

The GSECARS Program Overview

Prepared by Mark Rivers and Stephen Sutton, GSECARS, The University of Chicago

GSECARS runs 4 simultaneously operating beamlines at sector 13 at the APS. We have always submitted a single unified proposal to NSF for its operations funding which supports operations on the 4 beamlines and all scientific techniques. For this solicitation we have broken this into six proposals to make it easier to compare and evaluate with proposals for other facilities. Four of these are for the main themes at GSECARS:

1. Diamond anvil cell
2. Large-volume press
3. Microprobe and computed microtomography
4. Surface and interface scattering and ambient pressure diffraction

There are separate abstracts for each of these proposals. There are also two proposals to convert a currently unused bending magnet beamline, 14-BM-D, to a new geoscience beamline. The first proposal would use 14-BM-D as a white/pink beam station for the multi-anvil press and microtomography. The second proposal would use 14-BM-D as a monochromatic beam station for bulk and meso-scale X-ray absorption spectroscopy, X-ray fluorescence imaging, X-ray diffraction, and X-ray computed tomography. We have submitted both proposals to allow the steering committee and the new proposal PI to decide, which, if either, is best suited to the needs of the earth and environmental science community.

In the past 3 years GSECARS has hosted 715 experiments, with 868 unique users representing 248 unique institutions. The number of publications from GSECARS from 2017 through October 20, 2021 is 835, or more than 165 per year. These include 79 Ph.D. theses and 19 Masters theses. GSECARS has the third most publications of all 33 APS sectors during this time, with only sector 11 (includes powder diffraction mail-in beamline) and sector 24 (protein crystallography) having more. Compared to the APS as a whole GSECARS has 2.4 times the average total number (339) of publications per sector in this time period.

In the past 3 years GSECARS has made a number of important upgrades to improve the facility for our users. These include an advanced diamond anvil cell Raman laboratory, a benchtop SEM for offline sample characterization, 5 new Pilatus and Eiger detectors, and an upgrade to the 13-ID-C/D monochromator. We partnered with COMPRES in the PX² program to develop a diamond anvil cell facility in the 13-BM-C station which emphasizes single-crystal diffraction in the diamond cell. Going forward we propose that this program be integrated into GSECARS.

In the coming 5 years GSECARS aims to take maximum advantage of the APS-U upgrade to produce sub-micron focal spots and implement techniques to exploit the high coherence of the new source. This will require investment in x-ray optics improvements and in new detectors such as an Eiger 9M for the ID-D diamond cell program. It will also require investments in computer hardware and software to handle the increased data volumes. GSECARS is proposing to increase staffing supported by the NSF-EAR-IF at sector 13 by about 15% to support these new opportunities and challenges of APS-U. We also hope to expand the number of APS beamlines dedicated to earth and environmental science by developing currently unused 14-BM-D beamline at the neighboring BioCARS sector.