

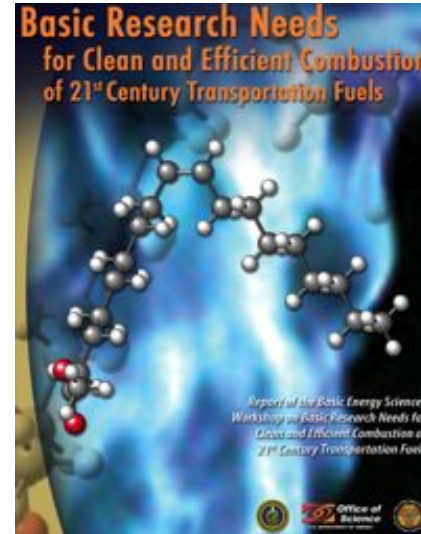
7-BM is open for business, officially!

Jin Wang
X-ray Science Division

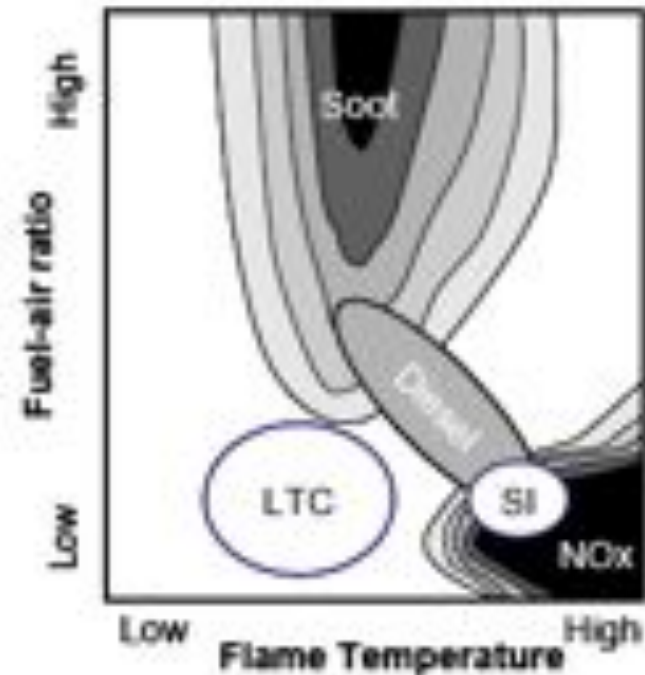
APS/Users Operations Monthly Meeting
August 29, 2012

Science and Technology Needs

- Optimized fuel sprays to
 - Improve combustion and reduce emissions
- Fuel sprays have been elusive, even more so now.
- We have made breakthroughs
 - With ultrafast x-radiography
 - μ s x-tomography
 - Quantitative fuel mass distribution
 - Validate spray and combustion simulation
- Guiding injection system design
 - Working with industrial partners



The evolution of fuel sprays plays a defining role ... in determining both combustion efficiency and the formation of ... pollutants. This level of understanding may permit extraordinary new technologies, such as smart fuel injectors ...

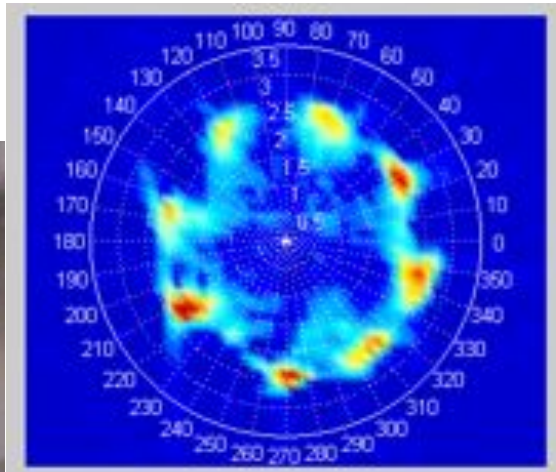


Injections Systems and Fluid Dynamics

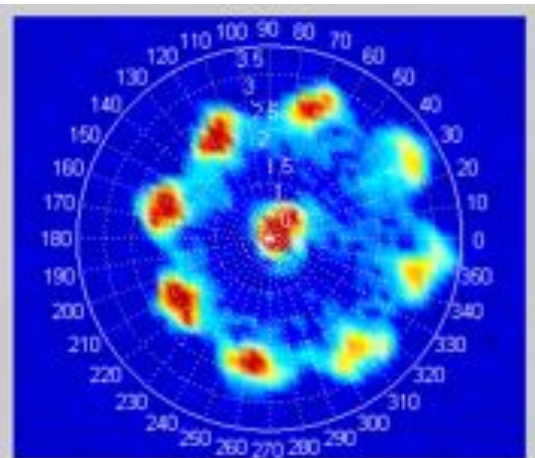
- Developing injection systems



Prototype



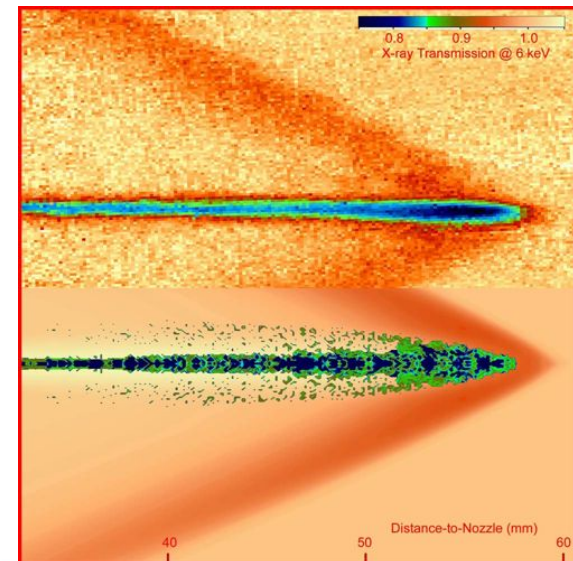
Product



- Understanding shockwaves



K.-s. Im *et al.* Phys. Rev. Lett., 074501 (2009)



Challenges and Opportunities

- Argonne Collaborations – ES and XSD
- Growing collaborators and partners from both industry and universities
 - Robert Bosch GmbH: diesel, and GDI
 - General Motor R&D: diesel
 - Visteon Corporation: GDI, HCCI
 - Delphi Corporation: diesel, GDI
 - Caterpillar: heavy duty diesel
 - Daimler AG: diesel, GDI
 - Continental AG (Siemens VDO): Diesel, GDI
 - ...
 - Sandia National Lab
 - Air Force Research Lab
 - EPA
 - ...
 - University of Wisconsin at Madison
 - Wayne State University
 - Cornell University
 - Michigan State University
 - Stony Brook University
 - Iowa University
 - University of Illinois at Chicago
 - University of California, Irvine
 - ...
- Most of problems can be tackled by “simple” but fast x-radiographic imaging.
- Requires dedicated beamline at the APS.

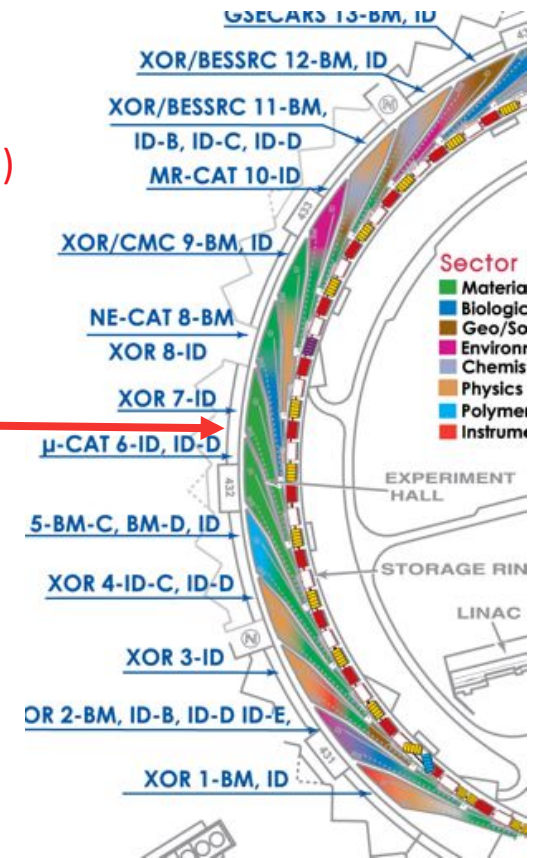


Need of a Dedicated Beamline

- Provide a centralized facility for transportation engine technologies
 - high-throughput measurement
- OVT/EERE invested \$850K capital (FY2008/2009)
 - Through ANL Transportation Technology R&D Center (Larry Johnson)
- Rebuild Sector 7-BM beamline
 - Partially built supported by BES (MHATT-CAT)
 - 2 x-ray hutches were in place.

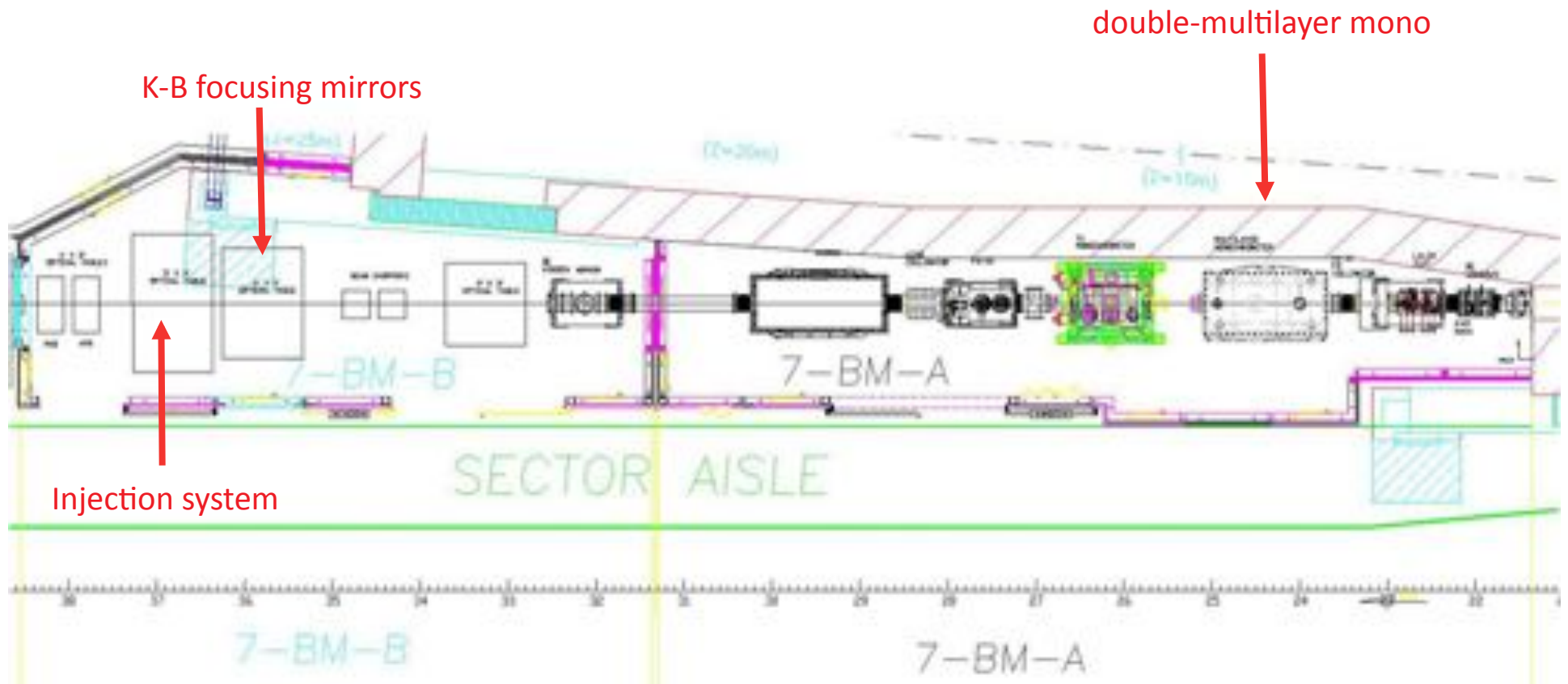


7-BM



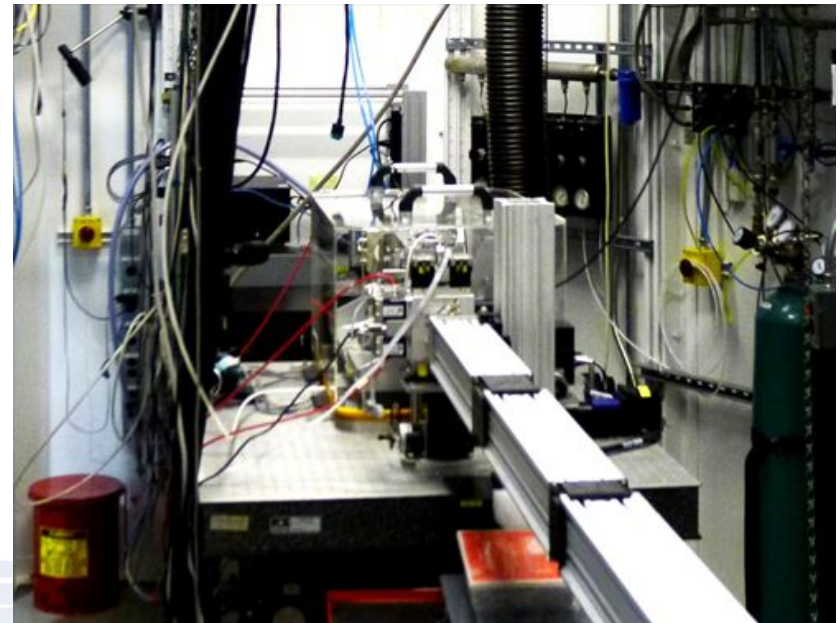
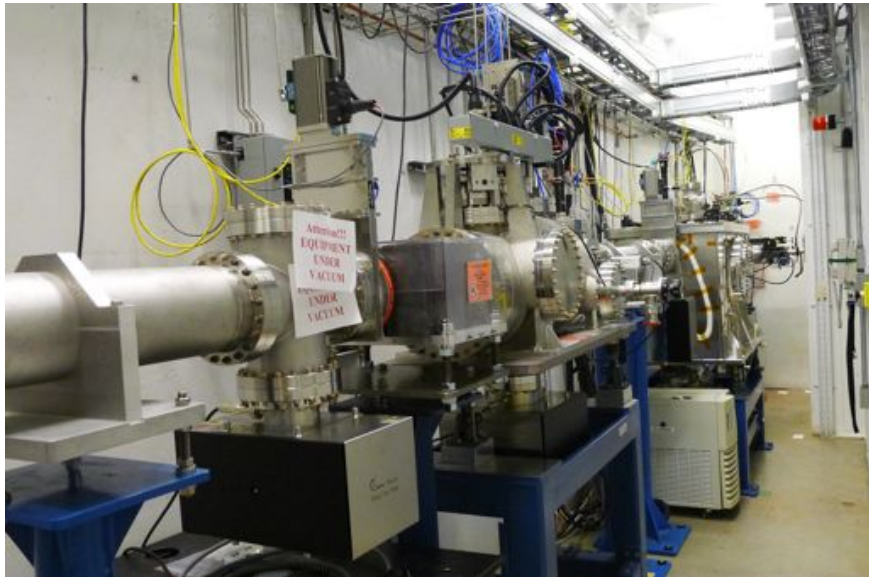
Beamline Design and Construction

- μ s x-radiography, μ s x-tomography
 - Wide-bandpass mono, $>10^{13}$ ph/s full beam, tunable from 5.5 to 12 keV
- Collaborative effort
 - Mark Erdmann, Mohan Ramanathan, David Kline, Yeldez Amer (AES)
 - Harold Gibson, Eric Dufresne, Dohn Arms (XSD)
 - Alan Kastengren, Chris Powell (ES/ANL)



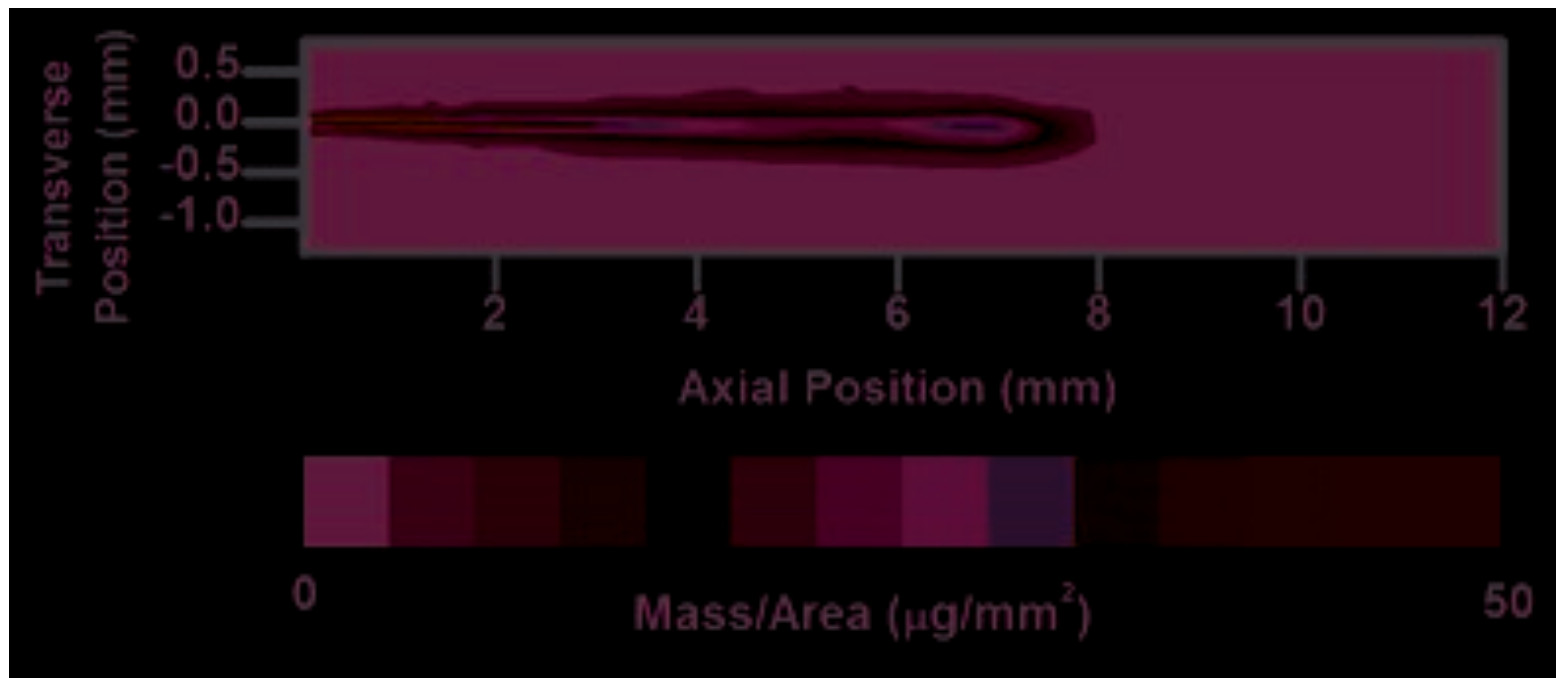
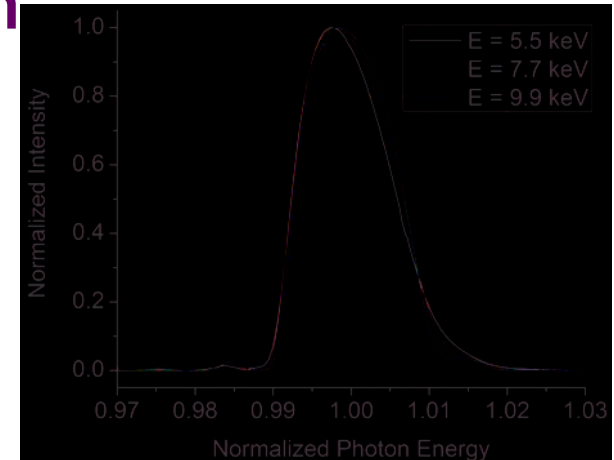
Fuel Spray Dynamics Beamline

- Construction and Commissioning is completed!
- August 1: new hire of beamline scientist –Alan Kastengran
 - Was responsible for the beamline commissioning
 - Is responsible for the operation.



Performance with Microfocus Beam

- Beamline performance and specifications
 - Multilayer monochromator: $\Delta E/E = 1.4\%$
 - Energy range 5.5 – 12 keV
 - K-B mirrors to create microbeam
 - Focus 5 x 6 μm FWHM
 - Flux at focus: 1.6×10^{11} ph/s at 8 keV
 - Data acquisition equipment tailored for MHz-rate data collection



Operations

- The beamline is officially operational starting 2012-3.
 - The beamtime will be allocated in Rapid Access for 2012-3 run only.
- Partner User Proposal from ANL ES division (Chris Powell) is approved.
 - DOE/EERE Vehicle Technology Program – related activities
- Reach out to the users from other communities
 - Dynamics in material processing
 - Fluid dynamics
 - Combustion
- Argonne-wide collaboration on combustion science.
- Future upgrade
 - Fast framing detectors for μs radiograph measurement
 - E.g. Analog Pixel Array detector from Sol Gruner's group at Cornell
 - Fast framing rate, 100% efficient
 - Pink beam capability – single-shot capability
 - High throughput.

