

SECTION 3: NATURE OF USE OF SYNCHROTRON X-RAY AND NEUTRON FACILITIES

This section provides an overview of the user's perspective on synchrotron X-ray facilities and neutron scattering facilities. It outlines how user programs are typically organized today, and it also provides a brief history of user programs at both types of facilities.

3.1. User Programs Today

3.1.1 Proposal Programs

The most common way for a user to obtain access to a facility to conduct an experiment is by submitting a written proposal to the facility. The user typically submits a proposal to conduct a specific experiment on a given beamline or instrument for a fixed number of days. All 32 synchrotron X-ray and neutron facilities responding to the questionnaire (see Section 4) operate proposal programs for their user communities. The percentage of total beamtime allocated through the proposal program at a particular facility ranges from 60% to 100%.

Typically, facilities hold a call for proposals with a specific due date two to four times a year. This call is today sent out by electronic mail to a wide range of individual users, institutions, and user societies. The call is also posted on the facility web site.

In response to the call, proposals are submitted to the facility via the web. The proposals are reviewed by a committee (often termed the Program Advisory Committee or PAC) made up entirely or predominantly of scientific peers from outside the facility. To supplement the review by the PAC, the proposals may also be reviewed by individual scientists from outside the facility who provide a written report. There is also an internal review of proposals for feasibility and safety by facility scientists.

Proposals are then ranked on the basis of scientific merit, effective use of the facility/instrument time, and experimental feasibility. Recommendations for beamtime are made based on the ranking and the amount of time requested compared to the amount of time available on the instrument and the number of highly rated proposals. If a proposal does not receive beamtime, feedback about the unsuccessful proposal is provided to the applicant. The feedback ranges from comments on the science to information on the level of competition for a particular instrument.

Some facilities reserve a portion of time (10-15 % of the total time available) that is awarded to proposals (formal or informal) received between formal proposal calls and for exceptional cases that merit exceptional access. This time is often denoted "Director's Time."

At all but two of the facilities responding to the survey, all proposals--independent of origin--go through the same review process. Once the proposal is ranked on the basis of scientific merit, other factors may come into play in the actual award of beamtime. These factors may include the national origin of the proposal, the presence on the scientific team of at least one collaborator who is a resident in the country (or in one of the member countries of the consortium that funds the facility), and the level of support of the proposal by the local contact at the facility. These factors are discussed in Section 4 ("Responses to Questionnaire to Synchrotron X-ray and Neutron Facilities") and in Section 6.1 ("Basic Access Policies").

In order to disseminate information about a particular facility and the opportunities available at that facility, informational sessions and/or booths are often set up at international, national, and local scientific meetings. Facilities also organize summer and/or winter schools and workshops for new users.

Prior to submitting a proposal, the potential user should always contact the instrument scientist at the facility responsible for the instrument they have an interest in using. One of the main roles of the instrument scientist is to guide users and assist in the eventual experiment. Contact with the instrument scientist is particularly important for new users and for scientists who are expert in their field of research but not in the use of X-rays or neutrons. For example, the user may be unaware of the optimum way to conduct the experiment, which instrument is best suited to the scientific goal, or even if X-rays or neutrons are the most appropriate tools. The instrument scientist can outline what is required to make successful measurements and how the user should prepare for the experiment. Many times, particularly for new users, the instrument scientist can advise on how to write a winning proposal.

The instrument scientist plays a critical role in scientific access to major facilities. The individual who serves effectively in this role must be a research-active scientist able to understand the goals of the user. He or she must have sufficient time to listen to the user with care. The development of a genuine collaboration between the instrument scientist and the users is the ideal situation for producing the best science. The role of instrument scientist will be increasingly important as the user base expands and as scientists who know little about the facilities or the details of a given technique constitute a larger fraction of the total users.

3.1.2 Participating Research Teams

In addition to the process of submitting a proposal, access can also be obtained by building and operating a specific beamline or instrument at a facility. Essentially, a group or institution creates a "Participating Research Team" (PRT) that funds and largely constructs and operates an instrument. PRTs are also called Collaborating Access Teams (CATs) and when we use PRT we include

CATs with the two terms used interchangeably. (In Europe, this team is often denoted a “Collaborating Research Group” or CRG.) PRTs enable the facility to expand the number of beamlines and instruments beyond the number that the facility by itself is able to fund and operate.

Typically, 20% of beamlines or instruments at facilities are constructed by PRTs. However, there is a wide variation in this percentage among facilities and some facilities (e.g., ISIS) do not have PRTs. Because PRTs operate outside the proposal review system, they offer flexible access to PRT members. The PRT is typically allowed to allocate, within the team, 2/3 of the overall time on the PRT instrument.

In recent years, the attitude within the scientific and funding communities about PRTs and CRGs has been mixed. PRTs are currently somewhat out of favor within the US Department of Energy as a result of some specific disadvantages which are discussed in section 6.3.2. However, CRGs at the ESRF are regarded as very successful. As further discussed in Sections 6.1.2 and 6.3.2, CRGs at the ESRF must be constructed and operated within clearly specified guidelines and are subject to review.

3.1.3 Collaboration with Instrument Scientists

In addition to the proposal process and PRTs, a third way to obtain access at a major facility is by collaborating directly with the facility’s instrument scientists. The instrument scientists may have time allocated to them (perhaps 20 % of facility beamtime) or may be able to submit proposals through a separate channel.

3.1.4. Evolution of Access for Users

Historically, use of synchrotron X-ray and neutron facilities in the US has evolved in the following sequence:

- (1) Initially, use was by national laboratory scientists directly associated with the facility plus their collaborators in the university or industrial community;
- (2) Subsequently, use included groups of scientists from outside the facility who developed and managed certain instruments or beamlines with varying degrees of assistance from the facility. (This approach has evolved into the PRTs of today.); and
- (3) General user programs open to all members of the scientific community, with the requirement to submit proposals for specific experiments which are reviewed as noted above in Section 3.1.1.

The percentage of beamtime allocated via these three modes of access was determined by historical circumstances relating to the interest and expertise available in the general scientific community, and by the funding situation in which the facilities have found themselves. All three modes have their

advantages and disadvantages (some of which are discussed in Section 6), but all three have proven capable of delivering first-class science.

Mode (1) was the first mode, used when major facilities were first established, particularly in the area of neutron scattering. In the early stages, the expertise with, familiarity with, and interest in these types of experiments existed only among a few university and industrial groups outside the facilities. Because mode (1) entailed the use of the facilities by experts in the field, who were also responsible for developing the field, it led to first-rate, pioneering, and sophisticated science. It also led to an increased awareness of the importance of the scientific potential of these facilities among the scientific community.

Mode (2) allowed expert groups outside the facility to have more formal and guaranteed access. This access was often with new instruments, because the instruments involved were not primarily the creations of the facility scientists. Via mode (2), the suite of instruments at a facility could be expanded beyond the number that the facility could support. In this approach, industrial scientists were drawn to use the facilities in an expanded and more systematic way than before. It also allowed expert scientists in the outside community more freedom to be innovative in the development of new techniques and new types of experiments.

Mode (3) began to be generally used when the scientific community became aware of the importance of these types of experiments and the use of the instruments reached threshold values. Mode (3) was perceived as the most democratic or “fair” method of access to the greatest number of scientists, and thus believed to have the capability of producing the largest quantity of good science. It was also free of the perception of the field being dominated or run by an “old boy” network or cronyism.

Currently, most national and international facilities utilize varying combinations of modes (2) and (3). They use mode (1) only in the initial phases of a new facility.

3.2. History of User Programs at Synchrotron X-ray Facilities

Synchrotron radiation owes its origin to high-energy physics research programs. The development of storage rings provided a major advance in the production of usable radiation as compared to synchrotron sources and led to the development of the first dedicated multi-user facility for synchrotron radiation for soft X-rays in 1968 – the TANTALUS-1 facility at the University of Wisconsin, Madison. This was followed by the development of synchrotron-radiation work on soft X-rays at storage rings in Orsay, France; at SURF-II (Synchrotron Ultraviolet Radiation Facility) at the National Bureau of Standards (NBS) in Gaithersburg, Maryland (NBS is now known as the National Institute of Standards and Technology or NIST); and in Japan. Hard X-ray storage ring sources came on line in the 1970s with the 2.5 GeV SPEAR ring (Stanford Positron Electron Accelerating Ring) on SLAC (Stanford Linear Accelerator Center) at Stanford

University; DORIS on the DESY synchrotron in Hamburg; at Orsay, France; at Novosibirsk, Russia; and the CHESS facility (Cornell High-Energy Synchrotron Source) at Cornell University. These hard X-ray synchrotron sources were, however, not dedicated to the production of synchrotron radiation but, rather, were operated in a parasitic mode with high-energy physics experiments as the primary goal. These facilities have become known as the “first-generation synchrotron sources.”

In the 1970s, as the first pioneering researchers in solid state physics, atomic physics, and crystallography began to realize the enormous potential of intense beams of X-rays for their research, the demand grew for sources dedicated to synchrotron radiation research. The growing demand in the United States was documented by a 1976 National Research Council study from “The Panel to Assess the National Needs for Facilities Dedicated the Production of Synchrotron Radiation.” This study noted an increasing imbalance between demand for synchrotron radiation and its availability. In response to this demand, two dedicated storage ring-based synchrotron radiation sources were constructed in the early 1980s at Brookhaven National Laboratory (the National Synchrotron Light Source (SLS) Soft X-ray and Hard X-ray rings). In addition, a new 1 GeV storage ring at Madison, Wisconsin was commissioned to replace TANTALUS-I. Similar considerations abroad led, during the same period, to the commissioning of other dedicated sources such as the Synchrotron Radiation Source (SRS) at Daresbury, England; the Laboratoire pour l’Utilisation du Rayonnement Electromagnetique (LURE) facility at Orsay, France; the Photon Factory in Tsukuba, Japan, which was founded as a facility for University researchers to carry out experiments using synchrotron radiation ; and the Berliner Elektronenspeicherring-Gesellschaft fur Synchrotronstrahlung (BESSY) soft X-ray facility in Berlin, Germany. These so-called “second-generation synchrotron sources” were dedicated to the production of synchrotron radiation primarily from the bending magnets of the storage ring.

Meanwhile, driven by the same demand, some of the first-generation facilities gradually evolved toward second-generation status by means of upgrades and agreements with laboratory managements to dedicate a fraction and sometimes all of the yearly machine operations to synchrotron radiation as the high-energy physics frontiers advanced. This resulted in the establishment of Stanford Synchrotron Radiation Laboratory (SSRL) at SLAC at Stanford and Hamburger Synchrotronstrahlungslabor (HASYLAB) at Deutsches Elektronen-Synchrotron (DESY) in Hamburg. All these second generation facilities established user programs with various combinations of systems involving a Program Advisory Committee which allocated beamtime for general users, and Participating Research Teams (PRTs) who managed the greater share of time on their own beamlines.

Because X-rays and UV sources as research tools had been familiar to scientists for over half a century, the use of soft and hard X-rays for spectroscopy and

crystallography had a natural constituency in the large community of researchers who carried out similar studies on more modest scales at their own laboratories. The power of hard X-rays as a tool for protein crystallography rapidly began to become apparent to the life sciences community. Similarly, the enormous possible improvements in small angle X-ray scattering experiments began to be realized by the materials science, soft condensed matter, and chemistry communities. Finally, the more esoteric X-ray scattering experiments on condensed matter were rapidly embraced by the community of people who had been carrying out similar studies using neutron scattering from the 1960s onwards.

In this period (roughly 1975 to 1995), the number of synchrotron source users grew into the thousands, spread across many disciplines at the various synchrotron facilities, enabled by the large number of available beamlines and the rapid turnaround times resulting from the high intensities of the X-ray beams. Thus, the synchrotron sources developed inevitably as user facilities instead of as facilities in which a small group of researchers dominated their use for a narrow field of scientific research.

Nevertheless, the initial (and often later) periods of these sources were dominated by teams of pioneering researchers in some of these fields who had the expertise and skill to exploit usefully the new capabilities, known as Participating Research Teams (PRTs) or Collaborative Access Teams (CAT's). (We will use the terms PRT and CAT interchangeably.) These PRTs were dedicated to research spread out over several fields and techniques.

Over time, the formal dedication of the largest fraction of beamtime has shifted gradually from the PRTs to the general individual user. This continuous and still-ongoing process is driven, in part, by financial considerations as the cost of constructing and maintaining beamlines has become ever more expensive.

In the 1980s, driven by the ever-growing demand for beamtime from the above communities and the recognition of the need for higher brightness to carry out research at the cutting edge, the construction of a new generation of dedicated synchrotron X-ray sources was recommended by the Seitz-Eastman Panel of the National Research Council. These insertion-device based sources, with increases in the brilliance of the X-ray beams by many orders of magnitude, were constructed in the US in the 1990s as the Advanced Photon Source (APS) at Argonne National Laboratory, primarily for hard X-rays, and the Advanced Light Source (ALS) at Lawrence Berkeley Laboratory, primarily for soft X-rays. Similar sources were commissioned in Europe (the ESRF at Grenoble, France) and in Japan (the Super Photo Ring – 8 GeV (SPring-8) facility at Harima, Japan). Later, these were joined by the Swiss Light source (SLS) in Villigen, Switzerland, MAX-II in Lund Sweden and BESSY-II in Berlin. These are the “third-generation synchrotron sources.”

The U.S. synchrotron facilities currently attract over 8,000 users per year on the average, among whom the protein crystallographers are perhaps the most rapidly growing community. The numbers are similar for Europe and Japan. The facilities each have a mix of PRTs (CATs) and general user programs, but cannot by any means be said to be dominated by any one group of users or in-house scientists. Upgrades of existing second-generation facilities and construction of new synchrotron facilities around the world have, by now, resulted in a number of third-generation synchrotron X-ray facilities in Europe and the United States. At the same time, less brilliant synchrotron sources have been, or are being, constructed in several other countries around the world.

It is interesting to note that machines originally built for particle physics research have evolved to serving very different communities of scientists, such as condensed matter scientists, materials scientists, chemists, geologists, and, increasingly, biologists. To some extent this has driven a certain degree of separation between those who run the accelerators, those who develop and maintain the instrumentation on the beamlines, and those who carry out the scientific research. The latter group, as it grows, will most probably increasingly consist of those who are more interested in the results pertaining to their scientific interests than in the subtleties of the instrumentation or the scattering techniques. This may lead to problems in the future unless scientists coming into the field are exposed to a broad education on all aspects of this endeavor.

Future X-ray sources will be of three types:

- Storage Rings with optimized capabilities, such as the one planned as a replacement for the National Synchrotron Light Source (NSLS) at Brookhaven National Laboratory (BNL), to be known as NSLS-II, and PETR III at HASYLAB at DESY in Germany;
- the X-ray Free Electron Laser (XFEL) sources, such as the source under construction at Stanford University in the United States, the sources under construction at Hamburg (and possibly also at Berlin in the future) in Europe, and in Japan; and
- the so-called Energy Recovery Linac (ERL) ring sources currently being planned (but not yet approved) for CHESS at Cornell University and under consideration for the upgrade of the APS at Argonne National Laboratory.

The latter two sources, will offer several important advantages. They will provide many orders of magnitude increase of brightness over even third-generation sources, as well as radiation that is almost completely coherent and can be in the form of short pulses of the order of 10 femtoseconds. These sources will thus offer unique opportunities for new kinds of science. They may attract totally new communities, such as chemists or atomic physicists interested in femtosecond spectroscopy or highly non-linear processes, as well as scientists interested in X-ray studies of matter under extreme conditions of temperature or density.

The XFEL sources will initially have only a few beamlines and will thus probably cater to a specialized community, rather than to the great majority of current synchrotron users. Over time, this mix of users may evolve.

The ERL sources will have lower brilliance than the XFEL sources. They will more closely resemble the current synchrotron X-ray sources, with many beamlines (but with the advantages of higher brilliance, coherence, and short pulses). The ERL sources are expected to draw on the current communities for their user base.

3.3. History of User Programs at Neutron Scattering Facilities

Neutron scattering science began in the national laboratories of the world. The early sources of neutrons were nuclear reactors, and those sources intense enough to conduct neutron scattering studies were in the national laboratories. The nuclear reactors were multipurpose, with a primary focus on research for nuclear power, nuclear weapons, and isotope generation. Neutron scattering science was an “add-on,” a side or an additional benefit.

The scientists who conducted the neutron scattering experiments were national laboratory staff members. For example, from the late 1940s to 1960, both Clifford Shull and Bertram Brockhouse did their pioneering research, which led to the 1954 Nobel Prize in Physics, when they were physicists on staff at Oak Ridge National Laboratory (ORNL) and at Chalk River Laboratories, respectively.

Many scientists in universities and corporate laboratories are familiar with X-rays and use them in their science. With very few exceptions, scientists in universities and corporate laboratories did not have a corresponding familiarity or use of neutron scattering. Thus, a deliberate program to involve scientists outside the national laboratories and beyond the security of atomic energy programs was required to make this important research tool widely available and to create a user community and user programs in corporations and universities.

In the 1950s, many research reactors were constructed in the United States to support Atomic Energy Commission (AEC) research programs (now included within DOE programs). These reactors included the Chicago Pile 3 (CP-3) and Chicago Pile 5 (CP-5) at ANL and the graphite reactors at ORNL and BNL. Research at these facilities was conducted by AEC laboratory staff scientists, and any external users were collaborators with AEC staff.

The reactors were often funded by contributions from individual units or cost centers within the laboratories and the AEC. They were not funded centrally, which would have more naturally supported an external user facility. Indeed, one of the reasons for closing several reactors some years later was that individual programs that were supporting the reactors wished to direct their funds elsewhere, and financial support was withdrawn (e.g., CP-5 was closed circa 1980).

During the 1950s, neutron scattering in the United States was done exclusively in AEC laboratories (including those in Ames, IA; Argonne, IL; Brookhaven, NY; Los Alamos, NM; Idaho; and Oak Ridge, TN). There were, however, some collaborations with scientists from university and corporate laboratories. For example, the spectrometers at BNL were used by Columbia University and Bell Laboratories.

In the 1960s, a second generation of reactors was constructed in the United States—the High Flux Beam Reactor (HFBR) at BNL (1965), the High Flux Isotope Reactor (HFIR) at ORNL (1966), and the Neutron Beam Split Core Reactor (NBSR) at NBS (now NIST) (1969). The HFBR and NBSR were devoted primarily to neutron scattering, and the HFIR was devoted primarily to isotope production (but also with high-intensity neutron beams). These facilities provided US scientists with high-intensity and reliable neutron beams and modern instruments. They enabled the United States to lead or be at the cutting edge in neutron scattering science in essentially all fields of condensed matter physics.

It is also interesting to note that construction of a large 100 MW research reactor, the Argonne Advanced Research Reactor (AARR) at ANL, was started at the close of the 1960s, but construction was terminated shortly after ground breaking. Going into the 1970s, scientists outside national laboratories increasingly recognized the value of neutrons as a tool, and an increasing number of outside scientists established collaborations with laboratory scientists to use AEC and NBS facilities. Visitor programs were set up at the laboratories, but external users were generally collaborators (not users). These connections were established informally rather than through formal user programs.

The first formal user program with beamtime funded and set aside explicitly for external users appears to have begun in Europe. In the United Kingdom in the mid-1950s, the Atomic Energy Research Establishment (AERE), which operated neutron facilities, and the Department of Scientific and Industrial Research (DSIR), which funded research and graduate education in universities, established an agreement. Through this agreement, DSIR provided funds and AERE set aside a portion of its neutron beamtime and neutron scattering facilities for use by university scientists. This agreement and the DSIR support opened

access to AERE facilities at Aldermaston and Harwell for university scientists. A number of students received their PhD degrees in neutron scattering at the DIDO reactor at Harwell in the late 1950s and early 1960s, going on to careers in neutron scattering both in and outside national laboratories.

In France, the Commissariat d' Energie Atomique (CEA) established a neutron scattering center in Saclay (Paris) in 1952 with the EL2 reactor and later the EL3 reactor with a cold source. In 1956, the CEA created a site at the Centre Etudes Nucleaires de Grenoble (CENG) with reactors Melouline and Siloué. Louis Neel, joint director of CENG and of the Centre National de Recherche Scientifique (CNRS) in Grenoble, played a key role in extending use of neutrons beyond the CEA and into CNRS laboratories. Many European nations, such as Sweden, Denmark and Holland, also established national facilities.

Development in Germany was somewhat different, because nuclear research was forbidden until 1955, and there was no atomic energy agency. In 1956, professor Maier-Leibnitz purchased a 1 MW reactor from General Electric (GE) for the Technical University of Munich. Again, many students received their PhD degrees using these European reactors. In 1961, the Karlsruhe Nuclear Research Centre constructed a 15 MW research reactor. In 1962, two British reactors (DIDO type 10 MW and 23 MW) were purchased at the German research center in Jülich. At a historic Geneva Conference on the Peaceful uses of Atomic Energy in 1964, French and German research ministers agreed to build a joint neutron facility. On January 19, 1966, a treaty was signed to construct the Institut Laue Langevin (ILL) in Grenoble. ILL was created as a symbol of French and German cooperation following the Second World War.

ILL opened in 1972 as the world's first full, independent, user neutron facility funded and dedicated entirely for neutron science, primarily for external users from the scientific community (as well as ILL scientists). Access to ILL was obtained by written scientific proposal, with beamtime awarded based on scientific merit as described in Section 3.1. ILL was independent from any atomic energy agency and sited outside the CEA gates, a feature regarded as critical in making ILL more accessible to the user community. ILL paid the travel and accommodation costs of the users, a feature seen as centrally important. The instrument scientists at ILL were regarded as the key scientific and technical link between the user and ILL, and they were critically important to successful user experience and experimental outcome. The British joined ILL in 1973 following an unsuccessful attempt to establish a high flux reactor in the United Kingdom. It took several years for ILL to develop instrumentation and a user community. By the end of the 1970s, however, it had become fully

competitive in distinction and in breadth of science, and it had become superior in numbers of users, including users in soft condensed matter.

In a clear break with the past in the United States, the Intense Pulsed Neutron Source (IPNS) at ANL opened in 1981 as the first full user facility dedicated entirely to neutron science in the United States and modeled after the ILL. The IPNS as a facility grew out of the Zero-gradient synchrotron (ZGS) Intense Neutron Generator projects (ZING-P and ZING-P') developed within ANL. IPNS opened with written proposals for beamtime that were reviewed by external review committees for scientific merit. Also in 1981, the Small Angle Neutron Scattering (SANS) facility at the HFIR reactor opened as a user facility. This SANS facility was supported by the National Science Foundation (NSF) and was the component of the HFIR programs that was a formal user facility. (NSF support terminated in 1989 because HFIR was often not available in the late 1980s, as discussed below.)

In 1983, a NRC study of neutron facilities in the United States noted that there were four major neutron facilities operating in the United States: HFBR at Brookhaven, HFIR at Oak Ridge, NBSR at NBS (now NIST), and the IPNS at Argonne. Each had approximately 100 users. Two other facilities, the spallation source at LANL (which has since grown into the Manuel Lujan Neutron Scattering Facility at Los Alamos Neutron Science Center (LANSCE)) and the MURI had together another 100 users, for a total of 500 users in the United States. The total number of users at these six US facilities was approximately the same number of users (650) as at ILL in 1982.

Other facilities soon initiated formal user programs. By 1985, for example, LANSCE had a user program with written proposals that were reviewed by the same external committees that reviewed proposals to IPNS. The LANSCE program, however, was hindered by unreliable operation. The Cold Neutron Research Facility (CNRF) at NIST opened with a new guide hall and suite of instruments in 1990 as a full user facility. This facility, now called the NIST Center for Neutron Research (NCNR), currently has the largest number of users in the United States, largely because of its modern suite of cold neutron instruments. From a user's perspective, the resources devoted to guide halls and instruments enormously expand the availability of neutrons. The HFBR at Brookhaven began a user program around 1990, with part of the beamtime accessible via written proposals that were reviewed by external committees.

Beginning in the mid-1980s, a changing regulatory environment in the DOE led to less predictable operation for HFBR and HFIR. Both facilities, previously highly reliable, became unpredictable and were often down under review. During this period, there were few upgrades in terms of new

instruments or guide halls, and HFIR and HFBR did not grow into broader-use neutron scattering centers. Indeed, this was a very low period of neutron availability and a difficult time for the user community in the United States, especially compared to Europe. HFBR last operated in 1997, and HFBR was closed permanently by DOE in 1999. This was a major loss. During this same period, HFIR has often been down, and when it reopens, with its new cold source and guide hall as part of a combined facility with the SNS, it will be a full and highly welcome user facility.

The history of neutron scattering facilities, of instruments, and of the number of users at US facilities and abroad can be found in the OSTP "Report on the Status and Needs of Major Neutron Scattering Facilities and Instruments in the United States" (2002). Because this information has already been compiled by OSTP, the goal of this American Physical Society report is, rather, to sketch the history and the evolution of user programs.

The nature of the user has also evolved, from being largely neutron scattering professionals in national laboratories to being predominantly users from outside the national laboratories who are experts in their own disciplines but often not experts in neutrons. This evolution is continuing. The occasional and less-experienced user of neutrons will therefore rely increasingly on the insight and scientific judgment of the instrument scientists at facilities to take best advantage of neutrons, to design penetrating experiments, and to succeed in collecting their results. This will be particularly so as data-acquisition rates increase and experimental times shorten. Thus, while instrument scientists were seen as critical in the first full user facility in 1972, they play an even more critical role today in successful access to neutron facilities.