

DOE Office of Science User Facilities
User Statistics Collection Practices, FY 2019

The documents that follow articulate the user statistics collection practices for the Office of Science User Facilities in the Fiscal Year 2019 reporting period. Each user facility or category of user facilities has a description with the following sections:

Steward: the Office of Science program that manages the facility—that provides funds and oversight for the facility operations. The steward determines the practices for defining and counting users under the framework of the Office of Science policy memorandum, “Defining and Counting Users for the Office of Science User Facilities” issued August 23, 2013. More information regarding each program can be found at <http://science.osti.gov>.

Capabilities provided to users: a summary description that provides context for the typical ways that users interface the facility. The description includes:

- at the highest level, the science that the facility enables
- the defining physical characteristics of the facility that inform how individuals utilize the facility
- the mode(s) in which it is utilized, including whether users work in series or in parallel
- a high level statement regarding the differences between the types of users.

Methods of acquiring user statistics:

Descriptions that articulate how the facility counts the three categories of user: On-Site, Remote, and Data. In some instances a statement is included that describes the logistical criteria by which the facility counts users (e.g., through execution of a user agreement and completion of safety training).

These descriptions are intended to promote transparency and efficacy in the Office of Science’s user statistics collection practices and to foster awareness of the diversity of user interactions supported by the user facilities.

DOE Office of Science
Germantown, Maryland
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Facility: Energy Sciences Network (ESnet)

Steward: Advanced Scientific Research Computing

Capabilities provided to users

The Energy Sciences Network (ESnet) is the Department of Energy's high-performance network, engineered and optimized for large-scale science. ESnet interconnects the entire national laboratory complex, including its supercomputer centers and all user facilities – enabling tens of thousands of scientists to transfer data, access remote resources, collaborate productively, and access the commercial Internet.

Massive science data flows require different network capabilities than network traffic generated by email, video, and web browsing. For this reason, ESnet does not resemble a commercial provider of Internet services. The facility's special capabilities include virtually lossless data transport, bandwidth guarantees spanning multiple network domains, and a distributed performance-monitoring platform. As the fastest science network in the world, ESnet aims to accelerate discovery by delivering unparalleled network infrastructure, capabilities and tools, tailored to the needs of large-scale science collaboration. Network traffic on ESnet is growing at twice the rate of the commercial Internet.

ESnet's peering connections to the global Internet are resilient, redundant, and decentralized. ESnet staff monitor connectivity on a 24/7 basis, and in case of problems they work with DOE sites, commercial providers, and other research networks for resolution. The network's multiple 100 Gbps ring topology ensures that no single backbone circuit failure will cause an outage to a site.

The ESnet HPN user facility also operates a continental-scale network research testbed for the purpose of conducting research in a range of high performance networking topics. Recent research projects have included software defined networking architecture, post-TCP protocol dynamics, and identification and improved performance of high-throughput science data flows.

Methods of acquiring user statistics:

User statistics are tabulated for the network research testbed and for access to guaranteed bandwidth services; other users of the network (the vast majority) are not counted in ESnet user statistics.

- **On-Site Users:** An individual who has been granted authority for physical access to testbed resources to conduct research and development on the ESnet network testbed.

The facility shall count each user who has completed registration, training, and safety requirements.

- **Remote Users:** An individual who has been granted authority to conduct research and development on the ESnet network testbed, or to transmit data using guaranteed bandwidth services.

The facility shall count each user who has completed registration, training, and safety requirements.

- **Data Users:** N/A

Category: Leadership Computing Facilities (LCFs)

Steward: Advanced Scientific Research Computing

Facilities:

- Argonne Leadership Computing Facility (ALCF)
- Oak Ridge Leadership Computing Facility (OLCF)

Capabilities provided to users:

The Leadership Computing Facilities provide the most powerful computing resources in the U.S. for unclassified scientific research that spans topics relevant to national and energy security and broadly advances the frontiers of knowledge in physical sciences and areas of biological, environmental, and computer sciences. This computationally intensive research would not be feasible on commercial cloud computing or smaller scale institutional computing systems. These computing facilities use massively parallel high-performance computers with performance reaching to 200 “petaflops,” or quadrillion mathematical calculations per second— several tens of thousands of times faster than a typical PC.

The resources of the LCF facilities are available year round on a 24 by 7 basis except during maintenance periods. The LCFs employ sophisticated scheduler applications to schedule work on the resources. The scheduler works to maximize the use of the resource at all times. In order to maximize the potential of the machines, SC mandates that a large portion of the computing resources be devoted to large, leadership-class jobs, currently defined as jobs requiring over 20 percent of the computational resources. Researchers receive access to the LCFs primarily through successful peer reviewed proposals submitted to either the Innovative and Novel Impact on Theory and Experiment (INCITE) (<https://science.osti.gov/ascr/Facilities/Accessing-ASCR-Facilities/INCITE>) or the ASCR Leadership Computing Challenge (<https://science.osti.gov/ascr/Facilities/Accessing-ASCR-Facilities/ALCC>).

In addition to the leadership computers themselves, both LCFs provide access to high performance storage and archival systems for the data generated, specialized data analysis and visualization systems, and expertise in how to make the most effective use of all parts of the facilities. The LCFs employ a multi-faceted approach to address the needs of their users ranging from basic support in accessing the computing resources to complex support for algorithm development and performance improvement. Specifically, some projects are assigned a computational scientist to assist in scaling and improving application performance in the relevant science area. The facilities are linked with each other and their users via ESnet and other national and international research networks.

Methods of acquiring user statistics:

- **On-site Users:** N/A. All users access the LCFs through remote logins.
- **Remote Users:** An individual who has been granted authority to conduct research and development at an LCF under an approved proposal and user agreement.

The facility shall count each user who has an approved proposal and signed user agreement.

- **Data Users:** An individual who has been granted authority to store and analyze their data at an LCF under an approved proposal and user agreement.

The facility shall count each user who has an approved proposal and signed user agreement.

Facility: National Energy Research Scientific Computing Center (NERSC)

Steward: Advanced Scientific Research Computing

Capabilities provided to users:

The National Energy Research Scientific Computing Center (NERSC) is the dedicated scientific computing facility for the Office of Science research community. As one of the largest facilities in the world devoted to providing computational resources and expertise for basic scientific research, NERSC is a world leader in accelerating scientific discovery through computation. NERSC's mission is to accelerate the pace of scientific discovery by providing high-end, high-performance computing, information, data, and communications services for SC-sponsored research activities.

NERSC provides large-scale, state-of-the-art computing for researchers supported by DOE'S unclassified scientific research programs spanning a wide range of disciplines and topical areas related to the DOE mission. In order to maximize scientific productivity, NERSC offers scientists integrated resources and services, such as one-on-one consulting services and in-depth collaboration as needed, which empower them to be more effective researchers. Many of NERSC's project consultants are themselves domain scientists in areas such as material sciences, physics, chemistry and astronomy, well-equipped to help researchers apply computational resources to specialized science problems.

Resources at NERSC (www.nersc.gov/systems) are available year round on a 24 by 7 basis except during maintenance periods. Because NERSC is SC's mission computing facility, DOE program managers across SC allocate most of the center's computing resources.

Methods of acquiring user statistics:

- **On-Site Users:** N/A. All users access NERSC through remote logins.
- **Remote Users:** An individual who is a member of an approved research project who has been authorized to use the facility and who has signed the NERSC Computer Use Policies form.

The facility shall count each user who has a valid user agreement.

- **Data Users:** N/A

Facility: ARM User Facility

Steward: Biological and Environmental Research

Capabilities provided to users:

DOE seeks to inform energy decisions by providing scientific knowledge and tools to understand the role of energy production and use in a changing climate and to project the impacts of climate change on future energy systems. In support of this objective the Atmospheric Radiation Measurement (ARM) User Facility is an integrated composite of highly instrumented research sites located in climatically important geographical regions of the earth. In-situ and remotely sensed measurements and associated data products are designed to improve the representation, in climate models, of clouds and aerosols, precipitation, extreme weather events and their interactions and coupling with the Earth's surface. This scientific infrastructure includes fixed research sites in three climate regimes, three mobile facilities, an aerial facility, and a data center; all are available for use by scientists worldwide as a scientific user facility. The three fixed ARM sites are situated in climatically distinct locations to sample continental and marine conditions in different environments (US Southern Great Plains; North Slope of Alaska; and the Eastern North Atlantic). ARM also has an aerial measurement capability and three mobile facilities that can be used in experiments across the globe. While two of the mobile facilities are deployed on a proposal-driven basis for 6–24 month durations, the third mobile facility is currently installed at Oliktok, Alaska, for an extended multi-year deployment. Scanning and vertically pointing radars at each of the ARM fixed and mobile sites provide a unique capability for high resolution delineation of cloud dynamical evolution, morphology, and radiative properties in support of both the atmospheric sciences and climate modeling. The simultaneous and parallel operation of multiple radar and lidar systems, capturing continuous data streams, provides an unparalleled capability for “interrogating” the three dimensional temporal evolution of individual clouds and their interactions with the larger associated weather systems. Additional measurements include surface and near-surface observations of turbulent heat fluxes, carbon flux, aerosol, methane, soil moisture, and soil temperature. ARM's newest capabilities include a high-resolution modeling component that ties together observational data and large-eddy simulation modeling to support the study of atmospheric processes and high performance computing resources that enable users to more easily work with large volumes of ARM data.

Methods of acquiring user statistics:

- **On-Site Users:** An individual who is physically present at the facility at least once during the reporting period to conduct research on an active, peer-reviewed project. Access is requested via the web-based Site Access Request form. The facility shall count each user who has completed registration and appropriate training.
- **Remote Users:** An individual who has been granted authority to participate remotely in experimental planning, execution, and data analysis of an approved research project through an approved Intensive Observation Period (IOP) request. Or an individual who remotely accesses the facility at least once during the reporting period, including to modify the operation of baseline instruments and/or investigator owned instruments, or to engage in remote use of the ARM computing resources. The facility shall count each user based on approved IOP, Site Access Request, or Computing Resources web forms.
- **Data Users:** An individual who remotely downloads data from ARM Data Center for scientific research and/or uses data extraction tools supported by the facility during the current reporting year. This includes ARM facility staff who are involved in the development of synthesis products, value-added products, instrument performance analysis, and uncertainty quantification. The facility shall count each user through the web-based data access/user registration form.

Facility: Environmental Molecular Sciences Laboratory (EMSL)

Steward: Biological and Environmental Research

Capabilities provided to users:

To address DOE's energy and environmental challenges, EMSL provides the biological, chemical, materials, and environmental research communities with a broad spectrum of premier instruments for molecular-level experimentation coupled with a high performance computer (HPC), parallelized software and data storage capabilities for modeling and simulation. With more than 75 premier capabilities, EMSL serves research teams using multiple experimental and computational capabilities as well as single-investigators using one to several capabilities.

Capabilities available in EMSL include a dozen types of nuclear magnetic resonance (NMR) spectrometers; more than a dozen types of scanning, transmission, and tunneling electron microscopes as well as helium ion, fluorescent and cryogenic microscopes; microfluidics and similar pore-scale fluidics systems; more than a dozen types of spectroscopy systems; two dozen types of mass spectrometry systems for proteomics, metabolomics and other -omics research; cell growth, isolation and characterization capabilities; interfacial surface characterization tools; atomic surface deposition and microfabrication tools; an HPC system; and open source software codes optimized for environmental- and molecular-level modeling and simulation. Scientists use EMSL's capabilities to study aerosol particle formation and transformations; carbon and nutrient cycling in soils, sediments and the rhizosphere; intracellular metabolic processes in bacteria, archaea, fungi and plants; microbial community, fungal and plant root interactions with soils and hydrologic processes relevant to bioenergy and biofuels; the fate and transport of inorganic and organic contaminants in soils, groundwater and the vadose zone; the long-term stability of nuclear waste in glass and ceramics; carbon sequestration in geologic media; battery and fuel cell energy storage materials; and catalyst, nanomaterials/nanostructures, and chemical sensor performance and optimization.

In addition to accepting general proposals and scientific partnerships to develop new capabilities, EMSL issues an annual call for Science Theme proposals and periodic calls for other types of proposals, including research campaigns.

Some capabilities can be remotely operated/used from another institution or location (e.g, the HPC system and the mass spectrometers) and run 24/7, but most of the instruments require staff support and are only available 10h/day, five days a week. Some capabilities are used to synthesize or analyze unique materials or surfaces. A few capabilities can be deployed outside the building in "field campaigns." Some users collaborate with EMSL staff to develop new *NWChem* modules or other software products that are made available to the scientific community. When *MyEMSL* is fully deployed, remote users will have access to multiple types of experimental and theoretical data, thereby enabling data analytics research.

Facility: DOE Joint Genome Institute (DOE JGI)

Steward: Biological and Environmental Research

Capabilities provided to users:

The U.S. Department of Energy (DOE) Joint Genome Institute (DOE JGI) is a federally-funded high-throughput genome sequencing and analysis facility dedicated to genomes of non-medical microbes, microbial communities, plants, fungi and other targets relevant to DOE missions in energy, climate, and environment. DOE JGI provides collaborators around the world with access to massive-scale DNA sequencing and analyses to provide fundamental data on key genes that may link to biological functions, including microbial metabolic pathways and enzymes that are used to generate fuel molecules, affect plant biomass formation, degrade contaminants, or capture CO₂.

Located in Walnut Creek, California, DOE JGI is managed by the Lawrence Berkeley National Laboratory, but involves partners from other Labs and institutions. Capabilities offered by the DOE JGI include high throughput sequencing, and resequencing, as well as single-cell and transcriptome sequencing, cell sorting and microfluidics, PCR and DNA synthesis. The DOE JGI serves three primary missions:

- **Bioenergy** Projects focus on developing plants that can be used as feedstocks for biofuel production, identifying organisms (e.g. fungi and microbes) with enzymes and pathways that can break down the lignin and cellulose in plant cell walls, and characterizing enzymes and pathways that can ferment sugars into biofuels.
- **Carbon Cycle** As microbes make up the largest component of the Earth's biodiversity, understanding how they metabolize carbon, and how environmental changes affect these processes, is crucial for the development of better predictive models for reducing the effects of increasing carbon dioxide emissions on the global climate.
- **Biogeochemistry** The field of biogeochemistry explores the full spectrum of biological, physical, geological and chemical processes and reactions involved in sustaining life on Earth. One area of emphasis targets microbes and microbial communities (or metagenomes) that can degrade or otherwise transform environmental contaminants such as toxic chemicals or heavy metals

Collaborators/users access JGI via periodic invitations to send in proposals, that are then peer reviewed, and successful proposers allocated appropriate sequencing or other resources. Access for most users is through DOE JGI User Programs (<http://www.jgi.doe.gov/programs/index.html>) including the Community Sequencing Program (CSP) (<http://www.jgi.doe.gov/CSP/index.html>) and the Emerging Technology Opportunities Program (ETOP) (<http://www.jgi.doe.gov/programs/ETOP/index.html>).

Category: High-Flux Neutron Scattering Facilities

Steward: Basic Energy Sciences

Facilities:

- **High Flux Isotope Reactor (HFIR)**
- **Spallation Neutron Source (SNS)**

Capabilities provided to users:

These facilities provide beams of high-flux neutrons for the exploration of matter and physical processes. Neutron scattering provides important information on the positions, motions, and magnetic properties of solids. Neutrons possess unique properties such as sensitivity to light elements, which has made the technique invaluable to polymer, biological, and pharmaceutical sciences. Neutrons also have magnetic moments and are thus uniquely sensitive probes of magnetic interactions. Neutron scattering studies have contributed to the development of higher strength magnets for more efficient electric generators and motors and to better magnetic materials for magnetic recording tapes and computer hard drives. Finally, the high penetrating power of neutrons allows nondestructive property measurements deep within a specimen and has been used to study defects in automotive gears and brake discs and in airplane wings, engines, and turbine blades. In addition to wavelengths comparable to atomic lattice spacing, thermal neutrons also have energies that are comparable to elementary excitations such as phonons and magnons, and thus neutrons can be used to measure the energy and momentum transfer of these excitations via inelastic scattering.

Experimental facilities are comprised of either a research reactor that produces continuous beams of neutrons (HFIR) or an accelerator facility that generates protons that impact a target and produce pulsed beams of neutrons in a process known as spallation (SNS). In both types of facilities, various types of specialized diffractometers and spectrometers are placed on beam tubes extending from the central core in the case of a reactor or from the spallation target at a pulsed neutron source. These facilities generally operate 24 hours a day with scheduled periods for maintenance and machine studies.

Scientific users or user groups obtain time on neutron instruments through a proposal system unique to each facility. Most users directly utilize the facility on-site, working with a host instrument scientist to set up their experiment at a particular beam line and in the analysis of the data. In limited cases for short duration routine experiments samples are "mailed-in" to the instrument who take the data and send the results back to the outside researcher for analysis.

Methods of acquiring user statistics:

- **On-Site User:** An individual who is physically present at the facility to conduct research on an approved research proposal.

The facility shall count each user who has completed registration, training, safety documentation, has a valid user agreement, and has a badge that facilitates tracking.

- **Remote User:** An individual who has been granted the authority to remotely produce data through computer access, or by shipping samples to facility scientist for data measurements, or by receiving custom-manufactured materials, tools, or devices from the facility scientists because the facility has unique or unusual capabilities to fabricate.

The facility shall count only one user per an approved proposal regardless of the number of co-investigators and only if there was no On-Site User under the same proposal. The user has completed registration, obtained required permissions for remote access, has a valid user agreement, and submitted an experiment safety form.

- **Data Users:** N/A. An individual who reduces and/or analyzes data and who is neither an On-Site nor a Remote User is not counted as a Data User.

Category: Nanoscale Science Research Centers (NSRCs)

Steward: Basic Energy Sciences

Facilities:

- **Center for Functional Nanomaterials (CFN)**
- **Center for Integrated Nanotechnologies (CINT)**
- **Center for Nanophase Materials Sciences (CNMS)**
- **Center for Nanoscale Materials (CNM)**
- **The Molecular Foundry (TMF)**

Capabilities provided to users:

The Nanoscale Science Research Centers (NSRCs) are DOE's premier user facilities for interdisciplinary research to understand and control matter at the nanoscale, serving as the basis for a national program that encompasses new science, new tools, and new computing capabilities. NSRCs provide critical infrastructure to support the national nanoscience research effort in energy and are the single largest investment of the National Nanotechnology Initiative. Each center has particular expertise and capabilities in selected theme areas such as electronic and photonic nanomaterials synthesis, electron microscopy, quantum materials and structures, nanostructure characterization, catalysis, theory/modeling/simulation, soft and biological materials, imaging and spectroscopy, nanofabrication, and nanoscale integration.

The centers are housed in custom-designed laboratory buildings located near major BES facilities for x-ray or neutron scattering, which complement and leverage the capabilities of the NSRCs. These laboratories contain clean rooms, nanofabrication resources, one-of-a-kind signature instruments, and other world-class instruments not generally available except at other major user facilities. NSRCs are knowledge-based facilities which, in addition to instrumentation capabilities, offer optional collaborative research with expert scientists in their fields. These facilities are routinely made available on a scientific-merit basis to the broad research community.

User proposals are by one principal investigator or a small group of researchers proposing a specific project that utilizes a distinct amount of time on one or more particular instruments or capabilities. Most users directly utilize the facility on-site, working with a host instrument scientist to set up their experiment at particular instruments or collaborate with staff scientists. Some users are researchers to whom the facility provides custom-manufactured materials, tools, or devices that the facility has unique or unusual capabilities to fabricate, while others are authorized to remotely generate data through computer access to physical instrumentation. Users can also access an extensive set of computation and simulation tools (i.e., first principles, machine learning, artificial intelligence, etc.) for theory and modeling projects.

Methods of acquiring user statistics:

- **On-Site User:** An individual who is physically present at the facility to conduct research on an approved research proposal.

The facility shall count each user who has completed registration, training, safety documentation, has a valid user agreement, and has a badge that facilitates tracking.

- **Remote User:** An individual who has been granted the authority to remotely produce data through computer access, or by shipping samples to facility scientist for data measurements, or by receiving custom-manufactured materials, tools, or devices from the facility scientists because the facility has unique or unusual capabilities to fabricate.

The facility shall count only one user per an approved proposal regardless of the number of co-investigators, and only if there was no On-Site User under the same proposal. The user has completed registration, obtained required permissions for remote access, has a valid user agreement, and submitted an experiment safety form.

- **Data Users:** N/A. An individual who reduces and/or analyzes data and who is neither an On-Site nor a Remote User is not counted as a Data User.

Category: Magnetic Fusion Research Facilities

Steward: Fusion Energy Sciences

Facilities:

- DIII-D Tokamak
- National Spherical Torus Experiment Upgrade (NSTX-U)

Capabilities provided to users:

These facilities confine plasmas at temperatures and densities close to what is required for a fusion energy source. These facilities enable researchers to study the stability, confinement, and other properties of fusion-grade plasmas under a wide variety of conditions and to explore a subset of the materials science issues required to manage the intense heat and particle fluxes of a fusion power plant. The experimental results from these facilities combined with theoretical and computational simulations build the scientific foundation needed to develop a fusion energy source.

These experimental facilities are comprised of magnetic field coils that confine a plasma in a large toroidal vacuum chamber, auxiliary heating systems to heat the plasma to tens of millions of degrees Kelvin, field-shaping coil systems that can produce a variety of plasma shapes, advanced digital control systems for feedback control of the plasma, and extensive diagnostic instrumentation to measure the properties of high-temperature plasmas. These experiments normally operate 8 hours per day during an annual operating period of 10-18 weeks per year. There are normally several maintenance weeks during the run period and a long outage of several months duration for major maintenance and facility upgrades at the end of each run period.

Experimental time on the facility is allocated on the basis of proposals submitted by teams. However, since most experimental proposals require extensive diagnostic measurements and specialized plasma control programming, a significant fraction of the host staff and collaborators are involved in most experimental proposals. It is important to note that since the creation and control of the plasma is a critical part of every experiment, many of the operations staff are therefore users. Some users participate in experiments from remote locations and/or are involved with planning and analysis of experiments from remote locations.

Methods of acquiring user statistics:

- **On-Site User:** An individual who is physically present at the facility and involved in planning, preparation, execution, and analysis of one or more approved experiments on the facility.

Facility staff shall count each user through badge requests/visitor forms, data access/user agreements, office assignments and proposal co-authorship.

- **Remote Users:** An individual who has been granted authority to participate remotely in experimental planning, execution, and data analysis. The individual might visit the facility to attend specific meetings or present results but would not have access to the experimental facilities.

Facility staff shall count each user through data access/user agreements and proposal co-authorship.

- **Data Users:** An individual who reduces and/or analyzes data provided by the facility but did not participate in the collection, calibration, or reconstruction of that data and who is neither an On-Site or Remote user.

Facility staff shall count Data Users through data access/user agreements.

Facility: Brookhaven Accelerator Test Facility (ATF)
Steward: High Energy Physics

Capabilities provided to users:

The Accelerator Test Facility (ATF) at Brookhaven National Laboratory is a facility for R&D, primarily in the areas of accelerator and advanced accelerator physics. The facility delivers a high brightness electron beam synchronized with high power lasers, to multiple experimental beam lines. In addition to the above capabilities, the facility also supports a developmental Ultrafast Electron Diffraction and Microscopy Facility. Electron beams and lasers are made available (subject to user readiness) in each of these experimental areas for 8 hours per day, Monday – Friday (not including public holidays) with scheduled maintenance and facility development periods.

Proposals for ATF experiments are reviewed at the annual ATF Program Advisory Committee Meeting (PAC), which coincides with the ATF Users' Meeting. The PAC assesses the merits of each proposal and its suitability for the ATF and passes its recommendations on to the ATF Director who awards approved experiment status where appropriate. Experimental time is allocated to user groups with approved experiments based on the experimental requirements and demand from other users. This allotment is determined quarterly by the Electron Beam and Laser Coordinators along with the Facility Director.

Methods of acquiring user statistics:

The ATF records each user arriving at the facility and also surveys the experiments using a census form collected annually. In addition we have access to the user data collected by the BNL Guest, User and Visitor Center. The vast majority of our users are On-Site Users (see below), but we also acquire statistics as listed below:

- **On-Site User:** An individual who is physically present at the facility at some point during the reporting period to conduct research on an approved experiment.

The facility shall count each user who has completed registration, training, has a valid user agreement, and has a badge that facilitates tracking.

- **Remote User:** An individual who has been granted the authority to remotely participate in approved experiment operations/data collection from a remote location **and who has utilized that authority at some point during the reporting period.** If an individual qualifies as an On-Site User and as a Remote User, that individual should be counted once as an On-Site User.
- **Data Users:** An individual who reduces and/or analyzes data provided by the facility but did not participate in the collection, calibration, or reconstruction of that data and who is neither an On-Site or Remote user.

Facility: Fermilab Accelerator Complex
Steward: High Energy Physics

Capabilities provided to users:

Fermilab's Accelerator Complex comprises ten particle accelerators and storage rings that provide beams to a number of experiments. The Fermilab Accelerator Complex supports or has supported studies of the fundamental physics of the world around us at the energy frontier and the intensity frontier. Fermilab's accelerators operate 24 hours a day, 7 days a week, with scheduled periods for maintenance, machine studies, and upgrades.

Proton beams are available at 8 GeV from the Booster and at energies from 60 GeV to 120 GeV from the Main Injector. These beams can be used directly for experiments or can be used to produce other elementary particles like muons, pions, kaons, or neutrinos for experiments. Currently, the Neutrinos at the Main Injector (NuMI) facility is the world's most intense neutrino source.

Proposals for Fermilab experiments are generally submitted by a collaboration of several university and laboratory research groups; the collaboration may be composed of up to several hundred physicists and graduate students. All proposals for experiments at Fermilab are peer reviewed for their scientific merit by the Physics Advisory Committee composed of senior physicists from institutions around the world. Approval is determined by the Fermilab Director based on the outcome of the merit review and consideration of laboratory resources needed by the experiment.

Methods of acquiring user statistics:

- **On-Site User:** An individual who is physically present at the facility at some point during the reporting period to conduct research on an approved experiment. Facility staff are counted as users if they participate in an approved experiment.

The facility shall count each user who has completed registration, training, safety documentation, has a valid user agreement, and has badge that facilitates tracking.

- **Remote User:** An individual who has been granted the authority to remotely monitor or control an approved experiment or process data from an approved experiment at the facility and who has utilized that authority at some point during the reporting period. If an individual qualifies as an On-Site User and as a Remote user, that individual should be counted as an On-Site user.
- **Data Users:** An individual who reduces and/or analyzes data provided by the facility but did not participate in the collection, calibration, or reconstruction of that data and who is neither an On-Site or Remote user.

Category: Nuclear Physics Accelerator Facilities

Steward: Nuclear Physics

Facilities:

- **Argonne Tandem Linac Accelerator System (ATLAS)**
- **Continuous Electron Beam Accelerator Facility (CEBAF)**
- **Relativistic Heavy Ion Collider (RHIC)**

Capabilities provided to users:

The Argonne Tandem Linac Accelerator System (ATLAS) at Argonne National Laboratory (ANL) is used to study questions of nuclear structure by providing high-quality beams of all the stable elements up to uranium and selected beams of short-lived nuclei for experimental studies of nuclear properties under extreme conditions and reactions of interest to nuclear astrophysics. The Continuous Electron Beam Accelerator Facility (CEBAF) at the Thomas Jefferson National Accelerator Facility (TJNAF) provides high quality beams of polarized electrons that allow scientists to extract information on the quark and gluon structure of protons, neutrons and nuclei. CEBAF also uses polarized electrons to make precision measurements of parity violating processes that can provide information relevant to the development of the New Standard Model. These two facilities conduct fixed target experiments, meaning that a beam of particles is directed onto a target of material, and scientific instrumentation is utilized to study the products of the reaction between the target and the beam of particles. The Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) uses relativistic heavy ion collisions to investigate the frontier of Quantum Chromodynamics (QCD) by trying to recreate and characterize new and predicted forms of matter and other new phenomena that might occur in extremely hot, dense nuclear matter and which have not existed since the Big Bang. RHIC also provides colliding beams of spin-polarized protons to probe the spin structure of the proton, another important aspect of the QCD frontier. RHIC is the only operating collider in the United States.

These facilities are all multi-user facilities, with the capability to conduct multiple experiments in parallel. The facilities have unique and cutting-edge instrumentation that are housed in experimental stations or halls. At ATLAS and CEBAF, there are multiple beam lines that direct the beam to experimental stations; at RHIC, experimental equipment is located at various collision points along the collider rings. These facilities can operate 24 hours a day, seven days a week, with scheduled periods for maintenance and machine studies. Frequency of operations is typically constrained by available funding.

Experimental time on the facility is allocated on the basis of proposals submitted by collaborations of scientists usually represented by a principal investigator or spokesperson. Each proposal defines a specific project that utilizes a distinct amount of beam time on a particular beam line or beam collision point, and which typically requires complex scientific instrumentation. Facility directors seek advice from facility Program Advisory Committees in determining the allocation of their valuable scientific resources. The facility Program Advisory Committees review research proposals requesting resources

and time at the facilities and then provide advice on the scientific merit, technical feasibility, and personnel requirements of the proposals. Most users directly utilize the facility on-site, working with a host instrument scientist to set up their experiment at a particular beam line or end station. Some users are authorized to remotely generate data through computer access to physical instrumentation. Other users play a key role in developing the instrumentation which is essential for the experiment to be conducted at the facility.

Methods of acquiring user statistics:

- **On-Site User:** An individual who is or has the intent to be physically present at the facility to conduct research on an approved research proposal during the reporting period. Facility staff are counted as users if they participate in an approved experiment.

The facility shall count each user who has completed registration, training, safety documentation, has a valid user agreement, and has a badge that facilitates tracking. Intent to be physically present is captured by including the names of all scientists on the Physics Advisory Committee-approved proposal.

- **Remote User:** An individual who has been granted the authority to remotely produce data through computer access or who has developed equipment or software at their home institution that plays a role in the production of data during the experiment.

The facility shall count each user who registers, completes all required training for remote access, has a valid user agreement, and submits an experiment safety form. Remote users can also include the scientists off-site who play a key role in the development of the complex instrumentation that is to be used in the conduct of the experiment at the facility.

- **Data User:** N/A. An individual who reduces and/or analyzes data and who is neither an On-Site nor a Remote User is not counted as a Data User.