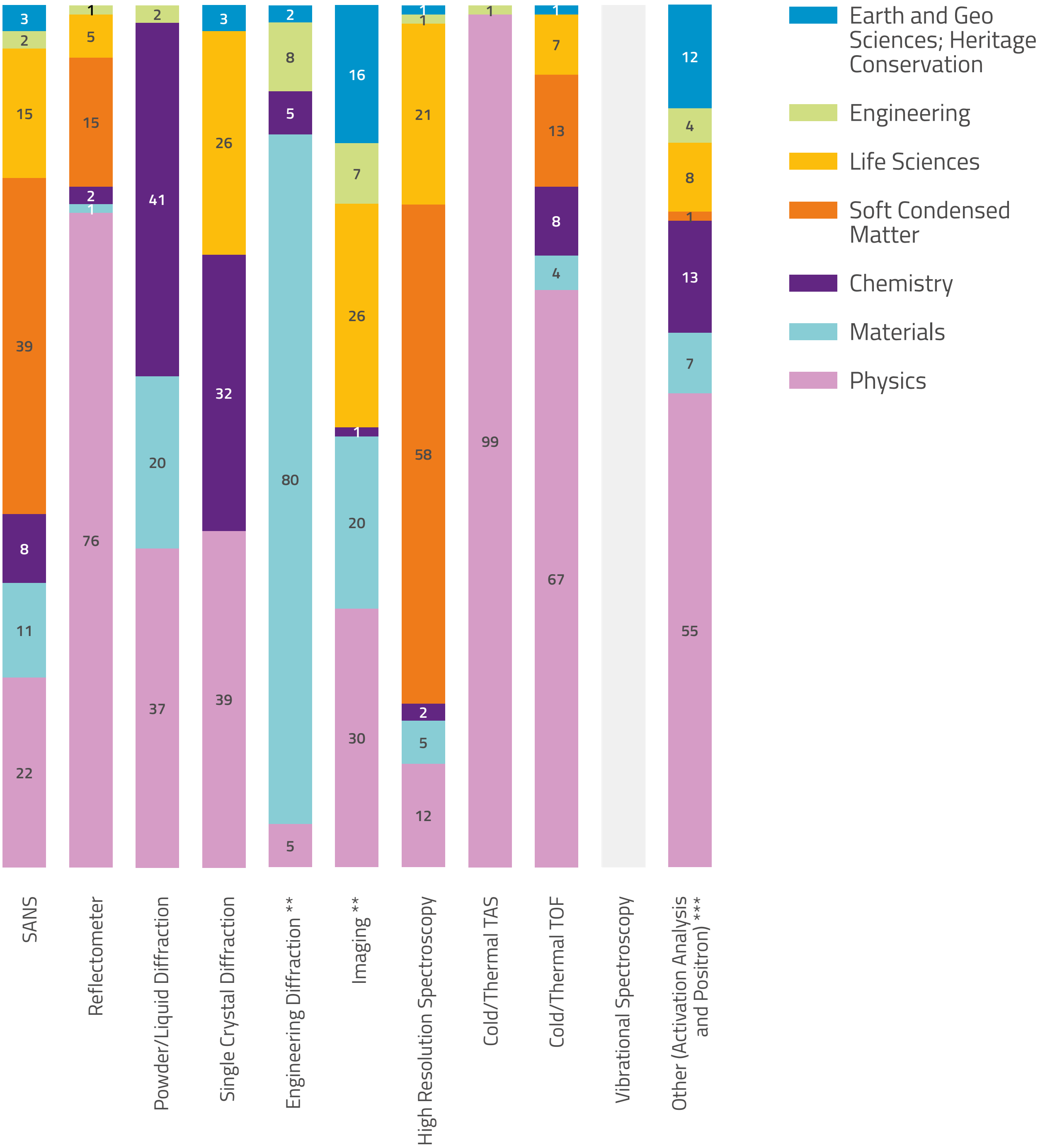


Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

	Regular	Emerging	No users
Germany	Materials Chemistry Soft Condensed Matter Life Sciences Engineering Condensed Matter/Magnetism***	Physics Earth/Geo/Heritage	
United Kingdom		Materials Chemistry Earth/Geo/Heritage Soft Condensed Matter Life Sciences Condensed Matter/Magnetism***	Physics Engineering
France		Materials Chemistry Soft Condensed Matter Life Sciences Condensed Matter/Magnetism***	Physics Engineering Earth/Geo/Heritage

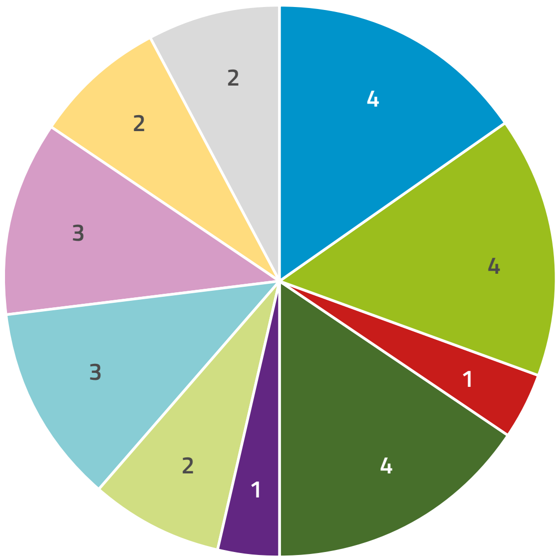
** The data provided in this chart refer to the number of conducted experiments in 2013 and the respective PIs from each country. The facility had four full cycles in 2013.*
*** Country where the facility is located. Figure includes PIs from MLZ FRM II.*
**** Extra category added by the facility. In the profiles of other facilities, this category is included in category "Physics".*

Science fields per method expressed as a percentage of beam time (Q14)

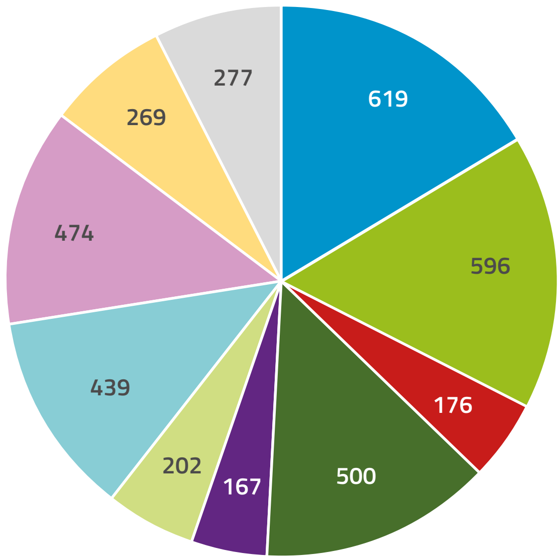


** Extra category added by the facility including data from the instruments PGAA and positron source NEPOMUC*
*** Methods with the highest industrial use (Q16)*

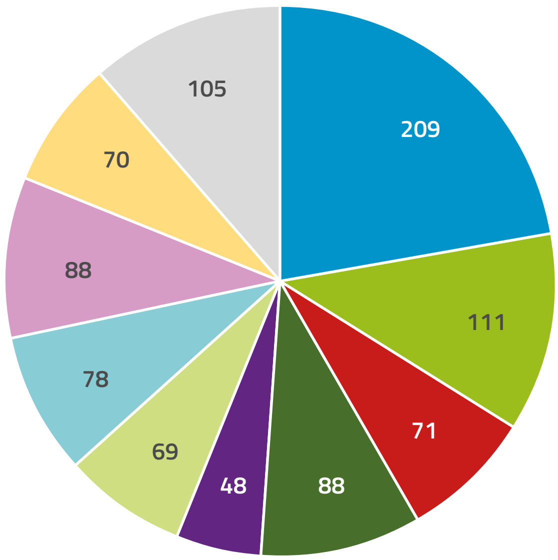
Number of instruments available for each method. Total: 26 (Q11)



Number of beam days available to users per method per year. Total: 3719 (Q12)

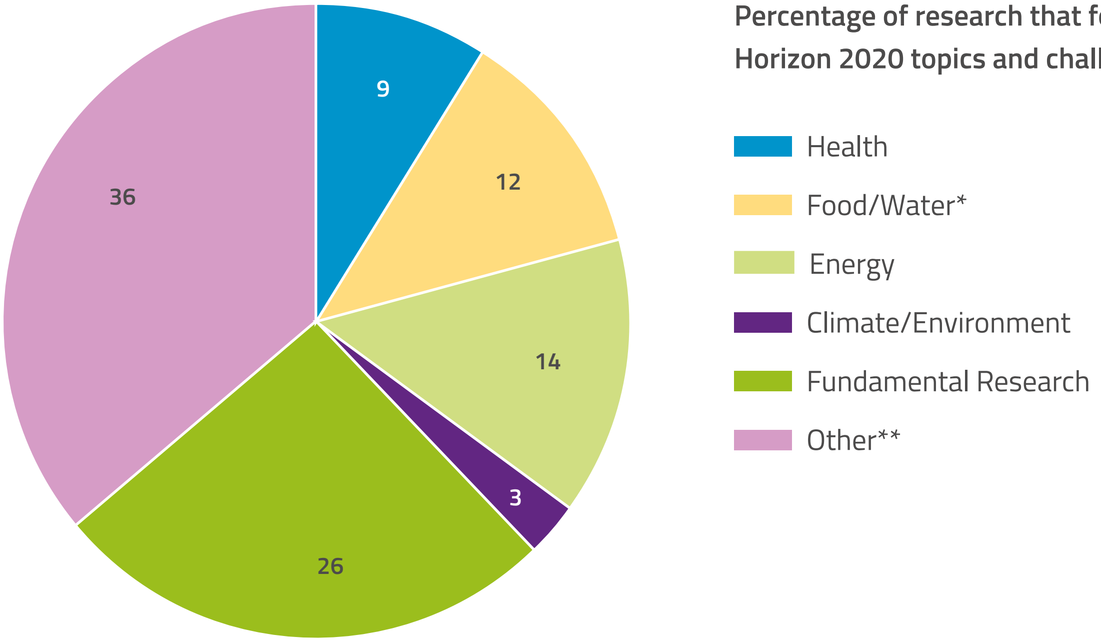


Number of experiments conducted per year using each method. Total: 937 (Q13)

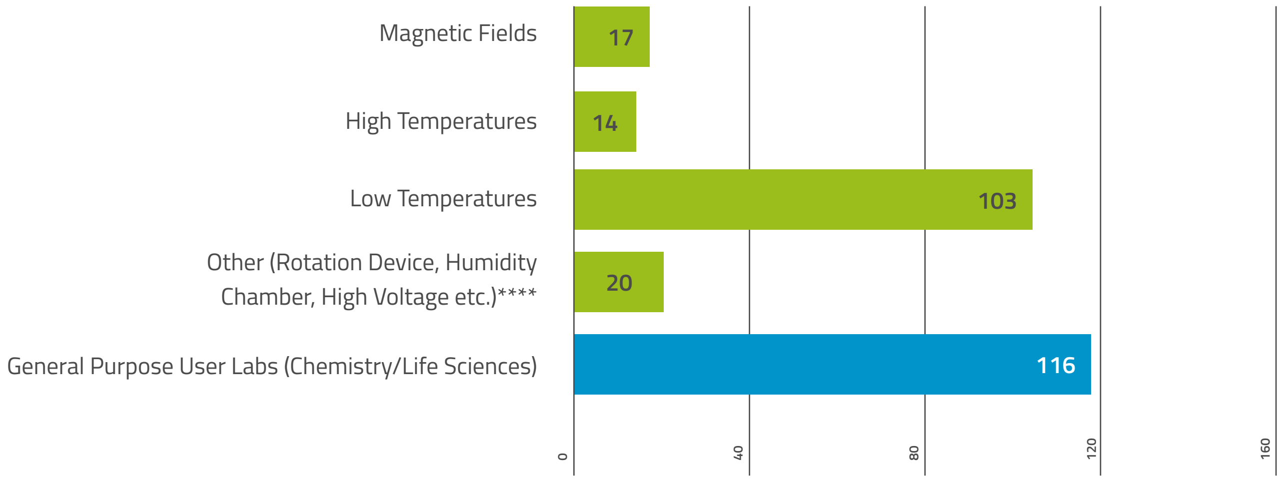


** Extra category added by the facility. Data in this category includes data related to instruments PGAA and the positron source NEPOMUC.*

Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)



Number of experiments requiring the following sample environment equipment and laboratories. ***(Q18)
Total number of experiments as per Q13: 937



** Includes soft matter research*
*** Includes information technology, nanotechnology etc.*
**** Number of experiments is not available for sample environments, such as high pressure, mechanical processing, gas handling, liquid handling, surfaces/troughs, and deuteration and macromolecular crystallisation support. However, all of these sample environments are very important and MLZ FRM II provides them to users. MLZ FRM II does not have any special deuteration laboratory, but gets deuteration through collaborating with Institut Laue-Langevin (ILL), Technical University of Munich (TUM) laboratories, and users. High pressure sample environment concerns mainly equipment provided by user groups.*
***** Extra category added by the facility*

Q23

The number of operational days at MLZ FRM II varied between 2013-2015 due to longer maintenance breaks in 2014 and 2015. The facility only had four full cycles in 2013. As a result, the figures provided in this question do not refer to the average over 2013-2015, as this would not reflect the number of unique users in a standard year of operation. Instead, the figures refer to the year of 2013 when MLZ FRM II operated four cycles and hosted 965 unique users. Approximately 65% (632) of them were individual visitors, who came to MLZ FRM II for a few days. Local users (316) who did not need accommodation were the second largest group. Unlike in the profiles of other facilities, the number of in-house users and PhD students is included in the category of local users. MLZ FRM II also had 17 remote users who used the mail-in service. MLZ FRM II usually has about 1400 visiting scientists per year.

Q15

The division of users into three categories (academia, partnerships, and industry) is not relevant for the user structure of MLZ FRM II. However, 30% of the neutrons used at MLZ FRM II go in the direction of industry and medicine. This includes the production of isotopes, Si doping, paid beam time by industry and cancer therapy.

Q20, Q21, Q22

MLZ FRM II sponsored 99% of its user programme for academia during 2013-2015. The remaining 1% was funded through neutron-based grants, such as NMI3. The entire user programme for industry was funded through proprietary research.

Q24

In 2013, there were 956 Principal Investigators who conducted experiments at MLZ FRM II. 694 (73%) of them were from Germany, i.e. the country where the facility is located, and also include PIs from MLZ FRM II. The other two largest groups were the United Kingdom, with 31 PIs, and France, with 30 PIs. MLZ FRM II was also used by a significant number (78) of non-European PIs.

Q25

The three countries with the highest number of PIs who performed experiments at MLZ FRM II in 2013 were Germany, the United Kingdom, and France. At MLZ FRM II, Germany is strongly represented in materials, chemistry, soft condensed matter, life sciences, engineering, and condensed matter/magnetism, and is emerging in physics and earth/geo/heritage. Please note that in the profiles of other facilities, condensed matter and magnetism in this question is included in category “physics”. At MLZ FRM II, the United Kingdom is emerging in materials, chemistry, earth/geo/heritage, soft condensed matter, life sciences, and condensed matter/magnetism. The United Kingdom and France have no users in physics or engineering at MLZ FRM II. In addition, France does not have any users in earth/geo/heritage at the facility. France is emerging in materials, chemistry, soft condensed matter, life sciences, and condensed matter/magnetism.

Q14

Engineering diffraction, imaging, and activation analysis and positron were the three methods with the highest industrial use at MLZ FRM II. The facility does not have any instruments for vibrational spectroscopy. SANS was mostly used for research in soft condensed matter (39%) and physics (22%). A significant proportion of beam time for reflectometers was used for physics (76%). Chemistry (41%) and physics (37%) were the most frequent science fields in powder/liquid diffraction. 39% of the beam time offered for single crystal diffraction was used for physics. Materials occupied 80% of the beam time offered for engineering diffraction. The three most frequent science fields in imaging were physics (30%), life science (26%), and materials (20%). Soft condensed matter (58%) dominated high resolution spectroscopy. Almost all beam time available for cold/thermal TAS was used for physics (99%). Physics also occupied a significant proportion of beam time (67%) offered for cold/thermal TOF. The most frequent science field in activation analysis and positron was physics (55%). Data related to this method refer to data from instruments PGAA and positron source NEPOMUC.

Q11, Q12, Q13

The highest number of instruments were available for small angle neutron scattering (4), reflectometry (4) and single crystal diffraction (4). Small angle neutron scattering was the method which offered the highest number of beam days (619) to users. Also, the highest number of experiments (209) per year was performed by small angle neutron scattering.

Q19

Fundamental research accounted for 26% of the overall research carried out at MLZ FRM II. Horizon 2020 challenges with the highest representation were energy (14%), food/water, including soft matter research (12%), and health (9%). In addition, 3% of research focused on climate/environment. A significant proportion (36%) of research was carried out in other fields, which included information technology and nanotechnology.

Q18

A total of 116 experiments were performed at the instruments at MLZ FRM II using general purpose user laboratories for sample preparation and/or additional sample characterisation. 103 experiments were carried out in a low temperature sample environment. The number of experiments requiring surface/troughs, liquid handling, gas handling, mechanical processing, high pressure, and deuteration and macromolecular crystallisation support is not available, but all of these sample environments are very important and MLZ FRM II provides them to users. MLZ FRM II has no special deuteration laboratory, but is provided with deuteration through collaboration with ILL, TUM laboratories, and users. High pressure sample environment concerns mainly equipment provided by user groups.

Laboratoire Léon Brillouin (LLB–ORPHÉE)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

LABORATOIRE LÉON BRILLOUIN (LLB–ORPHÉE)

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	14 MW
Thermal neutron flux at 1.5 Å (average)	4.3 x 10^{12} n.cm^{-2}.s^{-1}.Å^{-1}.Str^{-1}
Cold neutron flux at 5 Å (average)	0.86 x 10^{12} n.cm^{-2}.s^{-1}.Å^{-1}.Str^{-1}
Operational days per year	120
Total number of instruments	23
Number of instruments available to external users	20
Location	CEA Saclay, Gif-sur-Yvette, France

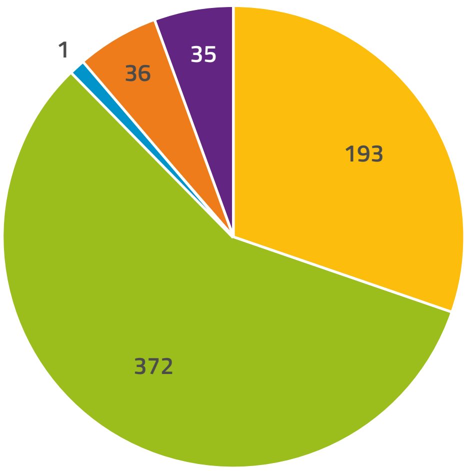
PROFILE OF THE FACILITY

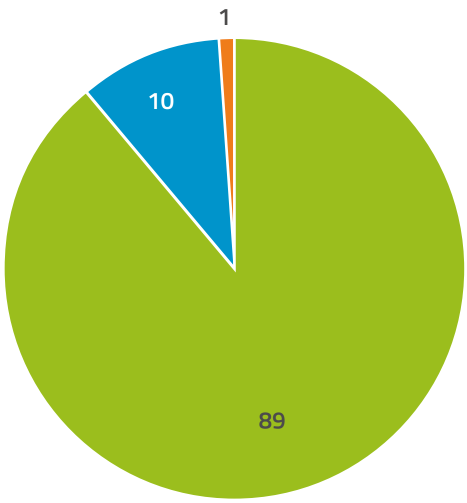
The LLB is a service-providing laboratory that also develops its own scientific research. One of its roles is the design, construction, and operation of neutron spectrometers installed around the Orphée reactor in Saclay. These are mainly used for the study of condensed matter. The scientific activities of the laboratory can be classified in three fields of equal importance: physical-chemistry, structural and phase transition studies, and magnetism and superconductivity.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

2015

USER COMMUNITY





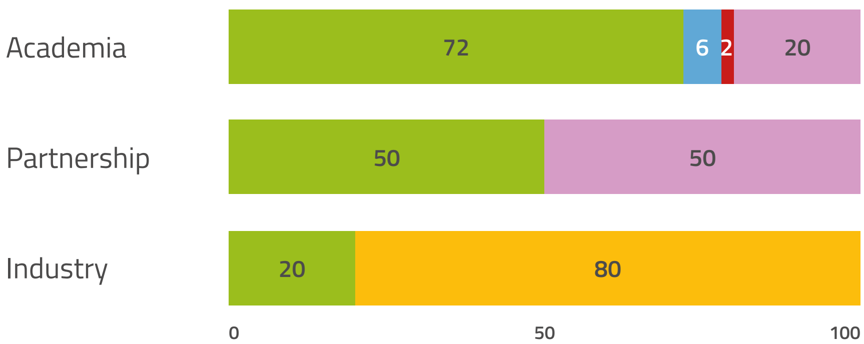
Number of unique users per year: 637 (Q23)

- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)
- Remote users/mail-in service

User type expressed as a percentage of beam time (Q15)

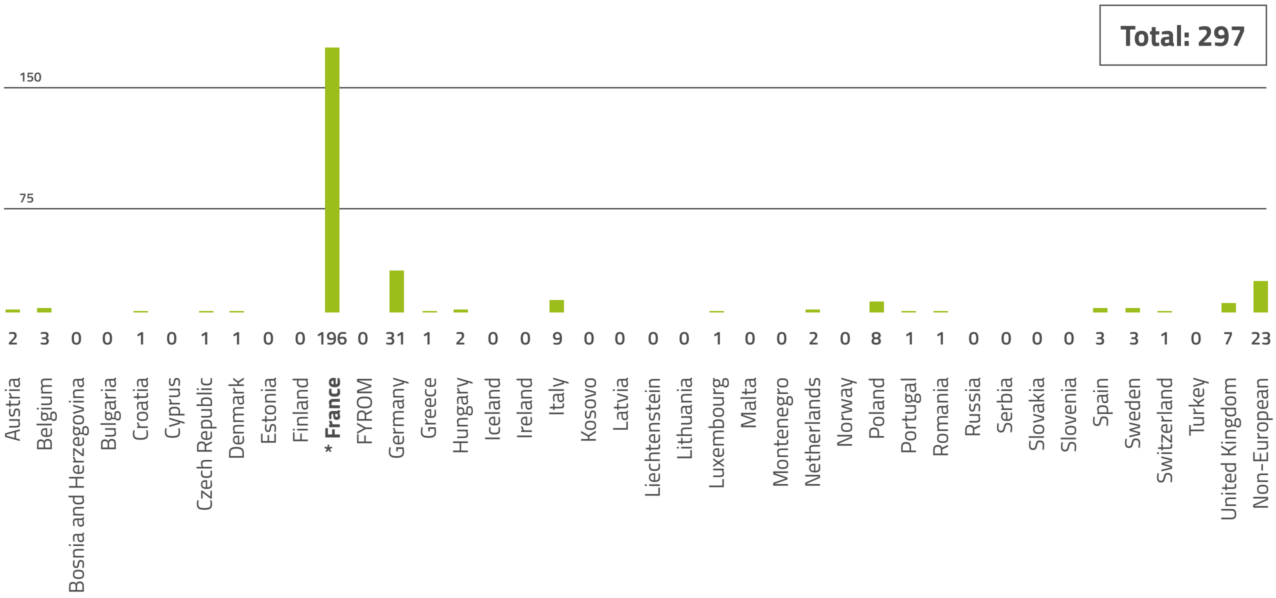
- Academia
- Partnership (public research of academia but supported by industry)
- Industry (proprietary research)

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



- Facility
- Umbrella organisations or national partnerships (CRGs)
- Neutron-based grants (such as NMI3)
- Science-based topical grants (such as nano science, soft matter)
- Money (proprietary)

Number of Principal Investigators (PIs) per country (Q24)



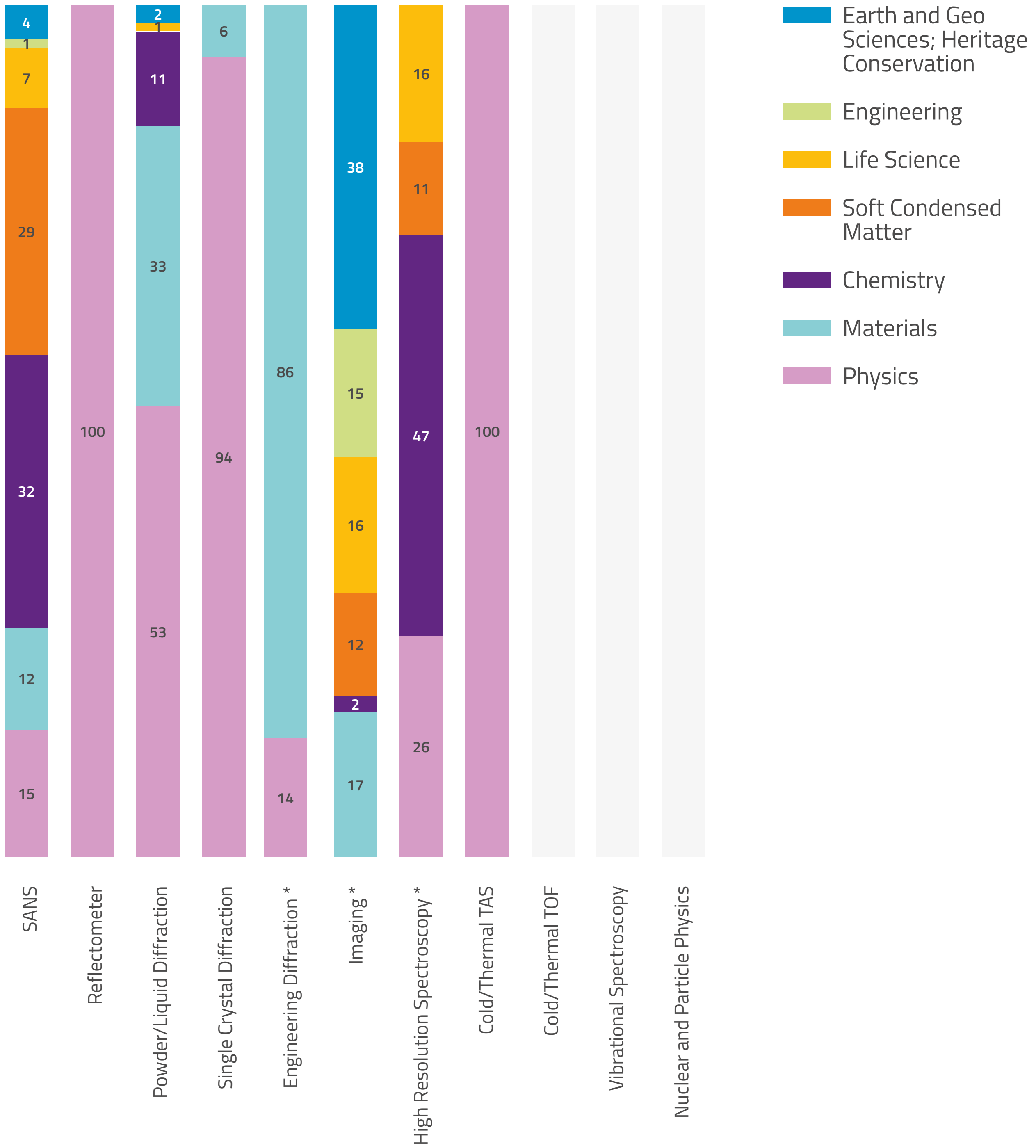
Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

	Regular	Emerging	No users
France	Physics Materials Chemistry	Soft Condensed Matter Life Sciences Engineering Earth/Geo/Heritage	
Germany	Physics Soft Condensed Matter	Chemistry Life Sciences Engineering Earth/Geo/Heritage	Materials
Italy		Physics Chemistry Earth/Geo/Heritage	Materials Soft Condensed Matter Life Sciences Engineering

** Country where the facility is located. Figure includes LLB staff.*

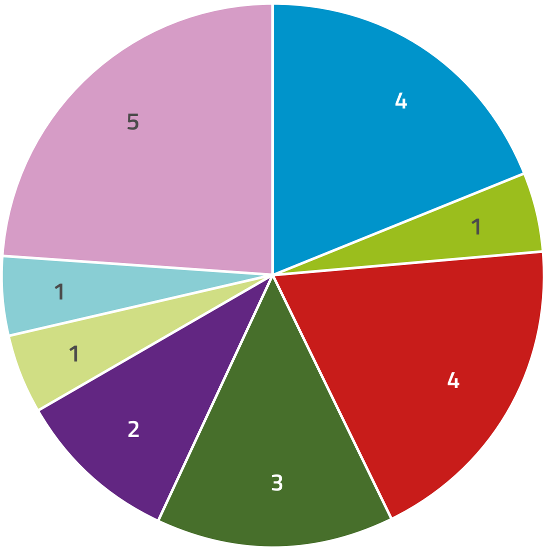
SCIENCE AND METHODS

Science fields per method expressed as a percentage of beam time (Q14)

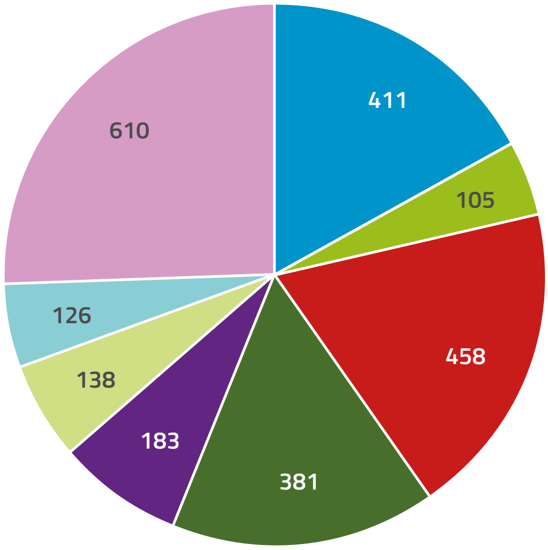


** Methods with the highest industrial use (Q16)*

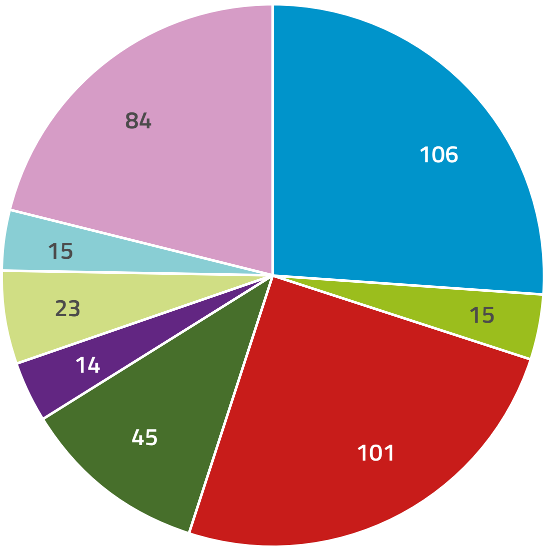
Number of instruments available for each method. Total: 21 (Q11)

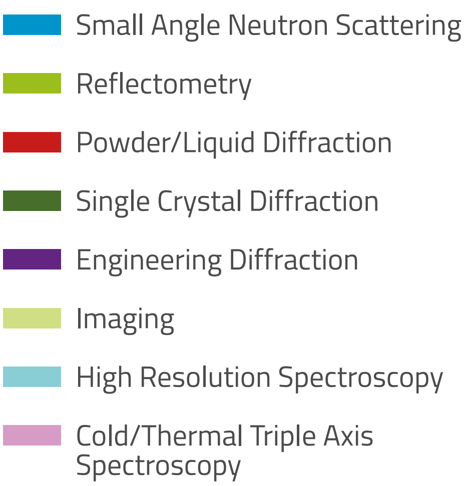


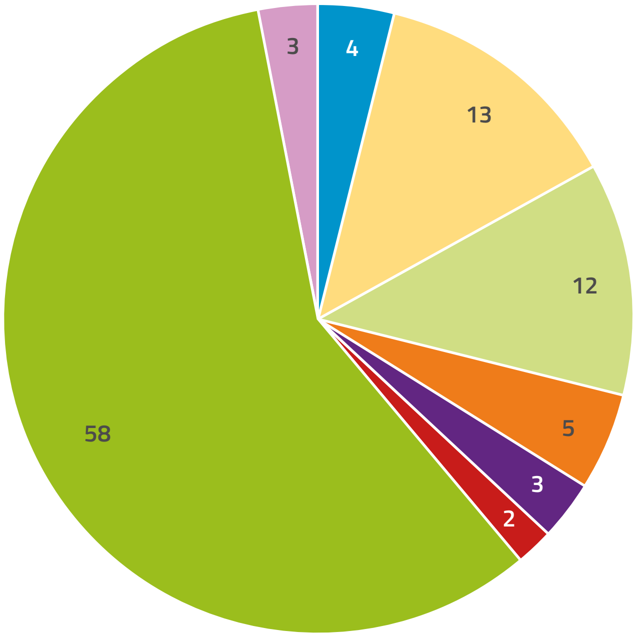
Number of beam days available to users per method per year. Total: 2412 (Q12)



Number of experiments conducted per year using each method. Total: 403 (Q13)



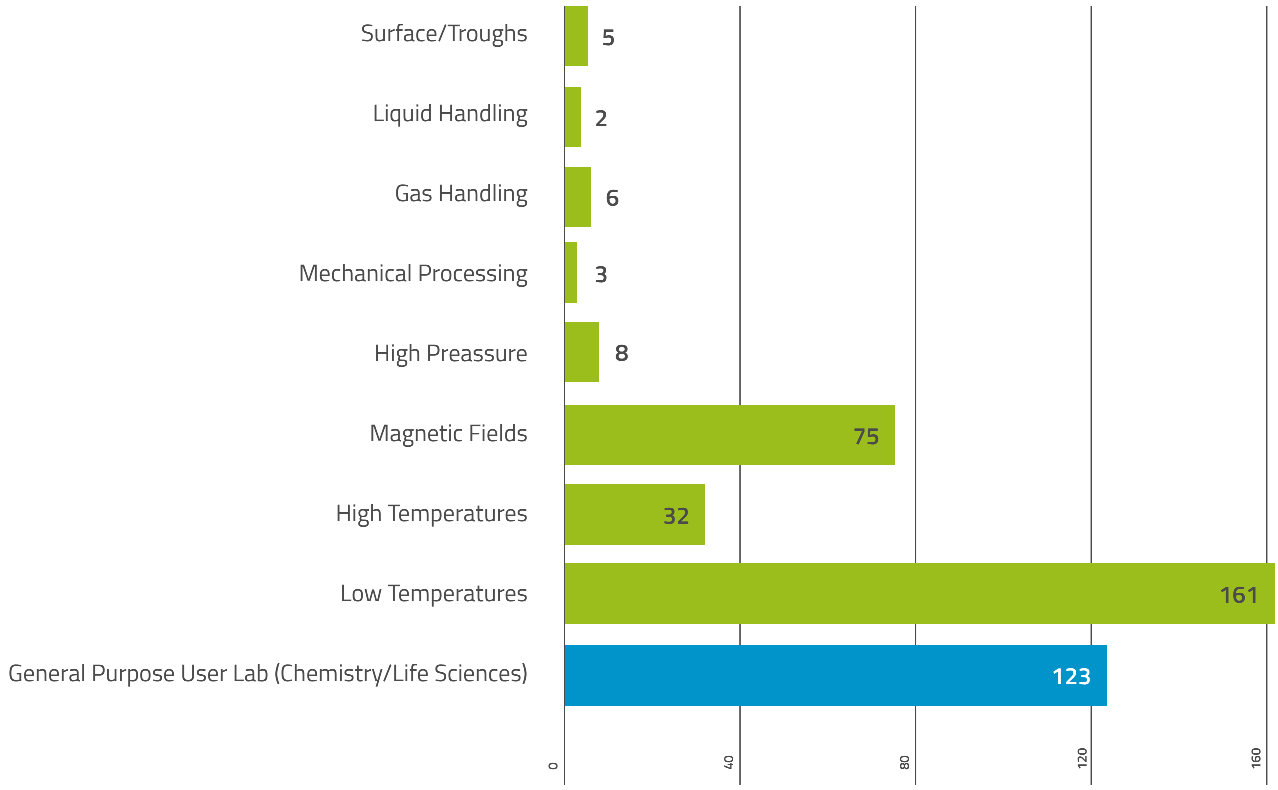




Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

- Health
- Food/Water
- Energy
- Transport
- Climate/Environment
- Security (soft security challenges such as terrorism, border security, cyber security etc.)
- Fundamental Research
- Other

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 403



Q23

LLB hosted 637 unique users in 2015. Approximately 58% (372) of them were individual visitors coming in for a few days. Local users (193) not needing accommodation were the second largest group. There were 36 in-house users, including PhDs, 35 remote users who opted for a mail-in service, and one long-term visitor.

Q15

As much as 89% of the overall beam time at LLB was used by academia. The remaining 10% of beam time was used by academia for public research supported by industry and 1% was used by industry.

Q20, Q21, Q22

In 2015, LLB contributed towards the costs covering its user programmes for academia and partnerships. The facility covered up to 72% of the costs associated with the user programme for academia. 20% of the costs of the programme was covered by science-based topical grants, 6% by umbrella organisations or national partnerships (CRGs), and the remaining 2% by neutron-based grants, such as NMI3. The user programme for partnerships was funded through proprietary money (80%) and LLB (20%).

Q24

297 principal investigators submitted proposals to LLB in 2015. 196 (66%) of them were from France, i.e. the country where the facility is located, and included LLB staff. The other two largest groups were Germany, with 31 PIs, and Italy, with 9 PIs. LLB also received proposals from 23 non-European PIs.

Q25

The three countries with the highest number of PIs at LLB were France, Germany, and Italy. At LLB, France is strongly represented in physics, materials and chemistry, and emerging in soft condensed matter, life sciences, engineering, and earth/geo/heritage. Germany is strongly represented in physics and soft condensed matter, and emerging in chemistry, life sciences, engineering, and earth/geo/heritage. However, there were no users from Germany in research materials at LLB. Italy is emerging in physics, chemistry, and earth/geo/heritage, but does not have any users at LLB in researching materials, soft condensed matter, life sciences, or engineering.

Q14

Imaging, engineering diffraction and high resolution spectroscopy were the three methods with the highest industrial use. LLB does not have any instruments for cold/thermal TOF, vibrational spectroscopy, or nuclear and particle physics. The beam time on SANS was mostly used for research in chemistry (32%) and soft condensed matter (29%). All beam time on reflectometer was used for research in physics (100%). Physics also occupied 53% of the beam time for powder/liquid diffraction and 94% of the beam time for single crystal diffraction. Materials (86%) were the dominant science field using engineering diffraction. The imaging instrument had a rather diverse usage across six different science fields. Earth and geo sciences, and heritage conservation occupied 38% of the beam time available for imaging. Chemistry (47%) was the dominant science field using high resolution spectroscopy. All beam time for cold/thermal TAS was used for research in physics (100%).

Q11, Q12, Q13

The highest number of instruments (5) and beam days (610) were available for cold/thermal triple axis spectroscopy. However, the highest number of experiments (101) per year were carried out using powder/liquid diffraction. It can be concluded that experiments conducted using small angle neutron scattering were the shortest among all, and experiments conducted using engineering diffraction were the longest.

Q19

The research conducted at LLB addressed all Horizon 2020 challenges and topics. 13% of the overall research focused on food/water and 12% on energy. The research topics also included transport (5%), health (4%), climate/environment (3%), and soft security (2%). Fundamental research accounted for 58% of the overall research at LLB.

Q18

161 experiments performed using LLB instruments required a low temperature sample environment, and 123 experiments required general purpose user laboratories for sample preparation.

Swiss Spallation Neutron Source (SINQ)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:

SWISS SPALLATION NEUTRON SOURCE (SINQ)

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Continuous spallation source
Power	1 MW
Thermal neutron flux at 1.5 Å (average)	Flux: 4.1 x 10^{14} n/cm^2/s/Å
	Brightness: 7.6 x 10^{11} n/mAs/cm^2/Å/Str
Cold neutron flux at 5 Å (average)	Flux: 2.6 x 10^{14} n/cm^2/s/Å
	Brightness: 4.8 x 10^{11} n/mAs/cm^2/Å/Str
Operational days per year	190-200
Total number of instruments	20
Number of instruments available to external users	13
Location	Villigen, Switzerland

PROFILE OF THE FACILITY

The Swiss Spallation Neutron Source (SINQ) at the Paul Scherrer Institut (PSI) is a continuous spallation source – the only one of its kind in the world. It is an open access user facility with approximately 800-900 user visits per year. The Laboratory for Neutron Scattering and Imaging (LNS) at PSI is responsible for the scientific exploitation, operation, and development of neutron scattering and imaging instruments at SINQ.

All answers refer to the 13 instruments in user operation only, (c)old, (t)hermal neutrons:

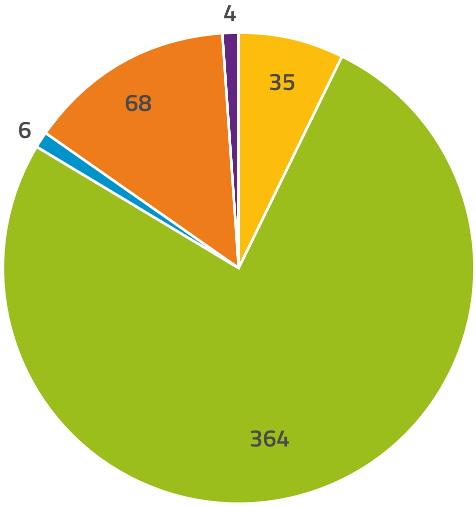
- SANS-I (c), SANS-II (c): small angle scattering facilities
- AMOR (c): reflectometer
- HRPT (t), DMC (c): powder diffractometers
- ZEBRA (t): single crystal diffractometer
- FOCUS (c): time-of-flight spectrometer
- RITA-II (c), TASP (c), EIGER (t): triple-axis-spectrometers
- POLDI (t): engineering diffractometer
- NEUTRA (t), ICON (c): imaging facilities

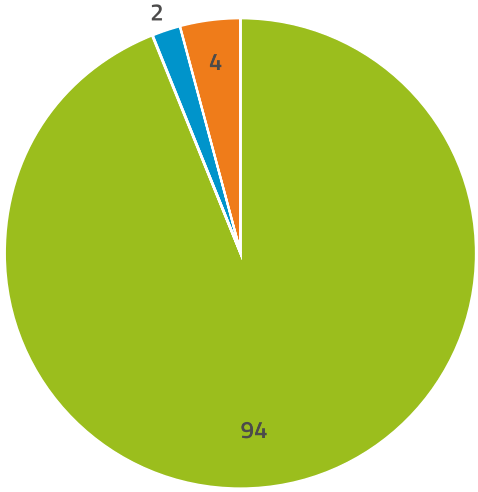
A list of all instruments at SINQ can be found here: https://www.psi.ch/sinq/instrumentation. PSI also operates a dedicated source for UltraCold Neutrons (UCN) for fundamental (nuclear and particle physics) experiments, e.g. neutron electric dipole moment. Data for that activity is not part of this questionnaire.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

Single year 2015; i.e. two cycles: I/15 (May-Aug), II/15 (Sep-Dec)

USER COMMUNITY





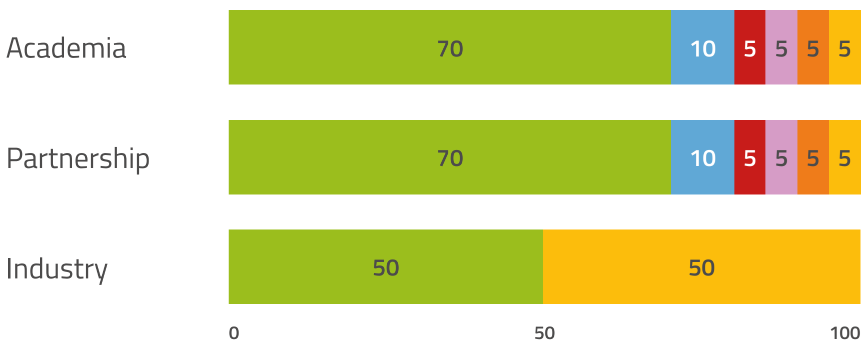
Number of unique users per year: 477* (Q23)

- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)
- Remote users/mail-in service

User type expressed as a percentage of beam time (Q15)

- Academia
- Partnership (public research of academia but supported by industry)
- Industry (proprietary research)

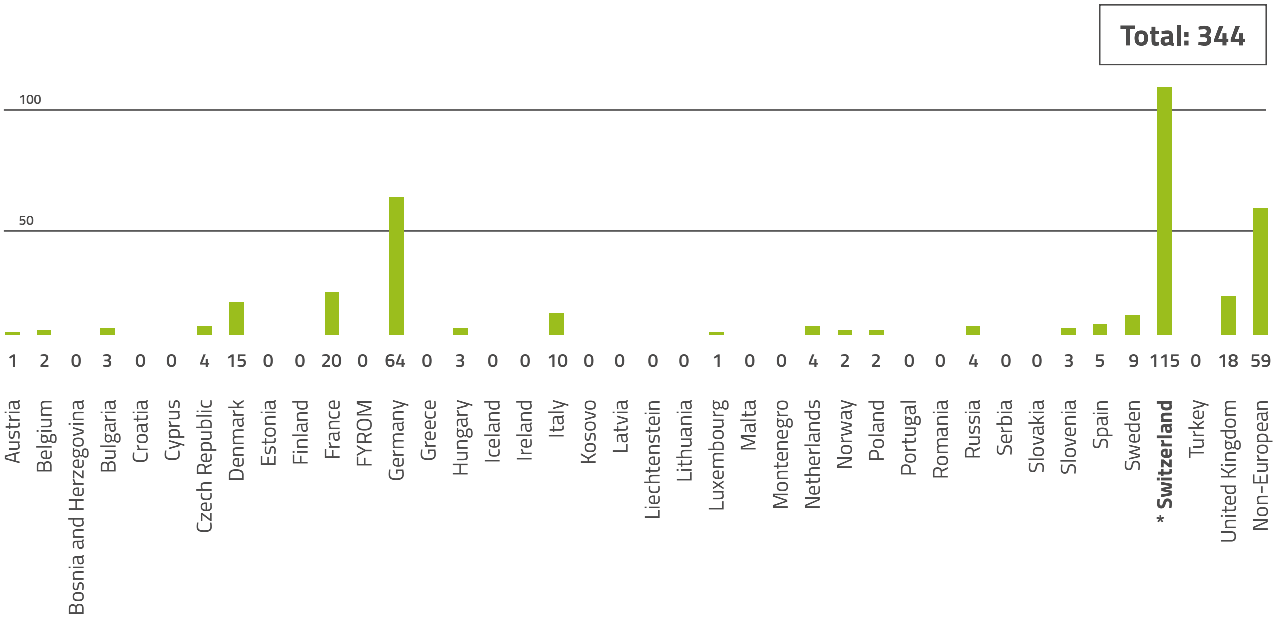
Funding of user programme for academia, partnership, and industry** (Q20, Q21, Q22)



- Facility
- Umbrella organisations or national partnerships (CRGs)
- Neutron-based grants (such as NMI3)
- Science-based topical grants (such as nano science, soft matter)
- Feasibility studies (such as SINE2020)
- Money (proprietary)

** SINQ typically has approx. 450-500 unique users performing 900-1000 visits per year*
*** The provided data does not include the operational costs of the facility. Otherwise, 99% of these three programmes would be funded by the facility. Nevertheless, the figures refer to manpower operating the instruments as well as some share for Travel and Subsistence support (T&S). SINQ does not distinguish between the user programme for academia and the user programme for industrial/academic partners. Therefore, answers concerning these two programmes are identical. Approximately 50% of proprietary research is funded by income from industry.*

Number of Principal Investigators (PIs) per country (Q24)



Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

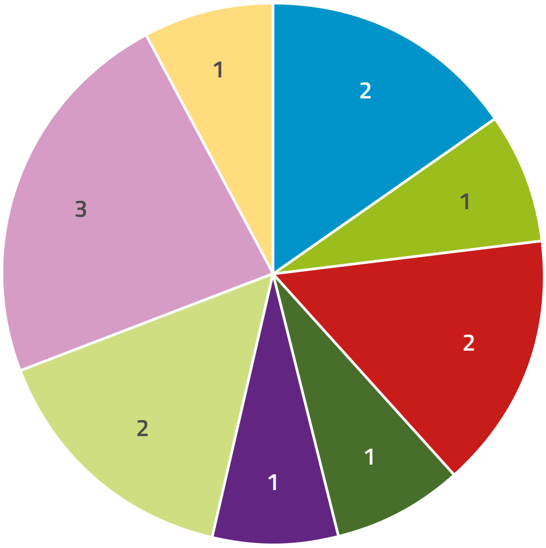
	Regular	Emerging	No users
Switzerland	Physics Materials	Chemistry Soft Condensed Matter Life Sciences Engineering Earth/Geo/Heritage	
Germany	Physics	Materials Chemistry Soft Condensed Matter Life Sciences Engineering Earth/Geo/Heritage	
France		Physics Materials Chemistry Soft Condensed Matter Life Sciences Engineering Earth/Geo/Heritage	

** Country where the facility is located. Figure includes SINQ staff.*

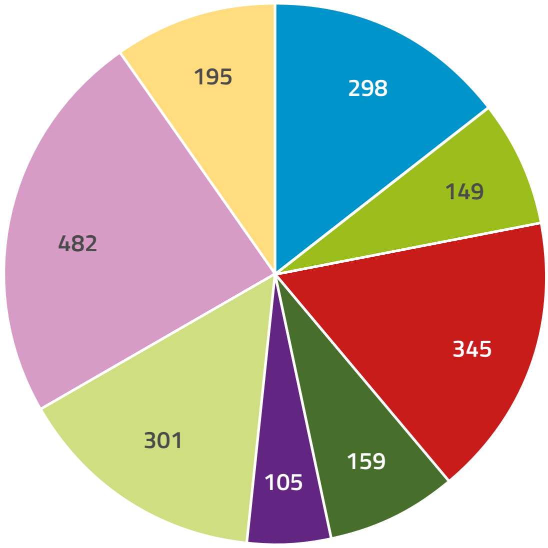
Science fields per method expressed as a percentage of beam time (Q14)

** Methods with the highest industrial use (Q16)*

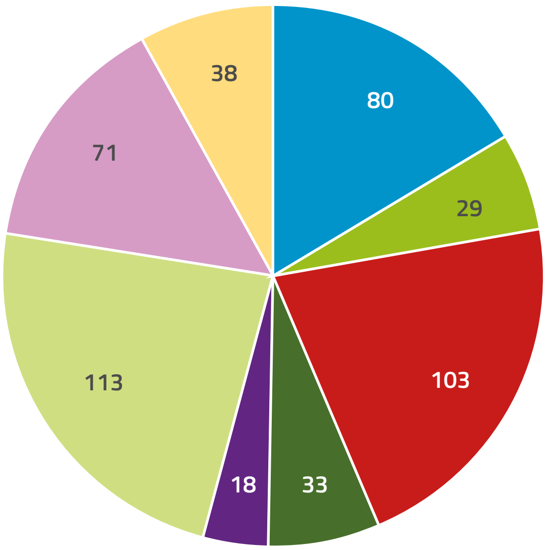
Number of instruments available for each method. Total: 13 (Q11)



Number of beam days available to users per method per year. Total: 2034 (Q12)



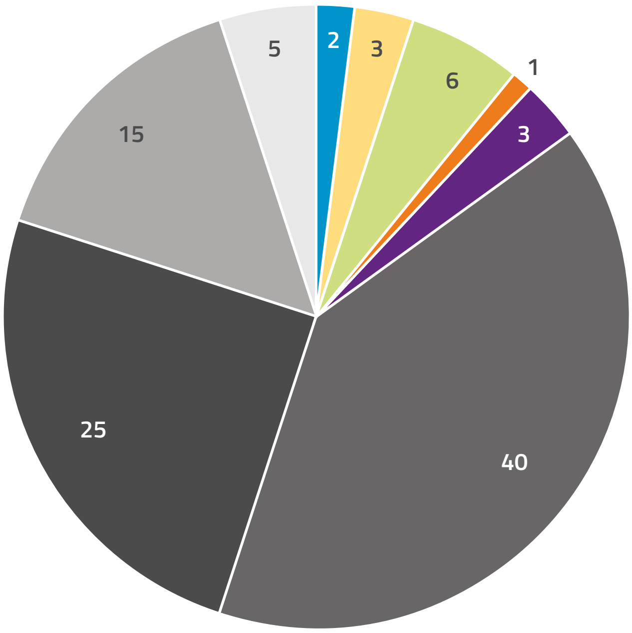
Number of experiments conducted per year using each method. Total: 485 (Q13)



- Small Angle Neutron Scattering
- Reflectometry
- Powder/Liquid Diffraction
- Single Crystal Diffraction
- Engineering Diffraction*
- Imaging
- Cold/Thermal Triple Axis Spectroscopy
- Cold/Thermal Time-of-Flight Spectroscopy

** Limited manpower available in 2015*

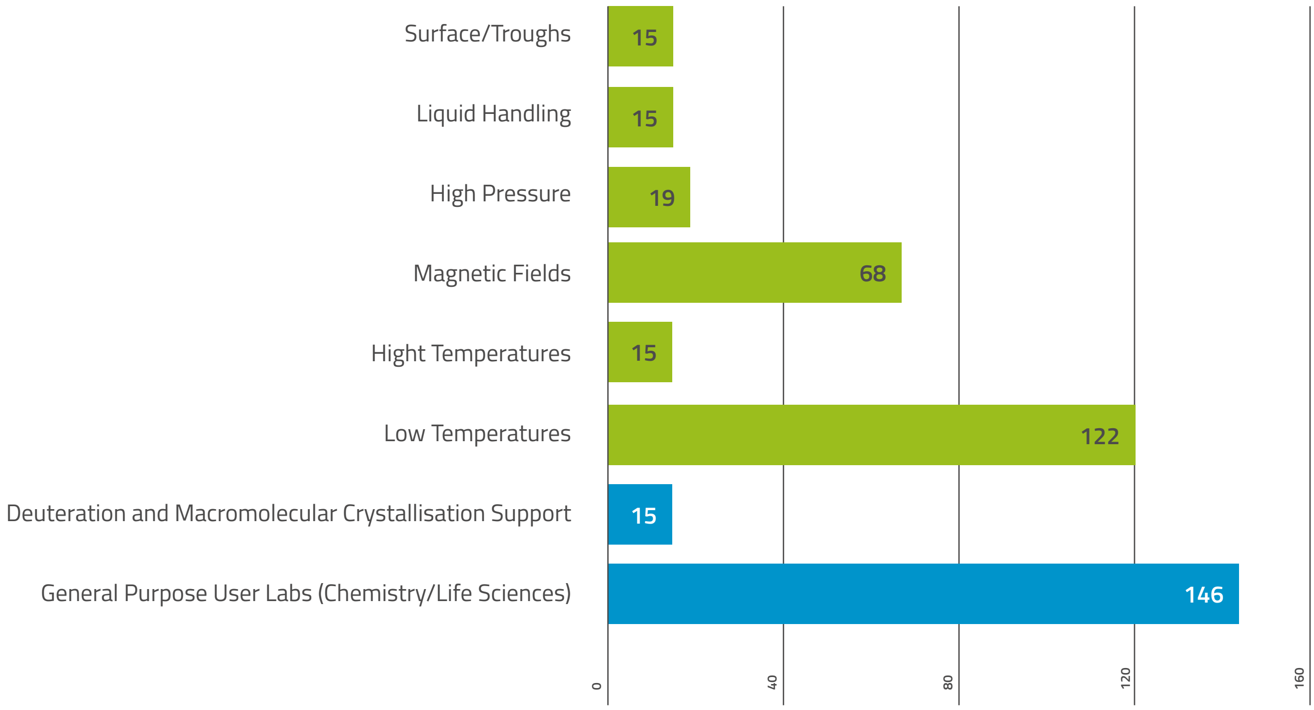
SCIENCE AND METHODS



Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

- Health
- Food/Water
- Energy
- Transport
- Climate/Environment
- Physics*
- Materials Science*
- Chemistry*
- Life Sciences*

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 485



** Extra category added by the facility*

Q23

SINQ hosted 477 unique users in 2015. Approximately 75% (364) of them were individual visitors, who came to PSI for a few days. In-house users (68), including PhD students, were the second largest group. There were 35 local users who did not need accommodation, six long-term visitors, and four remote users who used the mail-in service.

Q15

As much as 94% of overall beam time at SINQ was used by academia. An additional 2% of beam time was used by academia for public research sponsored by industry. The remaining 4% was used by industry for proprietary research.

Q20, Q21, Q22

SINQ contributed a great deal towards the costs covering its user programmes in 2015. The funding sources of the user programme for academia and the user programme for partnership were identical. In both cases, 70% of costs were covered by the facility, and 10% by umbrella organisations or national partnerships (CRGs). Neutron-based grants, science-based topical grants, feasibility studies, and proprietary money each covered 5% respectively. The user programme for industry was equally funded by facility and money for proprietary research. All figures refer to costs which exclude operational costs of the facility. If operational costs were included, 99% of all three programmes would be funded by the facility.

Q24

344 Principal Investigators submitted proposals to SINQ in 2015. 115 (33%) of them were from Switzerland, i.e. the country where SINQ is located, and included SINQ staff. The other two largest groups were Germany, with 64 PIs, and France, with 20 PIs. SINQ also received proposals from a rather large number (59) of non-European PIs. Denmark stood out with 15 PIs, as SINQ hosts some of former Risø instruments which were moved to Switzerland following the shut down of Risø National Laboratory for Sustainable Energy in Denmark.

Q25

At SINQ, the three countries with the highest number of PIs, i.e. Switzerland, Germany and France, are all emerging in chemistry, soft condensed matter, life sciences, engineering and earth/geo/heritage research. In addition, Germany and France are both emerging in materials research. Switzerland is strongly represented in materials research. While Switzerland and Germany are strongly represented in physics, France is only emerging in this field.

Q14

Powder/liquid diffraction, engineering diffraction and imaging were the three methods with the highest industrial use. SINQ does not have any high resolution spectroscopy instrument beyond the resolution of a cold neutron TOF instrument. SANS was mostly used for research in physics (58%) and materials (16%). Reflectometer also primarily served these two science fields, with physics taking up 42% and materials taking up 46% of beam time. Physics (64%) and materials (21%) were the most frequent science fields in powder/liquid diffraction. 79% of the beam time offered using the single crystal diffraction was used for physics. Materials occupied 71% of the beam time offered using engineering diffraction. Imaging, and cold/thermal TOF were the two instruments with the most diverse application across science fields. Both instruments hosted experiments from seven different science fields. Materials (26%) and earth/geo sciences, and heritage conservation (22%) were the two most frequent science fields in imaging. 76% of the beam time offered using the cold/thermal TOF was used for research in physics. Physics also dominated cold/thermal TAS and took up 94% of the beam time.

Q11, Q12, Q13

The highest number of instruments (3) was available for cold/thermal triple axis spectroscopy. cold/thermal triple axis spectroscopy was also the method, which offered the highest number of beam days (482) to users. However, the highest number of experiments (113) per year concerned imaging. In 2015, SINQ offered only 105 beam days for engineering diffraction because of limited manpower.

Q19

Horizon 2020 challenges and topics with the highest representation in the research carried out at SINQ were energy (6%), and climate/environment (3%). A significant proportion of research at SINQ focused on physics (40%), materials science (25%), chemistry (15%), and life science (5%).

Q18

The highest number of experiments (122) was performed in a low temperature sample environment. 146 experiments and their preparation made use of general purpose user labs.

HZB Helmholtz Zentrum Berlin

Helmholtz-Zentrum Berlin – BER II

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

HELMHOLTZ-ZENTRUM BERLIN – BER II

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	10 MW
Thermal neutron flux at 1.5 Å (average)	~2 x 10^{14} n/cm^{2}s in the core 7-9 x 10^{13} n/cm^{2}s in the beam tubes
Cold neutron flux at 5 Å (average)	1.1 x 10^9 n/cm^{2}s
Operational days per year	200
Total number of instruments	17
Number of instruments available to external users	10 (from 2016 on)
Location	Berlin, Germany

PROFILE OF THE FACILITY

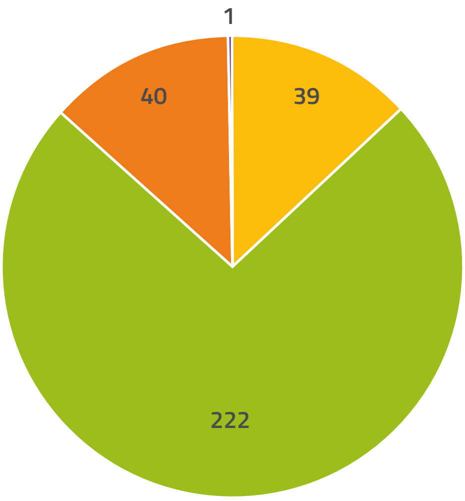
BER II, a research reactor at the Helmholtz-Zentrum Berlin, operates as a source for neutron beams for a wide range of scientific investigations. The specific profile of BER II is 'Complex neutron experiments - under extreme conditions'. For this purpose a broad range of sample environment equipment is provided for neutron scattering experiments with a wide temperature range, T = 30 mK - 2000 K, with variable magnetic fields up to H = 17 Tesla and with pressure up to p = 10 kbar. The components are mutually compatible and can be used on most of the instruments, both in the experimental and the neutron guide hall. In addition, HZB is hosting the following state-of-the-art on-site laboratories and user facilities:

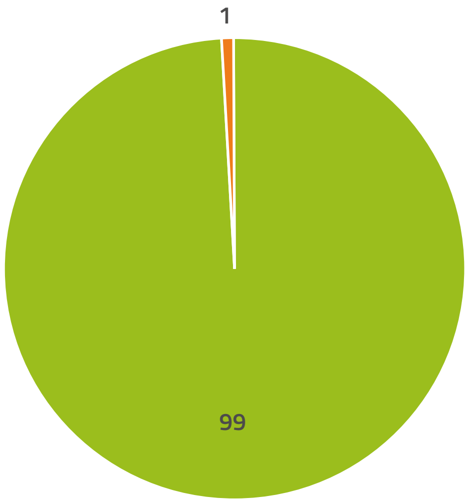
- Biology Lab
- Chemistry Lab
- Colloid Lab (Light Scattering, Rheology)
- Gas Lab (Gaseous Pressures, Adsorption Measurements)
- Mag Lab (Heat Capacity, Heat Conduction, Magneto-Caloric effect, Magnetisation and Resistivity) 3D Data Analytics Lab (Analysis of Tomography Data)
- Micro-CT Lab (X-ray Tomography)
- X-ray Lab (Powder and Single Crystal Diffraction)
- Sample Characterisation Lab
- Crystallography Lab (Sample Synthesis and Analysis)

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

Single year 2015.
Calls in 2014, experiments conducted in 2015.
No calls in 2015 (backlog from 2014).

USER COMMUNITY





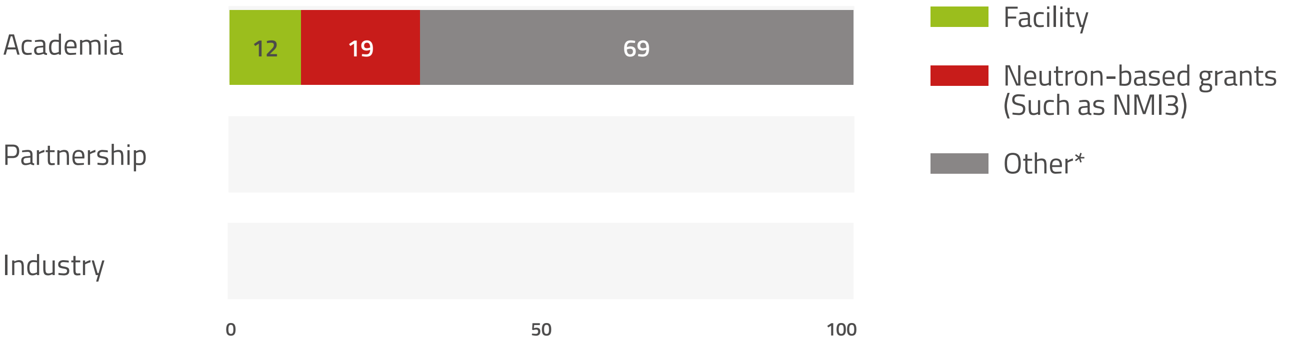
Number of unique users per year: 302 (Q23)

- Local users (no accommodation)
- Individual visitors (coming for a few days)
- In-house users (including PhD)
- Remote users/mail-in service

User type expressed as a percentage of beam time (Q15)

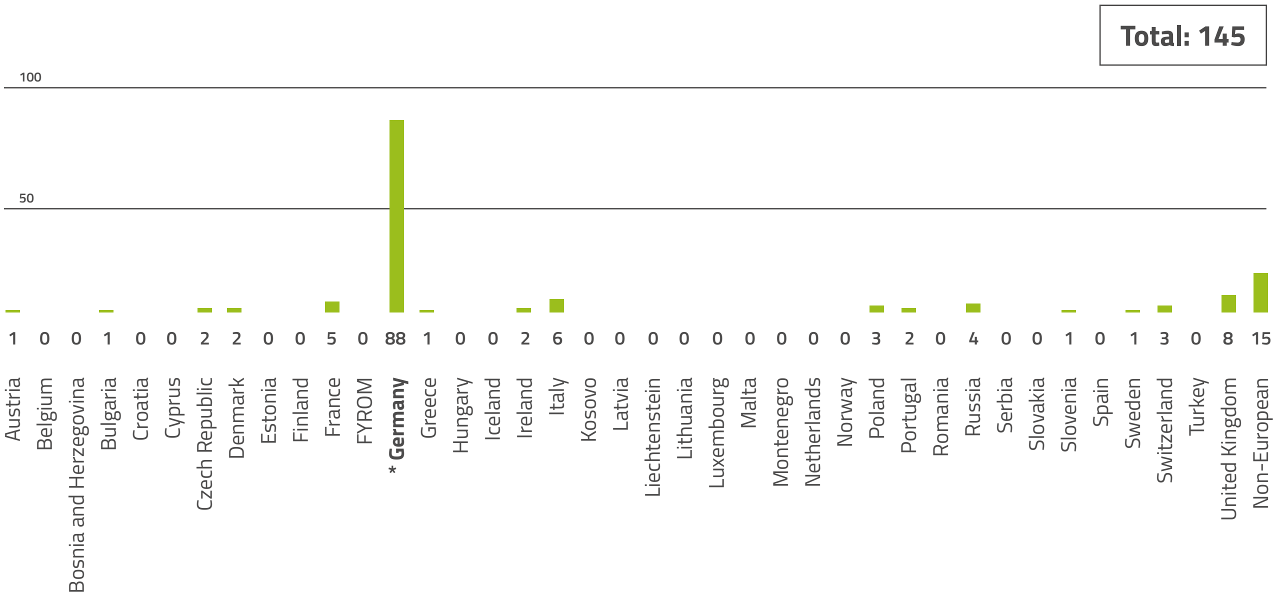
- Academia
- Industry (proprietary research)

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



** Extra category added by the facility*

Number of Principal Investigators (PIs) per country (Q24)

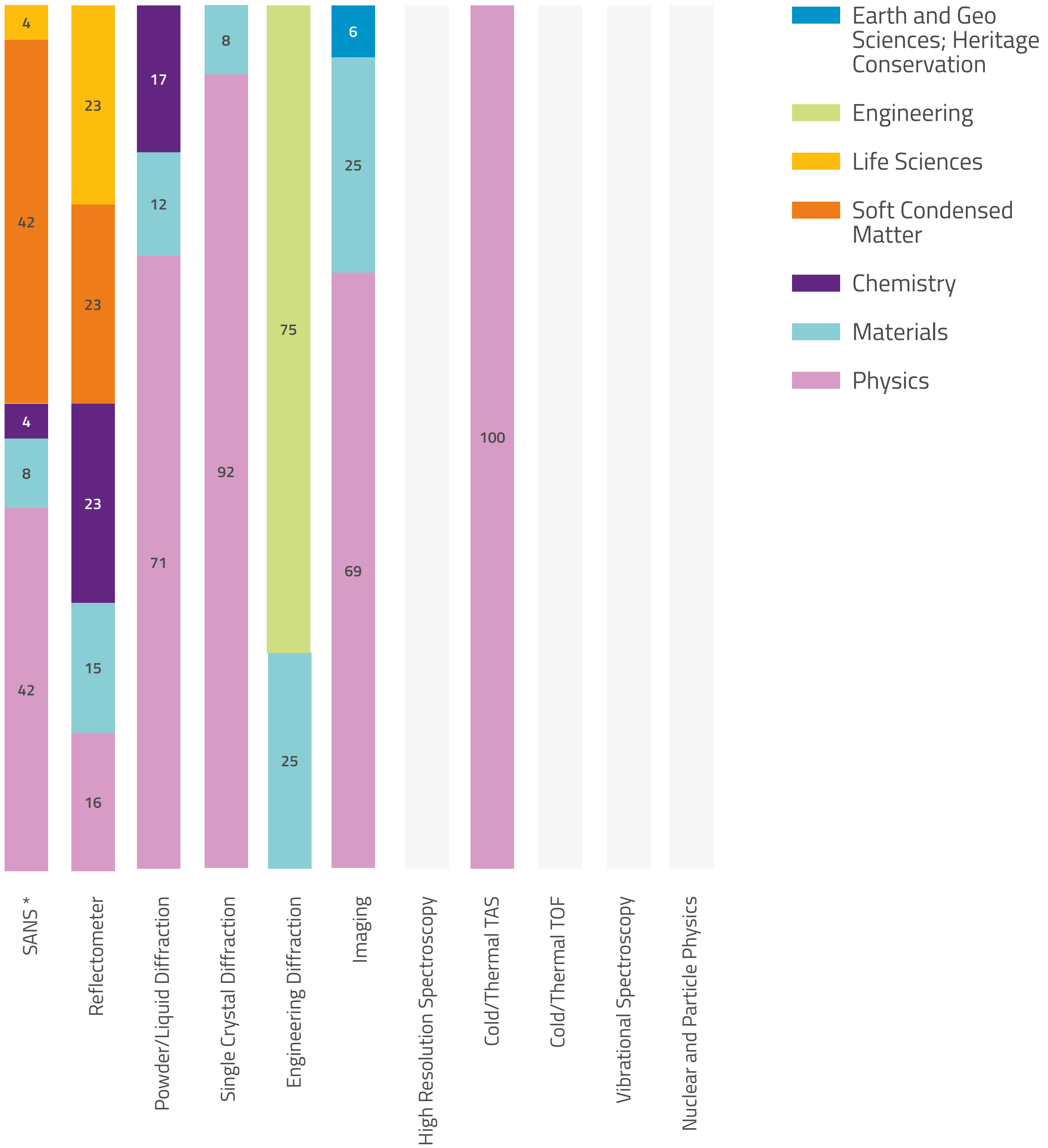


Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

	Regular	Emerging	No users
Germany	Physics	Materials Chemistry Soft Condensed Matter Life Sciences Engineering Earth/Geo/Heritage	
United Kingdom		Physics Engineering	Materials Chemistry Soft Condensed Matter Life Sciences Earth/Geo/Heritage
Italy		Materials Life Sciences Earth/Geo/Heritage	Physics Chemistry Soft Condensed Matter Engineering

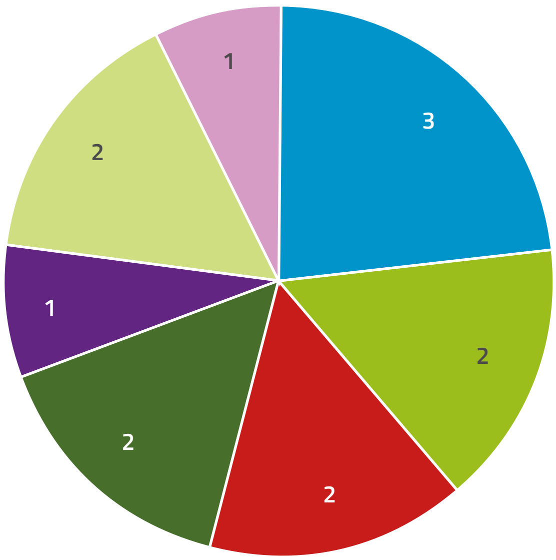
** Country where the facility is located. Figure includes HZB personnel.*

Science fields per method expressed as a percentage of beam time (Q14)

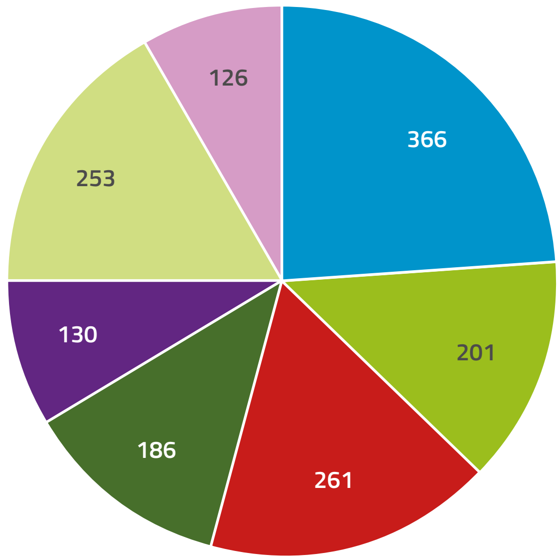


** One of the three methods with the highest industrial use. The other two methods are stress and strain, and tomography. (Q16)*

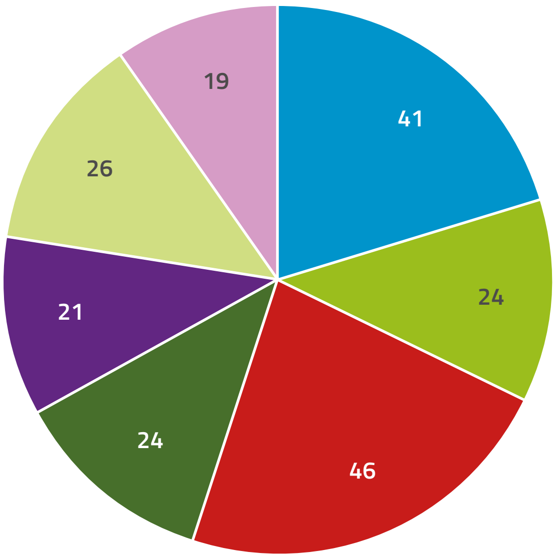
Number of instruments available for each method.* **Total: 13** (Q11)



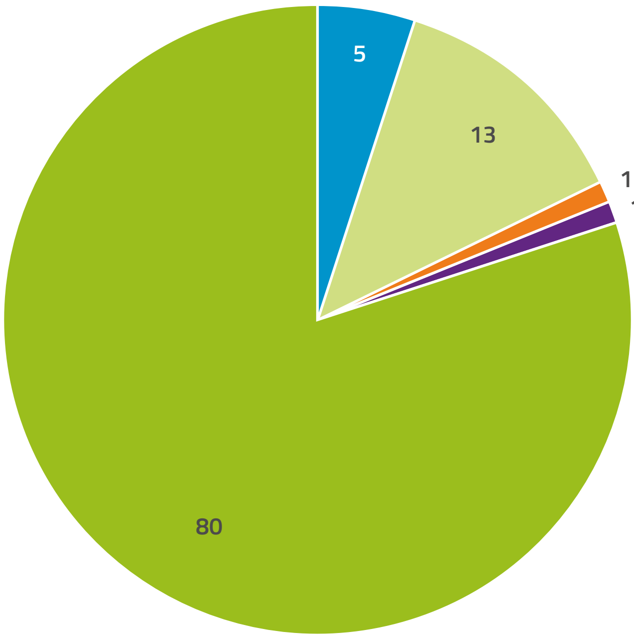
Number of beam days available to users per method per year.** **Total: 1523** (Q12)



Number of experiments conducted per year using each method. Total: 201 (Q13)



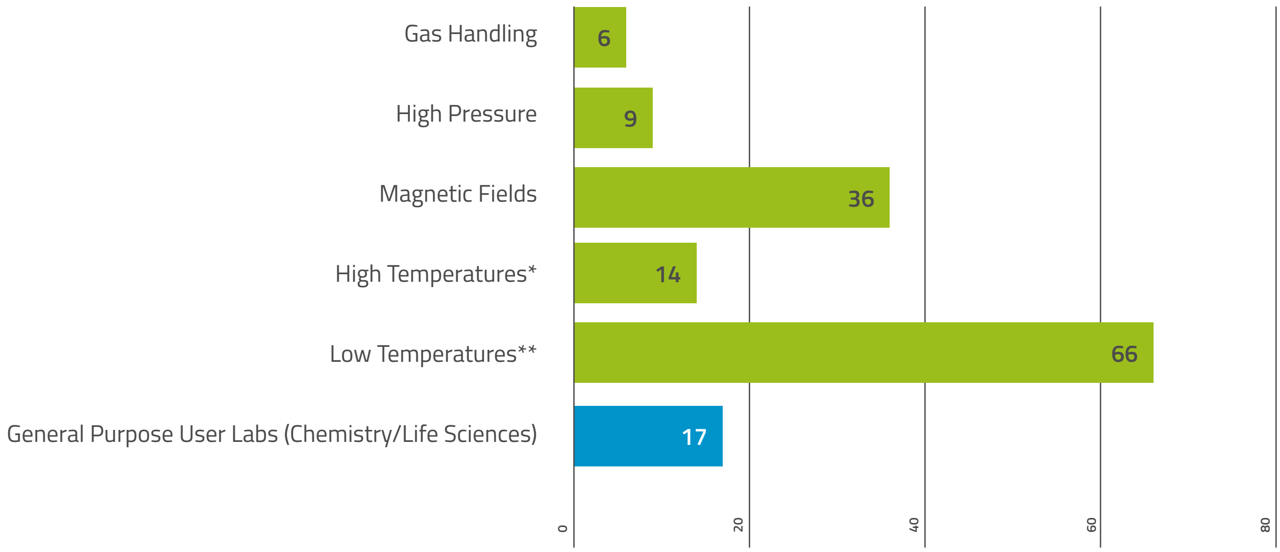
** Scheduled instruments in user service only*
*** Beam days for scheduled experiments only*



Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

- Health
- Energy
- Transport
- Climate/Environment
- Fundamental Research

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 201



** Above 375K*
*** Below 200K*

Q23
BER II hosted 302 unique users in 2015. Almost 74% (222) of them were individual visitors who came to BER II for a few days. In-house users (40), including PhD students, were the second largest group, closely followed by long-term visitors (39). BER II had one remote user who opted for the mail-in service.

Q15
99% of the overall beam time at BER II was used by academia. The remaining 1% was used by industry for proprietary research.

Q20, Q21, Q22
HZB funded 12% of the BER II users, 19% were funded through NMI3, and 69% came from their own resources.

Q24
In 2015, BER II accepted proposals from 145 principal investigators, who carried out 201 experiments and/or research projects in total. 88 (61%) of these principal investigators were from Germany, i.e. the country where BER II is located, and included HZB personnel. The other two largest groups were the United Kingdom, with 8 PIs, and Italy, with 6 PIs. BER II also received proposals from 15 non-European PIs.

Q25
The three countries with the highest number of PIs at BER II were Germany, the United Kingdom, and Italy. At BER II, Germany is strongly represented in physics and emerging in materials, chemistry, soft condensed matter, life sciences, engineering, and earth/geo/heritage. While the United Kingdom is emerging in physics and engineering, Italy is emerging in materials, life sciences, and earth/geo/heritage.

Q14
SANS, stress and strain, and tomography were the three methods with the highest industrial use. In 2015 BER II did not have any instrument dedicated to high resolution spectroscopy, cold/thermal TOF, vibrational spectroscopy, or nuclear and particle physics. SANS was mostly used for research in physics (42%) and soft condensed matter (42%). Reflectometers were primarily used for research in life sciences (23%), soft condensed matter (23%), and chemistry (23%). Physics is the dominant science field using powder/liquid diffraction (71%), single crystal diffraction (92%), imaging (69%) and cold/thermal TAS (100%). Engineering diffraction was mostly used for research in engineering (75%).

Q11, Q12, Q13
The highest number of instruments (3) and beam days (366) were available for Small Angle Neutron Scattering. However, the highest number of experiments (46) per year were carried out using powder/liquid diffraction.

Q19
Fundamental research was the dominant field at BER II and accounted for 80% of the overall research. Horizon 2020 challenges with the highest representation were energy (13%), and health (5%).

Q18
17 experiments were performed on the instruments at BER II, using general purpose user laboratories for sample preparation. 66 experiments required a low temperature sample environment.

Budapest Neutron Centre (BNC)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:
COURTESY OF BUDAPEST NEUTRON CENTRE

BUDAPEST NEUTRON CENTRE (BNC)

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	10 MW
Thermal neutron flux at 1.5 Å (maximum)	2.1×10^{14} n/cm^2/s
Cold neutron flux at 5 Å (average)	5×10^{7} n/cm^2/s
Operational days per year	120
Total number of instruments	15
Number of instruments available to external users	15
Location	Budapest, Hungary

PROFILE OF THE FACILITY

One of the key and largest research infrastructures in Hungary is the 10 MW Budapest Research Reactor (BRR) with its experimental stations. This is the base for the domestic and international user community to serve exploratory and applied research in many fields of science and technology, as well as for methodical developments in neutron beam and irradiation techniques.

The scientific utilisation of the research reactor is coordinated and managed by the Budapest Neutron Centre, which is a consortium founded by academic institutions in 1993. BNC is now a consortium of two research centres at the Hungarian Academy of Sciences – the Centre for Energy Research (MTA EK) and the Wigner Research Centre for Physics (Wigner RCP). BNC is legally represented by the Centre for Energy Research.

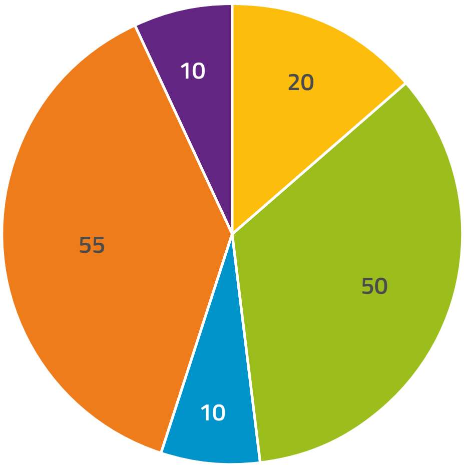
BNC is an open access facility for the domestic and international user community. A suite of reactor irradiation equipment, thermal neutron beam instruments, and cold neutron spectrometers in the neutron guide hall are available, and assisted by a professional team of scientists and engineers, for experimental services. The 10MW BRR provides a maximum thermal and fast neutron flux of 2.2×10^{14}n/cm^2/s and 1×10^{14}n/cm^2/s, respectively. The reactor has eight radial and two tangential beam tubes. A cold neutron source provides long-wavelength neutrons to three guides hosting eight instruments. Altogether, twelve instruments serve everyday user needs in the reactor hall and in Guide Hall 1 and 2. At this time, two additional instruments are in an advanced development phase.

BNC participates in several EU supported programmes, such as NMI3 (Integrated Infrastructure Initiative for Neutron Scattering and Muon Spectroscopy), IPERION CH (Cultural Heritage Science), C-ERIC (Central European Research Infrastructure Consortium, SINE2020 (Science and Innovation with Neutrons in Europe in 2020) and CHANDA (Solving Challenges in Nuclear Data). In the frame of these programmes, European scientists can get access to the BRR experimental facilities.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

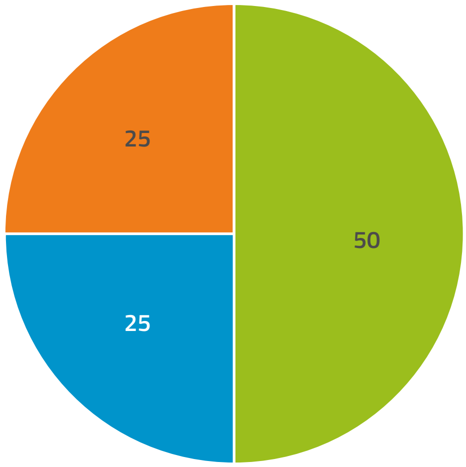
Average over 2013-2015

USER COMMUNITY



Number of unique users per year: 145* (Q23)

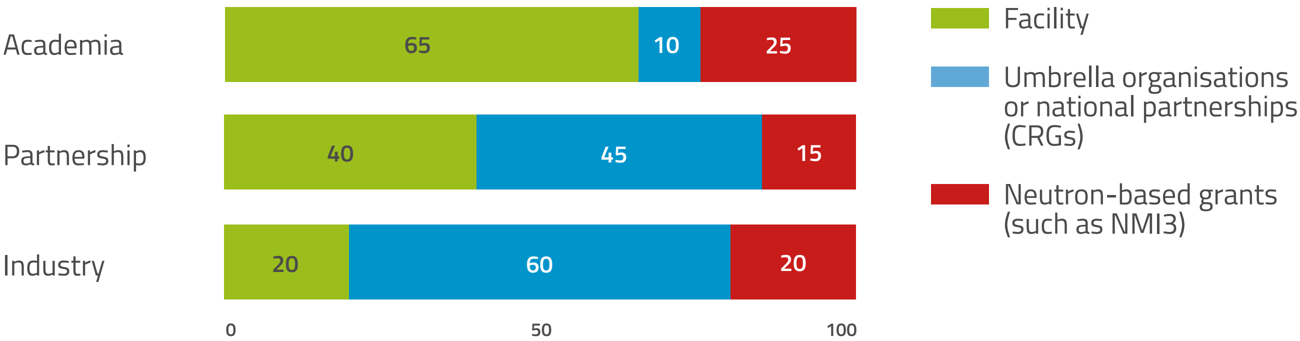
- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)
- Remote users/mail-in service



User type expressed as a percentage of beam time (Q15)

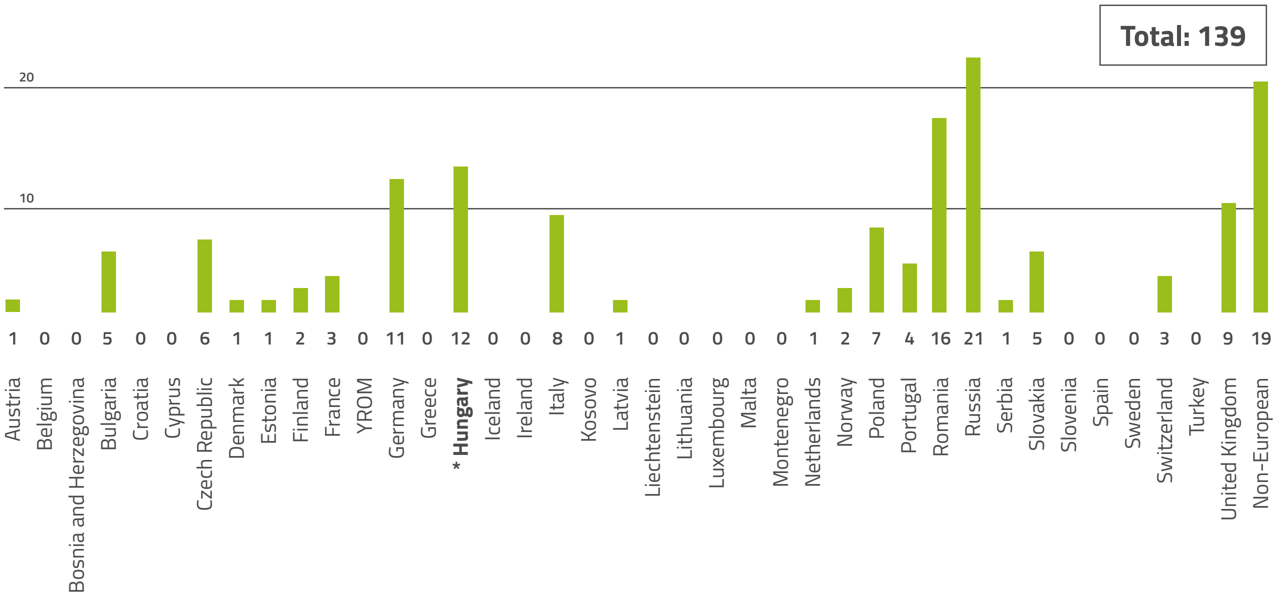
- Academia
- Partnership (public research of academia but supported by industry)
- Industry (proprietary research)**

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



** BNC usually hosts between 250-280 distinct users per year. The average number of users between 2013-2015 was lower due to the decrease of operating cycles.*
*** Figure includes materials testing*

Number of Principal Investigators (PIs) per country* (Q24)



Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

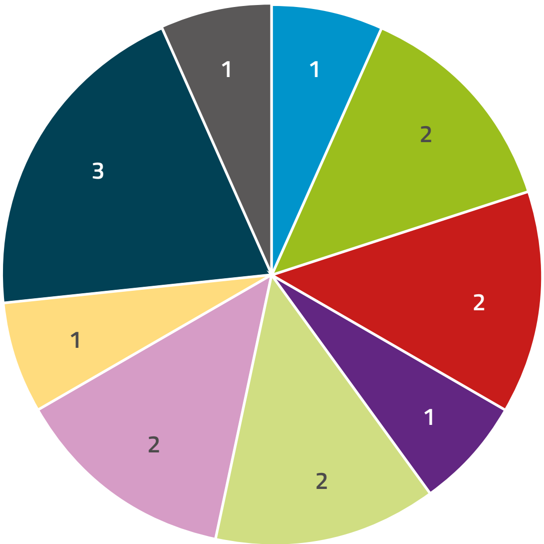
	Regular	Emerging	No users
Russia		Physics Materials Chemistry Life Sciences Engineering Earth/Geo/Heritage	
Romania		Physics Materials Chemistry Life Sciences Engineering	
Hungary		Physics Chemistry Engineering Earth/Geo/Heritage	

** Country where the facility is located. Figure includes BNC staff and operators responsible for the facility.*

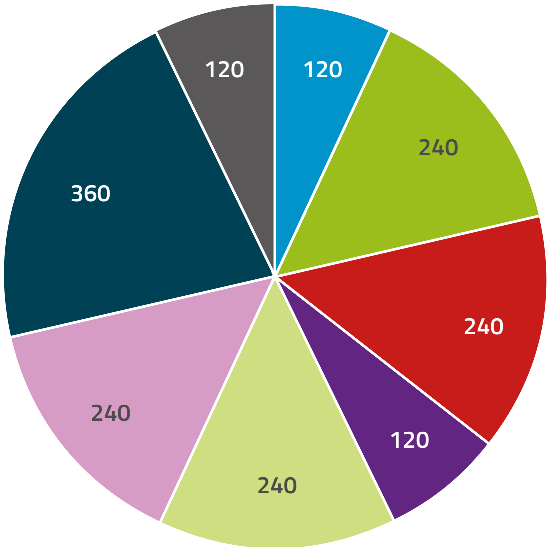
Science fields per method expressed as a percentage of beam time (Q14)

** Methods with the highest industrial use (Q16)*
*** Extra category added by the facility*

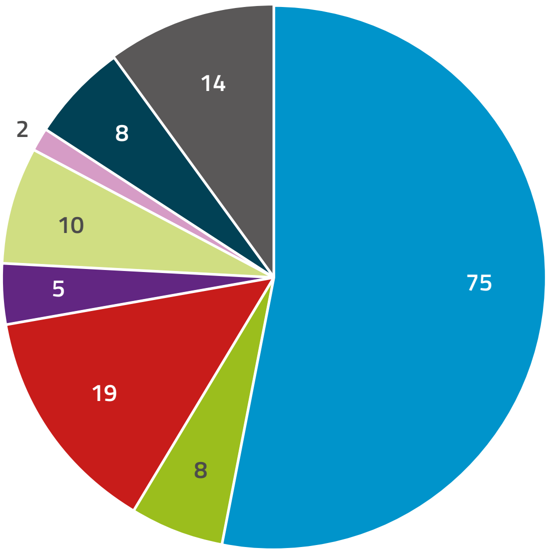
Number of instruments available for each method. Total: 15 (Q11)

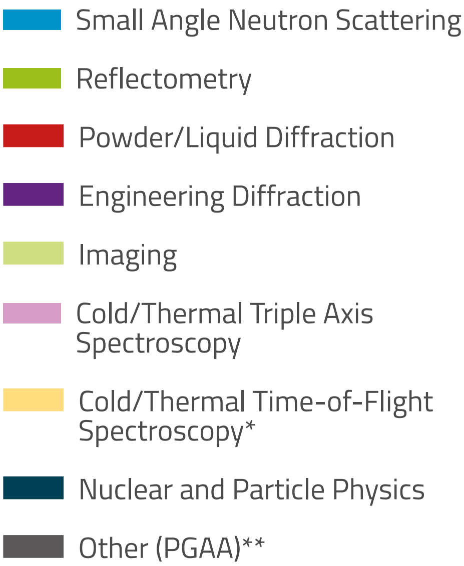


Number of beam days available to users per method per year. Total: 1680 (Q12)

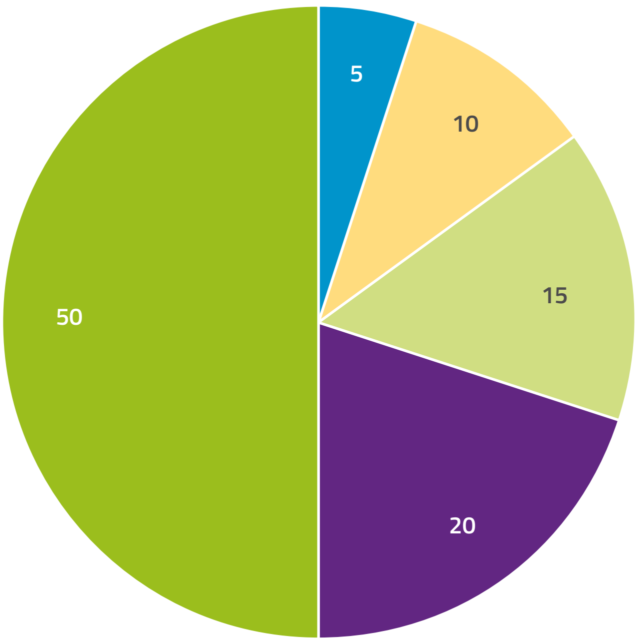


Number of experiments conducted per year using each method. Total: 141 (Q13)



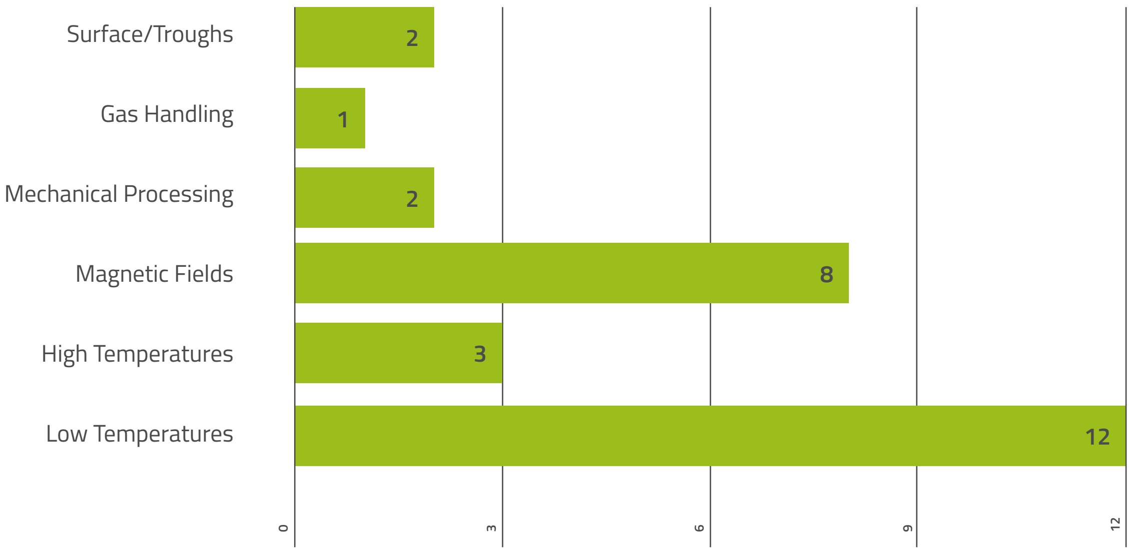


** Already calculated in "Powder/Liquid Diffraction"*
*** Extra category added by the facility*



Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 141



Q23

Between 2013 and 2015, BNC hosted 145 unique users on average every year. Approximately 38% (55) of them were in-house users, including PhDs. Individual visitors (50) coming in for a few days were the second largest group. There were 20 local users who did not need accommodation, 10 long-term visitors, and 10 remote users who used the mail-in service.

Q15

Half of the overall beam time at BNC was used by academia. An additional 25% of beam time was used by academia for public research supported by industry. The remaining 25% was used by industry for proprietary research.

Q20, Q21, Q22

Between 2013 and 2015, BNC contributed towards the costs covering its user programmes for academia, partnership and industry. The facility funded 65% of the costs of the user programme for academia. 25% of the user programme for academia was funded by neutron-based grants, and 10% by umbrella organisations or national partnerships (CRGs). Umbrella organisations and national partnerships also funded 60% of the user programme for industry. The rest of the user programme for industry was funded by the facility (20%) and neutron-based grants (20%). In the case of user programme for partnership, BNC funded 40%, umbrella organisations or national partnerships funded 45%, and neutron-based grants funded 15%.

Q24

Between 2013 and 2015, 139 principal investigators on average submitted proposals to BNC every year. The two largest groups were Russia (21) and Romania (16). Hungary, i.e. the country where the facility is located, only came third with 12 PIs. BNC also received proposals from 19 non-European PIs.

Q25

The three countries with the highest number of PIs are Russia, Romania and Hungary. At BNC, all of them are emerging in physics, chemistry, engineering, and earth/geo/heritage. In addition, Russia and Romania are also emerging in materials and life sciences.

Q14

SANS, reflectometry, and nuclear and particle physics were the three methods with the highest industrial use. BNC does not have any instruments for single crystal diffraction, high resolution spectroscopy, or vibrational spectroscopy. SANS was mostly used for research in physics (38%) and materials (29%). Reflectometers at BNC were equally used for research in physics (50%) and materials (50%). Physics (50%), and earth/geo sciences, and heritage conservation (30%) were the most frequent science fields researched using powder/liquid diffraction. All beam time for engineering diffraction was used for materials (100%). Earth/geo sciences and heritage conservation took up 60% of the beam on the imaging instruments. Beam time available for cold/thermal TAS was equally split between materials (50%), and engineering (50%). The dominant science fields using cold/thermal TOF were earth/geo sciences, and heritage conservation (57%). Physics (53%) together with chemistry (22%) were the two most frequently researched science fields using nuclear and particle physics. Earth/geo sciences, and heritage conversation dominated PGAA, with 75% of beam time offered for the method.

Q11, Q12, Q13

The highest number of instruments (3) and beam days (360) were available for nuclear and particle physics. However, the highest number of experiments (75) per year were conducted using small angle neutron scattering.

Q19

50% of research at BNC focused on fundamental research. Horizon 2020 challenges with the highest representation were climate/environment (20%), energy (15%), food/water (10%), and health (5%).

Q18

12 experiments were performed at the BNC instruments using a low temperature sample environment.

Nuclear Physics Laboratory (NPL)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:
COURTESY OF NEUTRON PHYSICS LABORATORY

NEUTRON PHYSICS LABORATORY (NPL)

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	10 MW
Thermal neutron flux at 1.5 Å (average)	10^{14} n × cm^{-2} s^{-1}
Cold neutron flux at 5 Å (average)	N/A
Operational days per year	189*
Total number of instruments	8
Number of instruments available to external users	8
Location	Řež, Czech Republic

PROFILE OF THE FACILITY

The Neutron Physics Laboratory (NPL) was founded in the frame of NPI in order to perform neutron-physics experiments according to the NPI research programme, as well as to provide experimental facilities and research experience to external users in the open access mode. The neutron channels hired at nuclear research reactor LVR-15 are employed for materials research using neutron diffraction, as well as for experiments in nuclear physics and for neutron activation analysis. NPL uses moderate flux of neutrons for neutron scattering experiments, for nuclear analytical methods, and for fundamental nuclear physics. Activity at the Neutron Physics Laboratory is focused basically in two directions:

- Scattering of neutrons is used to study structure of materials in various size scales, from ordering of atoms in crystal lattice to microscopic heterogeneities on nano- and microscopic scales. The high penetration of neutrons in most materials allows these tests to be carried out non-destructively in bulk and/or inside special sample environments (low and high temperatures, mechanical load).
- Nuclear reactions of neutrons with matter are employed to analyse concentrations or concentration profiles of elements in solids, as well as for fundamental nuclear physics.

Five neutron scattering instruments are installed at four horizontal thermal neutron channels (HK4 HK6, HK8 and HK9) and serve primarily to research in the fields of material science and solid state physics. In addition to five neutron scattering instruments, three nuclear analytical techniques involving neutrons are available at NPL.

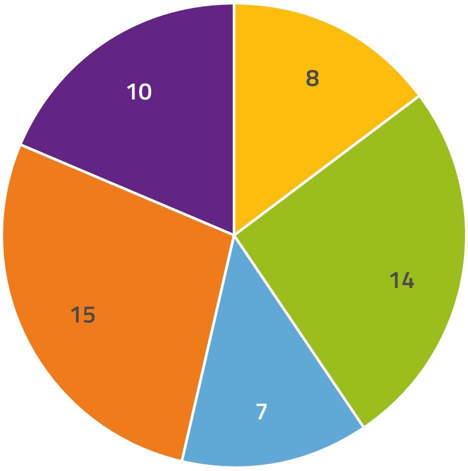
Neutron scattering instruments include high-resolution diffractometer (TKSN-400), double-crystal SANS diffractometer (MAUD), stress/strain diffractometer (SPN-100), medium resolution powder diffractometer (MEREDIT), and neutron optics test diffractometer (NOD). Three nuclear analytical techniques involving neutrons are available at NPL. In particular, neutron activation analysis (NAA), thermal neutron depth profiling (T-NDP) and the thermal neutron capture facility (NG) – suitable also for prompt gamma activation analysis.

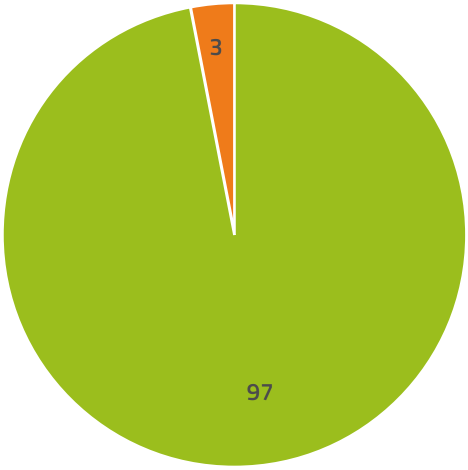
TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

Average over 2013-2015

** Average over the last ten years*

USER COMMUNITY





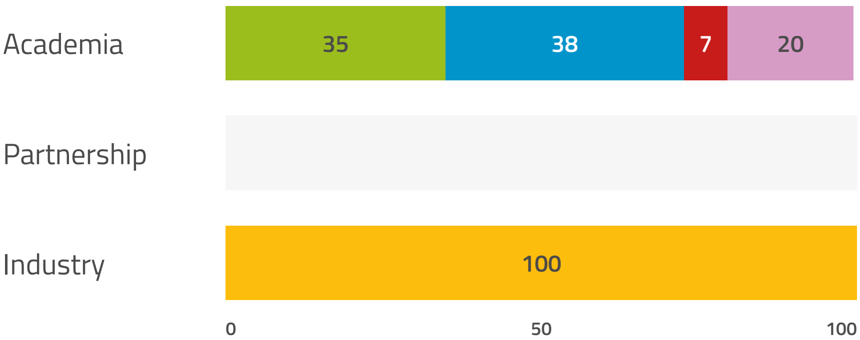
Number of unique users per year: 54 (Q23)

- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)
- Remote users/mail-in service

User type expressed as a percentage of beam time (Q15)

- Academia
- Industry (proprietary research)

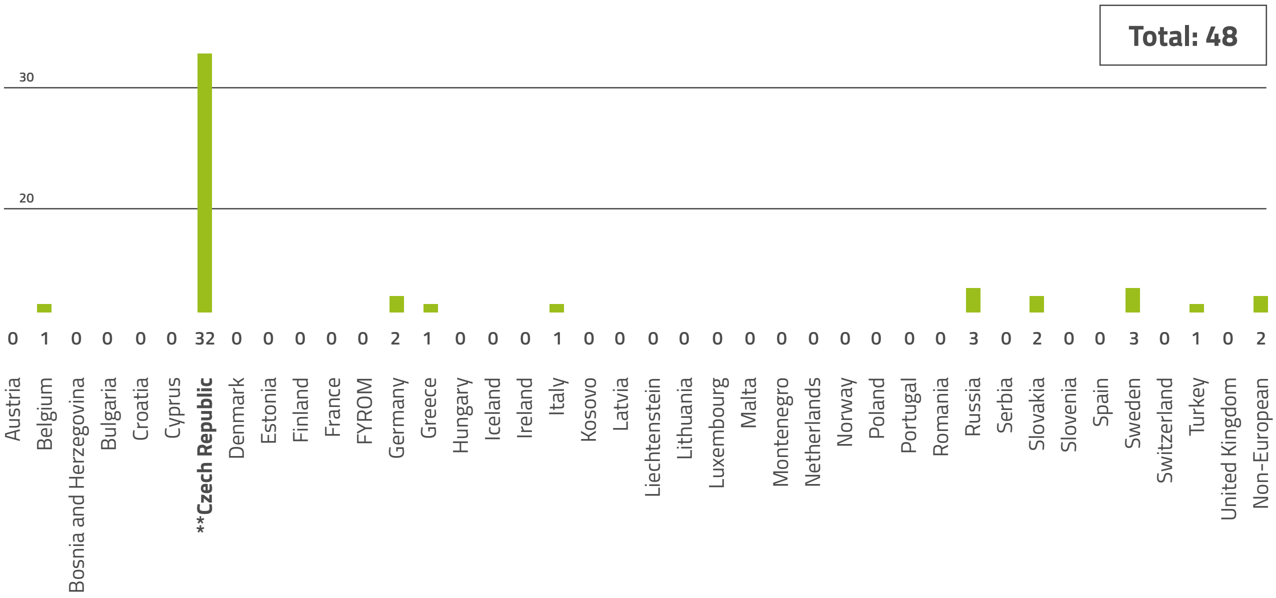
Funding of user programme for academia, partnership, and industry* (Q20, Q21, Q22)



- Facility
- Umbrella organisations or national partnerships (CRGs)
- Neutron-based grants (such as NMI3)
- Science-based topical grants (such as nano science, soft matter)
- Money (proprietary)

** NPL does not distinguish industrial users, who disseminate their research results in scientific journals, from academic users. Users who do not disseminate their results in scientific journals pay the full price of the beam time.*

Number of Principal Investigators (PIs) per country* (Q24)



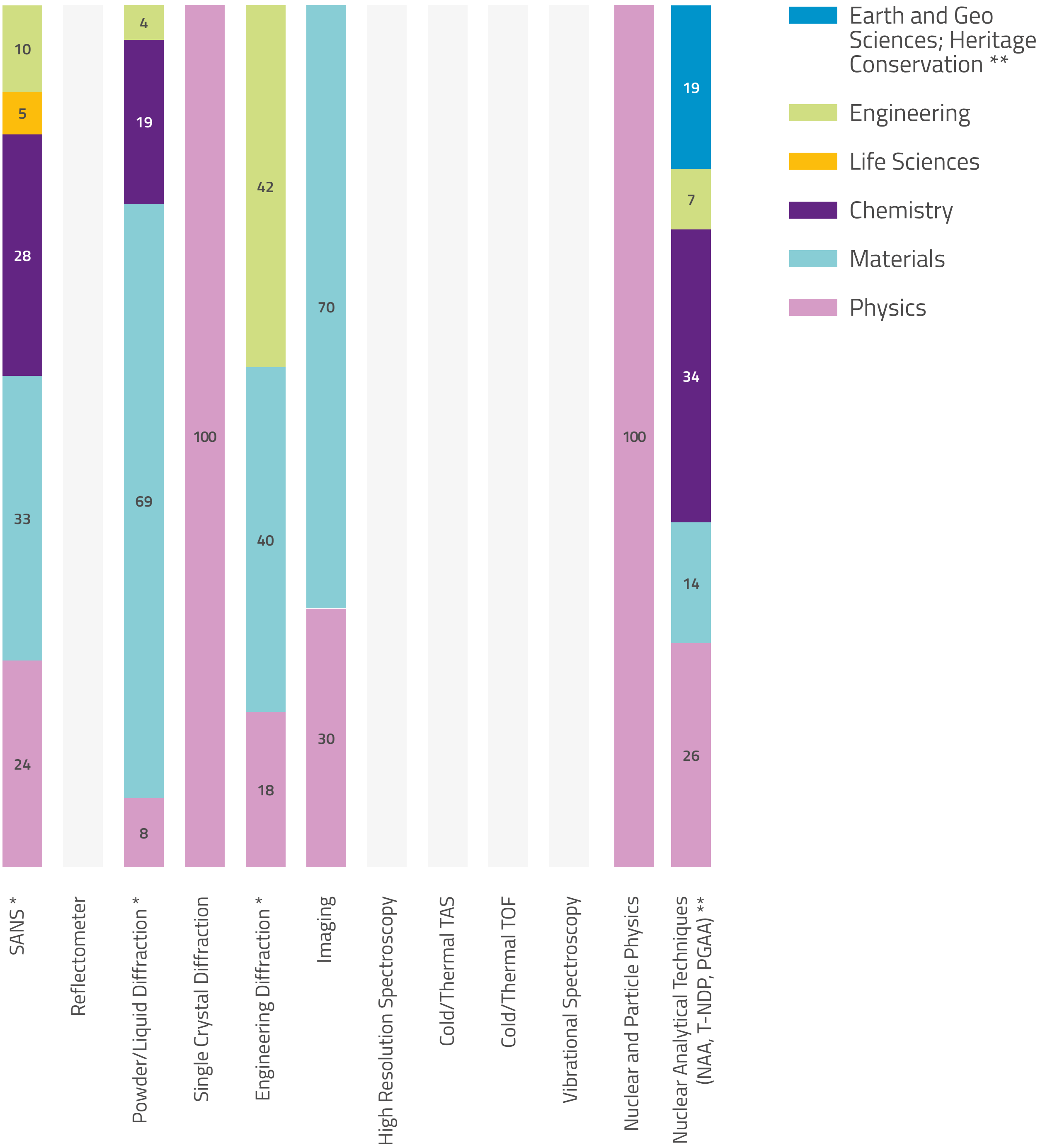
Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

Data not available

** In Total 146 PIs submitted proposals to NPL between 2013-2015. Figures in this chart present the average number of PIs per year rounded up to the nearest integer. In addition to the countries shown in the graph, one PI from each of the following countries submitted a proposal to NPL between 2013-2015: Denmark, France, the Netherlands, Poland and Portugal.*
*** Country where the facility is located. Figure includes NPL staff.*

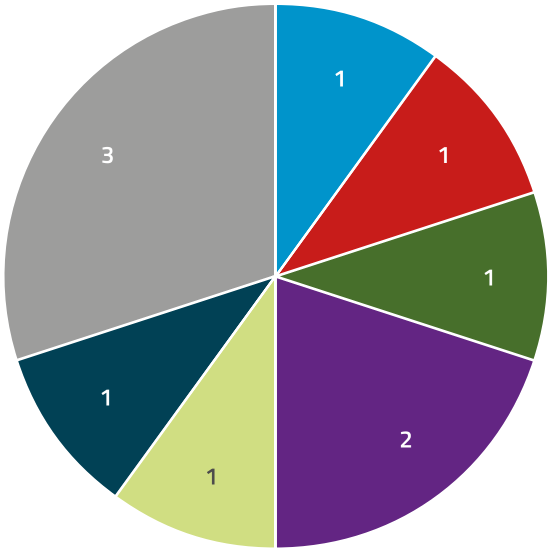
SCIENCE AND METHODS

Science fields per method expressed as a percentage of beam time (Q14)

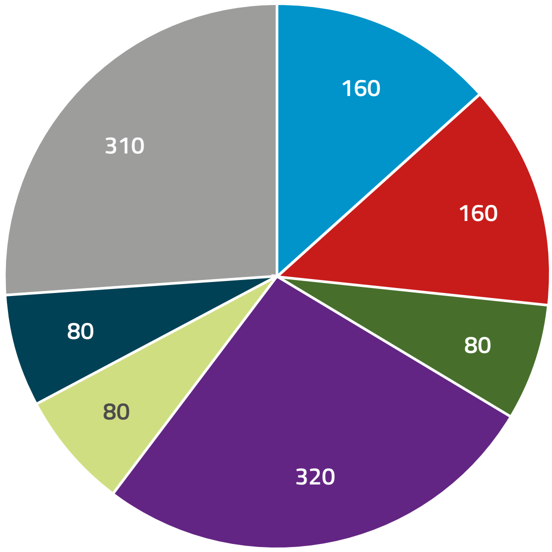


** Methods with the highest industrial use (Q16)*
*** Extra category added by the facility*

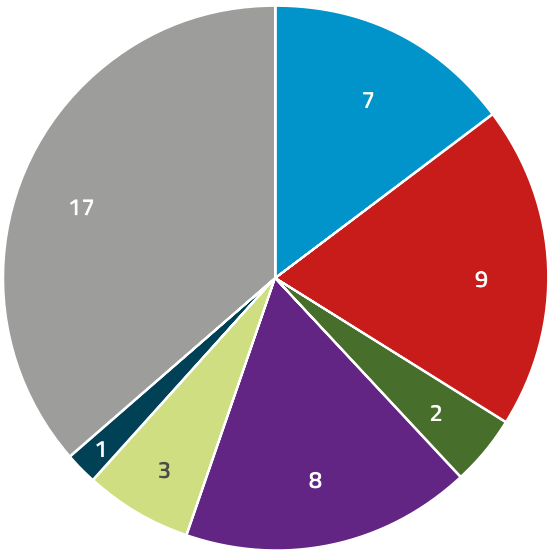
Number of instruments available for each method.* Total: 10 (Q11)



Number of beam days available to users per method per year. Total: 1190 (Q12)



Number of experiments conducted per year using each method. Total: 47 (Q13)



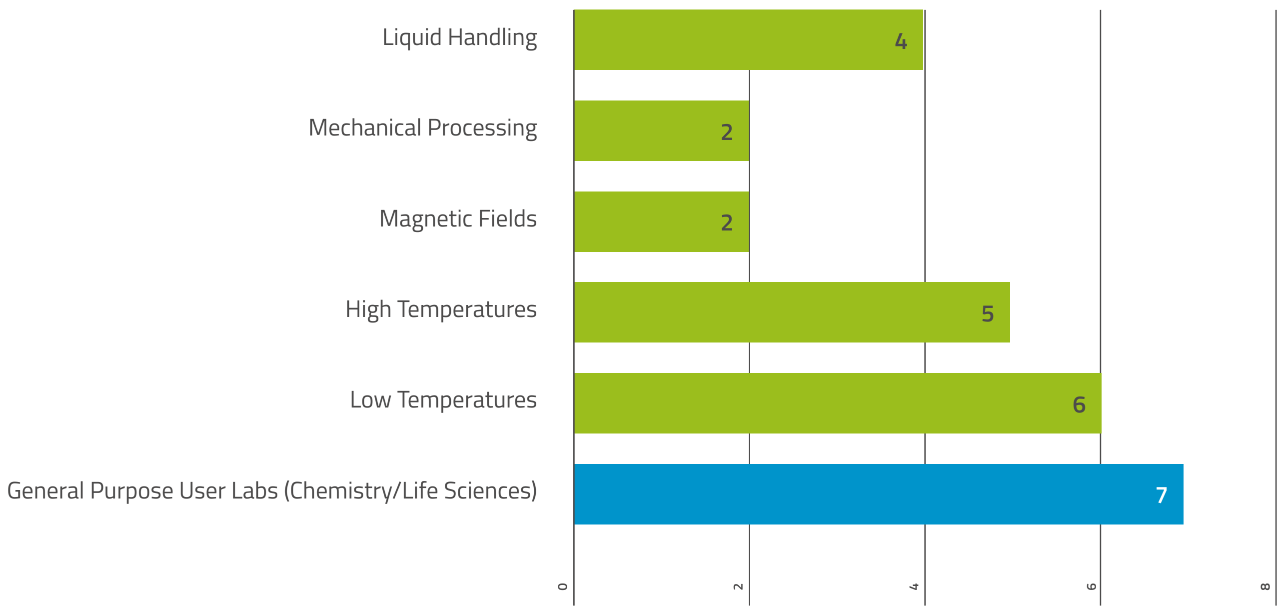
- Small Angle Neutron Scattering
- Powder/Liquid Diffraction
- Single Crystal Diffraction
- Engineering Diffraction
- Imaging
- Nuclear and Particle Physics
- Other (Nuclear Analytical Techniques - NAA, T-NDP, PGAA)**

** The total number of instruments at NPL is eight. Some of them can be used for more than one experimental technique. As a result, there are 10 instruments shown in this graph.*
*** Extra category added by the facility*

Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

Data not available

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 47



Q23

Between 2013 and 2015, NPL hosted 54 unique users per year, on average. Approximately 28% (15) of them were in-house users, including PhD students. The second largest group was individual visitors coming in for a few days. In addition, there were 10 remote users who opted for the mail-in service, eight local users who did not need accommodation, and seven long-term visitors.

Q15

As much as 97% of the overall beam time at NPL was used by academia. An additional 3% of beam time was used by industry for proprietary research.

Q20, Q21, Q22

The user programme for academia at NPL was funded from four different sources. The facility covered 35% of the costs associated with the programme. 38% was funded by umbrella organisations or national partnerships (CRGs), 20% by science-based topical grants, and 7% by neutron-based grants. The user programme for industry was fully funded by money for proprietary research. NPL did not run any user programme for partnerships.

Q24

Approximately 48 Principal Investigators submitted proposals to NPL every year between 2013 and 2015. 32 (67%) of them were from the Czech Republic, i.e. the country where the facility is located, and included NPL staff. Russia and Sweden had three PIs each. NPL also received proposals from non-European countries.

Q25

Data not available.

Q14

The three methods with the highest industrial use were engineering diffraction, SANS, and powder/liquid diffraction. SANS was mostly used for research in materials (33%), chemistry (28%), physics (24%), and engineering (10%). Research in materials dominated powder/liquid diffraction and took up 69% of the beam time available for this method. All beam time available for single crystal diffraction was used for research in physics (100%). Engineering (42%) and materials (40%) were the two major science fields researched using engineering diffraction. The beam time available for imaging was mostly used for materials (70%) research. All beam time available for nuclear and particle physics was used for research in physics (100%). Nuclear analytical techniques were mostly used for research in chemistry (34%), and physics (26%). NLP does not have any reflectometer or instruments for high resolution spectroscopy, cold/thermal TAS, cold/thermal TOF or vibrational spectroscopy.

Q11, Q12, Q13

The highest number of instruments (3) was available for nuclear analytical techniques, including Neutron Activation Analysis (NAA), Thermal Neutron Depth Profiling (T-NDP), and Prompt-Gamma Activation Analysis (PGAA). The highest number of beam days (320) was available for engineering diffraction. However, the highest number of experiments (17) was conducted using nuclear analytical techniques.

Q19

Data not available.

Q18

Seven experiments were performed on the instruments at NPL using general purpose user laboratories for sample preparation. Six experiments required a low temperature sample environment.

JG|U

TRIGA User Facility, Johannes Gutenberg-Universität Mainz (TRIGA JGU)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:
COURTESY OF TRIGA USER FACILITY, JOHANNES GUTENBERG-UNIVERSITÄT MAINZ

TRIGA USER FACILITY, JOHANNES GUTENBERG-UNIVERSITÄT MAINZ (TRIGA JGU)

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	100 KW
Thermal neutron flux at 1.5 Å (average and peak)	10^{12} (average)/4 x 10^{12} (peak)
Cold neutron flux at 5 Å (average)	N/A
Operational days per year	200
Total number of instruments	4
Number of instruments available to external users	4
Location	Mainz, Germany

PROFILE OF THE FACILITY

With a Super-Thermal UltraCold Neutrons (UCN) source at the TRIGA Mainz, a density of 10 UCN/cm^3 in a 10 litre storage volume has been reached. Background interference during data taking is essentially zero since the reactor is off during the measurements. Low magnetic noise is another quality feature of this reactor.

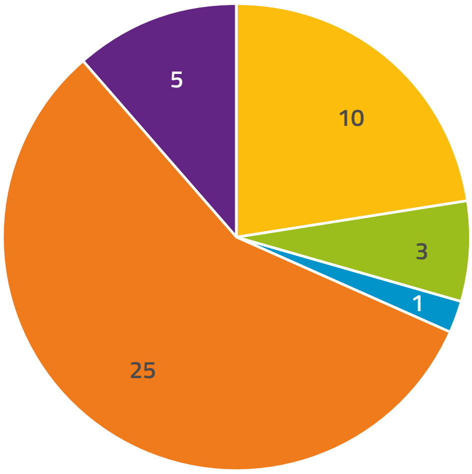
Within the PRISMA cluster of excellence, the TRIGA Mainz reactor will be transformed into a user facility for fundamental and applied research in nuclear chemistry and physics, which will attract researchers to perform new high-precision experiments with UCN. PRISMA provides the infrastructure to sustain long-term experiments at a facility well suited for UCN storage experiments.

Furthermore, at TRIGA Mainz a Penning trap and a laser spectroscopy setup for the investigation of short-lived fission products – TRIGA-SPEC – has been installed for highly precise measurements of neutron-rich isotopes of astrophysical relevance.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

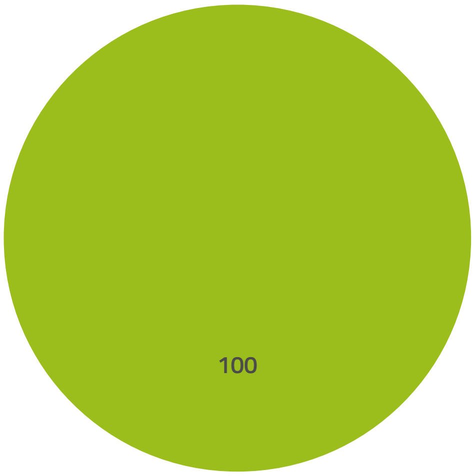
Average over 2013-2015

USER COMMUNITY



Number of unique users per year: 44 (Q23)

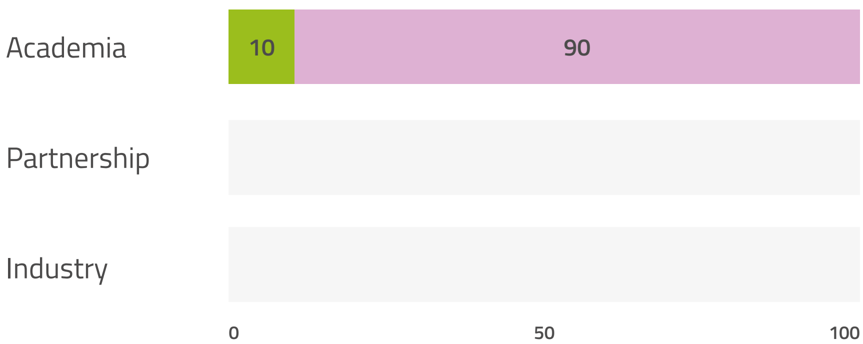
- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)
- Remote users/mail-in service



User type expressed as a percentage of beam time (Q15)

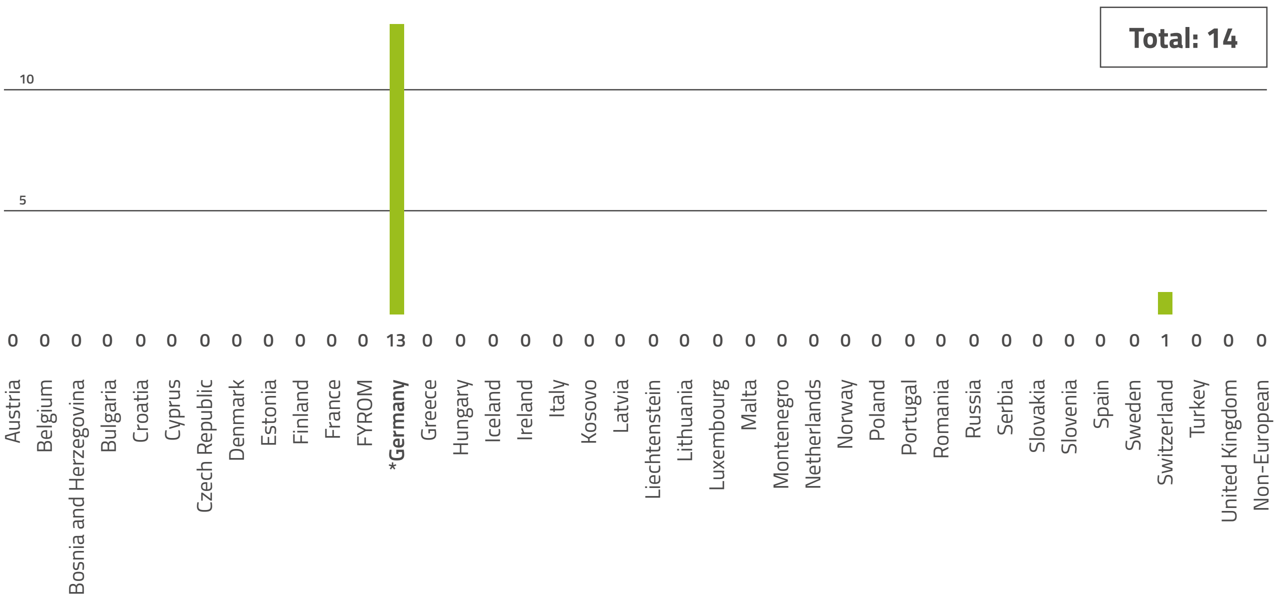
- Academia

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



- Facility
- Science-based topical grants (such as nano science, soft matter)

Number of Principal Investigators (PIs) per country (Q24)

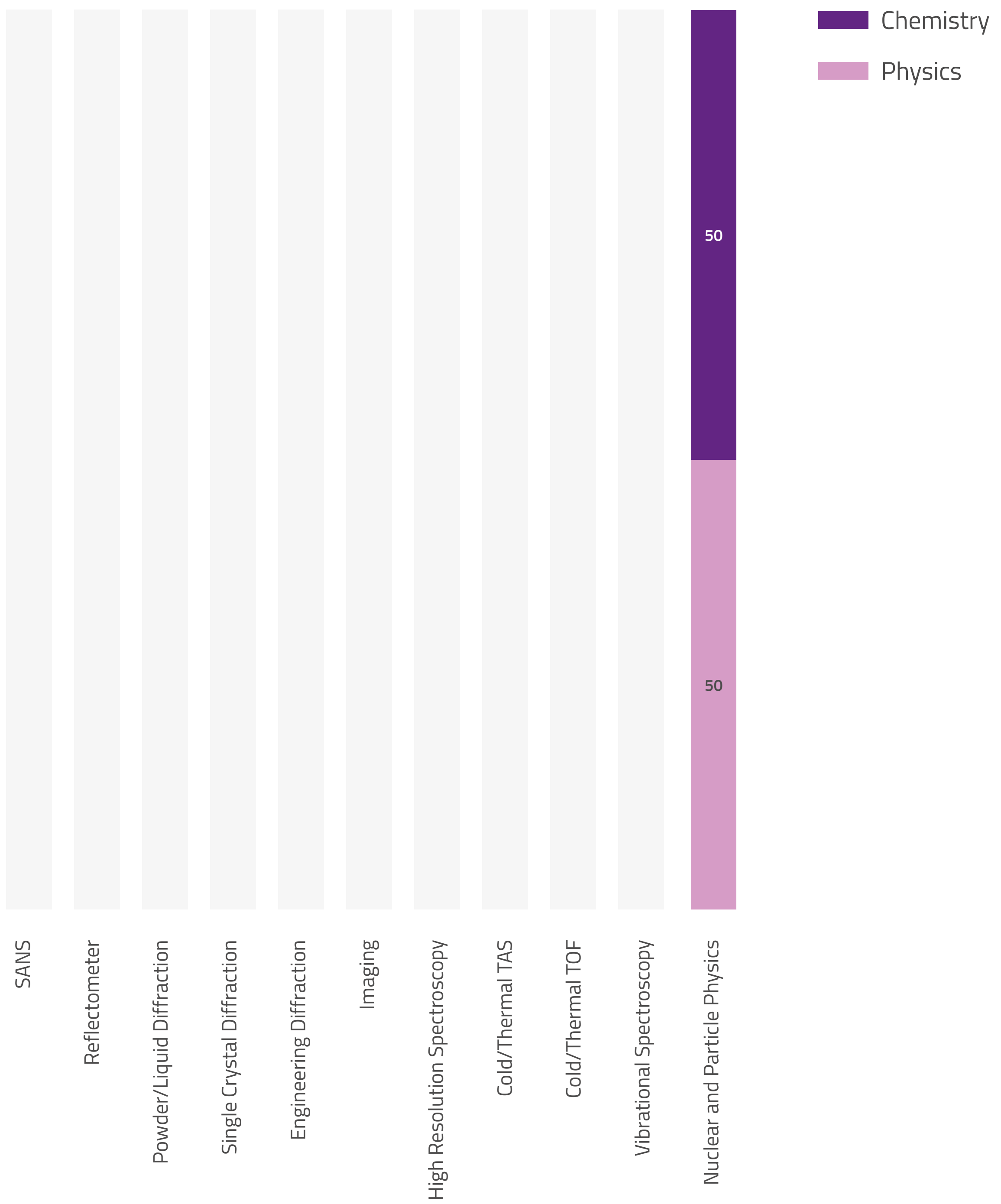


Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

Question not applicable

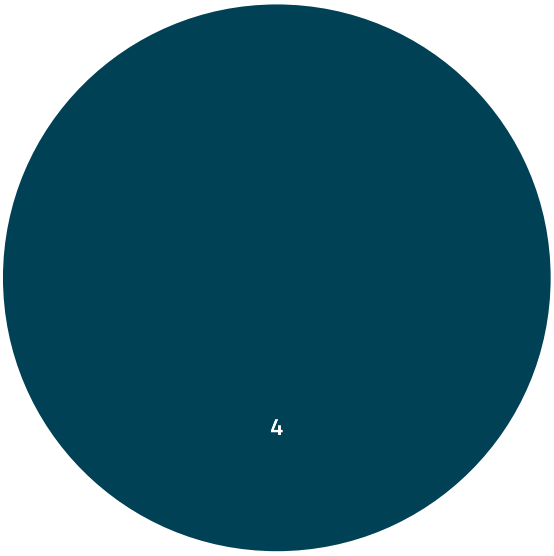
** Country where the facility is located*

Science fields per method expressed as a percentage of beam time (Q14)

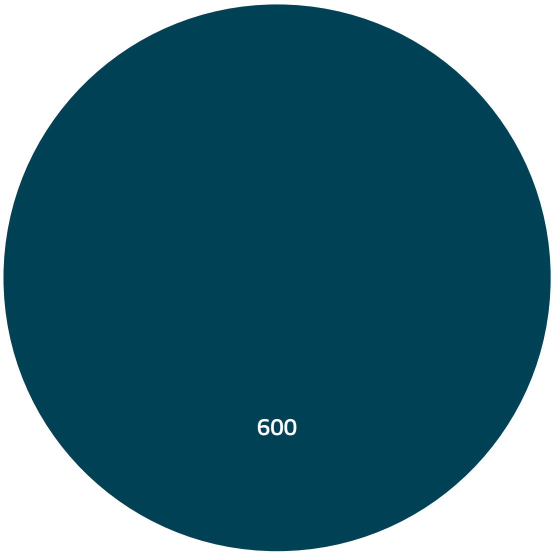


Question about methods with the highest industrial use not applicable (Q16)

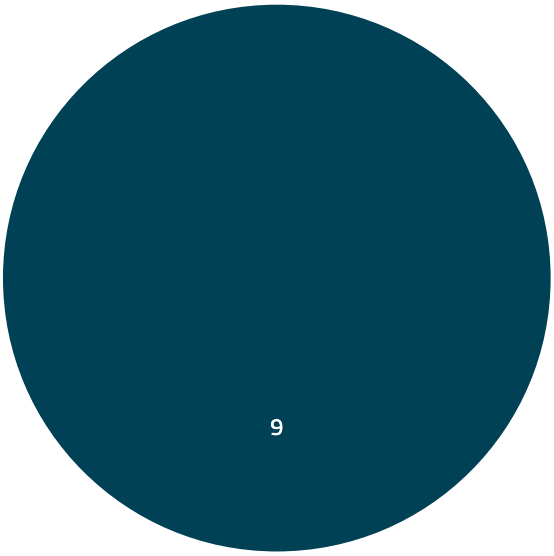
Number of instruments available for each method. Total: 4 (Q11)



Number of beam days available to users per method per year. Total: 600 (Q12)

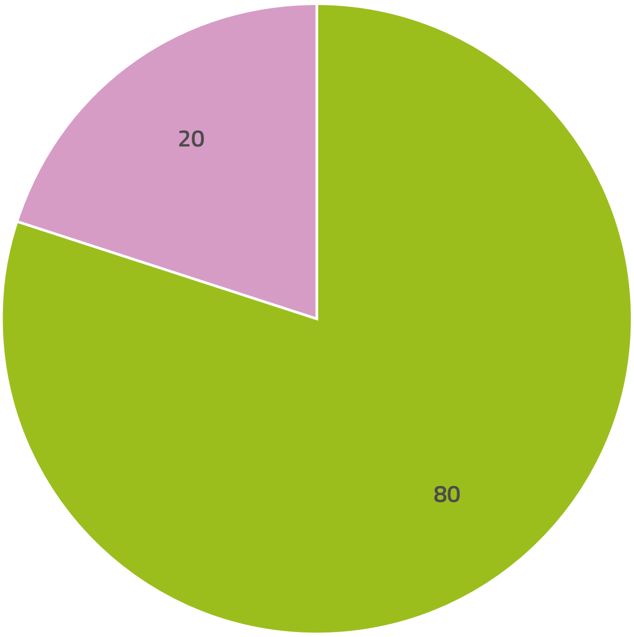


Number of experiments conducted per year using each method. Total: 9 (Q13)



Nuclear and Particle Physics*

** The total number of instruments at TRIGA Mainz is four. However, two sources of ultracold neutrons (UCN) at two different beam ports are currently in operation. In addition to that, a Penning trap for high-precision mass spectrometry (TRIGA-TRAP) and a beamline for high-resolution collinear laser spectroscopy (TRIGA-LASER) are installed at a third beam port. This adds up to four instruments used for fundamental physics research. Two of these four instruments are dedicated to high-resolution spectroscopy. In collaboration with the Technical University Munich, Germany, a setup for neutron reflectometry has been adopted for use at one of the UCN sources at the TRIGA Mainz. This setup is currently in use and might be transported back to Munich or to another available neutron source for future experiments.*

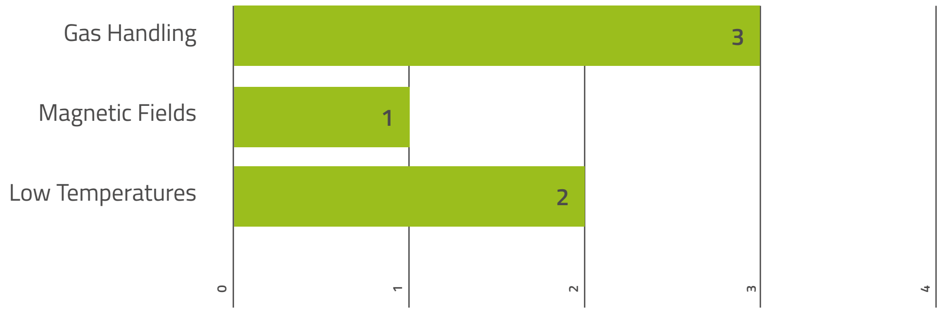


Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

Fundamental Research

Other (Neutron Activation Analysis, Tracer production, education and training)

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 9



Q23

Between 2013 and 2015 TRIGA Mainz hosted 44 unique users per year, on average. Approximately 57% (25) of them were in-house users, including PhD students. There were 10 local users who did not need accommodation, and five remote users who used the mail-in service. In addition, there were three individual visitors who came to TRIGA Mainz for a few days and one long-term visitor.

Q15

100% of the overall beam time at TRIGA Mainz was used by academia.

Q20, Q21, Q22

The user programme for academia at TRIGA Mainz was funded mainly through science-based topical grants (90%). The remaining 10% of the programme was funded by the facility. TRIGA Mainz did not run any programme for industry or partnerships.

Q24

There was one PI from Switzerland and 13 PIs from Germany, where the facility is based.

Q25

Question not applicable.

Q14

Question on methods with the highest industrial use is not applicable as TRIGA Mainz does not run any user programme for industry. The beam time allocated for nuclear and particle physics was used for research in chemistry (50%) and physics (50%).

Q11, Q12, Q13

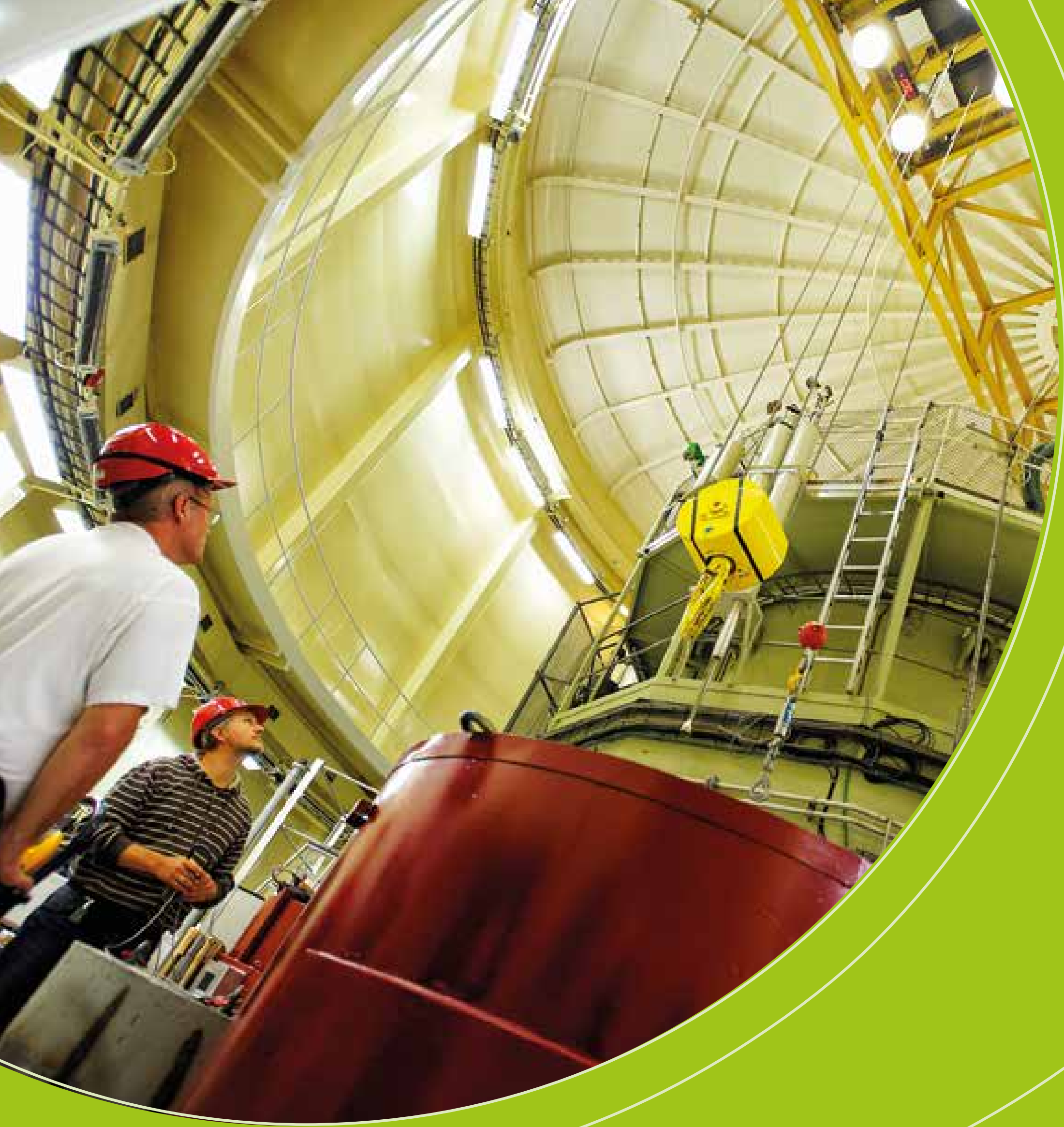
TRIGA Mainz has four instruments for nuclear and particle physics, which are available for 600 beam days per year. On average, nine experiments are carried out in nuclear and particle physics per year. While the total number of instruments at TRIGA Mainz is four, two sources of UltraCold Neutrons (UCN) at two different beam ports are currently in operation. In addition to that, a Penning trap for high-precision mass spectrometry (TRIGA-TRAP) and a beamline for high-resolution collinear laser spectroscopy (TRIGA-LASER) are installed at a third beam port. This adds up to four instruments used for fundamental physics research. Two of these four instruments are dedicated to high-resolution spectroscopy. In collaboration with the Technical University Munich, Germany, a setup for neutron reflectometry has been adopted for use at one of the UCN sources at the TRIGA Mainz. This setup is currently in use and might be transported back to Munich or to another available neutron source for future experiments.

Q19

Fundamental research (80%) was the dominant field at TRIGA Mainz. The rest of the research carried out at the facility focused on neutron activation analysis, tracer production, and education and training.

Q18

The highest number of experiments (3) required a gas handling sample environment.



Institute for Energy Technology - JEEP II

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:
COURTESY OF INSTITUTE FOR ENERGY TECHNOLOGY - JEEP II

INSTITUTE FOR ENERGY TECHNOLOGY - JEEP II

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	2 MW
Thermal neutron flux at 1.5 Å (peak)	3×10^{13} n/cm^2/s
Cold neutron flux at 5 Å (peak)*	8.4×10^{5} n/cm^2/s
Operational days per year	200
Total number of instruments	6
Number of instruments available to external users	5
Location	Kjeller, Norway

PROFILE OF THE FACILITY

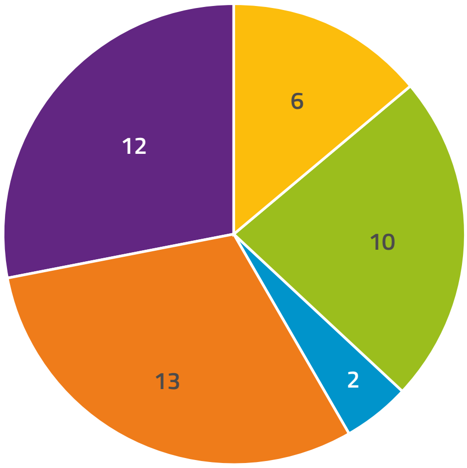
The Institute for Energy and Technology (IFE) is an international research foundation for energy and nuclear technology. IFE's mandate is to undertake research and development, on an ideal basis and for the benefit of society, within the energy and petroleum sector, and to carry out assignments in the field of nuclear technology for the nation. The Institute strives for a more climate-friendly energy system based on renewable and CO_2-free energy sources. The JEEP II reactor at Kjeller produces neutrons and is equipped with advanced instruments for material technology research. It is not a typical user facility. All beam time is in-house, and external access is through collaboration with facility staff.

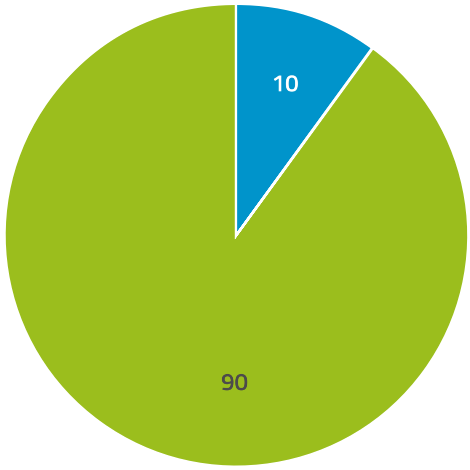
TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

2014

**Peak at sample position (SANS)*

USER COMMUNITY





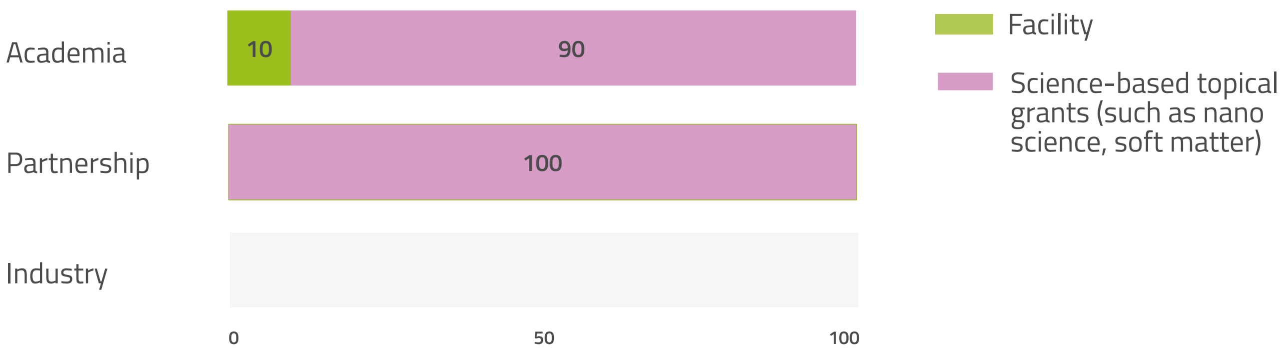
Number of unique users per year: 43 (Q23)

- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)
- Remote users/mail-in service

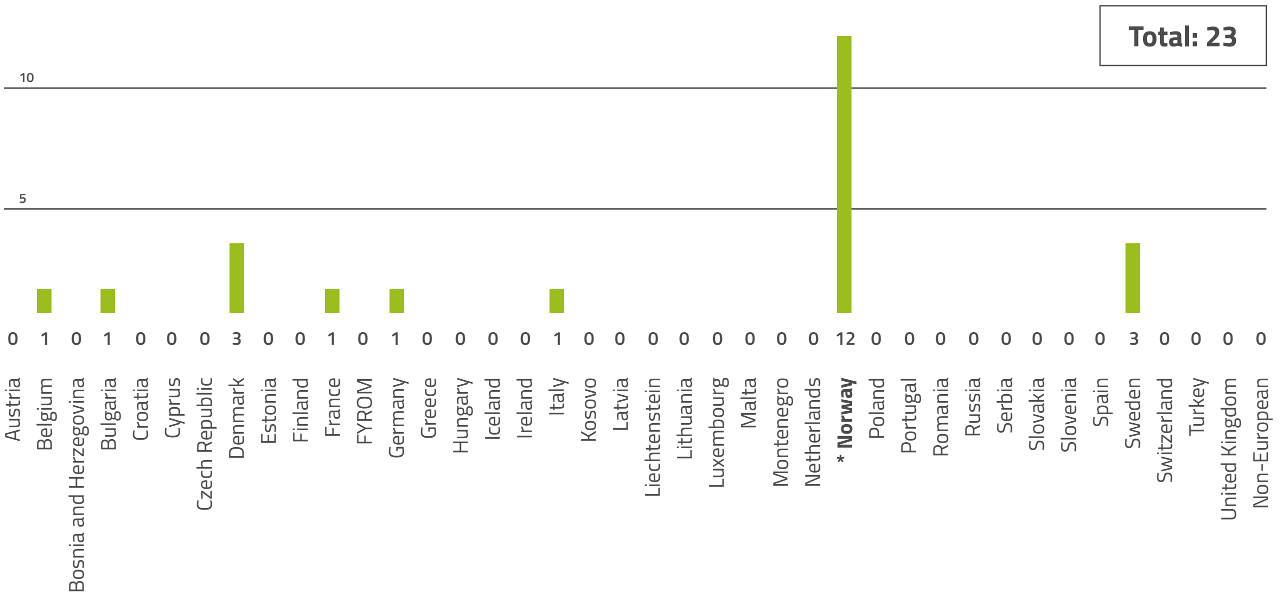
User type expressed as a percentage of beam time (Q15)

- Academia
- Partnership (public research of academia but supported by industry)

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



Number of Principal Investigators (PIs) per country (Q24)

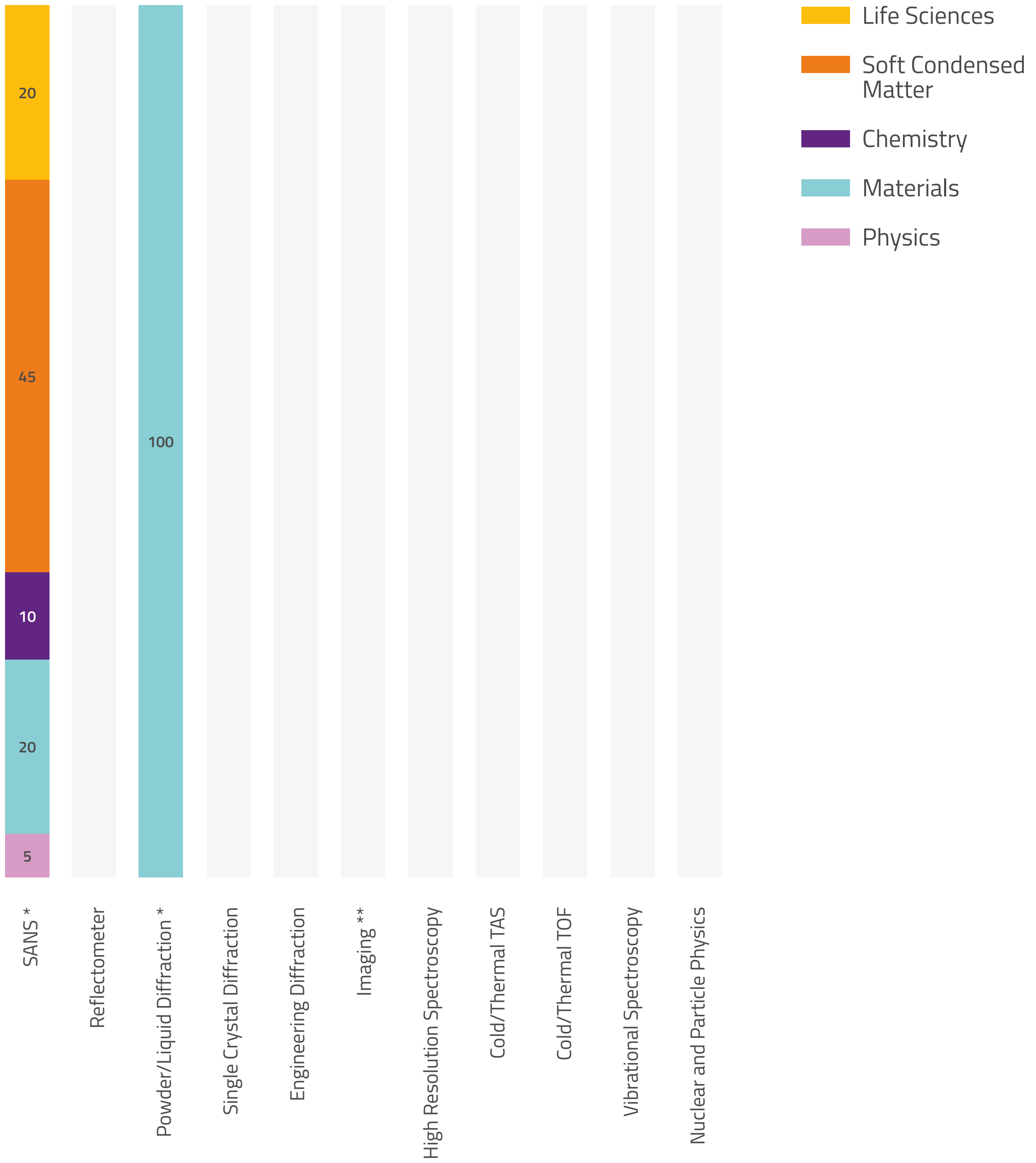


Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

Not applicable

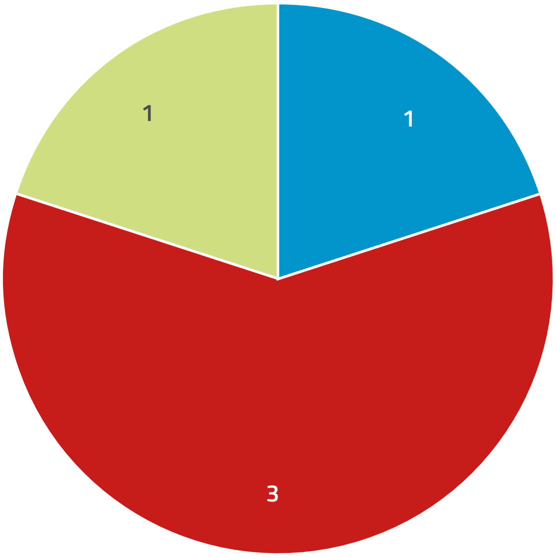
** Country where the facility is located. Figure includes JEEP II staff.*

Science fields per method expressed as a percentage of beam time (Q14)

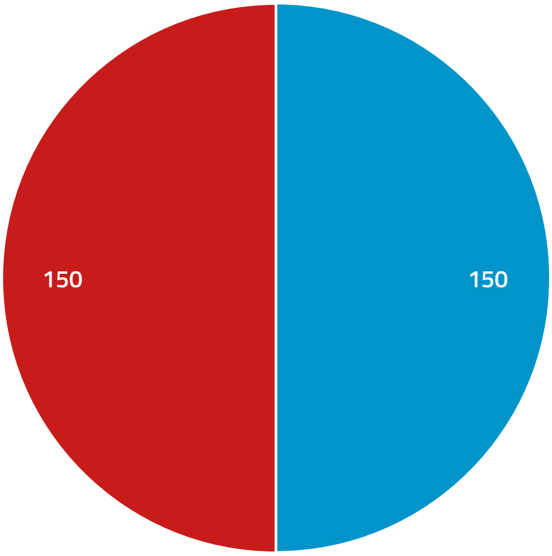


** Methods with the highest industrial use (Q16)*
*** JEEP II has an instrument for imaging, but only in-house experiments were performed.*

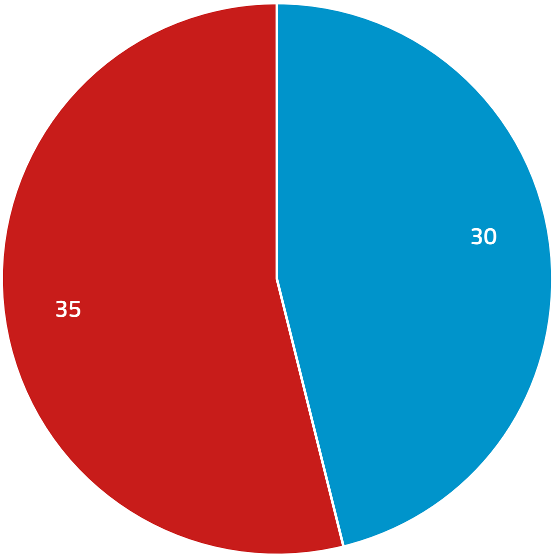
Number of instruments available for each method.* Total: 5 (Q11)

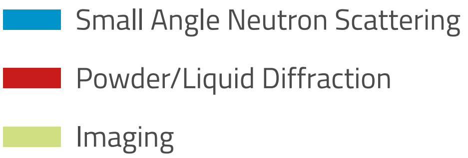


Number of beam days available to users per method per year. Total: 300 (Q12)

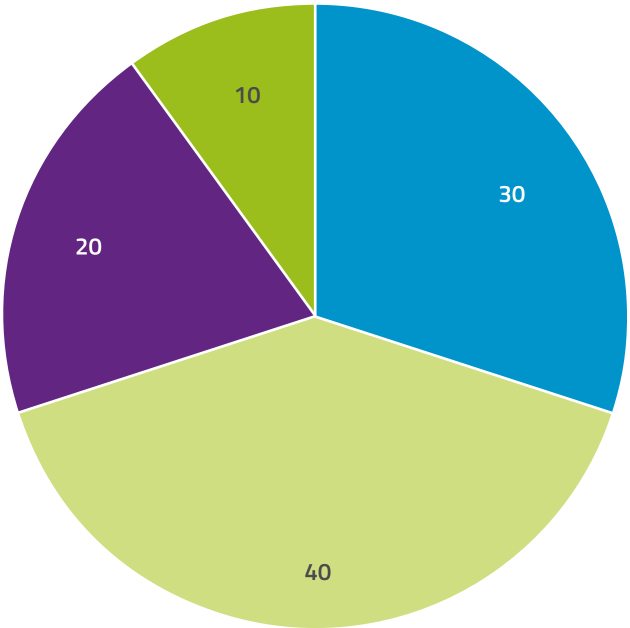


Number of experiments conducted per year using each method. Total: 65 (Q13)

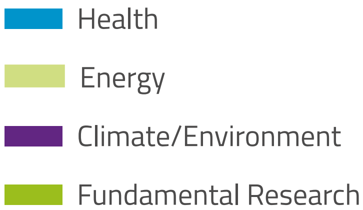




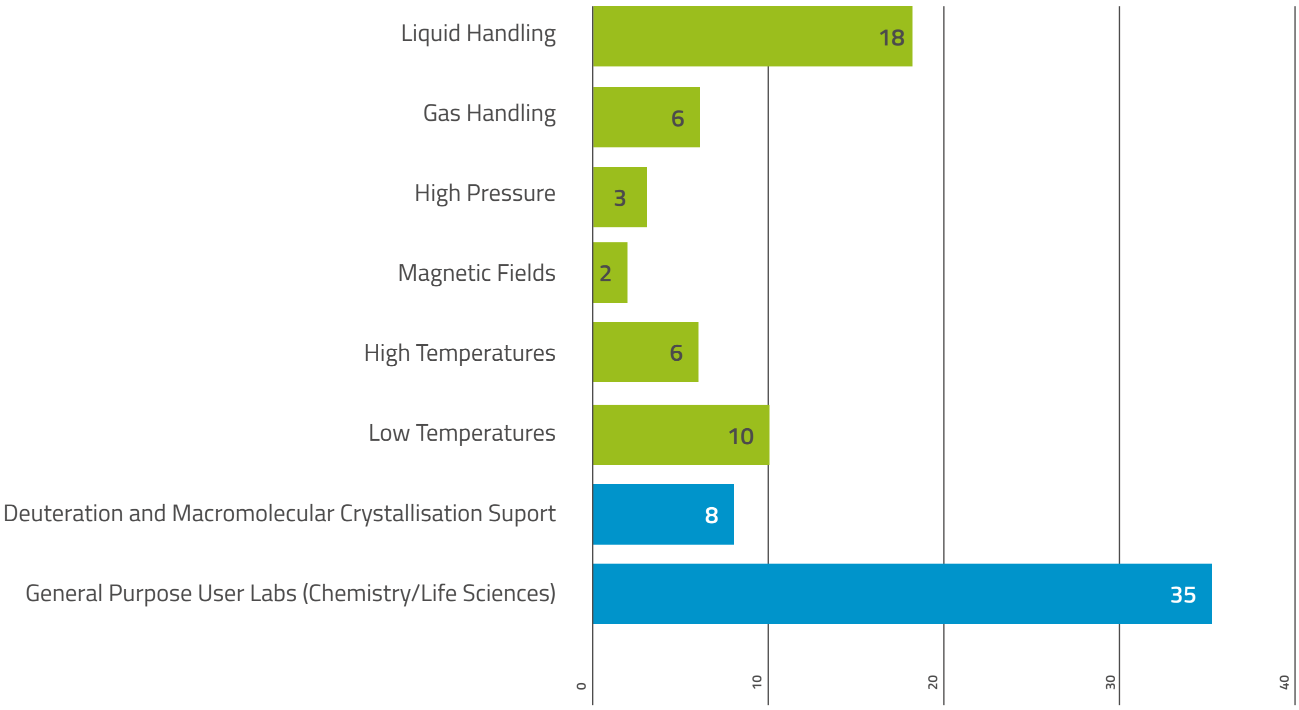
** In addition to the instruments presented in this chart, JEEP II has one test beamline (detector testing) available to external users. The instrument for imaging is currently not available to external users.*



Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)



Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 65



Q23

JEEP II hosted 43 unique users in 2014. Approximately 30% (13) of them were in-house users, including PhDs. There were 12 remote users who used the mail-in service, 10 individual visitors who came for a few days, six local users who did not need accommodation and two long-term visitors.

Q15

As much as 90% of overall beam time at JEEP II was used by academia. An additional 10% of beam time was used by academia for public research supported by industry.

Q20, Q21, Q22

The user programmes at JEEP II are mainly funded through science-based topical grants. These grants covered 100% of the costs associated with the user programme for partnership, and 90% of the costs in relation to the user programme for academia. The remaining 10% of the user programme for academia was funded by the facility.

Q24

23 Principal Investigators submitted proposals to JEEP II in 2014. 12 (52%) of them were from Norway, i.e. the country where the facility is located, and included JEEP II staff. The number of PIs from Denmark and Sweden was the same (3 each). Belgium, Bulgaria, France, Germany, and Italy counted for one PI each.

Q25

Not applicable.

Q14

The methods with the highest industrial use were SANS and powder/liquid diffraction. SANS was mostly used for research in soft condensed matter (45%), life sciences (20%), and materials (20%). 100% of the beam time available for powder/liquid diffraction was used for research in materials. JEEP II has an instrument for imaging, but only in-house experiments were performed. The facility does not have any reflectometer, or instruments for single crystal diffraction, engineering diffraction, cold/thermal TAS, cold/thermal TOF, vibrational spectroscopy, or nuclear and particle physics.

Q11, Q12, Q13

The highest number of instruments (2) was available for powder/liquid diffraction. The overall number of beam days at the facility were equally split between small angle neutron scattering (150), and powder/liquid diffraction (150). The highest number of experiments were carried out using powder/liquid diffraction (35).

Q19

A significant proportion of the overall research carried out at JEEP II addressed Horizon 2020 challenges and topics. Energy accrued for 40%, health for 30%, and climate/environment for 20%. The remaining 10% focused on fundamental research.

Q18

35 experiments were performed on JEEP II instruments using general purpose user labs for sample preparation. 18 experiments required a liquid handling sample environment.

Jožef Stefan Institute TRIGA Mark II Research Reactor (TRIGA JSI)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:
COURTESY OF JOŽEF STEFAN INSTITUTE TRIGA MARK II RESEARCH REACTOR

JOŽEF STEFAN INSTITUTE TRIGA MARK II RESEARCH REACTOR (TRIGA JSI)

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	250 kW at steady state
	1 GW at pulse mode
Thermal neutron flux at 1.5 Å (average)	5.107×10^{12} (0 – 0.625 eV)
Cold neutron flux at 5 Å (average)	N/A
Operational days per year	150
Total number of instruments	8
Number of instruments available to external users	8
Location	Ljubljana, Slovenia

PROFILE OF THE FACILITY

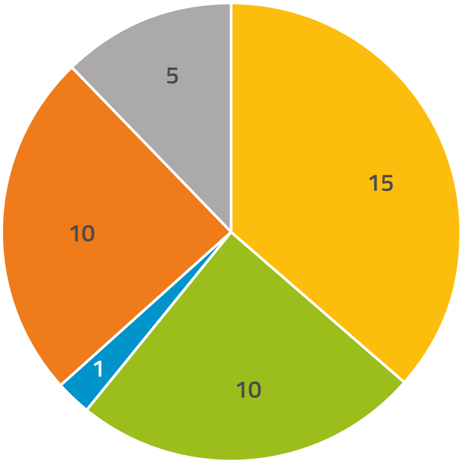
The TRIGA Mark II research reactor at the Jožef Stefan Institute (JSI) is extensively used for various applications, such as training and education, verification and validation of nuclear data, computational methods and computer codes, testing and development of experimental equipment used for core physics tests at the Krško Nuclear Power Plant, and irradiation of various samples. The latter activity occupies almost 80% of the reactor operation time and is related mainly to the use of the reactor as a source of neutrons in nuclear analytical techniques, e.g. Neutron Activation Analysis (NAA), and as a source of neutrons and gamma rays for irradiation of silicon detectors, radiation damage studies of materials, and of acquisition electronics for the ATLAS detector in CERN. Due to the relatively large 'triangular' channel, it enables the irradiation of silicon detectors at different temperatures by installing a heating/cooling module inside the channel. Due to the good characterisation of the irradiation channels, the JSI TRIGA Mark II reactor is a reference centre for neutron irradiation of detectors developed for the ATLAS experiment.

The JSI TRIGA Mark II reactor is a 250 kW lightwater pool type reactor, cooled by natural convection. The Central Channel (CC) is an irradiation channel, i.e. a hollow aluminum tube with the most intense neutron flux, around of $2{\times}10^{13}$ $cm^{-2}s^{-1}$. Other in-core irradiation channels are located in the outer F-ring of the reactor core, the so-called Triangular Channel (TIC) is located close to the core centre and occupies three fuel element positions. The latter can be used for irradiation of larger samples at relatively intense neutron flux levels. Due to its size, additional systems, such as cooling or heating of the samples during irradiation, can be installed in the channel. The reactor features several ex-core irradiation channels. The irradiation channel (ThCol) in the thermalising column is a large cube of edge length of 62 cm, filled with air. It enables irradiation of large objects with (mostly) thermal neutrons. The tangential channel (TangCh) is a horizontal cylindrical tube of radius 7.7 cm. The Radial Beam Port (RBP) and the Radial Piercing Port (RPP) are horizontal cylindrical tubes of same radius. The radial beam port ends at the outside of the graphite reflector, whereas the radial piercing port reaches the outside edge of the core itself.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

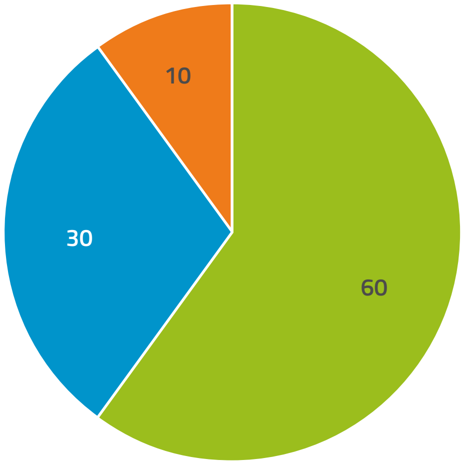
Average over 2013-2015, no irregularities

USER COMMUNITY



Number of unique users per year: 41 (Q23)

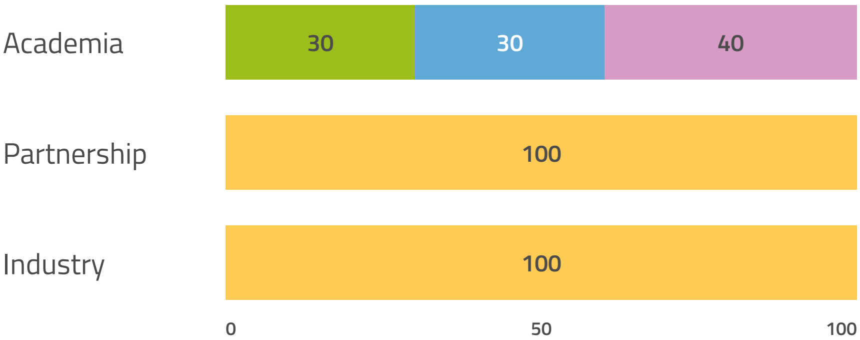
- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)
- Remote users/mail-in service



User type expressed as a percentage of beam time (Q15)

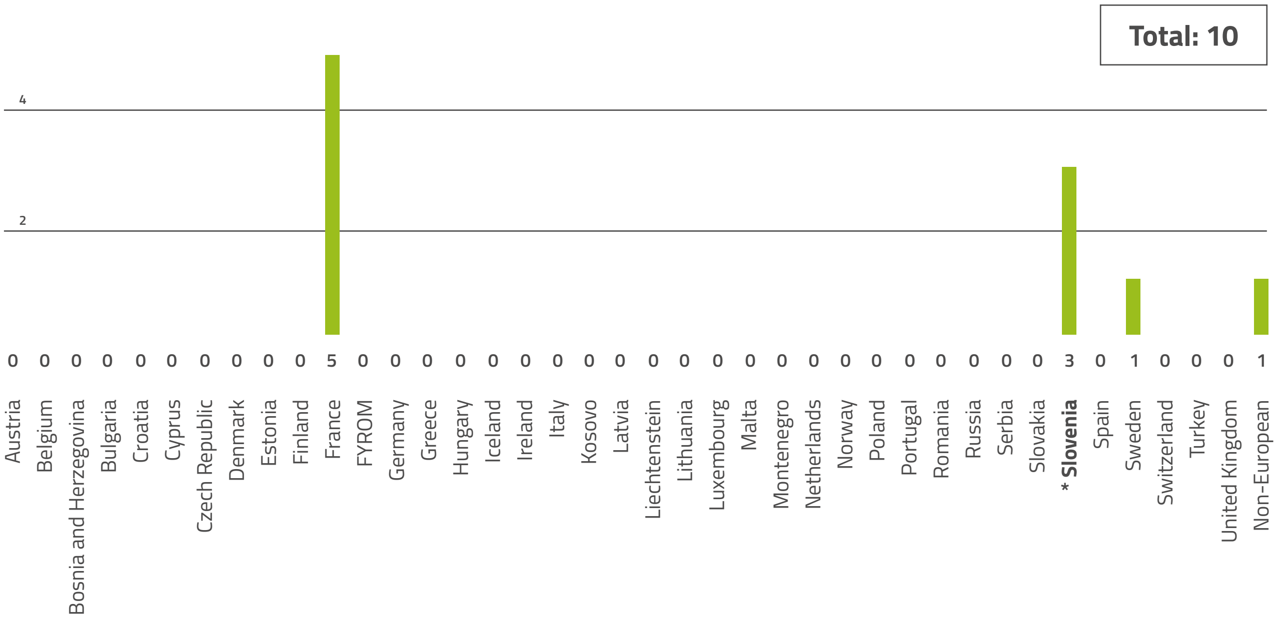
- Academia
- Partnership (public research of academia but supported by industry)
- Industry (proprietary research)

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



- Facility
- Umbrella organisations or national partnerships (CRGs)
- Science-based topical grants (such as nano science, soft matter)
- Money (proprierity)

Number of Principal Investigators (PIs) per country (Q24)

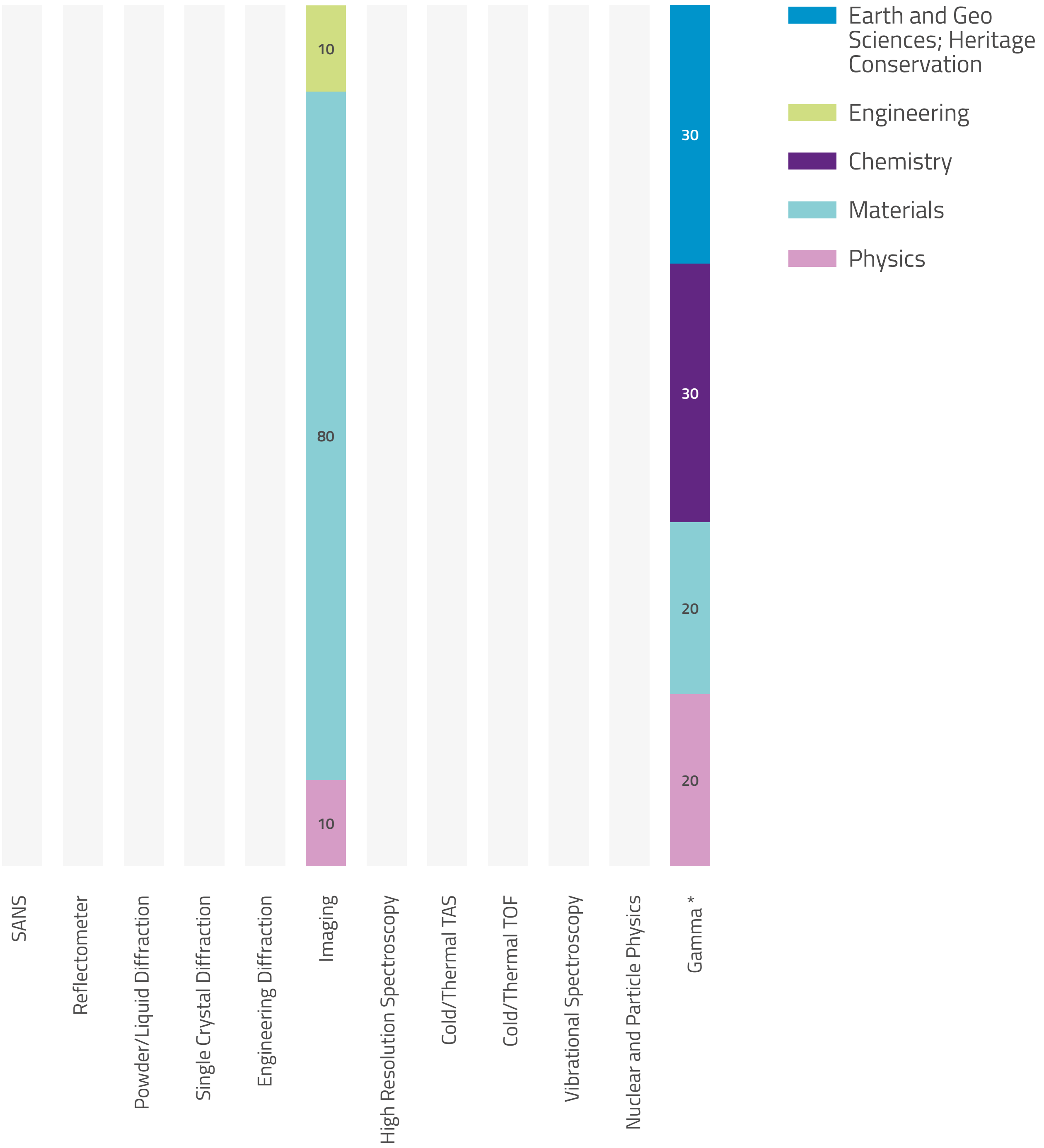


Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

Question not applicable

** Country where the facility is located. Figure does not include TRIGA Mark II Research Reactor staff.*

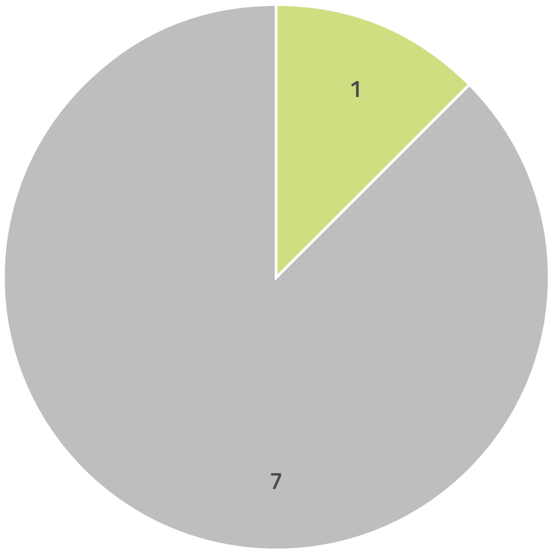
Science fields per method expressed as a percentage of beam time (Q14)



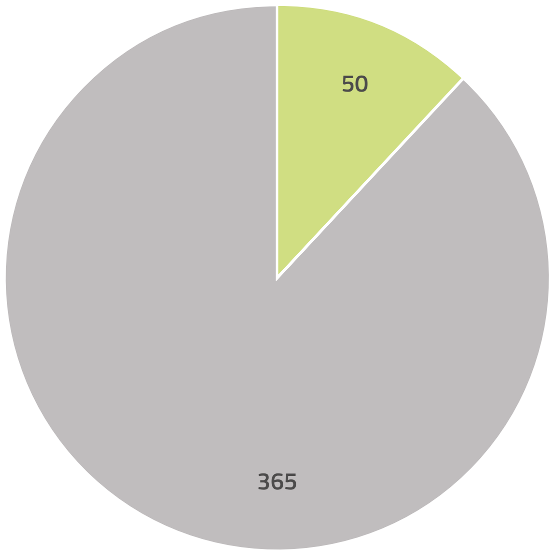
Methods with the highest industrial use: material hardness studies by gamma irradiation, material hardness studies by neutron irradiation, and neutron radiography. (Q16)

** Extra category added by the facility*

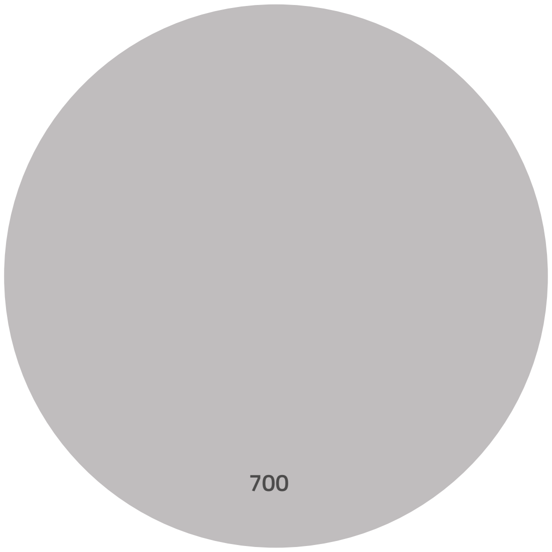
Number of instruments available for each method. Total: 8 (Q11)



Number of beam days available to users per method per year. Total: 415 (Q12)



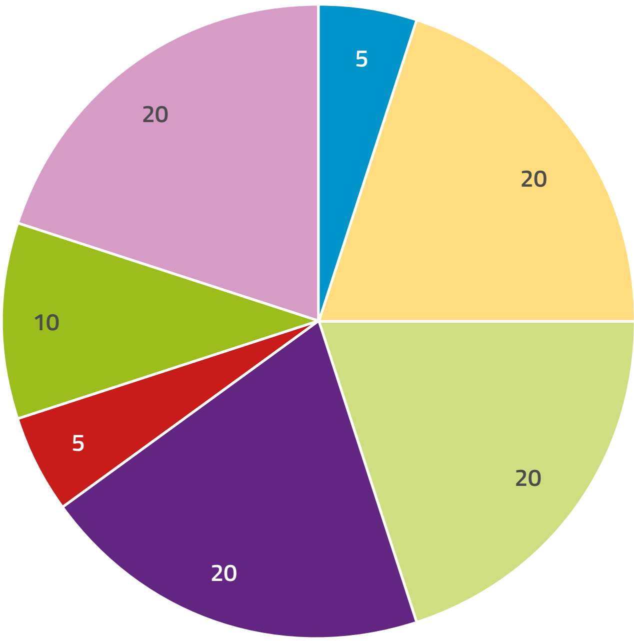
Number of experiments conducted per year using each method. Total: 700 (Q13)



Imaging

Other (Gamma)*

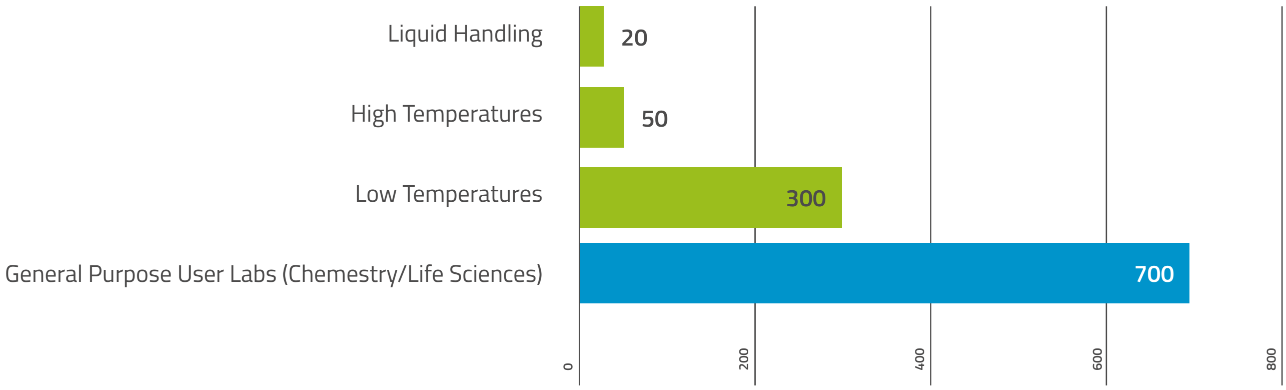
** Extra category added by the facility*



Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

- Health
- Food/Water
- Energy
- Climate/Environment
- Security (soft security challenges such as terrorism, border security, cyber security etc.)
- Fundamental Research
- Other

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 700



Q23
Between 2013 and 2015, TRIGA Mark II Research Reactor hosted 41 unique users on average every year. Approximately 37% (15) of them were local users who did not need accommodation. There was an equal number of individual visitors (10) coming in for a few days, and in-house users (10), including PhD students. There were five remote users who used mail-in service, and one long-term visitor.

Q15
As much as 60% of the overall beam time at the TRIGA Mark II Research Reactor was used by academia. An additional 30% of the beam time was used by academia for public research sponsored by industry. The remaining 10% was used by industry for proprietary research.

Q20, Q21, Q22
The user programme for industry, as well as the user programme for partnership, were both fully funded by money for proprietary research. The funding of the user programme for academia was more diverse. The facility funded 30% of the user programme. The rest was funded by umbrella organisations or national partnerships (30%) and science-based topical grants (40%).

Q24
Between 2013-2015, 10 Principal Investigators on average submitted proposals to TRIGA Mark II Research Reactor every year. Five (50%) of them were from France. Slovenia, i.e. the country where the facility is located, came second with three users. There was also one PI from Sweden and from Azerbaijan.

Q25
Not applicable.

Q14
The three methods with the highest industrial use were material hardness studies by gamma irradiation, material hardness studies by neutron irradiation, and neutron radiography. None of these methods was among the selection of methods in the original survey questionnaire. TRIGA Mark II Research Reactor does not have any reflectomer, instrument for SANS, powder/liquid diffraction, single crystal diffraction, engineering diffraction, cold/thermal TAS, cold/thermal TOF, vibrational spectroscopy or nuclear and particle physics. 80% of the beam time for imaging is used for materials. The rest is equally divided between engineering and physics (10% each). Gamma is used across four science fields. Chemistry, and earth/geo sciences, and heritage conservation both take up 30% of the beam time. The rest is equally divided among materials and physics (20% each).

Q11, Q12, Q13
TRIGA Mark II Research Reactor has seven instruments for gamma, and one imaging instrument. There were 365 beam days available for gamma, and 700 experiments were conducted using this method. No experiments were performed with the imaging instrument.

Q19
TRIGA Mark II Research Reactor is active in almost all Horizon 2020 topics and challenges. Food/water, energy, and climate/environment each accounted for 20% of overall research. The facility also showed activity in fundamental research (10%), soft security challenges (5%), and health (5%).

Q18
The highest number of experiments (700) were conducted in general purpose user labs. 300 experiments were performed in a low temperature sample environment.

Portuguese Research Reactor (RPI)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:
COURTESY OF PORTUGUESE RESEARCH REACTOR

FACILITY

PORTUGUESE RESEARCH REACTOR (RPI)

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	1 MW
Thermal neutron flux at 1.5 Å (average and peak)	1 x 10^{13} n/cm^2/s, 2 x 10^{13} n/cm^2/s
Cold neutron flux at 5 Å (average)	N/A
Operational days per year	150
Total number of instruments	1*
Number of instruments available to external users	0
Location	Bobadela, Portugal

PROFILE OF THE FACILITY

The RPI is an open pool type research reactor of 1 MW thermal power, owned and operated by the Instituto Superior Técnico (IST), University of Lisbon. The reactor went critical in 1961, and since then has undergone several modifications and refurbishments, including conversion of the core fuel from highly enriched uranium to low enriched uranium. The reactor is mainly utilised for neutron activation analysis, education, and research and development. The largest sustained activity in recent years has been neutron activation analysis of environmental and archaeological samples. The percentage of users of the RPI outside IST was around 20% in 2013-2015.

The RPI is prepared to handle a large number of long irradiations in positions close to the reactor core. Short irradiations, of the order of a few seconds, are also supported for cases when the isotopes under study have a very short half-life. The RPI also supports neutron tomography and irradiation of electronic components and systems in two dedicated beam lines. Public visits to the RPI are an important part of their work, hosting around 50 visits per year.

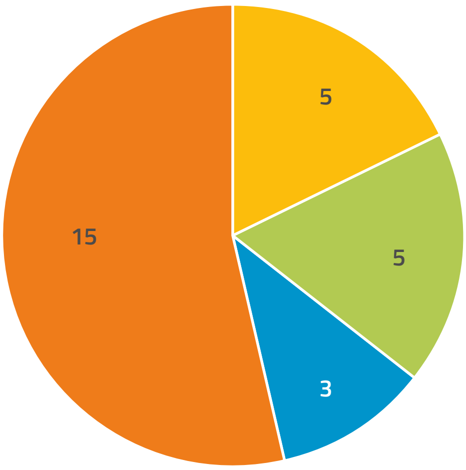
TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

Average over 2013-2015

The RPI reactor closed down in 2017

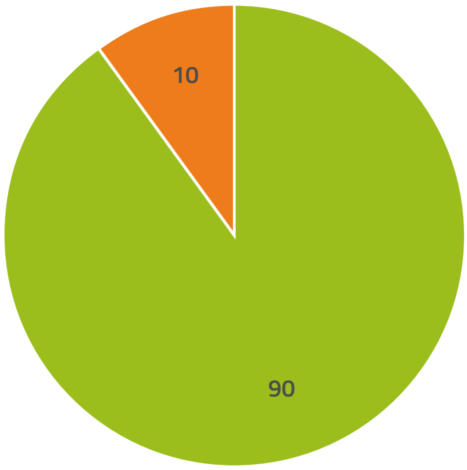
** No operational neutron scattering instruments*

USER COMMUNITY



Number of unique users per year: 28 (Q23)

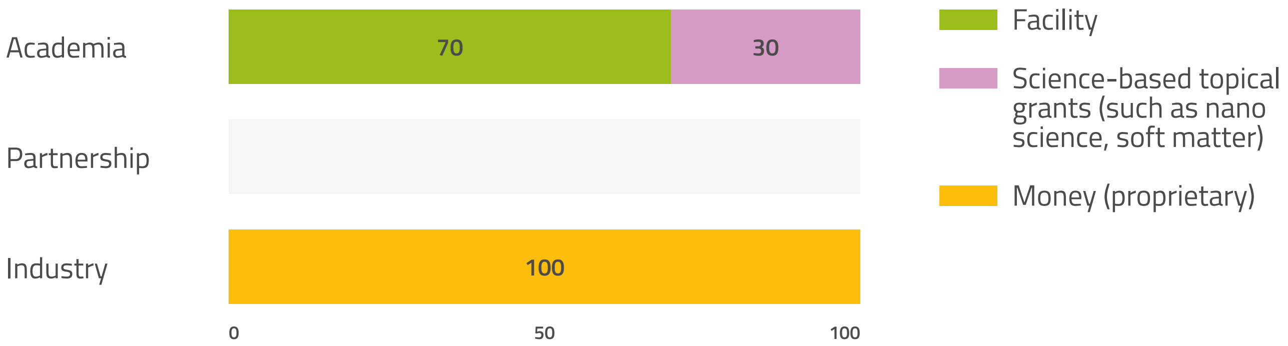
- Local users (no accommodation)
- Individual visitors (coming for a few days)
- Long-term visitors
- In-house users (including PhD)



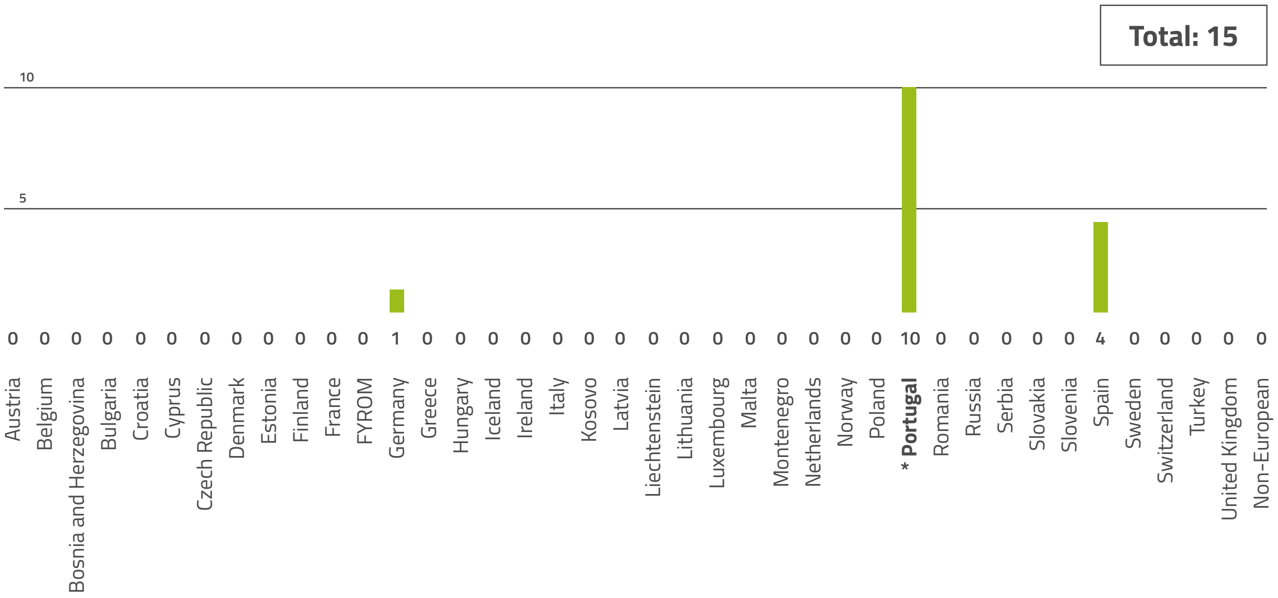
User type expressed as a percentage of beam time (Q15)

- Academia
- Industry (proprietary research)

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



Number of Principal Investigators (PIs) per country (Q24)

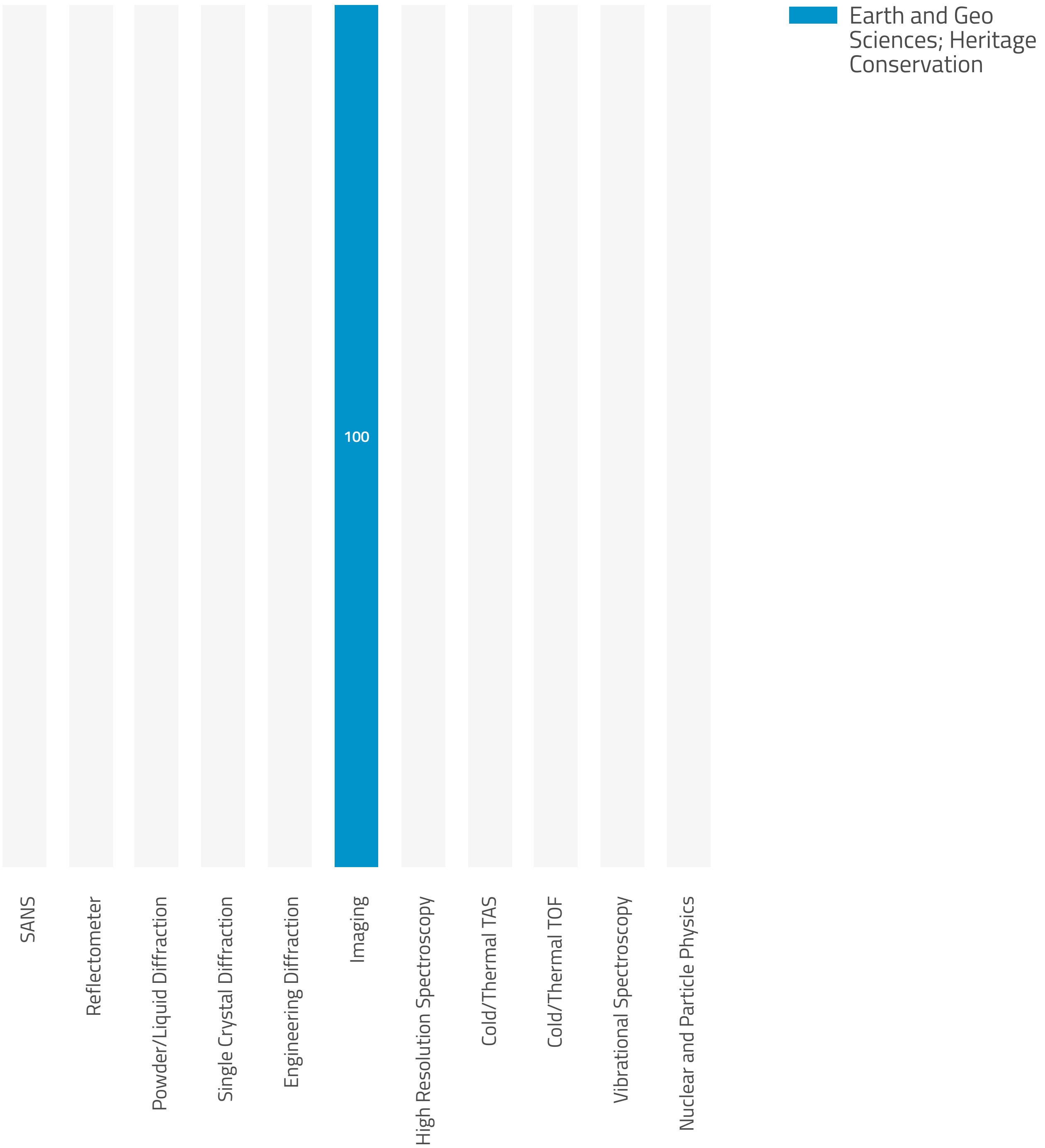


Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

Question not applicable

** Country where the facility is located. The figure includes RPI staff that have acted as a PI in a given research grant or activity.*

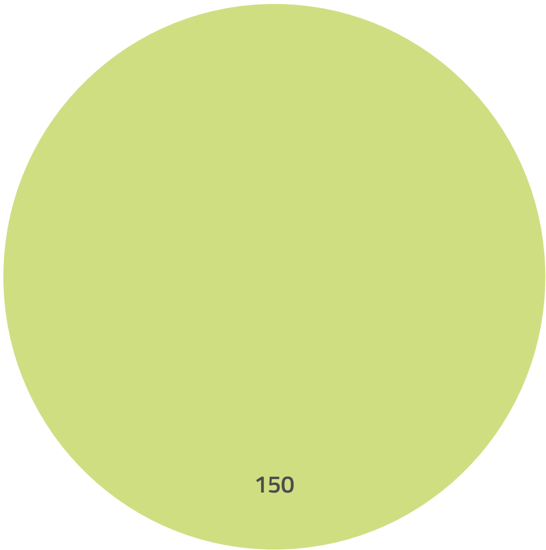
Science fields per method expressed as a percentage of beam time (Q14)



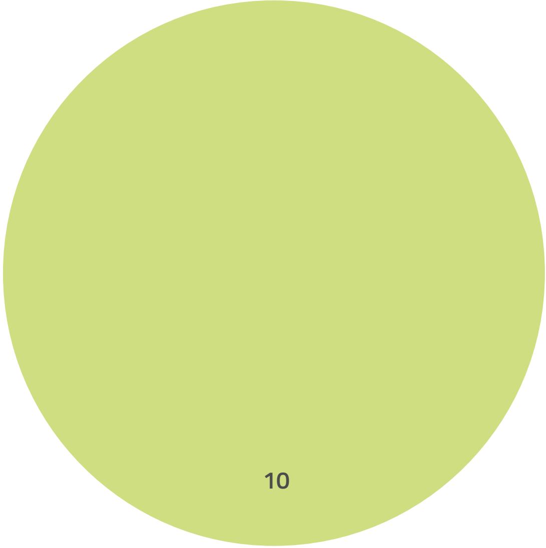
Methods with the highest industrial use were in core irradiation and mixed fields beam tube (Q16)

Number of instruments available for each method. Total: 1 (Q11)

Number of beam days available to users per method per year. Total: 150 (Q12)

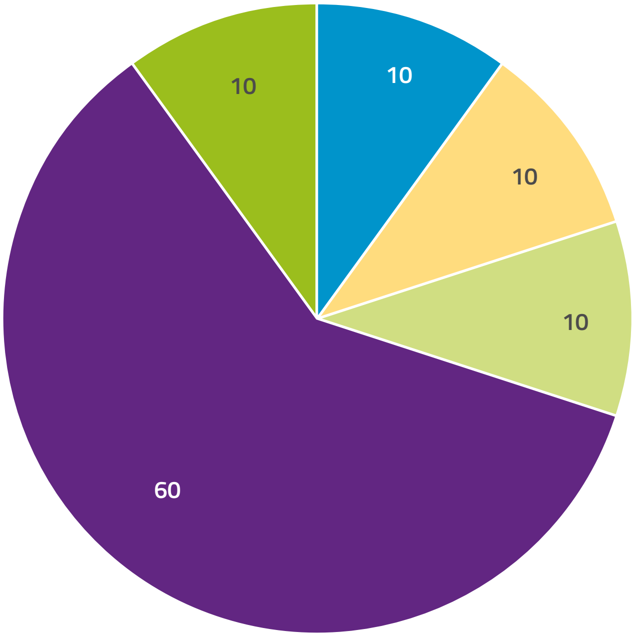


Number of experiments conducted per year using each method. Total: 10 (Q13)



Imaging

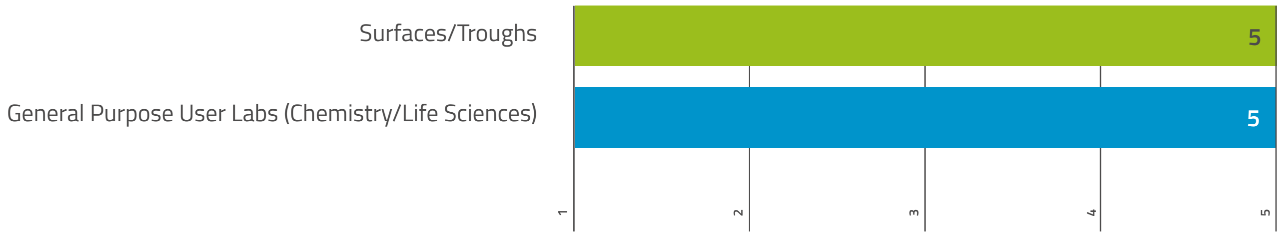
SCIENCE
AND METHODS



Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

Health
Food/Water
Energy
Climate/Environment
Fundamental Research

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 10



Q23

Between 2013 and 2015, RPI hosted 28 unique users on average every year. Approximately 54% (15) of them were in-house users, including PhDs. There was an equal number of local users (5) who did not need accommodation, and individual visitors (5) coming in for a few days. In addition, there were three long-term visitors. RPI did not have any remote users.

Q15

As much as 90% of the overall beam time at RPI was used by academia. The remaining 10% of beam time was used by industry for proprietary research.

Q20, Q21, Q22

While RPI contributed towards the costs covering its user programme for academia, the user programme for industry was fully funded by money for proprietary research. The contributions of RPI covered up to 70% of the costs of the user programme for academia. The remaining 30% of the programme was funded by science-based topical grants.

Q24

Between 2013 and 2015, 15 Principal Investigators on average submitted proposals to RPI every year. Almost 67% (15) of them were from Portugal, i.e. the country where the facility is located, and included RPI staff. Spain came second with four PIs and Germany followed with one PI.

Q25

PIs from three countries conducted research at RPI, i.e. Portugal, Spain, and Germany. Portugal is strong in materials, life sciences and engineering. While Germany is emerging in earth/geo/heritage, Spain is emerging in life sciences and engineering.

Q14

Methods with the highest industrial use at RPI were in core irradiation, and mixed field beam tube. All beam time dedicated to imaging was used for research in earth/geo science and heritage conservation (100%). RPI does not have any reflectometer or instruments for SANS, powder/liquid diffraction, single crystal diffraction, engineering diffraction, high resolution spectroscopy, cold/thermal TAS, cold/thermal TOF, or vibrational spectroscopy.

Q11, Q12, Q13

RPI has one imaging instrument and offered 150 beam days to users per year. Between 2013 and 2015, 10 imaging experiments were conducted at RPI on average per year.

Q19

Research carried out at RPI addressed several Horizon 2020 topics and challenges. As much as 60% of the research between 2013 and 2015 focused on climate/environment. Health, food/water, energy and fundamental research all had an equal share with 10%.

Q18

There are approximately five experiments carried out every year at RPI that require general purpose user laboratories for sample preparation and five experiments that require surfaces/troughs.

TU Wien, Atominstitut (ATI)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

TU WIEN, ATOMINSTITUT (ATI)

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	250 kW
Thermal neutron flux at 1.5 Å (average and peak)	5×10^{12} n/cm^{2}s, 5×10^{15} n/cm^{2}s
Cold neutron flux at 5 Å (average)	N/A
Operational days per year	200*
Total number of instruments	5
Number of instruments available to external users	5
Location	Vienna, Austria

PROFILE OF THE FACILITY

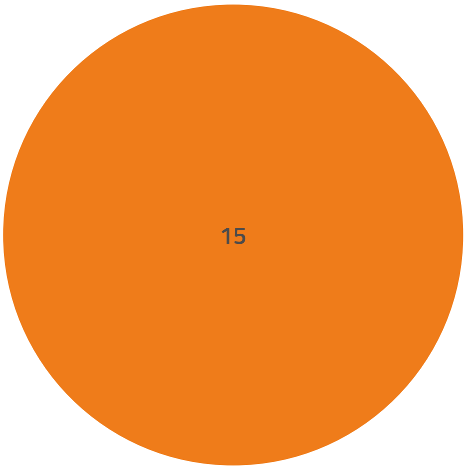
The Atominstitut (ATI) was established in 1958 as an inter-university institute, and in 1962 opened at its current location on the Prater with the commissioning of the TRIGA Mark II research reactor. As part of the reform of the university system, the Atominstitut was integrated in 2002 into the Faculty of Physics at the TU Wien and is now dedicated to today's broad range of research and education, ranging from very fundamental questions about symmetries and interactions in nuclear and particle physics to neutron, atomic and quantum physics, and quantum optics to radiation and reactor physics to applied tasks such as environmental monitoring, radiation protection or, for example, the radiation resistance of modern materials. A central facility thereby is the TRIGA Mark II research reactor and the connected teaching and research infrastructure, which allow us to educate and work with radioactive materials and ionising radiation. An important contribution thereby is the training of international experts for the International Atomic Energy Authority (IAEA). Currently, the Atominstitut has a scientific staff of 32, as well as 29 technical staff. In addition, third-party-funded project assistants (currently 75) have been increasing in number over recent years, which is important to be able to fulfil the research and training activities of the institute. In addition, the Atominstitut has about 70 students working on their bachelor, master, or doctoral theses. The educational opportunities offered by the institute cover all areas of research and are fully integrated into the curriculum of the Faculty of Physics.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

Average over 2013-2015

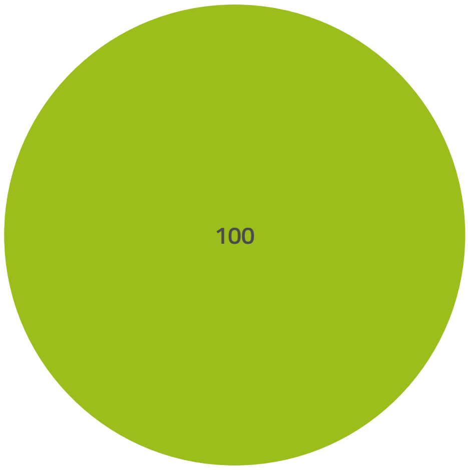
**Figure refers to a 7-hour working day. The research reactor is not on full power at all times. Approximately half of the time, it is on low power for training and education.*

USER COMMUNITY



Number of unique users per year: 15 (Q23)

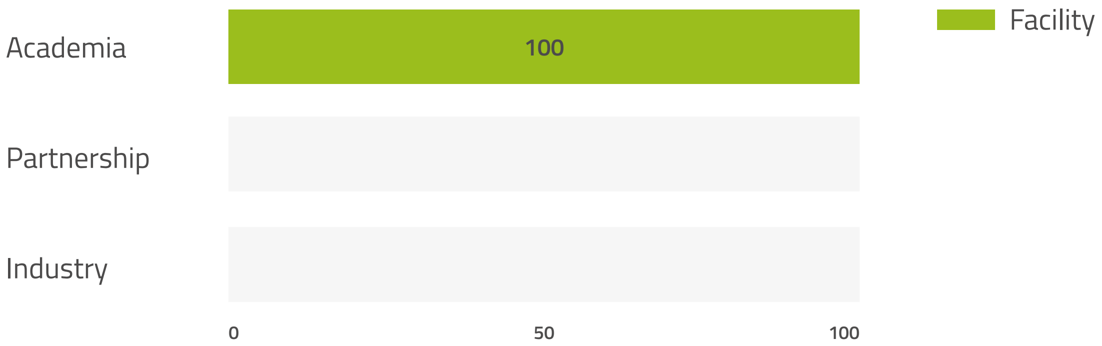
In-house users (including PhD)



User type expressed as a percentage of beam time (Q15)

Academia

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



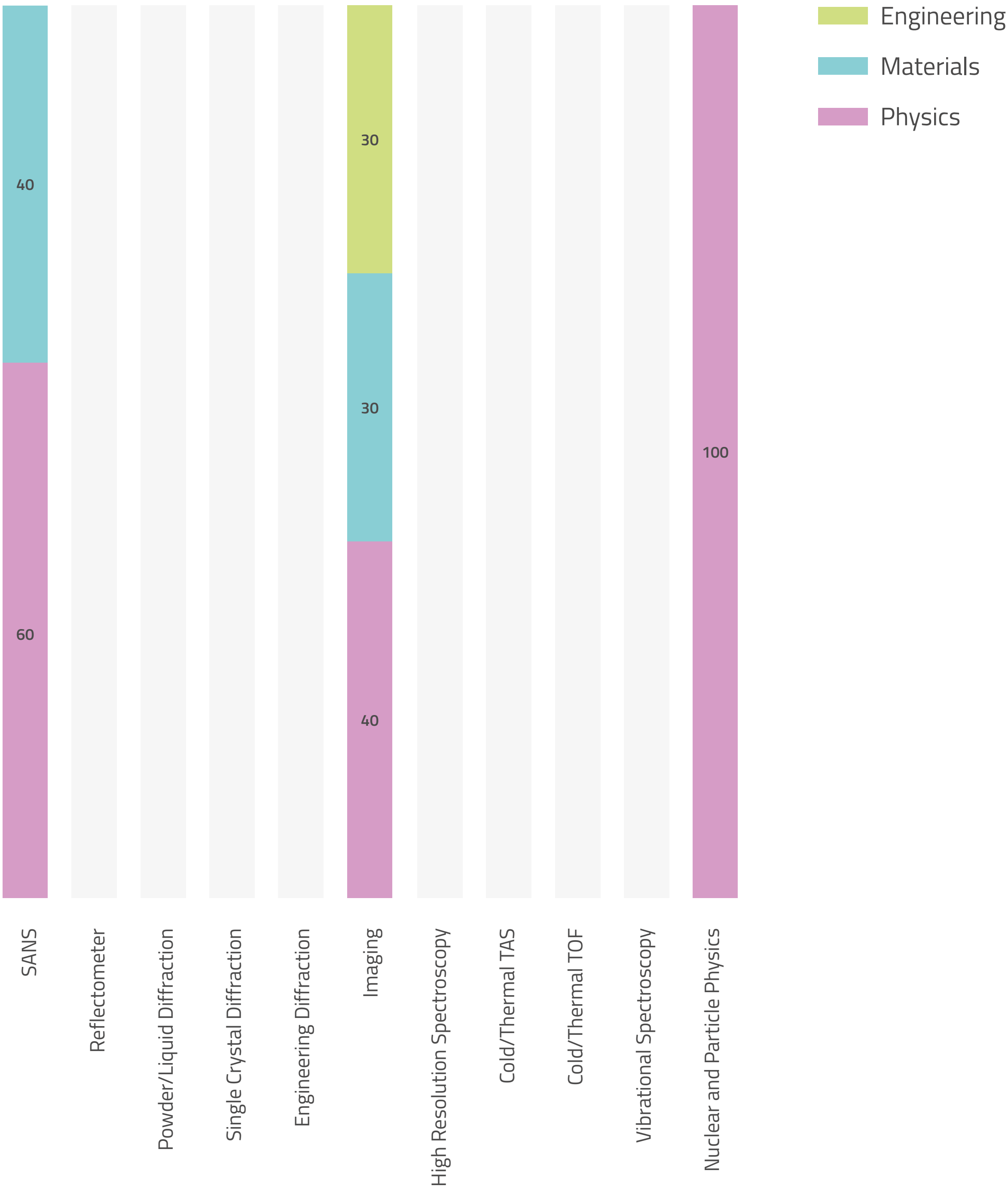
Number of Principal investigators (PIs) per country (Q24)

Question is not applicable
Atominstitut does not have any proposal system

Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

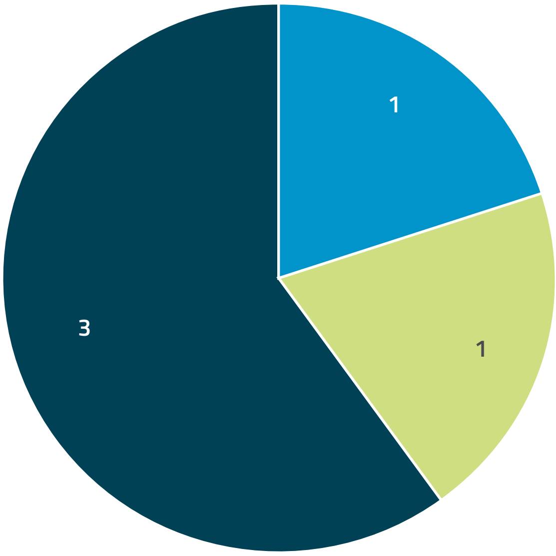
Question is not applicable
Atominstitut does not have any proposal system

Science fields per method expressed as a percentage of beam time (Q14)

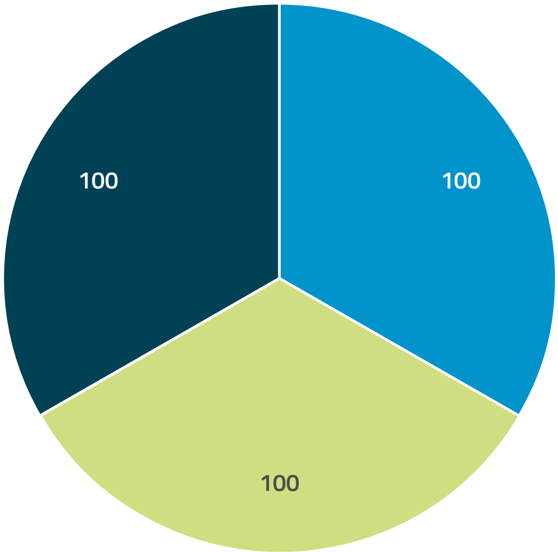


Question about methods with the highest industrial use not applicable (Q16)

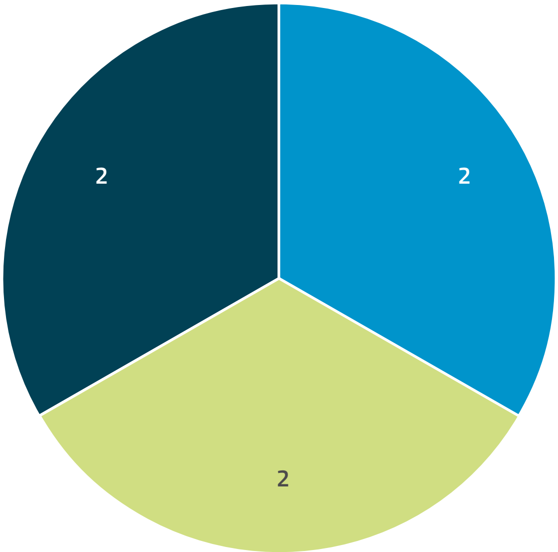
Number of instruments available for each method. Total: 5 (Q11)

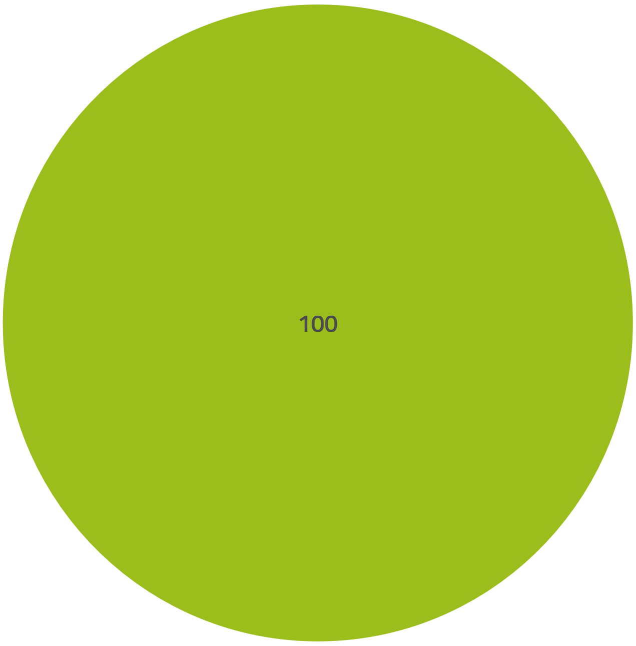


Number of beam days available to users per method per year. Total: 300 (Q12)



Number of experiments conducted per year using each method. Total: 6 (Q13)





Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

Fundamental Research

Number of experiments requiring the following sample environment equipment **and laboratories.** (Q18)
Total number of experiments as per Q13: 6

Q23
Between 2013 and 2015, ATI hosted 15 unique users per year on average. All of them were in-house users and included PhD students. ATI did not have any remote users, long-term visitors, visitors coming in for a few days, or local users without the need for accommodation. The facility does not run any proposal system.

Q15
The beam time available at ATI was fully allocated to research by academia. No proprietary research and no public research by academic-industrial partnerships was carried out at ATI.

Q20, Q21, Q22
ATI fully funds its user programme for academia, and covers 100% of all costs associated with the programme. It does not have any user programme for industry or partnerships. The facility does not run any proposal system.

Q24
Question not applicable. ATI does not have any proposal system.

Q25
Question not applicable. ATI does not have any proposal system.

Q14
Since ATI does not have any user programme for industry, the question about methods with the highest industrial use is not applicable. 60% of the beam time for SANS was dedicated to research in physics and the remaining 40% focused on materials. The imaging instrument was used for research in physics (40%), materials (30%), and engineering (30%). All beam time allocated for nuclear and particle physics focused on research in physics (100%). ATI does not have any reflectometer or instruments for powder/liquid diffraction, single crystal diffraction, engineering diffraction, high resolution spectroscopy, cold/thermal TAS, cold/thermal TOF, or vibrational spectroscopy.

Q11, Q12, Q13
The highest number of instruments (3) was available for nuclear and particle physics. The beam days available at ATI were equally split between small angle neutron scattering (100), imaging (100), and nuclear and particle physics (100). The number of experiments performed using each of these methods was the same and included two experiments in small angle neutron scattering, two imaging experiments, and two experiments in nuclear and particle physics.

Q19
All research carried out at ATI between 2013 and 2015 was fundamental research.

Q18
Four experiments carried out at ATI required magnetic fields as the sample environment.

NATIONAL CENTRE FOR NUCLEAR RESEARCH ŚWIERK

National Centre for Nuclear Research – MARIA

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

COVER PHOTO:
COURTESY OF NATIONAL CENTRE FOR NUCLEAR RESEARCH – MARIA

NATIONAL CENTRE FOR NUCLEAR RESEARCH – MARIA

FACILITY

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	30 MW
Thermal neutron flux at 1.5 Å (average)	10^{14} cm^{-2} s^{-1}
Cold neutron flux at 5 Å	N/A
Operational days per year	180
Total number of instruments	6
Number of instruments available to external users	4
Location	Otwock-Świerk, Poland

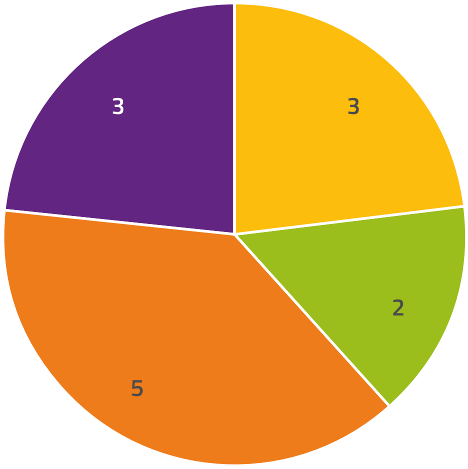
PROFILE OF THE FACILITY

MARIA is currently the sole research nuclear reactor operated in Poland. It is run by the National Centre for Nuclear Research. Its construction started in June 1970 in the then Institute of Nuclear Research in Świerk. MARIA became operational for the first time in December 1974. The main reactor applications include production of radioisotopes, testing of fuel and structural materials for nuclear power engineering, neutron transmutation doping of silicon, neutron modification of materials, research in neutron and condensed matter physics, neutron radiography, neutron activation analysis, neutron beams in medicine, and training in the field of reactor physics and technology.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

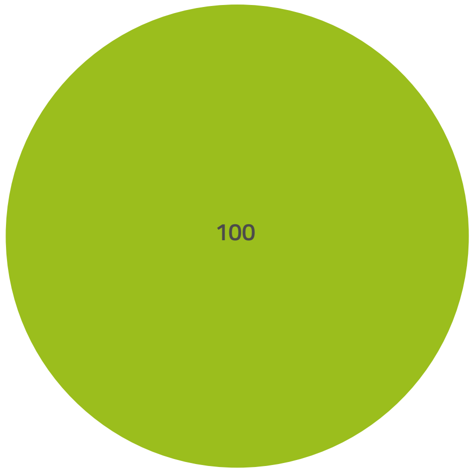
Average over 2013-2015

USER COMMUNITY



Number of unique users per year: 13 (Q23)

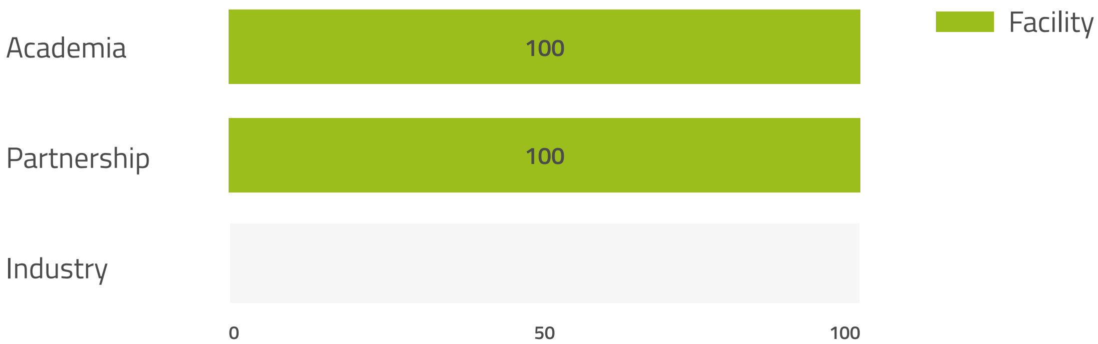
- Local users (no accommodation)
- Individual visitors (coming for a few days)
- In-house users (including PhD)
- Remote users/mail-in service



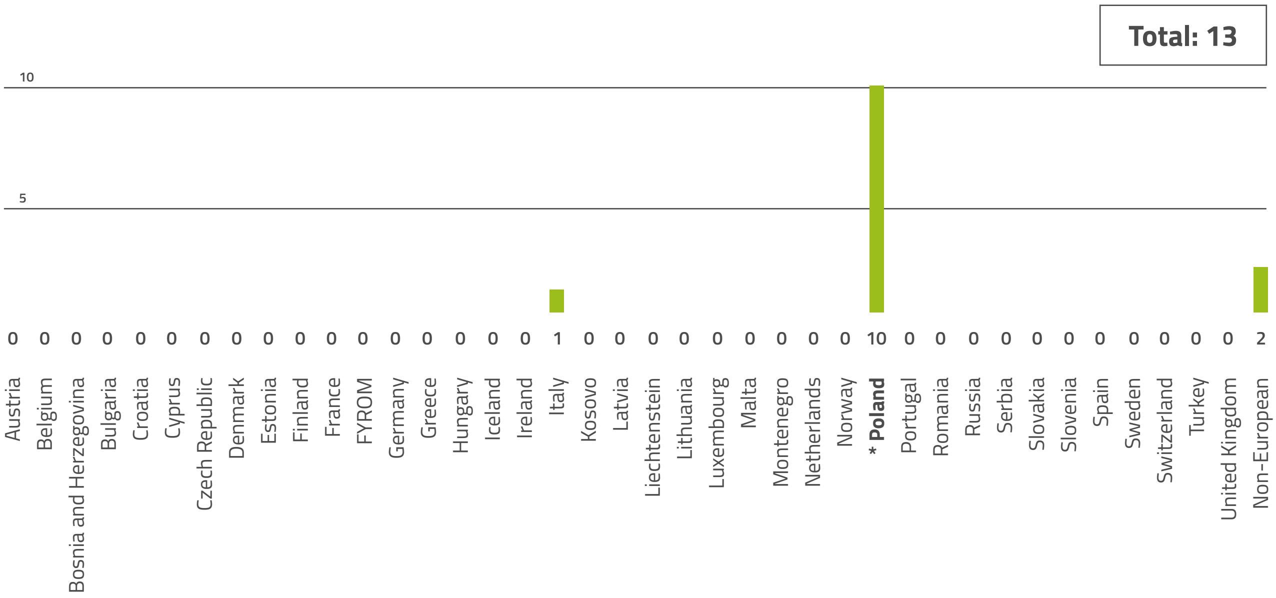
User type expressed as a percentage of beam time (Q15)

- Academia

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)



Number of Principal Investigators (PIs) per country (Q24)

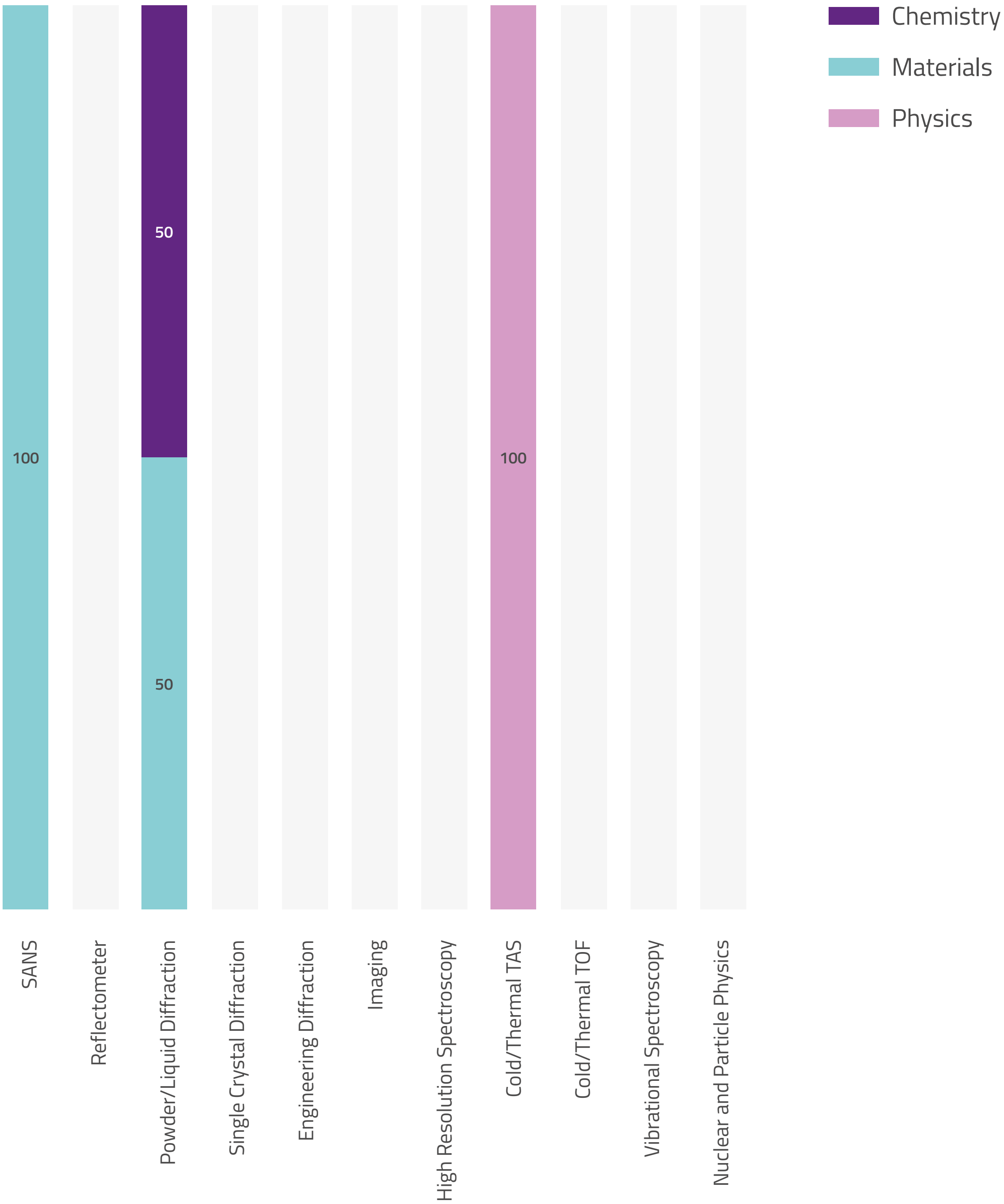


Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

Not applicable

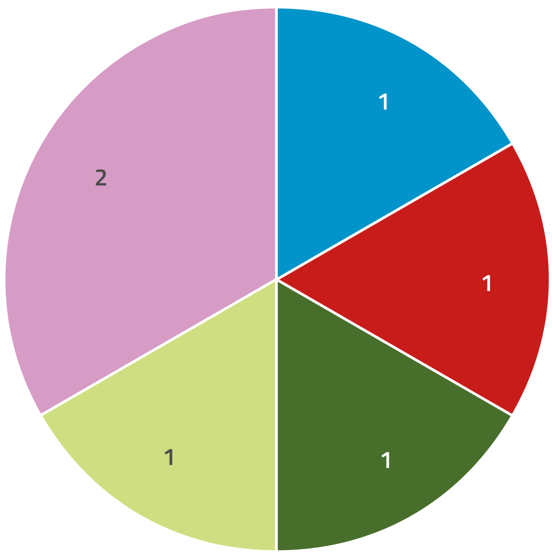
** Country where the facility is located. Figure includes MARIA staff.*

Science fields per method expressed as a percentage of beam time (Q14)

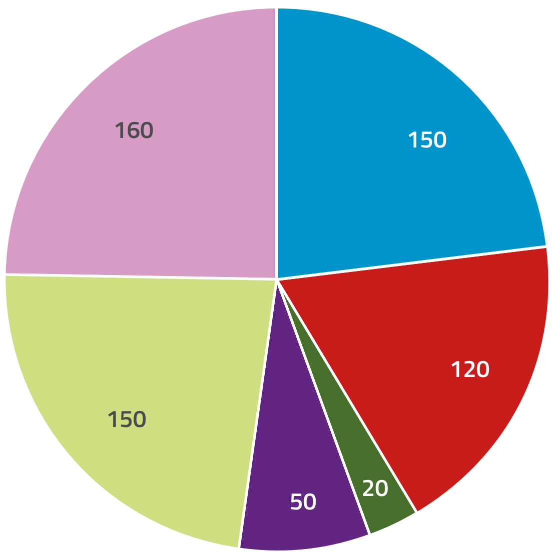


Question on methods with the highest industrial use is not applicable as MARIA does not have any user programme for industry (Q16)

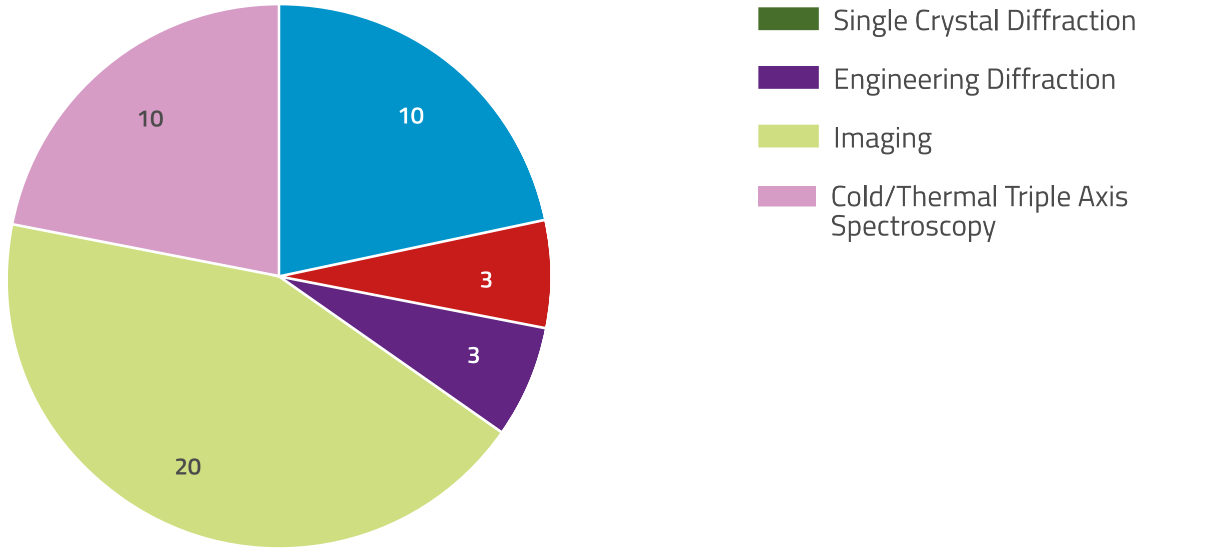
Number of instruments available for each method.* Total: 6 (Q11)



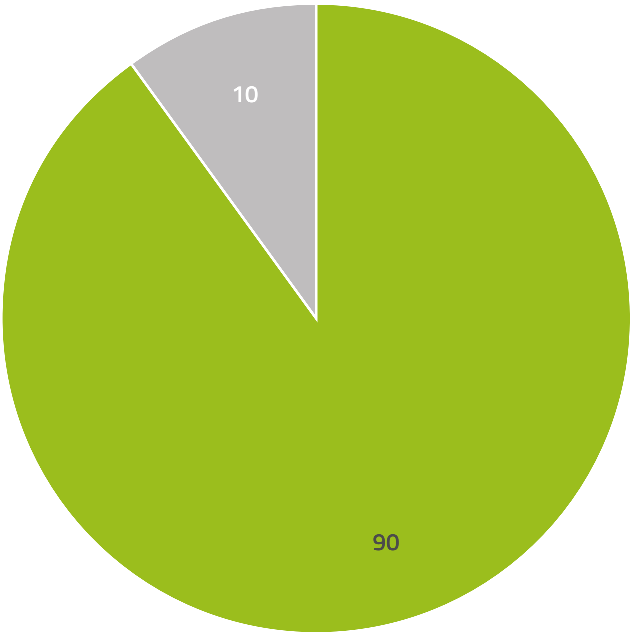
Number of beam days available to users per method per year. Total: 650 (Q12)



Number of experiments conducted per year using each method. Total: 46 (Q13)



** There is no instrument dedicated to engineering diffraction at MARIA. Nevertheless, a limited number of measurements have been performed in the field, on special request from Polish technical universities, using other instruments, i.e. powder/liquid diffraction, diffractometer, or TAS. The neutron radiography facility is used mainly for liquid migration in porous systems studies, 90% of which can be allocated as studies in chemistry. Only about 10% of beam time has been attributed to inspection of technical objects' internal arrangements.*

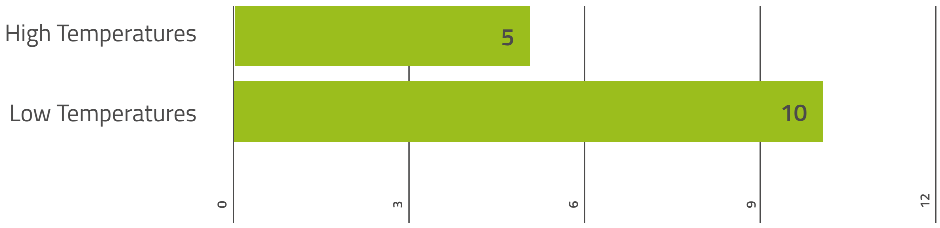


Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

Fundamental Research

Cultural Heritage*

Number of experiments requiring the following sample environment equipment and laboratories. (Q18)
Total number of experiments as per Q13: 46



** Extra category added by the facility*

Q23
Between 2013 and 2015, MARIA hosted 13 unique users per year, on average. Approximately 38% (5) of them were in-house users, including PhD students. There were equal numbers of local users who did not need accommodation and remote users who used the mail-in service (3). In addition, there were two individual visitors who came to MARIA for a few days.

Q15
During the last three years, MARIA, has only hosted users from academia.

Q20, Q21, Q22
The facility fully funded its user programmes for academia and partnership. MARIA did not run any programme for industry.

Q24
13 Principal Investigators, on average, submitted proposals to MARIA every year between 2013 and 2015. 10 (77%) of them were from Poland, i.e. the country where the facility is located, and included MARIA staff. There was one PI from Italy and two PIs from South Africa.

Q25
Question not applicable.

Q14
Since MARIA does not have any user programme for industry, information on methods with the highest industrial use is not available. 100% of beam time for SANS was used for materials. All beam time available for cold/thermal TAS was used for physics. The beam time available for powder/liquid diffraction was equally split between materials and chemistry. There is no instrument dedicated to engineering diffraction at MARIA. Nevertheless, a limited number of measurements have been performed in the field, on special request from Polish technical universities, using other instruments, i.e. powder/liquid diffraction, diffractometer, or TAS. The neutron radiography facility is used mainly for liquid migration in porous systems studies. 90% of the beam time is allocated for studies in chemistry. Only about 10% of the beam time has been attributed to inspection of technical objects' internal arrangements.

Q11, Q12, Q13
The highest number of instruments (2) and beam days (160) was available for cold/thermal triple axis spectroscopy. However, the highest number of experiments (20) per year concerned imaging. It can be concluded that experiments conducted with imaging were the shortest among all, and experiments conducted with powder/liquid diffraction were the longest.

Q19
The Horizon 2020 challenge and topic with the highest representation in research carried out at MARIA was fundamental research (90%). In addition, 10% of research at MARIA focused on cultural heritage.

Q18
10 experiments were performed in an low temperature sample envirmonment and five experiments in a high temperature sample environment.

Reactor Institute Delft (RID)

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.

FACILITY

REACTOR INSTITUTE DELFT

REACTOR INSTITUTE DELFT (RID)

FACTS AND GENERAL INFORMATION

Type of facility	Reactor
Power	2 MW
Thermal neutron flux at 1.5 Å (average and peak)	$3E13^{12}$ $cm^{-2}s^{-1}$
Cold neutron flux at 5 Å (average)	None yet
Operational days per year	200
Total number of instruments	9
Number of instruments available to external users	9*
Location	Delft, The Netherlands

PROFILE OF THE FACILITY

The Reactor Institute Delft (RID) is a knowledge centre on nuclear issues, is part of the Delft University of Technology, and operates a 2 MW reactor, neutron beam instruments, and irradiation facilities. In conjunction with the scientific department of Radiation Science and Technology (RST) of the faculty of Applied Sciences, RID accommodates resident and visiting scientists from a variety of scientific disciplines, educates students, professionals, and scientists on an academic and non-academic level, and serves as an independent source of information for society on radiation- and nuclear-related issues. The institute operates a suite of neutron and positron beam-line instruments, runs analytical techniques, such as neutron activation analysis, and develops and exploits a variety of irradiation facilities; the latter, for example, for R&D on isotope production.

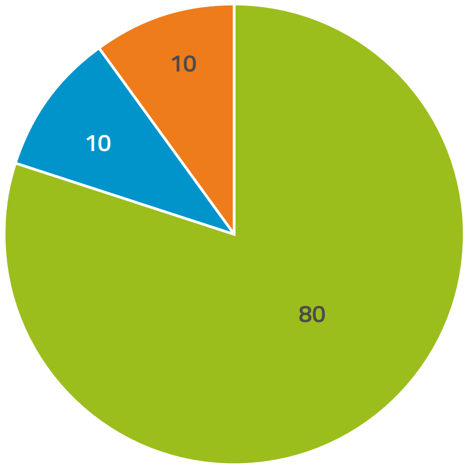
RID does not have any extensive user programme. The beam-line instruments mostly accommodate PhD projects from within the Delft University of Technology. Beam time use by external users through, for example, NMI3, is small, and the number of experiments accommodated for such external users is in the order of five per year. The Instrumental Neutron Activation Analysis (INAA) facilities are used externally more often. However, the larger context of the analyses performed is confidential.

TIMEFRAME FOR DATA PRESENTED IN THE SURVEY

Average over 2013-2015

** RID does not have any user programme*

USER COMMUNITY



Number of unique users per year Q23)

Question not applicable
RID does not have any user programme

User type expressed as a percentage of beam time (Q15)

- Academia
- Partnership (public research of academia but supported by industry)
- Industry (proprietary research)

Funding of user programme for academia, partnership, and industry (Q20, Q21, Q22)

Question not applicable
RID does not have any user programme

Number of Principal Investigators (PIs) per country (Q24)

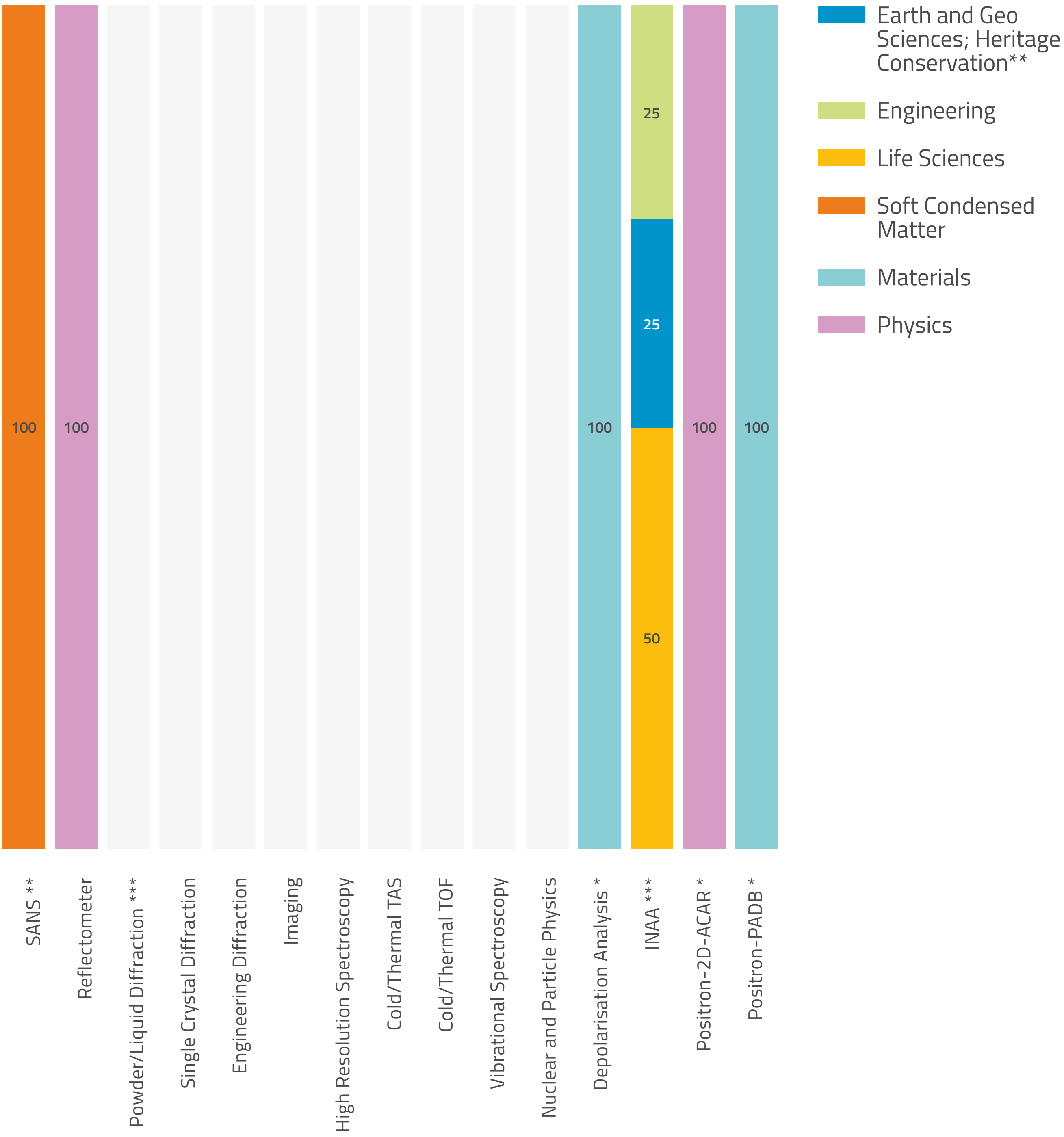
Question not applicable
RID does not have any user programme

Users from the three countries with the highest number of PIs assorted into the following categories: regular (many users, >20), emerging (few users, <5), no users. (Q25)

Question not applicable
RID does not have any user programme

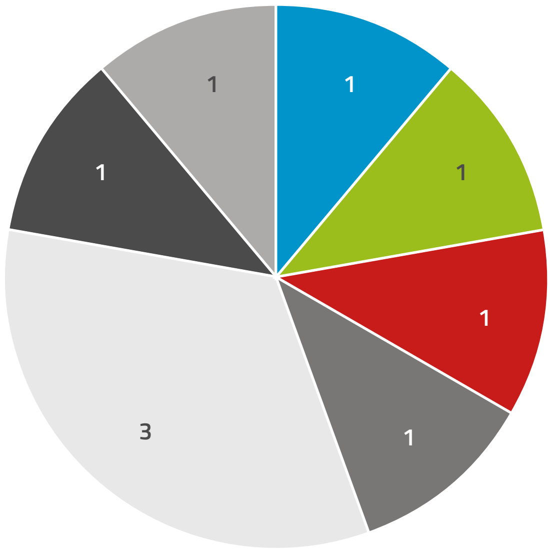
SCIENCE AND METHODS

Science fields per method expressed as a percentage of beam time (Q14)

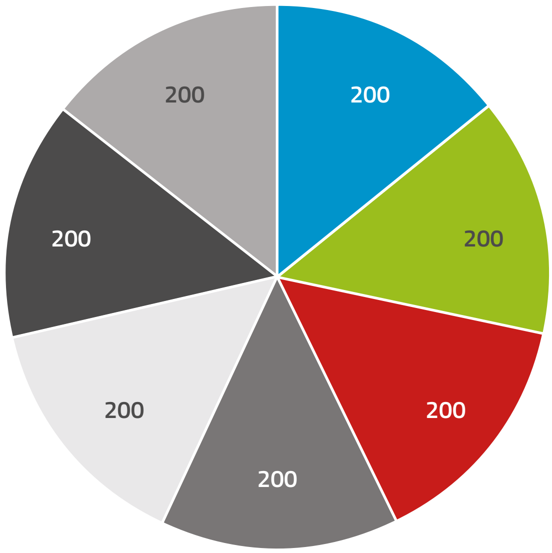


** Extra category added by the facility*
*** Methods with the highest industrial use (Q16)*
**** Data not available*

Number of instruments available for each method. Total: 9 (Q11)



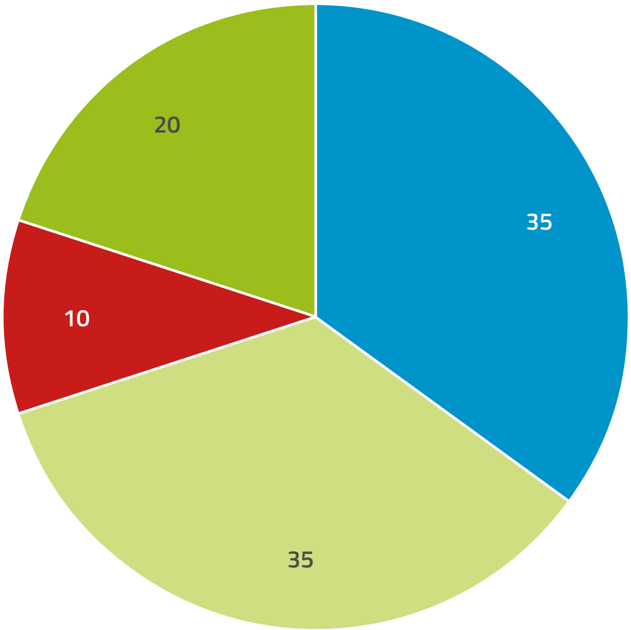
Number of beam days available to users per method per year. Total: 1400 (Q12)



Number of experiments conducted per year using each method. Total: 40 (Q13)

- Small Angle Neutron Scattering
- Reflectometry
- Powder/Liquid Diffraction
- Depolarisation Analysis*
- INAA*
- Positron-2D-ACAR*
- Positron-PADB*

** Extra category added by the facility*



Percentage of research that focuses on Horizon 2020 topics and challenges (Q19)

- Health
- Energy
- Security (soft security challenges such as terrorism, border security, cyber security etc.)
- Fundamental Research

Number of experiments requiring the following sample environment equipment and laboratories (Q18).

Question not applicable

Q23
Question not applicable. RID does not have any user programme.

Q15
Between 2013 and 215, 80% of the overall beam time at RID was allocated to users from academia. An additional 10% of beam time was used for public research of academia supported by industry. The remaining 10% was proprietary research carried out by industry.

Q20, Q21, Q22
Questions not applicable. RID does not have any user programme.

Q24
Question not applicable. RID does not have any user programme.

Q25
Question not applicable. RID does not have any user programme.

Q14
SANS and INAA were the two methods with the highest industrial use. RID does not have any instruments for single crystal diffraction, engineering diffraction, imaging, high resolution spectroscopy, cold/thermal TAS, cold/thermal TOF, vibrational spectroscopy, or nuclear and particle physics. Data on the usage of powder/liquid diffraction across science fields is not available. All beam time for SANS was used for research in soft condensed matter (100%). In a similar way, the reflectometer was only used for research in physics (100%). The depolarisation analysis instrument was solely used for research in materials (100%). However, the INAA instruments had a more diverse use across science fields. Half of the beam time for these instruments was used for research in life science (50%). The remaining beam time was equally split between engineering and earth/geo sciences and heritage conservation (25% each). While all beam time on positron-2D-ACAR was used for research in physics (100%), all beam time on positron-PADB was dedicated to materials research (100%).

Q11, Q12, Q13
The highest number of instruments (3) was available for INAA. The beam time at RID was equally split between seven different methods. Small angle neutron scattering, reflectometry, powder/liquid diffraction, depolarisation analysis, INAA, positron-2D-ACAR, and positron-PADB were each allocated 200 beam days. 40 INAA experiments were carried out at RID.

Q19
A substantial part of the research performed at RID addressed Horizon 2020 challenges and topics. Between 2013 and 2015, Horizon 2020 challenges with the highest representation were health (35%) and energy (35%). Research at the facility also addressed soft security challenges (10%). The remaining 20% focused on fundamental research.

Q18
Question not applicable.

Questionnaire for Research Infrastructures

brightness is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 676548.


SPALLATION SOURCE
NUCLEAR REACTOR
JEEP II
(KJELLER)
JRC
(PETTEN)
BER II
(BERLIN)
MARIA
(OTWOCK-ŚWIERK)
ISIS
(DIDCOT)
RID
(DELFT)
NPL
(ŘEŽ)
TRIGA JGU
(MAINZ)
LLB
(GIF-SUR-YVETTE)
ATI
(VIENNA)
MLZ FRM II
(GARCHING)
SINQ
(VILLIGEN)
BNC
(BUDAPEST)
TRIGA JSI
(LJUBLJANA)
ILL
(GRENOBLE)
RPI
(BOBADELA)
DEMOKRITOS
(AGIA PARASKEVI)

This survey is conducted within the scope of BrightnESS, a project in support of the European Spallation Source (ESS) funded within European Commission's Horizon 2020 Research and Innovation programme. The aim is to collect consolidated information about neutron users of research infrastructures in Europe, and identify scientific trends in the European neutron scattering community. Data will be collected and analysed by ESS and consequently shared with all participating research facilities, as well as made publicly available on the BrightnESS website. The information collected in this survey will also serve to plan tailored activities for the neutron user community in Europe, which is one of the target groups of anticipated outreach activities within BrightnESS.

Please return the completed questionnaire to ute.gunsenheimer@esss.se by 24th April 2016.

Budapest Neutron Centre (BNC), Hungary

Demokritos, Greece

Forschungs-Neutronenquelle Heinz Maier-Leibnitz Zentrum (MLZ FRM II), Germany

Helmholtz-Zentrum Berlin - BER II, Germany

Institute for Energy Technology - JEEP II, Norway

Institut Laue-Langevin (ILL), France

ISIS Neutron and Muon Source, United Kingdom

Joint Research Centre (JRC), Netherlands

Jožef Stefan Institute TRIGA Mark II Research Reactor (TRIGA JSI), Slovenia

Laboratoire Léon Brillouin (LLB-ORPHÉE), France

National Centre for Nuclear Research - MARIA, Poland

Nuclear Physics Laboratory (NPL), Czech Republic

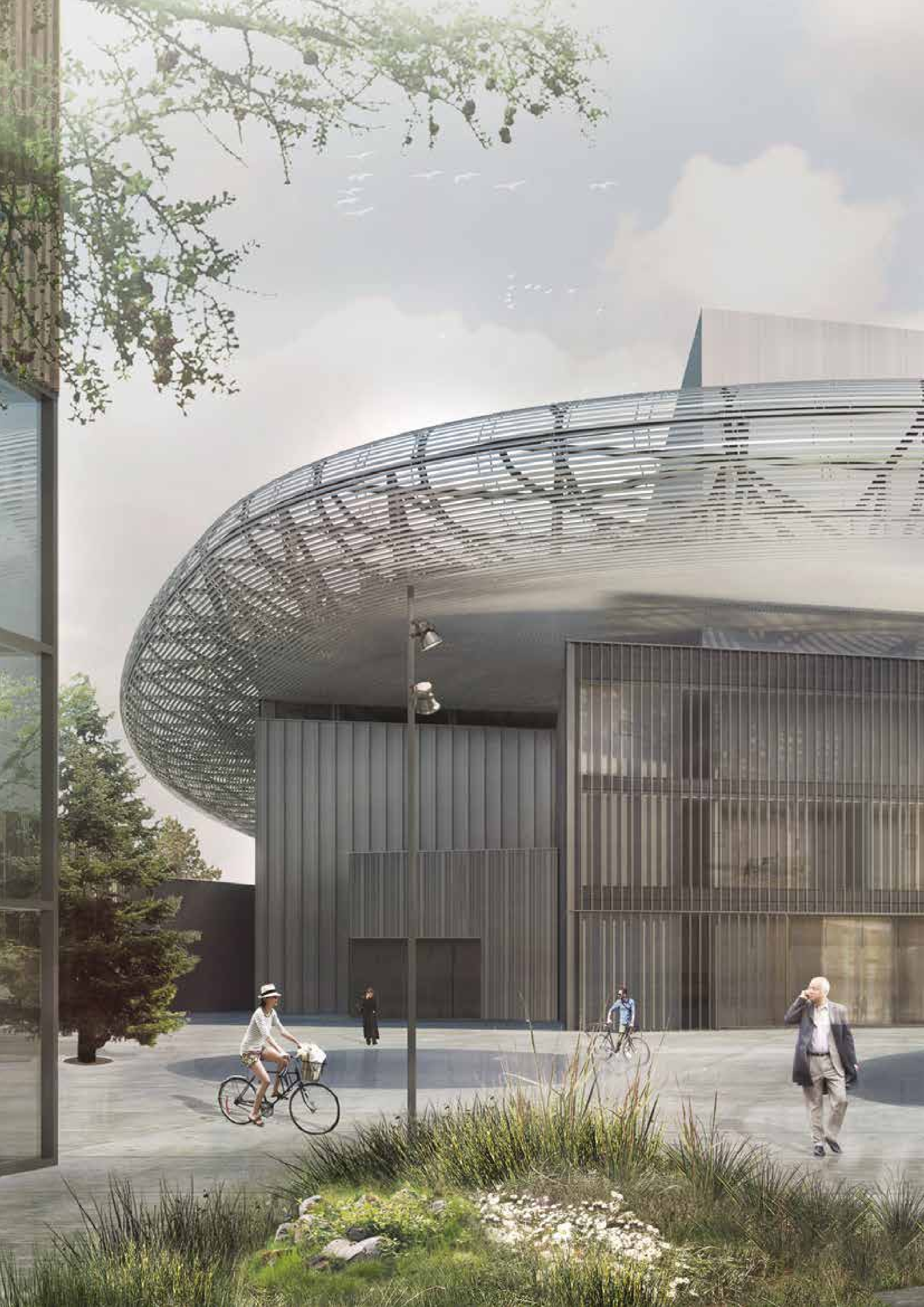
Portuguese Research Reactor (RPI), Portugal

Reactor Institute Delft (RID), Netherlands

Swiss Spallation Neutron Source (SINQ), Switzerland

TRIGA User Facility, Johannes Gutenberg-Universität Mainz (TRIGA JGU), Germany

TU Wien Atominstitut (ATI), Austria



A

FACILITY AND GENERAL INFORMATION

1. Name of facility:

2. Type of facility (reactor, spallation source, other):

3. Power:

4. Thermal neutron flux at 1.5 Å (average and peak):

5. Cold neutron flux[1] at 5 Å (average and peak):

6. Operational days per year:

7. Total number of instruments:

8. Number of instruments available to external users:

9. Profile of facility (please describe your facility and instruments for methods other than neutron scattering):

10. Timeframe for the information provided in this questionnaire (choose between: single year 2015, single year 2014, or average over 2013-2014-2015. Please provide any additional information regarding the selected timeframe in case of irregularities; e.g. number of cycles performed in the year etc.):

---

[1] *Please provide answer if applicable*

11. What is the number of instruments available for each of the following methods?

12. What is the number of beam days available to users per year for each of the following methods?

13. What is the number of experiments conducted per year using each method?

Method	Q11	Q12	Q13
Small Angle Neutron Scattering			
Reflectometry			
Powder/Liquid Diffraction			
Single Crystal Diffraction			
Engineering Diffraction			
Imaging			
High Resolution Spectroscopy			
Cold/Thermal Triple Axis Spectroscopy			
Cold/Thermal Time-of-Flight Spectroscopy			
Vibrational Spectroscopy			
Fundamental (Nuclear and Particle) Physics			

14. What is the proportionate representation (expressed as a percentage of beam time) of each scientific field? Please provide an answer for each method.

Method	Physics	Materials	Chemistry	Soft Condensed Matter	Life Sciences	Engineering	Earth & Geo Sciences; Heritage Conservation
SANS							
Reflectometer							
Powder/ Liquid Diffraction							
Single Crystal Diffraction							
Engineering Diffraction							
Imaging							
High Resolution Spectroscopy							
Cold/Thermal TAS							
Cold/Thermal TOF							
Vibrational Spectroscopy							
Fundamental (Nuclear and Particle) Physics							

15. What is the proportionate representation of each user type at your research infrastructure expressed as a percentage of beam time?

User type	Q15
Academia	
Partnership (public research of academia but supported by industry)	
Industry (proprietary research)	

16. What are the three methods with the highest industrial use (provide a percentage of beam time)?

17. What are the three methods with the lowest industrial use (provide a percentage of beam time)?

18. What is the number of experiments requiring the following sample environment equipment and laboratories?

Sample environment and labs	Q18
Low Temperatures	
High Temperatures	
Magnetic Fields	
High Pressure	
Mechanical Processing	
Gas Handling	
Liquid Handling	
Surfaces/Troughs	
General Purpose User Labs (Chemistry/Life Sciences)	
Deuteration and Macromolecular Crystallisation Support	

19. What percentage of research at your research infrastructure is focused on the following Horizon2020challenges?

Horizon 2020 challenge	Q19
Health	
Food/Water	
Energy	
Transport	
Climate/Environment	
Security (soft security challenges such as terrorism, border security, cyber security, etc.)	
Fundamental Research	
Other	

20. What percentage of your user programme for academia is funded through:

21. What percentage of your user programme for partnerships is funded through:

22. What percentage of your user programme for industry is funded through:

User programme funded through	Q20	Q21	Q22
Facility			
Umbrella organisations or national partnerships (CRGs)			
Neutron-based grants (such as NMI3)			
Science-based topical grants (such as nano science, soft matter)			
Feasibility studies (such as SINE2020)			
Money (proprietary)			

D

USERS

23. What is the number of unique users in the following categories per year?

User category	Q23
Local users (no accommondation)	
Individual visitors (coming for a few days)	
Long-term visitors	
In-house users (including PhD)	
Remote users/mail-in service	

24. What is the number of Principal Investigators (PIs), i.e. the main/first author of a proposal, per country? Please provide data for all nationalities.

Country	Number	Country	Number
Austria		Lithuania	
Belgium		Luxembourg	
Bosnia and Herzegovina		Malta	
Bulgaria		Montenegro	
Croatia		Netherlands	
Cyprus		Norway	
Czech Republic		Poland	
Denmark		Portugal	
Estonia		Romania	
Finland		Russia	
France		Serbia	
Germany		Slovakia	
Greece		Slovenia	
Hungary		Spain	
Iceland		Sweden	
Ireland		Switzerland	
Italy		The former Yugoslav Republic of Macedonia	
Kosovo		Turkey	
Latvia		United Kingdom	
Liechtenstein		Other	

25. Please assort PIs from each country into one of the following categories: regular (many users), emerging (few users), no users. Please provide data for at least three countries with the highest number of users (ref. Q23). Please provide an answer for every science field per country.

COUNTRY 1: Enter country name	**Regular (many users, >20)**	**Emerging (few users)**	**No users**
Physics			
Materials			
Chemistry			
Soft Condensed Matter			
Life Sciences			
Engineering			
Earth/Geo/Heritage			

COUNTRY 2: Enter country name	**Regular (many users, >20)**	**Emerging (few users)**	**No users**
Physics			
Materials			
Chemistry			
Soft Condensed Matter			
Life Sciences			
Engineering			
Earth/Geo/Heritage			

COUNTRY 3: Enter country name	**Regular (many users, >20)**	**Emerging (few users)**	**No users**
Physics			
Materials			
Chemistry			
Soft Condensed Matter			
Life Sciences			
Engineering			
Earth/Geo/Heritage			

Please copy the table if needed

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