

# Dante Quirinale

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## Research Interests

*In situ* studies of the solidification of structural materials, structural and thermophysical property measurement, and novel ordering in liquids. Design and construction of non-conventional high temperature instrumentation and integration with scattering methods. Specialization in the development and operation of unique levitation systems for neutron scattering to enable experiments at high temperatures or in phase spaces that would be otherwise impossible to access.

## Education

**2010-2017** Ph.D, Condensed Matter Physics - Iowa State University

"Structural and magnetic properties of metastable phases and undercooled liquids in  $\text{Fe}_{83}\text{B}_{17}$ "  
*Electrostatic Levitation, X-ray and Neutron Scattering, High Temperature Instrumentation*

**2006-2010** B.S., Physics, Minor in Mathematics - SUNY Buffalo

## Professional Experience

**Nov 2019 -** Oak Ridge National Laboratory

**Present** *High Temperature Development Scientist*

Development and operational support of high temperature instrumentation and research programs in the Neutron Sciences Directorate:

- Design, construction, and testing of new Creep Electrostatic Levitation system for first-in-the-world contactless in situ creep measurements of ultra-high temperature systems.
- Maintenance, upgrades, and support of existing levitation suite; continued development of containerless processing capabilities both in-house and with university collaborators
- Development of new high temperature furnace instrumentation with internal and external partners, including novel heating techniques and temperature measurement paradigms
- Operational support of high temperature experiments and proposal preparation as part of the user program
- Authoring and co-authoring of funding proposals
- Development of improved safety guidelines and participation in safety review processes
- Participation in Second Target Station activities; involvement in the CHES and TITAN proposal process; continued participation in CHES advisory board and sample environment working group

**Jul 2017** - Oak Ridge National Laboratory

**Nov 2019** *Postdoctoral Research Associate*

Postdoctoral appointment to oversee the Neutron Electrostatic Levitator (NESL) program. As part of this appointment I:

- Performed an overhaul of NESL, including designing new optical pathways, vacuum components, simplified electronics, and unique automation algorithms. Worked in close coordination with craft and technical staff.
- Drove and oversaw the integration of NESL with the Cold Neutron Chopper Spectrometer to enable unique quasi-elastic scattering measurements.
- Led and assisted in the preparation and execution of many beamtime proposals.
- Subcontracted on development of Aero-Acoustic levitator for ultra-high temperature neutron scattering experiments for the NOMAD beamline.

**Jun 2011** - Iowa State University

**Jul 2017** *Graduate Research Assistant*

Advisors: Alan Goldman and Andreas Kreyssig

Performed doctoral research in the Iowa State Electrostatic Levitation lab (ISU-ESL). From Fall 2014, functioned as the sole dedicated researcher in the lab. Activities included:

- Studies of high temperature metastable phases and the liquid structure of Fe-B and Fe-C via the thermophysical capabilities of the ISU-ESL, a prototype tunnel-diode oscillator instrument, and multiple scattering experiments at the Advanced Photon Source (APS) at Argonne National Laboratory and the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory. Additional systems studied included undercooled liquid semiconductors, metastable phases in zirconium-based glass-forming systems, and novel potential glass forming systems.
- Analysis of structural data, including identification of unknown phases, extensive use of rietveld refinement, the internal development of techniques specific to solidification studies of levitated samples, and PDF and reverse monte-carlo studies on scattering data obtained on liquids
- Mentoring and managing undergraduate research assistants on projects in software and hardware development, and training them in lab procedures

**Aug 2010** - Iowa State University

**Jun 2012** *Graduate Teaching Assistant*

Taught recitations and lab courses for undergraduates, including Physics 111: General Physics, Physics 221: Introduction to Classical Physics I, and Physics 222: Introduction to Classical Physics II. Designed group work, graded homework, planned review sessions, and tutored one-on-one in the help room environment.

**May 2008-** State University of New York at Buffalo

**May 2010** *Undergraduate Research Assistant*

Advisor: Athos Petrou

Spectroscopic studies of spintronic devices, including InAs and GaAs quantum wells. Work included cryogenic liquids, high-field superconducting magnets, and sample mounting.

## Selected Publications

- Haberl, B., **Quirinale, D. G.**, Li, C. W., Granroth, G. E., Nojiri, H., Donnelly, M. E., ... & Winn, B. L. "Multi-extreme conditions at the Second Target Station", *Review of Scientific Instruments*, 93(8), 083907. (2022)
- Sala, G., Mourigal, M., Boone, C., Butch, N. P., Christianson, A. D., Delaire, O., ... & Stone, M. B. "CHESS: The future direct geometry spectrometer at the second target station", *Review of Scientific Instruments*, 93(6), 065109. (2022)
- Ushakov, S. V., Niessen, J., **Quirinale, D. G.**, Prieler, R., Navrotsky, A., & Telle, R. "Measurements of Density of Liquid Oxides with an Aero-Acoustic Levitator", *Materials*, 14(4), 822. (2021)
- Dai, R., Neufeind, J. C., **Quirinale, D. G.**, & Kelton, K. F. "X-ray and neutron scattering measurements of ordering in a Cu<sub>46</sub>Zr<sub>54</sub> liquid", *The Journal of chemical physics*, 152(16), 164503. (2020)
- Ashcraft, R.A., Wang, Z., Abernathy, D., **Quirinale, D.G.**, Egami, T., & Kelton, K.F., "Experimental measurements of the time-dependent Van Hove function in a Zr<sub>80</sub>Pt<sub>20</sub> liquid", *Journal of Chemical Physics*, 152(7), 074506. (2020)
- **Quirinale, D.G.**, Messina, D., Rustan, G. E., Kreyssig, A., Prozorov, R., & Goldman, A. I., "In situ Investigation of Magnetism in Metastable Phases of Levitated Fe<sub>83</sub>B<sub>17</sub> During Solidification," *Physical Review Applied*, 8(5), 054046, (2017)
- **Quirinale, D. G.**, Rustan, G. E., Kreyssig, A., Lapidus, S. H., Kramer, M. J., & Goldman, A. I., "The solidification products of levitated Fe<sub>83</sub>B<sub>17</sub> studied by high-energy x-ray diffraction," *Journal of Applied Physics*, 120(17), 175104, (2016)
- Johnson, M.L., Blodgett, M.E., Lokshin, K.A., Mauro, N.A., Neufeind, J., Pueblo, C., **Quirinale, D.G.**, Vogt, A.J., Egami, T., Goldman, A.I. and Kelton, K.F., "Measurements of structural and chemical order in Zr<sub>80</sub>Pt<sub>20</sub> and Zr<sub>77</sub>Rh<sub>23</sub> liquids.", *Physical Review B* 93(5):054203 (2016)
- Mauro, N.A., Vogt, A.J., Derendorf, K.S., Johnson, M.L., Rustan, G.E., **Quirinale, D.G.**, Kreyssig, A., Lokshin, K.A., Neufeind, J.C., An, K. and Wang, X.L., "Electrostatic levitation facility optimized for neutron diffraction studies of high temperature liquids at a spallation neutron source", *Review of Scientific Instruments*, 87(1):013904. (2016)
- **Quirinale, D. G.**, G. E. Rustan, A. Kreyssig, and A. I. Goldman. "Synergistic stabilization of metastable Fe<sub>23</sub>B<sub>6</sub> and -Fe in undercooled Fe<sub>83</sub>B<sub>17</sub>." *Applied Physics Letters* 106(24):241906, (2015)
- **Quirinale, D. G.**, G. E. Rustan, S. R. Wilson, M. J. Kramer, A. I. Goldman, and M. I. Mendeleev. "Appearance of metastable B2 phase during solidification of Ni<sub>50</sub>Zr<sub>50</sub> alloy: electrostatic levitation and molecular dynamics simulation studies." *Journal of Physics: Condensed Matter* 27(8): 085004 (2015)
- Anand, V.K., **Quirinale, D.G.**, Lee, Y., Harmon, B.N., Furukawa, Y., Oglolichiev, V.V., Huq, A., Abernathy, D.L., Stephens, P.W., McQueeney, R.J. and Kreyssig, A., "Crystallography and physical properties of BaCo<sub>2</sub>As<sub>2</sub>, Ba<sub>0.94</sub>K<sub>0.06</sub>Co<sub>2</sub>As<sub>2</sub>, and Ba<sub>0.78</sub>K<sub>0.22</sub>Co<sub>2</sub>As<sub>2</sub>", *Physical Review B*, 90(6), p.064517. (2014)
- Pandey, A., **Quirinale, D.G.**, Jayasekara, W., Sapkota, A., Kim, M.G., Dhaka, R.S., Lee, Y., Heitmann, T.W., Stephens, P.W., Oglolichiev, V. and Kreyssig, A., "Crystallographic, electronic, thermal, and magnetic properties of single-crystal SrCo<sub>2</sub>As<sub>2</sub>", *Physical Review B*, 88(1), p.014526. (2013)
- **Quirinale, D.G.**, Anand, V.K., Kim, M.G., Pandey, A., Huq, A., Stephens, P.W., Heitmann, T.W., Kreyssig, A., McQueeney, R.J., Johnston, D.C. and Goldman, A.I., "Crystal and magnetic structure of CaCo<sub>1.86</sub>As<sub>2</sub> studied by x-ray and neutron diffraction." *Physical Review B*, 88(17), p.174420. (2013)
- Xie, W., Thimmaiah, S., Lamsal, J., Liu, J., Heitmann, T.W., **Quirinale, D.G.**, Goldman, A.I., Pecharsky, V. and Miller, G.J., "-Mn-Type Co<sub>8+x</sub>Zn<sub>12x</sub> as a Defect Cubic Laves Phase: Site Preferences, Magnetism, and Electronic Structure", *Inorganic chemistry*, 52(16), pp.9399-9408. (2013)

## Presentations

- **Invited Lecture** Quirinale, D.G., "Thinking Outside the Crucible: Containerless processing for Materials Science and Condensed Matter Physics", UTK 2022
- **Talk** Quirinale, D.G. "Non-contact Mechanical Testing: The Creep Electrostatic Levitator (CrESL) for Neutron Scattering", IMAT 2021
- **Poster** Quirinale, D.G. "Ultra-high Temperature neutron Scattering at Oak Ridge National Laboratory", ACNS 2020
- **Talk**, Quirinale, D.G. "Levitation Furnaces for Neutron Scattering at ORNL", ISSE 2020
- **Lightning Talk**, Quirinale, D.G. "High Temperature Levitation Furnaces in the Neutron Sciences Directorate", ORPA 2019
- **Poster** Quirinale, D.G., Mills, R.A., Everett, S.M., Lynn, G.W. "Levitation Furnaces for Neutron Scattering at ORNL", SNS-HFIR User Group meeting, 2019
- **Talk** Quirinale, D.G. "Progress in Neutron Scattering with the Electrostatic Levitator at the Spallation Neutron Source," MRS 2018
- **Talk** Quirinale, D.G. "Electrostatic Levitation of High Temperature Materials at the SNS", ORPA 2018
- **Poster Presentation:** Quirinale, D.G., Kreyssig, A, Goldman, A.I., Kramer, M.J., Mendelev, M.I., "The B2-B33 transition during the solidification of Ni-Zr". NESL User Workshop, August 2016, Oak Ridge National Laboratory
- **Invited Talk:** Quirinale, D.G., Rustan, G.E., Kreyssig, A, Goldman, A.I., "Structural and Magnetic Studies of Metastable Phase Formation in Levitated Fe<sub>83</sub>B<sub>17</sub>", NESL User Workshop, August 2016, Oak Ridge National Laboratory
- **Poster Presentation:** Quirinale, D.G., Goldman, A.I., Kramer, M.J., Mendelev, M.I., "High-Energy X-ray Diffraction Studies on Ni-Zr Using Electrostatic Levitation", TMS 2015

## Misc. Research Skills

- System integration, from conceptual design through manufacturing, assembly, and programming
- Expertise with electrostatic and aerodynamic levitators, particularly for scattering environments.
- Rietveld refinement and quantitative phase analysis.
- Reverse Monte Carlo simulations
- Design, maintenance, and operation of high-vacuum systems. Experience with the operation of high voltage systems. Experience with high powered lasers and laser optics. Experience with the basic design of neutron optics.
- Competency in Matlab/Simulink, LabVIEW, and Python programming and instrument I/O
- Hardware design with Solidworks and CREO Parametric
- Time-critical troubleshooting of hardware and software during beamline experiments

## Awards

- Outstanding First-Year Teaching Award (2011)
- Outstanding Graduate Teaching Award (2012)
- Richard G. Patrick Award; Outstanding Teaching Assistant (2012)
- People's choice award, Oak Ridge Postdoctoral Research Association Lightning Talks (2019)

## References

**Name** Alan Ira Goldman  
**Company** Iowa State University  
Ames Laboratory, Division of Materials Science & Engineering  
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