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◆ Employment history

Argonne National Laboratory Assistant Physicist

Tenure: February 2005 – present
Position: Assistant Physicist — Molecular Environmental Science Group,
Staff Scientist — The Materials Research Collaborative Access Team
at The Advanced Photon Source

Naval Research Laboratory Research Physicist

Tenure: December 2001 – January 2005
Director: NRL Synchrotron Radiation Consortium
Spokesperson: NSLS Beamlines X11A, X11B, X23B

American Society of Electrical Engineers Post-Doctoral Fellow

Employer: Naval Research Laboratory, Washington DC
Tenure: July 2000 – November 2001
Research Project: XAFS Studies of Half-Metallic Heusler Alloys

European Synchrotron Radiation Facility Visiting Scientist

Employer: Centre National de la Recherche Scientifique, Grenoble France.
Tenure: October 1999 – June 2000
Research Project: Diffraction Anomalous Fine Structure Investigation of
Superlattice Reflections in $\text{La}_{1/3}\text{Ca}_{2/3}\text{MnO}_3$
Responsibilities: Staff member at beamline BM02, local contact for outside users,
data acquisition software development.

National Research Council Research Associate

Host: National Institute of Standards and Technology
Tenure: September 1997 – September 1999
Research Project: Diffraction Anomalous Fine Structure Investigation of the Ferroelectric Phase
Transitions of BaTiO_3

◆ Education

Doctor of Philosophy in Physics University of Washington 1997

Thesis title: Ferroelectric Phase Transitions in Oxide Perovskites Studied by XAFS

Advisors: Dr. Edward A. Stern and Dr. John J. Rehr

Thesis topic: Temperature dependent EXAFS and XANES measurements are presented on a variety of titanium perovskite materials, including PbTiO_3 and BaTiO_3 . The order-disorder behavior of the local structures of these materials through their structural and ferroelectric phase transitions is demonstrated. Also a real space full multiple scattering approach to *ab initio* calculations of the x-ray-absorption near edge structure is presented.

Master of Science in Physics University of Washington 1991

Bachelor of Arts in Physics

Wesleyan University 1989

Graduated: *Magna Cum Laude*

Member: *Phi Beta Kappa*

◆ Current Research Interests**Subsurface Biogeochemical Cycling**

An unhappy legacy of decades of production of nuclear fuel material is the contamination of ground water by various heavy metals, including uranium, at various sites throughout the United States. The fate and transport of those metallic contaminants is determined by the complex interactions between the metals, the groundwater, the mineral surfaces over which the groundwater passes, and the microbial communities which exist in the subsurface. The valence and speciation of the metal determines the mobility of the contaminant and, consequently, its threat to human health. Bulk and microprobe X-ray Absorption Spectroscopy provide a tool for direct, *in situ*, non-destructive measurement of valence and speciation. Through a combination of lab investigations and measurement of samples obtained from field study sites, the fundamental science underlying remediation strategies is understood.

Development of Resources for X-ray Absorption Spectroscopy

MRCAT devotes a majority of its time to a variety of spectroscopy experiments. In my time with MRCAT, I have overseen significant upgrades to the signal and control system at the undulator beamline. The new system greatly expands signal capacity while improving signal integrity. The bending magnet line is currently under construction with first light expected in fall of 2007. The beamline will feature simple robotics and a high level of automation as well as an in-line anoxic chamber for fine control over the sample environment.

XAS Investigations of Interstellar Media

The high resolution and broad energy bandwidth available on the Chandra x-ray observatory and planned for future missions makes feasible the prospect of determining material composition of the interstellar medium (ISM). Along with a collaborator, I am currently investigating the feasibility of the measurement of solid state properties of the ISM using extant observatories, a bright pulsar as the radiation source, and the formalism of XAS analysis to interpret the satellite data.

Novel XAFS Analysis Tools

I am the author of a suite of XAS data analysis tools — ATHENA, ARTEMIS, and HEPHAESTUS — which are used by hundreds of scientists world-wide. The goal of this software is to be a complete solution to the problem of planning and interpreting an XAS experiment. Along with extensive data processing capabilities, the user can manage all aspects of data analysis, including theory calculations using FEFF,

creation of fitting models, and statistical evaluation of fitting results. Current development efforts are aimed at reimplementing and greatly expanding the basic functionality of the suite to allow for more powerful graphical interfaces, easier scripting of specialty analysis problems, and high-throughput and automated processing and analysis. More information about this project can be found on the web at <http://cars9.uchicago.edu/~ravel/software/>.

◆ Teaching and Consulting Experience

EXAFS Data Collection and Analysis

This four day course at NSLS and APS provides a broad introduction to the EXAFS technique and includes lectures and hands-on data collection and analysis. In three years we have had 88 students in the course. I am on the organizing committee, give lectures on the topic of XAS theory, and proctor the data analysis practicals. The IFEFFIT package and my programs ATHENA and ARTEMIS are used during the analysis practicals.

- National Synchrotron Light Source, 23–25 September, 2002
- National Synchrotron Light Source, 14–17 July, 2003
- National Synchrotron Light Source, 22–25 June, 2004
- Advanced Photon Source, 26–29 July, 2005
- Advanced Photon Source, 26–28 July, 2006
- Advanced Photon Source, 23–27 July, 2007

EXAFS Analysis Using FEFF and FEFFIT

This is a three day workshop on advanced topics in EXAFS analysis using these two programs. This course has been given several times with audiences ranging in size from 15 to 30 and consists of a series of three lectures and two sessions of computer practicals. References available on request; information and course materials available at <http://cars9.uchicago.edu/~ravel/talks/course/>.

- ESRF, Grenoble France, 15–17 March, 2000
- University of Leuven, Belgium, 2–4 May, 2000
- CNRS, Grenoble France, 17–19 May, 2000
- University of Seville, Spain, 24–26 May, 2000
- University of Wuppertal, Germany, 13–15 June, 2000
- LNLS, Campinas, Brazil, 7–9 May, 2001
- NSLS, Brookhaven National Laboratory, 27–29 June, 2001

Other XAS Events

These are seminars and courses on XAS in other formats that I have been invited to give over the years. The recent courses have focused on the use of ATHENA and ARTEMIS.

- The Dow Chemical Company, 16–17 September, 1996
- HERCULES 2000, “Introduction to FEFF Analysis of Absorption Spectra”, 29 March, 2000
- Alberta Synchrotron Institute, 12–14 November, 2002
- Irregular seminar series at NSLS, several dates, 2004
- Canadian Light Source, 16–17 November, 2004
- Michigan State University, 20–21 January, 2005
- Lecturer at the National School on Neutron and X-ray Scattering, 2005–2007
- Swiss Light Source, 20–21 February, 2006
- Physics Institute of the Polish Academy of Science, 13–15 November 2006

◆ Language Skills

I possess strong conversational abilities in French and Spanish. I spoke French daily in the workplace at the CNRS and am able to converse on a professional level in both languages. The computer practicals for the “EXAFS Analysis Using FEFF and FEFFIT” workshops at the CNRS and the University of Seville were conducted in French and Spanish respectively.

◆ Publications

Journal Articles

1. *Precipitation of gold by reaction of aqueous gold(III)-chloride with cyanobacteria at 25-80C, studied by X-ray absorption spectroscopy* M. F. Lengke, B. Ravel, M. E. Fleet, G. Wanger, R. A. Gordon, G. Southam, *Can. J. Chem.* in press (2007)
2. *Protein Oxidation Implicated as the Primary Determinant of Bacterial Radioresistance* M. J. Daly, E. K. Gaidamakova, V. Y. Matrosova, A. Vasilenko, M. Zhai, R. D. Leapman, B. Lai, B. Ravel, S.-M. W. Li, K. M. Kemner, J. K. Fredrickson *PLOS Biology* **5**:4, e92 doi:10.1371/journal.pbio.0050092 (2007)
3. *Speciation of organotins in polyvinyl chloride pipe via X-ray absorption spectroscopy and in leachates using GC-PFPD after derivatisation* C. A. Impellitteri, O. Evans, and B. Ravel, *J. Environ. Monit.*, **9**, p. 358 (2007)
4. *Mechanisms of Gold Bioaccumulation by Filamentous Cyanobacteria from Gold(III)-Chloride Complex* M. F. Lengke, B. Ravel, M. E. Fleet, G. Wanger, R. A. Gordon, G. Southam, *Environ. Sci. Technol.* **40**(20); p. 6304–6309. (2006)
5. *Role of local disorder in the dielectric response of BaTaO₂N*, B. Ravel, Y.-I. Kim, P.M. Woodward, and C.M. Fang, *Physical Review* **B73**, p. 184121 (2006)
6. *ATHENA, ARTEMIS, HEPHAESTUS: data analysis for X-ray absorption spectroscopy using IFFFIT*, B. Ravel and M. Newville, *J. Synchrotron Rad.* **12**, pp. 537–541 (2005)
7. *Determining the grain composition of the interstellar medium with high resolution X-ray spectroscopy*, J.C. Lee and B. Ravel, *The Astrophysical Journal*, **622**:2 pp. 970–976 (2005)
8. *A Practical Introduction to Multiple Scattering Theory*, B. Ravel, *J. Alloys Compounds*, B. Ravel, *Journal of Alloys and Compounds* **401**:1-2 pp. 118–126 (2005)
9. *Diffraction anomalous fine-structure spectroscopy at beamline BM2 at the European Synchrotron Radiation Facility*, H. Renevier, S. Grenier, S. Arnaud, J.F. Berar, B. Caillot, J.L. Hodeau, A. Letoublon, M.G. Proietti, B. Ravel, *J. Synchrotron Radiat.* **10**:6, pp. 435–444 (2003)
10. *Dense medium plasma synthesis of carbon/iron-based magnetic nanoparticle system*, F.S. Denes, S. Manolache, Y.C. Ma, V. Shamamian, B. Ravel, S. Prokes, *J. Appl. Phys.* **94**:5, pp. 3498–3508 (2003)
11. *Multiedge refinement of extended x-ray-absorption fine structure of manganese zinc ferrite nanoparticles*, S. Calvin, E.E. Carpenter, B. Ravel, V.G. Harris, and S.A. Morrison, *Phys. Rev.* **B66**, pp. 224405–224418, (2002)
12. *Presence of Antisite Disorder and its Characterization in the Predicted Half-Metal Co₂MnSi*, M.P. Raphael, B. Ravel, Q. Huang, S.F. Chang, M.A. Willard, B.N. Das, R.M. Stroud, K.M. Bussman, J.H. Claassen, and V.G. Harris. *Phys. Rev.* **B66**, pp. 104429–104435 (2002)
13. *Atomic Disorder in Heusler Co₂MnGe Measured by Anomalous X-Ray Diffraction*, B. Ravel, J.O. Cross, M.P. Raphael, V.G. Harris, R. Ramesh, V. Saraf. *Applied Physics Letters*, **81**:15. pp. 2812–2814 (2002).

14. *An EXAFS and Neutron Diffraction Study of the Heusler Alloy Co_2MnSi* , B. Ravel, M.P. Raphael, V.G. Harris, and Q. Huang, *Phys. Rev.* **B65** #18, pp. 184431–184438 (2002). Also published online in *Virtual Journal of Nanoscale Science & Technology*, 5:20, May 20, 2002
15. *A new atomic database for X-ray spectroscopic calculations*, W.T. Elam, B. Ravel, and J.R. Sieber, *Radiation Physics and Chemistry* **63**, pp. 121-128 (2002)
16. *Surface Structure and Orientation of PTFE Films Determined by Experimental and FEFF8-Calculated NEXAFS Spectra*, L.J. Gamble, B. Ravel, D.A. Fischer, and D.G. Castner, *Langmuir* **18**, pp. 2183–2189 (2002)
17. *Magnetic, Structure, and Transport Properties of Thin Film and Single Crystal Co_2MnSi* , M.P. Raphael, B. Ravel, M.A. Willard, S.F. Chang, B.N. Das, R.M. Stroud, K.M. Bussman, J.H. Claassen, and V.G. Harris, *Appl. Phys. Lett.*, **79**, #26, pp. 4396–4398 (2001).
18. *Polarisation effects in hexagonal Boron Nitride Near-Edge Structure: a real space multiple scattering approach.*, M. Jaouen, G. Hug, B. Ravel, A.L. Ankudinov, and J.J. Rehr, *Europhysics Letters* **49**(3), pp. 343–349 (2000).
19. *Microtomography of Integrated Circuit Interconnect with an Electromigration Void*, Z. H. Levine, A. R. Kalukin, M. Kuhn, S. P. Frigo, I. McNulty, C. C. Retsch, Y. Wang, U. Arp, T. B. Lucatorto, B. Ravel, and C. Tarrío, *J. Appl. Phys.*, **87**, p. 4483 (2000).
20. *A Combined EXAFS and First Principles Theory Study of $\text{Pb}_{1-x}\text{Ge}_x\text{Te}$* , B. Ravel, E. Cockayne, M. Newville, and K.M. Rabe, *Phys. Rev.* **B 60**, #21, pp. 14632–14642 (1999).
21. *X-Ray-Absorption Edge Separation Using Diffraction Anomalous Fine-Structure*, B. Ravel, C. E. Bouldin, H. Renevier, J.-L. Hodeau, J.-F. Berar, *Phys. Rev.* **B 60**, #2 pp. 778-785 (1999).
22. *Real Space Multiple Scattering Calculation and Interpretation of X-Ray Absorption Near Edge Structure*, A.L. Ankudinov, B. Ravel, J.J. Rehr, and S. Conradson, *Phys. Rev* **B58**, #12, pp. 7565-7576, (1998)
23. *Diffraction anomalous fine-structure study of strained $\text{Ga}_{1-x}\text{In}_x\text{As}$ on $\text{GaAs}(001)$* , J.C. Woicik, J.O. Cross, C.E. Bouldin, B. Ravel, J.G. Pellegrino, B. Steiner, S.G. Bompadre, L.B. Sorensen, K.E. Miyano, and J.P. Kirkland, *Phys. Rev* **B58**, #8, pp. R4215–R4218, (1998)
24. *Identification of Materials in Integrated Circuit Interconnects Using X-Ray Absorption Near Edge Spectroscopy*, Z.L. Levine and B. Ravel, *J. Appl. Physics. J. Appl. Phys.* **85**, #1, pp. 558–564 (1999)
25. *X-Ray-Absorption Fine-Structure Study of the B1-to-B2 Phase Transition in RbCl* S. Kelly, R. Ingalls, F. Wang, B. Ravel, and D. Haskel, *Phys. Rev.* **B57**, #13, pp. 7543–7550, (1998)
26. *Local Structure and the Phase Transitions of BaTiO_3* , B. Ravel, E.A. Stern, R.I. Vedrinskii, and V. Kraizman, *Ferroelectrics* **206–207**, pp. 407–430 (1998)
27. *Order-Disorder Behavior in the Phase Transition of PbTiO_3* , B. Ravel, N. Sicon, Y. Yacoby, E.A. Stern, F. Dogan, J.J. Rehr, *Ferroelectrics* **164**, pp. 265, (1995)
28. *Diffraction Anomalous Fine Structure: Unifying X-ray Diffraction and X-ray Absorption with DAFS*, L.B. Sorensen, J.O. Cross, M. Newville, B. Ravel, J.J. Rehr, H. Stragier, C.E. Bouldin, J.C. Woicik, *Resonant Anomalous X-ray Scattering: Theory and Applications*, G. Materlik, C.J. Sparks, K. Fischer, eds. North Holland, Amsterdam (1994)
29. *The Nature of the Ferroelectric Phase Transition in PbTiO_3* , N. Sicon, B. Ravel, Y. Yacoby, E.A. Stern, F. Dogan, J.J. Rehr, *Phys. Rev.* **B50**, #18, 1 November (1994)

Conference Proceedings and Short Articles

1. *EXAFS Energy Shift and Structural Parameters* S. Kelly and B. Ravel, AIP Conference Proceedings Volume 882, pp. 132–134 (2007)
2. *EXAFS Analysis with Self-consistent Atomic Potentials* S. Kelly and B. Ravel, AIP Conference Proceedings Volume 882, pp. 135–137 (2007)

3. *The Difficult Chore of Measuring Coordination by EXAFS* B. Ravel and S. Kelly, AIP Conference Proceedings Volume 882, pp. 150–152 (2007)
4. *A pH-Dependent X-Ray Absorption Spectroscopy Study of U Adsorption to Bacterial Cell Walls*, B. Ravel, S. D. Kelly, D. Gorman-Lewis, M. I. Boyanov, J. B. Fein, and K. M. Kemner, AIP Conference Proceedings Volume 882, pp. 202–204 (2007)
5. *XAFS and X-Ray and Electron Microscopy Investigations of Radionuclide Transformations at the Mineral-Microbe Interface*, Ken Kemner, Ed O’Loughlin, Shelly Kelly, Bruce Ravel, Maxim Boyanov, Deirdre Sholto-Douglas, Barry Lai, Russ Cook, Everett Carpenter, Vince Harris, and Ken Nealson, AIP Conference Proceedings Volume 882, pp. 250–252
6. *ATHENA and ARTEMIS: Interactive graphical data analysis using IFEFFIT*, B. Ravel and M. Newville, *Physica Scripta*, 2005 No T115 pp. 1007-1010 (2005)
7. *Atomic structure and the magnetic properties of Zr-doped Sm₂Co₁₇*, B. Ravel and K. Gallagher, *Physica Scripta*, No T115 pp. 606–608 (2005)
8. *Proceedings of the National Research Facilities Workshop: Opportunities for DoD Utilization*, B. Ravel and B.B. Rath, Naval Research Laboratory, Washington DC, October 20–21, 2003
9. *Oxidation of iron in iron/gold core/shell nanoparticles*, B. Ravel, E.E. Carpenter, and V.G. Harris, *J. Appl. Phys.*, **91**:10, pp. 8195–8197 (2002). Also published online in *Virtual Journal of Nanoscale Science & Technology*, **5**:22, June 3, 2002
10. *ATOMS: Crystallography for the X-Ray Absorption Spectroscopist*, B. Ravel *J. Synchrotron Rad.*, **8**, pp. 314–316 (2001).
11. *Valence selective DAFS measurements of Mn in La_{1/3}Ca_{2/3}MnO₃*, B. Ravel, S. Grénier, H. Renevier, C.B. Eom *J. Synchrotron Rad.*, **8**, pp. 384–386 (2001).
12. *Separating Overlapping X-Ray-Absorption Edges Using Diffraction Anomalous Fine-Structure*, B. Ravel, C.E. Bouldin, H. Renevier, *Synchrotron Radiation News*, **12.3**, May/June (1999).
13. *Edge Separation Using DAFS*, B. Ravel, C.E. Bouldin, H. Renevier, J-L. Hodeau, and J-F. Berar, *ESRF Newsletter*, **31**, (September 1998) (on the web at: <http://www.esrf.fr/info/science/newsletter/sep98/DOSEXP/PAGEXPER.HTM>)
14. *The Local Structure of Ferroelectric Pb_{1-x}Ge_xTe*, B. Ravel, E. Cockayne, and K.M. Rabe, *J. Synchrotron Rad.*, **6**, pp. 567-569 (1999)
15. *Edge Separation Using Diffraction Anomalous Fine-Structure*, B. Ravel, C.E. Bouldin, H. Renevier, J-L. Hodeau, and J-F. Berar *J. Synchrotron Rad.*, **6**, pp. 338-340 (1999)
16. *Full Multiple Scattering XANES Calculations*, B. Ravel, J.J. Rehr, *J. Physique IV Colloq.* **7**, C2 pp. 229–230 (1997)
17. *Temperature and Polarization Dependent XANES Measurements in PbTiO₃*, B. Ravel and E.A. Stern, *J. Physique IV Colloq.* **7**, C2 pp. 1223–1224 (1997)
18. *Co-Refinement of Diffraction Anomalous Fine-Structure Data*, M. Newville, J.O. Cross, B. Ravel, L.B. Sorenson, C.E. Bouldin, and Y. Yacoby, *J. Physique IV Colloq.* **7**, C2 pp. 759–760 (1997)
19. *Effect of Hydrostatic Pressure on the Local Structural Distortions in K_{0.85}Na_{0.15}TaO₃*, Y. Yacoby, F. Wang, B. Ravel, *J. Physique IV Colloq.* **7**, C2 pp. 1225–1226 (1997)
20. *Local Disorder and Near Edge Structure in Titanate Perovskites*, B. Ravel and E.A. Stern, *Physica B*, **208&209**, p. 316, (1995)
21. *Analysis of DAFS Fine Structure and Background*, B. Ravel, M. Newville, J.O. Cross, and C.E. Bouldin, *Physica B*, **208&209** p. 145, (1995)
22. *Single and Multiple Scattering XAFS in BaZrO₃: A Comparison Between Theory and Experiment*, D. Haskel, B. Ravel, M. Newville, E.A. Stern, *Physica B*, **208&209** p. 151, (1995)

23. *The UWXAFS Analysis Package: Philosophy and Details*, E.A. Stern, M. Newville, B. Ravel, Y. Yacoby, D. Haskel, *Physica B*, **208&209** p. 117, (1995)
24. *Analysis of Multiple-Scattering XAFS Using Theoretical Standards*, M. Newville, B. Ravel, D. Haskel, J.J. Rehr, E.A. Stern, Y. Yacoby, *Physica B*, **208&209** p. 154, (1995)
25. *Structural Disorder in Oxygen Perovskite Crystals*, B. Rechav, N. Sicron, Y. Yacoby, B. Ravel, M. Newville, E.A. Stern, *Physica C*, **209**, p. 55 (1993)
26. *Lead Titanate is not a Classic Case of a Displacive Ferroelectric Phase Transition*, B. Ravel, E.A. Stern, Y. Yacoby, F. Dogan, *Jpn. J. Appl. Phys.*, **32**, suppl. 32-2, p. 782 (1993)

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