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August 7, 2009

Dear Murray:

On behalf of the Sector 1 High Energy Materials Diffraction Beamline Advisory Group (BAG), I write this letter to express our strong support for the development of a new white beam experimental hutch end station at beamline 1-ID. The 1- ID beamline currently supports three programs, (1) high-energy diffraction microscopy (HEDM), (2) high-energy SAXS/WAXS studies and (3) high-energy structural studies. These programs share the 1-ID-C hutch, with some HEDM work also performed in the 1-ID-B hutch, and are enabled by the high brilliance, high-energy x-rays available at 1-ID. Similar to other programs originated at 1-ID (for example, phase contrast imaging and Rapid-PDF) that have subsequently moved to dedicated instruments at other beamlines, these three programs have experienced significant growth in recent years. This has led to unmanageable oversubscription rates (~5-fold as of run 2009-2). With such high levels of demand for beamtime, outreach to potential new users is not possible. Furthermore, the need to share limited hutch real-estate between three fundamentally different types of experiments has reduced the quality of scientific output, by diverting staff efforts towards set-up/tear-down modes, at the expense of measurement quality and optimization as well as hurting staff availability for data analysis, where they have world-leading expertise.

In order to alleviate the latter situation, we support the proposal to build a new white-beam hutch (1-ID-D) downstream of 1-ID-C to house the HEDM program, noting that this will allow the high-energy SAXS/WAXS program to have dedicated space in the 1-ID-C hutch, while the structural science work will have dedicated space in the 1-ID-B hutch. These plans are consistent with the larger goal of increasing high-energy capability to the APS, as presented in a number of scientific cases in the APS renewal. Our support is based primarily on three observations:

1) *Limitations on HEDM development*. The new hutch will facilitate the further development of unique capabilities that have been developed by Ulrich Lienert and a small group of users over the past decade.

These techniques, referred to collectively as High Energy X-ray Diffraction Microscopy (HEDM), provide information to the materials community that has never before been available. Structure deep inside of bulk polycrystalline materials can be obtained non-destructively and can be tracked as samples are processed in a variety of ways. Measured quantities include local strain states, defect concentrations, and maps of ensembles of crystals. These data, currently obtainable only at the APS and ESRF (but with significant expansions taking place in Europe), are unique in providing the exact data – including the full stress state at the scale of each crystal - that modelers need to validate theories of materials response. More importantly, these micromechanical/microstructural characterization experiments are conducted on a size scale that enables a new methodology; one where neither the experiment, nor the simulation is considered to be the validation "standard" and the degrees of freedom represented by the combined simulation and experiments exactly span the solution space describing the material and its response. Such formulations will enable accelerated routes to the design of new materials for many industrial, energy, and military applications. While 1-ID capabilities are currently unique, the hutch arrangement and workload at Sector 1 are inhibiting efforts to generate data sets that combine several different measurements (e.g., grain level strains and microstructure maps) and to optimize beam configurations and measurement apparatus. In other words, an upgrade will not only enable more work to be done but will enable new areas of science to be explored.

2) *Strengthen scientific output of other sector 1 programs.*
Creating dedicated hutches will enhance both the efficiency and quality of available beamtime to both the high-energy SAXS/WAXS and structural studies programs at 1-ID. The HE-SAXS/WAXS program is already heavily oversubscribed and highly productive, with a diverse scientific base including bio-materials deformation, chemistry/synthesis, layered systems for energy applications (fuel cells/thermal-barrier coatings, etc) and nuclear materials.
The HE structural studies program will remain unique at the APS with energy tunability at high-energies, which enables resonant scattering studies of high-Z elements. This program will continue its focus on studies of fundamental structures and structural changes under various environmental conditions that relate to properties, activities and functionalities of materials.
3) *Consistency with APS Renewal plans.* As part of the APS Renewal program, we hope that in the future the three different classes of measurements at 1-ID will be separated out to more than one beamline, allowing these programs to meet the demand already present in the community (noting, for example, that several new users proposed 1-ID experiments in the 2009-3 proposal cycle). We are confident that the materials diffraction program at 1-ID could expand far more, to suit a much wider range of materials researchers, if the capacity allowed for greater outreach. We see this upgrade as supporting the eventual goals for HE upgrades in the Renewal plans,

in that with this new white beam hutch, HEDM will create a permanent and optimized home at 1-ID, once subsequent work is done to allow transmission of white radiation to this hutch. This will then allow even greater flexibility in monochromator and focusing optics and further optimize the set of techniques available.

We understand that use of ARRA funds can allow APS programmatic funding to be used for a project such as this one. We encourage you to deploy these funds in 1-ID, as we think it would be a wise investment; it is crucial to the communities we represent. We note that the techniques at 1-ID are unique to third generation high energy synchrotrons. With new lower energy facilities such as NSLS-II coming on line, it is crucial that the APS grow those niches where it has unique capabilities. The work carried out at 1-ID greatly impacts materials science and materials engineering and can only be done at a high-energy source. This research plays an important role across industry, academia, defense and government research programs.

We would be happy to meet with you to discuss these issues or to exchange ideas via e-mail or a conference call.

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Other BAG Members:
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