

WORKSHOP ON NANOMAGNETISM USING X-RAY TECHNIQUES



Introduction to Workshop

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Workshop Chairs

August 29 – September 1, 2004, The Abbey, Fontana, Lake Geneva Area, WI





Is a part of a study to explore future scientific directions for the Advanced Photon Source (APS)

Chair: Gopal Shenoy (APS/ANL)

Co-Chair: Sunil Sinha (UCSB/LANL)



Workshops held at the APS

1 Future Directions in Synchrotron Environmental Science

(**APS Users' Meeting**, May 4, 2004, APS)

Chairs: Steve Sutton, Ken Kemner, Shelly Kelly

2 Emerging Areas in Biological Crystallography

(Dates July 26-28, 2004, APS)

Chairs: Wayne Hendrickson, John Helliwell

3 Frontier Science Using Soft X-rays

(August 5-6, 2004, APS)

Organizers: Richard Rosenberg, Juan Carlos Campuzano

4 Science with High-Energy X-rays

(August 9-10, 2004, APS)

Chair: Dean Haeffner

5 Membrane Science

(August 17-18, 2004, APS)

Chairs: Millicent Firestone, Tom Irving, Jin Wang, Randall Winans

Workshop Scope

- To understand the magnetic behavior of individual building blocks of a nanomagnetic system, which are combined into more complex structures leading to devices with new functionalities.
- Evaluate the advances in nanomagnetism that are scientifically and technologically exciting and significant.
- Areas of nanomagnetism where x-ray characterization techniques have major impact:
 - **Confined Magnetism**
 - **Cluster Magnetism**
 - **Phase Separated Systems/Complex Oxides**
- Develop the potential of x-ray polarization based techniques which are ideal to study nanomagnetism



Challenges

**Grand Challenges
In
Nanomagnetism and
Opportunities for X-ray
Techniques to Address them**



A Small Sampling Scientific and Technology Challenges

- **Confined Magnetism**
- **Cluster Magnetism**
- **Phase Separated Systems/Complex Oxides**

*.....and We Will Identify Many More Challenges
Of Next 5-10 Years at this Workshop*

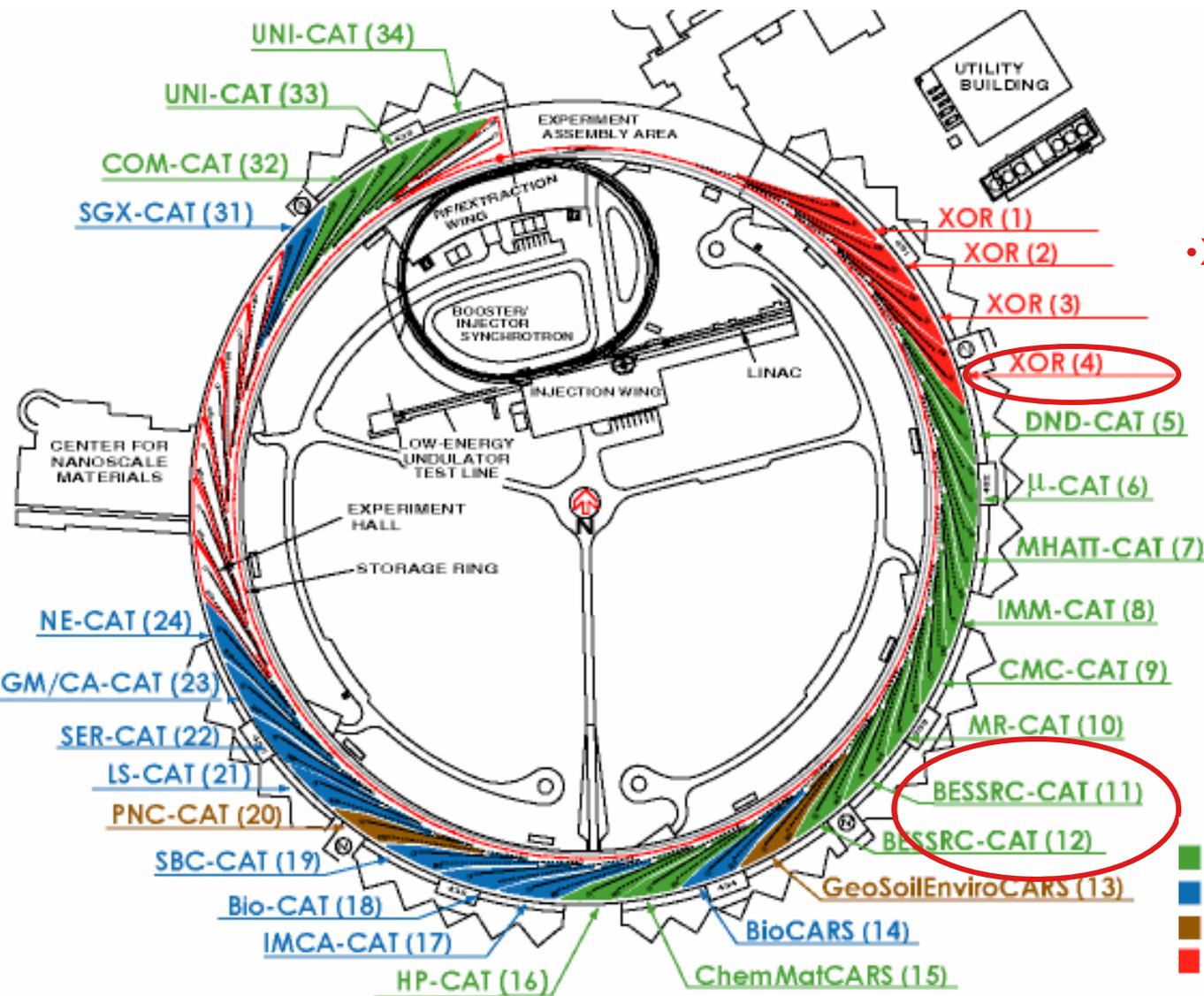
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Practical Challenges

- Higher beam brilliance with variable polarization
 - Polarization switching
 - Photon energy ranges
 - Nanofocus capabilities
- Techniques required to address scientific challenges -?
- Unique experimental environments
 - High static magnetic fields
 - Domain switching at high frequency
 - Integration of laboratory based techniques with x-ray tools (E.g. MOKE)
 - Need for large H/T capabilities (E.g., Sub Kelvin refrigerator in large magnetic fields)
 - Sub-micro sample scanning stages
- R&D on Polarized X-ray Techniques, Etc., Etc.....

APS Nanomagnetism Study Capabilities



- XOR (S 4)
- XOR/BESSRC (S 11,12)

■ MATERIALS, CHEMICAL, & ATOMIC SCIENCE
■ BIOLOGY
■ GEO, SOIL, & ENVIRONMENTAL SCIENCE
■ INSTRUMENTATION



Draft Workshop Objectives

1. Explore the breadth of nanomagnetism covered by the workshop topics, *not* limiting to synchrotron techniques alone.
2. Identify opportunities for continued scientific and technology discoveries and the impact using the APS during the next 5-10 years.
3. Identify new scientific proposals/programs specific to the emerging areas of nanomagnetism that the participants will bring to the APS during next 5 to 10 years. Also evaluate the capital and operational requirements for these proposals/programs.

Draft Workshop Objectives

4. In addition to available beamline capabilities at the APS, identify future needs to support research in this area of science and technology.
5. Address R&D in enhancing the capabilities of the APS nanomagnetism research effort.
6. Address the need and support for theoretical work to strengthen the experimental research.
6. Prepare a summary document for the archival literature to serve as a roadmap for nanomagnetism research using x-rays at the APS and suggest the role of the APS towards this objective.