



... for a brighter future

APSUO/PUC Meeting Update on APS

J. Murray Gibson

September 16th, 2009



U.S. Department
of Energy



A U.S. Department of Energy laboratory
managed by The University of Chicago

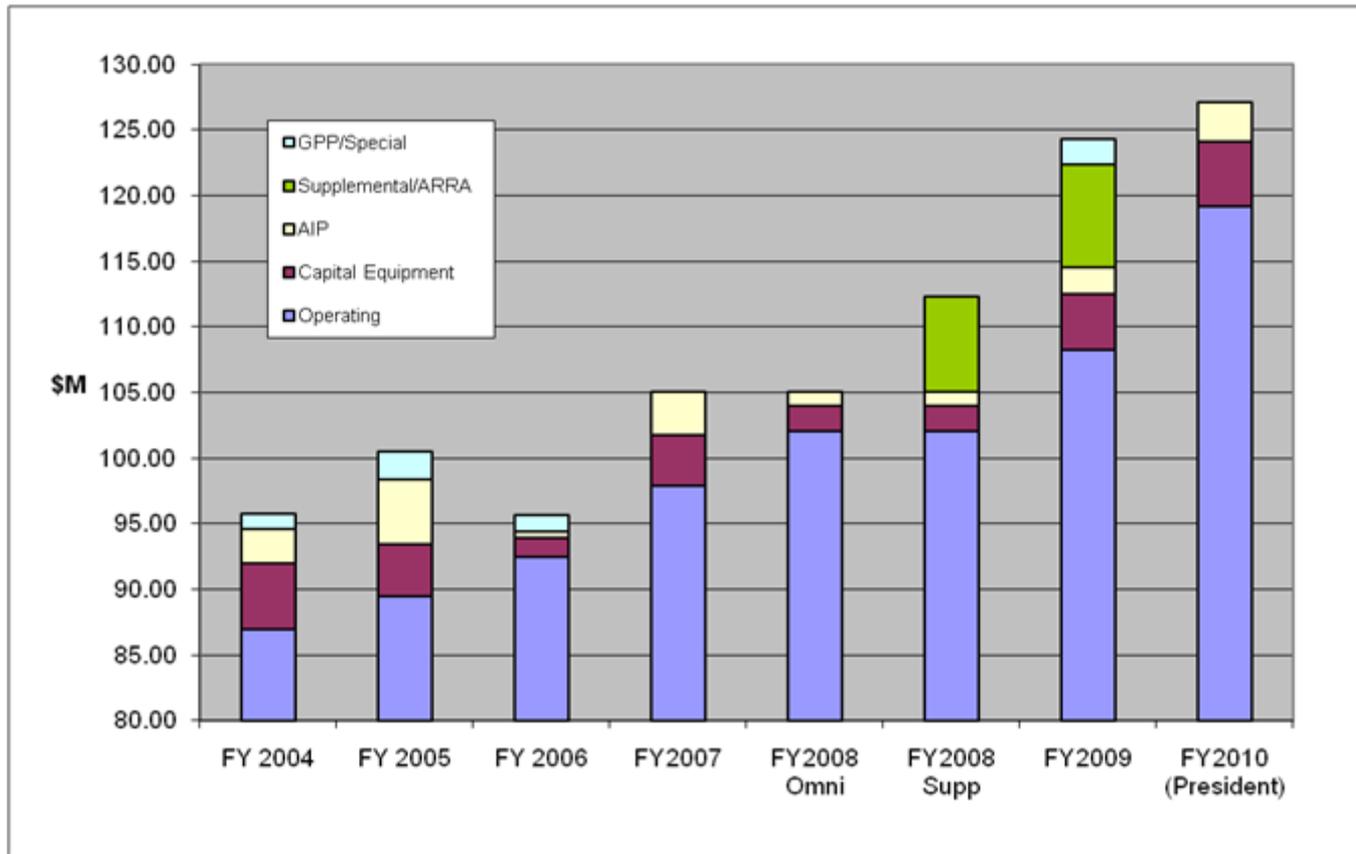
Agenda

■ 9:00 – 11:30 APS Update

- Budget – M. Gibson
- APS Renewal and October SAC Meeting – M. Gibson
- APS Renewal Planning – D. Mills
- Renewal Beamline Summary – D. Haeffner
- Experimental Work Planning and Control – P. Zschack

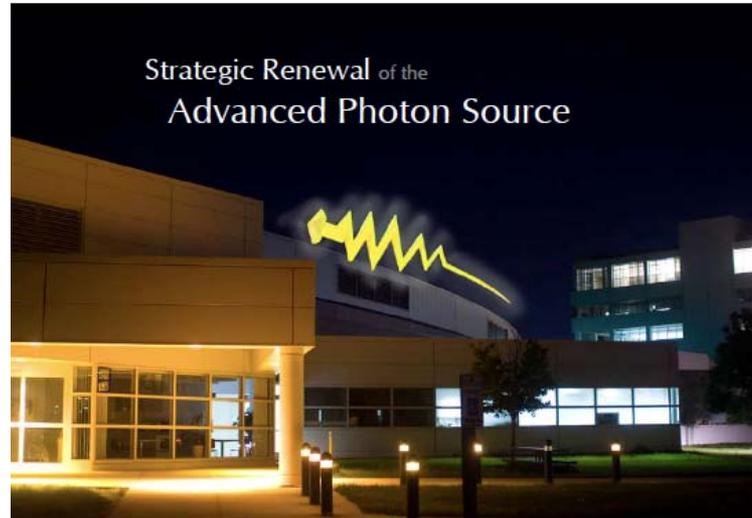
■ 11:30 – 12:30 Renewal Planning Discussion (boxed lunches will be served)

APS Budget



~\$10M increment very important to APS
House and Senate likely to conference FY2010 bill this month,
but not yet scheduled

APS Renewal Planning

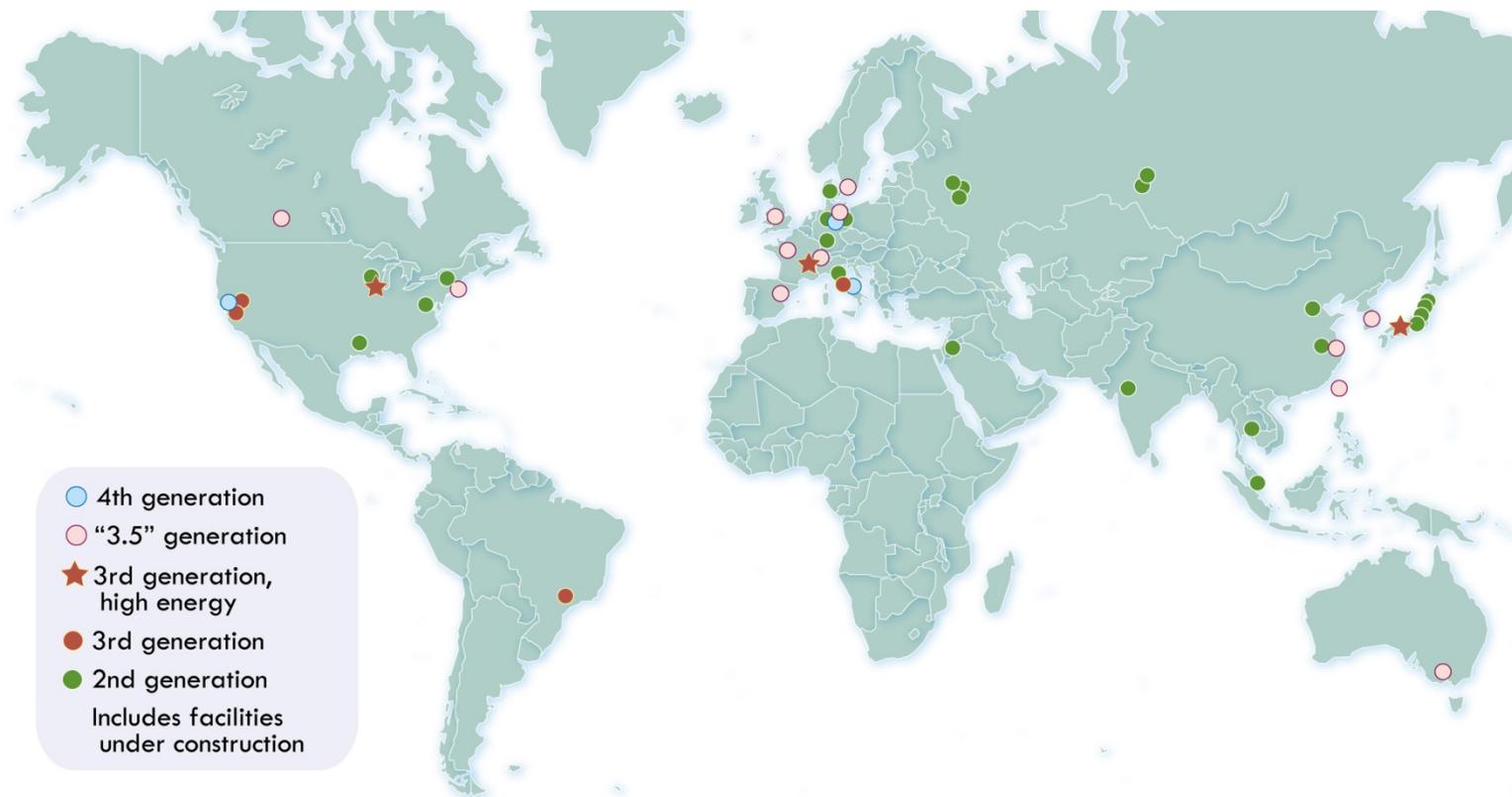


Proposal for approval
of Conceptual Design (CD-0)

Submitted to the US Department of Energy
Office of Basic Energy Sciences
May 31, 2009

Informal feedback that we will go ahead – reviews not yet available

Synchrotrons around the world



Capabilities of APS and other comparable sources

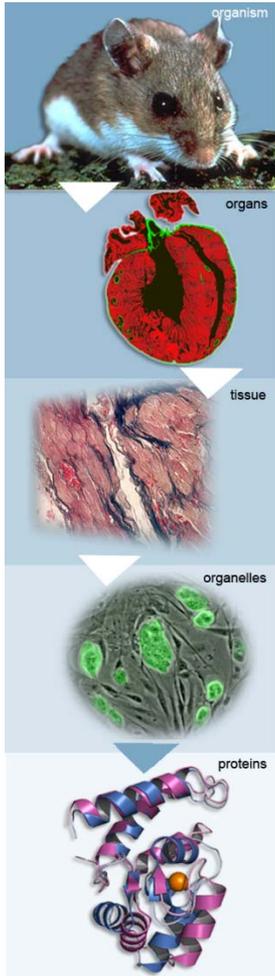
Brightness comparisons

Country	Name	Brightness @ 8 KeV	Brightness @ 25 KeV	Brightness @ 60 KeV
Japan	SPRING-8	1.5×10^{20}	8.3×10^{19}	2.4×10^{19}
England	DIAMOND	5×10^{19}	N/A	N/A
France	ESRF	1.2×10^{20}	8.4×10^{18}	4.9×10^{17}
France	ESRF Upgrade	2.4×10^{20}	8.3×10^{19}	7.0×10^{18}
Germany	PETRA-III	8×10^{20}	5.9×10^{19}	3.5×10^{18}
U.S.	APS	7×10^{19}	1.7×10^{19}	1.3×10^{18}
U.S.	APS Upgrade	1.4×10^{20}	1.5×10^{20}	4.2×10^{19}
U.S.	NSLS-II	1.2×10^{21}	9.9×10^{18}	1.2×10^{16}

Flux comparisons

Country	Name	Flux @ 8 keV	Flux @ 25 keV	Flux @ 60 keV
Japan	SPRING-8	1.1×10^{15}	4.6×10^{14}	1.1×10^{14}
England	DIAMOND	1×10^{15}	N/A	N/A
France	ESRF	1.9×10^{14}	6.4×10^{13}	6.4×10^{12}
France	ESRF Upgrade	9.6×10^{14}	2.6×10^{14}	2.9×10^{13}
Germany	PETRA-III	4.5×10^{14}	9.4×10^{13}	1.4×10^{13}
U.S.	APS	5×10^{14}	1.4×10^{14}	2.9×10^{13}
U.S.	APS Upgrade	1.6×10^{15}	1×10^{15}	2.8×10^{14}
U.S.	NSLS-II	1.6×10^{15}	2.5×10^{13}	8×10^{10}

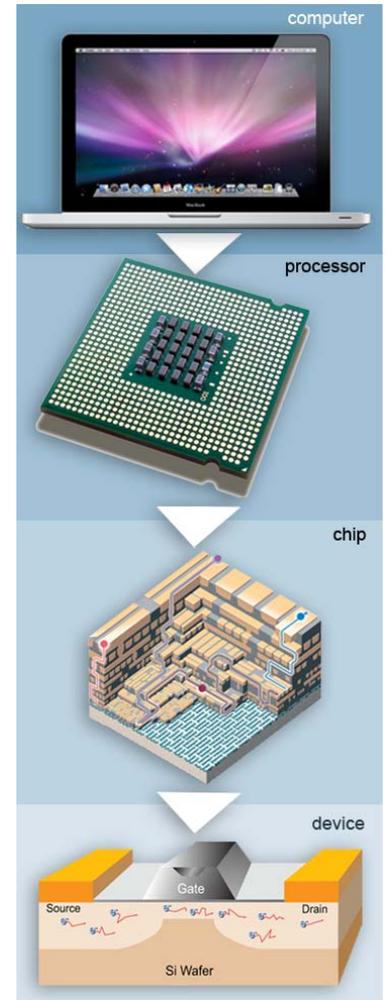
SCIENCE DRIVER: Mastering hierarchical structures through imaging



“Imaging specific molecules and their interactions in space and time will be essential to understand how genomes create cells, how cells constitute organisms and how errant cells cause disease. Molecular imaging must be extended and applied from nanometre to metre scales...”, Roger Tsien

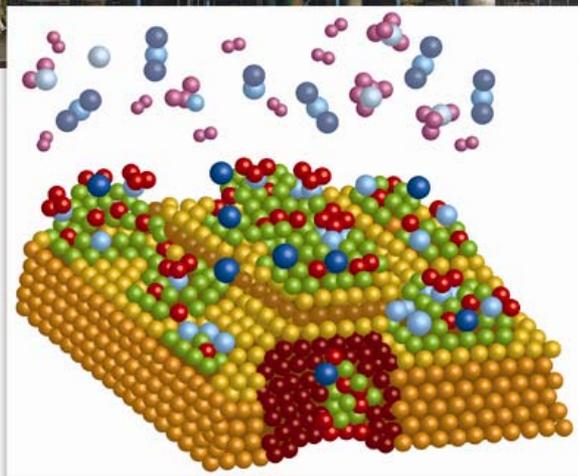
- Hierarchical structures are key to life, machines and complex nanostructured materials

- High-energy x-rays offer a unique tool to probe all relevant length scales and understand their interconnection

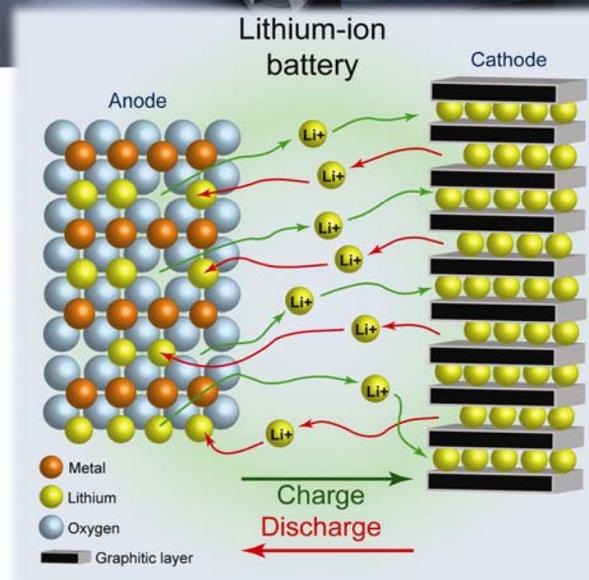


SCIENCE DRIVER: Real materials under real conditions in real time

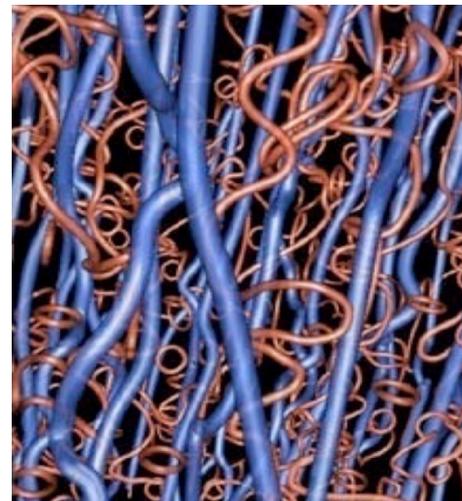
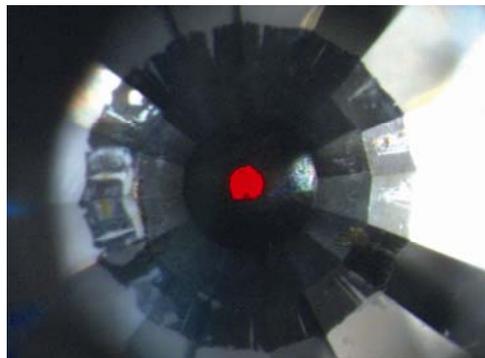
Catalysis



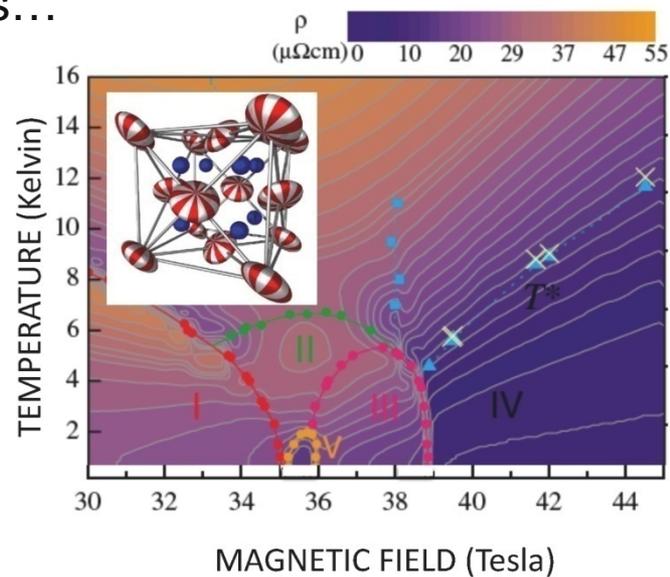
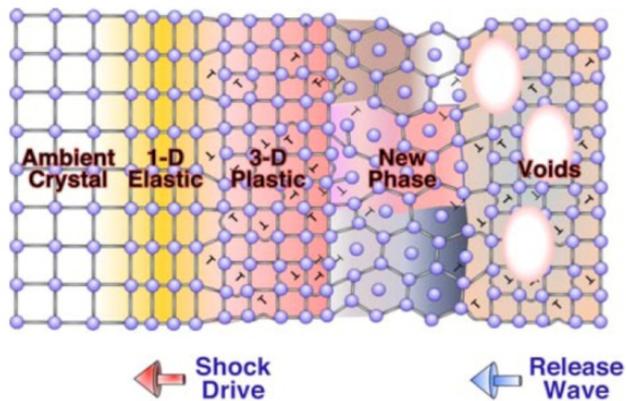
Batteries



Beamline WBS Element: Materials under extreme conditions

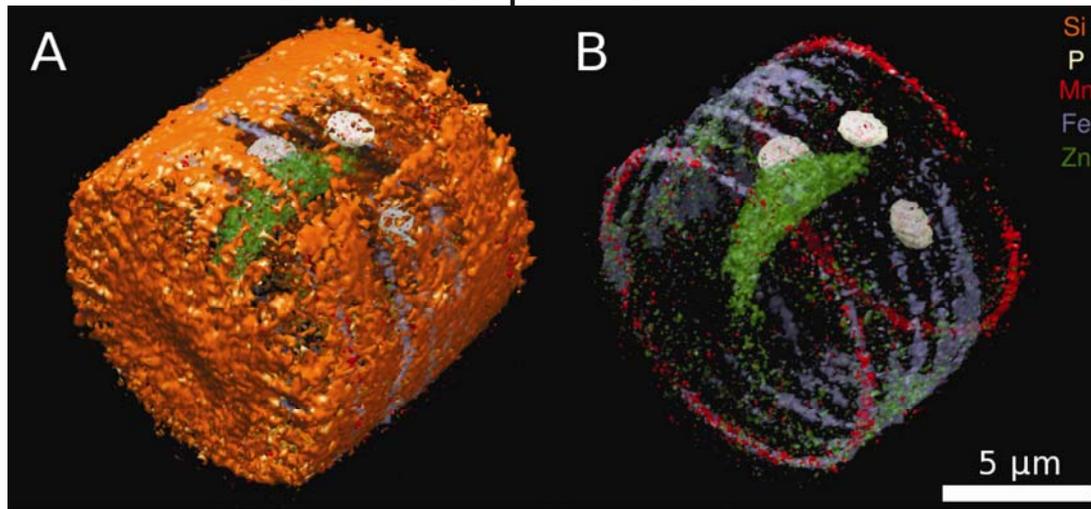


High pressures, high magnetic fields...

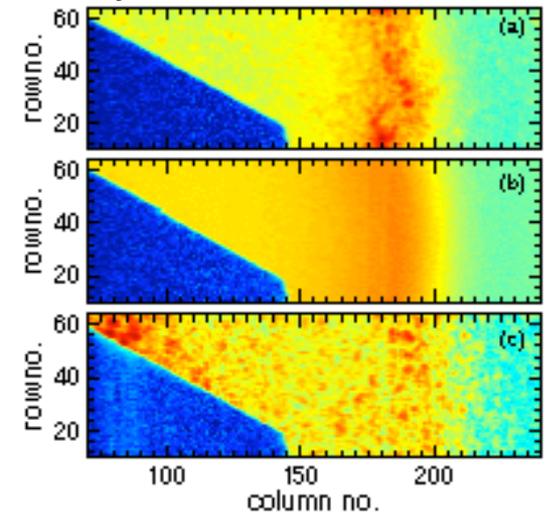


Beamline WBS Element : Imaging and coherence

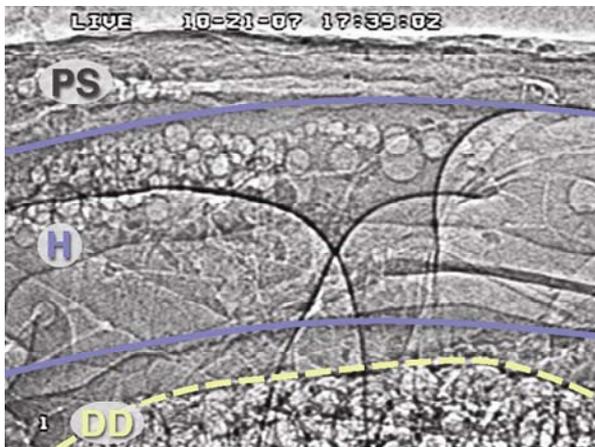
Carbon sequestration



Polymer nanostructures

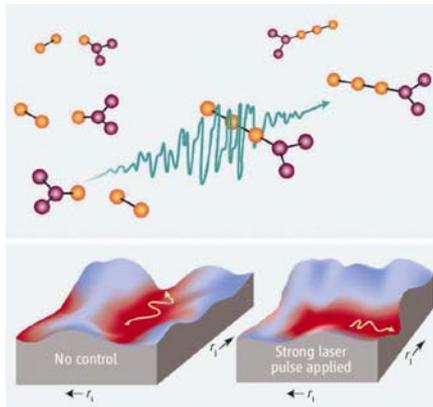
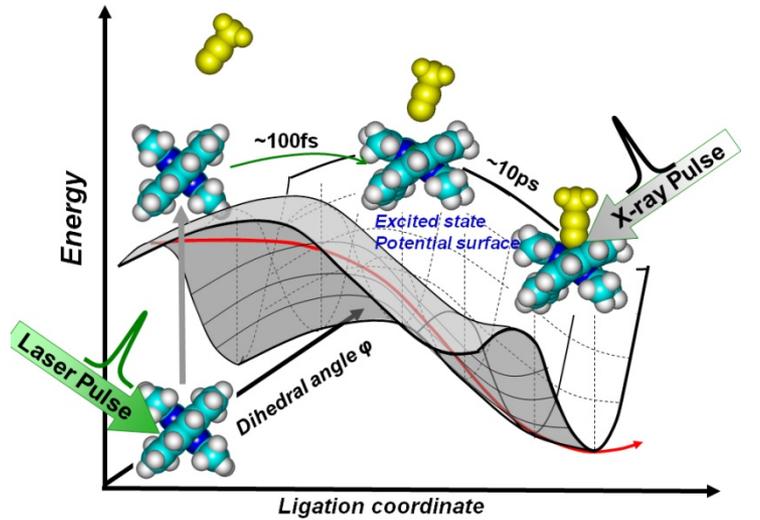


Organisms at work



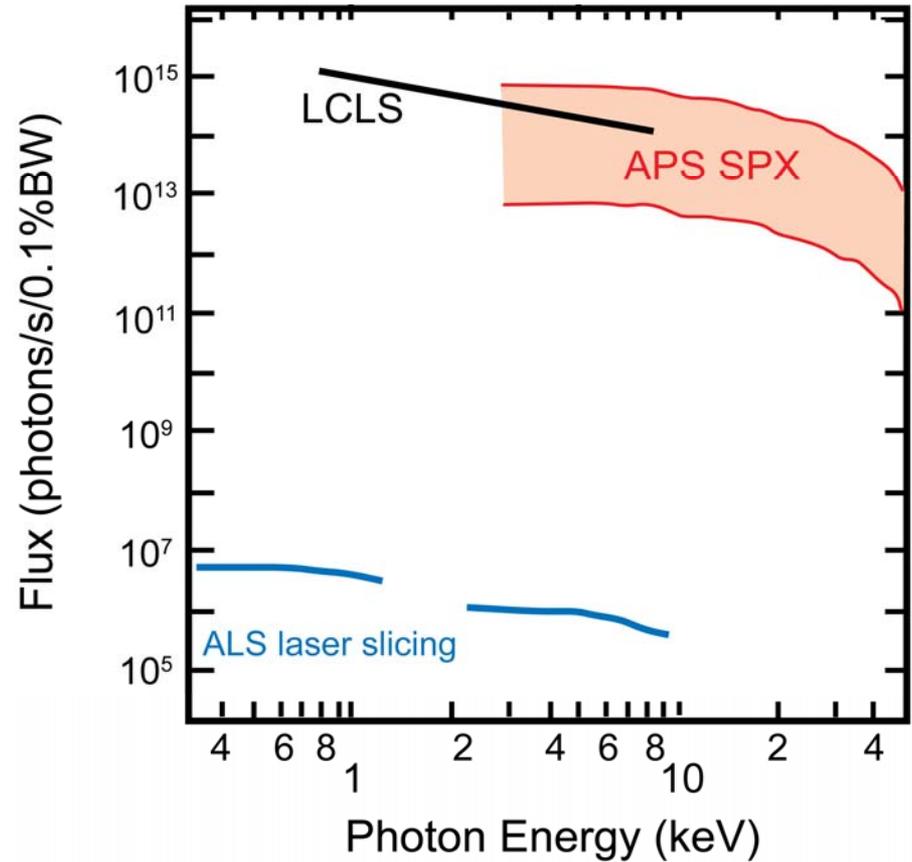
Beamline WBS Element : Ultrafast dynamics

Photosynthesis



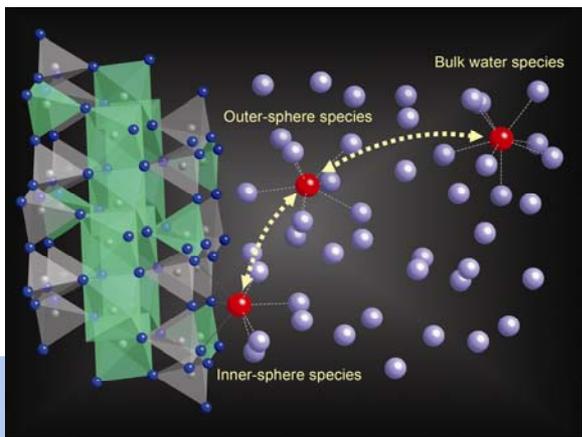
New reaction paths

Short Pulse ($\sim 1\text{ps}$) X-Rays (SPX)

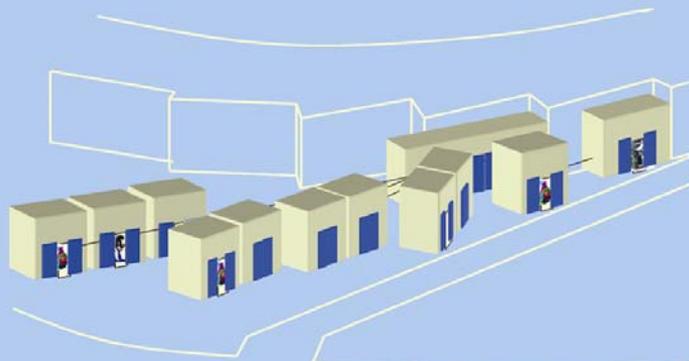
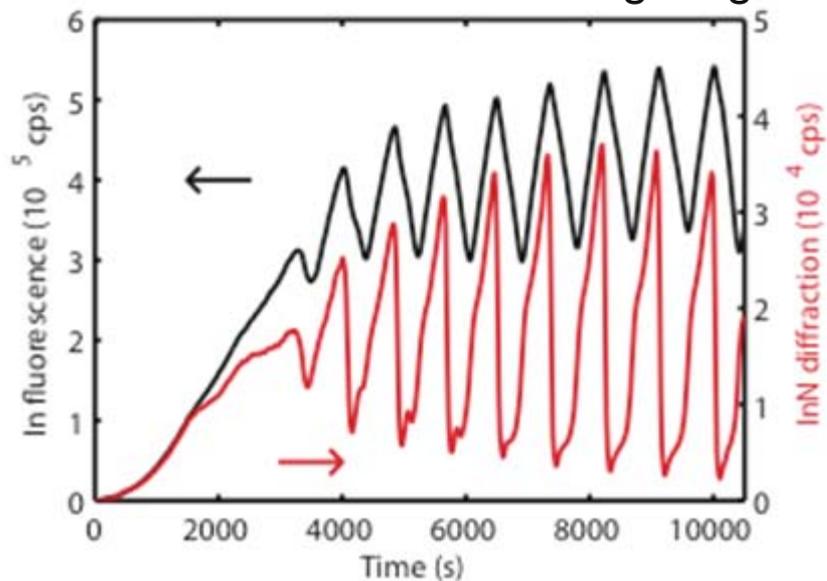


Beamline WBS Element : Interfaces in complex systems

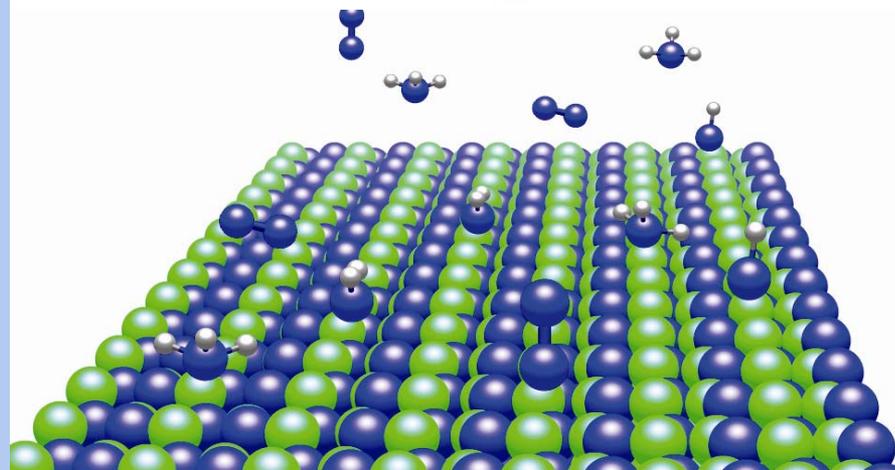
Geochemistry



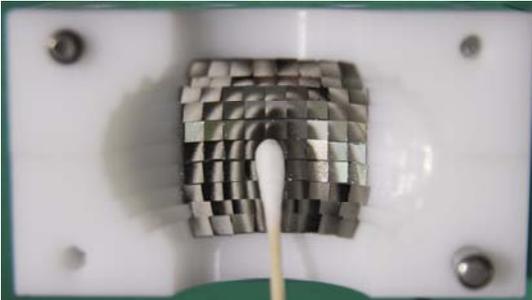
Solid-state lighting



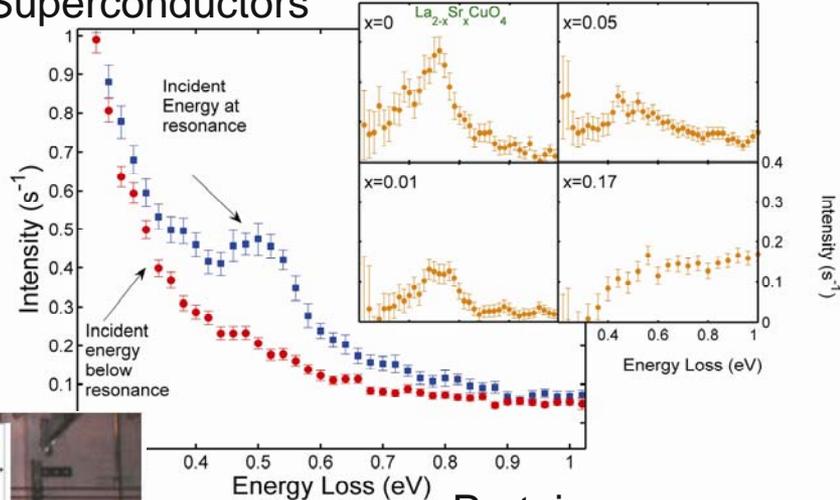
Conceptual layout of the X-Ray Interface Science facility



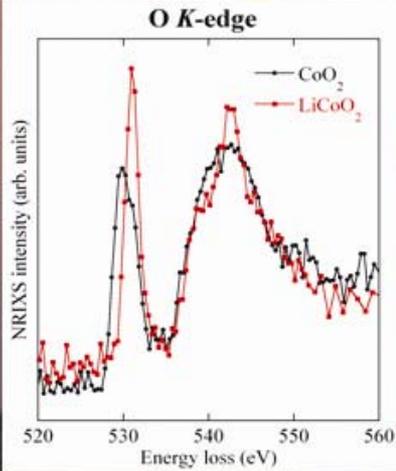
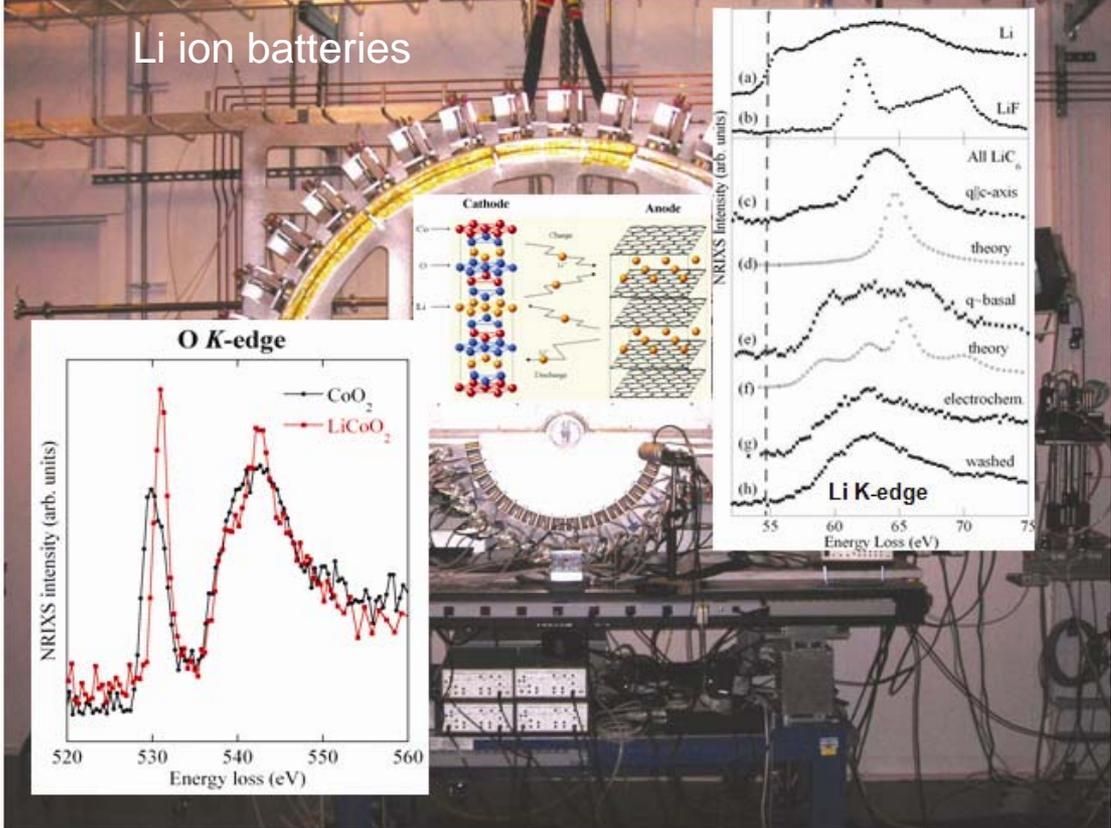
Beamline WBS Element: High-resolution spectroscopy



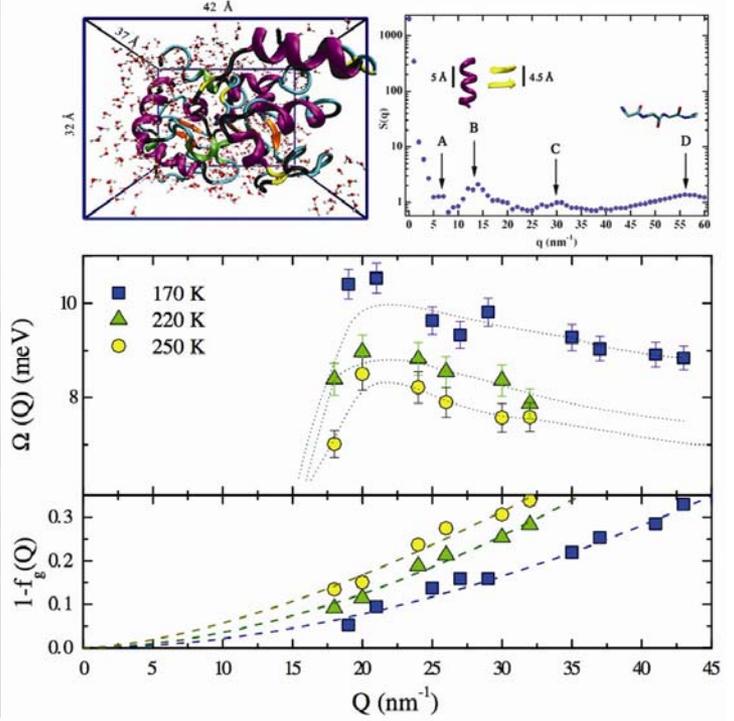
Superconductors



Li ion batteries

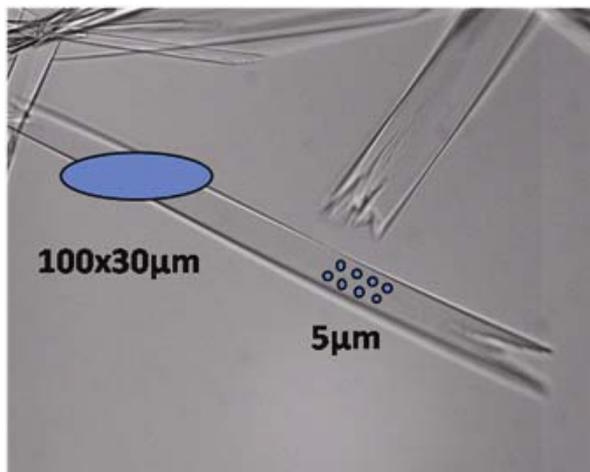
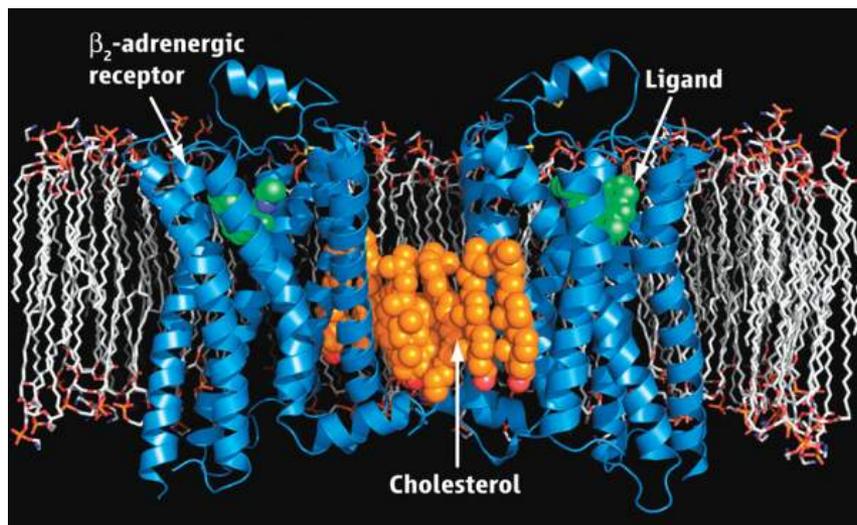


Proteins



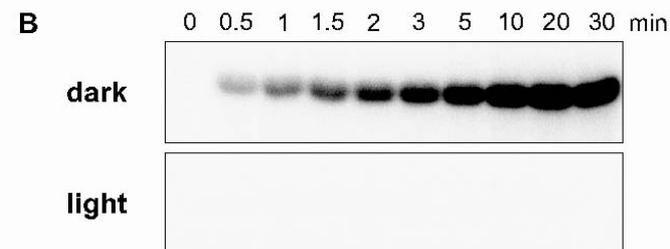
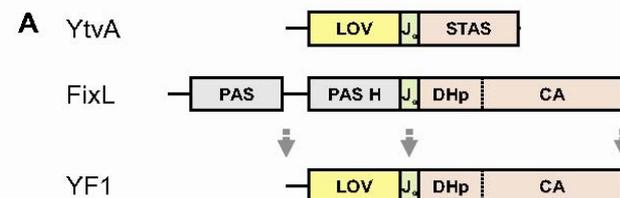
Beamline WBS Element: Connecting proteins to organisms

GPCR Membrane Protein



Microcrystallography

Optogenetics

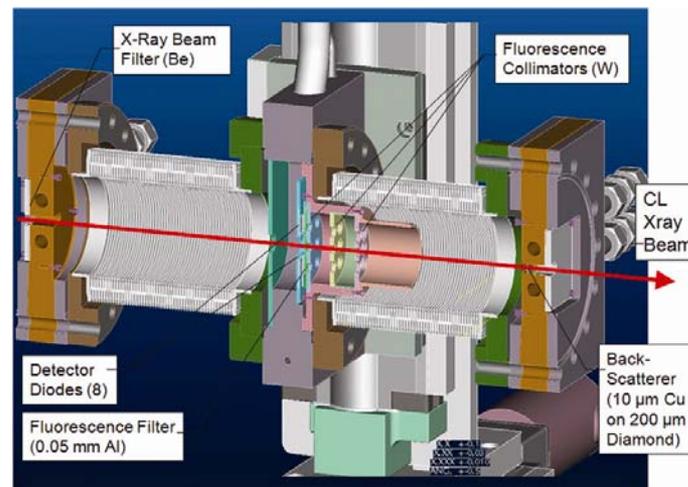
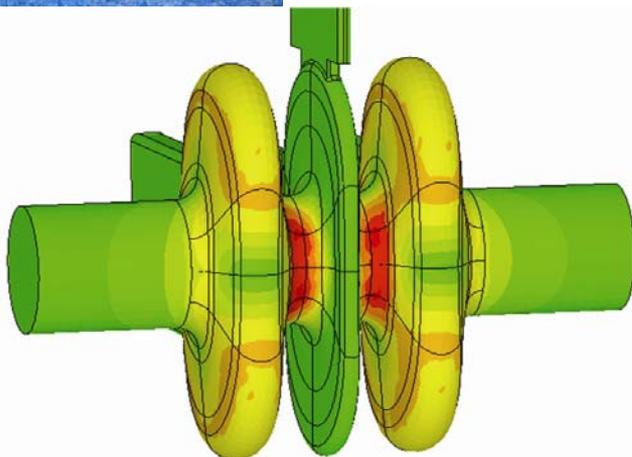


Accelerator WBS Elements

Longer straight sections



SPX "crab" cavities[★]



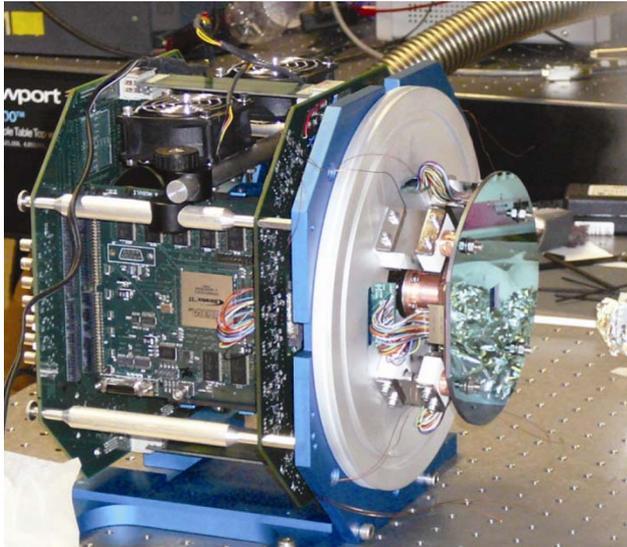
X-ray beam position monitors

Superconducting undulators[★]

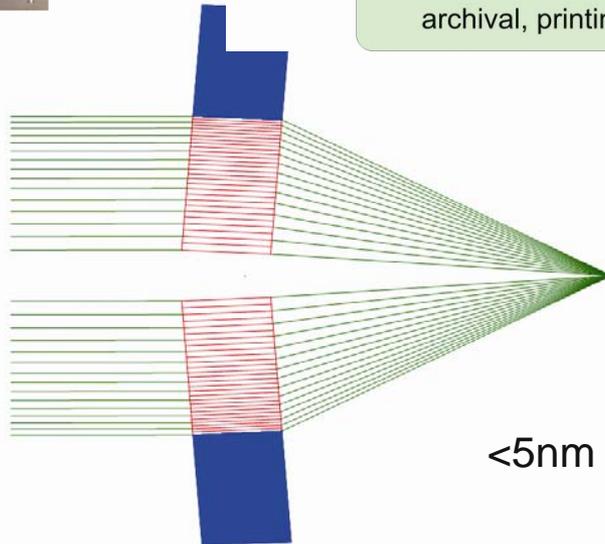
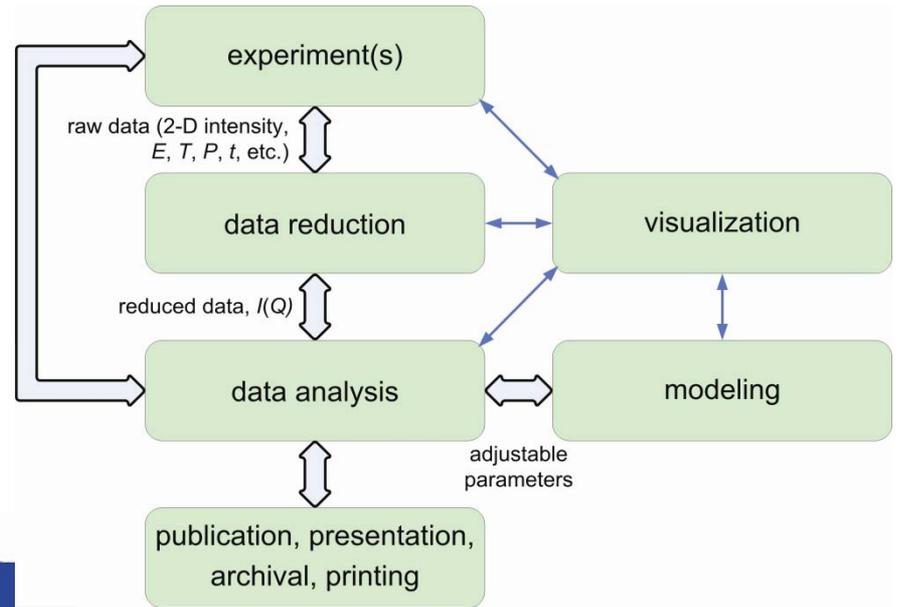
And higher operating current

★
R&D needed

WBS element: enabling technical capabilities



Detectors



<5nm focusing optics

Renewal project is being set-up (still not formal)

- Renewal project will be pulled off as a separate box under Photon Sciences
 - J. Murray Gibson – Project Director (reports to Eric Isaacs)
 - *Geoff Pile – Project Manager*
 - *Ed Temple – Senior Project Advisor*
 - *(unconfirmed) Ron Lutha – Federal Project Director*
 - *Harriet Kung – Federal Acquisition Executive*
 - *Rod Gerig will become Deputy APS Director for Operations during project*
- First task is to obtain CD-0 – Mission Need Statement - must be approved by Bill Brinkman, Director Office of Science
- Hope to prepare Conceptual Design Report in FY2010, and get CD-1 near end of FY2010
 - Have requested ~\$10M extra funds for CDR and R&D in 2010

October 8th and 9th – SAC Meeting to review Renewal Planning

- Denny will discuss format
- Most important outcome is the process for moving towards a CDR