

Orbital order in the bilayer manganites and soft x-ray scattering instrumentation at Diamond

Presented by Thomas Beale
10th June 2009

Outline

- 1) Soft x-ray resonant diffraction
- 2) Orbital Order in $\text{Pr}(\text{Sr}_{0.1}\text{Ca}_{0.9})_2\text{Mn}_2\text{O}_7$
- 3) Soft x-ray resonant diffraction at Diamond

with thanks...

Peter Hatton, Durham University
Stewart Bland, Durham University
Andrew Boothroyd, University of Oxford
D. Prabhakaran, University of Oxford
Sarnjeet Dhesi, DLS
Richard Mott, DLS
Mark Roper, Daresbury Laboratory
Júlio Cezar, ESRF

Gerrit van der Laan, DLS
Paul Steadman, DLS
Andrew Marshall, DLS
Linda Pratt, DLS
Suren Patel, DLS

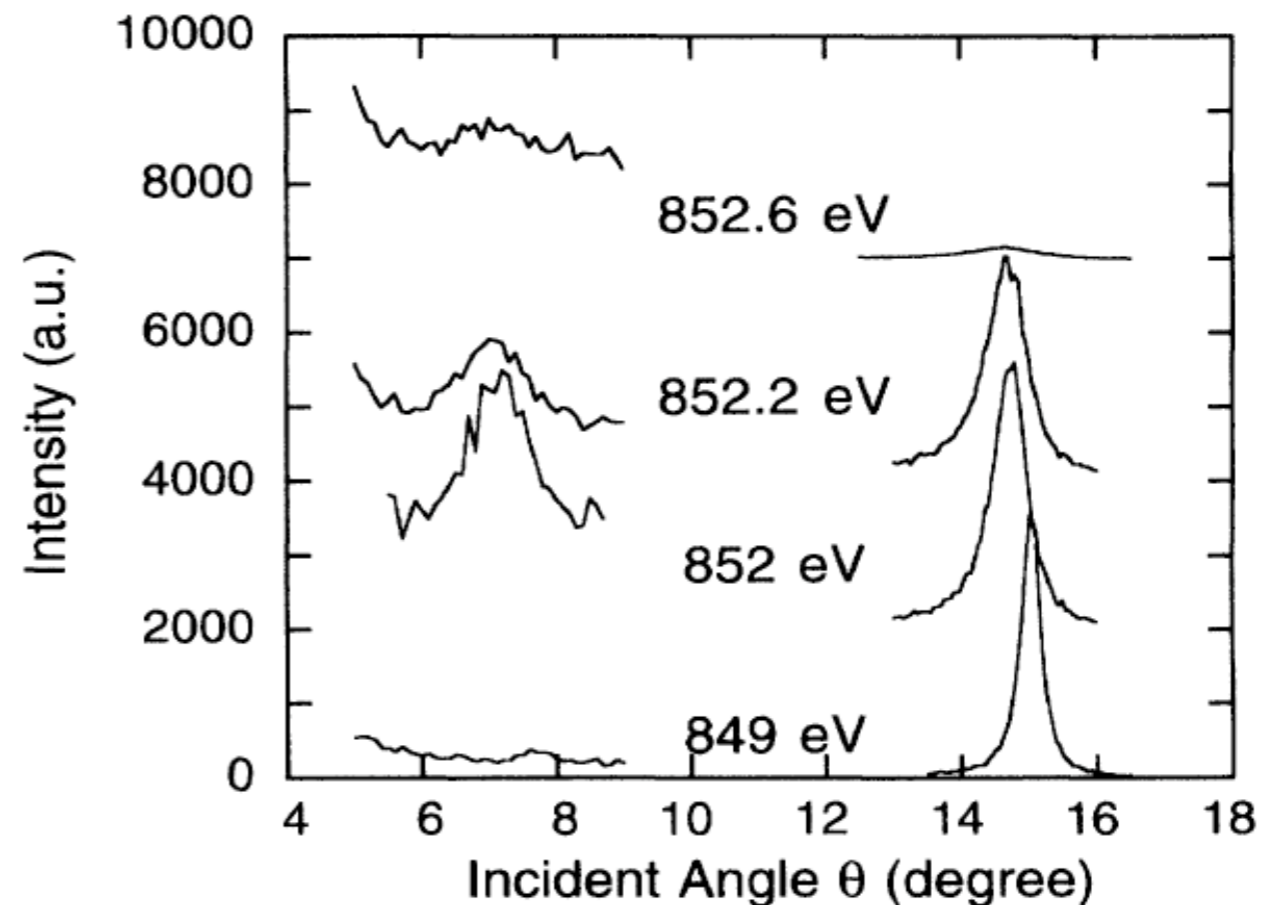
Soft x-ray diffraction

Direct probe of 3d electrons through
2p - 3d transition.

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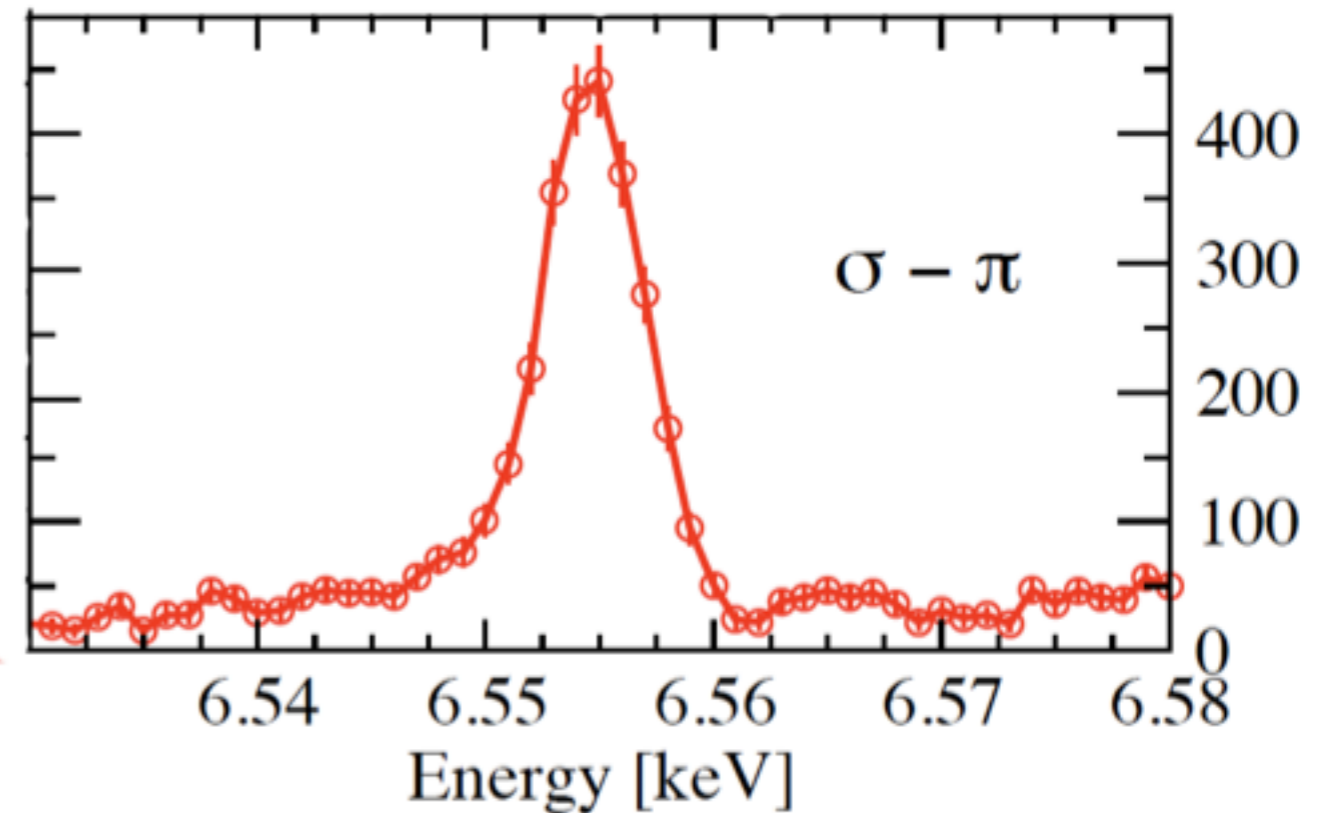
First measurements “manmade
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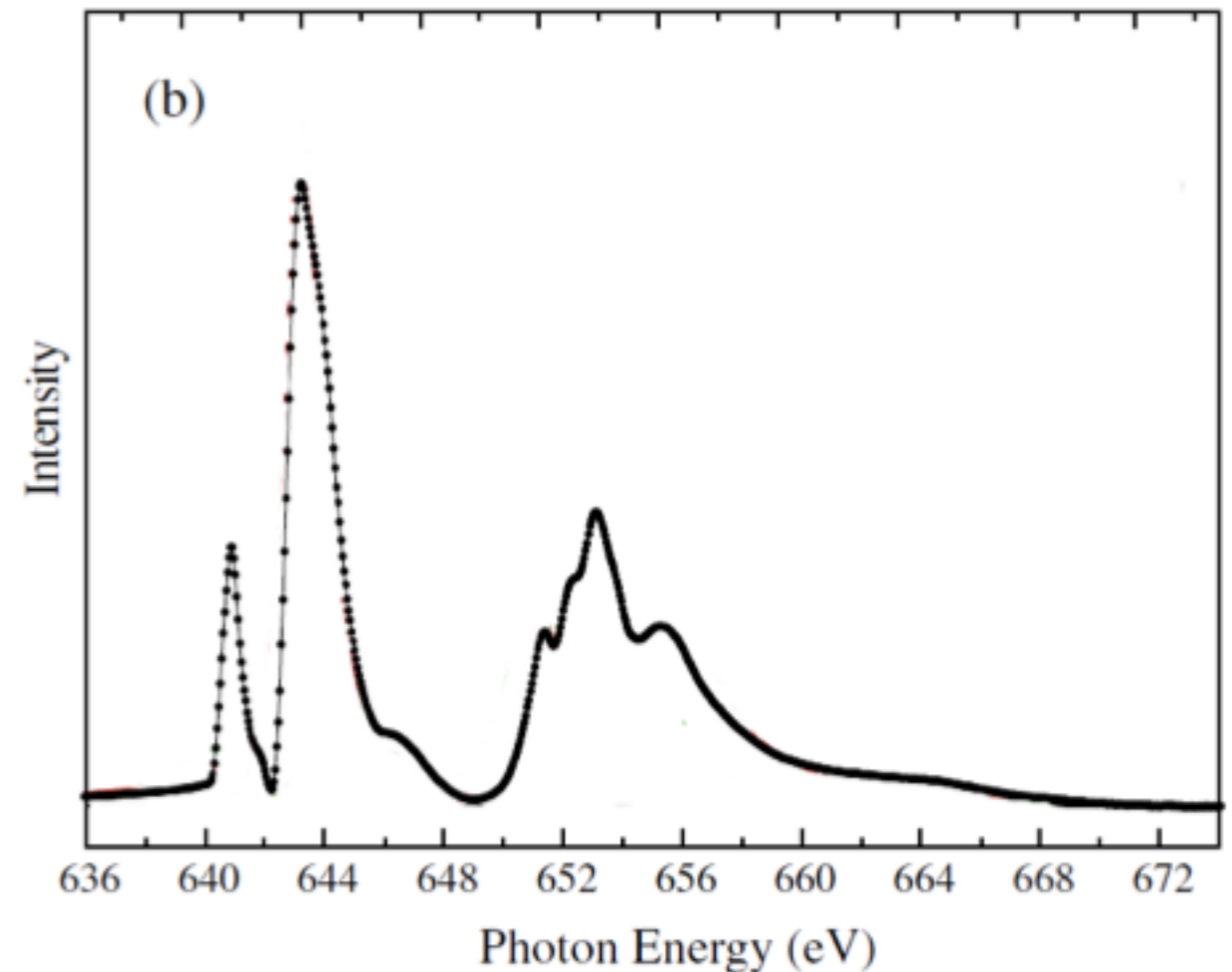


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Resonance of a diffraction signal
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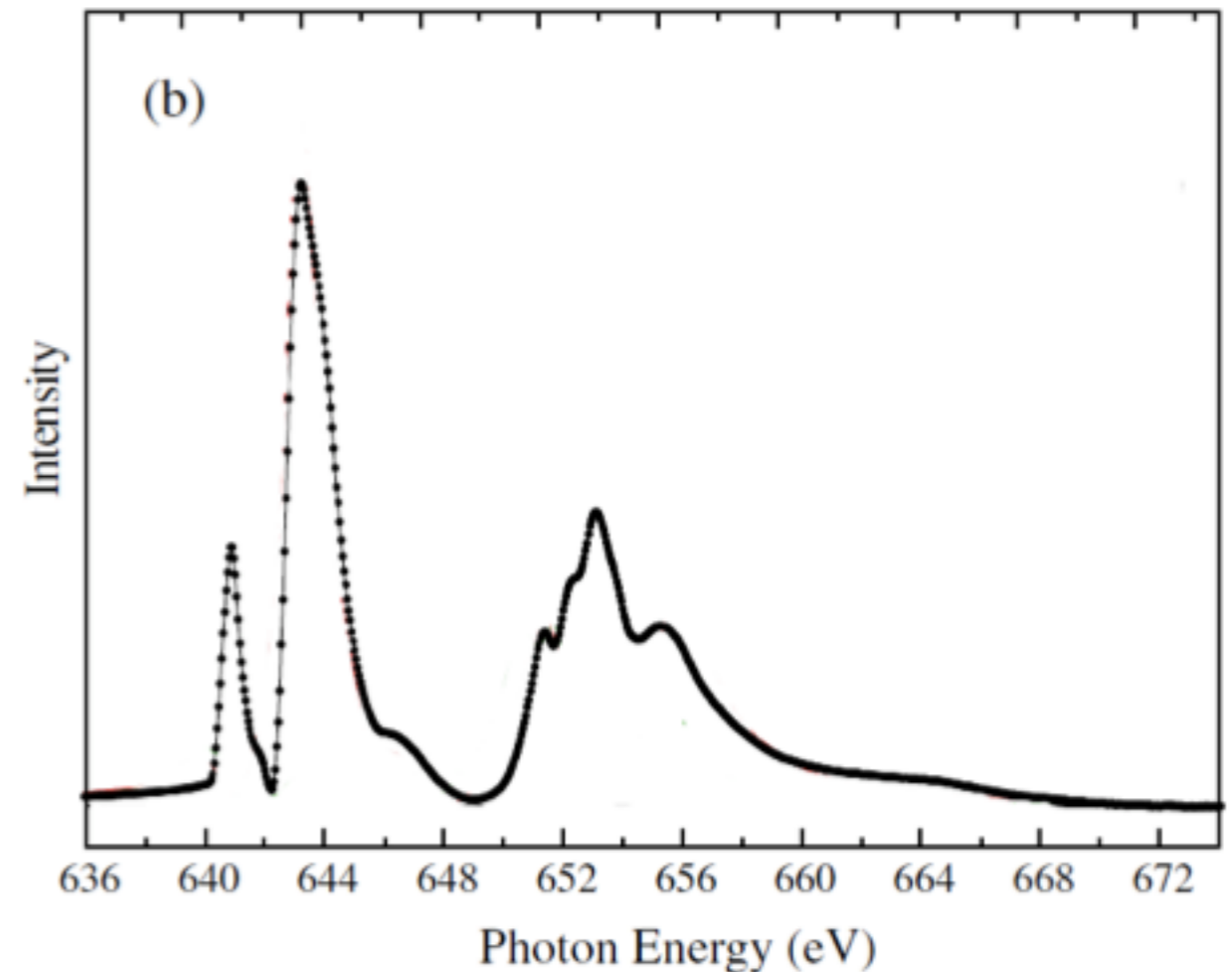
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Resonance of a diffraction signal
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Potentially fitted through various
ab initio calculations

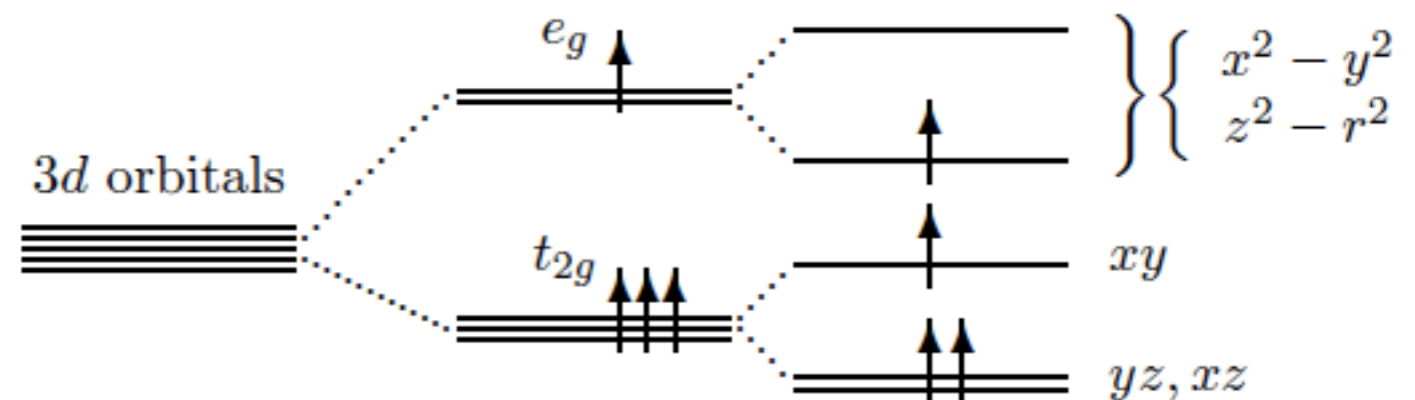


Orbital order

Spontaneous ordering of
electron orbitals

In manganites, Mn^{3+} ions
have a single e_g electron

Orbital order tends to be
accompanied by a Jahn-
Teller type distortion

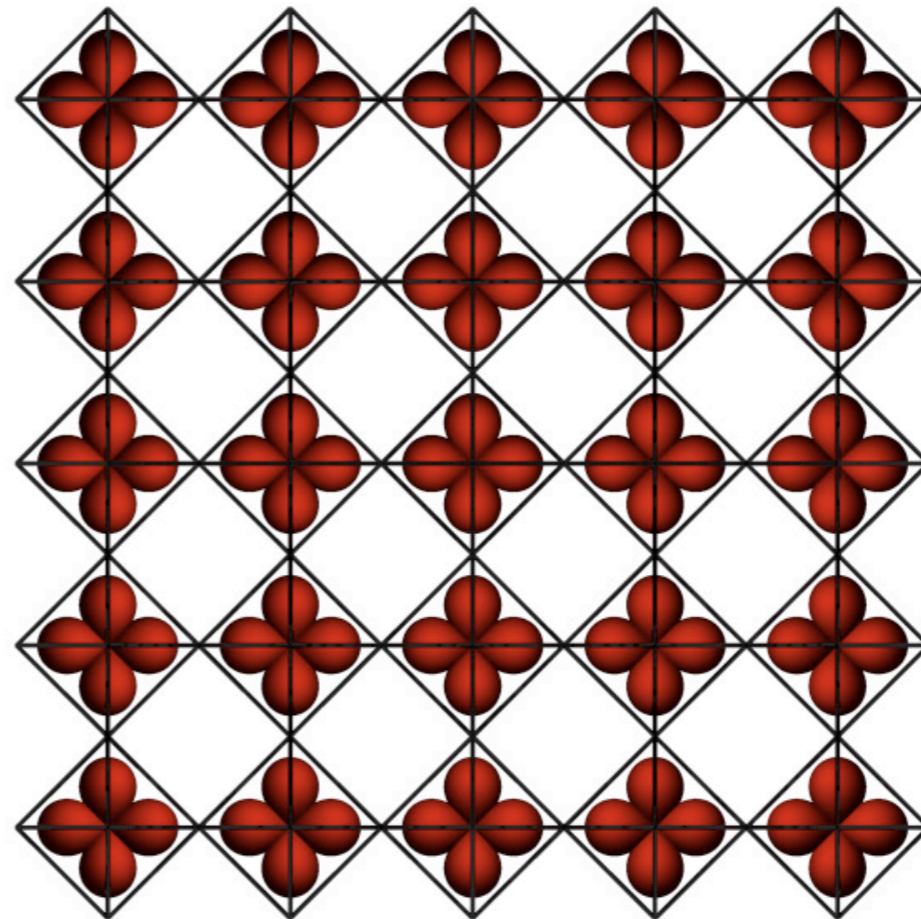


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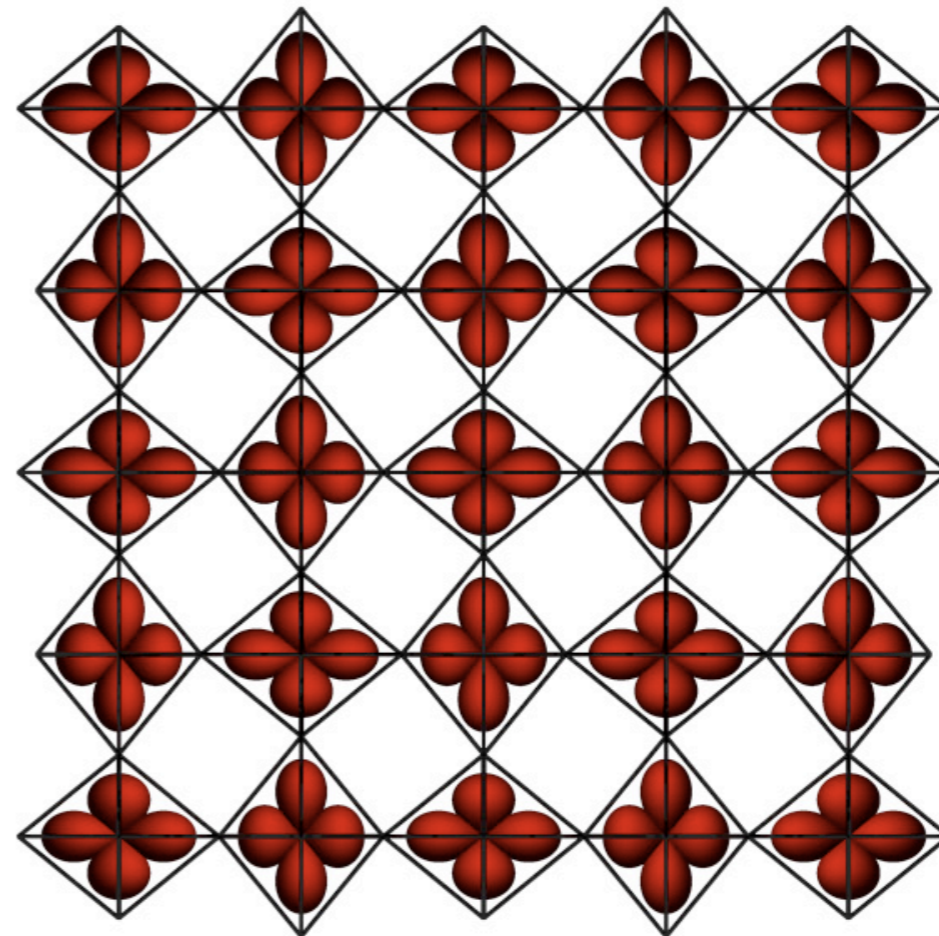


Orbital order

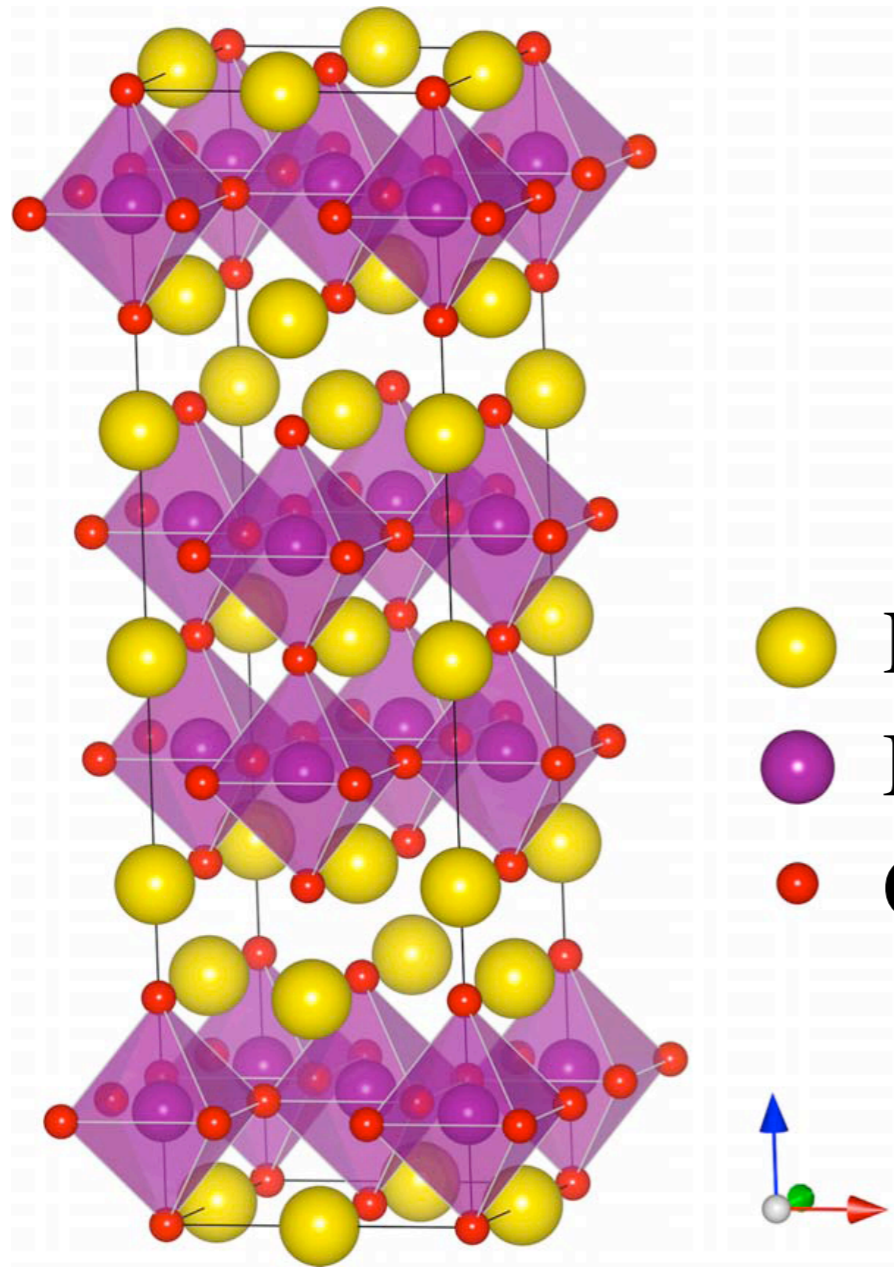
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$\text{Pr}(\text{Sr}_{0.1}\text{Ca}_{0.9})_2\text{Mn}_2\text{O}_7$



Unusual as $a \neq b$

Amam orthorhombic
spacegroup

Confines the orbital
domains

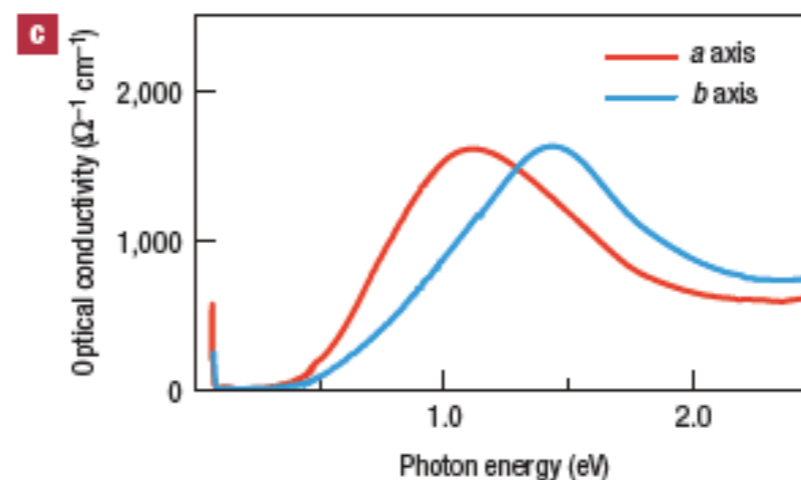
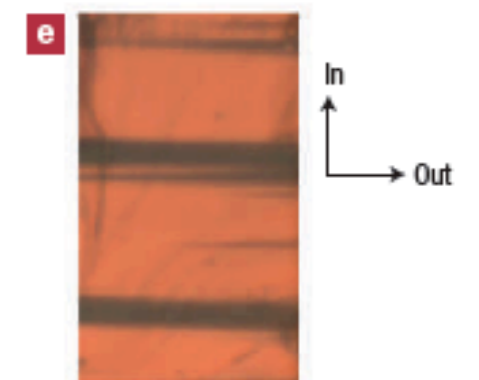
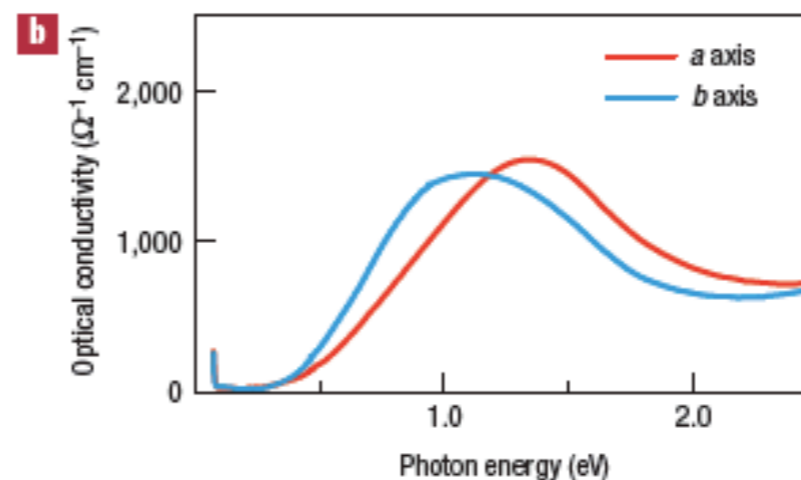
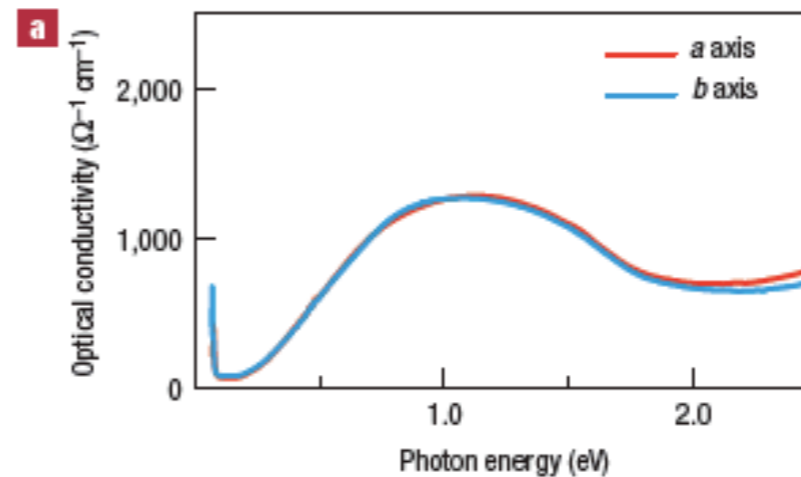
Optical anisotropy of PCSMO

Panel **a** $T = 423$ K

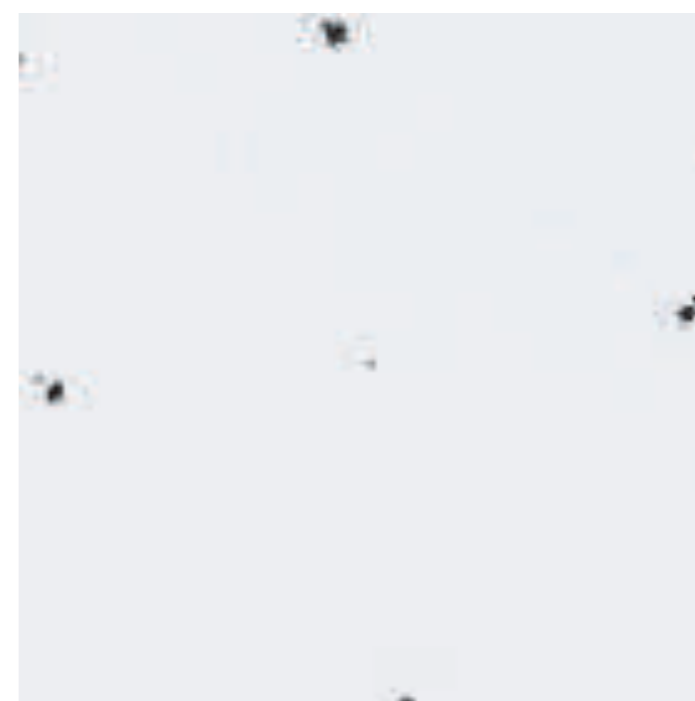
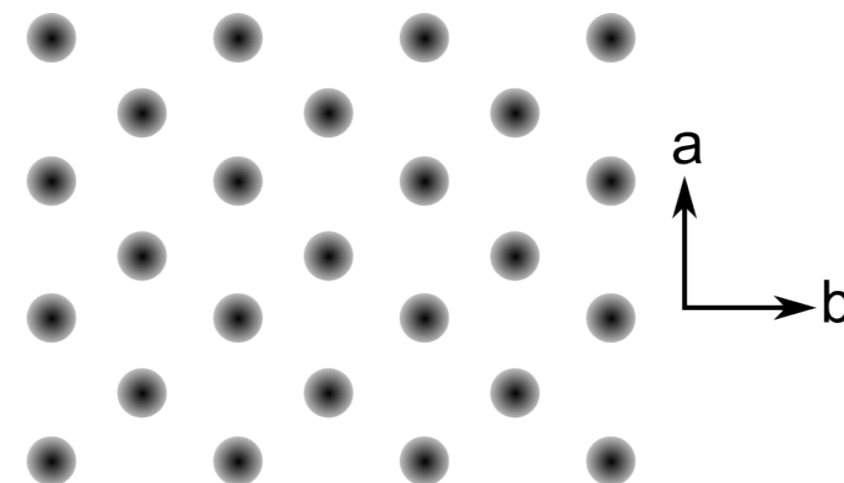
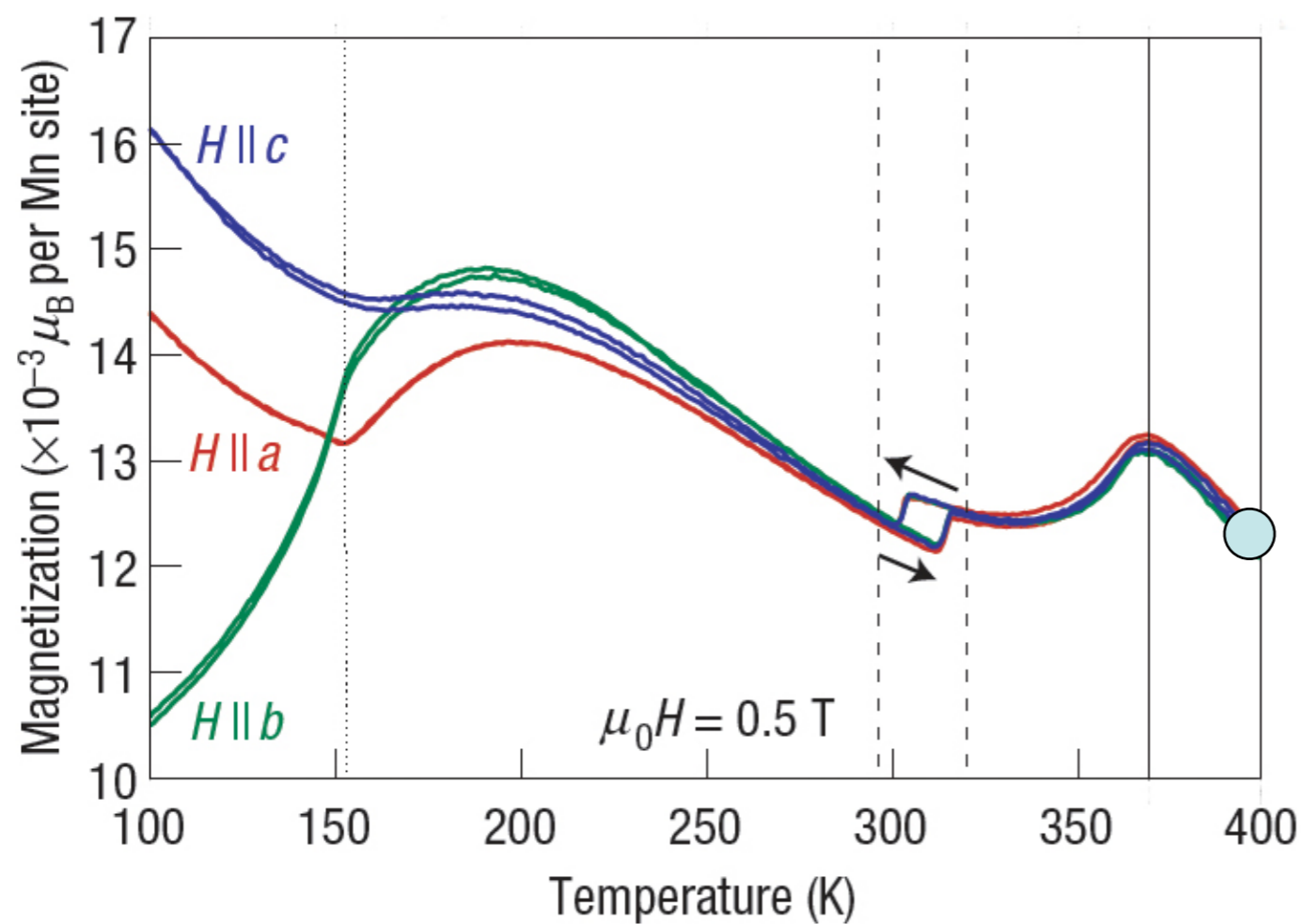
Panel **b** $T = 323$ K

Panel **c** $T = 300$ K

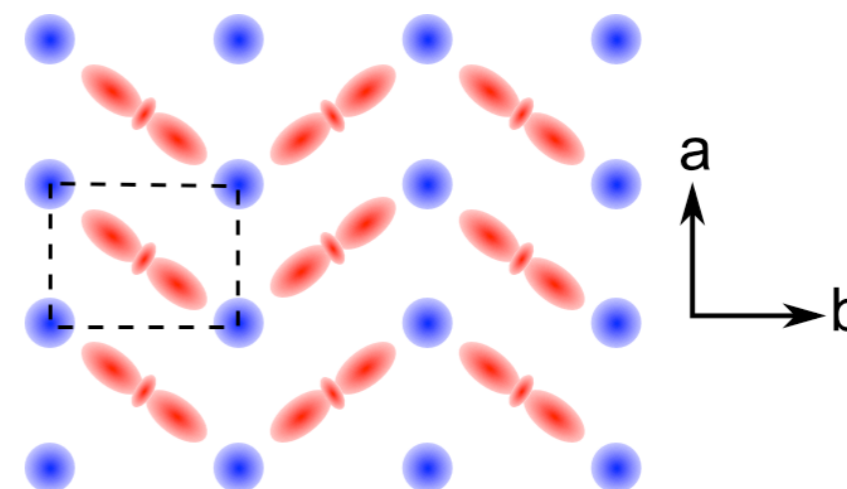
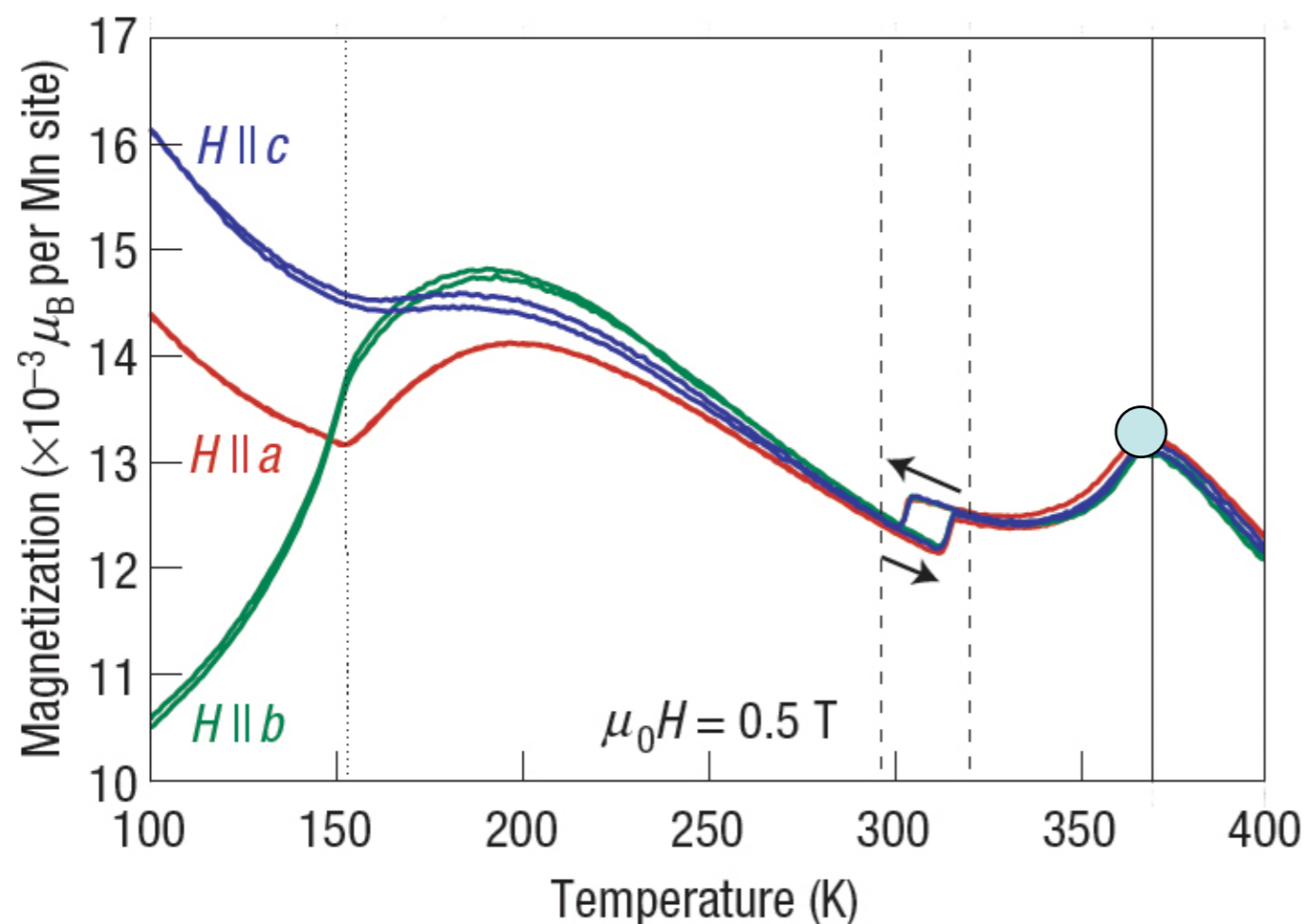
Y. Tounaga, Nature Mat. **5**, 937, (2006)



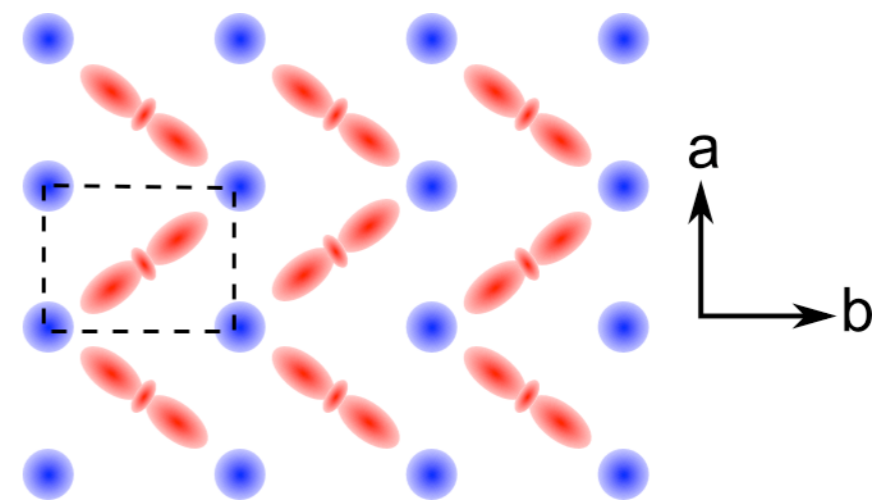
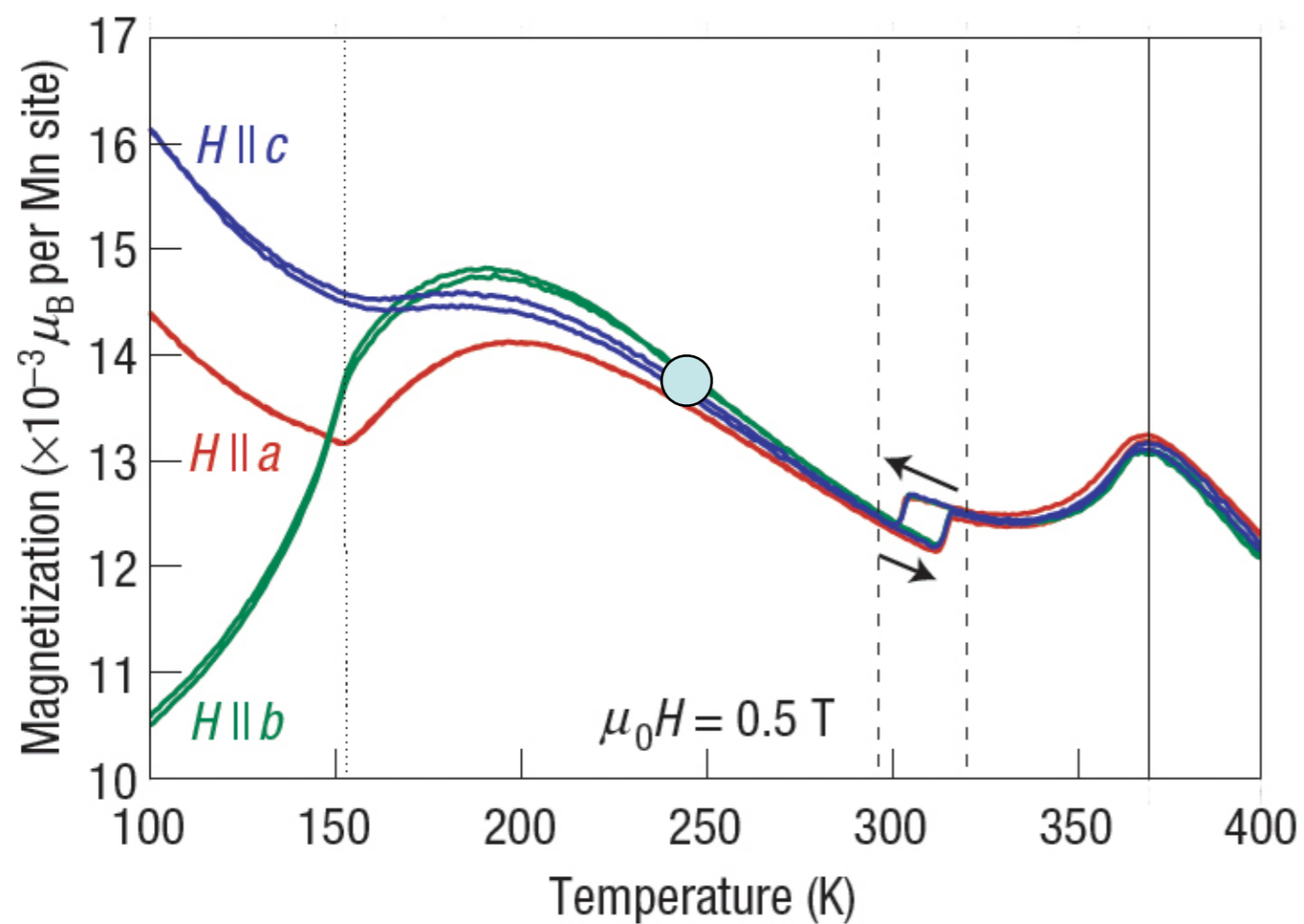
Orbital Rotation sequence



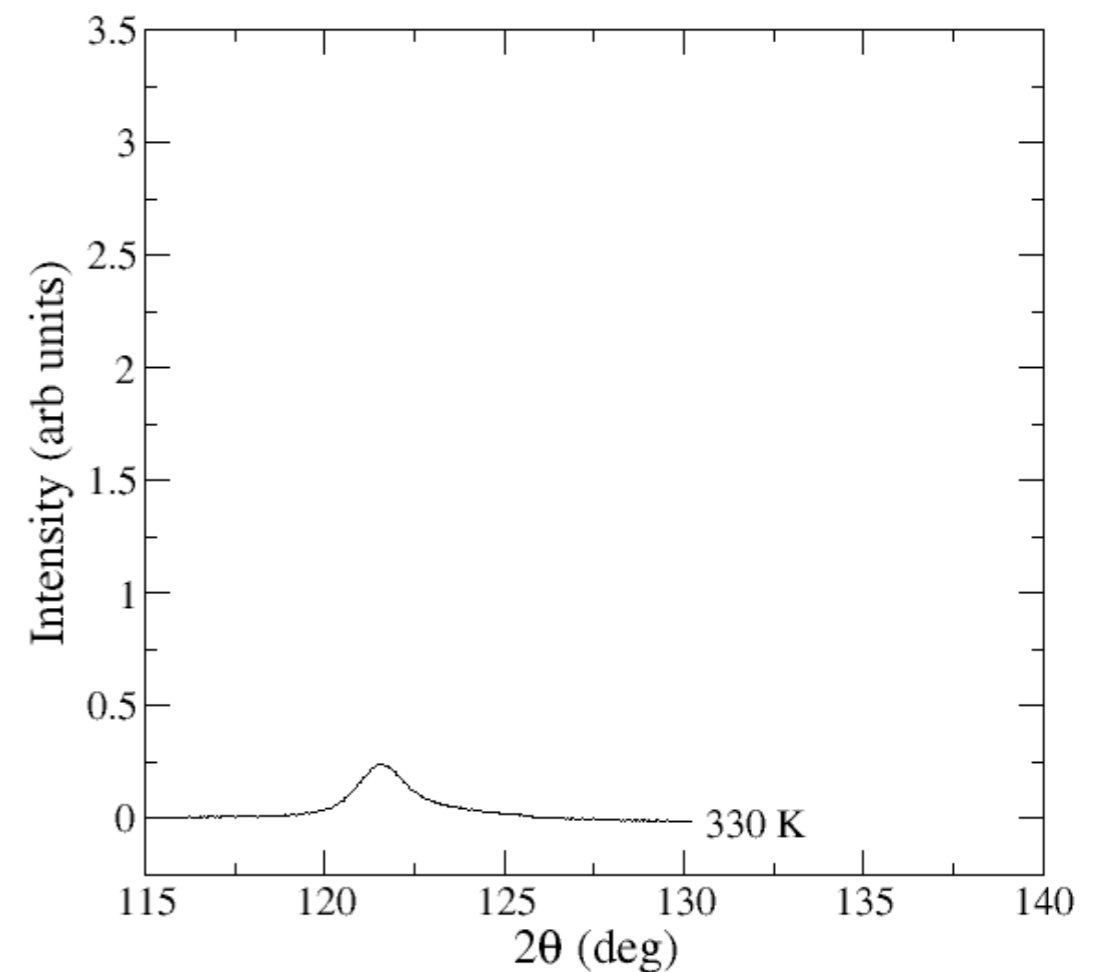
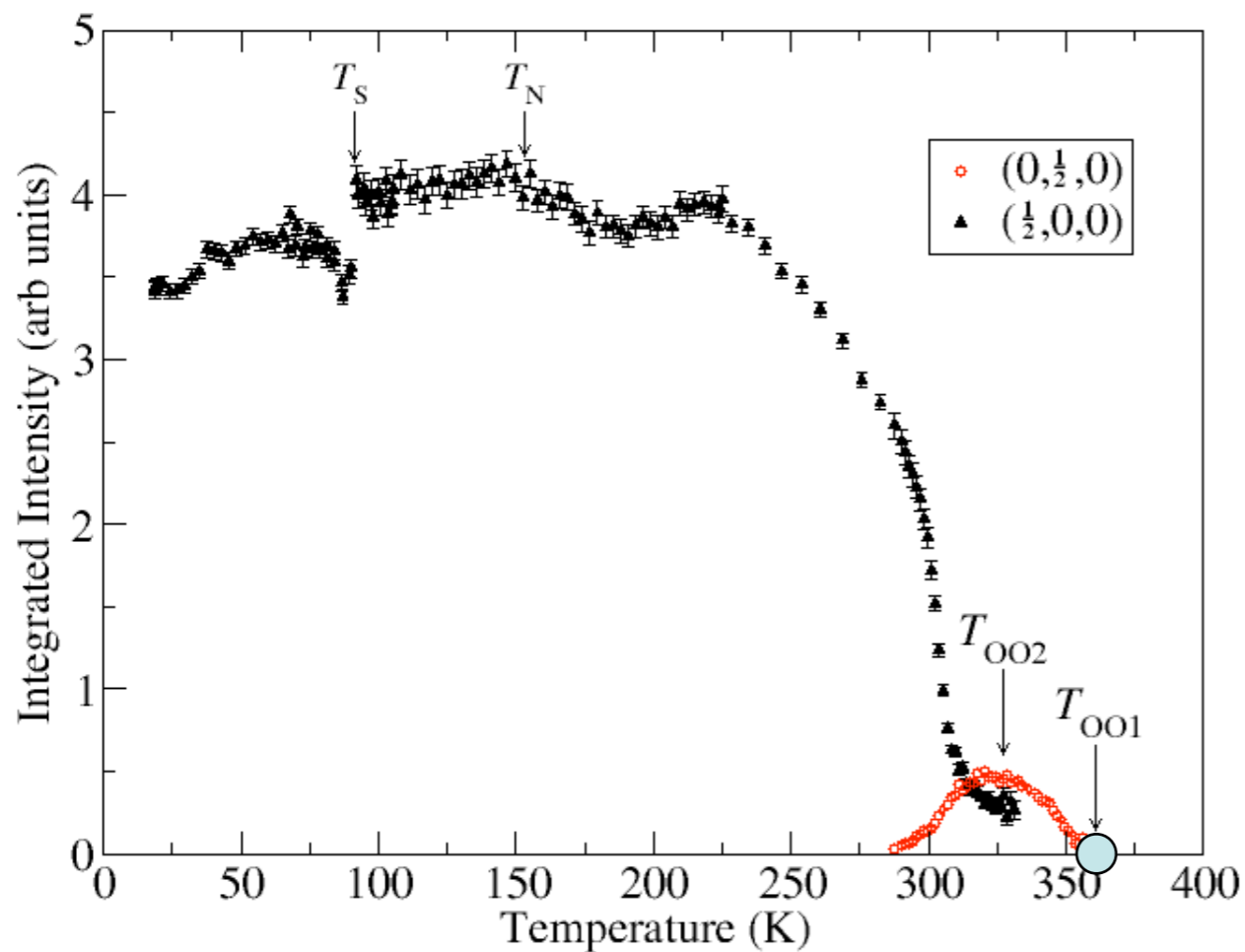
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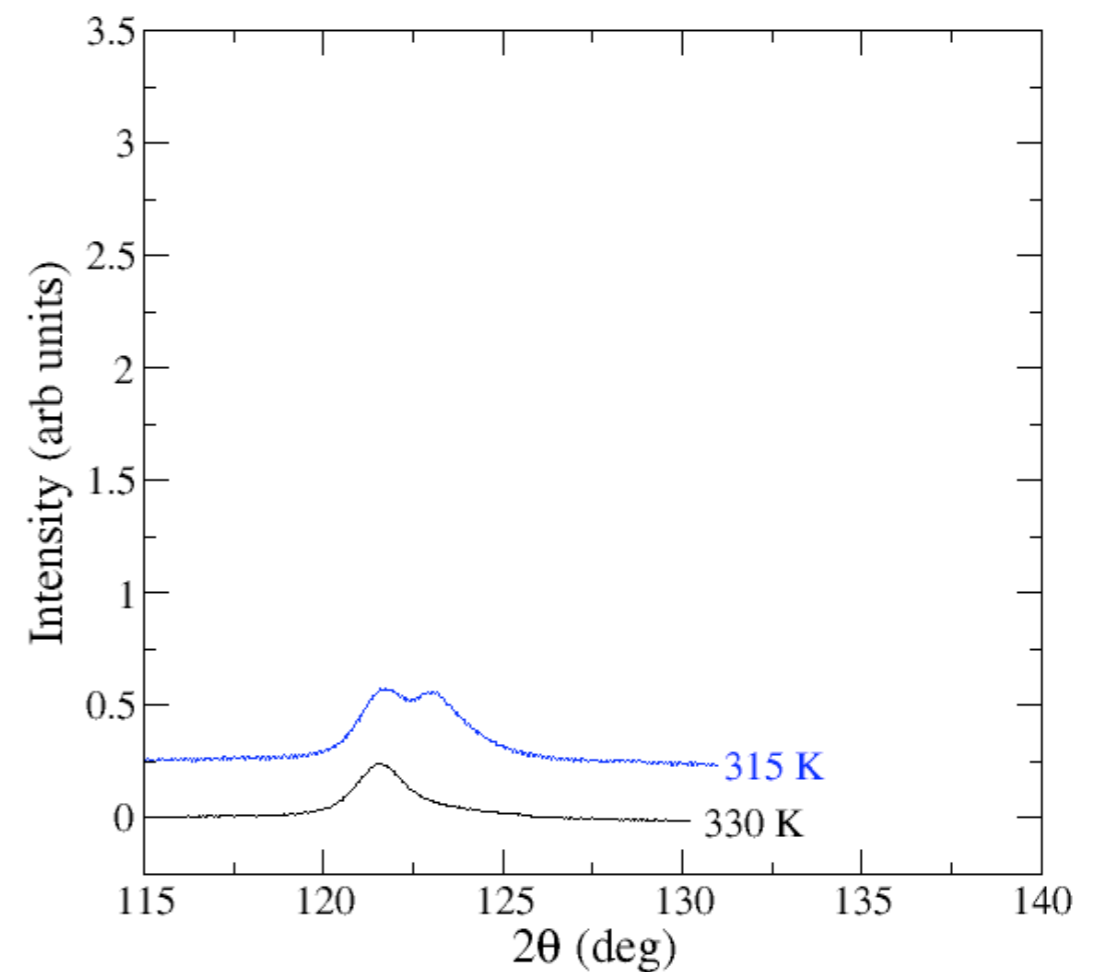
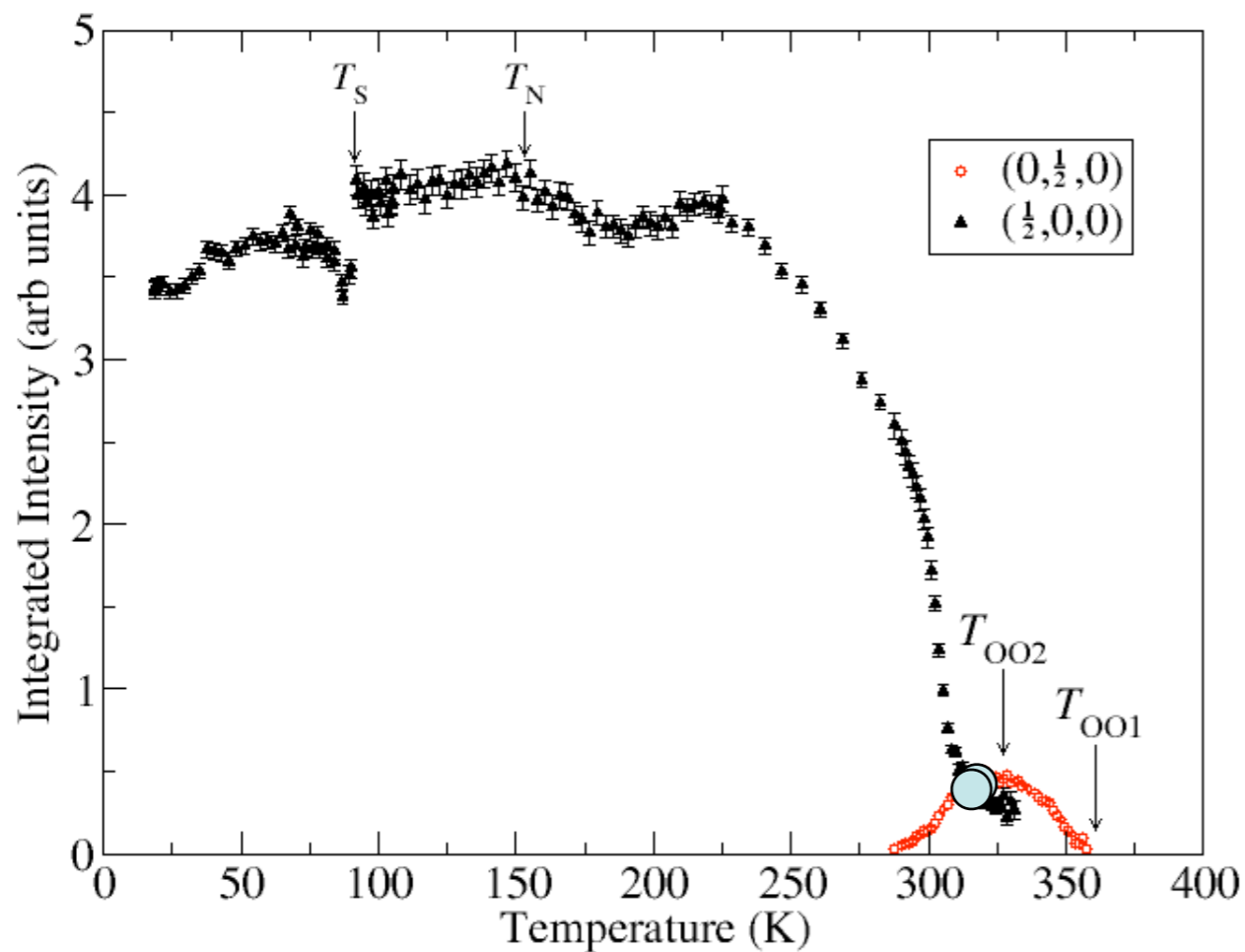
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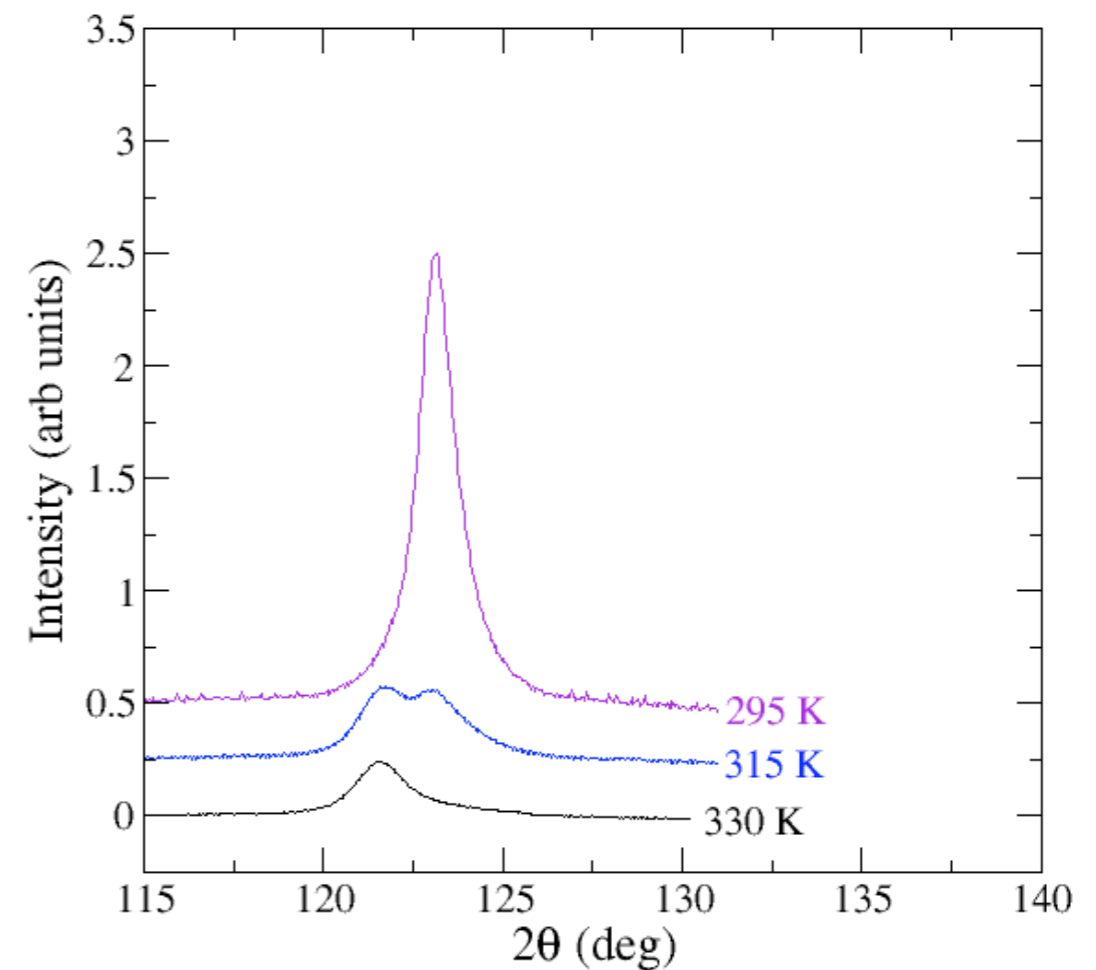
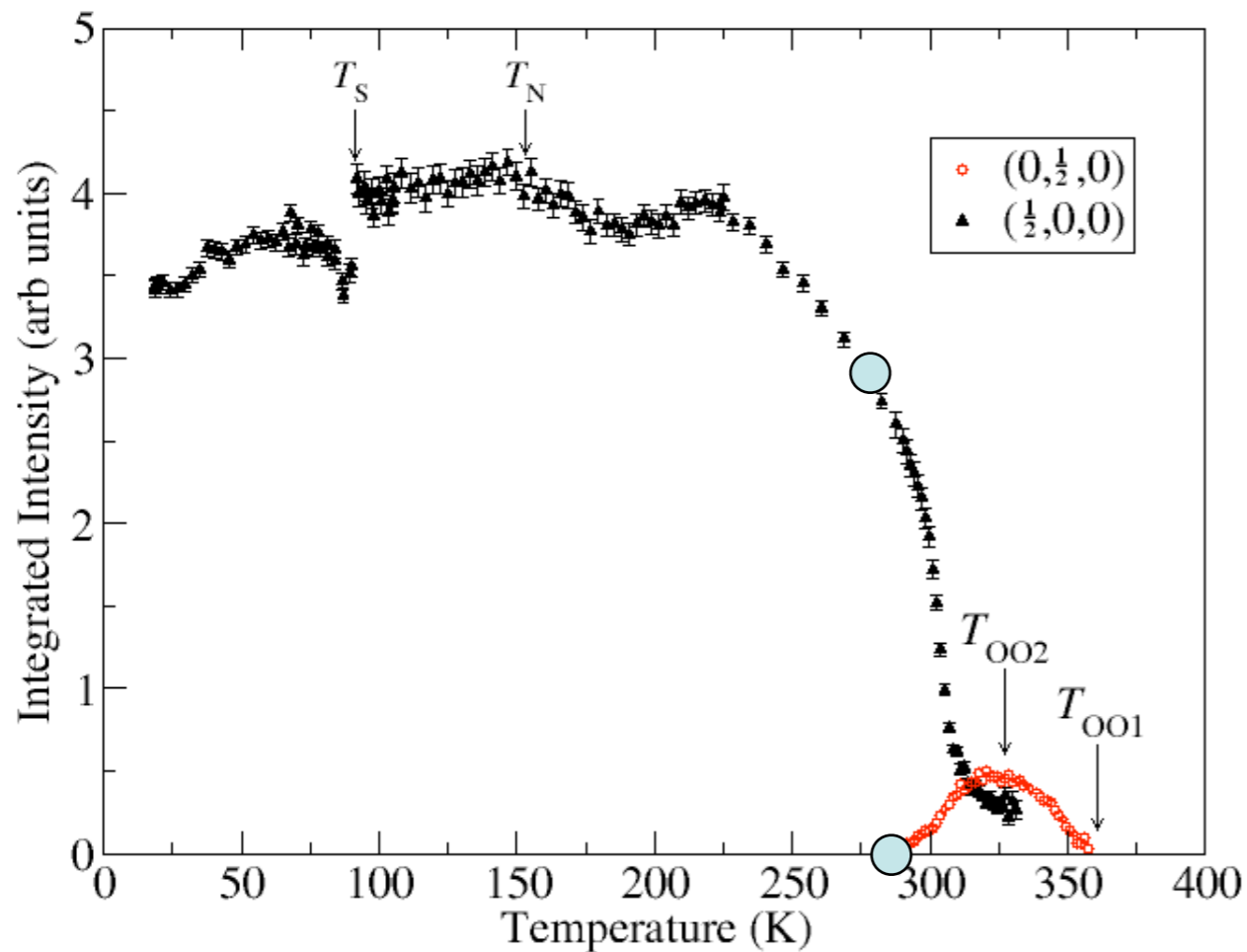
Temperature dependence of $(0, \frac{1}{2}, 0)$ and $(\frac{1}{2}, 0, 0)$ reflections



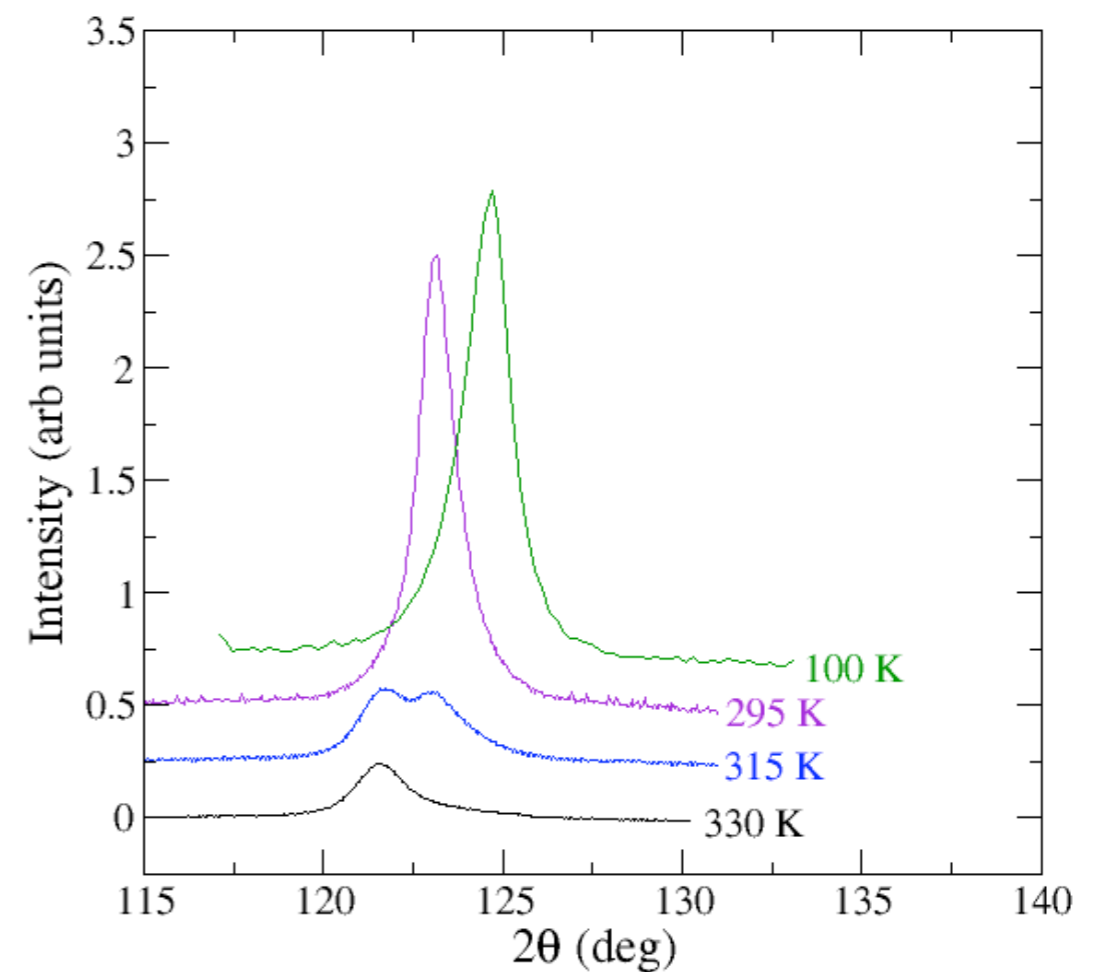
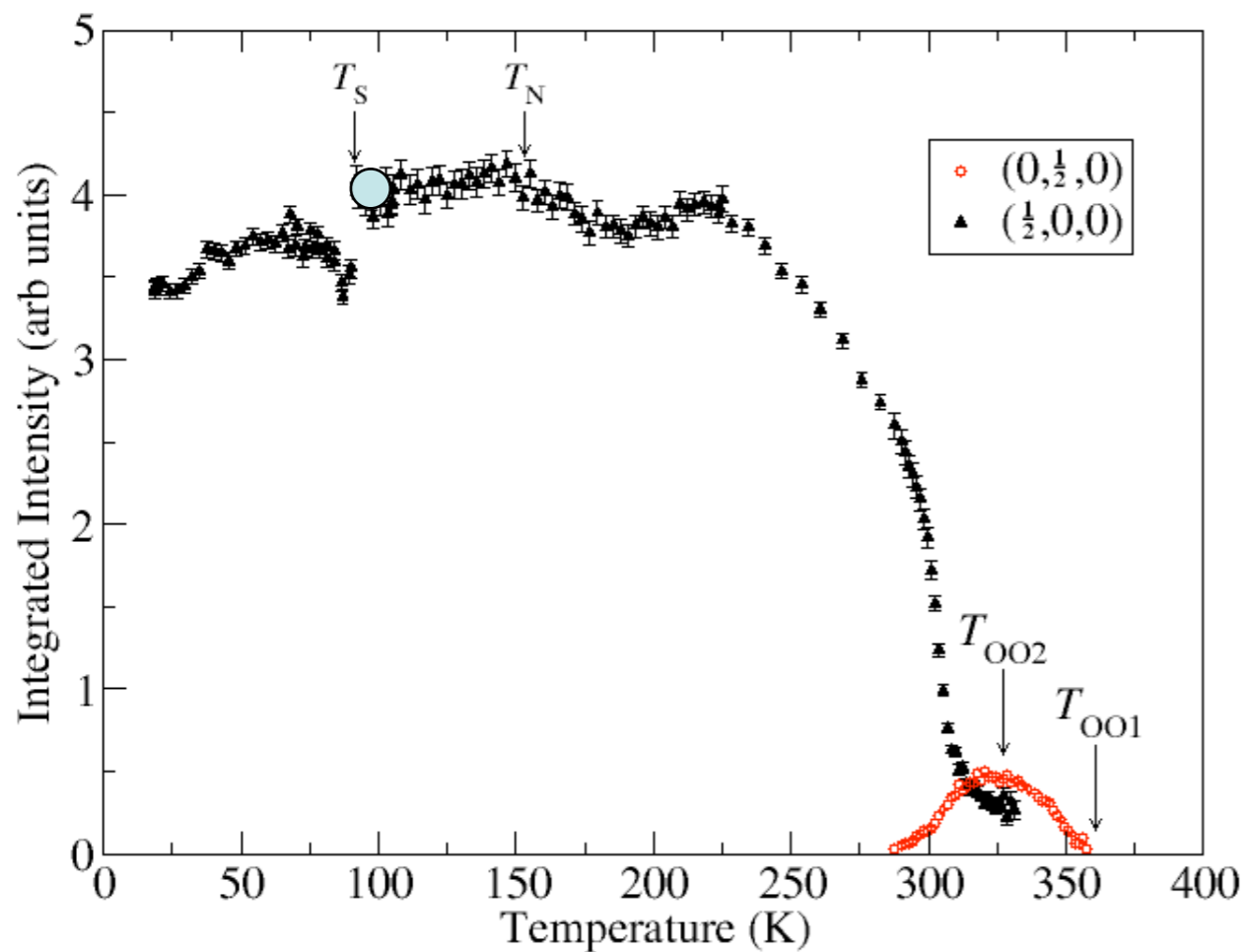
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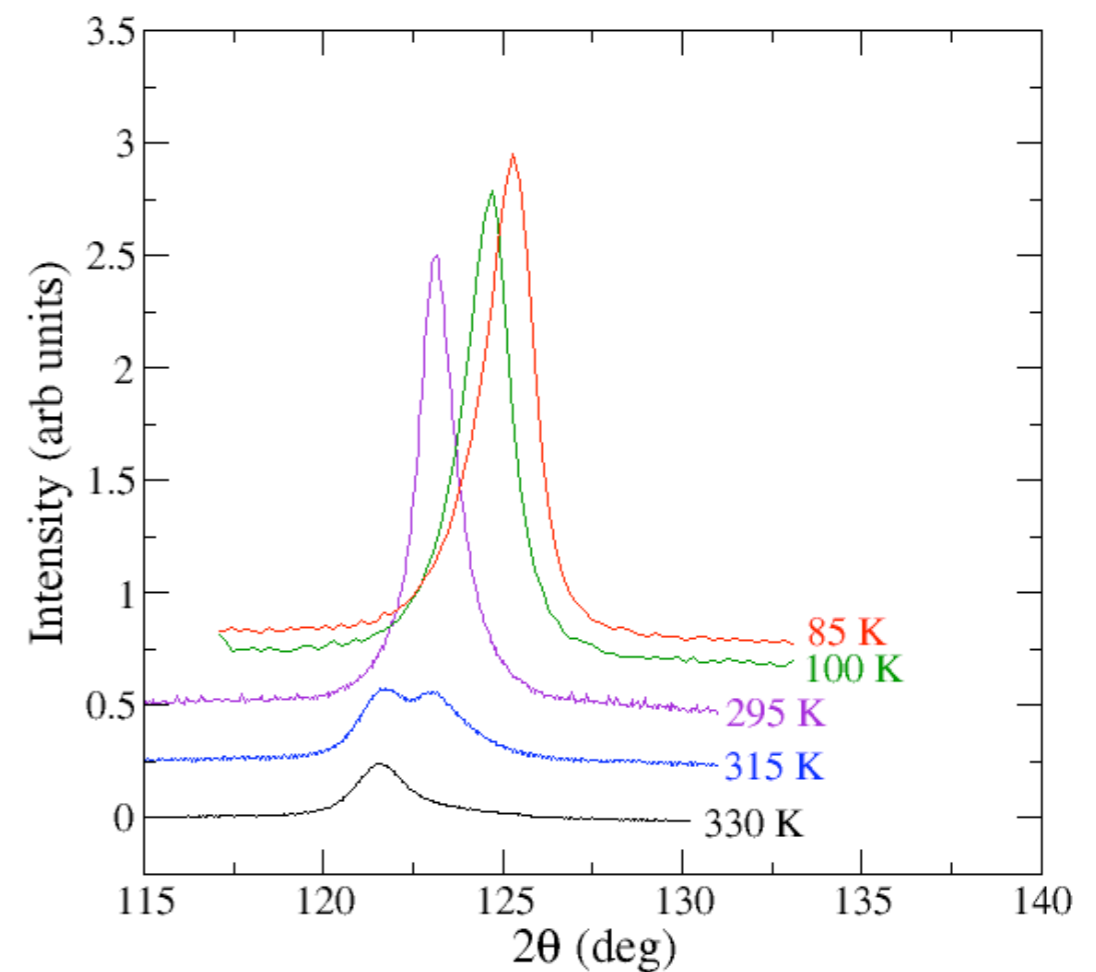
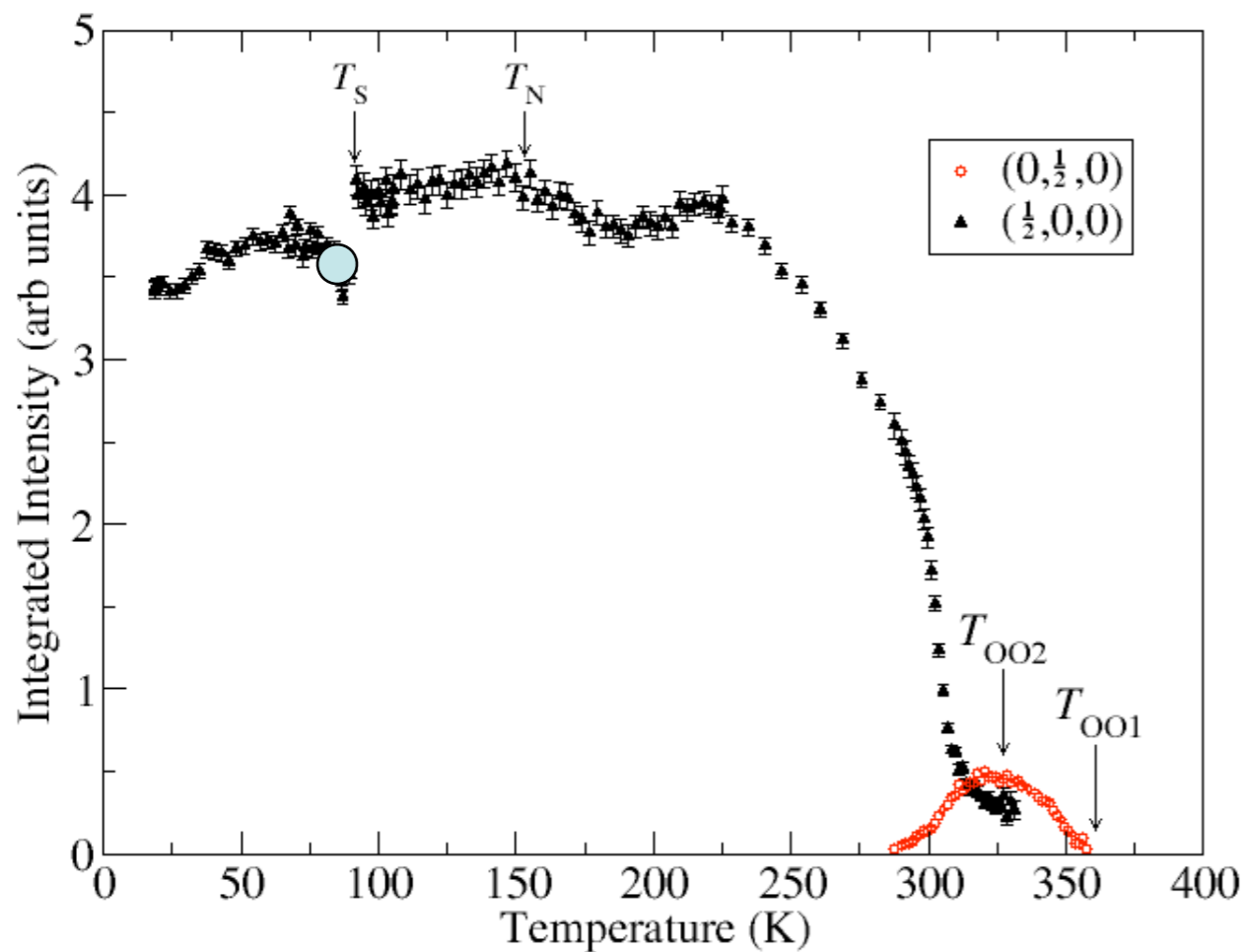
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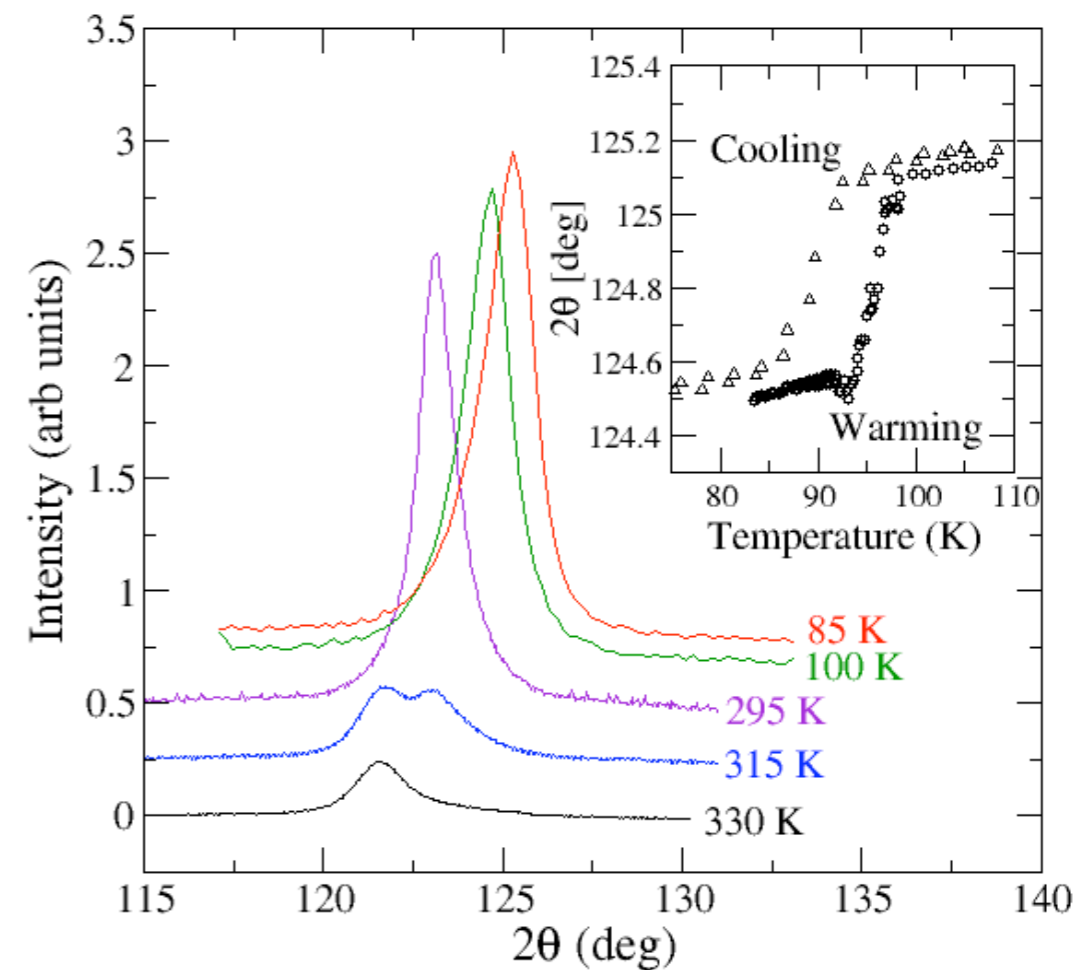
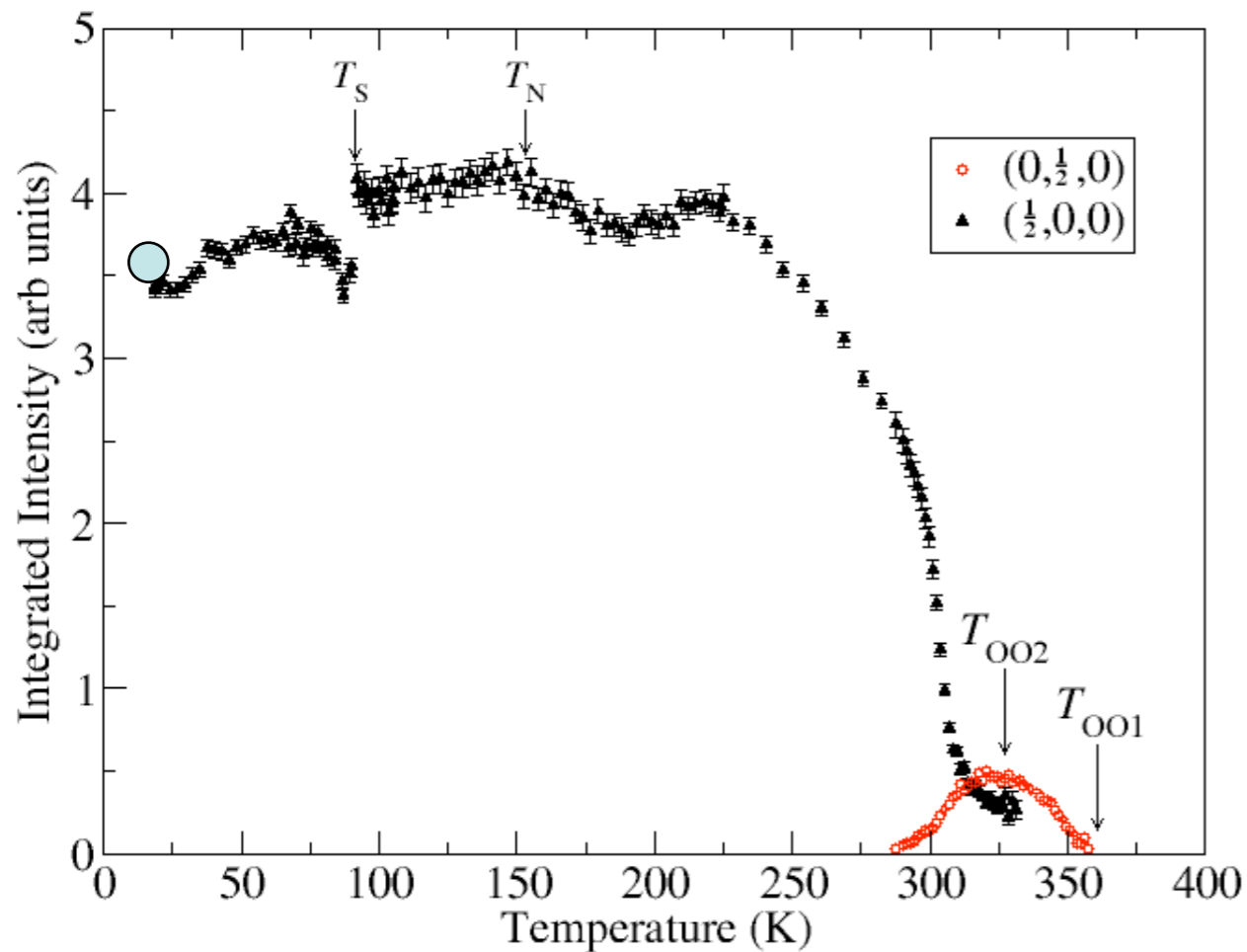
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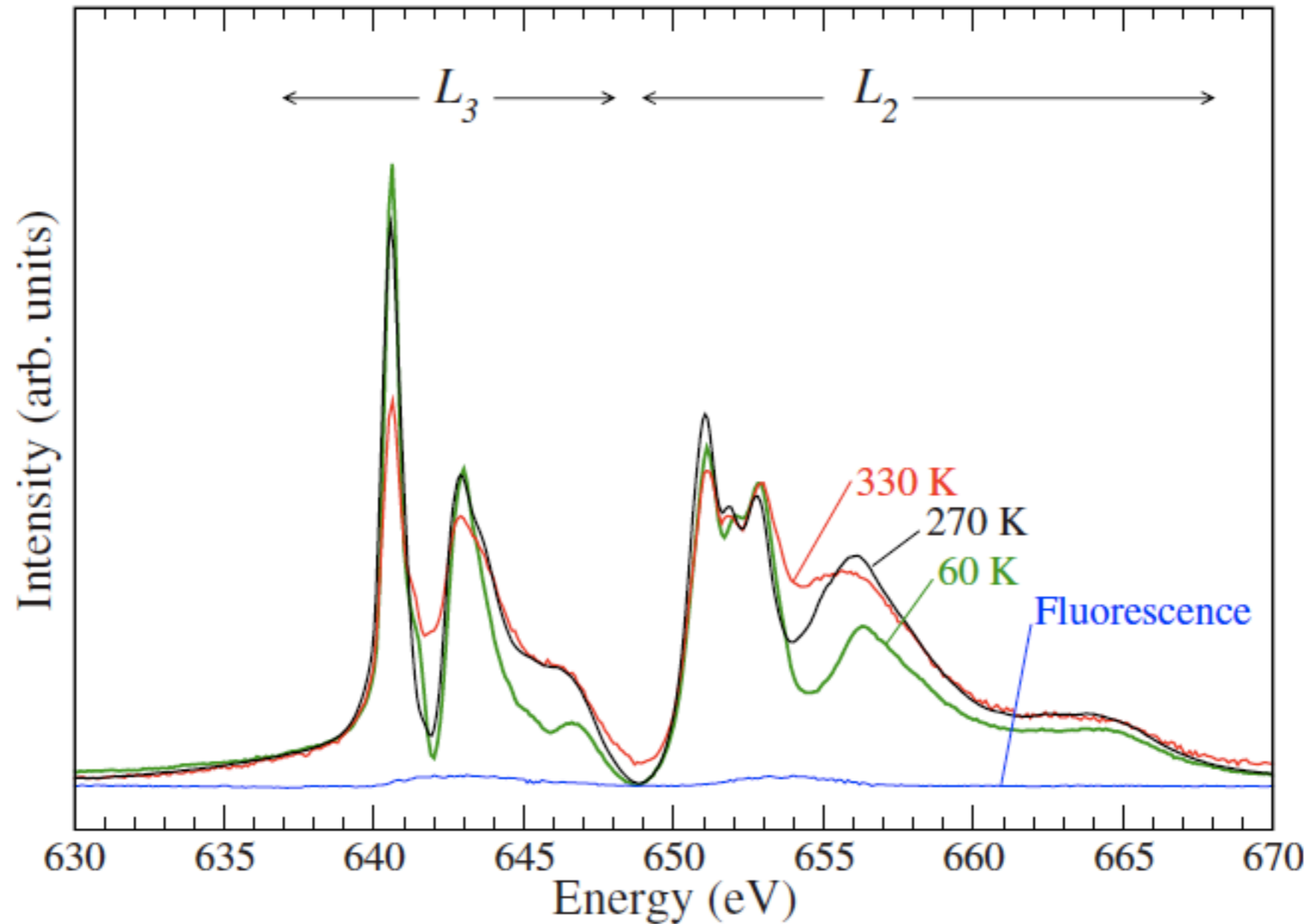
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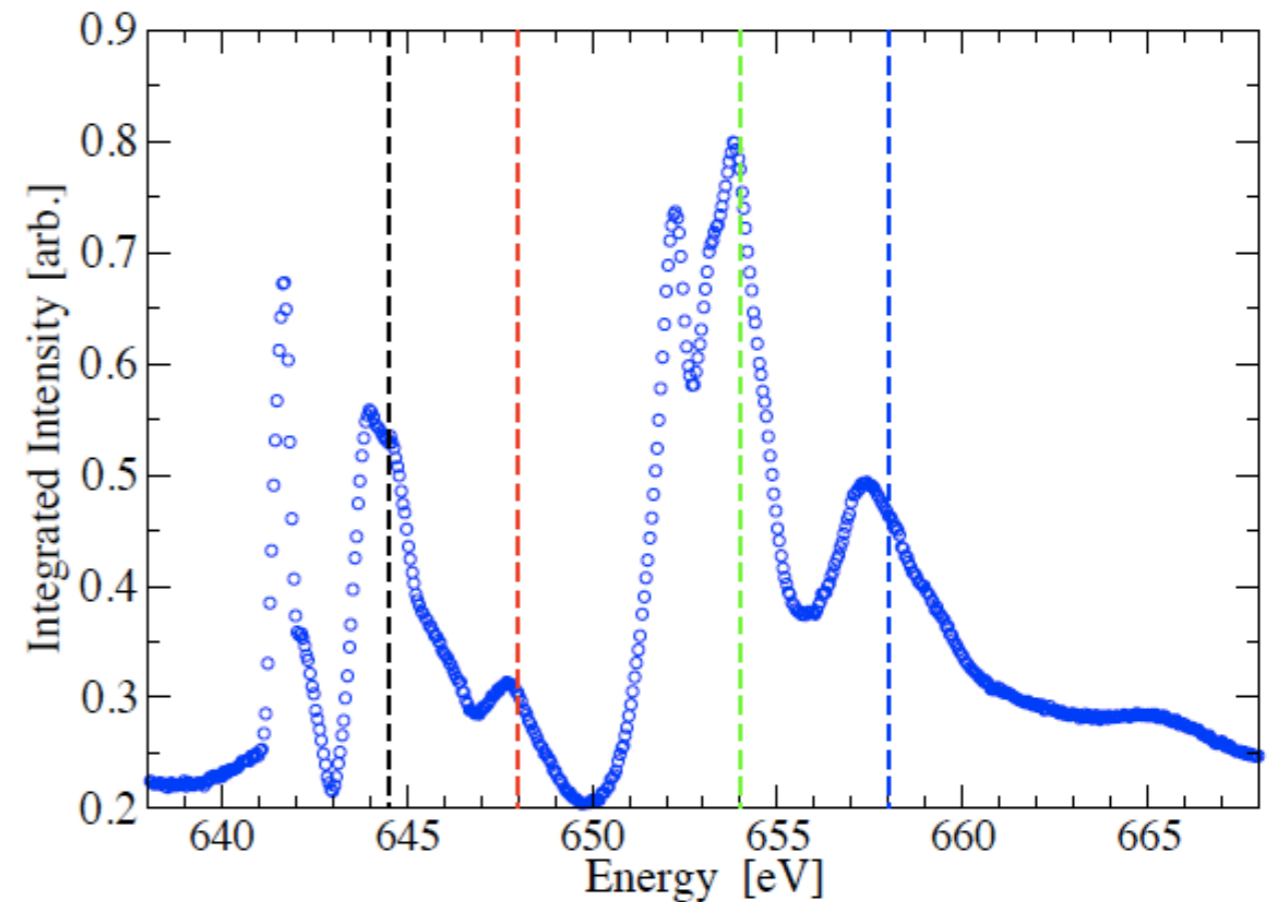
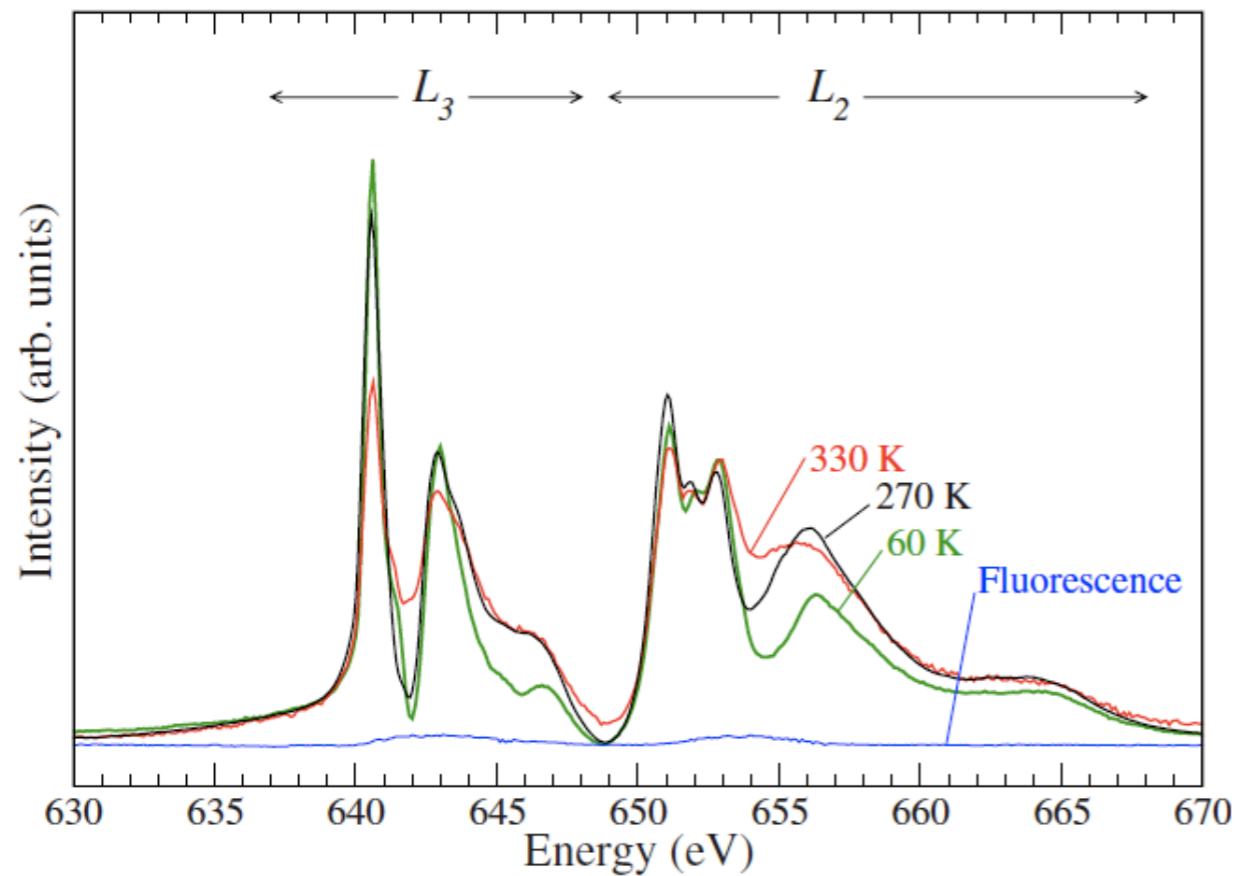
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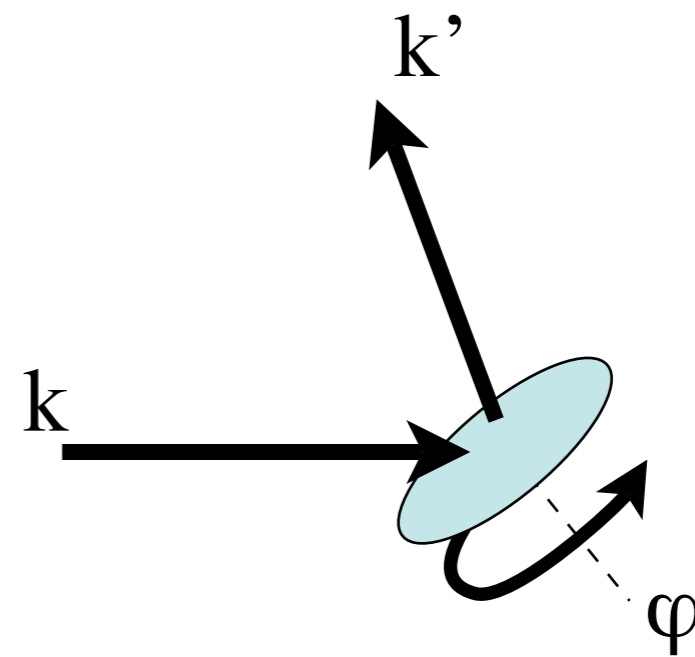
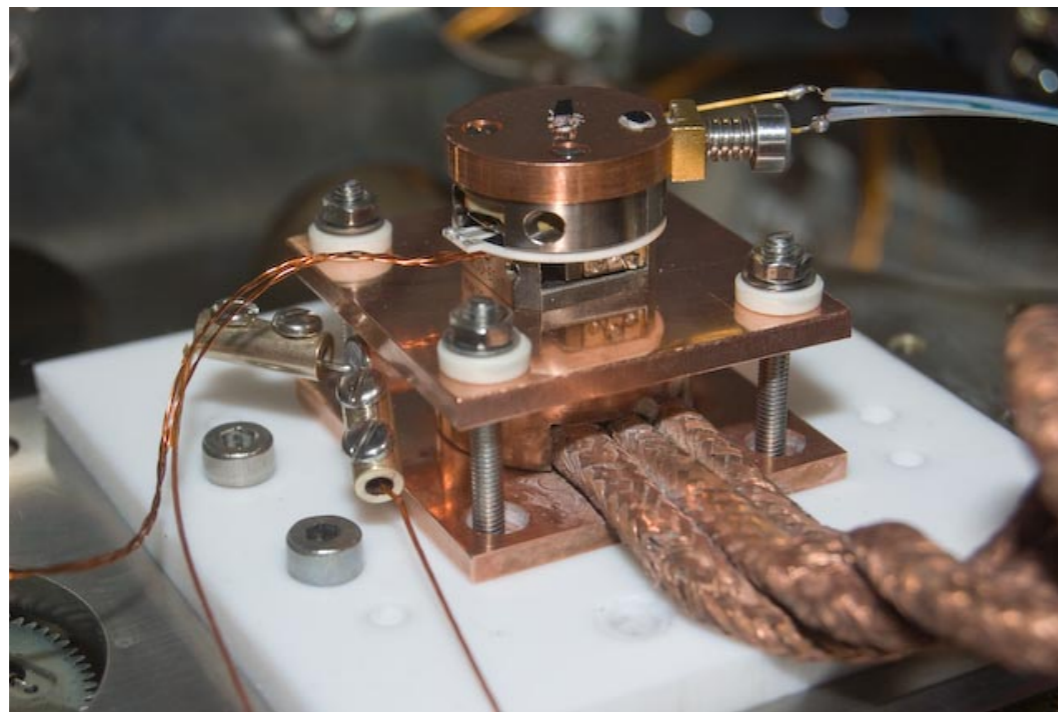
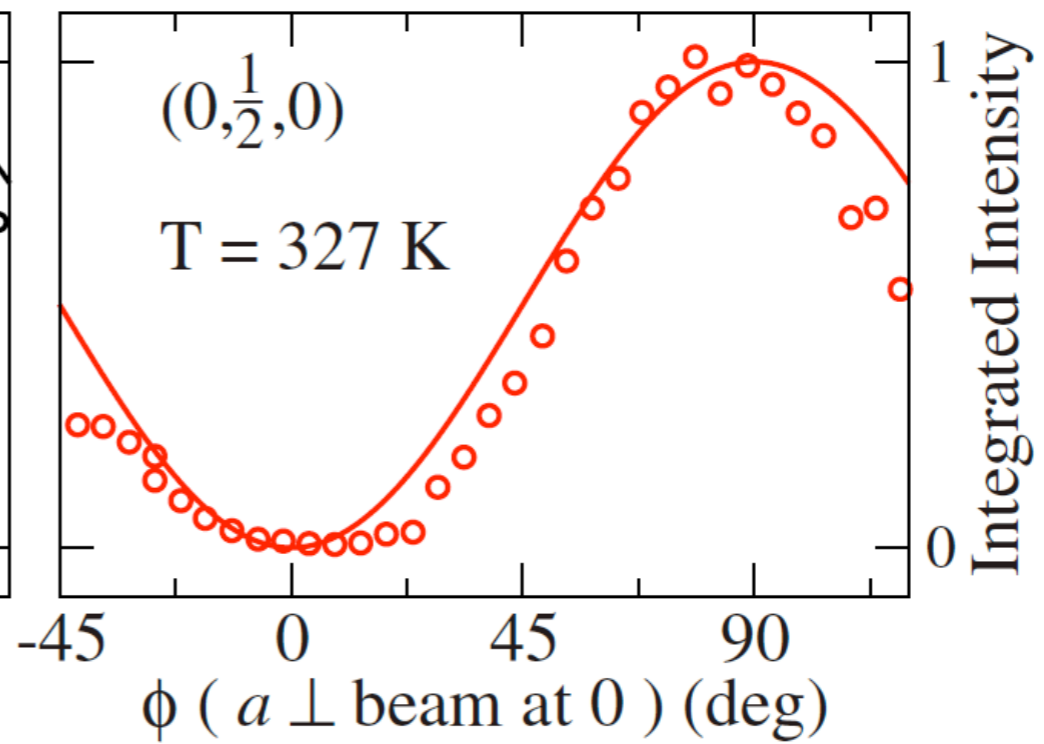
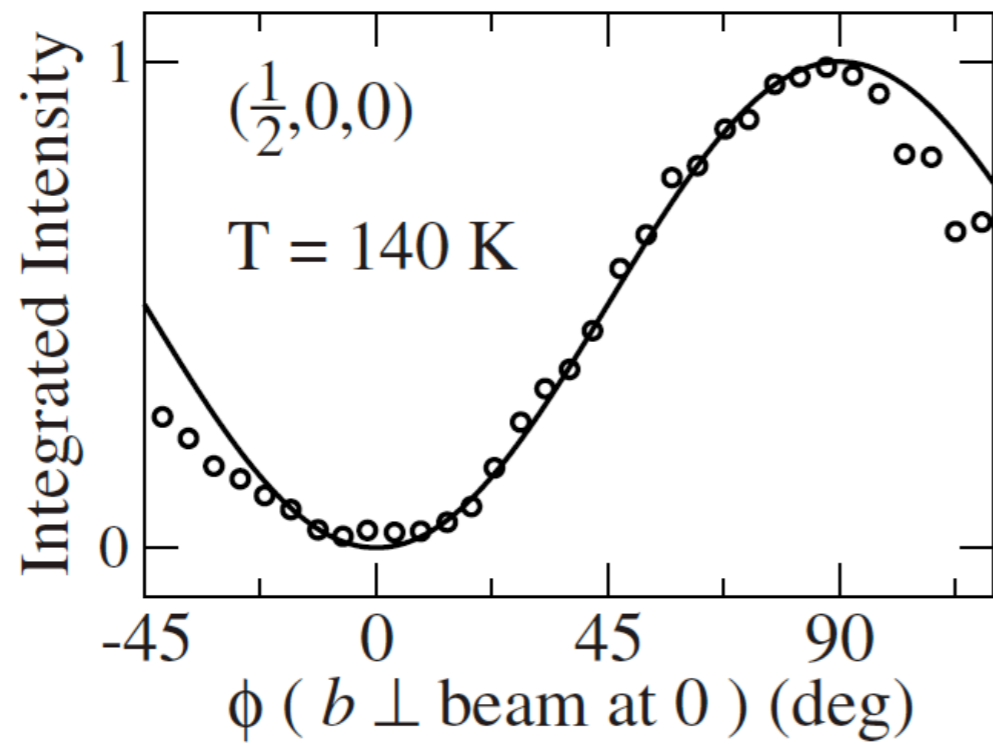


Spectroscopy of orbital order



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RASOR

(Reflectivity and Advanced Scattering from Ordered Regimes)

Project brief: To design and construct an instrument for the UK reflectivity and diffraction community optimised for use at Diamond Light Source



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- ✻ Analysis of scattered beam (Polarisation state, Area detector)



Science & Technology
Facilities Council



diamond



Durham
University

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- ✱ Analysis of scattered beam (Polarisation state, Area detector)
- ✱ Flexible sample environments (Magnetic field, electric field)



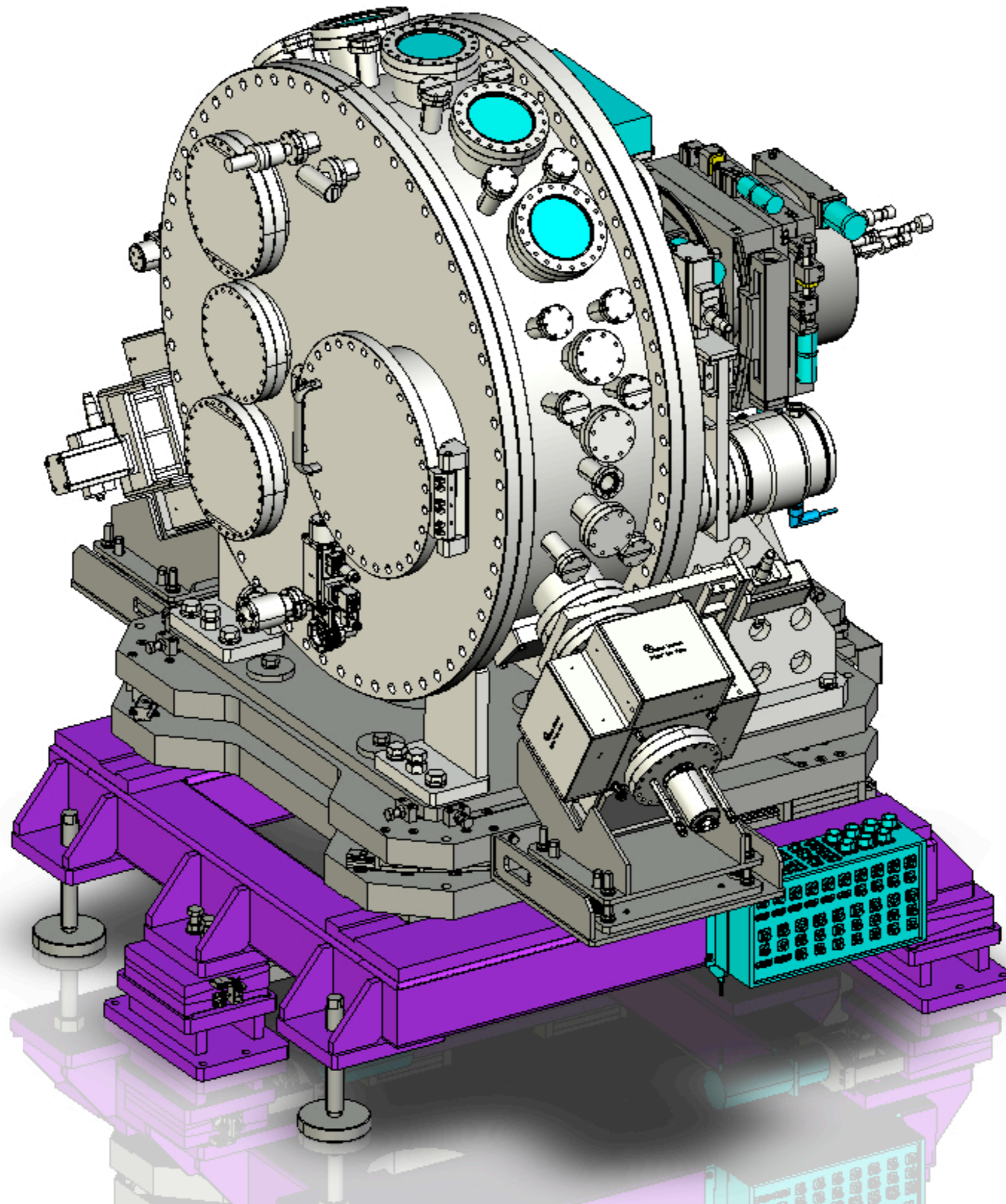
Science & Technology
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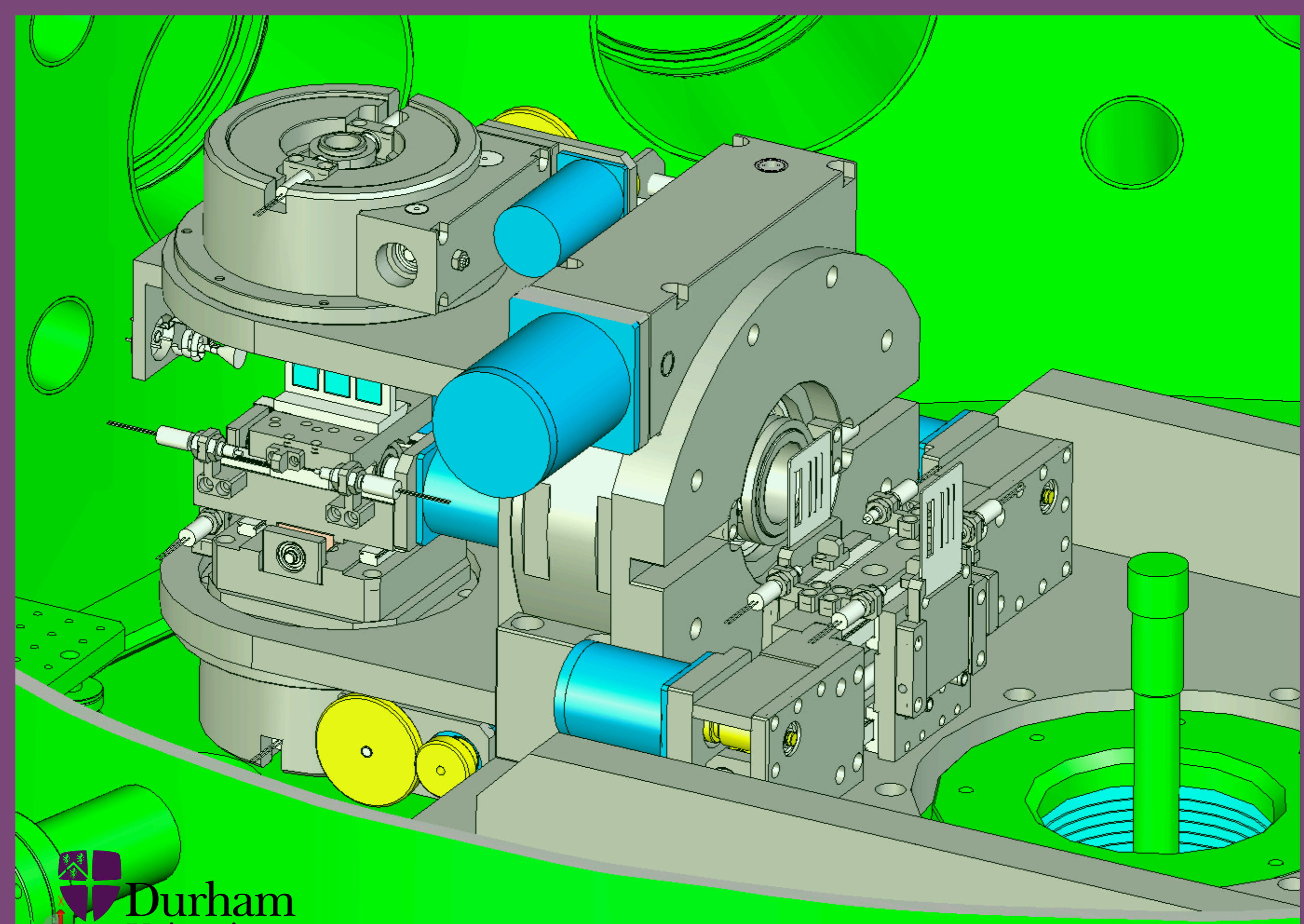


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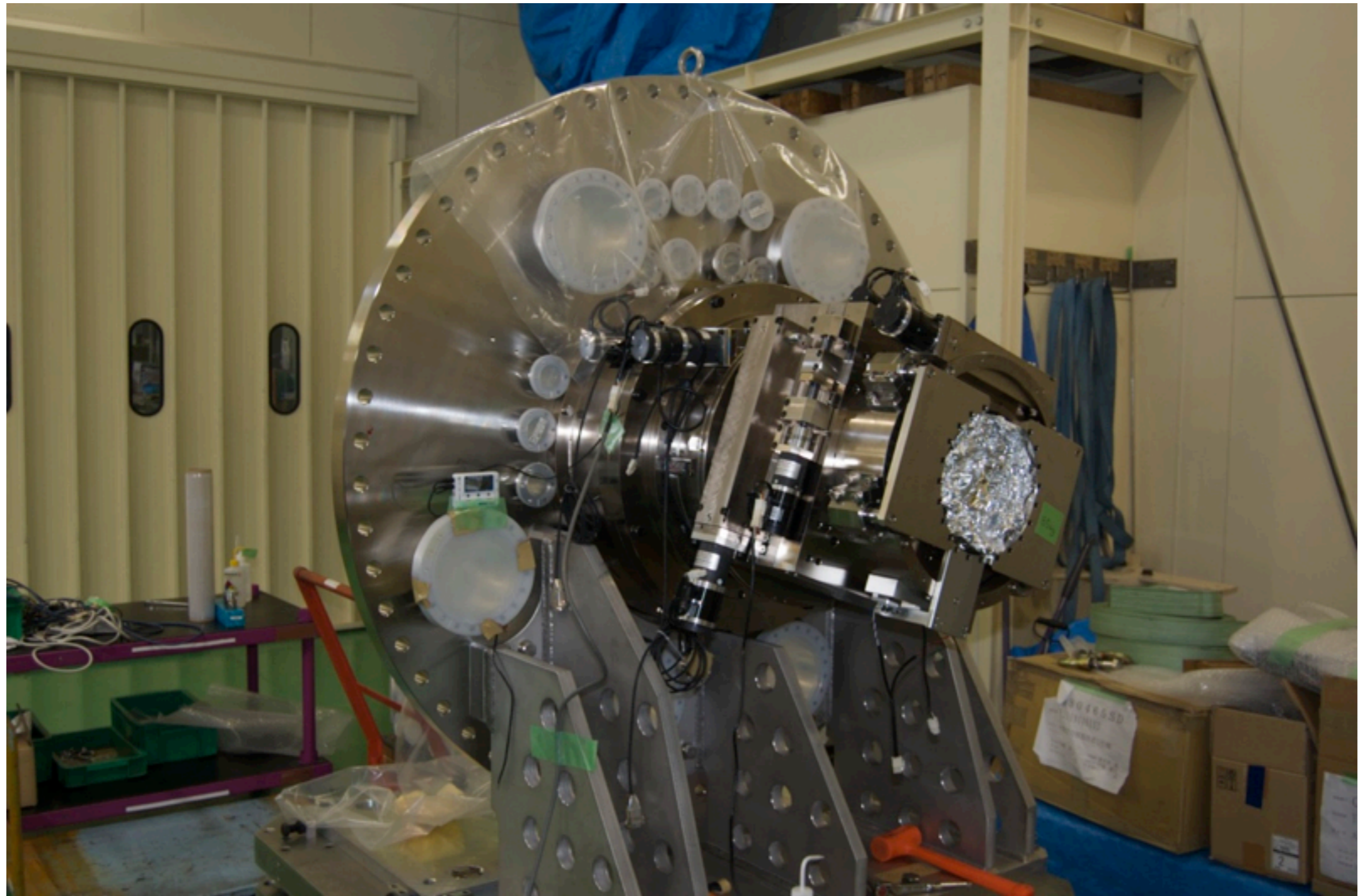
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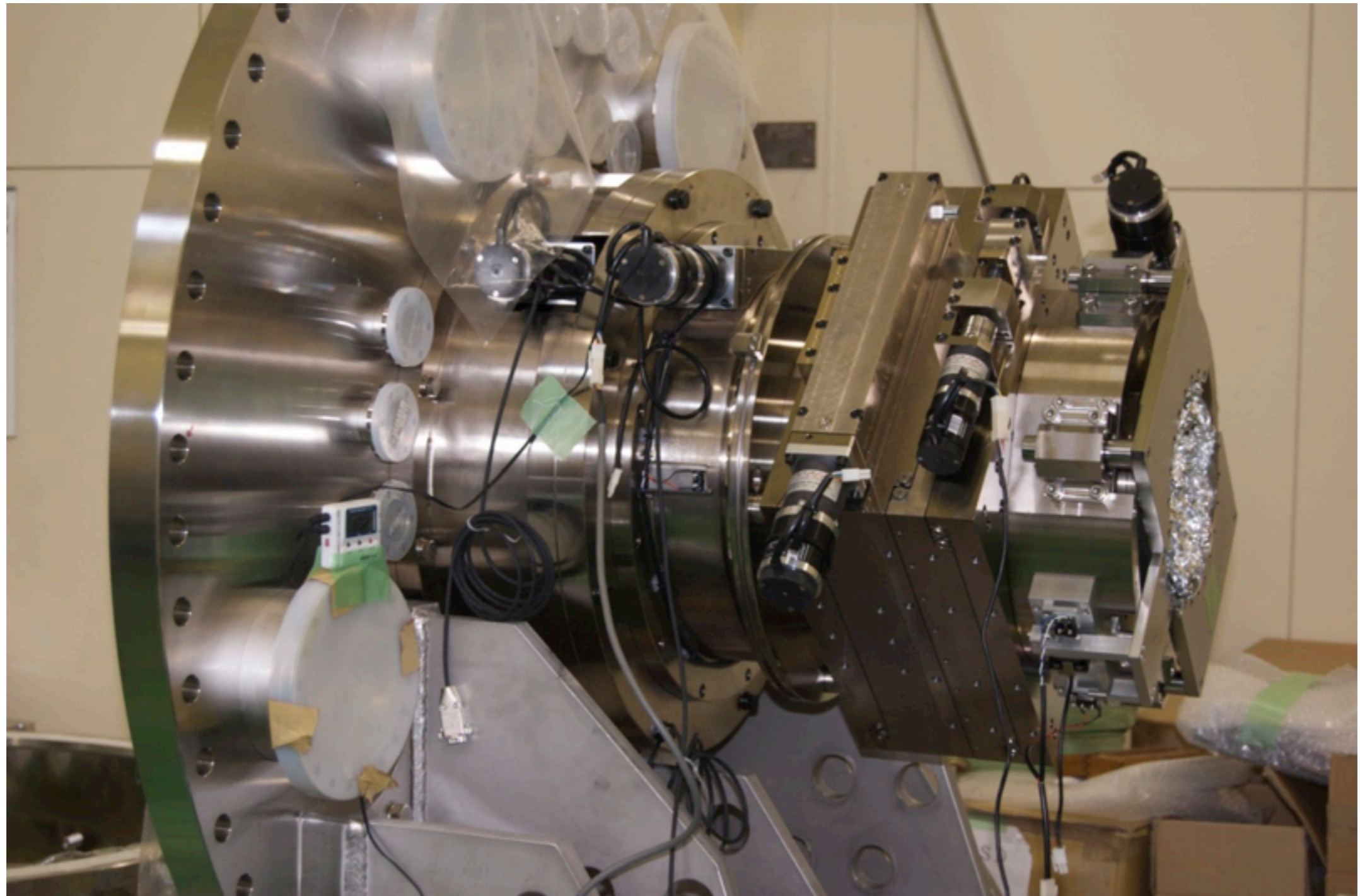


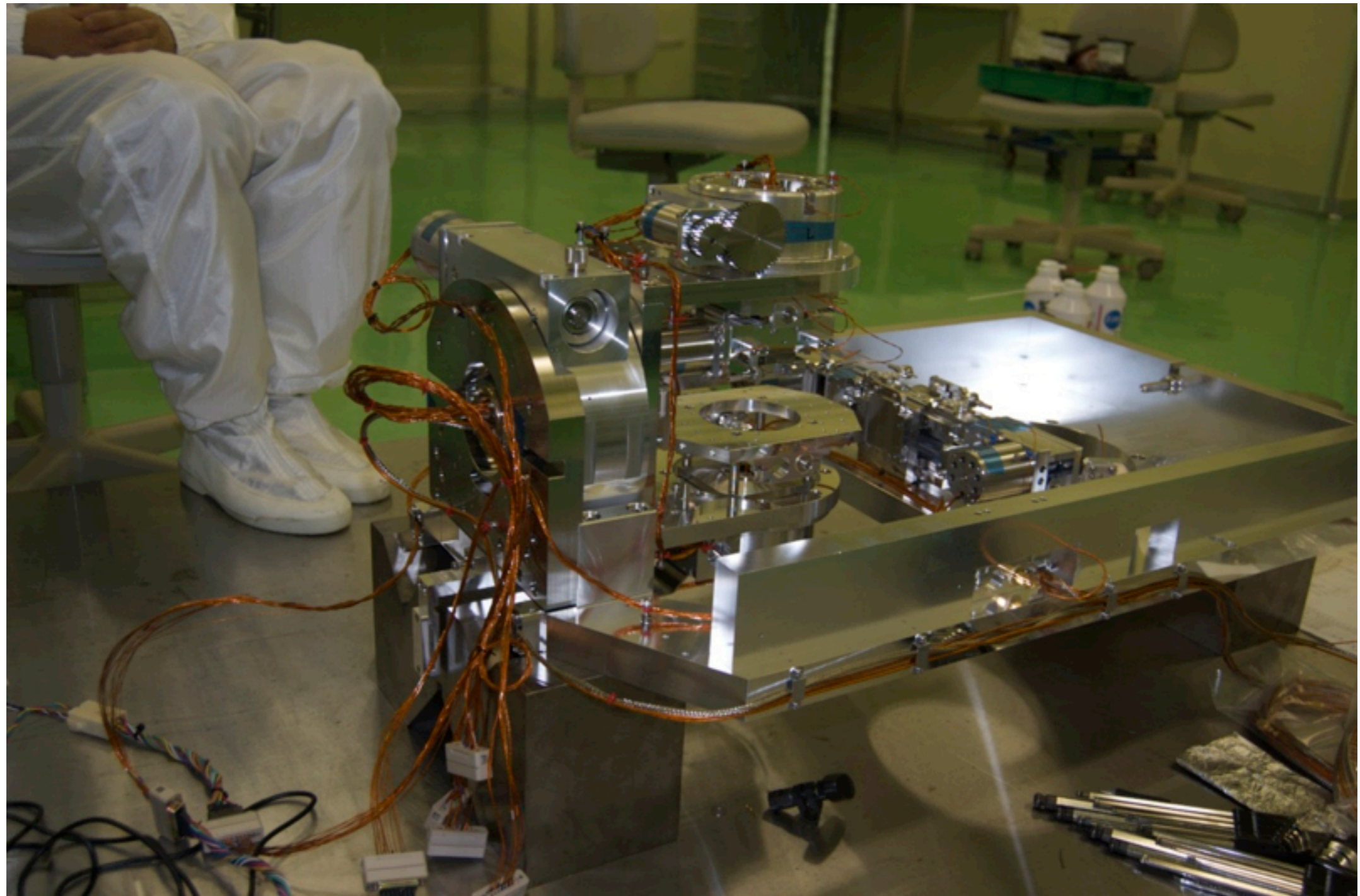


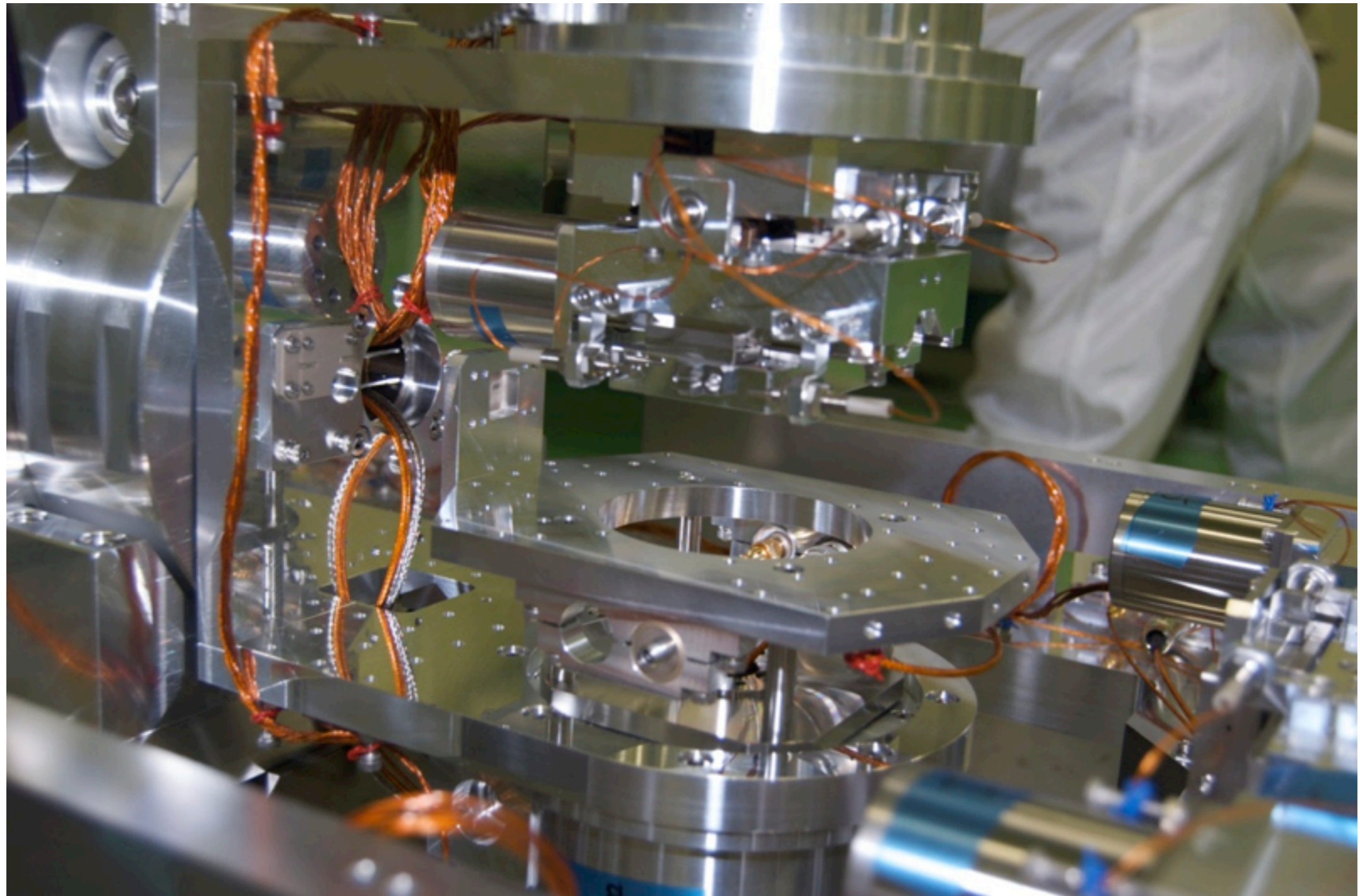
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<http://www.dur.ac.uk/xray.magnetism/rasor>

Rasor [wiki](#) [blog](#)

Tags:

Updated Jun 5, 2009 3:09 PM by [Thomas Beale...](#)

The RASOR Wiki

Welcome to the RASOR wiki. This site is a repository for all the useful information that users may have for running the RASOR diffractometer. This is open to all users, and any potential users. If you feel there should be more information about a specific topic on here - please request it!

Please contribute to this site as you discover useful tips - or problems that need to be solved.

To add or edit content to this site, you will need to [apply for an account](#).

News:

28th May 2009
Estimates from project management meetings at Diamond Light Source indicate that RASOR will be ready for experiment November 2009.

10th April 2009
[Further Construction Photographs](#). Tom Beale visited Japan in April, to observe impressive

Wiki pages

- Construction Photographs - April 2009
- What can RASOR do?
- Timescale - When can I use it??
- Supporters
- Apply for an account

What's Hot

- What can RASOR do?
- Timescale - When can I use it??
- Construction Photographs - March 2009
- Supporters