

## GETTING BEAMTIME: TRICKS OF THE TRADE



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With help from John Budai (ORNL) and Suzanne G. E. te Velthuis (ANL)

## MY PERSPECTIVE

- Former beamline scientist (NIST BT-1)
- Former instrument developer (11-BM) & former group leader (x2)
- Done experiments at NSLS, HFBR, IPNS, ILL, NIST, APS
- Proposal reviewer for HFIR, SNS, NIST, APS... (site reviews: NScD, ALS, Diamond)

### ***Presentation Outline***

1. User facilities & DOE Basic Energy Sciences
2. Where can I get time
3. The review process
4. How & what to put in a proposal (& what to not do)
5. Getting help

# GOVERNMENTS PROVIDE BEAMTIME FOR FREE

But it costs money (lots!) to provide. (Facilities cost \$60M to \$200M/yr to run.)

- The supply of time is limited. Research projects cover travel and related expenses (N.B. in some other countries, facilities may cover travel)
  - COVID has prompted beamlines to offer mail-in or remote access. (How much of that will be retained is unclear.)
  
- Few beamlines have sufficient availability for all interested users
  - Almost none have enough time to satisfy all requests.
  - Some beamlines get requests for x4-5 over what is available
  - In most user facilities beamlines have very little “internal” time
  
- To make sure access is equitable, access is granted with priorities based on externally reviewed proposals

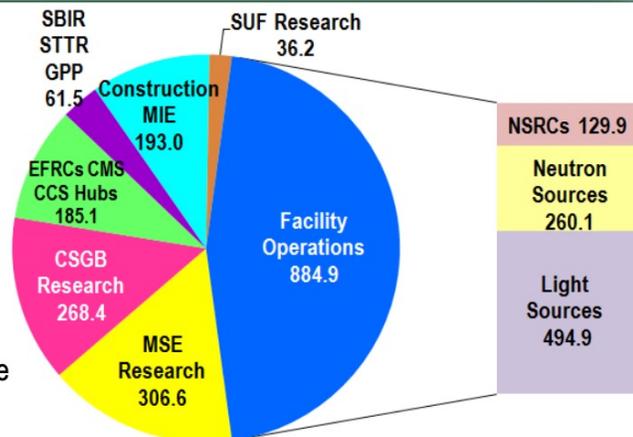
\* Free when goal of work is to publish in open literature. For proprietary research, U.S. law requires cost recovery (FWIW, cost recovery expenses are pretty reasonable, considering).



## FY 2021 President's Request: \$1,935.7M (-\$277.3M or -12.5% from FY 2020)

### Research programs $\Delta = -\$5.9M$

- Core Research (\$575M) includes new investments (\$73M) in **critical materials, data/AI/ML, polymer upcycling, next-generation biology, microelectronics, and accelerator R&D (Direct Air Capture of CO<sub>2</sub> – Marks)**
- Computational Materials and Chemical Sciences continue (\$26M)
- Energy Frontier Research Centers continue (\$115M)
- Energy Innovation Hubs continue (\$44.1M)



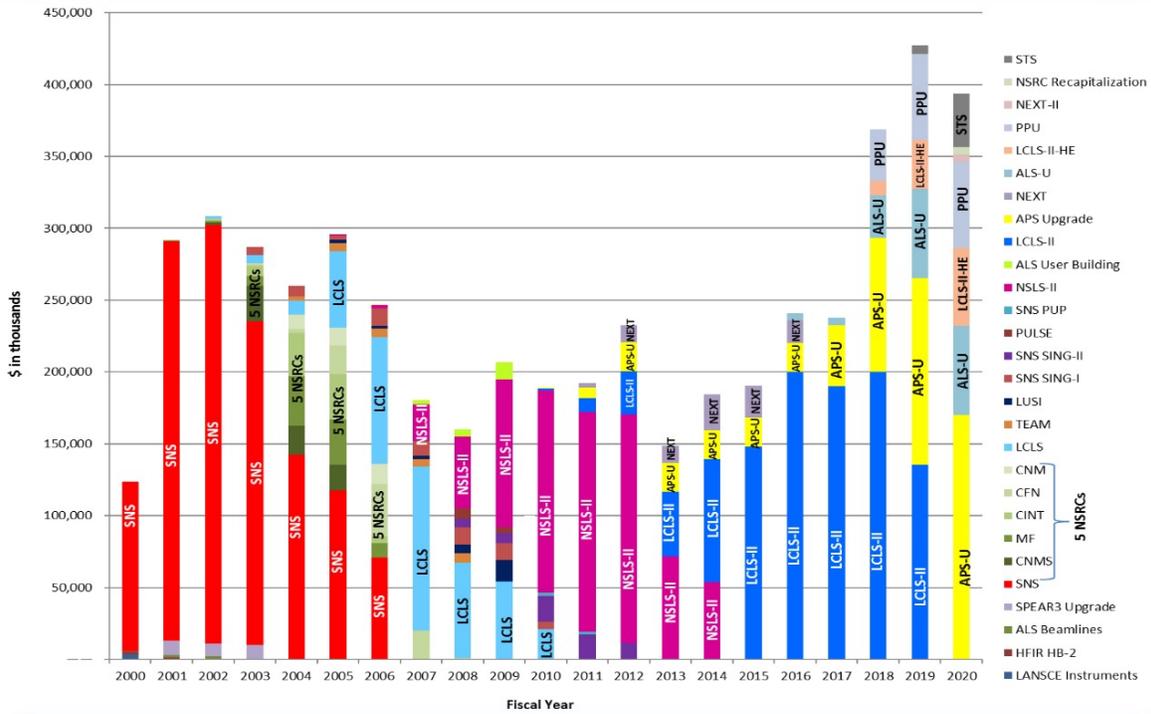
### Scientific user facilities $\Delta = -\$66M$

- Operations of 12 facilities continue at ~91% of optimal. LCLS at 97% of optimal (\$884.9M).
- Facilities research continues for AI/ML; increases for accelerator R&D (\$36.2M).

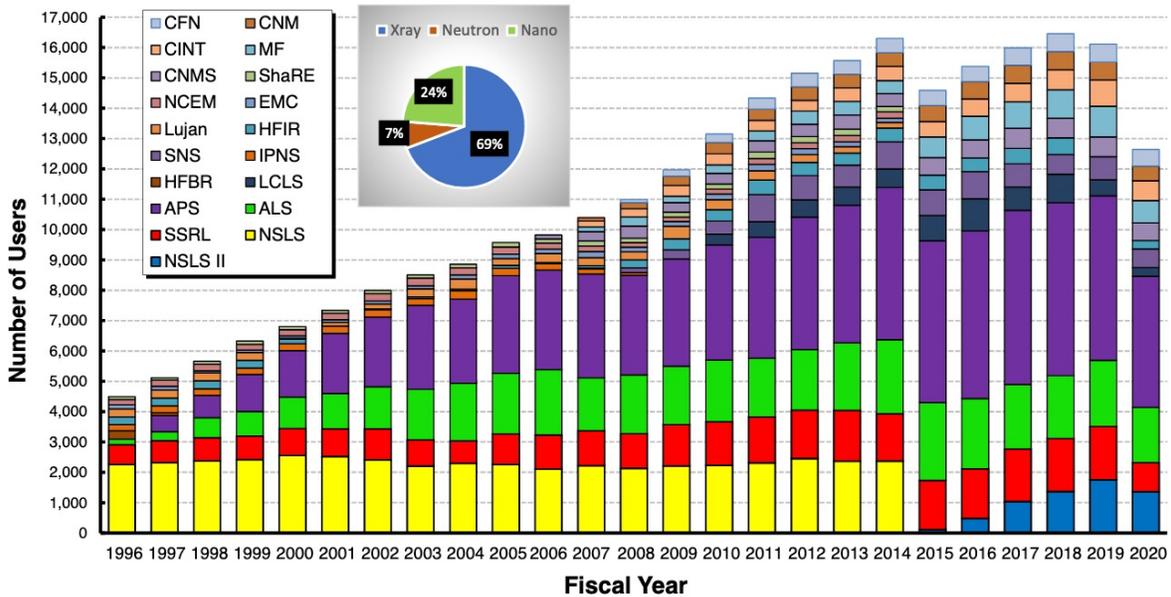
### Construction/MIE\* $\Delta = -\$200.5M$

- APS-U (\$150M); LCLS-II-HE (\$16M); ALS-U (\$13M); PPU (\$8M); STS (\$2M)
- MIEs: NSRC Recap (\$1M); NEXT-II (\$1M)
- New start: Cryomodule Repair & Maintenance Facility (CRMF) (\$2M)

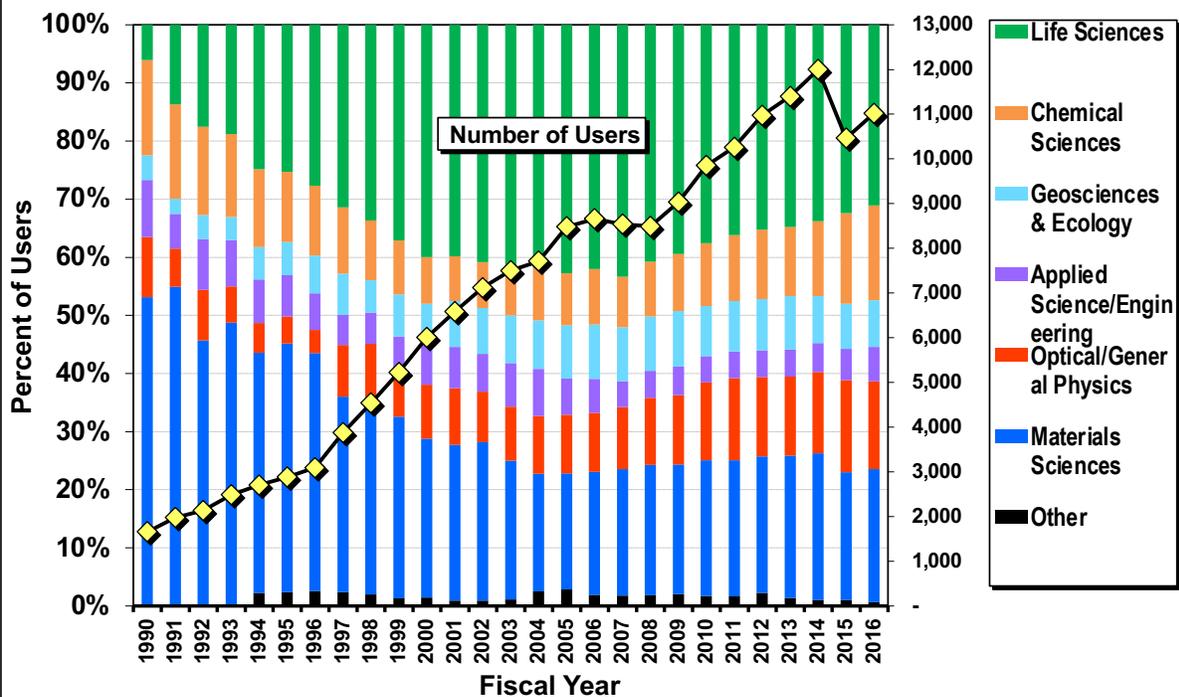
# BES Construction/MIE Funding Profiles: 2000 – 2020



# BES User Facilities Hosted Over 12,500 Users in FY 2020 Impacted by COVID-19



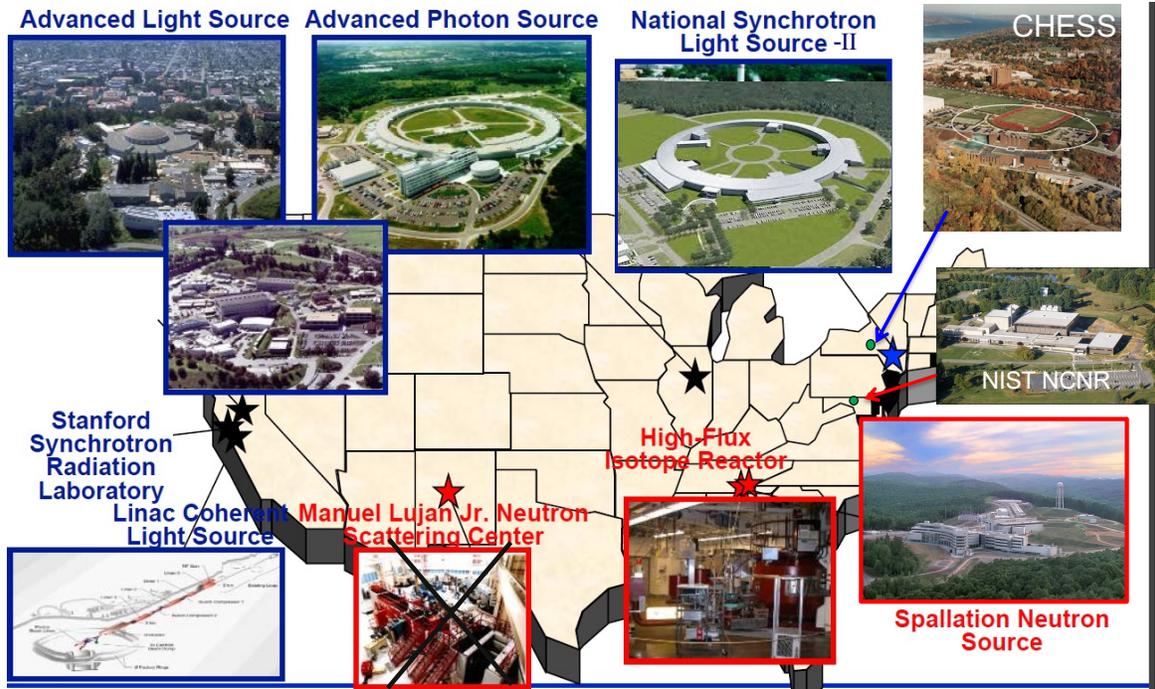
## Users by Discipline at the DOE Light Sources



John Budai: 2018 NX School presentation

WHERE CAN I GET TIME?

## X-ray and Neutron Sources (most DOE-Basic Energy Sciences)



**Also** 5 DOE Nanoscience Centers (BNL, SNL/LANL, ORNL, ANL, LBNL)  
DOE Electron Microscopy Centers (ANL, LBNL, ORNL)

John Budai: 2018 NX School presentation

## CONSIDER FACILITIES WORLDWIDE

For some measurements, the leading instruments are outside the US

### ◆ Light Sources (see [www.lightsources.org](http://www.lightsources.org)), >50 synchrotrons + FELs

- European Synchrotron Radiation Facility (ESRF), Grenoble, France
- Swiss Light Source (SLS, Paul Scherrer Institute)
- LNLS - Laboratório Nacional de Luz Síncrotron (Brazil)
- Canadian Light Source / Centre Canadien de Rayonnement Synchrotron
- SPRING-8, Japan
- PETRA III, Germany
- Diamond Light Source, Oxfordshire, UK

### ◆ Neutron Sources (see [www.neutronsources.org](http://www.neutronsources.org)), ~50 centers

- Institut Laue-Langevin (ILL), Grenoble, France
- ISIS UK
- JSNS at J-PARC, Japan
- China Spallation Neutron Source, Dongguan
- European Spallation Source (ESS), Lund, Sweden (user program ~2023)

Several universities run small reactors, but they are seldom appropriate for cutting edge research.

# WHAT BEAMLINES OFFER GU TIME?

**GU = General User**

## APS/NSLS/SSRL/ALS

- Beamlines run by facilities offer most (80-100%) of beamtime to users.
  - Externally-run (e.g. CATs, etc.) may offer a smaller fraction (typically 25% at APS), but all beamlines must offer GU beam time

## SNS/HFIR

- Amount varies by instrument, but typically ~75% GU time

## NIST

- Cold neutron instruments are typically run by NSF and are ~75% GU
- Thermal neutron instruments are typically internally and are ~25% GU

# HOW DO I GET BEAM TIME AT A USER FACILITY?

- All DOE, NIST, and NSF neutron and x-ray sources offer access to beam time through an experimental proposal system. “General User (GU) time”
  - Other specialized programs may be possible for other types of access (technique/instrumentation development; long-term experiments,...)
  - Beamlines do get a bit of discretionary time; sometimes a beamline scientist may be able to get in a short “proof of concept” measurement, or may be willing to collaborate
- Proposal submission is done through a web-based application. When and how often proposals are submitted varies by facility
  - APS, NSLS-II three times (“cycles”) per year
  - SNS/HFIR, ALS, LCLS two times per year
  - **Deadlines are “hard”; a submission 1 minute late may not be accepted**
- All proposals are peer-reviewed and rated, and beam time is allocated based on the scores of these reviews
- The highest ranked proposals are usually allocated time; the beamline staff schedule those proposals
  - At APS: if a proposal is not given time, and the request is renewed each cycle, the review score is improved each cycle (proposals “age up”)

# NON-GU PROPOSALS

Each facility handles this different

## APS

**GUP** - General User Proposal are valid for two years or until recommended shifts are fully used. A beam time request has to be submitted for each cycle for which the proposal is to be considered.

**PUP** – Partner User Proposal - Groups whose work involves a greater degree of collaboration with the APS. (e.g. major new instrumentation or technique).

**Rapid Access Mail in Powder Diffraction** for 11-BM, 11-ID, 17-BM. Very easy, they send you capillary tubes.

**Rapid Access General User Proposal** is valid for a single cycle, single Beam Time Request

## CHES – Cornell

**Standard Proposal** is good for two years from the date of review and acceptance. After a proposal has been reviewed and accepted, it generates its first beam time request. A Beam Time Request (BTR) must be submitted for every following cycle for which a user requests beam time.

**Feasibility study** proposals are only granted for one-time access to test something never done before.

## NIST Center for Neutron Research

**New Proposal** Regular proposal (including continuation) for one beam time access, reviews by Committee (BTAC)

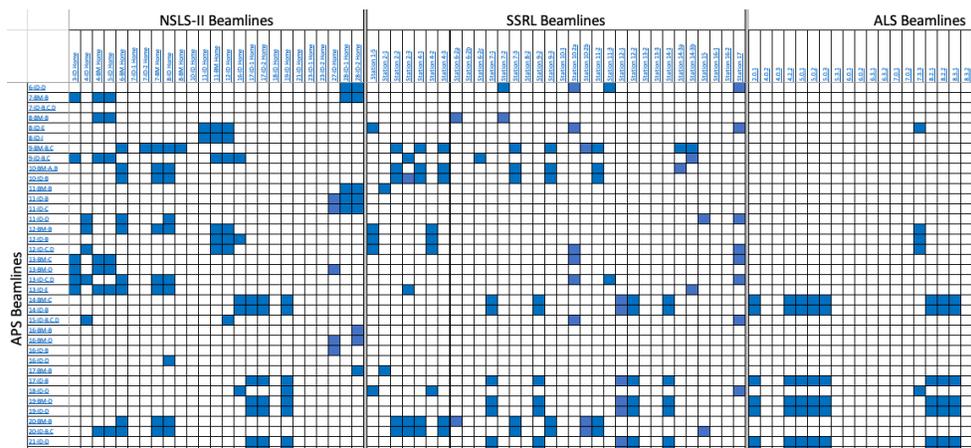
**Quick Access Proposal** for experiments that cannot be delayed. Reviewed by BTAC but held to higher standard

**Beam Time Request** is a request for part of the instrument time reserved for NIST internal research programs. Such requests may be made by external users through collaborative research projects with a NIST Staff member.

# ALSO CONSIDER: APS WILL BE “DARK” FROM APRIL 2023 TO APRIL 2024

Other beamlines with similar capabilities to APS beamlines will likely be more busy during this period

- See <https://aps.anl.gov/APS-Upgrade/Comparable-Beamline-Options-For-Users>
- Understand that every beamline in the U.S. has different strengths and may not be able to perform equivalent measurements



# HOW DO I SUBMIT A PROPOSAL

## FIRST: LEARN ABOUT WHAT YOU WANT TO DO

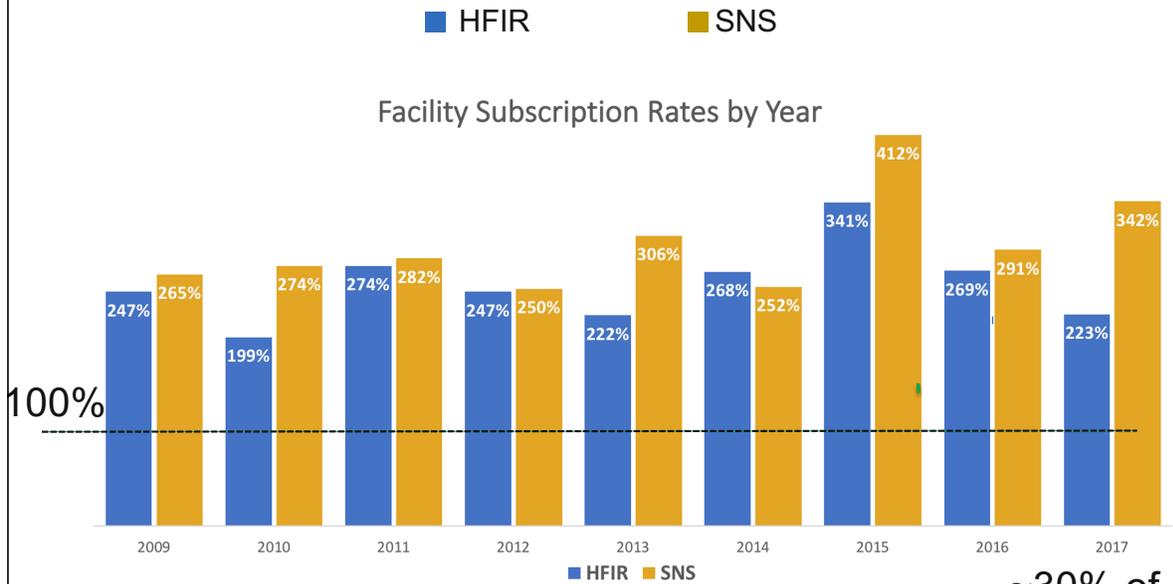
### Study facilities and instrument web pages

Questions to consider:

- What is the research problem? What do you hope to learn?
- Which instrument(s) are appropriate? (what level of review scores are needed?)
- How mature is the research project (risk, size)?
- What is the material – sample composition, form, size, availability? Consider safety restrictions
- What are the experimental conditions? (Temperature, pressure, magnetic field, *etc*)
- What will be measured?
- Probability of success? Impact? Significance?
- How will results be presented and to whom?
- What is the timeline? Pay attention to proposal deadlines!

**Unless you have access to an expert, contact an Instrument Scientist to discuss your research**

# Overall subscription rates at HFIR/SNS remain high



~30% of requested time is granted

John Budai: 2018 NX School presentation

## Submitting a proposal

## Facilities have link on home page

**PASS**  
Proposal Allocation, Safety, and Scheduling System

All General User proposals for NSLS-II beamlines must be submitted through the PASS system. For those users familiar with the original NSLS PASS system, it has been retired. Authentication through the new PASS system can be completed with either (1) a BNL domain account or (2) a Google account. If you do not have one of these accounts, you'll need to sign up for a free Google account before continuing.

Once you log in to PASS, you will be able to view a list of your proposals and submit new proposals. You may find it convenient to complete the General User proposal using the [US Store](#) template prior to login, and then copy/paste the information into the proposal form online. (See the [NSLS-II User Guide](#) for details of the General User proposal submission process.) Please note that other features of the PASS system, including the Safety Approval Form (SAF) system, are still under development and will be made available to users in time for proposal allocation.

Run	Run Dates	OU Proposal Deadline	Beamlines Available
2015-1	Jan–April 2015	October 27, 2014	CSX1, CSX2
2015-2	May–Aug 2015	February 8, 2015	CSX1, CSX2, CHX, HXN, XPD, SRX
2015-3	Sept–Dec 2015	June 1, 2015	CSX1, CSX2, CHX, HXN, IXS, XED, SRX

**Argonne National Laboratory**  
Advanced Photon Source  
an Office of Science User Facility

**APS User Portal**

Apply for Beam Time  
Machine Status | Schedule

Conferences  
Seminars & Meetings  
Publications  
Safety and Training  
Construction Schedule

Find People  
Organization Charts

Email | WebVPN | Intranet  
APS Conference Rooms  
Suggestion Box  
Document Central

Argonne Guest House @ Argonne Accelerator Inst. @ National User Facility Org. @ lightources.org @

**EVENTS AND ANNOUNCEMENTS**

**June 27 : Friday**  
User Science Seminar  
APS Seminar | 401-A-1100 @ 12:00 PM

**Reminders**  
National School on Neutron and X-ray Scattering  
June 14, 2014 - June 28, 2014  
Apply for Beam Time - Deadline  
July 11, 2014

APS Upgrade Project  
APS-U MBA LATTICE WORKSHOP Information

**NIST Center for Neutron Research**

**CALL FOR PROPOSALS**  
June 2015

Proceed to the following links for details on proposal submission, proposal review, and site access:

- PROPOSAL FORMS
- PROPOSAL INSTRUCTIONS
- PROPOSAL WRITING
- PROPOSAL SITE ACCESS

The NIST Center for Neutron Research (NCNR) offers neutron scattering and chemical analysis instruments to all qualified users.

The next deadline for receipt of proposals is **Tuesday, June 16, 2015**.

Note that contribution proposals are no longer a separate category, and the deadline applies to all proposals, except for Quick Access proposals. All proposals will be critically reviewed for scientific merit by experts selected by the NCNR.

Proposals that are formally reviewed by referees and recommended by the Beam Time Allocation Committee will be scheduled for experiments from September 2015 through March 2016.

**For this proposal round:**

**PROPOSAL SUBMISSION FORM**  
You must have an account on the new NCNR Information Management System (NCNR-IMS) to submit a proposal. Go to the login link on the upper left hand side of our home page. Login if you have an account, or create an account if you do not. Your email address is your user ID. If you already have an account of which you are unaware, you will know that you do by the error message referring to an existing account with the same email address. We will send you your password in the same case. If you have forgotten your password, PLEASE do not create multiple or hidden accounts.

**NEW INCREASED AVAILABILITY FOR THE MULTI-ANGLE CRYSTAL SCATTERING (MACS) THIS ROUND**  
MACS has been increased from 1000 to 1500 hours per week. The spectrometer is now operating routinely. MACS is a cold neutron instrument featuring 20 individual detector channels, each with its own focusing optic analyzer. It provides superior data for many situations, including magnetic scattering from low-dimensional systems.

**NOTE: MACS IS SAMPLES FOR POWER DIFFRACTION**  
We will accept proposals for experiments on the FT1 powder diffractometer on "trial" periods. That is, for approved proposals, samples may be mailed to NCNR staff, who will execute the data collection. Up to 200-5000 instrument time may be allocated to each proposal. **NOTE THAT ONLY RUSH MAIL PROPOSALS ARE ACCEPTED FOR FT1.**

**SPINNS AND NOT REFLECTOMETERS UNAVAILABLE THROUGH PROPOSALS**  
SPINNS, the spin-polarized triple-axis spectrometer on NS-4, is no longer being offered to users through proposals. Likewise, the NSF funded multiple reflectometer is no longer available through proposals. If you wish to use SPINNS OR NZ27 REFLL, you may contact an NCNR staff member to investigate whether a collaborative research project is possible.

**UPLOAD A PDF document of the description of your experiment on our proposal form.**  
The new feature allows you conveniently to include figures and equations. The uploaded material may be no longer than 800 to 1000 to the size, no longer than 4 letter size pages in length. The font size must be 12 point or larger.

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Researching a cure for Huntington's Disease

**NEWS & UPDATES**  
Neutron Scattering Science Call for Proposals

Thank you for submitting a proposal for the current call. The next call deadline is August 25, 2015.

**OPERATING STATUS**  
SNS Beam on target at ~875kW. The plan for Tuesday is Neutron Production without any interruption.

HFIR is operating at 85MW for full cycle 420.

**UPCOMING EVENTS**  
16 Goldschmidt Conference Knoxville, TN, USA  
19 National School on Neutron and X-ray Scattering Oak Ridge, TN, USA

Let us know what capabilities would you like to see at SNS and HFIR.

John Budai: 2018 NX School presentation

# TYPICAL PROPOSAL FORMS

SNS/HFIR

APS

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# TYPICAL QUESTIONS IN A PROPOSAL

- Proposal Title
- General Info (Title, Experimenters, Funding source, etc.)
- Abstract-What is the *scientific importance* of the proposed research?
- Why do you need the facility to do this research?
  - (Neutron vs. X-rays) or (Neutrons + X-rays)?
  - Need for a particular facility (instrument, insertion device vs bending magnet?)
  - Spallation vs. reactor source
  - Hard X-rays vs. soft
  - Particular technique or sample environment
- Previous experience with technique/materials;
- Previous sample characterization
- Previous results; related publications
  - If similar work has been done by others, how will yours be different?
- Describe the proposed experiment(s), including samples and measurement process. *Show that you are prepared!*
- Time needed for measurement; justify that number

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# WHAT DOES A REVIEWER WANT TO KNOW?

## Things to think about when writing a proposal

- Does the proposer have what they need to do the measurement?
  - A well-characterized pure material
  - Do they have the expertise to analyze the data?
- Does the proposer know what they want to learn?
- Is the measurement likely to provide a useful result?
  - Is this the right measurement?
  - Is the instrument sensitive enough to show what is needed?
- Can the desired goal be reached with a lab-based measurement?
- Is anyone going to care?
  - Important scientific questions are more likely to get time with an “unlikely to succeed proposal”

# AN OUTLINE FOR A PROPOSAL (I-A)

## Provide some background

- **Pick a good title.** Specific and to the point is better than spectacular and vague. Spectacular and specific is fine if credible.
  - Good: “XAS study of Fe valence in  $\text{CaFe}_2\text{As}_2$  under pressure ”
  - Bad: “Understanding superconductivity in superconductors”
- Is it thesis related? Is there a deadline?
  - DOE likes to see thesis research at beamlines
  - May push your proposal up if scores are close
- Write a good abstract - this is where the reviewer develops first impression
  - Do not just upload a PDF document! Creates more work for reviewer
  - Scientific merit in abstract is most important criteria for the score
- Do include a figure from previous work
  - Shows how you made use of previous beamtime
  - Do NOT upload 20 pages of supplemental materials. Only a few figures to help your scientific case

## AN OUTLINE FOR A PROPOSAL (I-B)

### Provide some background

- Who is involved? Include your advisor (& have he/she read your initial proposals)
  - If you have expert collaborators, list them
  - (include your supervisor!)
  - Collaborator who supplied sample.
  - Theorists
  - Don't include a beamline scientist unless you have discussed collaboration with them
  
- Why is this research being done?
  - Big picture: 1-2 sentences, max. (Don't assume that the reader will know that your family of materials is of interest for catalysis, thermoelectrics, solar...). Reviewer is probably familiar with instrument, but possibly in a very different field. Try to capture imagination of reviewer with basic idea.
  - Curiosity-based research is fine, but relate the research to bigger questions (planetary science, cosmology...)

## AN OUTLINE FOR A PROPOSAL (II-A)

### Describe the measurement

- What exactly do you want to measure (how many samples, how are the samples different, what environmental conditions)
  - Say if you have the samples on hand. If not (not good!) how do you know you can make/get them?
  - How are samples characterized? (Do you really have a good sample?)
  - Measurement conditions may be impossible for a particular beamline
  
- Be clear about experimental limitations that you plan to work around
  - For neutrons, be aware of "impossible" isotopes/elements (be clear about deuteration, etc.);
  - For x-rays consider fluorescence & absorption edges, penetration depths...
  
- If you have any preliminary facility measurements, mention them.
  - Explain why what has been done is not sufficient; what will be different in the proposed measurement.
  
- Likewise, discussing theoretical work can show that you are well prepared

## AN OUTLINE FOR A PROPOSAL (II-B)

### Measurement time estimates

- Beamtime estimates are looked at critically
  - Asking for way too little time marks you as unknowledgeable
  - If you ask for a large fraction of the available time, even if estimate is reasonable, your experiment will be seen as impossible
    - Consider breaking the project up into manageable segments with separate proposals

Discuss the expected measurement with someone who has experience with the technique or intended instrument (usually a beamline scientist), they have the best idea what is needed.

If your experiment requires extra time than usual (for example, with a dilute sample) explain why this is the case

## AN OUTLINE FOR A PROPOSAL (III)

### Analysis

- Discuss how will you go from a measurement to a result?
  - Have you (or your group or even cite someone else) done something related?
- Why do you think the measurement will give you the result you want?
  - “If we see... this will demonstrate that...”
  - “This measurement will resolve the debate in the literature between..., because...”
  - Can you model the experiment to show expected differences if your hypothesis is or is not true?

*You do not need to be certain your measurement is going to work – this is experimental science after all – but if the reviewer is sure that the experiment will not work, they are not going to give you time. If you convince them that you have examined the issues they are thinking about and still have reasons to consider the odds as worthwhile, they are more likely to give your idea a chance.*

# KEEP IT SHORT AND SWEET

## A proposal is not a paper

- Some of the best rapid access proposals I have reviewed have been 3 or 4 paragraphs!
  - Long proposals make for grumpy reviewers
  
- You do not need to cite all the literature or prove your claims.
  - It is enough to say “Skutterudites are a very promising class of thermoelectrics” or “A goal in our work is to find lead-free piezoelectrics”
  
  - “The Smith-Jones group has applied XYZ analysis to <their problem>; this approach can be applied to <our problem>.”
  
- An experiment need not be “fancy” to require a synchrotron/neutron source.
  - I have approved of experiments on known-structure materials for 11-BM when the goal was low level crystalline impurity quantification or size/microstrain
    - Crucial: explain why the experiment is not possible on lab instrument

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# ONE REVIEWER’S PET PEEVES

- When the proposal is inconsistent: Tables list different numbers or composition samples than text; are inconsistent on measurement conditions (e.g. numbers of temperature points)
  - Without knowing what measurements will be done, one cannot decide how much time is needed
  - If the proposer can’t get this right, can you trust anything else in the proposal?
  
- Proposals that tell me what will be determined (e.g. a crystal structure) without explaining why that is needed for the project
  
- When the proposal requires environmental control that is not available or ignores the difficulty that it adds to the measurement

***I will be trying to decide if your measurement will have enough sensitivity to learn what you want. If you have already demonstrated this (calculation or prior measurement), please tell me.***

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## SAMPLES ARE KEY

When reviewing a proposal, I look very carefully at what samples will be used

- I have seen too many proposals that underestimate the task of creating appropriate samples (for example, amount scale-up for neutrons)
  - Showing up and saying "we could only make these..." is not a good thing
- Experiments fail because samples are not worthy of beamtime (phase pure, well characterized, in sufficient quantities...)
  - Sometimes this is unavoidable, but if you waste beamtime for lack of characterization that could have been done with more preparation, you may not be so welcome for your next measurement
- If you have well characterized samples ready, say so.
  - If you don't, I probably will assume you are writing a proposal for samples that you hope to have by the time you get beamtime

***As a reviewer, one goal is to separate the people who are prepared from the ones who are not.***

## GETTING HELP

# INSTRUMENT SCIENTISTS ASSIST FIRST-TIME AND RETURNING USERS

- **Beamline scientists provide technical advice, guidance, and assistance**
  - Instrument options
  - Sample and experiment preparation
  - Will estimate amount of beamtime needed
  - Logistics (scheduling, transporting and storing samples)
  - Proposal preparation tips and assistance
  - Will usually not provide data analysis, but can help get you started
- **Publication considerations**
  - Beamline scientists should not automatically be considered a collaborator, but often should be offered co-authorship
  - You must acknowledge the beamline and facility; consider thanking non-collaborator beamline scientists by name
  - Chocolate never hurts...

**Depending on the level of involvement, consider if beamline staff should be seen as collaborators. Include them as co-author if she/he put in a significant amount of time, provides scientific insight or helps significantly with data analysis.**

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# IF YOU ARE A NEWBIE, GET SOME HELP

## ***Consult with a Beamline Scientist***

- Beamline scientists are really busy (particularly, just before proposal deadlines), but they are the ultimate resource. Most really like working with students and see bringing in new users as an important part of their job.

## ***When all else fails:***

- If you are having trouble getting time, you can see if you can enlist a beamline scientist as a collaborator
  - She/he may be able to make a preliminary measurement as a proof of concept
  - Beamlines do not get much internal time: proposals are still usually needed
  - They may be able to help improve your proposal
  - **Note:** simply adding the name of a beamline scientist as a participant will not make a weak proposal any stronger.

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## Feedback

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Lecture – 3:30 – 4:30

Proposal writing - Brian Toby

<https://forms.office.com/g/gye2UKB3Sf>

