PROPOSAL WRITING TIPS

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Argonne National Laboratory
2019 National School on Neutron and X-ray Scattering
June 16-29, Argonne and Oak Ridge National Laboratory

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WHAT DO SCIENTISTS WANT?

Neutrons Investigate Tomatoes for Insights Into Interplant Chatter
WHAT DO SCIENTISTS DO?

- Need to get funding, beamtime
- Call for proposals
  - write proposals
  - review proposals
  - give presentations
- (try to) get (more) funding, beamtime
WHAT DO SCIENTISTS DO?

• Need to get funding, beamtime
• Call for proposals
• write proposals
• review proposals
• give presentations
• (try to) get (more) funding, be

Then a Miracle occurs

I think you should be a little more specific, here in Step 2

"Still nothing. You sure this is the best computer we have?"
X-RAY AND NEUTRON SOURCES AVAILABLE WORLDWIDE

• **Light Sources summarized at** [www.lightsources.org](http://www.lightsources.org)
  ~61 facilities: 48 synchrotrons + 13 free electron lasers (FELs)
  ◦ European Synchrotron Radiation Facility (ESRF), Grenoble, France
  ◦ SPRING-8, Japan
  ◦ PETRA III, Germany
  ◦ CLS, SLS, Shanghai, DIAMOND, BESSYII, SOLEIL, Taiwan, Pohang, ...
  ◦ XFEL.EU, SACLA, FLASH, ...

• **Neutron Sources summarized at** [www.neutronsources.org](http://www.neutronsources.org)
  ~50 research centers:
  ◦ Institut Laue-Langevin (ILL), Grenoble, France
  ◦ ISIS UK
  ◦ JSNS at J-PARC, Japan
  ◦ China Spallation Neutron Source, Dongguan (~2018)
  ◦ European Spallation Source (ESS), Lund, Sweden (~2019)
U.S. X-RAY AND NEUTRON SOURCES (MOST DOE-BASIC ENERGY SCIENCES)

Also

5 DOE Nanoscience Centers (BNL, SNL/LANL, ORNL, ANL, LBNL)
3 DOE Electron Microscopy Centers (ANL, LBNL, ORNL)
FY 2019 BES Budget: $2166.0M (+$76M or +3.6% from FY 2018)

Research programs

- Core Research will emphasize quantum information science, data science for discovery, and BRN topics ($551M).
- Computational Materials and Chemical Sciences continue ($26M)
- Energy Frontier Research Centers continue ($110M)
- Funding continues for Energy Innovation Hubs (JCAP & JCESR) ($39M).

Scientific user facilities

- Operations of 12 facilities at nearly 100% optimal level ($922M; Δ=+$23.4M)

Construction/MIE* Δ=+$58.4M

- Last year of funding, LCLS-II ($135.4M)
- APS-U ($130M), LCLS-II-HE ($34M), ALS-U ($62M), PPU ($60M)
- One new start: STS ($6M)

*includes OPC
Research at APS Contributes to 2018 Chemistry Nobel Prize

Scientific Achievement
Dr. Frances Arnold (California Institute of Technology) was 1 of 3 2018 Chemistry Nobel awardees for work showing how “directed evolution” can be used to develop proteins or enzymes that have desired enzymatic activity, which can be used to produce chemicals, biofuels, and pharmaceuticals.

Significance and Impact
“The structures were critically important to advancing and understanding the overall evolutionary design successes for which Dr. Arnold has been recognized,” said Matthew Redinbo, William R. Kenan Distinguished Professor of Chemistry, Biochemistry, Microbiology, and Genomics at the University of North Carolina at Chapel Hill, who collaborated on the study.

Research Detail
As part of this research, samples of the enzymes that were created were studied utilizing the General Medical Sciences and Cancer Institutes beamline 23-ID-D at the Advanced Photon Source (APS), a U.S. Department of Energy Office of Science User Facility.

Structure of an evolved biocatalyst for cyclopropanation, determined at the APS.

See: P.S. Coelho et al., Nat. Chem. Biol. 9, 485 (2013). DOI: 10.1038/nchembio.1278
Contact: frances@cheme.caltech.edu


Work performed at Argonne National Laboratory
More than 300 companies from various sectors of the manufacturing, chemical, & pharmaceutical industries conducted research at BES scientific user facilities. Over 30 companies were Fortune 500 companies.
BOTH SNS AND HFIR ARE OVERSUBSCRIBED

Getting beam time is not guaranteed

Facility Subscription Rates by Year

<table>
<thead>
<tr>
<th>Year</th>
<th>SNS</th>
<th>HFIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>247%</td>
<td>199%</td>
</tr>
<tr>
<td>2010</td>
<td>265%</td>
<td>274%</td>
</tr>
<tr>
<td>2011</td>
<td>282%</td>
<td>274%</td>
</tr>
<tr>
<td>2012</td>
<td>250%</td>
<td>222%</td>
</tr>
<tr>
<td>2013</td>
<td>306%</td>
<td>268%</td>
</tr>
<tr>
<td>2014</td>
<td>252%</td>
<td>252%</td>
</tr>
<tr>
<td>2015</td>
<td>341%</td>
<td>412%</td>
</tr>
<tr>
<td>2016</td>
<td>291%</td>
<td>269%</td>
</tr>
<tr>
<td>2017</td>
<td>328%</td>
<td>220%</td>
</tr>
</tbody>
</table>
BASICS OF THE FACILITY PROPOSAL SYSTEMS

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 Users (GU)”.

• 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

• All proposals are peer-reviewed and rated, and beam time is allocated based on the scores of these reviews. Once time has been allocated, the beamline staff schedule the proposals.
AMOUNT OF **GENERAL USER TIME AVAILABLE**

**APS/NSLS/SSRL/ALS**
- ✓ All beamlines offer **GU beam time**.
- ✓ Most DOE/NSF funded beamlines provide 80-100% of their time to general users.

**SNS/HFIR**
- ✓ Amount varies by instrument.
- ✓ ~75% of time will be for general users.

For most, you can search facility websites by technique or by beamline. Quality of proposal websites varies.
### PROPOSAL DEADLINES

<table>
<thead>
<tr>
<th>X-ray sources (cycles/yr)</th>
<th>Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>APS (3)</td>
<td>July 5, 2019 (every 4 months)</td>
</tr>
<tr>
<td>ALS (2)</td>
<td>Sept 4, 2019 (every 6 months)</td>
</tr>
<tr>
<td>NSLS-II (3)</td>
<td>Sept 30, 2019</td>
</tr>
<tr>
<td>LCLS (~2)</td>
<td>down for upgrade</td>
</tr>
<tr>
<td>SSRL (3)</td>
<td>May 1, Aug 1, Nov 1</td>
</tr>
<tr>
<td>CHESS</td>
<td>July 8, 2019 (8 am)</td>
</tr>
</tbody>
</table>

**Neutron sources**

<table>
<thead>
<tr>
<th>Source</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFIR (2)</td>
<td>currently not operational</td>
</tr>
<tr>
<td>SNS (2)</td>
<td>soon</td>
</tr>
<tr>
<td>NIST-NCNR (2)</td>
<td>~ October and April</td>
</tr>
</tbody>
</table>

- These are hard deadlines.
- APS at Friday midnight, central time (12:01 → next cycle)
Get Started with Assistance From the Instrument Scientists

• Study facilities and instrument web pages
• **Contact an Instrument Scientist to discuss your research**
  • What is the research problem?
  • Which instrument(s) are appropriate? (scores?)
  • How mature is the research project (risk, size)?
  • What is the material – sample composition, form, size, availability?
  • 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?
Instrument Scientists Assist First-time and Returning Users

• Provide technical advice, guidance, and assistance
  – Instrument options
  – Sample and experiment preparation
  – Number of experiment days
  – Logistics (scheduling, transporting and storing samples)
  – Proposal preparation tips and assistance
  – Experiment team members
  – Data analysis
  – Publication considerations

• Consider beamline staff as collaborators
Submitting a proposal

Facilities generally have link on home page

NSLS-II
Submitting a proposal

Facilities generally have link on home page
Submitting a proposal

Facilities generally have a link on their home page.
Submitting a proposal

Facilities generally have link on home page
Different types of proposals allow facility flexibility

Each facility has particular systems or proposal modes:

**APS**
- **General User Proposal (GUP)**: Valid for two years or until recommended shifts are fully used. A beam time request must be submitted for each cycle for which the proposal is to be considered.
- **Partner User Proposal (PUP)**: Groups whose work involves a greater degree of collaboration with the APS (e.g., major new instrumentation or technique).

**CHESS – Cornell**
- **Standard Proposal**: 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**: 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**: 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.
Proposal forms at SNS and APS

SNS/HFIR

Each proposal system will ask very similar questions

APS

Select Your General User (GU) Proposal Type:
- Rapid Access Mail-in Powder Diffraction or PDF (11-BM, 11-ID, 17-BM) Proposal
- Macromolecular Crystallography Proposal (includes rapid access MC)
- Standard General User Proposal
- Rapid Access General User Proposal (DO NOT USE FOR MC PROPOSALS)

Use for Mail-in Work Only

These proposals are for mail-in rapid access powder diffraction or PDF measurements at 11-BM, 11-ID-B, and 17-BM. No expiration notices are sent.

Not accepted:
- Biohazards
- Human-Derived Materials
- Radioactive Materials
- Particle irradiated samples
- Non-Sterilized Regulated Soils
- Explosives or Unstable Materials
- Liquids

Choose beamline: 11-BM, 11-ID-B, 17-BM

Select Your General User (GU) Proposal Type:
- Rapid Access Mail-in Powder Diffraction or PDF (11-BM, 11-ID, 17-BM) Proposal
- Macromolecular Crystallography Proposal (includes rapid access MC)
- Standard General User Proposal
- Rapid Access General User Proposal (DO NOT USE FOR MC PROPOSALS)

Standard general user proposals are valid for two years (6 cycles) or until recommended shifts are fully used.

Available Cycle(s) for Standard GU Proposal:
Select 2019-3 Due 06-JUL-19
Proposal forms at SNS and APS

Each proposal system will ask very similar questions.
Questions asked

- 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)?
  - Why do you need an insertion device beamline instead of a bending magnet?
  - Spallation source vs. reactor source
  - Hard X-rays vs. Soft X-rays
- Why do you need the beam line (and/or instrument)?
  - Particular technique or sample environment
- What previous experience / sample characterization / results do you have (pubs important)?
- Describe the proposed experiment(s), including samples and procedures. **Show that you’re prepared.**
- Justification of the amount of time requested. Don’t be greedy or unrealistic about time needed. Ask beamline staff if not known from previous experience.
Proposal: General information

- 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 CaFe2As2 under pressure”
  - Bad: “Understanding superconductivity in superconductors”

- Is it thesis related? Is there a deadline?
  - May push your proposal up if scores are close

- Fill in the 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 upload 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
Proposal: Experimenters page

- Use the “find” feature
- List everyone involved in experiment
- Even theorists are useful to show impact / readiness of the team to interpret results
**Note guidance!**

Don’t write one sentence or 1000 words.

Do not use undefined jargon or acronyms that could frustrate reviewer!
Experimental Details

- Give background information why it is important.
  - Science at facilities is very diverse. Reviewer is not necessarily an expert on your subject. Try to capture imagination of reviewer with basic idea.
  - Each committee gets many proposals each cycle. Proposal needs to be clear and concise.

- Clearly state what you want to measure and how
  - Give some details. Temperature range, X-ray Energy, Sample geometry
  - What sample characterization has been done already (XRD, SEM, etc.)? Is there preliminary data?
  - Can you provide a calculation to show sensitivity is there?
  - Reviewer needs to judge if experiment is feasible

  ➡ Does x-ray energy match laser penetration depth
  ➡ % of dilute atoms OK for fluorescence measurements
Experimental Details

- Why use x-rays or neutrons?
  - Neutron vs. X-rays OR Neutron + X-rays?
  - TEM, Mössbauer, Laser Raman, etc. (Have you done your homework?)

- Justify the amount of beam time requested (ask instrument scientist!)
  - Be reasonable.

- How will you analyze your data?
  - Don’t count on a Miracle to occur
APS proposals are valid for two years, but need to put in beam time request each cycle.

- Chose multiple beamlines.
  - SAXS (12-ID, 5-ID, 15-ID)
  - XAFS (20-BM, 10-ID, 12-BM)
  - General Diffraction

- Don’t list only one week that you can come. Holidays?

- Special sample environment / detectors will place more constraints on schedule.
  - GE amorphous Si detector
  - Magnet
  - …
Ratings for APS Proposals

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Extraordinary</td>
<td>The proposal involves highly innovative research of great scientific importance. Proposed research will significantly advance knowledge in a specific field or scientific discipline. Considerable societal relevance is demonstrated. The radiation characteristics of the APS are highly desirable for the success of the proposed work.</td>
</tr>
<tr>
<td>2 - Excellent</td>
<td>The proposed research is of high quality and has potential for making an important contribution to a specific field or scientific discipline. The work is cutting edge and is likely to be published in a leading scientific journal. The radiation characteristics of the APS are important to the success of the proposed work.</td>
</tr>
<tr>
<td>3 - Good</td>
<td>The proposed research is near cutting-edge and likely to produce publishable results. Impact on a specific field or scientific discipline is likely. Synchrotron radiation is essential to accomplish the intended goals of the research. The proposed work will greatly benefit from access to the APS.</td>
</tr>
<tr>
<td>4 - Fair</td>
<td>The proposed research is interesting but may not significantly impact a specific field or scientific discipline. Publication may or may not result from this research. Synchrotron radiation is required, but the proposed work could be performed at other facilities.</td>
</tr>
<tr>
<td>5 - Poor</td>
<td>The proposed research is not well planned or is not feasible. Results would not make important contributions to fundamental or applied understanding, and work is not likely to result in publication. The need for synchrotron radiation is not clear.</td>
</tr>
</tbody>
</table>

APS proposals are rated on a scale from 1 to 5
Cut off score for receiving beam time varies by beamline (<1.5 to 2.2)

Proposal “ageing” (score improves by 0.2 each cycle it does not receive time). This is needed for getting time at some oversubscribed beamlines, so long-term planning is needed. But you have to remember to request beamtime again for every cycle.
Pick appropriate panel - Important!

Current Panels
High Pressure
Instrumentation
Imaging/Microbeam
Macromolecular Crystallography
Scattering - Condensed Matter
Scattering - Applied Materials
Scattering – Chem / Bio / Environment
Small Angle Scattering (SAXS)
Spectroscopy
Structural Science
Inelastic X-ray scattering
Pump Probe
Dynamic Compression

If multiple possibilities - Look at members & Ask staff

https://www1.aps.anl.gov/About/Committees/Proposal-Review-Panels
ALS provides cutoff scores - Helps you know what to expect

https://als.lbl.gov/general-user-proposal-score-statistics/

SNS/HFIR does not tell you a score or panel members. You can try asking user office or beamline.

<table>
<thead>
<tr>
<th>Beaml ine</th>
<th>% Beam Time Allocated / Requested</th>
<th>Cutoff Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4 (IR)</td>
<td>76</td>
<td>easier 2.84</td>
</tr>
<tr>
<td>2.4 (SNS)</td>
<td>54</td>
<td>2.08</td>
</tr>
<tr>
<td>4.0.2 (Magnetic Spectroscopy/Scattering)</td>
<td>18</td>
<td>1.63</td>
</tr>
<tr>
<td>4.0.3 (MERLIN)</td>
<td>22</td>
<td>1.68</td>
</tr>
<tr>
<td>5.3.2.2 (Polymer STXM)</td>
<td>71</td>
<td>1.73</td>
</tr>
<tr>
<td>5.4 (OR)</td>
<td>79</td>
<td>easier 2.40</td>
</tr>
<tr>
<td>6.1.2 (Soft X-Ray Microscopy)</td>
<td>51</td>
<td>1.73</td>
</tr>
<tr>
<td>6.3.1.1 (Magnetic Spectroscopy)</td>
<td>25</td>
<td>1.80</td>
</tr>
<tr>
<td>6.3.2 (Calibration, Optics Testing, Spectroscopy)</td>
<td>68</td>
<td>2.36</td>
</tr>
<tr>
<td>7.0.1.2 (COSMIC)</td>
<td>28</td>
<td>1.50</td>
</tr>
<tr>
<td>7.0.2 (Surface &amp; Materials Science [MAESTRO])</td>
<td>20</td>
<td>1.44</td>
</tr>
<tr>
<td>7.1.1 (ISAAC)</td>
<td>56</td>
<td>1.80</td>
</tr>
<tr>
<td>7.3.3 (SAKS)</td>
<td>46</td>
<td>1.58</td>
</tr>
<tr>
<td>8.0.1 (SKF)</td>
<td>19</td>
<td>1.68</td>
</tr>
<tr>
<td>8.3.2 (Tomography)</td>
<td>48</td>
<td>1.87</td>
</tr>
<tr>
<td>9.0 (Chemical Dynamics, Coherent Imaging)</td>
<td>68</td>
<td>2.03</td>
</tr>
<tr>
<td>9.1.1 (Tender APXPS)</td>
<td>14</td>
<td>1.20</td>
</tr>
<tr>
<td>9.3.2 (APXPS)</td>
<td>29</td>
<td>1.48</td>
</tr>
<tr>
<td>10.0.1 (HERS/AMO)</td>
<td>24</td>
<td>1.76</td>
</tr>
<tr>
<td>10.3.2 (Micro XAFS)</td>
<td>50</td>
<td>1.73</td>
</tr>
<tr>
<td>11.0.1 (PEEM3, Soft X-Ray Scattering)</td>
<td>20</td>
<td>1.55</td>
</tr>
<tr>
<td>11.0.2 (Molecular Environmental Sciences, STXM, ambient pressure XPS)</td>
<td>22</td>
<td>1.24</td>
</tr>
<tr>
<td>12.2.1 (Small Molecule Crystallography)</td>
<td>53</td>
<td>1.60</td>
</tr>
<tr>
<td>12.2.2 (High Pressure)</td>
<td>25</td>
<td>1.55</td>
</tr>
<tr>
<td>12.3.2 (Microdiffraction)</td>
<td>38</td>
<td>1.70</td>
</tr>
</tbody>
</table>
Tips (see also: https://neutrons.ornl.gov/users/tips)

- Pick a good science question
- Give a concise explanation, with a good bit of background for non-specialist
- Provide background on importance
  - what is the bigger picture
  - what is known, what is not known
- State a clear hypothesis
  - what are you going to measure
  - how is it related to your big science question
- Include relevant details regarding the experiment, but do not get too verbose
  - Reviewer needs to judge feasibility of the experiment, choice of instrument
Tips (see also: https://neutrons.ornl.gov/users/tips)

- Talk to the local contact / instrument scientist (in particular if first time user)
  - Find out about details of the instrument, typical measuring times…
  - Over-subscription rate? Can a less popular instrument do the same measurements?
  - Send them the proposal ahead of time and ask for advice. Collaborate?
- If you have previous results from other experiments include them!
  - Home, other institution, previous experiment.
  - Sample characterization.
- Take advantage of proposal ageing. Plan ahead!
- Do not submit a bad proposal in a rush.
Several common pitfalls

- Proposer assumes committee is familiar with their specialty. Explain impact.
- Proposer writes large general vague proposal asking for multiple weeks of time. Better to write a shorter proposal with a well defined objective. Be realistic with beam time request.
- Proposer submits 2 (or more) similar proposals for related materials thinking that multiple proposals increases chances.
- Proposal deadline (for next cycle) is before scheduled beam time this cycle.

Common Reviewer comments:

- “The score could be improved by including more experimental details, attaching previous results and expanding on the purpose and importance of the research.”
- “Hasn't the proposed research been published previously?”
- “We do not feel that granting 20 shifts/cycle for 2 years is consistent with the history of publication of this work.”
- “Proposer should perform initial characterization with lab sources or TEM.”
- “Will the signal be strong enough compared to background?”
After submission

- Allow time for review and revisions
- Expect feedback several weeks from the call close
- Be ready to schedule experiment if approved
  - Identify participating team members
  - Respond to facility access approval information
  - Facilitate execution of user agreements
  - Complete required training
  - Confirm sample availability and description and laboratory needs
- Consider reviewer comments if not approved and plan to resubmit this proposal or a new proposal in the next call. Opportunities (# of facilities and beamlines/facility) continue to grow.
Scientific and Funding Opportunities

As a student

- Attend neutron & x-ray schools, workshops & user meetings. Knowledge and connections have long-term impact. Collaborations are essential.
- Join SNS HFIR User Group (SHUG) and other facility user organizations
  - Advocacy group, learn about and influence new developments
- Explore DOE and NSF internships, fellowships, and research programs
  - SCGSR; ORISE/ORAU (HERE, GO!). Local contacts help (a lot).
  - [https://science.energy.gov/wdts/scgsr/how-to-apply/priority-sc-research-areas/](https://science.energy.gov/wdts/scgsr/how-to-apply/priority-sc-research-areas/)
- Invite scientists from national labs to your campus, e.g. for seminar

As a young professional

- Continue to use “free” user facilities
  - New faculty and industrial users can be favored in reviews
- Volunteer to be a reviewer on proposal panels
- Consider EPSCoR programs if located in a participating state
- Apply for Early Career award – great for tenure application
LIST OF FACILITIES WEBPAGES

ALS  https://als.lbl.gov/
APS  https://www.aps.anl.gov
CHESS https://chess.cornell.edu
LCLS https://lcls.slac.stanford.edu
SSRL https://www-ssrl.slac.stanford.edu
NSLS-II https://www.bnl.gov/ps/
SNS/HFIR https://neutrons.ornl.gov
NIST https://www.nist.gov/ncnr

Worldwide resources: https://lightsources.org/
                          https://neutronsources.org/
THANKS TO

• Jonathan Lang
• John Budai
• Suzanne te Velthuis