



XDL-2011: Workshops on Science at the Hard X-ray Diffraction Limit

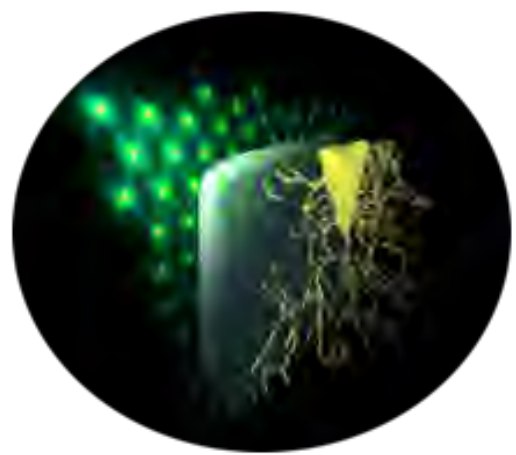
Joel D. Brock and Sol M. Gruner
Cornell University, Ithaca, NY 14853

Diffraction Microscopy, Holography and Ptychography using Coherent Beams

June 6 & 7, 2011

Harald Ade, North Carolina State University - *"Spectromicroscopy, Resonant Scattering, Possible Extensions to Ptychographic Imaging"*
Don Bilderback, Cornell University - *"Energy Recovery Linac (ERL) and Ultimate Storage Ring (USR) Properties"*
Jim Fienup, University of Rochester - *"X-ray Coherent Diffractive Imaging with an Extended Reference"*
Sol Gruner, Cornell University - *"X-ray Detectors: State-of-the-art & Future Possibilities"*
Ross Harder, Advanced Photon Source - *"Probing Strain and Defects in Single Crystals with Coherent X-ray Diffraction"*
Chris Jacobsen, Northwestern University - *"Imaging with Coherent Beams: let's not do it in a vacuum"*
Chae Un Kim, Cornell University - *"Cryopreservation of Structural Integrity under High Pressure"*
Stefano Marchesini, Lawrence Berkeley National Laboratory - *"High-efficiency Fourier Holography with Uniformly Redundant Arrays"* [tentative]
Ian McNulty, Advanced Photon Source - *"Resonant Coherent X-ray Imaging"*
John Miao, University of California, Los Angeles - *"Three-Dimensional Coherent Diffraction Imaging of Materials and Cells"*
Yoshinori Nishino, Hokkaido University - *"Imaging Cellular Organelles"*
David Shapiro, National Synchrotron Light Source II - *"High-resolution Imaging of Biological Specimens"*
Qun Shen, National Synchrotron Light Source II - *"New Opportunities with Hard X-ray Diffraction Limited Sources"*
Oleg Shpyrko, University of California, San Diego - *"Magnetic Domains and Dynamics"*
Pierre Thibault, Technische Universität München - *"Ptychography in 2D and 3D"*
Ivan Vartanants, Deutsches Elektronen-Synchrotron - *"Coherent Diffractive Imaging and Determining Structural Properties from Cross-correlation Analysis"*
Garth Williams, Linac Coherent Light Source - *"Coherent Imaging Without a Laser: getting the most bang for your electrons"*

Organizers:
Janos Kirz (Lawrence Berkeley National Lab),
Qun Shen (National Synchrotron Light Source II), & Darren Dale (Cornell University)



WS1

Biomolecular Structure from Nanocrystals and Diffuse Scattering

June 13 & 14, 2011

Philip Anfinrud, National Institutes of Health - *"Time-resolved Scattering of Proteins in Solution: new opportunities for an ERL"*
Don Bilderback, Cornell University - *"Energy Recovery Linac (ERL) and Ultimate Storage Ring (USR) Properties"*
Martin Caffrey, Trinity College, Ireland - *"Toward Rational Crystallization for Structure-Function Studies of Membrane Proteins"*
Brian Crane, Cornell University - *"Biological Opportunities with Solution Scattering"*
Bob Fischetti, Argonne National Laboratory - *"Data Collection from Nanocrystals with Reduced Radiation Damage"*
Seth Fraden, Brandeis University - *"Microfluidics to Produce and Manipulate Microcrystals"*
Sol Gruner, Cornell University - *"X-ray Detectors: State-of-the-art & Future Possibilities"*
James Holton, Lawrence Berkeley National Laboratory - *"Predicting and Processing Nanocrystal Diffraction Data"*
Roger Sunahara, University of Michigan - *"G Protein Coupled Receptor Structure Determination Enabled by Microdiffraction Technology"*
Lee Makowski, Northeastern University - *"Next Generation Solution Scattering"*
Alex McPherson, University of California, Irvine - *"The Challenge of Novel, Nanoscale Biological Samples"*
George Phillips, University of Wisconsin, Madison - *"Non-Bragg Scattering from Protein Crystals"*
Doug Rees, California Institute of Technology - *"Membrane Proteins and Membrane Potentials"*
Ilme Schlichting, Max Planck Institute, Heidelberg - *"Emerging Biological Opportunities with ERL/USR Beams"* [tentative]
John Spence, Arizona State University & Lawrence Berkeley National Laboratory - *"Nanocrystals, Injectors and Correlations for an ERL"*
Dmitri Svergun, European Molecular Biology Laboratory - *"Small-angle Scattering from Biological Solutions: potential of the ERL/USR Sources"*

Organizers:
Ed Lattman (Hauptmann-Woodward Medical Research Inst.), Mavis Agbandje-McKenna (University of Florida), Keith Moffat (University of Chicago), & Sol Gruner (Cornell University)



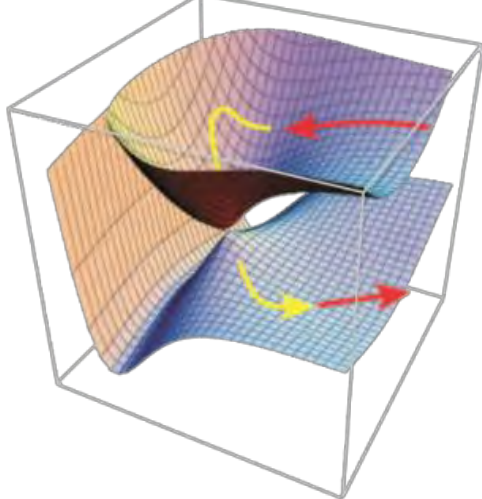
WS2

Ultra-fast Science with "Tickle and Probe"

June 20 & 21, 2011

Shin-ichi Adachi, High Energy Accelerator Research Organization, KEK - *"Toward Fourier-limited X-ray Science"*
Don Bilderback, Cornell University - *"Expected Performance of CW ERL & USR Ultra-fast Hard X-ray Sources"*
Christian Bressler, European XFEL GmbH - *"Time-resolved X-ray Spectroscopies and Scattering with One Trillion Photons"*
Edward Castner, Rutgers University - *"Rapid Chemical and Physical Processes in Solution"*
Lin Chen, Northwestern University - *"X-ray Transient Absorption Spectroscopy: a journey in past and future decades"*
Chi-Chang Kao, SLAC National Accelerator Laboratory - *"What is the 'ideal' X-ray Source?"*
Aaron Lindenberg, SLAC National Accelerator Laboratory - *"High-repetition-rate Ultrafast X-ray Experiments with Accelerator-based Sources"*
Anne Marie March, Advanced Photon Source - *"X-ray Probes of Laser-controlled Molecules in Gases and Solutions"*
David Reis, SLAC National Accelerator Laboratory - *"Time-resolved Diffuse Scattering"*
Robert Schoenlein, Lawrence Berkeley National Laboratory - *"Ultrafast X-ray Studies of Complex Materials: Science Challenges and Opportunities"*
Roseanne Sension, University of Michigan - *"Using Optical Knobs to Control Photoinitiated Reactions"*
Simone Techert, Max Planck Institute, Goettingen - *"Molecular Switches and Molecular Machines Investigated with Ultrafast Pulsed X-ray Radiation"*
Carol Thompson, Northern Illinois University - *"Ferroelectrics at the ERL"*

Organizers:
Robert Schoenlein (Lawrence Berkeley National Laboratory), Brian Stephenson (Argonne National Laboratory), Eric Dufresne (Advanced Photon Source) & Joel Brock (Cornell University)



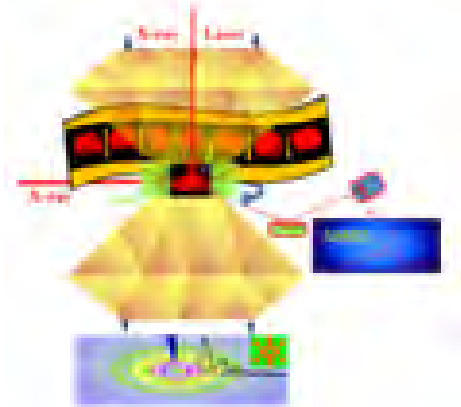
WS3

High-pressure Science at the Edge of Feasibility

June 23 & 24, 2011

Don Bilderback, Cornell University - *"Energy Recovery Linac (ERL) and Ultimate Storage Ring (USR) Properties"*
Reinhard Boehler, Carnegie Institute of Washington - *"Static and Dynamic Heating of Materials"*
Stanimir Bonev, Lawrence Livermore National Laboratory - *"Structure and Stability of Low-Z Materials at Extreme Pressure and Temperature"*
Alexander Goncharov, Carnegie Institute of Washington - *"Time-domain Measurements in Diamond Anvil Cells"*
Sol Gruner, Cornell University - *"X-ray Detectors: State-of-the-art & Future Possibilities"*
Yogendra Gupta, Washington State University - *"Dynamic Compression of Condensed Matter: Need for Time-Resolved Measurements"*
Rold Hoffmann, Cornell University - *"Solid Hydrogen Under Pressure"*
Jennifer Jackson, California Institute of Technology - *"Illuminating Earth's Core-mantle Boundary with Ultrabright X-rays"*
Malcolm McMahon, University of Edinburgh - *"Single Crystal X-ray Diffraction and IXS of Elements under Extreme Pressure"*
John Parise, Stony Brook University - *"Addressing Emergent Issues in High Pressure Research"*
Vitali Prakapenka, Advanced Photon Source - *"Dynamics of Crystallization and Melting under Pressure"*
Isaac Silvera, Harvard University - *"Hydrogen under Extreme Pressure"*
Wenge Yang, Advanced Photon Source - *"Synchrotron Techniques, X-ray Tomography and Imaging Through DAC"*
Choong-Shik Yoo, Washington State University - *"Time- and Angle-resolved X-ray Diffraction to Probe Structural and Chemical Evolutions of Single-event Phenomena"*
Yusheng Zhao, University of Nevada at Las Vegas - *"Energy Materials Research in Conversion, Storage, and Efficiency"*

Organizers: Russell J. Hemley (Carnegie Institution of Washington), Neil Ashcroft (Cornell University), Rold Hoffmann (Cornell University), John Parise (SUNY Stony Brook), & Zhongwu Wang (Cornell University)



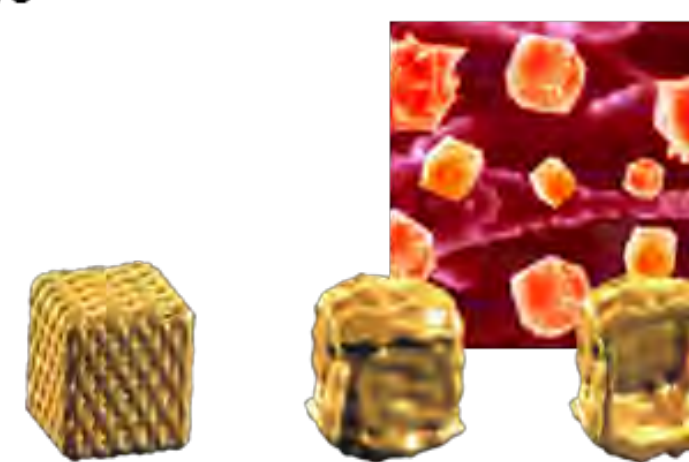
WS4

Materials Science with Coherent Nanobeams at the Edge of Feasibility

June 27 & 28, 2011

Héctor Abbruña, Cornell University - *"In-situ Probing of Fuel Cell and Battery Systems"*
Don Bilderback, Cornell University - *"Introduction to ERL & Beamline Example: fluorescence analysis at the yoctogram level"*
Simon Billinge, Columbia University - *"Nanostructure and Diffraction of Heterogeneous Materials with Nanobeams"*
David Eisenberg, University of California, Los Angeles - *"Adventures in Microcrystallography of Biological Specimens"*
Paul Evans, University of Wisconsin, Madison - *"Ultrafast Diffraction with Nanobeams: reversible and irreversible processes"*
Sol Gruner, Cornell University - *"X-ray Detectors: State-of-the-art & Future Possibilities"*
Gene Ice, Oakridge National Laboratory - *"3D Ptychography with Differential Aperture Microscopy"*
Wendy Mao, Stanford University - *"Fluorescence Tomography in a Diamond Anvil Cell"*
Jörg Maser, Advanced Photon Source - *"High Resolution Hard X-ray Microscopy at the Advanced Photon Source: current capabilities and future thrust"*
Jennifer Mass, University of Delaware - *"The Degradation Mechanisms of Matisse's and van Gogh's Pigments - Probing Photo-oxidation Reactions at the Nanoscale"*
David Muller, Cornell University - *"3D and Atomic-resolution Imaging with Coherent Electron Nanobeams - Opportunities and Challenges for X-rays"*
Mark Pfeiffer, Cornell University - *"Coherent Diffraction Imaging with Nano- and Microbeams"*
Harald Reichert, European Synchrotron Radiation Facility - *"High-Energy Scattering with Micro- and Nanobeams"*
Christian Riekkel, European Synchrotron Radiation Facility - *"Contact-free Manipulation and Probing of Single Biological and Soft Matter Objects"*
Stephan Roth, Deutsches Elektronen-Synchrotron - *"GISAXS: Development and applications using nanobeams, microbeams and tomography"*
Christian Schroer, Technical University Dresden - *"Hard X-ray Scanning Nanoprobe: coherent nanobeam optics limits; refractive lenses"*
Laszlo Vincze, Ghent University - *"3D X-ray Fluorescence Tomography with Nanoscale Resolution on Cosmic Dust"*
Stefan Vogt, Advanced Photon Source - *"X-ray Fluorescence Microscopy Biology and Bionanotechnology: Challenges and Unique Opportunities"*

Organizers: Christian Riekkel (European Synchrotron Radiation Facility), Simon Billinge (Columbia University), Kenneth Evans-Lutterodt (Brookhaven National Laboratory), & Detlef Smlgies (Cornell University)



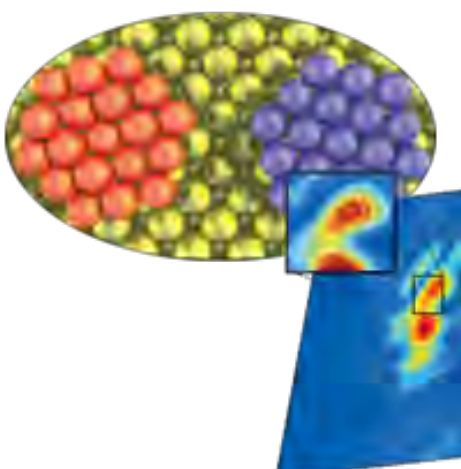
WS5

Frontier Science with X-ray Correlation Spectroscopies using Continuous Sources

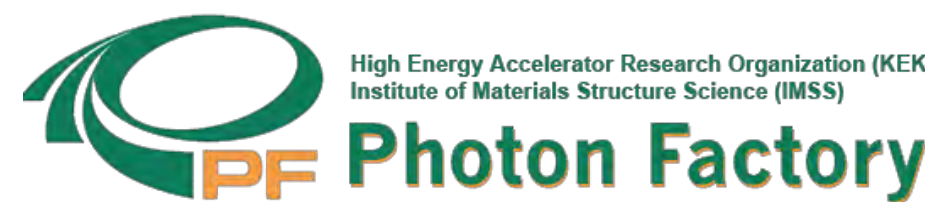
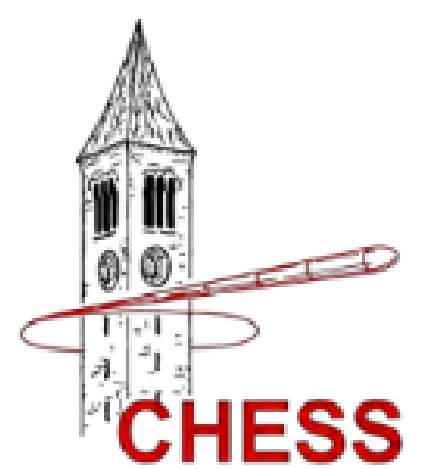
June 29 & 30, 2011

Don Bilderback, Cornell University - *"Energy Recovery Linac (ERL) and Ultimate Storage Ring (USR) Properties"*
Wes Burghardt, Northwestern University - *"XPCS During Shear"*
Andrei Fluerașu, National Synchrotron Light Source II - *"Dynamics in Soft-matter and Biological Systems: Trends and Opportunities at NSLS-II"*
Sol Gruner, Cornell University - *"X-ray Detectors: State-of-the-art & Future Possibilities"*
Christian Gutt, Deutsches Elektronen-Synchrotron - *"X-ray Cross Correlation Analysis (XCCA) and Bond-order in Liquid and Glasses"*
Stephen Kevan, University of Oregon - *"Probing Magnetic Complexity with Coherent Soft X-ray Beams"*
Karl Ludwig, Boston University - *"Martensitic Transitions & Opportunities in Non-equilibrium Physics"*
Larry Lurio, Northern Illinois University - *"Dynamics at Liquid and Soft-Matter Interfaces"*
Simon Mochrie, Yale University - *"Biophysics and Soft Matter"*
Michael Pierce, Advanced Photon Source - *"XPCS on Surfaces: Challenges and Opportunities"*
Maikel Rheinstädter, McMaster University - *"Nanobiology: Membranes and Proteins in Motion"*
Alec Sandy, Advanced Photon Source - *"Scientific Trends and Opportunities from the Perspective of 8-ID"*
Bogdan Sepiol, University of Vienna - *"Nanoscale Dynamics, Atomic Diffusion"*
Yuya Shinohara, University of Tokyo - *"Dynamics in Nanocomposite and Opportunities at Japanese Future Light Source"*
Michael Sprung, Deutsches Elektronen-Synchrotron - *"Scientific Trends and Opportunities: P10 @ PETRA III"*
Mark Sutton, McGill University - *"New Opportunities for XPCS"*

Organizers: Mark Sutton (McGill University), Simon Mochrie (Yale University), & Arthur Woll (Cornell University)



WS6



A series of six (6) workshops exploring the scientific potential of a continuous-duty, coherent (fully diffraction-limited), hard ($\lambda \leq 1.5 \text{ \AA}$) synchrotron x-ray source were held on the Cornell University Campus in June 2011. A continuous-duty source (also known as a continuous wave or "CW" source) is one that delivers x-rays in a continuous train of pulses at rates exceeding a million per second.

CW, diffraction-limited, hard x-ray sources will be especially advantageous for a variety of coherent and nanobeam experiments including: (i) cases where the sample must be repetitively probed; (ii) cases where the samples are unique and the requisite scattering information cannot be obtained with a single pulse; and, (iii) cases such as spectroscopy where incident beam stability is paramount. Potential future synchrotron x-ray source technologies meeting these constraints include ultimate storage rings (USRs), energy recovery LINACS (ERLs), high-repetition-rate, x-ray free-electron lasers (X-FELs), and x-ray free-electron laser oscillators (X-FELOs).

The modest coherent x-ray flux currently available at partially-coherent 3rd generation synchrotron sources has enabled the development of exciting new experimental techniques such as X-ray Photon Correlation Spectroscopy (XPCS) and Coherent Diffraction Imaging (CDI). However, full utilization of these and other novel techniques awaits the deployment of more advanced hard x-ray sources with orders of magnitude more coherent flux. Fully coherent hard x-ray sources promise to enable revolutionary new techniques for examining non-crystalline and time evolving systems on atomic length scales.

See: <http://www.chess.cornell.edu> or http://erl.chess.cornell.edu/gatherings/2011_Workshops/index.htm

For more information contact Kathy Dedrick, User Administrator – 607-255-0920



Local scientific organizing committee:

Ivan Bazarov, Don Bilderback, Joel Brock, Darren Dale, Bruce Dunham, Ken Finkelstein, Ernie Fontes, Sol Gruner, Georg Hoffstaetter, Alex Kazimirov, Matthias Liepe, Mark Pfeiffer, Peter Revesz, Detlef Smlgies, Maury Tigner, Zhongwu Wang, & Arthur Woll

Local organizing committee:

Kathy Dedrick & Laura Houghton

WS1



Anne Watson, North Carolina State University
Zack DiSantis, University of Rochester
Edwin Fohtung, University of California at San Diego



WS2



Nadia Zatsepin, Imran Khan, Michael Heyman, Charlezetta Wilson, Shya Biswas

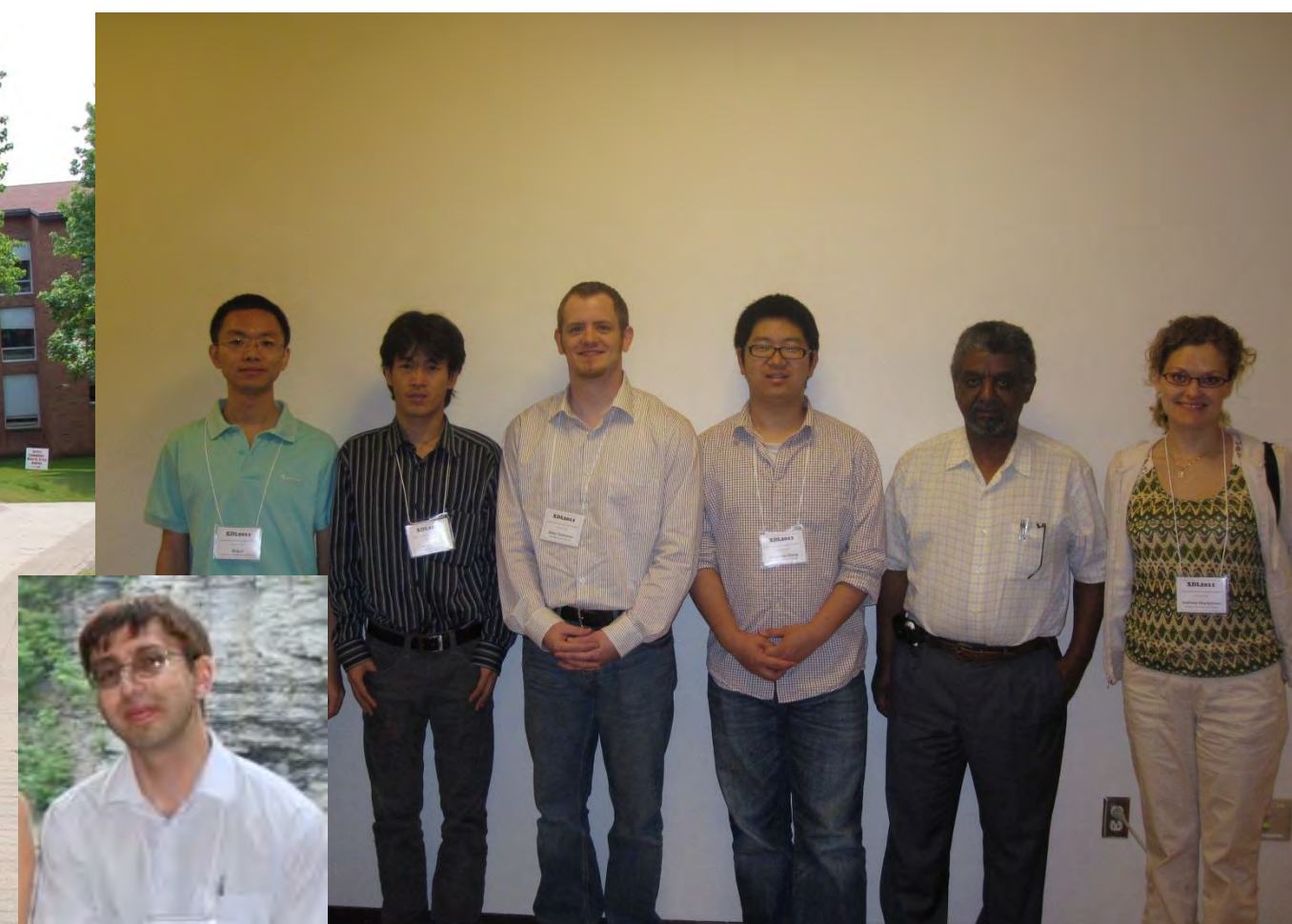
WS3



Megan Shelby, Michael Mara



WS4



Kirill Zhuravlev, Bing Li, Junyue Wang, Dane Tomasino, Dongzhao Zhang, GuebreTessema, Svetlana Khrlamova

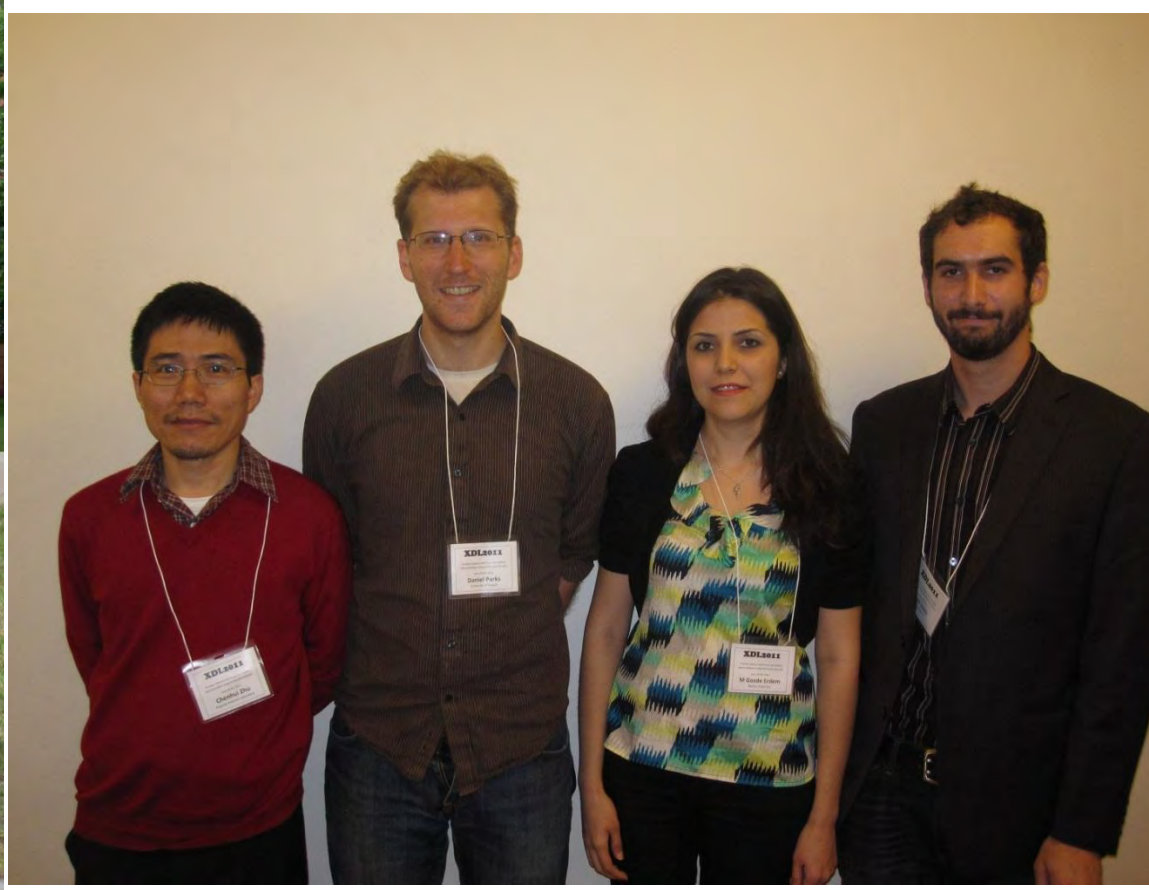
WS5



Nyssa Crompton and Si Chen



WS6



Chenhui Zhu, Dan Parks, Gozde Erdem, Jake Davis