NSF’s ChemMatCARS Expansion Project

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Scope of the Project

Former Beamline Layout

beamline optics

3 experimental stations
Scope of the Project

Demolition

- remove beamline optics
- remove 1 experimental station
Scope of the Project

**Under Construction**

- **15-ID-A**
- **15-ID-B**
- **15-ID-C**
- **15-ID-D**
- **15-ID-E**

- New beamline optics
- 2 new experimental stations

*Construction Project*
Beamline Development Increases Capacity and Enables New Science

2-Beamline ChemMatCARS

*Modernize existing beamline optics for APS—Upgrade X-rays and build a second beamline*

Continue to meet the needs of ongoing scientific programs – but with a better X-ray beam

New research initiatives require new instrumentation and more beamtime

Two beamlines will provide X-rays to 2 experiments concurrently

Each beamline has its own undulator X-ray source and optics
15-ID1 beamline:

- 5 – 70 keV (high energy capabilities)
- Double Crystal Multilayer Monochromator (DCMM) – crystal and multilayer optics
- Mirror focusing for energy scanning measurements (EXAFS, XANES, DAFS)
- Compound Refractive Lens (Al CRL) – 1D and 2D focusing for smaller beams (without mirrors)

15-ID2 beamline:

- 3.5 – 31.5 keV: extends energies to a useful range below 5 keV for resonant diffraction
- Side-bounce monochromator and CRL (Be) – 1D and 2D focusing – small beams and high coherence
APS-Upgrade: Smaller, Brighter X-ray Beams for ChemMatCARS

Upgrade has Much Smaller Beam Sizes

<table>
<thead>
<tr>
<th>15-ID1</th>
<th>Upgraded</th>
<th>Current</th>
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<tbody>
<tr>
<td>Mirror</td>
<td>Vertical</td>
<td>Horizontal</td>
</tr>
<tr>
<td>20 µm</td>
<td>700 µm</td>
<td>150 µm</td>
</tr>
<tr>
<td>CRL</td>
<td>2-3 µm</td>
<td>7-11 µm</td>
</tr>
<tr>
<td>15-ID2</td>
<td>New ID-B</td>
<td>New ID-E</td>
</tr>
<tr>
<td>Mirror</td>
<td>Vertical</td>
<td>Horizontal</td>
</tr>
<tr>
<td>4 µm</td>
<td>18 µm</td>
<td>2 µm</td>
</tr>
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Smaller beams in special situations using K-B mirrors (1 µm to 100s nm) and zone plates (30 nm)

Beam Flux (photons/second)

<table>
<thead>
<tr>
<th>15-ID1</th>
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<tbody>
<tr>
<td>Energy (keV)</td>
</tr>
<tr>
<td>Flux (ph/s)</td>
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<tr>
<td>Multilayer (20 &amp; 30 keV)</td>
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<table>
<thead>
<tr>
<th>15-ID2</th>
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</thead>
<tbody>
<tr>
<td>Energy (keV)</td>
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<tr>
<td>Flux (ph/s)</td>
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Upgraded APS beam will have substantially higher brightness above 3 keV than other US sources.
15-ID-D-Station (ASWAXS & Crystallography)

15-ID-B-Station (Crystallography)

15-ID-A-Station (X-ray Optics)

15-ID-C-Station (Liquid Interface)

15-ID-E-Station (Liquid Interface)
Virtual Walk-Through - 15-ID-A
Virtual Walk-Through - 15-ID-A

*Double mirror system (DMS)
*Double crystal and multilayer monochromator (DCMM)
*Side-bounce monochromator (SBM -1)
*Compound refractive lens transfocator (CRL)
*Beam position monitor

Monochromatic slits
White beam stop and brem. stop
White beam slits
White beam stop and brem. collimator
White beam slits

Shutter

33 m
28 m

* By AXILON

White beam slits
Monochromatic slits
White beam stop and brem. stop

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Virtual Walk-Through - 15-ID-A

*Double mirror system (DMS)
*Double crystal and multilayer monochromator (DCMM)
*Side-bounce monochromator (SBM -1)
*Side-bounce monochromator (SBM -2)
*Compound refractive lens transfocator (CRL) with beam position monitor (BPM)

By AXILON
Virtual Walk-Through - 15-ID-A

*Double crystal and multilayer monochromator (DCMM)

*Side-bounce monochromator (SBM -1)

*Side-bounce monochromator (SBM -2)

*By XILON
Virtual Walk-Through - 15-ID-A

*Double mirror system (DMS)
Virtual Walk-Through - 15-ID-A

*Compound refractive lens transfocator (CRL)

*Beam position monitor

* By AIXILON
Virtual Walk-Through - 15-ID-E, B

Space for future expansion

*Compound refractive lens transfocator (CRL)

Shutter

*
Virtual Walk-Through