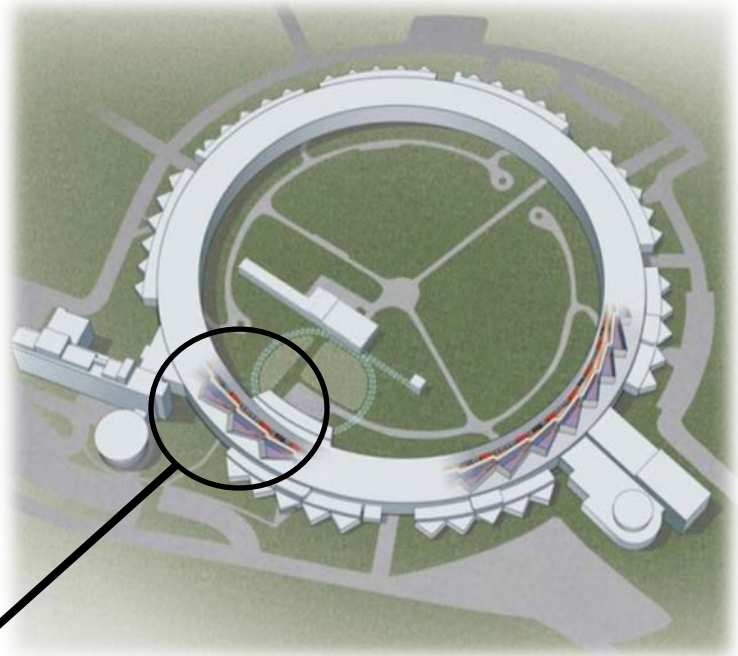
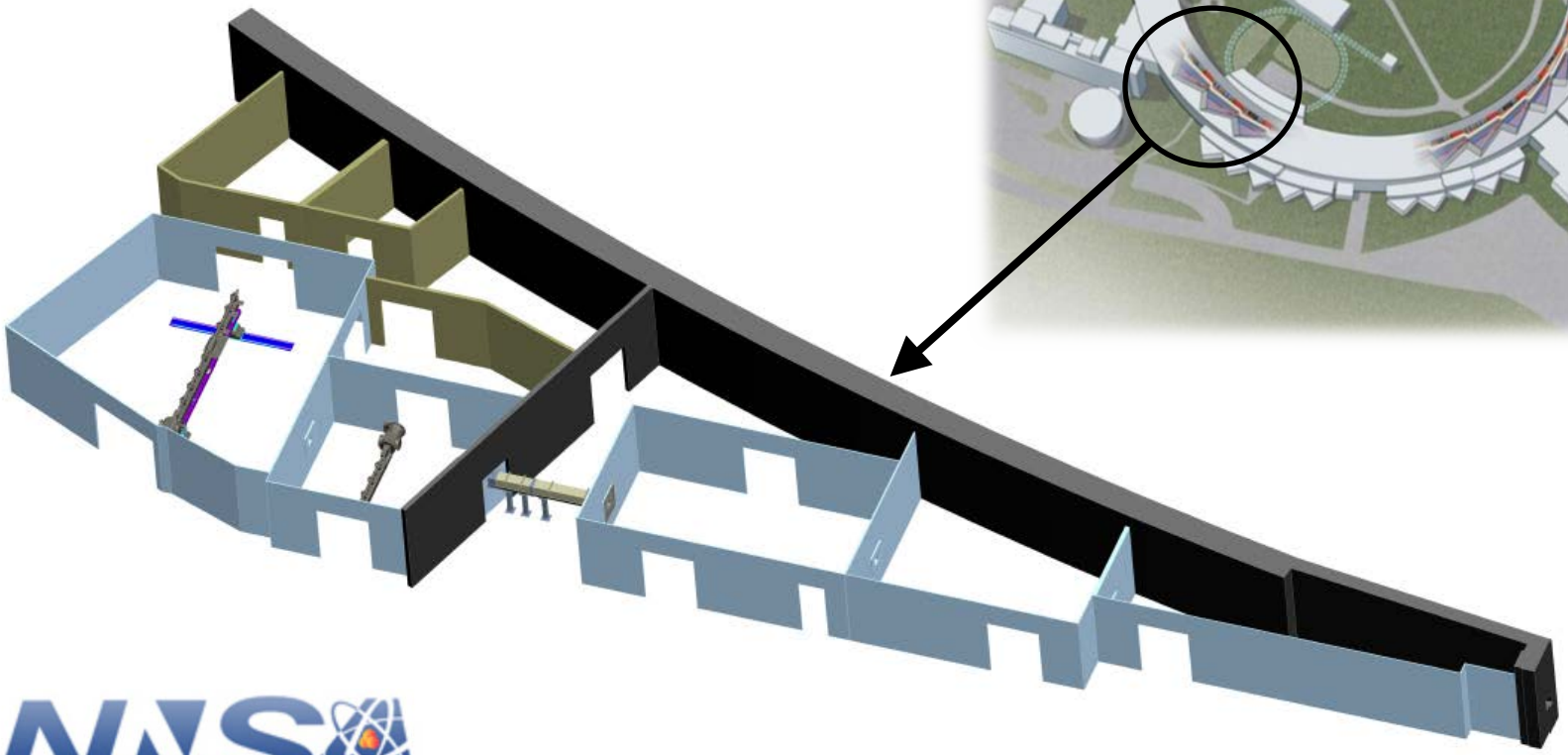
Dynamic Compression Sector Update

Timothy Graber
DCS@APS Sector Manager
Washington State University
10/31/2012





National Nuclear Security Administration

ISP

Dynamic Compression Sector Update

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D. Capatina

WSU
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P. Ruggiero
N. Arganbright

NNSA Labs
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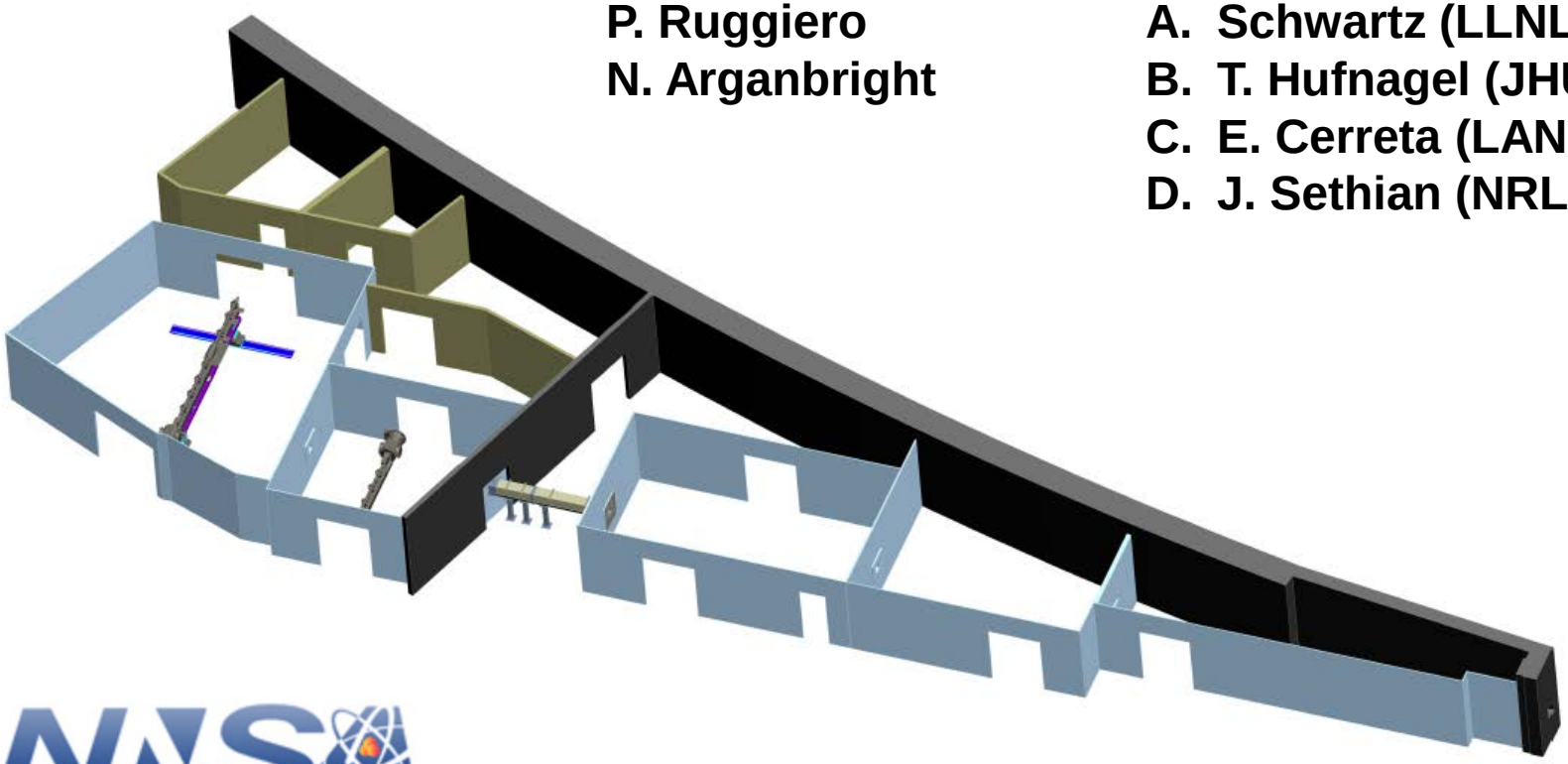
J. Eggert (LLNL)
J. Hawreliak (LLNL)
A. Schwartz (LLNL)
B. T. Hufnagel (JHU)
C. E. Cerreta (LANL)
D. J. Sethian (NRL)



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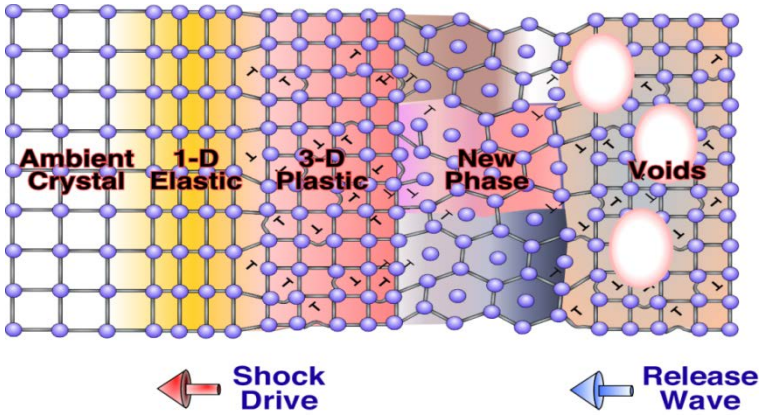
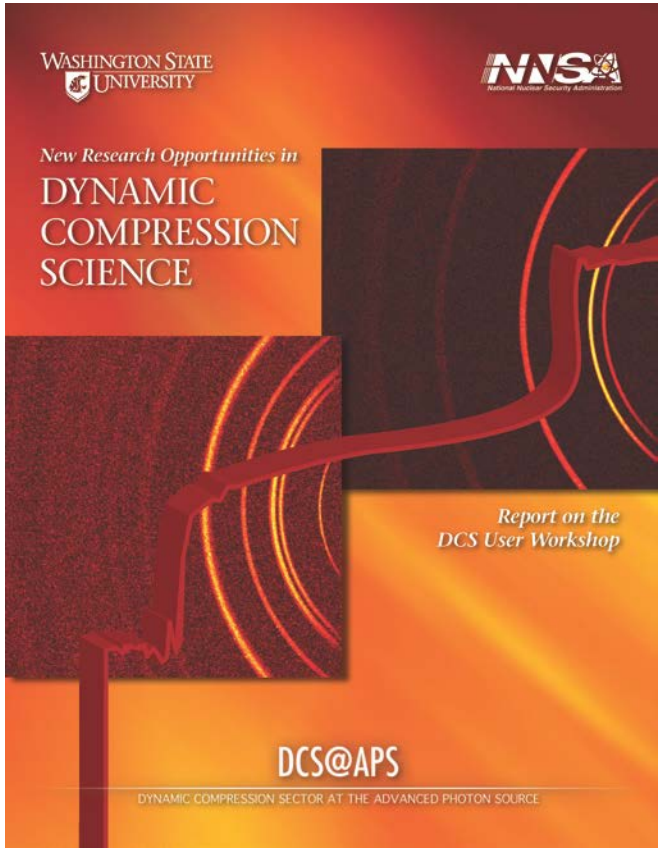
The Dynamic Compression Sector at the Advanced Photon Source (DCS@APS)

- Time-resolved X-ray diffraction and imaging measurements in materials subjected to dynamic compression.
- X-ray energies and time structure of the APS are ideal to study time-dependent changes in materials subject to
- Peak stresses from 5 GPa to above 100 GPa and time durations from ns to μs.
- DCS will complement other user facilities that emphasize static high pressure studies of materials and warm dense matter/plasma physics regimes.



Lorenzana, LLNL



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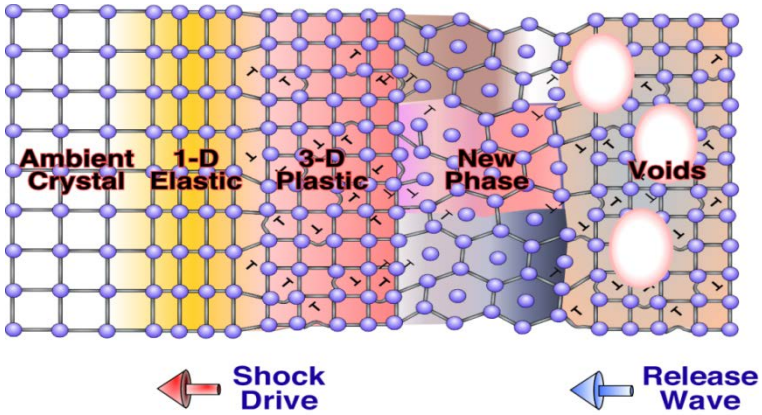
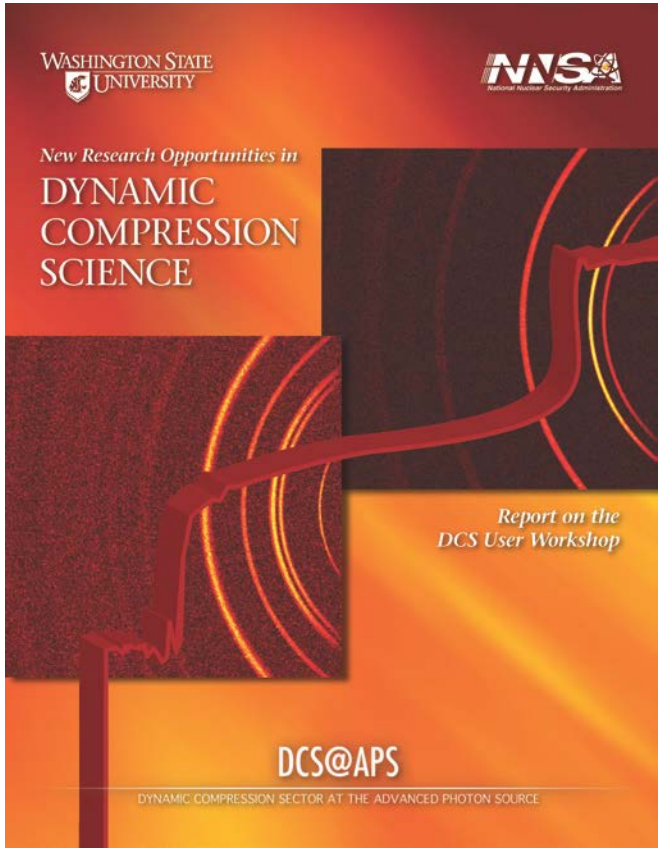
The Dynamic Compression Sector at the Advanced Photon Source (DCS@APS)

- Structural changes
- Phase transformations
- Deformation processes
- Fracture dynamics in materials
- Dynamics of chemical reactions
- Advanced diagnostics and detectors
- X-ray optics
- Governance models



Lorenzana, LLNL



Organizing Committee

John Sarrao, Co-Chair, LANL
Christian Mailhiot, Co-Chair, LLNL
Yogendra Gupta, WSU
Dennis Mills, ANL
Chi-Chang KaoSSRL

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Recent Milestones

- **A Memorandum of Understanding between the APS and WSU was signed on September 6, 2012**
- **Critical Decision 2 (CD2) granted**
- **Sector 35 assigned to DSC@APS**
- **Hutch and LOM procurement underway**

Yogendra Gupta; Brian Stephenson, Eric Isaacs, Chris Deeney, Daryll DeWald, and Keith LeChien,

Preparing for construction at Sector 35

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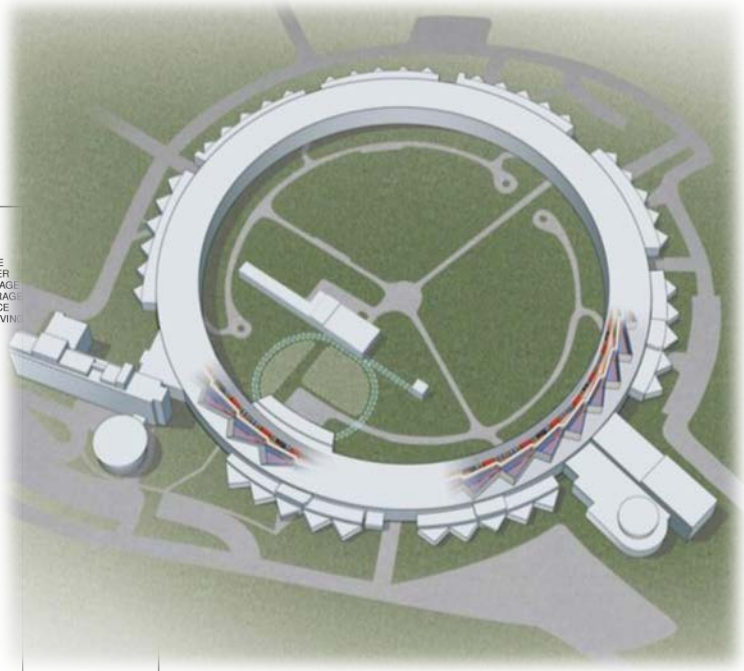
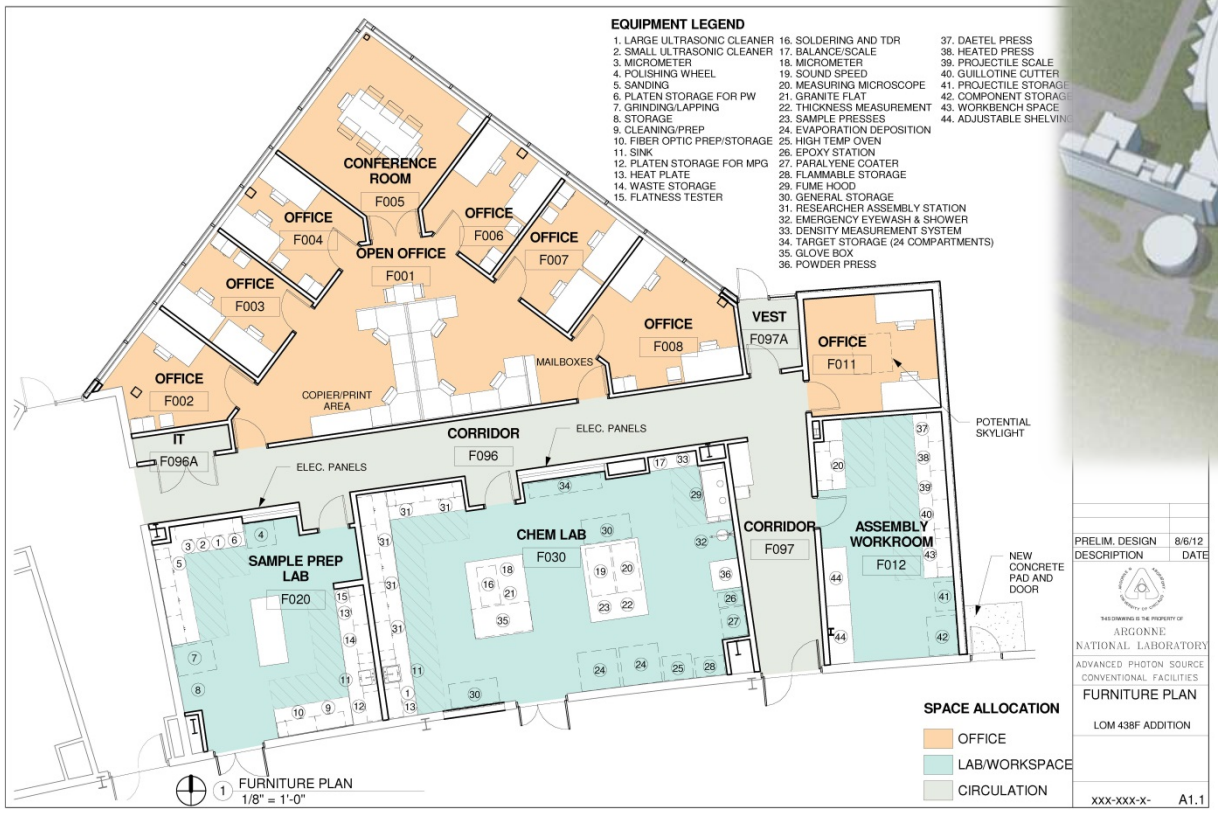
Sector 35 LOM 435F

- **Construction to start May 2013**
- **Beneficial Occupancy October 2013**





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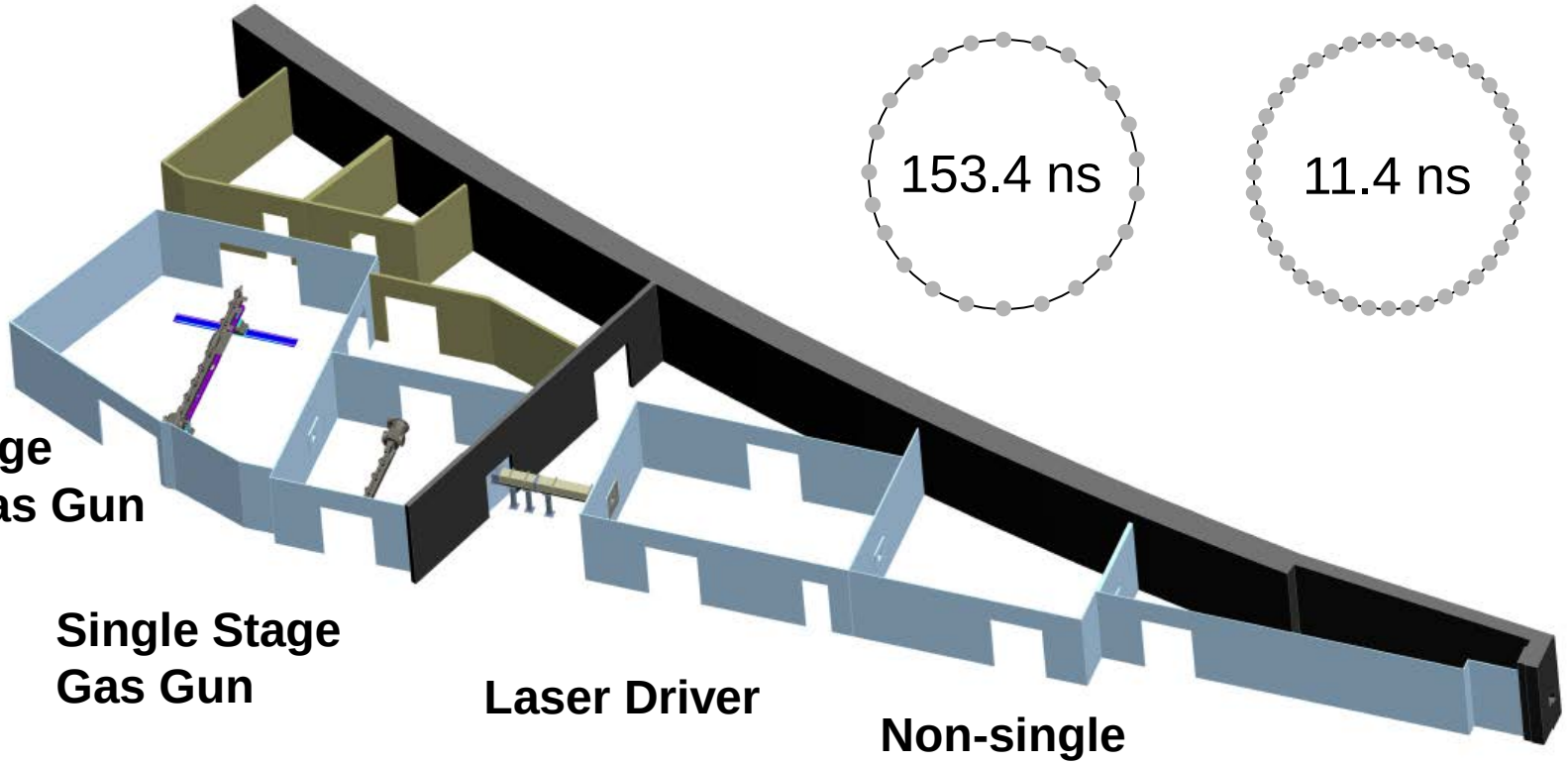
Dynamic Compression Sector

Utilize time structure of the APS to make X-ray movies of dynamic compression events



- **Construction to start May 2013**
- **Enclosure validation October 2013**

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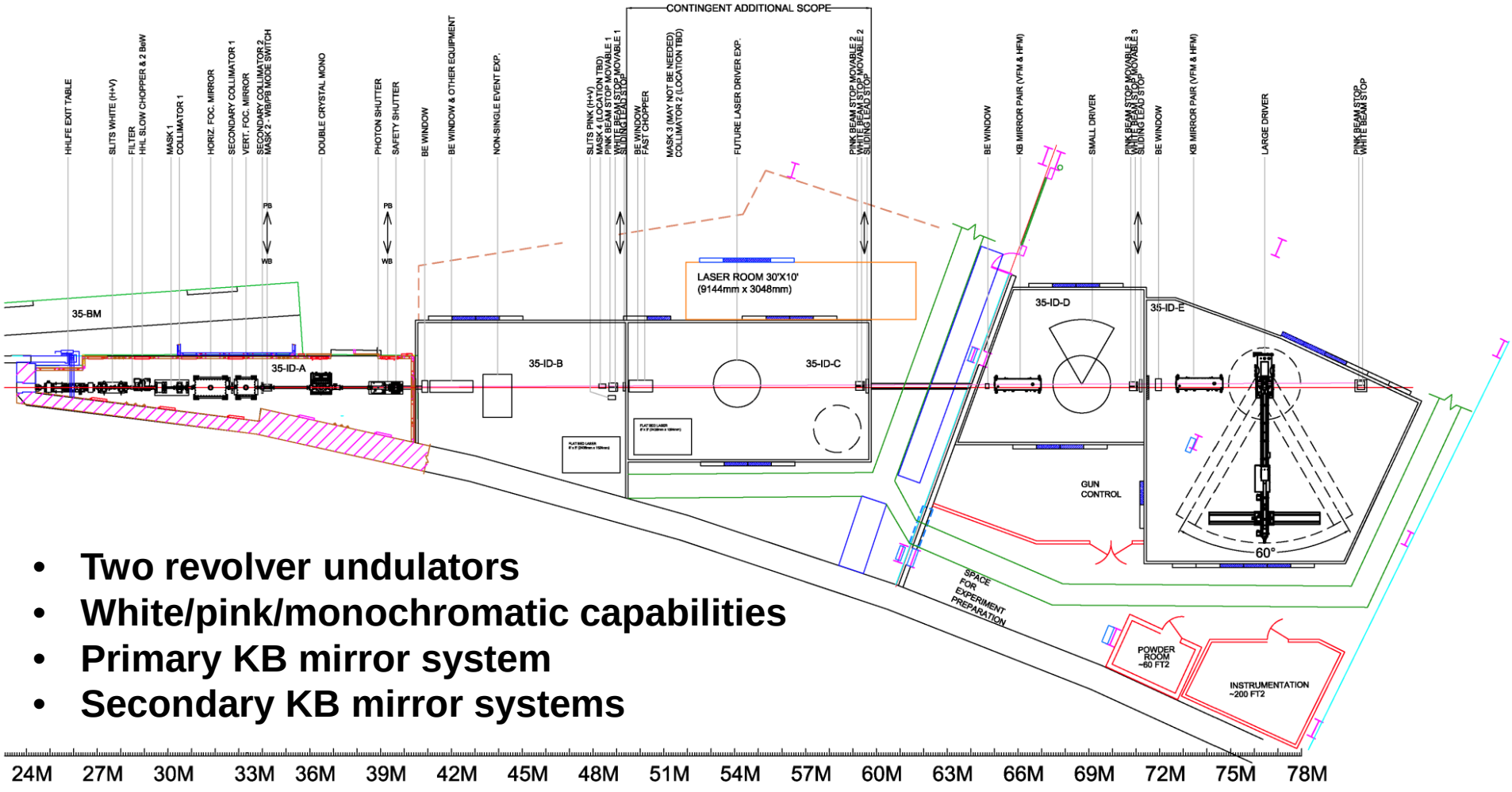
Beamline Layout

K. D'Amico
D. Capatina



- **Two revolver undulators**
- **White/pink/monochromatic capabilities**
- **Primary KB mirror system**
- **Secondary KB mirror systems**

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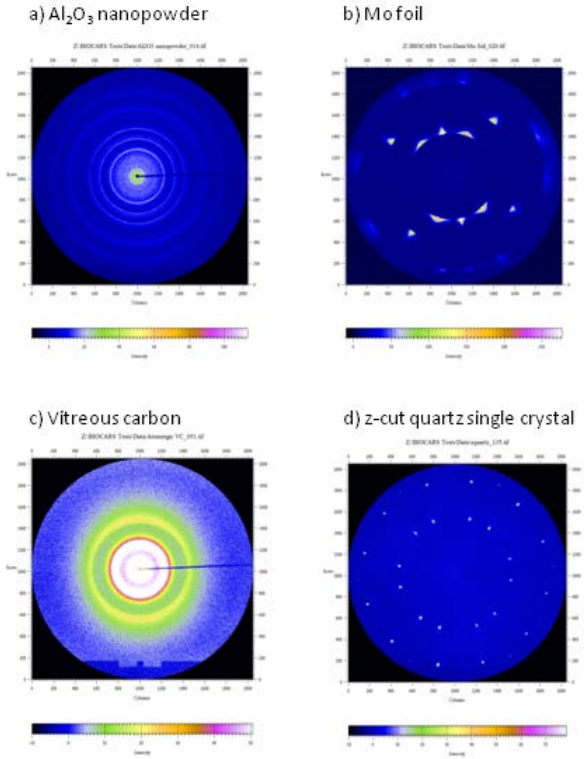
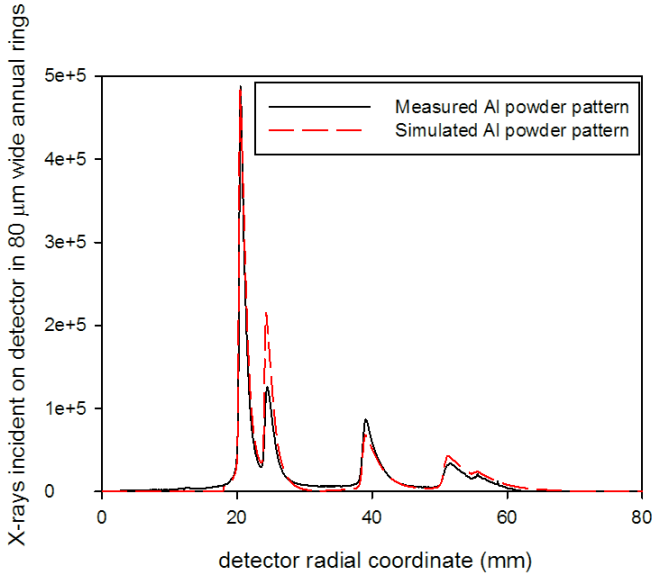
Single-pulse Pink-beam Measurements

S. Turneaure

Recent WSU Data at Sector 14



- **Structural changes**
- **Phase transformations**
- **Deformation processes**
- **Fracture dynamics in materials**
- **Dynamics of chemical reactions**
- **Advanced diagnostics and detectors**
- **X-ray optics**
- **Governance models**



- Single pulse diffraction (ambient) tests with un-gated detector at APS useful for laser drive or impact experiments
- Incorporating ultrafast x-ray shutters
- WSU demonstrated detector gating method to isolate signal from a single pulse during impact experiments at APS

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APS visit to the Institute for Shock Physics

Kenneth Volin (AES/MED)
Jeff T. Collins (AES/MED)
Elroy Chang (AES/ESH Coordinator)

- Tour of Institute for Shock Physics (ISP) Impact Laboratory.
- Gas Gun
- Two-Stage Light Gas Gun
- ISP's propellant and storage operations
- Review Washington State University and ISP ESH documents with respect to:
  - Storage and use of propellants
  - Hydrogen safety
  - Gas Gun for Impact Studies
  - Operation of gas and two-stage impact guns.
- Inspect the propellant storage facility (magazine) and protocol for handling the propellants.
- Discuss with IPS staff Argonne documentation requirements for the design, fabrication, testing, and operation of the proposed two-stage gun
- Observe the operation of the existing two-stage impact gun on loan to the ISP from Sandia National Laboratory.

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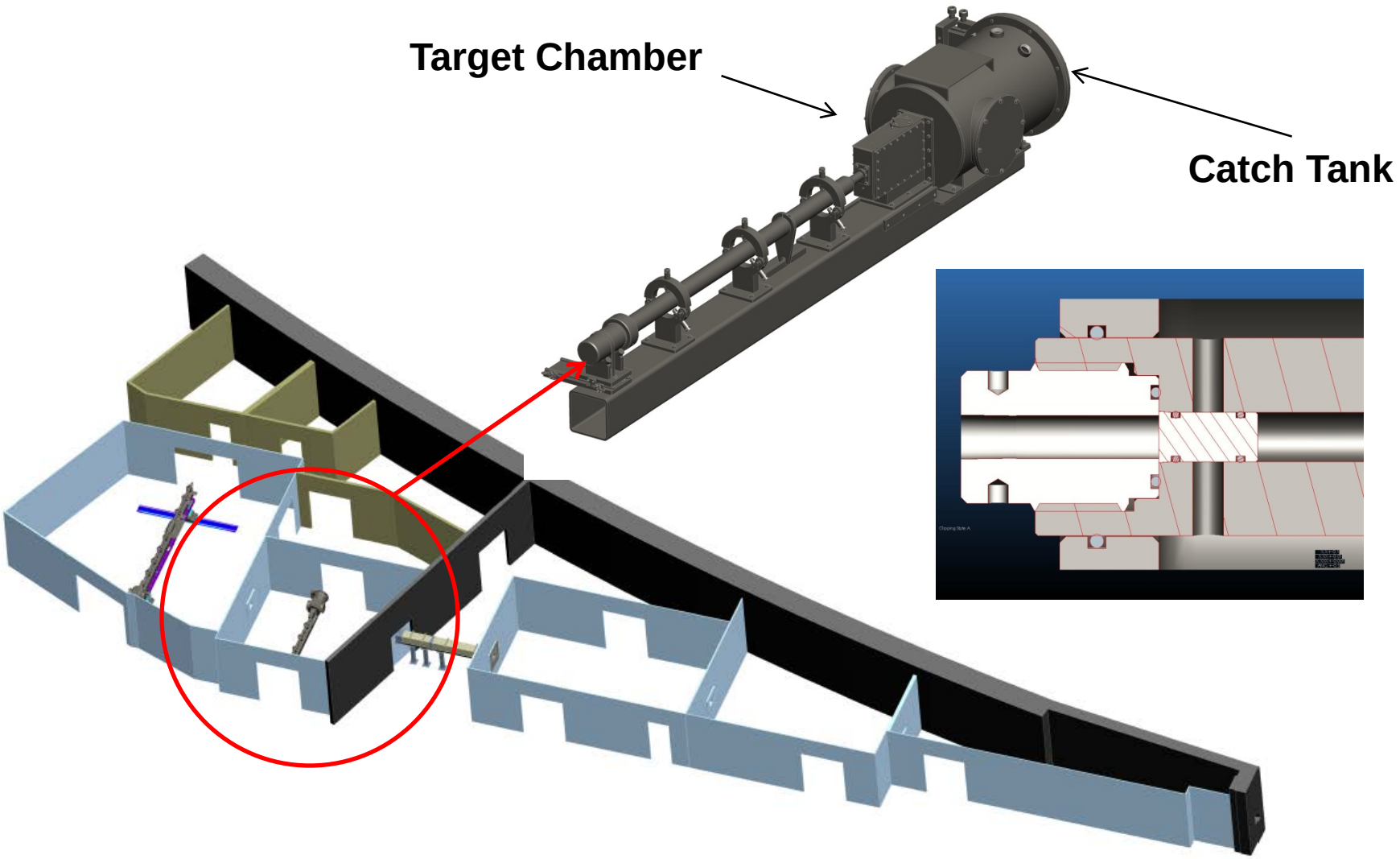
Single Stage Gas Gun (SSGG)

C. Konrad



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SSGG Characteristics

C. Konrad

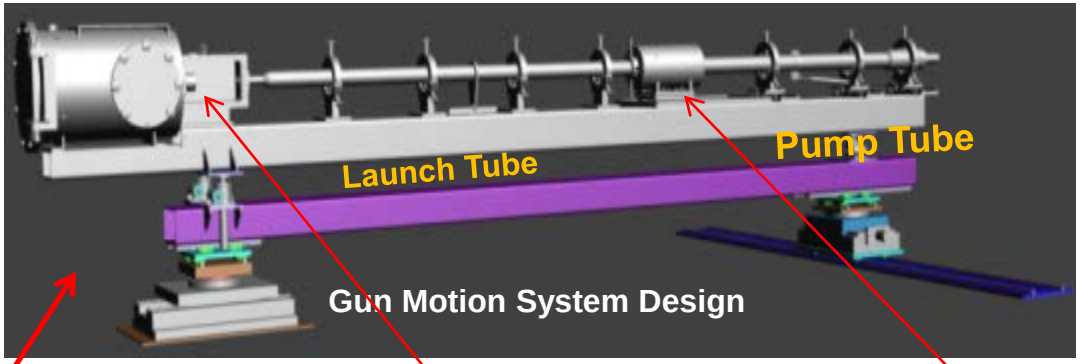
- Breech
  - Wrap-Around Design
  - Double Burst Diaphragm Design
- Launch Tube
  - 2.44 meters (8.0 feet)
  - 12.7 mm (0.50 inch) & 20 mm (0.787 inches) bore
- Velocity
  - Meters/sec minimum
  - 1.6 km/s (5,248 ft/sec) maximum
- Projectile Mass
  - 5 grams, 12.7 mm bore
  - 8 grams, 20 mm bore

The SSGG is designed to meet our operational goals.

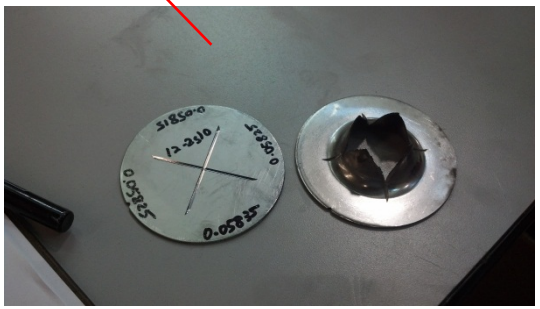
ISP

Two Stage Light Gas Gun (2SLGG)

C. Konrad



Target Chamber



Burst Disk

ISP

2SLGG Characteristics

C. Konrad

- **Pump Tube**
  - **2.286 meters (7.5 feet)**
  - **41.9 mm (1.65 inch) bore**
- **Launch Tube**
  - **3.454 meters (11.3 feet)**
  - **12.7 mm (0.50 inch) bore**
- **Velocity**
  - **1.5 km/s (4900 ft/sec) minimum**
  - **6.0 km/s (19,685 ft/sec) maximum**
- **Projectile Mass**
  - **5 grams**

The 2SLGG is designed to meet our operational goals.

Schedule Highlights: Project Milestones

Item	Date
Place enclosure order	December 2012
Place mirror order	December 2012
Begin site preparation on sector	January 2013
Begin shielding enclosure installations	March 2013
Site preparation for LOM construction	May 2013
CD-3 Review	June 2013
Enclosure Validation	October 2013
Ready for gun installation	November 2013
Begin beamline equipment installation	November 2013
Beneficial occupancy of LOM	March 2014
First shot	April 2014
Install new front end	September 2014
Install revolver undulator	September 2014
Project ready for CD-4 review	November 2014