IAN McNULTY

Senior Scientist and Group Leader

X-ray Microscopy Group

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Education

Ph.D. Physics, Stony Brook University
M.S. Physics, Stony Brook University
B.A. Physics, Reed College

Awards and honors

2009	University of Chicago Distinguished Performance Award
2005	European Union Marie Curie Senior Scientist Fellowship
2001	Argonne National Laboratory Director's Award
1999	Argonne National Laboratory Pacesetter Award
1998	SC98 High Performance Computing Challenge Award
1991	Argonne National Laboratory Enrico Fermi Scholar
1984	Antarctic Service Medal, National Science Foundation
1983	Presidential Award for Antarctic Winter-over Service

Research interests

- Ordering and phase transitions in magnetic materials
- Coherent diffractive imaging and x-ray optics
- Orbital angular momentum states of light

Professional Experience

Argonne National Laboratory - Center for Nanoscale Materials *2012-present*
Group Leader, X-ray Microscopy Group

- Responsible for scientific program and operations of the X-ray Microscopy Group and the CNM/APS Hard X-ray Nanoprobe facility
- Principal Investigator for XMG nanomagnetism program. Co-PI on Argonne and DOE funded x-ray microscopy and coherent imaging projects. Scientific contact for Hard X-ray Nanoprobe users.

Argonne National Laboratory - Advanced Photon Source - X-ray Science Division
Senior Scientist *2011-present*
Group Leader 2000-2004
Physicist *1996-2011*
Assistant Physicist *1992-1996*

- Directed APS x-ray microscopy science programs, facilities, and staff
- Responsible for APS Sector 2 construction, commissioning, and operation
- Principal investigator for APS 2-ID-B beamline program on coherent x-ray science

Berliner Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung (BESSY), Berlin *2005-2006*
Senior Visiting Scientist

Argonne National Laboratory - Advanced Photon Source - X-ray Science Division *1991-1992*
Enrico Fermi Scholar Postdoctoral Fellow

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Selected Publications

Selected from 180+ publications:

Nanomagnetic and heterostructural materials

1. J.M. Logan, R. Harder, L. Li, D. Haskel, P. Chen, R. Winarski, P. Fuesz, D. Vine, D. Schlagel, C. Benson, and I. McNulty, "Hard x-ray polarizer to enable simultaneous three-dimensional nanoscale imaging of magnetic structure and lattice strain," *J. Synchrotron Rad.*, in press.
2. S.O. Hruszkewycz, M.V. Holt, C.E. Murray, J. Bruley, J. Holt, A. Tripathi, O.G. Shpyrko, I. McNulty, M.J. Highland, and P.H. Fuoss, "Quantitative imaging of lattice distortions in epitaxial semiconductor heterostructures using x-ray Bragg ptychography," *Nano Lett.* **12**, 5148-5154 (2012).
3. A. Tripathi, J. Mohanty, S.H. Dietze, O.G. Shpyrko, E. Shipton, E.E. Fullerton, S.S. Kim, and I. McNulty, "Dichroic coherent diffractive imaging," *Proc. Natl. Acad. Sci.* **108**, 13393-13398 (2011).
4. J.J. Turner, X. Huang, O. Krupin, K.A. Seu, D. Parks, S. Kevan, E. Lima, K. Kisslinger, I. McNulty, R. Gambino, S. Mangin, S. Roy, and P. Fischer, "X-ray diffraction microscopy of magnetic structures," *Phys. Rev. Lett.* **107**, 033904 (2011).
5. A. Scherz, W.F. Schlotter, K. Chen, R. Rick, J. Stöhr, J. Lüning, I. McNulty, Ch. Günther, F. Radu, W. Eberhardt, O. Hellwig, and S. Eisebitt, "Phase imaging of magnetic nanostructures using resonant soft x-ray holography," *Phys. Rev. B* **76**, 214410 (2007).

Nanoporous, core-shell, and other nanomaterials

6. A. Singer, L. Boucheron, S.H. Dietze, K. Jensen, D. Vine, I. McNulty, E.R. Dufresne, R.O. Prum, S.G.J. Mochrie, and O.G. Shpyrko, "Domain morphology, boundaries, and topological defects in biophotonic gyroid nanostructures of butterfly wing scales," *Sci. Advances* **2**, e1600149 (2016).
7. Y.A. Wu, L. Li, Z. Li, A. Kinaci, M.K.Y. Chan, Y. Sun, J.R. Guest, I. McNulty, T. Rajh, and Y. Liu, "Visualizing redox dynamics of a single Ag/AgCl heterogeneous nanocatalyst at atomic resolution," *ACS Nano* **10**, 3738-3746 (2016).
8. W. Cha, N.C. Jeong, S. Song, H.-J. Park, T.C.T. Pham, R. Harder, B. Lim, G. Xiong, D. Ahn, I. McNulty, J. Kim, K.B. Yoon, I.K. Robinson, and H. Kim, "Core–shell strain structure of zeolite microcrystals," *Nature Materials* **12**, 729-734 (2013).
9. Y.-C. K. Chen-Wiegart, S. Wang, I. McNulty, and D.C. Dunand, "Effect of Ag-Au composition and acid concentration on dealloying front velocity and cracking during nanoporous gold formation," *Acta Materialia* **61**, 5561-5570 (2013).
10. Y.-C. Chen, Y. Chu, J. Yi, I. McNulty, Q. Shen, P. Voorhees, and D.C. Dunand, "Morphological and topological analysis of coarsened nanoporous gold by x-ray nanotomography," *Appl. Phys. Lett.* **96**, 043122 (2010).

Environmental and life sciences

11. A.F. Longo, E.D. Ingall, J.M. Diaz, M. Oakes, L.E. King, A. Nenes, N. Mihalopoulos, K. Violaki, A. Avila, C.R. Benitez-Nelson, J. Brandes, I. McNulty, and D. Vine, "P-NEXAFS characterization of aerosol phosphorus delivered to the mediterranean sea," *Geophys. Res. Lett*. **41**, 4043-4049 (2014).
12. M.R. Krejci, B. Wasserman, L. Finney, I. McNulty, D. Legnini, S. Vogt, and D. Joester, "Selectivity in biomineralization of barium and strontium," *J. Struct. Biol.* **176**, 192-202 (2011).
13. M.D. de Jonge, C. Holzner, S.B. Baines, B.S. Twining, K. Ignatyev, J. Diaz, D.L Howard, D. Legnini, A. Miceli, I. McNulty, C.J. Jacobsen, and S. Vogt, "Quantitative 3-D elemental microtomography of Cyclotella meneghiniana at 400-nm resolution," *Proc. Natl. Acad. Sci.* **107**, 15676–15680 (2010).
14. J. Diaz, E. Ingall, C. Benitez-Nelson, D. Paterson, M.D. de Jonge, I. McNulty, and J.A. Brandes, "Marine polyphosphate: A key player in geologic phosphorus sequestration," *Science* **320**, 652-655 (2008).

X-ray orbital angular momentum

15. S. Sasaki and I. McNulty, "Proposal for generating brilliant x-ray beams carrying orbital angular momentum," *Phys. Rev. Lett.* **100**, 124801 (2008).
16. M. van Veenendaal and I. McNulty, "Prediction of strong dichroism induced by x-rays carrying orbital momentum," *Phys. Rev. Lett.* **98**, 157401 (2007).
17. A. Peele, K. Nugent, A. Mancuso, D. Paterson, J.P. Hayes, and I. McNulty, "X-ray phase vortices: theory and experiment," *J. Opt. Soc. Am. A* **21**, 1575-1584 (2004).
18. A.G. Peele, P.J. McMahon, D. Paterson, C.Q. Tran, A.P. Mancuso, K.A. Nugent, J.P. Hayes, E. Harvey, B. Lai, and I. McNulty, "Observation of an x-ray vortex," *Opt. Lett.* **27**, 1752 (2002).

X-ray coherent diffractive imaging and microscopy

19. C. Kim, Y. Kim, S.S. Kim, H.C. Kang, I. McNulty, and D.Y. Noh, "Fresnel coherent diffractive imaging of elemental distributions in nanoscale binary compounds," *Optics Express* **22**, 5528-5535 (2014).
20. A. Tripathi, I. McNulty, and O.G. Shpyrko, "Ptychographic overlap constraint errors and the limits of their numerical recovery using conjugate gradient descent methods," *Optics Express* **22**, 1452-1466 (2014).
21. R.P. Winarski, M.V. Holt, V. Rose, P. Fuesz, D. Carbaugh, C. Benson, D. Shu, D. Kline, G.B. Stephenson, I. McNulty, and J. Maser, "A hard x-ray nanoprobe beamline for nanoscale microscopy," *J. Synchrotron Rad.* **19**, 1056-1060 (2012).
22. D.J. Vine, D. Pelliccia, C. Holzner, S.B. Baines, A. Berry, I. McNulty, S. Vogt, A.G. Peele, and K.A. Nugent, "Simultaneous x-ray fluorescence and ptychographic microscopy of Cyclotella meneghiniana," *Optics Express* **20**, 18287-18296 (2012).
23. B. Abbey, L.W. Whitehead, H.M. Quiney, D.J. Vine, G.A. Cadenazzi, C.A. Henderson, K.A. Nugent, E. Balaur, C.T. Putkunz, A.G. Peele, G.J. Williams, and I. McNulty, "Lensless imaging using broadband x-ray sources," *Nature Photonics* **5**, 420 (2011).
24. C.T. Putkunz, J.N. Clark, D.J. Vine, G.J. Williams, M.A. Pfeifer, E. Balaur, I. McNulty, K.A. Nugent, and A.G. Peele, "Phase-diverse coherent diffractive imaging: high sensitivity with low dose," *Phys. Rev. Lett.* **106**, 013903 (2011).
25. L.W. Whitehead, G.J. Williams, H.M. Quiney, D. Vine, S. Flewett, K.A. Nugent, A.G. Peele, E. Balaur, and I. McNulty, "Coherent diffractive imaging with partially coherent X-rays," *Phys. Rev. Lett.* **103**, 243902 (2009).
26. B. Abbey, K.A. Nugent, G.J. Williams, J.N. Clark, A.G. Peele, M.A. Pfeifer, M. de Jonge, and I. McNulty, "Keyhole coherent diffractive imaging," *Nature Physics* **4**, 394-398 (2008).
27. M.M.J. Treacy, J.M. Gibson, L. Fan, D.J. Paterson, and I. McNulty, "Fluctuation microscopy: a probe of medium range order," *Rep. Prog. Phys.* **68**, 2899-2944 (2005).

Patents

- No. 7,864,415 "Use of a focusing vortex lens as the objective in spiral phase contrast microscopy," I. McNulty
- No. 5,558,091 "Magnetic determination of position and orientation," D.E. Acker, I. McNulty, R.C. Pacheco, and W. Grandner