National Superconducting Cyclotron Laboratory
Call for Proposals—ReA Stand Alone during FRIB Transition

October 15, 2019

Dear NSCL User:

We invite proposals for beam time using ReA3 or ReA6 in stand-alone mode, to be considered at a special meeting of the NSCL Program Advisory Committee (ReA-PAC) scheduled for March 3-4, 2020. All proposals for review by the ReA-PAC need to be received at the NSCL by 5 pm EDT on Thursday, January 9, 2020 to allow for scientific and technical review of the proposals prior to the ReA-PAC meeting.

ReA-PAC will consider experiments using stable and long-lived delivered by ReA3 and ReA6. Proposals to use low energy or thermalized beams in the Low Energy Beam Area will also be considered (see item #6 under Special Considerations). The approved experiments will be run during the transition period between the end of the CCF running period and the start of the FRIB running period or September 30, 2021, whichever comes first. Please see item #2 under Special Considerations for more information on anticipated beams.

General information on the NSCL proposal process is available at: (http://nscl.msu.edu/users/guide.html). The website includes information on the PAC process, and includes a link to Advice on Proposal Preparation, http://www.nscl.msu.edu/users/Advice.html, where users can find two example proposals.

The timetable for ReA-PAC is:

Monday, November 25, 2019	Beam list finalized (see page 4, item #2)
Thursday, January 9, 2020	Proposals must be received by 5 pm EST
Tuesday-Wednesday, March 3-4, 2020	ReA-PAC Meeting
Thursday, March 5, 2020	List of approved experiments posted online and spokespersons notified.

The members of ReA-PAC are:

Daniel Bardayan	University of Notre Dame
Michael Carpenter	Argonne National Laboratory
Catherine Deibel	Louisiana State University
Paul Fallon	Lawrence Berkeley National Laboratory
Alexandra Gade	NSCL
Kirby Kemper	Florida State University
Eric Ormand	Lawrence Livermore National Laboratory
Guy Savard	Argonne National Laboratory

Brad Sherrill (NSCL Director) is the non-voting convener and Jill Berryman (Manager for User Relations) is the PAC administrator.

Information must be provided for your proposed use of NSCL facilities to allow the Program Advisory Committee to assess the scientific merit and level of NSCL support needed to carry out the proposed research. Therefore, each proposal submission must contain the following items:

(A) Completed ReA-PAC Proposal Form including a proposal summary of no more than 200 words. The Proposal Form is available on-line and can be accessed from the “Submit

Proposal" link at the website: http://nscl.msu.edu/users/call-for-proposals.html. The Beam Request Worksheets, the Safety Information worksheet, the "Status of previous NSCL experiments" page, and the "Educational Impact of the proposed experiment" page are all included in the online form. When listing the Status of previous NSCL experiments, please list outcomes, such as publications or theses of each prior experiment. The supporting Proposal Elements Document (described in part B below) should be uploaded using links within the online form.

(B) The ReA-PAC Proposal Elements Document, available at the same web site, must contain a description of the experiment, or the body of the proposal. There is a strict text limit for the description of 4 text pages, 12 pt. font, 1.5 line spacing; with no limit on figures or tables. Please organize the material under the following headings or their equivalent:

1. Physics justification, including background and references;
2. Goals of the proposed experiment;
3. Experiment details
    i. what is to be measured;
    ii. technical feasibility of measurement (demonstrated by simulation and/or reference to prior work);
    iii. counting rate estimates (including assumptions), expected statistics, and level of uncertainty;
    iv. explanation of the basis of the time request (include time for experimental device tuning, debugging the experimental setup, calibrations, any test runs, and any stable beam runs necessary for reference, etc.);
    v. an indication of present state of readiness of the experiment and an estimated earliest date for the run;
    vi. a clear statement of any technical assistance (design, fabrication, installation, etc.) that may be requested from NSCL;
    vii. apparatus (including drawing);

(C) The estimates for ReA beam intensities are available on the website https://nscl.msu.edu/users/beams.html. To ensure that the required beam characteristics (purity, time structure, energy spread, etc.) can be achieved, a ReA beam request worksheet should be completed as part of the online Proposal Form.

Please submit your completed proposal via the "Submit Proposal" link at the website http://nscl.msu.edu/users/call-for-proposals.html by 5 pm Eastern Standard time on Thursday, January 9, 2020. It will not be possible to submit proposals for the ReA-PAC after this deadline.

Please note the following:

- Previous PACs have emphasized that particular care should be taken to submit well-written proposals, with the proposed scientific goals clearly presented. In addition, the PAC has urged that proposers strictly follow the specified proposal format rules, including:
    - The proposal text, including the Physics Justification, Goals, and Experiment Details must be kept to a maximum of four pages.
    - References, figures, and tables should follow the text (do not imbed in text).
    - One figure should show a physical layout of the experiment.
    - A summary (no more than 200 words) of the experiment is required and must be included in the online Proposal Form.

  - The Safety Information Worksheet must be completed in full, including the name of the Safety Contact for the proposed experiment.

- The total beam time request for an experiment must include on-target beam time needed to test and debug equipment and to perform calibrations. Each additional beam required for testing and performing calibrations must be listed explicitly. It is especially important to identify all beams (stable or not) necessary for calibration or reference reactions for ReA experiments in the proposal. Requests for interruptions in beam time (for example a gap between a test run and the main run or an interruption in the main run to change the experimental configuration) must also be indicated.

- The spokesperson must affirm upon submission of the Proposal Form that all collaborators listed on the proposal have at least read the Description of Experiment section and have agreed to participate in the experiment.

- Spokespersons must be members of the FRIB Users Organization (FRIBUO). To become a member, please register at http://fribusers.org/organization/join.html.

- The PAC considers the experience and technical and scientific strength of the experimental team, in addition to the physics of the proposal and its technical feasibility. Therefore, please apprise the Manager for User Relations, Jill Berryman, of any changes in experimental personnel after submission and/or approval of the proposal.

- The titles of approved proposals and the spokesperson are publicly announced by title on the NSCL website. Proposers may wish to carefully consider the title of their work for competitive experiments.

- The role of *Spokesperson* carries significant management responsibility for the successful completion of approved experiments. The Spokesperson is the primary contact person from the experimental group for the NSCL. Potential Spokespersons should review the expected roles they will play and responsibilities that must be executed in preparing, performing, and after completing an experiment at NSCL. For example, among other duties, the Spokesperson must:

  (1) Respond to requests for information about the proposal, about scheduling, and any other requests from the Manager from User Relations.
  (2) Once approved, complete the *Scheduling and Safety Questionnaire*.
  (3) Participate in person, by video, or by telephone in an Experiment Readiness Review with NSCL staff to establish the level of NSCL support and to review the final setup. The Experiment Readiness Review includes a full safety review.
  (4) Read the document "Responsibilities of Experimenters at NSCL" prior to the experiment, and sign a form acknowledging that all members of the experimental team have also read it.
  (5) Manage the execution of the experiment or indicate that this function has been delegated to a specific individual.
  (6) Complete and sign a checklist upon completion of the experiment.
  (7) Complete the Experiment Feedback Form upon completion of the experiment.

  Following the performance of the experiment, the Spokesperson must take responsibility for data management and the active organization of data analysis to facilitate timely publication of results. Additional information about the Spokesperson's responsibilities is available at: http://nscl.msu.edu/users/guide.html.

Each proposal will be reviewed by the entire PAC and will be assigned to two PAC members (one primary and one backup) for detailed consideration. The names of the primary and backup PAC members will be sent to the spokesperson no later than two weeks after the proposal due date. The spokesperson or delegate is encouraged to contact the primary PAC member charged with the detailed review of your proposal in order to address questions she/he may have and/or provide clarifications, afterthoughts, etc. The proposals will also undergo a technical review and a safety review by the NSCL staff and the results will be communicated to spokespersons and the PAC, as described in items #7 and #8 of the "Notes for ReA-PAC" given below.

SPECIAL CONSIDERATIONS FOR ReA-PAC

1. Duration of PAC Approvals: The length of validity for proposals is until 30 September 2021 or the start of FRIB Operations, whichever comes first.

2. General Beam Information: Users can propose experiments with any stable isotope of the elements listed at https://nscl.msu.edu/users/beams.html. A list of possible long-live radioactive isotopes is available on the same webpage. If a user would like to request a stable isotope or long-lived isotope that is not on the list (must have a half life longer than 6 days), please contact the Manager for User Relations, Jill Berryman, ***prior to November 25, 2019***. The requested isotope will be reviewed by the Operations Department for feasibility, prior to the proposal deadline. Once the requested isotope has been approved, it will be put on the website and other users may then request the same long-lived isotope. Check the website regularly for updates. All of the long-lived radioactive beams will require development time, and may not be available at the beginning of the ReA stand-alone running period.

3. Beam Properties for ReA3 and ReA6: The ReA3 experimental program enables experiments with reaccelerated beams of 0.3-6 MeV/u depending on mass-to-charge ratio of the beam extracted from the EBIT. The ReA6 experimental program enables experiments from 3-12 MeV/u. Both ReA3 and ReA6 can offer an alternative microstructure of the beam at 16.1 MHz, instead of the original 80.5 MHz, using a new multi-harmonic buncher. This would allow delivery of beam bunches spaced at 62.1 ns instead of 12.4 ns. Please, note that the overall efficiency of the system decreases by about 30% when using the new buncher. Note also that, for the moment, this capability is offered without a chopper, which means that satellite bunches are still present at 80.5 MHz frequency with intensity equivalent to about 5% of the full beam intensity.

Desired beam characteristics should be entered on the ReA beam request worksheet. Please, use http://nscl.msu.edu/users/beams.html as a guideline for the energies available with ReA3 and ReA6. The (final) maximum possible energy will depend on the final charge state selected for the experiment and generally results from an optimization process of minimizing beam impurities and maximizing EBIT charge breeding efficiencies. Please, use E_{max} (MeV/u) = 12 q/M for ReA3 and E_{max}(MeV/u) = 24 q/M for ReA6 – where q is the charge state of the beam and M its mass – as a guideline (note that: $0.20 \leq q/M \leq 0.5$).

The typical macro time structure provided by the EBIT charge breeder is a repetition rate from 2 Hz to 25 Hz with a variable time-on period (pulse width). The pulse width can be as wide as 100's of ms, depending on the frequency and duty cycle. As noted before, within the time-on period, the

micro bunch structure from the linac is 12.5 ns. Any requirements for special macro time structures (and whether the experiment is sensitive to the time structure) should be noted on the beam request worksheet.

4. Beam Delivery Time Calculation: Please include 16 hours of tuning time for the initial setup setting of the beam from the ion source to the experiment. Tuning time for energy changes are 2 hours for standard energy changes where the variation in energy is not greater than 20%. If you have questions on how much tuning time should be included for a particular case, please contact Antonio Villari. Please note that the most efficient energy variations are carried out by decreasing the beam energy. The time involved for increasing the beam energy can be significantly higher.

5. Experimental Devices: Experimental equipment for the ReA3 program resides on one dedicated beam line (JENSA/SECAR) and two general purpose beam lines. The ReA6 experimental area will contain one dedicated beam line (SOLARIS) and a general purpose beamline. With the exception of SeGA, which is a lab-supported device, collaboration is required for use of the existing equipment:

Si-barrel ANASEN, Jeff Blackmon
Active Target Time Projection Chamber (AT-TPC), Daniel Bazin
Gas Handling System for Hydrogen Gas Target, Jorge Pereira
JENSA gas target, Kelly Chipps
Low Energy Neutron Detector Array (LENDA), Remco Zegers
Heavy ion Accelerated Beam induced (Alpha,Neutron) Emission Ratio Observer (HabaNERO), Fernando Montes
Segmented Germanium Array (SeGA), Dirk Weisshaar (lab-supported device)
Separator for Capture Reactions (SECAR), Hendrik Schatz
SOLARIS, Ben Kay
Summing NaI (SuN) detector, Artemis Spyrou
SuperORRUBA (Oak Ridge Rutgers University Barrel Array), Steven Pain

A list of all experimental devices is available at http://nscl.msu.edu/users/equipment.html. The contact persons listed there will be able to provide further information on the devices. Keep in mind that most of the devices listed on that page are used for fast-beam experiments and may not have been used for a reaccelerated beam experiment in the past.

Please include any device tuning time in your beam time request.

We also welcome equipment provided by experimental groups. If you would like assistance in preparing a proposal to use your device at NSCL please contact Jill Berryman. If you have a question about the general layout of the ReA3 and/or ReA6 experimental areas, the Experimental Area Coordinator is Dave Morrissey

6. Low-Energy Beams: Rare isotope beams as well as selected stable beams found on the beam list (website) may also be delivered to the low-energy beam area. Devices that have been run in the low-energy beam area include BECOLA, LEBIT, and SuN. These devices require substantial experience and training to operate safely and properly, therefore, collaboration with qualified MSU researchers is necessary. Other experimental devices may also be used in the low-energy beam area. Experimenters who wish to bring their own equipment into this area, or have general questions should contact Chandana Sumithrarachchi. The Low-Energy beam area has recently been expanded and there are two general purpose beams lines for users.

The contact persons are:
Low Energy Beam and Ion Trap (LEBIT), Ryan Ringle
Beam Cooling and Laser Spectroscopy (BECOLA), Kei Minamisono;
Summing NaI Detector (SuN), Artemis Spyrou.
General Purpose Low-energy beam lines: Chandana Sumithrarachchi

7. Technical Review: Prior to the PAC meeting, technical experts on NSCL staff will review each proposal to assess its technical feasibility from the point of view of device capability and beam delivery. During this review, the estimates of the beam preparation time will be verified and revised, if necessary. Any issues identified in the technical review will be promptly communicated to the spokesperson of the proposal, and the issue(s) along with response(s) from the spokesperson will be distributed to the PAC.

8. Safety Review: NSCL users must perform their experiments safely. To allow us to assess any hazards associated with the specific experimental set-up, the Safety Information Worksheet must be completed in full as part of the proposal package. MSU and NSCL safety experts will review all proposals upon receipt for safety issues. The committee's findings will be promptly communicated to the spokespersons and to the PAC. If the experiment is approved, NSCL requires the experimental group to appoint a safety representative who will participate in a more detailed safety review prior to scheduling the experiment. The duties of the safety representative are available at http://nscl.msu.edu/users/safety.html. Any specialized or non-commercial equipment brought to NSCL will require an Activity Hazard Document be prepared that describes the potential hazards and planned mitigation strategies. Transportation of all radioactive source materials and activated materials (targets) must comply with the FRIB Laboratory radioactive materials license and must be approved by the Laboratory radiation safety officer, Petra Grivins.

9. Liaison with NSCL: All communications and particularly requests for assistance should be directed to the Manager for User Relations, Jill Berryman. Users are responsible for staging and carrying out their approved experiments. The level of support needed should be identified in the proposal and stated in detailed in a questionnaire submitted by the spokesperson, which is required at least six months prior to when an experiment can be scheduled. Decisions on the level of assistance reside with the NSCL Director or his/her designee. The delegation of tasks to appropriate NSCL technical personnel will be coordinated by the Manager for User Relations. It is assumed that experimenters will provide any special equipment needed for their experiments.

Brad Sherrill
NSCL Director