Argonne NATIONAL LABORATORY

… for a brighter future

U.S. Department of Energy

UChicago ▶ Argonne LLC

Office of Science U.S. DEPARTMENT OF ENERGY

A U.S. Department of Energy laboratory managed by UChicago Argonne, LLC

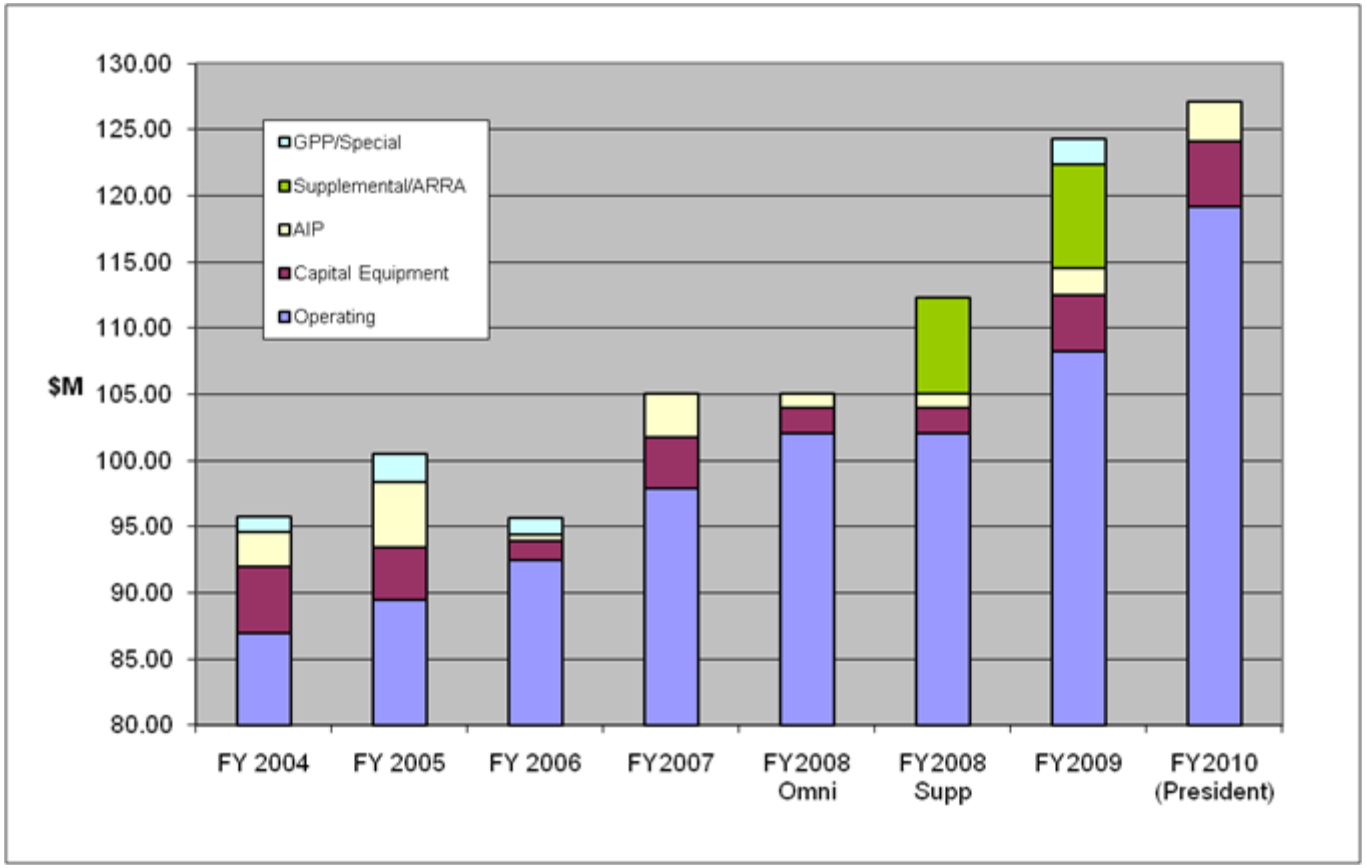
APS Update for Partner User Council Meeting

Murray Gibson 07/20/2009

Agenda for APS part of PUC meeting (Denis Keane)

- Brief APS update, especially budget news–M. Gibson
- APS Renewal CD-0 proposal –M. Gibson
- APS Renewal planning process (including October SAC meeting and possible cross-cut review) –D. Mills
- Instrumentation and ARRA– G. Srajer
- User Communications on Site – K. Sidorowicz
- Beamline Scheduling Policy–D. Mills
- Beamline Scheduling Demo–C. Saunders

APS Budget



House and senate likely to conference FY2010 bill after August recess

Budget gives confidence to do key hiring (e.g. XSD, BCDA, IT)
And we have allocated funding for equipment, obsolescence issues

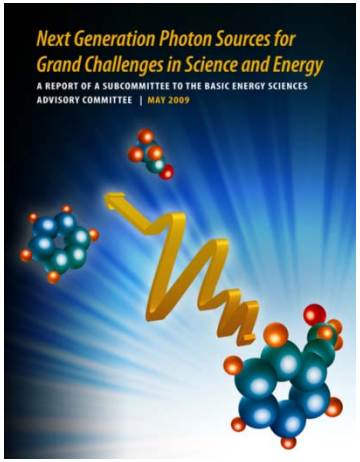
Planning for the Renewal: What are we best at, and where do we aspire to be best? (from ANL Board of Governor's Presentation 6/09)

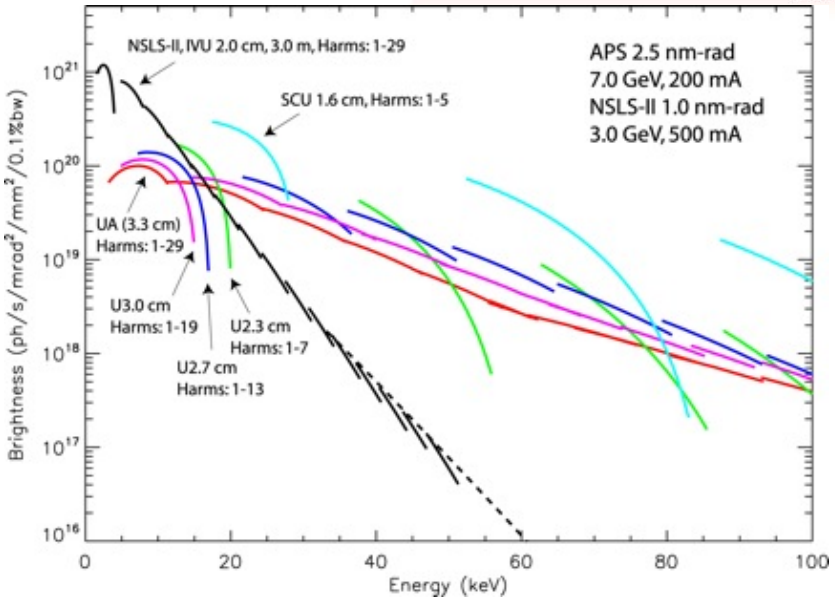
- Protein structures – we solve more than any other facility world wide
  - Success here has been due to community and CAT approach allowing major NIH investments (also a challenge because of lack of collaboration), less because of intrinsic APS capability
- High-pressure science – more high impact research than any other facility worldwide
  - Success here is partly community, but mostly intrinsic APS capability for high-energy x-rays which can penetrate into real environments, and impact of the science
- Innovative machine – stability and top-up, are world recognized and imitated
  - Issue here is flexibility designed into APS, and retaining the cadre of physics and *engineering* experts

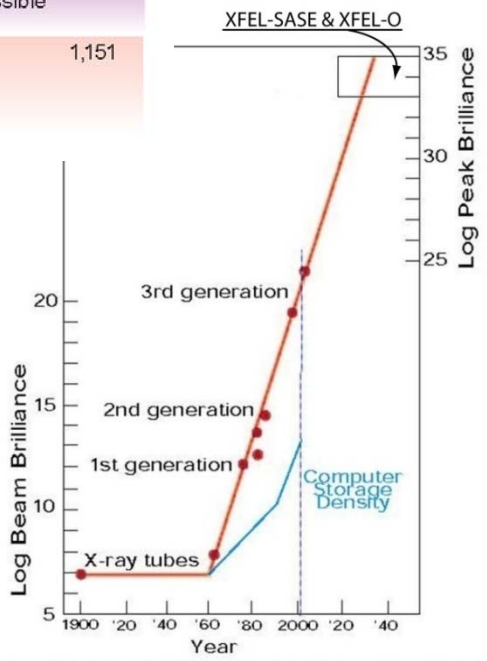
TODAY: What is the competition, their strengths and weaknesses? Synchrotrons around the world

Desire for new capability and increased access

Source Name	Location	Type	1st Year Operation	Characteristic Energy	Beam-lines	Users (2007)
Advanced Light Source	California	Third-gen storage ring	1993	3.2 keV (12 keV super-bend)	43	1,784
Advanced Photon Source	Illinois	Third-gen storage ring	1996	19.5 keV	60	3,420
Linac Coherent Light Source	California	Free-electron laser	2009	N/A	4 (instmnts)	N/A
National Synchrotron Light Source	New York	Second-gen storage ring	1982	7.1 keV	65	2,219
National Synchrotron Light Source II	New York	Third-gen storage ring	2015	2.4 keV	~58 possible	N/A
Stanford Synchrotron Radiation Laboratory	California	From second to third-gen storage ring	1973 (upgraded in 2004)	7.5 keV	34	1,151



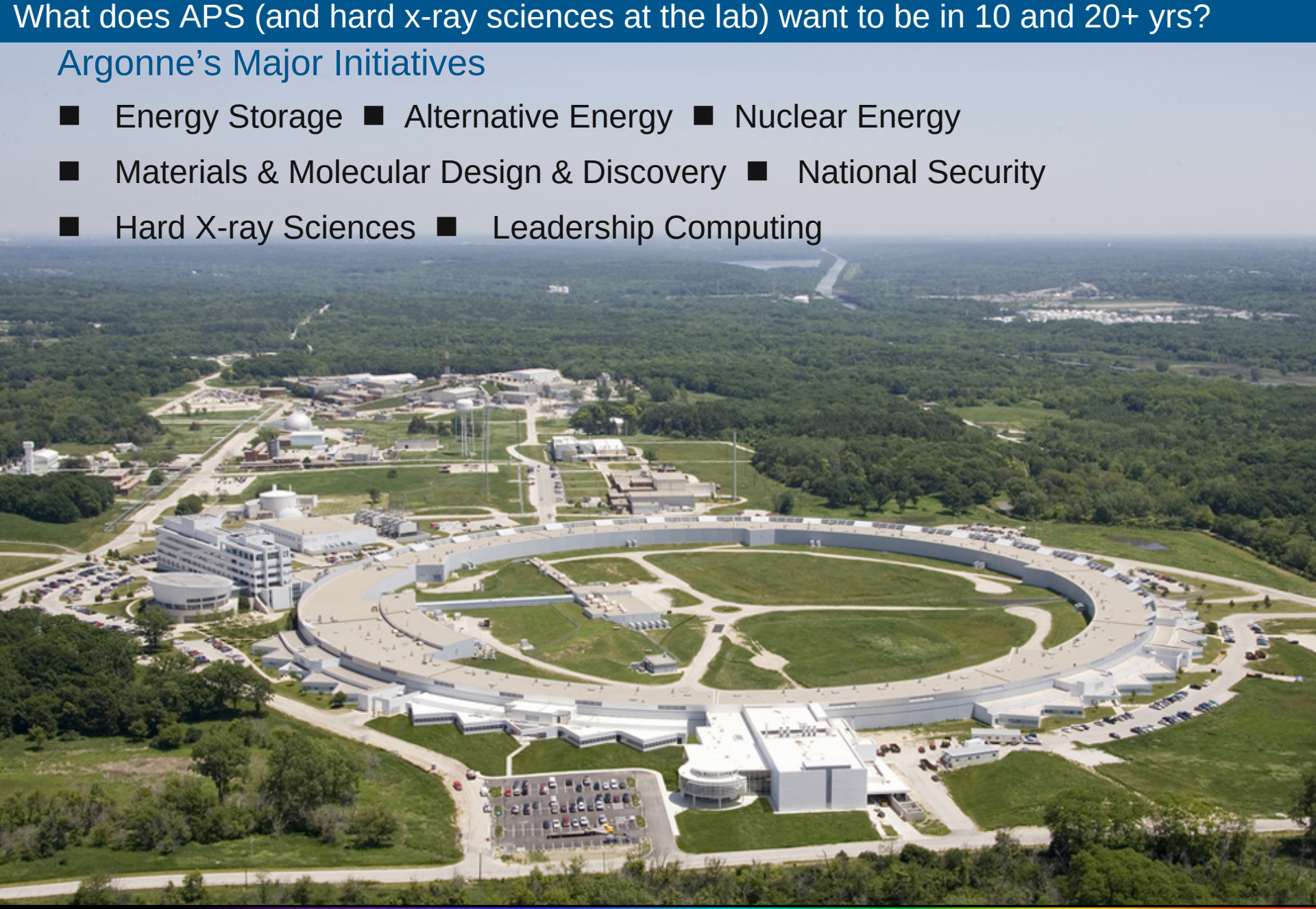




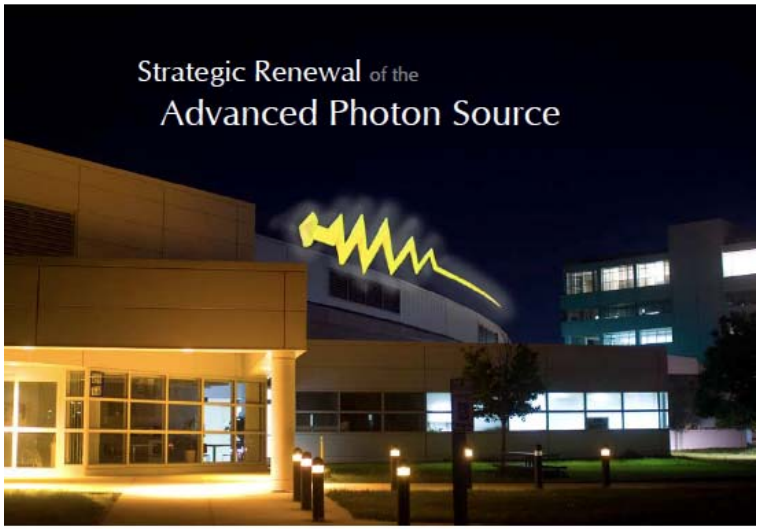
What does APS (and hard x-ray sciences at the lab) want to be in 10 and 20+ yrs?

Argonne's Major Initiatives

- Energy Storage
- Alternative Energy
- Nuclear Energy
- Materials & Molecular Design & Discovery
- National Security
- Hard X-ray Sciences
- Leadership Computing

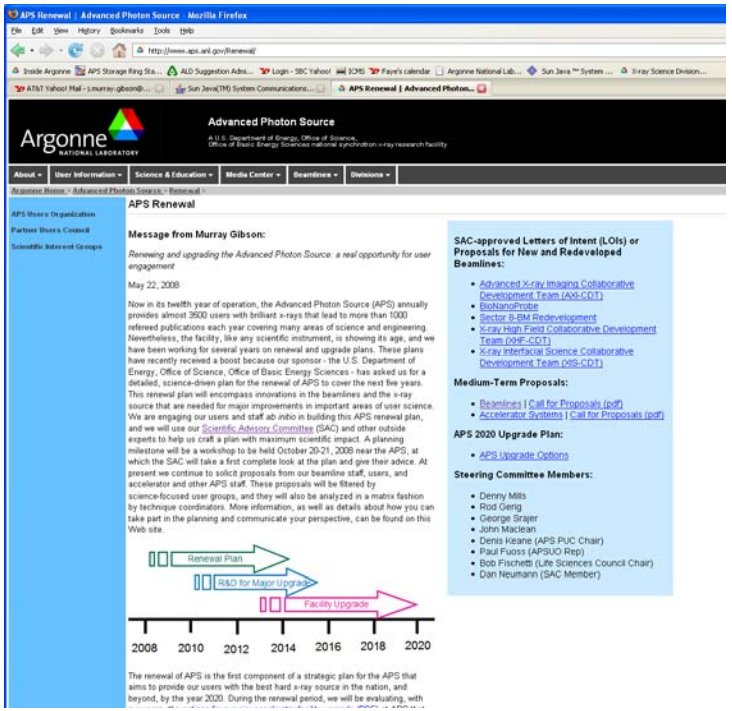


Strategic planning for APS renewal

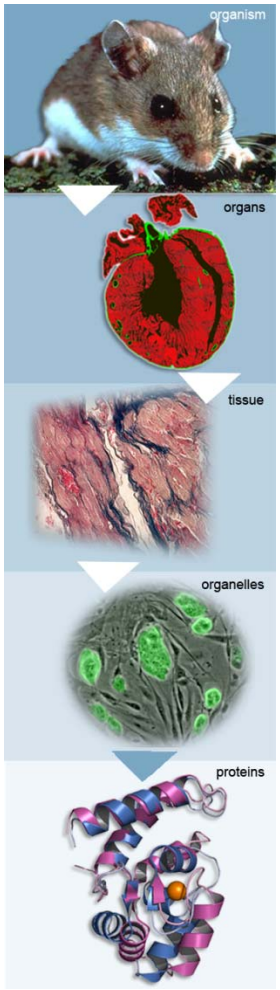


Proposal for approval
of Conceptual Design (CD-0)

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



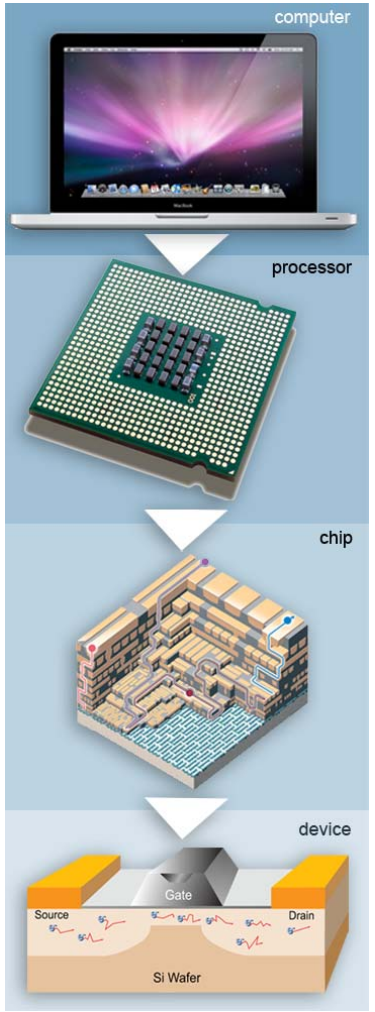
SCIENCE DRIVER: Mastering hierarchical structures through imaging



"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

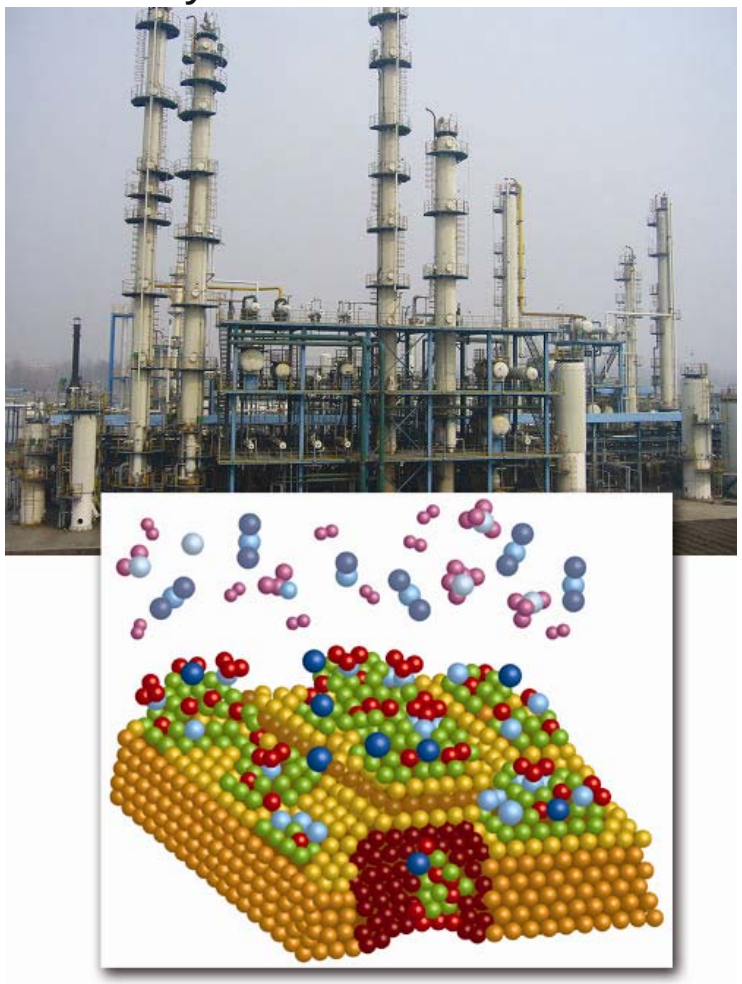
- Hierarchical structures are key to life, machines and complex nanostructured materials

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

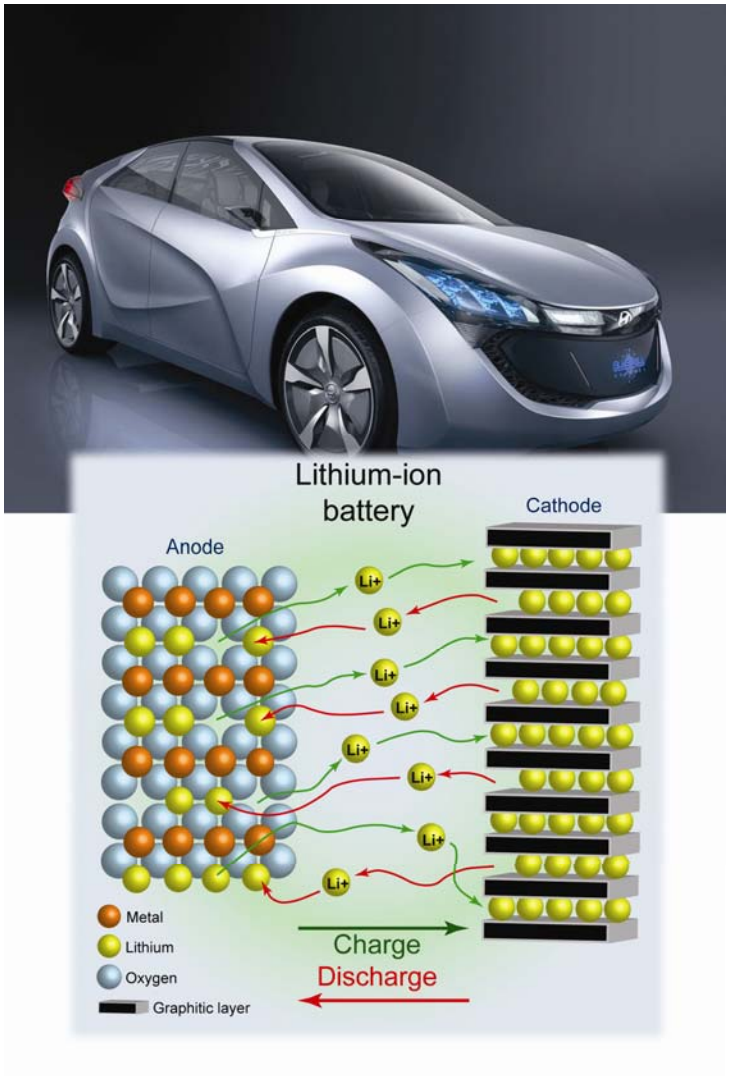


SCIENCE DRIVER: Real materials under real conditions in real time

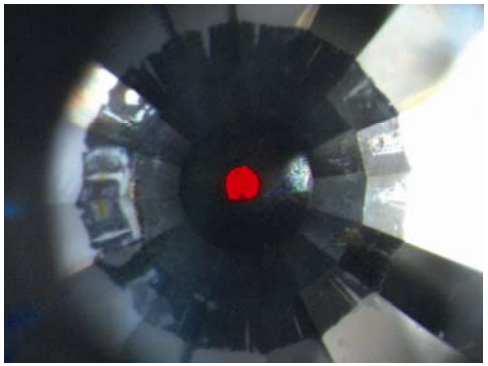
Catalysis

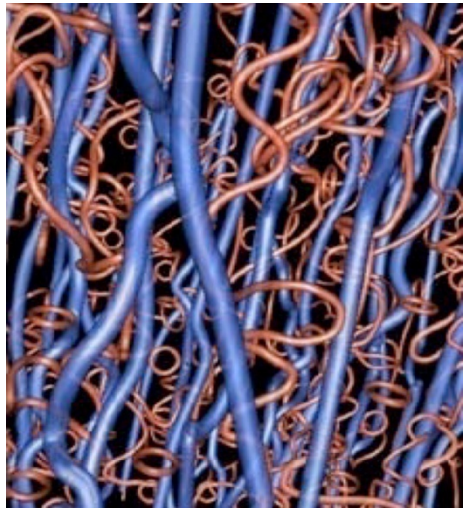


Batteries

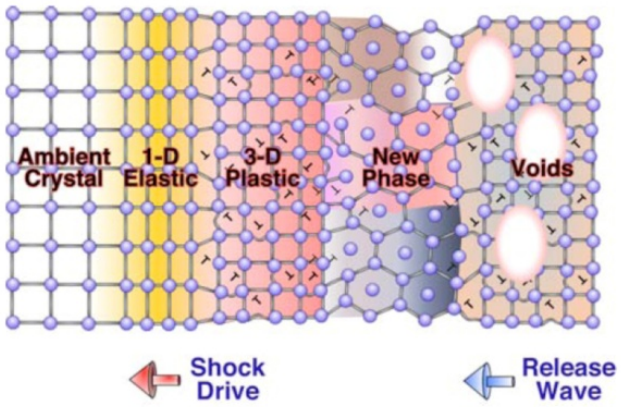


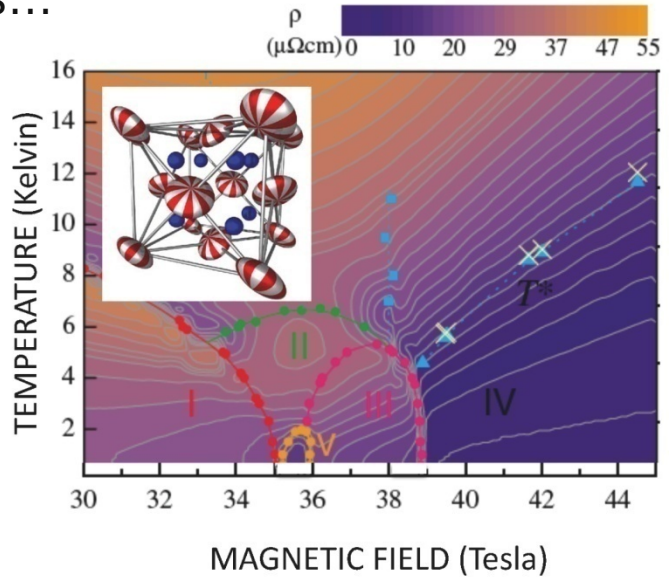
THEME: Materials under extreme conditions





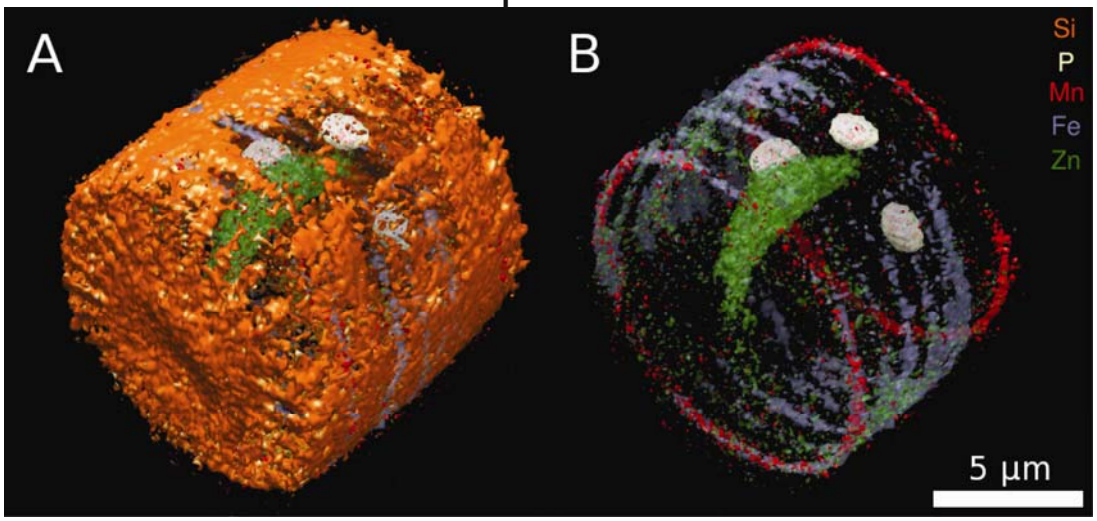
High pressures, high magnetic fields…



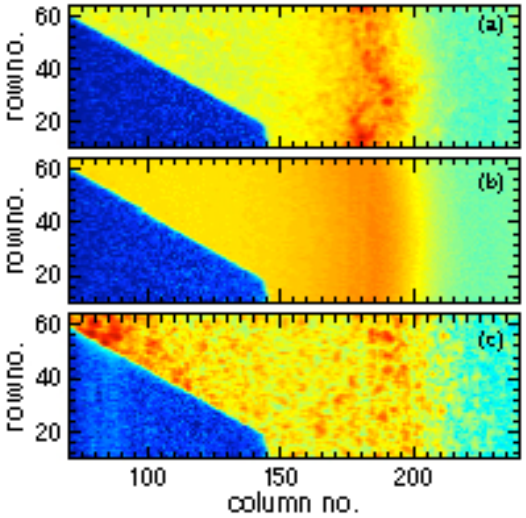


THEME: Imaging and coherence

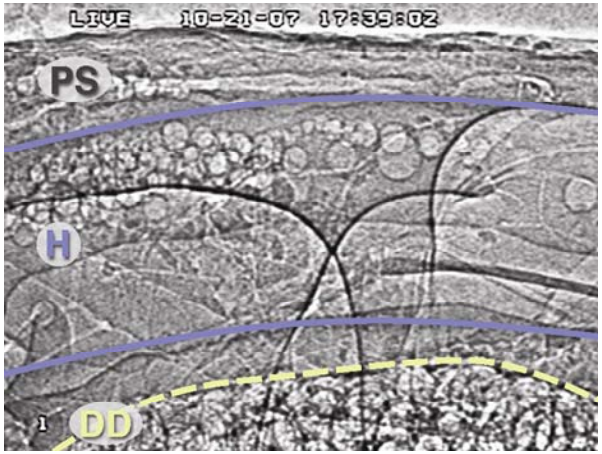
Carbon sequestration



Polymer nanostructures

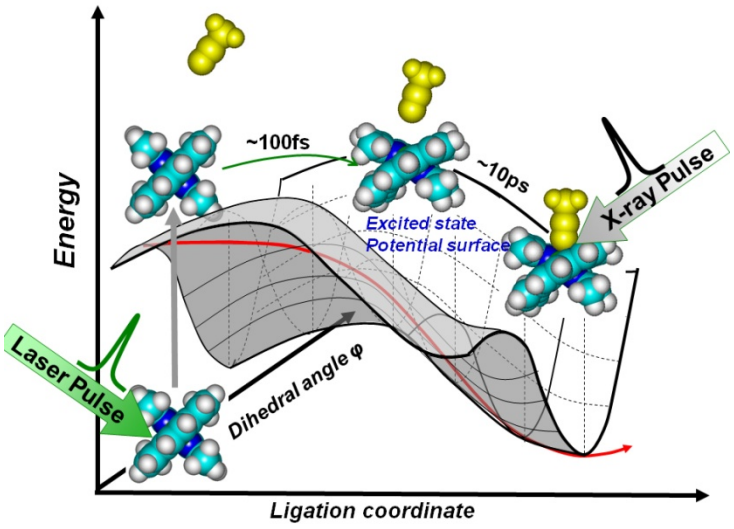


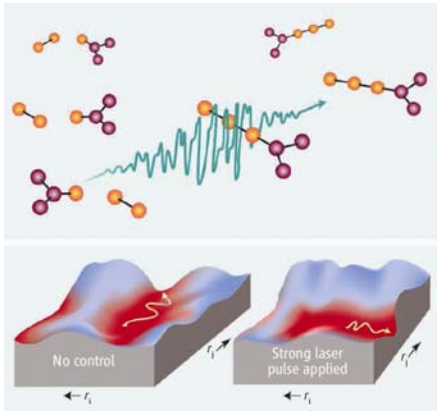
Organisms at work



THEME: Ultrafast dynamics

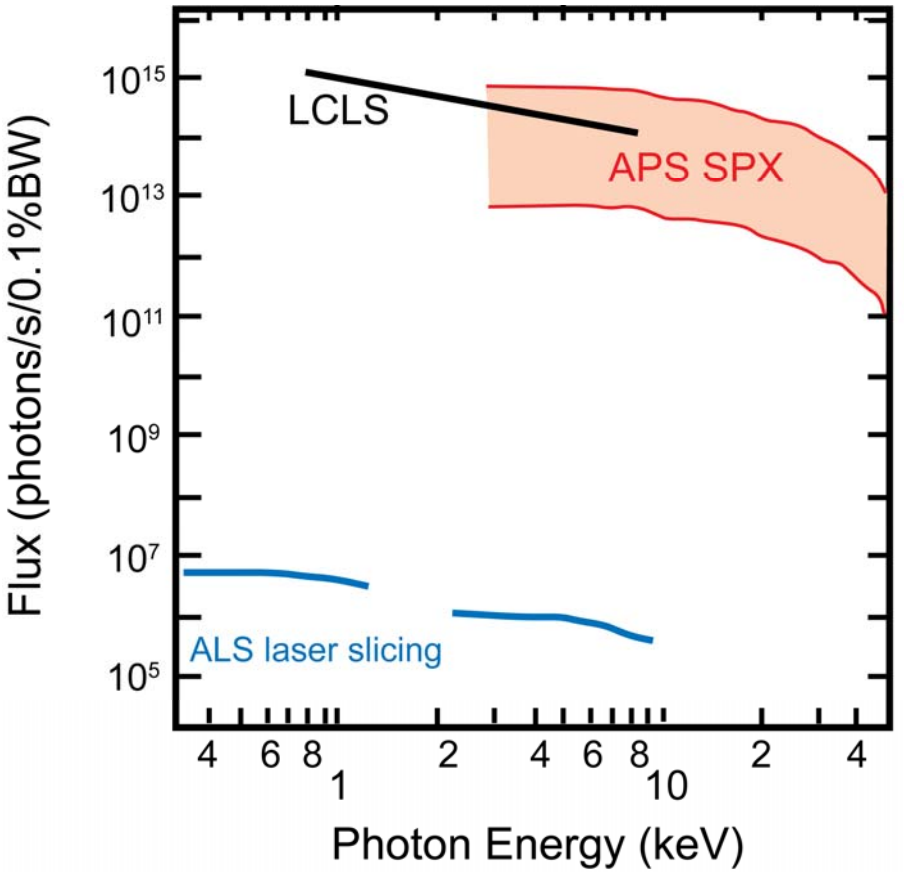
Photosynthesis





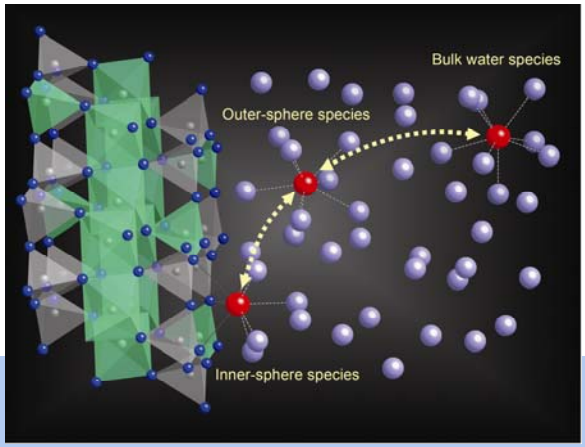
New reaction paths

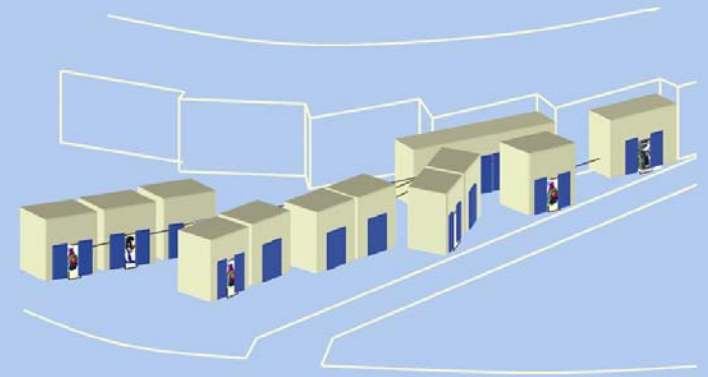
Short Pulse (~1ps) X-Rays (SPX)



THEME: Interfaces in complex systems

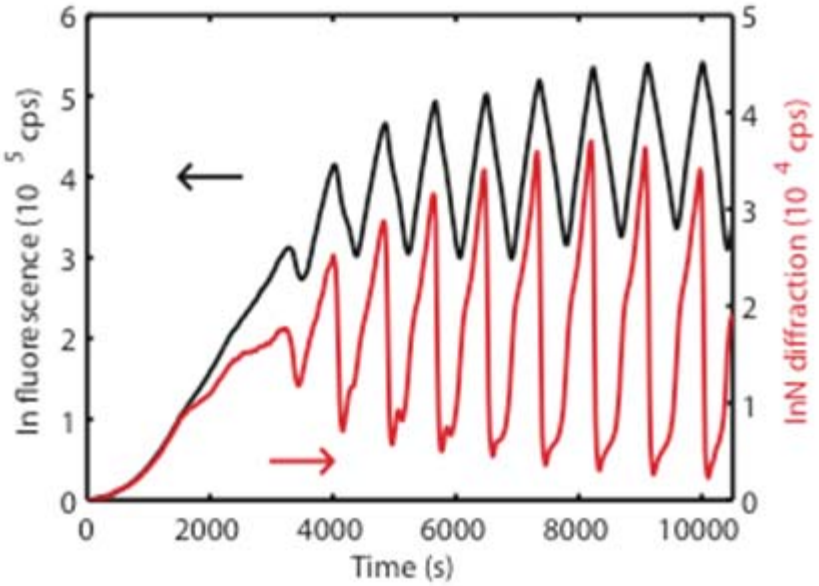
Geochemistry

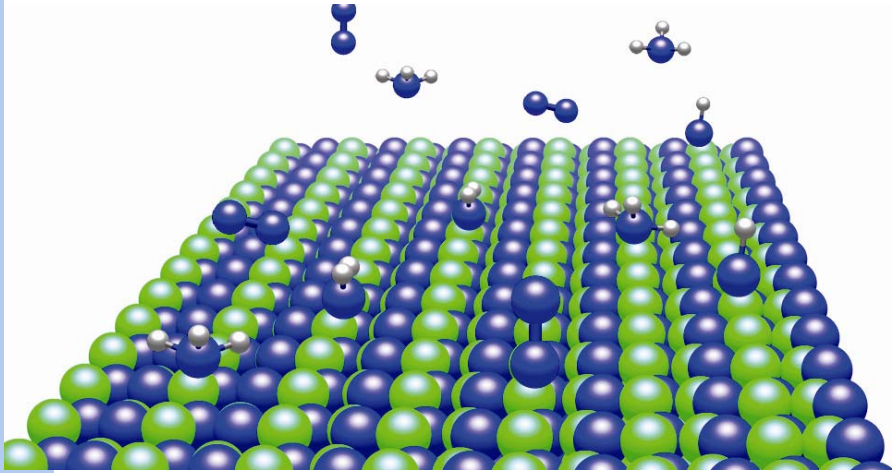




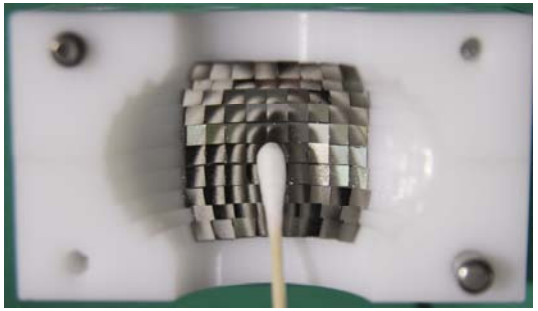
Conceptual layout of the X-Ray Interface Science facility

Solid-state lighting

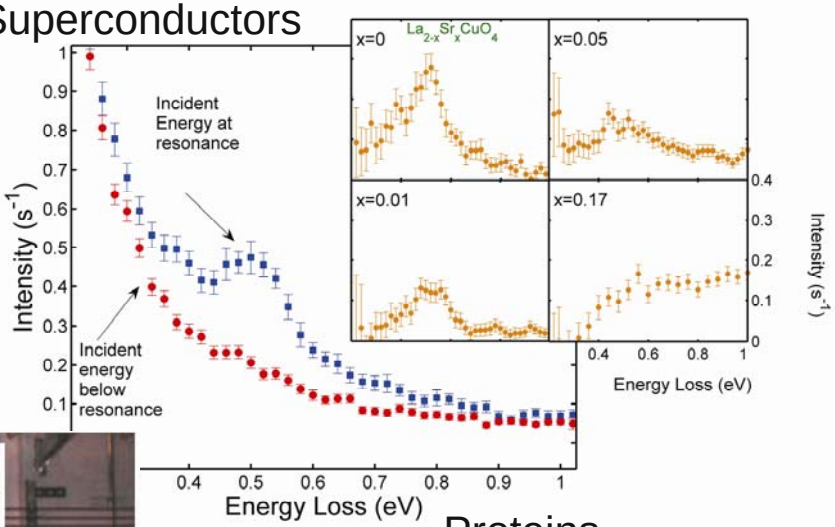




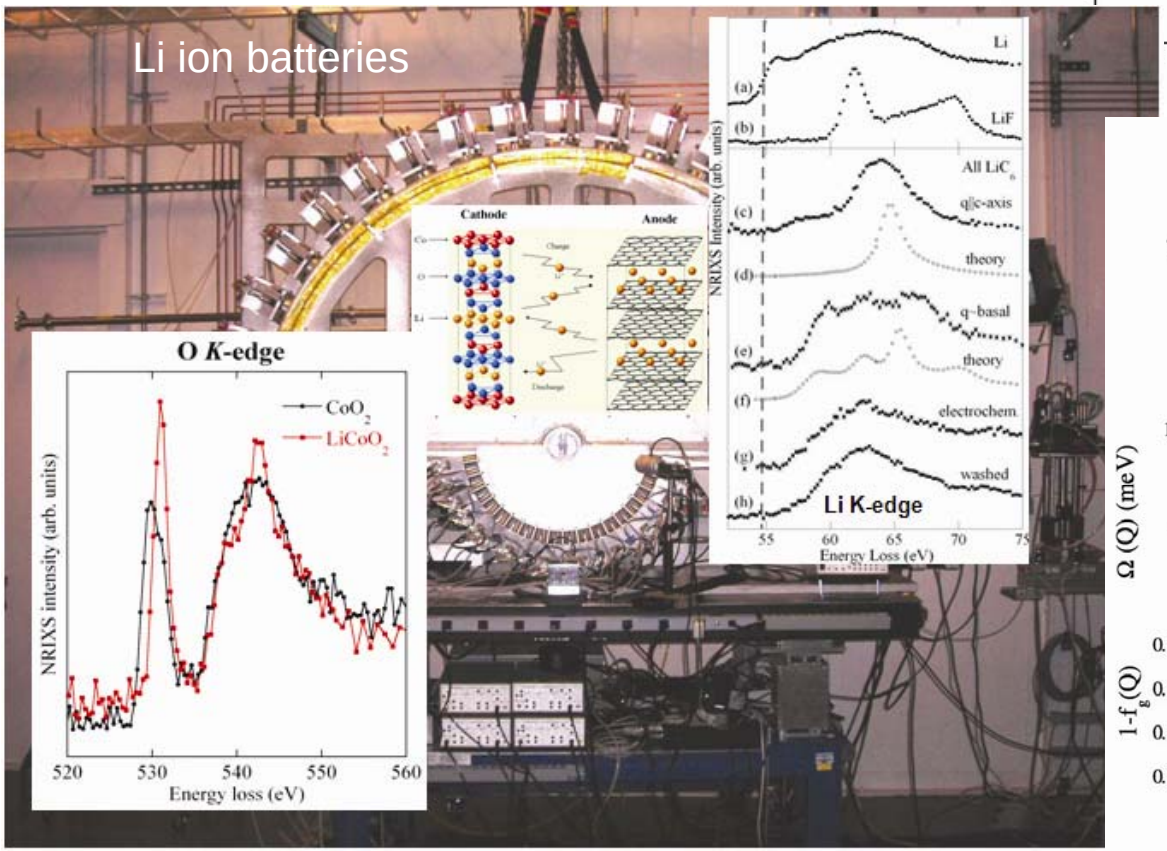
THEME: High-resolution spectroscopy



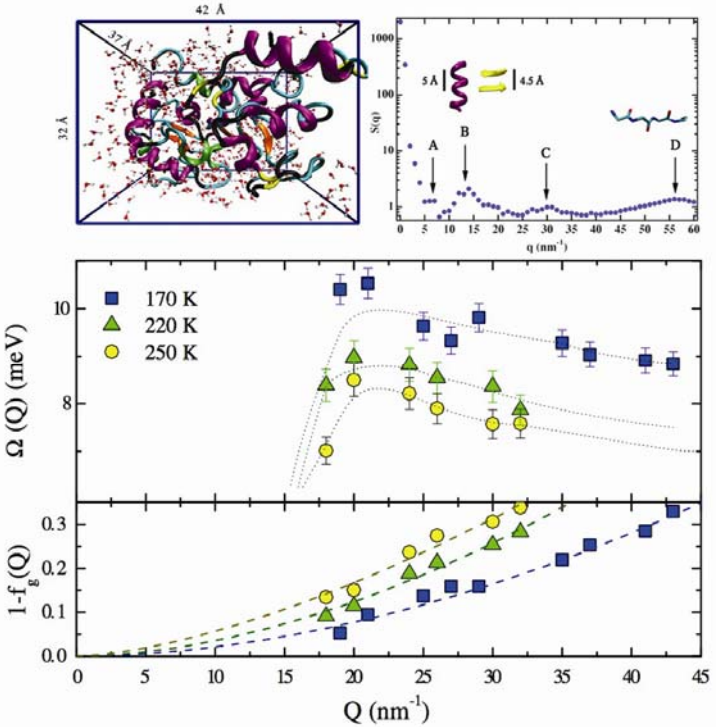
Superconductors



Li ion batteries

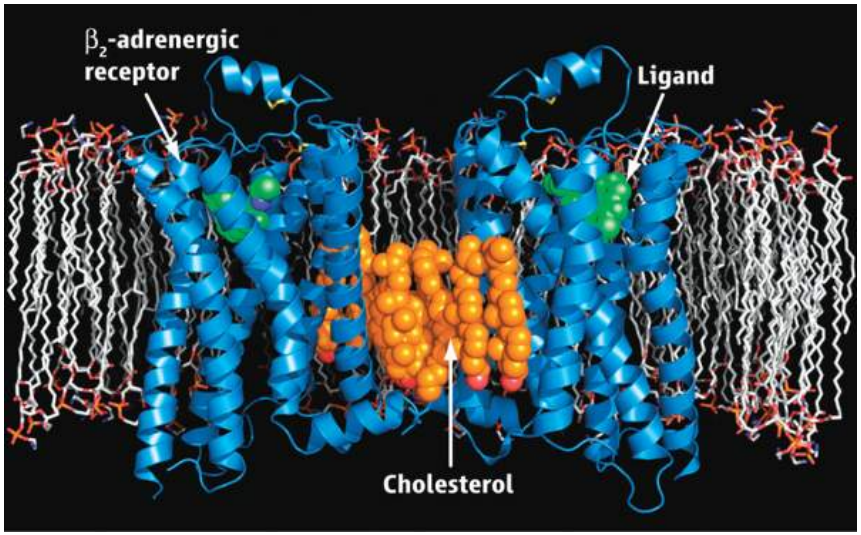


Proteins

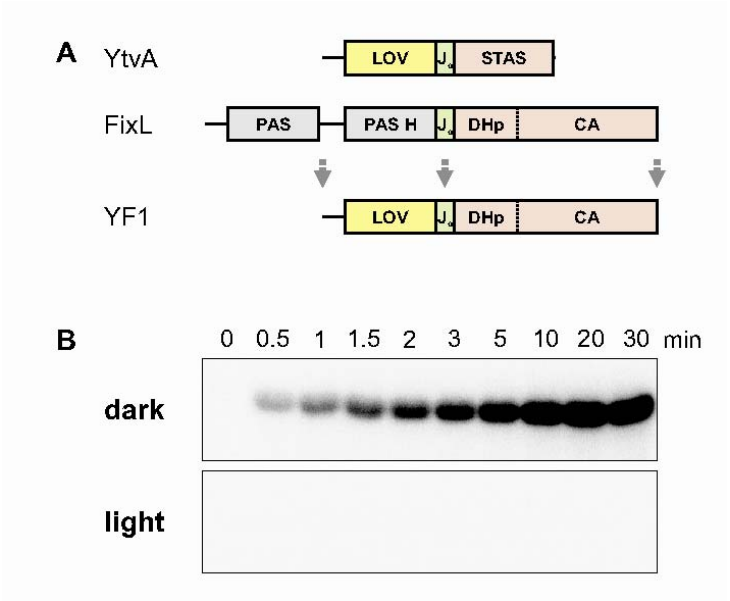


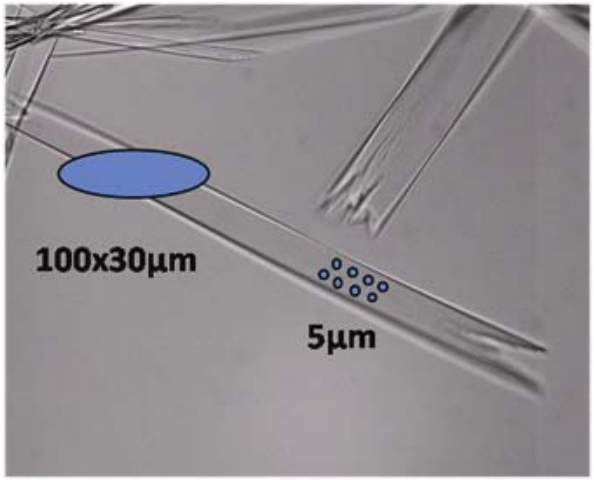
THEME: Connecting proteins to organisms

GPCR Membrane protein



Optogenetics



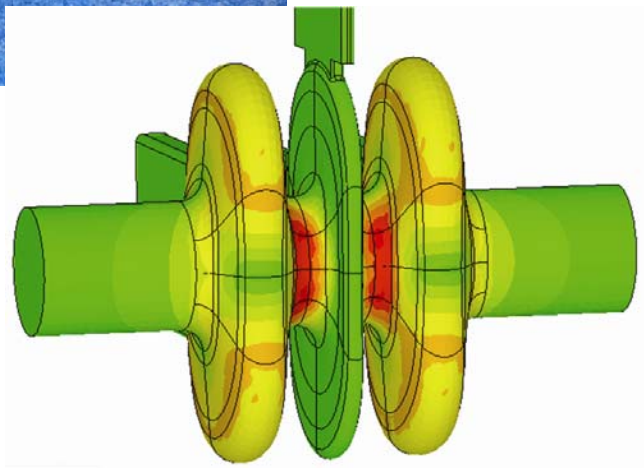


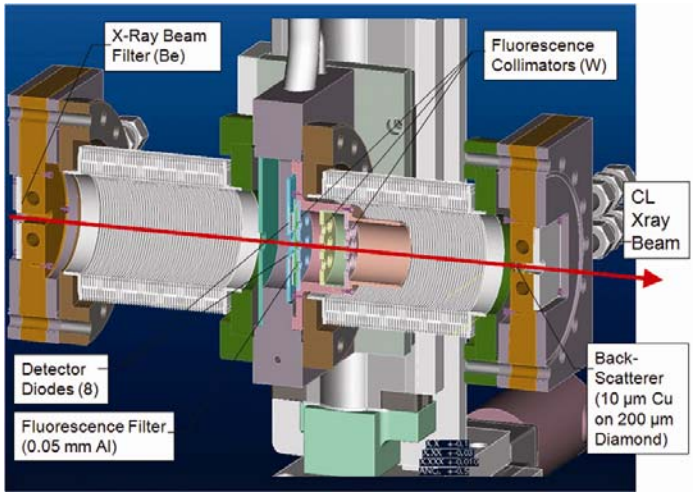
Microcrystallography

Renewal accelerator upgrades

Longer straight sections

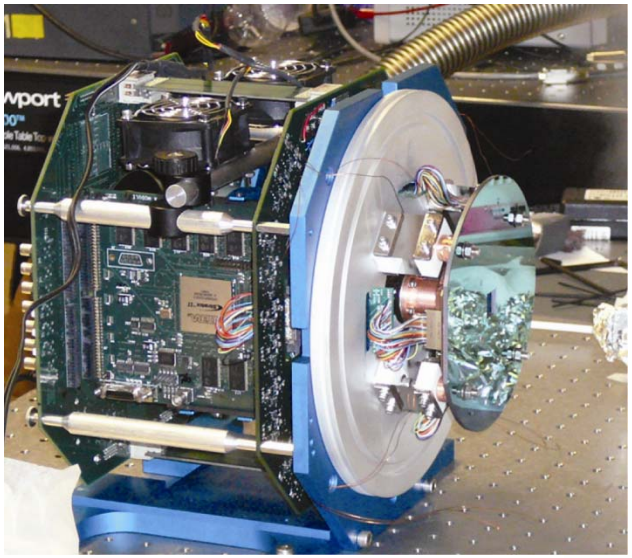
SPX “crab” cavities



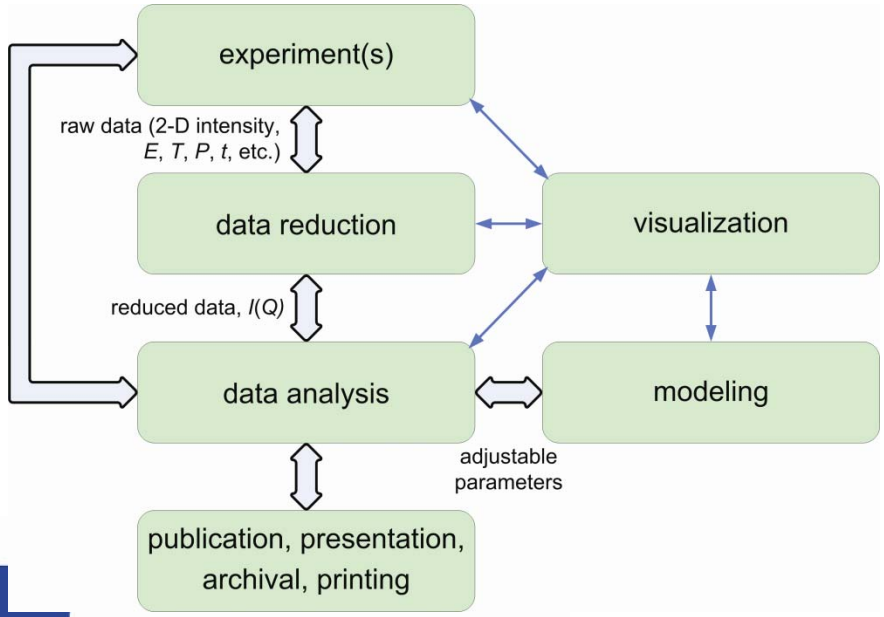


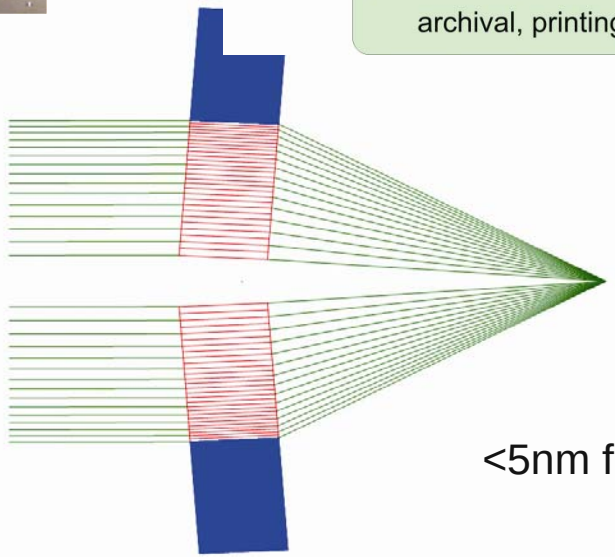
X-ray beam position monitors

Renewal - enabling technical capabilities



Detectors

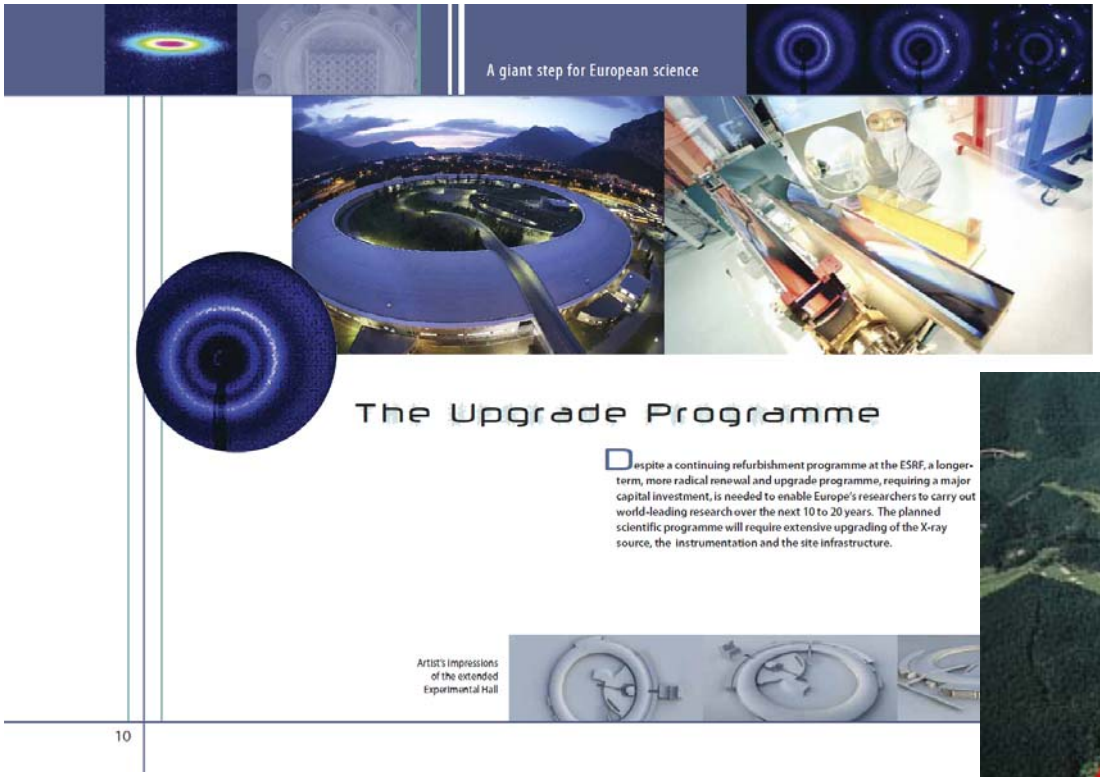




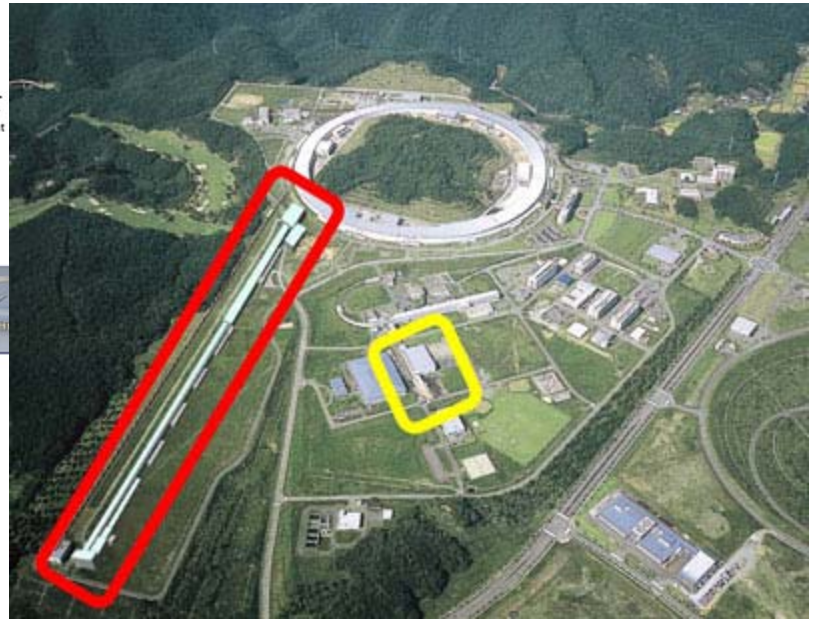
<5nm focusing optics

THE COMPETITION: Upgrades to SPring-8 and ESRF

European Synchrotron Research Facility (ESRF)
Grenoble-France



SPring-8 (Harima, Japan)



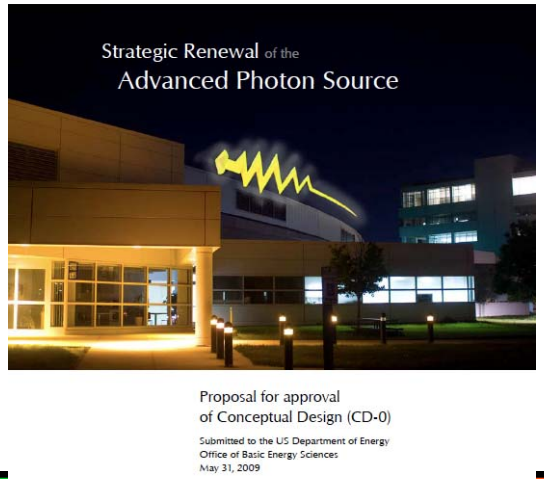
Both upgrade projects under construction

TACTICS: the APS renewal will revolutionize capabilities

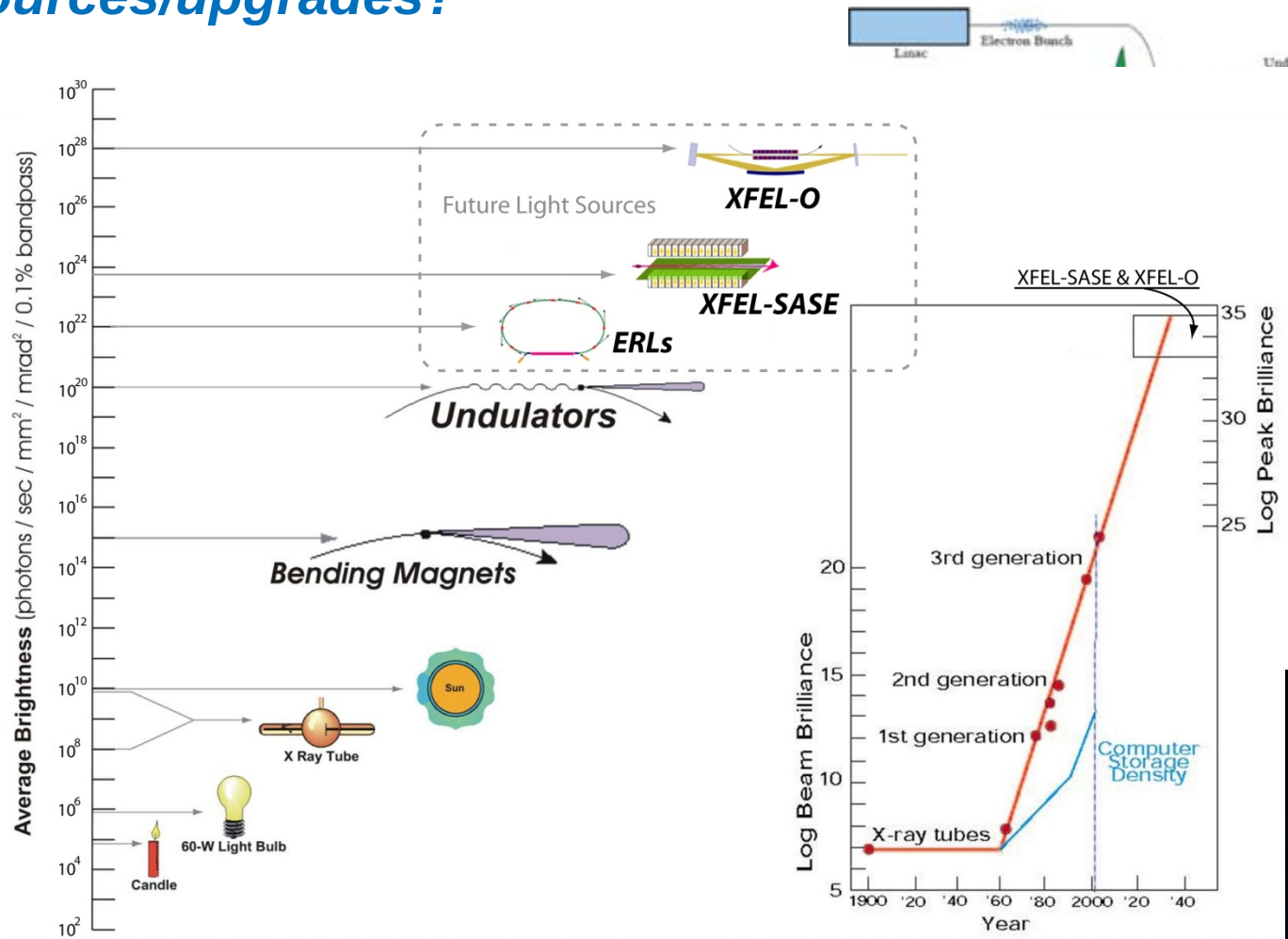
- Machine upgrade
  - Higher current, longer, optimized insertion devices, improved stability, ultrafast (~1ps) x-ray pulses
- New and upgraded beamlines addressing key science drivers
- Enabling technical capabilities
  - Detectors, optics, nanopositioning, data analysis software
- AND POSITION US TO LEAD HARD X-RAY SCIENCE INTO THE NEXT GENERATION

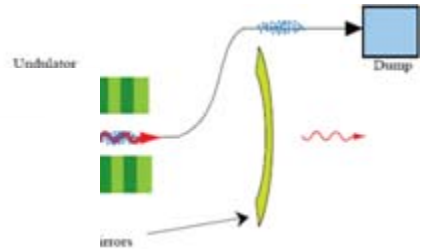
- Proposal (for DOE's CD-0) submitted May 31st, describes vision of the upgraded APS…

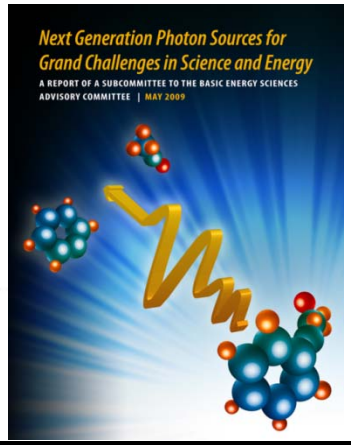
- Project cost $350M 6 years, begin FY2011
  - $10M R&D needed in FY2010



Beyond the renewal - new possibilities for future hard x-ray sources/upgrades?







Offer far higher brilliance, coherence and shorter pulses

SUMMARY SLIDE – A VISION FOR APS WHICH BUILDS ON OUR STRENGTHS

- Unique source of tunable high-energy x-rays in the US for next decades
- We have leadership in hard x-ray science, our vision is to boldly expand that to dominance world-wide
  - Retain and recruit the best users/developers of high-energy x-ray techniques
- Capitalize on existing strength in materials under extreme conditions
- Develop greater strength in hard x-ray imaging for hierarchical structures
  - Expand on our strengths in structural biology
- Strengthen ultrafast science
- Exploit opportunities for partnering on key laboratory strategic missions
  - (energy storage, materials and molecular design and discovery…)
- Retain and expand team of accelerator physicists and engineers
  - Be at the state-of-the-art in source knowledge and science drivers for next generation high-energy x-ray sources

SUMMARY SLIDE – TACTICS TO ENABLE OUR VISION (from ANL BOG presentation)

- Seek to obtain CD-0 for APR Renewal this summer
  - $350M project funding beginning in FY11
  - $10M in R&D for FY10 (not in FY2010 President's budget)
- Strengthen team on hard x-ray science and accelerator sides
  - Leverage with our partners e.g. with joint appointments
- Lead the development of the science and machine case for next generation hard x-ray sources beyond LCLS
  - Secure support for R&D on the X-Ray FEL-O

Other issues for discussion with PUC

- Industrial users
  - Preliminary report from NUFO in draft stage
  - DOE will want some changes to accommodate industrial users
    - *Technology review panel; revised criteria?*
  - Plan to discuss with other light sources (and BESAC?)
- Possibility of a cluster of independently operated bending magnet beamlines funded by NSF?
  - Positive response from G. Tessema, would like more info (white paper, visits)
  - Assembling university partners (IIT has shown interest already)

Questions?

- Brief APS update, especially budget news–M. Gibson
- APS Renewal CD-0 proposal –M. Gibson
- APS Renewal planning process (including October SAC meeting and possible cross-cut review) –D. Mills
- Instrumentation and ARRA– G. Srajer
- User Communications on Site – K. Sidorowicz
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