High Pressure -- A New Dimension at APS

Guoyin Shen
HPCAT
High-pressure and synchrotron

- Sample size and synchrotron beam
- Surrounding (window) materials and x-ray energies
- Novel science and synchrotron *in situ* probes
Pressure as a dimension

- **Fundamental Physics**
  - Novel Phenomena and States of Matter
- **Fundamental Chemistry**
  - New Periodic Table and Bonding
- **Geophysics & Geochemistry**
  - Root of Plate Tectonics and Core Formation
- **Planetology & Astrophysics**
  - Extrasolar Planets and Warm Dense Matter
- **Materials Science**
  - New Classes of Materials (10X)
- **Biology and Biochemistry**
  - Origin and Evolution of Life
Hot iron at high pressures

Sectors 3, 13, 16
Gregoryanz et al, PRL (2005)
Dense sodium at high pressure
GSECARS: Understanding micro-to-macro relations
High-pressure researches at APS

- **Sector 1**: PDF, high energy
- **Sector 3**: Phonon DOS, NFS, NEXS
- **Sector 4**: Magnetic, XMCD
- **Sector 11**: Amorphous, high energy
- **Sector 13**: DAC, LVP, diffraction, imaging, Geoscience
- **Sector 16**: Diffraction, spectroscopy (NRIXS, XES, Raman)
- **Sector 20**: EXAFS
- **Sector 34**: micro-diffraction, single crystal
The ideal approach
APS promotes the high-pressure dimension and connects CATs
HPCAT advances novel development
# Town meeting on Nov 2, 2005 at APS

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>8:30 a.m.</td>
<td>Welcome</td>
<td>Murray Gibson/Dennis Mills Gabrielle Long</td>
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<tr>
<td>8:45 a.m.</td>
<td>A proposal for a High-Pressure Center at the Advanced Photon Source - HPCAPS</td>
<td>Dave Mao</td>
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<tr>
<td>9:15 a.m.</td>
<td>GSECARS needs and COMPRES Facilities Committee Views of HP-CAPS</td>
<td>Mark Rivers</td>
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<tr>
<td>9:30 a.m.</td>
<td>HPCAT facilities for high pressure research</td>
<td>Guoyin Shen</td>
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<tr>
<td>9:45 a.m.</td>
<td>High pressure research with nuclear resonant scattering</td>
<td>Wolfgang Sturhahn</td>
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<tr>
<td>10:00 a.m.</td>
<td>Research opportunities at the large-volume high pressure facilities at GSECARS</td>
<td>Yanbin Wang</td>
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<tr>
<td>10:45 a.m.</td>
<td>Prospects for Polychromatic Nanoprobe Beams for HP</td>
<td>Gene Ice</td>
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<tr>
<td>11:00 a.m.</td>
<td>Capabilities for high-energy scattering at Sector 1 and how they might benefit HPCAPS</td>
<td>Dean Haeffner</td>
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<tr>
<td>11:15 a.m.</td>
<td>High Pressure Biological Macromolecules</td>
<td>Keith Brister</td>
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<td>11:30 a.m.</td>
<td>EXAFS at high pressure</td>
<td>Matt Newville</td>
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<tr>
<td>11:45 a.m.</td>
<td>High pressure studies from glasses and amorphous materials</td>
<td>Chris Benmore</td>
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<tr>
<td>1:30 p.m.</td>
<td>High pressure XMCD studies of 3d metals</td>
<td>Jonathan Lang</td>
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<tr>
<td>1:45 p.m.</td>
<td>High pressure induced quantum phase transition in strongly correlated condensed matter systems</td>
<td>Yejun Feng</td>
</tr>
<tr>
<td>2:00 p.m.</td>
<td>Novel approaches to microdiffraction and their applications in high-pressure research</td>
<td>Przemek Dera</td>
</tr>
<tr>
<td>2:15 p.m.</td>
<td>Prospects for high pressure research at the new IXS beamline</td>
<td>E. Ercan Alp</td>
</tr>
<tr>
<td>2:30 p.m.</td>
<td>Sector 2 microprobes' capabilities</td>
<td>Barry Lai</td>
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<tr>
<td>2:45 p.m.</td>
<td>Round table discussion: Mission of the HPCAPS</td>
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HPC at APS - missions

- Advance novel HP-SR science & technology
- Establish a state-of-the-art HP center lab
- Support/coordinate HP instrumentation and program development at APS sectors
- Support/coordinate APS HP users
- Community outreach and technology transfer
HPC at APS - organization

• An APS Consortium
• A executive committee (APS, CAT members, users)
• At the beginning, the CIW-HPCAT group will take the initiative to organize the user community, raise funding from non-conflicting sources, provide high-pressure expertise.
We would like to have your input.

- Your vision of HP science at your sector.
- What do you want the HPCAPS to do for you, your users, and your science?
- Anything you would like to contribute to the HPCAPS? Science? Equipment? Beam time? Coordination?