
Erik Brekke

Associate Professor of Physics
St. Norbert College

Contact

920-403-3189 Erik.Brekke@snc.edu

Curriculum Vitae

Education	
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Ph.D. Physics	University of Wisconsin - Madison (2009): Atomic, Molecular, and Optical Physics Thesis: "Stimulated Emission Studies of Ultracold Rydberg Atoms"
M.A. Physics	University of Wisconsin - Madison (2005)
B.A. Physics	Gustavus Adolphus College (2003)

Experience	
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St. Norbert College Associate Professor of Physics Courses taught: <ul style="list-style-type: none">• PHYS 100 - Physics in the Arts• PHYS 111 - Fundamentals of Physics I• PHYS 112 - Fundamentals of Physics II• PHYS 121 - General Physics I• PHYS 122 - General Physics II• PHYS 211 - Classical Mechanics• PHYS 241 - Modern Physics• PHYS 250 - Advanced Laboratory• PHYS 311 - Thermodynamics• PHYS 321 - Electricity and Magnetism• PHYS 352 - Optics and Atomic Physics	2011 - Present
Wheaton College Visiting Assistant Professor of Physics	2009 - 2011
University of Wisconsin - Madison Teaching/Research Assistant	2003 - 2009

Teaching Philosophy:

Learning is best accomplished by doing, rather than watching, and so my classes emphasize active learning techniques. Working in small groups to solve problems helps students understand physics, and additionally helps them develop collaborative problem solving skills essential in so many contexts. I enjoy making use of whatever tools and techniques are available to help students develop problem solving, experimental method, and critical thinking skills. My teaching philosophy has grown through being a part of St. Norbert College, to not only to include acquiring physics knowledge, but aim more broadly at fostering intellectual, spiritual, and personal development. Impactful learning comes through meaningful relationships, and I love having the opportunity to know and grow with my students.

Research Focus and Current Projects

The main focus of my research is on atom-light interactions using frequency narrowed diode lasers and rubidium atoms. Currently we are exploring the nonlinear optical process of parametric four-wave mixing, where coherent 420 nm light is generated from a single high power 778 nm laser in Rb vapor. This light is of particular interest to me in relation to my research on two-photon excitation of rubidium atoms to Rydberg states, of interest for their properties for use in quantum computation. I also enjoy developing new techniques for the generation of narrow, high power laser sources. My lab provides an excellent opportunity for undergraduate students to be centrally involved in research projects, and I enjoy mentoring students during this process.

Presentations and Publications

Presentations

- “Optical cavity for enhanced parametric four-wave mixing in rubidium” S. Potier and E. Brekke, Poster Presentation: 49th Meeting of the Division of Atomic Molecular and Optical Physics, Ft. Lauderdale, FL, May 28-31, 2018.
- “Frequency Characteristics of Four-wave Mixing Generated Light” E. Brekke and E. Herman, Poster Presentation: 47th Meeting of the Division of Atomic, Molecular and Optical Physics, Providence, RI, May 20-24, 2016.
- “Generating New Coherent Light Sources through Four-Wave Mixing” E. Brekke. **Invited Talk:** UWSP Physics Colloquium Series, Nov 7, 2014.
- “Optimizing Parametric Four-Wave Mixing in Rubidium” E. Herman and E. Brekke. Poster Presentation: 45th Meeting of the Division of Atomic, Molecular and Optical Physics, Madison, WI, June 2-6, 2014.
- “Atom-Light Interaction: Generating New Coherent Light Sources” E. Brekke. **Invited Talk:** Lawrence College Colloquium Series, Jan 10, 2014.
- “Coherent Light Generation Using Four Wave Mixing” L. Alderson and E. Brekke. Poster Presentation: 44th Meeting of the Division of Atomic, Molecular and Optical Physics, Quebec City, June 3-7, 2013.
- “Coherent Light Generation Using Four Wave Mixing” L. Alderson and E. Brekke. Poster Presentation: Cold Atoms Workshop Urbana-Champaign, IL, Nov. 3, 2012
- “Microwave Enhanced Suppression of Rydberg Excitation” E. Brekke, L. A. Hardy, T. G. Walker. Poster Presentation: 41th Meeting of the Division of Atomic, Molecular and Optical Physics, Houston, TX, May 25-29, 2010.
- “Microwave Enhanced Rydberg-Rydberg Interactions” E. Brekke, J. O. Day, and T. G. Walker. **Invited Talk:** Midwest Cold Atoms Workshop, University of Chicago, IL, Nov. 21, 2009
- “Exploring New Physics With Ultracold Rydberg Atoms” E. Brekke. **Invited Talk:** Wheaton Science Seminar Series, Nov 24, 2009
- “Four-Wave Mixing and Atom-Atom Interactions Using Rydberg Atoms” E. Brekke, J. O. Day, and T. G. Walker. Submitted Talk: Division of Atomic, Molecular and Optical Physics, Charlottesville, VA, May 19-23, 2009.
- “Coherent Light Emission From Ultracold Rydberg Atoms” E. Brekke, J. O. Day, and T. G. Walker. **Invited Talk:** Midwest Cold Atoms Workshop, Argonne National Lab, Nov. 15, 2008
- “Dynamics of Low-Density Rydberg Gases” E. Brekke, J. O. Day, and T. G. Walker. Poster Presentation: 39th Meeting of the Division of Atomic, Molecular and Optical Physics, State College, PA, May 27-31, 2008
- “Non-Degenerate Four-Wave Mixing through Rydberg States in a Magneto-Optical Trap” J. O. Day, E. Brekke, and T. G. Walker. Poster Presentation: Division of Atomic, Molecular and Optical Physics, Calgary, AB, Canada, June 5-9, 2007
- “Two Photon Excitation of Rydberg States in a Magneto-Optical Trap” J. O. Day, E. Brekke, and T. G. Walker. Poster Presentation: Midwest Cold Atoms Workshop Urbana-Champaign, IL, Oct. 15, 2005
- “Two Photon Excitation of Rydberg States in a Magneto-Optical Trap” J. O. Day, E. Brekke, and T. G. Walker. Poster Presentation: 36th Meeting of the Division of Atomic, Molecular and Optical Physics, Lincoln, NE, May 17-21, 2005

Publications

- “Optical cavity for enhanced parametric four-wave mixing in rubidium” E. Brekke and S. Potier, *Applied Optics* **56**, 46 (2017).
- “Frequency Characteristics of far-detuned parametric four-wave mixing in Rb” E. Brekke and E. Herman, *Optics Letters* **40**, 5674 (2015).
- “Observation of laser feedback using a grating spectrometer” E. Brekke and M. Schulz, *Am. J. Phys.* **83**, 616 (2015).
- “Parametric four-wave mixing using a single cw laser” E. Brekke and L. Alderson, *Optics Letters* **38**, 2147 (2013).
- “Excitation Suppression Due to Interactions Between Microwave-Dressed Rydberg Atoms” E. Brekke, J. O. Day, and T. G. Walker, *Phys. Rev. A* **86**, 033406 (2012).
- “Four-Wave Mixing in Ultracold Atoms using Intermediate Rydberg States” E. Brekke, J. O. Day, and T. G. Walker, *Phys. Rev. A* **78**, 063830 (2008).
- “Dynamics of Low-Density Ultracold Rydberg Gases” J. O. Day, E. Brekke, and T. G. Walker, *Phys. Rev. A* **77**, 052712 (2008).
- “High-Density Mesoscopic Atom Clouds in a Holographic Atom Trap” J. Sebby-Strabley, R. T. R. Newell, J. O. Day, E. Brekke, and T. G. Walker, *Phys. Rev. A* **71**, 021401(R) (2005).

Collaborative Student Presentations

- “Optical cavity for enhanced parametric four-wave mixing” **A. Puyleart** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 20, 2018.
- “Designing a multi-laser diffraction setup” **T. Bennet** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 20, 2018.
- “Determining Laser Frequency using a Grating Spectrometer” **C. Mahon** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 21, 2017.
- “Investigation of Laser Frequency using Lock-in Amplification” **G. Schwantes, J. Zeilinski**, and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 21, 2017.
- “Optical Cavity for Enhanced Parametric Four-wave Mixing in Rubidium” **S. Potier** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 21, 2017.
- “Ring Cavity for Optimization of Four-wave Mixing” **S. Potier** and E. Brekke. Contributed Talk: Society of Physics Students Regional Conference, UW-Platteville, Nov 4th, 2016.
- “Increasing Circulating Laser Intensity by Utilizing a Ring Optical Cavity” **S. Potier** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 22, 2016.
- “Increasing laser efficiency through exploration of optical pumping and cell size” **G. Schwantes, J. Zielinski, Q. Van Oudenhoven** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 22, 2016.
- “Determining Atomic Temperatures Using Laser Absorption” **G. Schwantes** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, March 31, 2015.
- “Observation of Laser Feedback Using a Grating Spectrometer” **M. Schulz** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 1, 2014.
- “Optimizing Parametric Four-Wave Mixing in Rubidium” **E. Herman** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 1, 2014.
- “Coherent Light Generation Using Four Wave Mixing” **L. Alderson** and E. Brekke. Poster Presentation: National Conference for Undergraduate Research, La Crosse, WI, April 11-13, 2013.
- “Controlling Laser Frequencies with Atomic Transitions” **J. DesChane** and E. Brekke. Poster Presentation: St. Norbert Undergraduate Research Forum, April 3, 2012.
- “Using Flames to Visualize Sound Waves” **J. DesChane, J. LaJeunesse** and E. Brekke. Poster Presentation: SNC Undergraduate Research Forum, April 3, 2012.

Ongoing Service and Advising

Research Advisor	Advisor to undergraduate students working on atomic and optical physics experiments (June 2010-present)
Physics Demonstrations	Led physics demonstration shows for elementary age students, approximately four times per year (2009-present)
SPS Advisor	Advisor to the student organization "Society of Physics Students". (2011-present)
Home Sweet Home Driver	Volunteer coordinator and truck driver for Home Sweet Home, providing furnishings and support for those escaping homelessness.. (2016-present)
Soccer Coach	Soccer coach for De Pere recreational teams (2012-present)

Grants and Honors

- Applied for Claire Boothe Luce Grant to support student fellowships for women in the natural sciences (2017)
- Grant for Jonathan F. Reichert Foundation to fund enhancing the advanced lab curriculum, successful for \$1,900 (2017)
- St. Norbert Summer Curricular Development Grant (2017)
- Writing Across the Curriculum Course Design Fellowship (2016)
- Kresge Grant for Student Summer research (2016)
- St. Norbert Faculty Development Grant (2016)
- St. Norbert Summer Research Grant (2016)
- Collaborative Student-Faculty Research Grants (Spring 2016, Fall 2016)
- DLI Course Redesign Grant Fellow (2015-2016)
- St. Norbert Summer Research Grant (2015)
- **Faculty Fellow for Academic Service Learning (2014-15)**
- St. Norbert Faculty Development Grant (2014)
- **Instructional Technology Mini-Grant (2013)**
- St. Norbert Faculty Development Grant (2013)
- St. Norbert Summer Curricular Development Grant (2013)
- St. Norbert Summer Research Grant (2012)
- Wheaton College Faculty Development Grant (2010)
- UW Madison TA Teaching Excellence (2003 and 2004)
- Norelius Scholarship for community service (1999-2003)
- John Borneman Prize for excellence in physics and mathematics (2002)
- Milward Rodine Award for physics achievement (2002)
- Phi Beta Kappa Society (Inducted 2002)

Committee Service at St. Norbert College

Library Advisory Committee	Elected to serve as advisor to Library programming, resources and vision (2012-14)
Faculty Welcoming Committee	Elected to serve incoming faculty through organizing gatherings and moving assistance. (2012-15)
Technology Advisory Committee	Appointed to advise ITS regarding technology changes and vision. (2012-16)
Sexual Misconduct Review Board	Appointed to serve as a review board member for student cases involving sexual misconduct on campus. (2014-present)
Faculty Vocation Seminar Leader	Appointed to lead two year-long faculty seminar groups on vocation (2014-16)
Faculty Advisory Council	Elected to serve to help give direction and organization to upcoming faculty issues and meetings. (2015-2017) Elected chair by committee members in 2016.
Board of Trustee Mission and Heritage	Elected to represent the faculty at the Board of Trustees Mission and Heritage Committee (2016-2018)
Academic Service Learning Committee	Appointed to serve to give insight and feedback on the colleges community engagement and academic service learning programming. (2018-present)

St. Norbert and Community Presentations and Leadership

- Panel Member and planner for Nobertine Pedagogy workshop (2017)
- Community talk at Fox River Tours "Astronomy and the History of the Universe" (August 2017)
- Alumni College "Observing Gravitational Waves" session (April 2017)
- Agape Latte talk "Connecting Faith: Fitting Life Together" (Feb 2017)
- SNC Day "Fun with Physics" session (Sept 2014, 2015, 2016, 2017)
- Alumni College "Physics and Photography" session (April 2013 and April 2016)
- Honors Program Tutorial on "Vocation: Leading a Life that Matters" (Spring 2016)
- Panelist for SNC Teaching and Learning Workshop "Improving Learning with Community Engagement: Three Models" (April 2016)
- Invited talk at De Pere High School STEM Day "Gravitational Waves" (March 2016)
- Panelist for SNC Teaching and Learning Workshop "Collaborative Teaching" (February 2016)
- Co-Led Faith Learning and Vocation faculty community (2014-2015 and 2015-2016)
- "Personally Speaking" Article in SNC Magazine Fall/Winter edition 2015
- Presented on "Classroom Response Systems" for the T3 Conference (June 2015)
- Invited Talk for Math Colloquium Series "Making Lasers" (March 2015)
- Panelist for students questions on "Faith, Physics and Philosophy" (February 2015)
- Honors Program Tutorial on "Science and Faith" (Fall 2014 & Spring 2015)
- Catholic Intellectual Tradition Presentation on "Physics and Communion" (February 2014), Published in the COMMUNICATOR XXXI: 2 (June 2014), 20 – 30.
- Community Presentation on Physics and Belief (Bay Covenant Church, April 2014)
- Led Sacred Hour small group "Science and Faith" (2013-2014)
- SNC Day "Physics and Photography" session (Sept 2013)
- Community Presentation on Science and Faith (Faith Chapel, April 2013)
- Lead Physics Career Day for students (October 2011)