

# Dr. Katrina Hay

Associate Professor of Physics  
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## EDUCATION

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- Ph.D. Physics, Emphasis on Fluid Physics** **June 2008**  
Oregon State University, Corvallis, OR  
Dissertation: *Physical processes that control droplet transport in rock fracture systems.*  
Advisor: Dr. Maria Dragila
- Bachelor of Science, Majors: Physics, Mathematics** **June 2002**  
Linfield College, McMinnville, OR  
Computational Undergraduate Research Thesis: *Simulations of Relativistic Heavy Ion Collisions.*  
Advisor: Dr. Joelle Murray

## PROFESSIONAL EXPERIENCE

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- Associate Professor of Physics:** Pacific Lutheran University, Tacoma, WA **2013 – present**  
**Assistant Professor of Physics:** Pacific Lutheran University, Tacoma, WA **2008 – 2013**
- Research-based interactive teaching in advanced and introductory physics and engineering courses, including a study-away sustainable energy physics course.
  - Advise physics and dual-degree engineering students, liaison (2018-2020) to engineering affiliate universities. Personalized letters of recommendation.
  - Conduct independent research and mentor undergraduate student research in fluid physics, astronomy, and physics education research.
  - Service to department, campus, physics profession, and community.
- Summer Faculty:** Holden Village, Lake Chelan, WA **Summer 2017**
- Lead a physics series of guest lectures on energy, sustainability, and astronomy to participants of all ages at this village retreat.
  - Co-lead a worship service.
- Online Physics Quiz Author:** W.H. Freeman and Company Publishers **2012**
- Authored 560 multiple choice questions with answer-specific feedback to accompany physics textbook, "University Physics for Life Sciences."
- Research Assistant:** Oregon State University Crop and Soil Science Department, Corvallis, OR **2005-2008**
- Experimental investigation of fluid transport in fractures to develop a theoretical transport equation.
  - Additional graduate courses in fluid instabilities, pore-scale fluid physics. Substitute taught for undergraduate course in soil physics.

- Research Experience for Undergraduates Mentor:** Oregon State University Crop and Soil Science Department, Corvallis, OR **2007**
- Designed fluid physics research project and guided an undergraduate through a summer experimental research experience.
  - Evaluated student's work for submission as an undergraduate physics senior thesis and co-authored presentation at American Geophysical Union national conference.
- Mentor Teacher:** Oregon State University Physics Department, Corvallis, OR **2006-2007**
- Worked closely with physics instructors organizing course, planning lectures, demonstrations and tests for Introductory Physics course and Astronomy course.
- Science Intern:** NASA Jet Propulsion Laboratory, Pasadena, CA **2005**
- Timeline development for the Dawn mission spacecraft in its approach and orbit around asteroid Vesta, using spacecraft-specific computer software.
  - Participated in weekly meetings with the Dawn Spacecraft Science Team.
- Teaching Assistant:** Oregon State University Physics Department, Corvallis, OR **2002-2005**
- Recitation and Lab instruction for Introductory Physics with Calculus, Astronomy, Paradigms of Physics (year-long junior level course).
- Geophysics Research Assistant:** Oregon State University Geophysics Department, Corvallis, OR **2004**
- Calibrated raw thermal data from the MBARI (Monterey Bay Aquarium Research Institute) June 2000 cruise, developed and analyzed thermal profiles of Southern Hydrate Ridge (off the Oregon coast).
- Adventures in Learning Teacher:** Oregon State University, Corvallis, OR **2004**
- Taught Rollercoaster Physics and Astronomy courses (daily, two weeks each) to middle school students.
- Optics Research Assistant:** Oregon State University Physics Department, Corvallis, OR **2003-2004**
- Instrumentation assistance and repair of hardware in Argon Ion Laser
- Nuclear Physics Research Intern:** Linfield College Physics Department, McMinnville, OR **2001-2002**
- Revised and wrote computer programs to simulate heavy ion collisions and compare to data from Au-Au collisions at Relativistic Heavy Ion Collider (RHIC) in Brookhaven, New York.
  - Oral Presentation of Senior Thesis at 2001 Murdock Science Conference.
- Astronomy Research Intern:** Pacific Northwest National Laboratory (PNNL), Richland, WA **Summer 2000**
- Repaired Rattlesnake Mountain Observatory telescope instrumentation to improve tracking for telescope automation.
  - Captured astrophotographs, created an educational webpage on sun spots, led public tours of observatory.
- Teaching Assistant and Academic Peer Advisor:** Linfield College Physics Department, McMinnville, OR **2000-2002**
- Bi-weekly tutor for undergraduate physics students
  - Graded Introductory Physics assignments
  - Co-taught, with faculty advisor, an academic orientation semester class to first year students interested in physics.
  - Guided 20 students each year through a college orientation and advised them individually throughout their first college year.
- Resident and Apartment Advisor:** Linfield College Housing, McMinnville, OR **1999-2001**
- Created academic, social programs for residence hall students.
  - Responded to incidents and emergencies, filed reports.

## Scholarly Activity

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An asterisk \* denotes PLU undergraduate co-author.

### Refereed Publications:

- K. Hay and Z. Wiren, "Do-It-Yourself Low Cost Desktop Lightboard for Engaging Flipped Learning Videos," *The Physics Teacher*, **57**, 8 (2019). [Article was featured on the journal's cover.]
- M. Dragila, K. Hay, S. Wheatcraft, "9. Initial pipe development within epikarst microfractures", chapter in *The Geological Society of America Special Paper 516*, pp. 129-136 (2016).
- K. Hay, "Physics of Energy: A Sustainability-Themed University Travel Course" chapter in *Handbook of Research on Pedagogical Innovations for Sustainable Development IGI Global, USA*, pp. 442-453 (2014).
- M. Hubbard\* and K. Hay, "How Tongue Size and Roughness Affect Lapping," *Journal of Undergraduate Research in Physics*, **16** (2013).
- K. Hay, "Teaching the Physics of Energy while Traveling by Train" *The Physics Teacher*, **51** (2013). [Article was featured on the journal's cover.]
- K. Hay and M. Dragila, "Physics of Fluid Spreading on Roughness", *International Journal of Numerical Analysis and Modeling, Special Issue on Modeling, Analysis and Simulations of Multiscale Nonlinear Systems, Conference proceedings, Oregon State University*, **5** (2008).
- K. Hay, M. Dragila, and J. Liburdy, "A Theoretical Model for the Wetting of a Rough Surface" *Journal of Colloid and Interface Science*, **325**, 2 (2008).

### Other Publications:

- K. Hay, "Little Bear's Big Night Sky," CreateSpace Independent Publishing, North Charleston, SC, (October 2015).
- K. Hay, Online Quizzes for textbook, "University Physics for Life Science" W. H. Freeman Publisher (2012).
- K. Hay, "Physics of energy as a travel course", *EnergyTeachers.org Community Newsletter*, Ithaca, NY, February 2012.

### Mentorship of Undergraduate Research:

Jamin Perry, Pacific Lutheran University, Tacoma, WA

Spring 2021

Co-advised engineering statics bridge truss analysis for physics Capstone project.

Megan Longstaff and Justin deMattos, Pacific Lutheran University, Tacoma, WA

Summer 2018

Co-mentored, with a **grant from Murdock Charitable Trust**, summer observational astronomy research at PLU's Keck Observatory. Students delivered **three presentations: selected for oral presentation at 2018 Murdock Conference** (titled, "Observational Astronomy in Tacoma: Analyzing Jupiter's Rotation and the Brightness of Saturn's Rings." Vancouver, WA.), **Dr. Rae Linda Brown Undergraduate Research Symposium Spring 2019**, and a public presentation to **Tacoma Astronomical Society June 2019**.

<p>10 Physics Capstone Students, Pacific Lutheran University, Tacoma, WA</p> <p><i>Mentored/co-mentored 10 students' physics research projects from design to analysis-experimental, theoretical, and computational. Three projects led to <b>student-authored publications in the Journal of Undergraduate Advanced Physics Laboratory Investigation:</b></i></p> <ul style="list-style-type: none"> <li>• <i>Measuring Planck's Constant and Plotting Current-Voltage Characteristics of Spectral Lines Using the Photoelectric Effect, by Ashley Clendenen.</i></li> <li>• <i>The Michelson Interferometer as a Device for Measuring the Wavelength of a Helium-Neon Laser, authored by Carly Stauffer and Kimberley Belmes.</i></li> <li>• <i>Using a Michelson Interferometer to Measure the Index of Refraction of Air, authored by Kimberly Belmes and Carly Stauffer.</i></li> </ul>	<p><b>Spring 2018</b></p>
<p>Kimberly Belmes, Pacific Lutheran University, Tacoma, WA</p> <p><i>Co-Mentored, with a <b>grant from Murdock Charitable Trust</b>, a Summer Research Internship on Sunspot Evolution, using images captured with PLU's Keck Observatory. Student was selected for an <b>oral presentation at the 2016 Murdock Conference</b>, Gonzaga University, Spokane, WA, titled: "Sunspot Decay Rate Correlations and Temperature Ratios."</i></p>	<p><b>Summer 2016</b></p>
<p>Matthew Hubbard, Pacific Lutheran University, Tacoma, WA</p> <p><i>Mentored, with a <b>grant from Murdock Charitable Trust</b>, a Summer Research Internship on Pet Physics: Cat lapping- Current Fluid Physics Phenomenology. Invited to co-present to the <b>PLU Board of Regents</b>. Student presented "How does Tongue roughness affect Lapping?" at the <b>Student-Faculty Collaborative and Creative Projects Celebration</b>, PLU, and presented a poster at <b>Murdock Conference 2011</b>, and the <b>Northwest Section American Physical Society</b>, Vancouver, B.C., Canada (2012).</i></p>	<p><b>Summer 2011</b></p>
<p>Jacob Berman, Pacific Lutheran University, Tacoma, WA</p> <p><i>Mentored, with a <b>grant from Murdock Charitable Trust</b>, a Summer Research Internship on simulated fracture flow in environmental fluid physics. Hosted event: "Fluid Lab Open House" for PLU summer science research community. Student was selected to give <b>oral presentation at 2009 Murdock Conference</b>, Gonzaga University, Spokane, WA, titled, "A video analysis of film left behind fluid droplets in fractured rock."</i></p>	<p><b>Summer 2009</b></p>
<p>Daniel Schwartz, Oregon State University, Corvallis, OR</p> <p><i>Mentored an experimental fluid physics research project on fraction flow. Evaluated student's work for submission and acceptance as the student's physics senior thesis. Work resulted in joint <b>presentation at the American Geophysical Union Fall Meeting</b> in San Francisco, 2007.</i></p>	<p><b>Summer 2007</b></p>
<p><b>Selected Presentations and Talks:</b></p>	
<p>"Worlds Not in Collision: How Saturn's Co-orbiting Moons Avoid Hitting Each Other"</p> <p>Tacoma Astronomical Society seminar, K. Hay, and S. O'Neill</p>	<p><b>February 2023</b></p>
<p>"Don't Give Up on Pair Programming"</p> <p>American Association of Physics Teachers, National Winter Meeting on Portland, OR, K. Hay</p>	<p><b>January 2023</b></p>
<p>"Spacecraft Propulsion Systems"</p> <p>Guest lecture, International Honors course, PLU: The Natural World, Professor D. Heath</p>	<p><b>February 2022</b></p>
<p>"Theoretical and Computational Models for Saturn's Co-orbiting Moons, Janus and Epimetheus"</p> <p>American Geophysical Union (AGU) Fall Meeting (<i>virtual</i>), S. O'Neill, J. deMattos, and K. Hay</p>	<p><b>December 2021</b></p>

“Creating Study Groups that are Helpful to Students in a Virtual Physics Course,” Washington American Association of Physics Teachers (AAPT) (virtual)	<b>October 2021</b>
“Visual Model of Force on a charge in the center of a ring of N charges using VPython,” Partnership of Integration of Computation into Undergraduate Physics (PICUP) Virtual Workshop (“showcase” informal presentation)	<b>July 2021</b>
“Computer Simulations of Astronomical Phenomena,” Tacoma Astronomical Society, Public Meeting, J. deMattos, M. Longstaff, K. Hay, S. O’Neill	<b>June 2019</b>
“Our Place in the Universe: The Structure and Fabric of Space-Time,” (Invited talk) at event: Grit City Think and Drink, University of Washington, Tacoma, WA	<b>August 2018</b>
“PLU Astronomy Internship 2018” Marketing video for REU recruiting Over a thousand views on YouTube, <a href="https://youtu.be/DBgQ5PoID8Q">https://youtu.be/DBgQ5PoID8Q</a>	<b>January 2018</b>
Physics Lecture Series at Holden Village, Lake Chelan, WA 1. <i>"What is Energy? What Powers our Devices?"</i> 2. <i>"Our Energy Future: Innovations in Responsible use of Earth's Resources"</i> 3. <i>"Our Place in the Cosmos"</i> 4. <i>"Children's Storytime and discussion: Little Bear's Big Night Sky"</i>	<b>Summer 2017</b>
Guest on PLU Faculty Podcast “Open to Interpretation,” Host Amy Young, Episode titled, “Stress.”	<b>Spring 2017</b>
“LightBoard Videos for a Flipped Classroom” (Invited Talk, award recipients) K. Hay and J. Stoeber, Northwest Academic Computing Consortium (NWACC), Portland, OR.	<b>November 2016</b>
“Celestial Navigation: Wise Ones Navigate by the Stars,” Agnus Dei Lutheran Church, Gig Harbor, Washington.	<b>January 2016</b>
“Cosmology of the early universe,” and “Space and time, not what they appear to be” Guest Lecture Series, Gig Harbor Women’s Correctional Facility, Freedom Education Project	<b>Spring and Fall 2014</b>
“Capillary Droplets Embedded in a Lubricating Film: Enhancing rock-liquid solute transfer” Geoscience Association Denver, Colorado, M. Dragila and K. Hay	<b>October 2013</b>
“Erosion potential of capillary solitons in fluid transport through the epikarst” Geoscience Association Denver, Colorado, M. Dragila and K. Hay	<b>October 2013</b>
“Pre-Course Student Questions as Motivators for Class Lessons” American Association of Physics Teachers Conference, Philadelphia, PA.	<b>August 2012</b>
“Cat lapping: a fluid physics project for undergraduate students,” Beyond First Year Physics Laboratory Conference, Philadelphia, PA.	<b>July 2012</b>
“Physics of Energy by Train” American Association of Physics Teachers Conference, Omaha, NE.	<b>August 2011</b>
“Physics of Energy, A Travel Course” Pacific Northwest Association of Physics Teachers (PNACP) Conference, Moscow, ID.	<b>Spring 2011</b>
“Environmental Fluid Physics” (Invited seminar) University of Puget Sound Science Division, Tacoma, WA.	<b>November 2010</b>

- “How to Implement JITT - Just In Time Teaching” **March 2010**  
American Physical Society (APS) March Meeting, K. Hay and C. Illie
- “Improving the Force Concept Inventory” **March 2010**  
American Physical Society (APS) March Meeting, A. Chediak and K. Hay
- “Do you JITT? Benefits of using Just In Time Teaching at SUNY Oswego and Pacific Lutheran University” **May 2010**  
Conference on Instructional Technologies in Plattsburgh, NY. C. Illie and K. Hay
- “A high-speed video analysis of advancing and receding droplet interfaces in simulated rock fractures” **December 2009**  
American Geophysical Union Fall Meeting, San Francisco, CA

**Referee for:**

*The Physics Teacher*  
*Advances in Water Resources*

**Membership in Professional & National Societies**

American Association of Physics Teachers, American Geophysical Union, Tacoma Astronomical Society, Sigma Pi Sigma

**FELLOWSHIPS, AWARDS and ACHIEVEMENTS**

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- Faculty Excellence Award* in Advising, Pacific Lutheran University. **2019**
- Innovation in Instructional Technologies Award* and Grant **2016**  
Northwest Academic Computing Consortium, for “Lightboard for Flipped Learning.”
- Outstanding Student Paper* in Hydrology Section **2006**  
American Geophysical Union Fall Meeting, San Francisco, CA  
for presentation: “Physics of two-phase flow on rough surfaces.”
- Certificate of Appreciation* for work completed at the Jet Propulsion Laboratory **2005**  
Oregon Space Consortium (Annual Affiliate Meeting, Newport, OR).
- Teaching Fellowship, Oregon State University. **2002-2008**
- Sigma Pi Sigma (undergraduate physics honor society). **2002**
- Murdock Science Conference research grant for undergraduate summer internship **2001**  
Nuclear Physics with faculty mentor Dr. Joelle Murray.
- Energy Research Undergraduate Laboratory Fellowship (ERULF) **2000**  
Rattlesnake Mountain Observatory at Pacific Northwest National Lab (PNNL).
- Artistic performances, lessons, galleries, and teaching in dance, art, theater and music. **Life-Long**

**UNIVERSITY SERVICE, COMMUNITY SERVICE, and OUTREACH**

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- University Service** **2008 - Present**  
Faculty Governance: Faculty Affairs Committee 2018-2021, Faculty Joint Committee on the Reduction and Reallocation of Force 2020-2021, Academic Dishonesty Hearing Panel leader 2012, Campus Life Committee 2010-2013.

Interviewer (2018): Regent and President's Scholarship Program Interview potential students competing for top PLU scholarships.

Co-Advisor (2014-2017): Society of University Physicists (SUP)/Physics Club Provide advice and logistical support for PLU's Physics Club.

**Science Outreach and Community Service**

**1999 - Present**

"Jazz Under the Stars" summer co-host at PLU's Keck Observatory. Read my children's book about astronomy "Little Bear's Big Night Sky," as a local author at elementary schools, libraries, and churches. Present physics lectures and demonstration shows to students, local schools, camps, churches, retirement communities. Judge middle school science fair projects in Oregon and Washington.

**Advocate for Patients with Muscular Dystrophy, Parent Project Muscular Dystrophy (PPMD)**

**2021 - Present**

Team Captain in PPMD's *Race to End Duchenne* (we raised \$3,750 in our 5K race, June 2021).

*PPMD Advocacy Conference* March 8, 2022: Met with four congress members, senators and their staff to advocate for research funding, treatment, and care considerations for children and adults with this terminal genetic disease, like my nephews Liam and Kellan Hay.

**ELCA Agnus Dei Lutheran Church Volunteer, Gig Harbor, WA**

**2010 - Present**

As an elected council member 2018-2020, I made decisions regarding budget, programs, and initiatives for the congregation. Volunteer in youth group and camp lesson teacher, choir member (including performances for prisoners at Shelton Men's Prison 2010, 2011).