# Dr. Wei Guo

Professor of Mechanical Engineering

*Mechanical Engineering Department*
*FAMU-FSU College of Engineering*
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## Biographical Sketch

**Profession Preparation:**

| Institute | Major | Degree | Year |
|---|---|---|---|
| Wuhan University (Wuhan, China) | Physics | B.Sc. | 2002 |
| Brown University (Providence, USA) | Physics | Ph.D. | 2008 |
| Yale University (New Haven, USA) | Postdoctoral | | 2010 |

**Appointments:**

2023- : Professor, Mechanical Engineering Department, FAMU-FSU College of Engineering, Florida State University

2023- : Co-director of FSU Quantum Initiative, Florida State University

2018-2023: Associate Professor, Mechanical Engineering Department, FAMU-FSU College of Engineering, Florida State University

2012-2018: Assistant Professor, Mechanical Engineering Department, FAMU-FSU College of Engineering, Florida State University

2010-2012: Associate Research Scientist, Department of Physics, Yale University

2008-2010: Postdoctoral Associate, Department of Physics, Yale University

2002-2008: Research Assistant, Department of Physics, Brown University

**Honors and Awards**

- American Physical Society Fellow (2023)
- Outstanding Research Accomplishment Award from the FAMU-FSU College of Engineering (2023)
- Gordon and Betty Moore Foundation Experimental Physics Investigators Award (2022)
- JSPS Invitation Fellowships for Research in Japan (2017).
- FSU CRC Planning Grant Award, Florida State University (2015).
- FSU CRC First Year Assistant Professor Award, Florida State University (2013).
- Coline M. Makepeace Dissertation Fellowship, Brown University (2007).

**Selected Grants/Awards in Recent 5 Years:**

- Title: Tackling challenging problems in quantum and classical turbulence using liquid helium-4 (Period: 9/2022-8/2027)
  PI: W. Guo
  Agency: Gordon and Betty Moore Foundation; Amount: $1,250,000.
- Title: Liquid Helium Fluid Dynamics Studies for Accelerator Applications (Period: 7/2022-7/2025)
  PI: W. Guo, Agency: US Department of Energy; Amount: $675,000.
- Title: IZEA - Integrated Zero-Emission Aviation using a Robust Hybrid Architecture (Period: 6/2022-5/2027)
  PI: L. Cattafesta, Co-PIs: W. Guo, *et al*.; Agency: NASA; Amount: $9,986,548.
- Title: Stereoscopic visualization study of turbulence and vortex-tangle dynamics in He II (Period: 8/2021-7/2024)
  PI: W. Guo; Agency: National Science Foundation; Amount: $521,489.
- Title: Searching for Interactions of Light Dark Matter Using Zero-Field Detectors with Transition Edge Sensor Readout (Period: 6/2020-9/2024)
  PI: D. McKinsey (UC Berkeley), co-PIs: W. Guo, *et al.*; Agency: US Department of Energy; Amount: $2,700,000.
- Title: Liquid Helium Fluid Dynamics Studies (Period: 8/2019-03/2022)
  PI: Guo, W.; Agency: US Department of Energy; Amount: $600,000.
- Title: Advanced Molecular Tagging Velocimetry In Cryogenic Helium (Period: 12/2018-12/2019)
  PI: W. Guo and co-PI: L. Cattafestta, Agency: Army Research Office; Amount: $216,893.
- Flow Visualization Study of Quantum Hydrodynamics in Superfluid Helium-4 (Period: 8/2018-7/2021)
  PI: W. Guo; Agency: National Science Foundation; Amount: $335,023.
- High Reynolds Number Turbulence Research in Cryogenic Helium (Period: 6/2018-5/2021)
  PI: W. Guo and co-PI: L. Cattafestta; Agency: NSF; Amount: $375,003.

**Representative Publications:**

(a) Quantum fluid dynamics and turbulence:

- Y. Tang, W. Guo[†], H. Kobayashi, S. Yui, M. Tsubota, and T. Kanai, "Imaging quantized vortex rings in superfluid helium to evaluate quantum dissipation", Nature Communications, 14, 2941 (2023)
- S. Yui[*], Y. Tang[*], W. Guo[†], H. Kobayashi, and M. Tsubota, "Universal anomalous diffusion of quantized vortices in ultra-quantum turbulence", Phys. Rev. Lett., 129, 025301 (2022). (Selected as PRL Editor's Suggestion)
- Y. Tang, S. Bao, and W. Guo[†], "Superdiffusion of quantized vortices uncovering scaling laws in quantum turbulence", PNAS, 118, e2021957118 (2021).
- T. Kanai and W. Guo[†], "True Mechanism of Spontaneous Order from Turbulence in Two-Dimensional Superfluid Manifolds", Phys. Rev. Lett., 127, 095301 (2021).

- T. Kanai, W. Guo†, M. Tsubota, and D. Jin, "Torque and Angular Momentum Transfer in Merging Rotating Bose-Einstein Condensates", Phys. Rev. Lett., 124, 105302 (2020).
- S. Yui, H. Kobayashi, M. Tsubota, and W. Guo, "Fully coupled dynamics of the two fluids in superfluid 4He: Anomalous anisotropic velocity fluctuations in counterflow", Phys. Rev. Lett., 124, 155301 (2020).
- B. Mastracci and W. Guo†, "Characterizing vortex tangle properties in steady-state He II counterflow using particle tracking velocimetry", Phys. Rev. Fluids, 4, 023301 (2019). (Selected as Editor's Suggestions)
- Marakov, J. Gao, W. Guo†, S.W. Van Sciver, G.G. Ihas, D.N. McKinsey, and W.F. Vinen, "Visualization of the normal-fluid turbulence in counterflowing superfluid $^4$He", Phys. Rev. B 91, 094503 (2015).
- W. Guo, D.P. Lathrop, M. La Mantia, and S.W. Van Sciver, "Visualization of two-fluid flows of superfluid helium-4 at finite temperatures", PNAS, 111, 4653 (2014).
- D.E. Zmeev, F. Pakpour, P.M. Walmsley, A.I. Golov, W. Guo, D.N. McKinsey, G.G. Ihas, P.V.E. McClintock, S. N. Fisher, and W.F. Vinen, "Excimers $He_2$ as Tracers of Quantum Turbulence in $^4$He in the T=0 Limit", Phys. Rev. Lett., 110, 175303 (2013).
- W. Guo, S.B. Cahn, J.A. Nikkel, W.F. Vinen and D.N. McKinsey, "Visualization Study of Counterflow in Superfluid $^4$He using Metastable Helium Molecules", Phys. Rev. Lett., **105**, 045301 (2010). (Selected in APS Spotlighting Exceptional Research).

(b) Flow visualization technique development:

- X. Wen, S. Bao, L. McDonald, J. Pierce, G.L. Greene, L. Crow, X. Tong, A. Mezzacappa, R. Glasby, W. Guo, and M.R. Fitzsimmons, "Imaging fluorescence of $^4He_2$ excimers created by neutron capture in liquid helium II", Phys. Rev. Lett., 124, 134502 (2020). (Selected as PRL Editor's Suggestion)
- (J-PARC Collaboration) V. Sonnenschein, *et al.*, "An experimental setup for creating and imaging $^4He_2$ excimer cluster tracers in superfluid Helium-4 via neutron-$^3$He absorption reaction", Rev. Sci. Instrum., 91, 033318 (2020). (Selected as Editor's Pick).
- H. Sanavandi, S. Bao, Y. Zhang, R. Keijzer, W. Guo†, and L. N. Cattafesta III, "A cryogenic-helium pipe flow facility with unique double-line molecular tagging velocimetry capability", Rev. Sci. Instrum., 91, 053901 (2020).
- B. Mastracci and W. Guo†, "An apparatus for generation and quantitative measurement of homogeneous isotropic turbulence in He II", Rev. Sci. Instrum., 89, 015107 (2018).
- J. Gao, A. Marakov, W. Guo†, B.T. Pawlowski, S.W. Van Sciver, G.G. Ihas, D.N. McKinsey, and W.F. Vinen, "Producing and Imaging a Thin Line of $He_2$ Tracer Molecules in Helium-4", Rev. Sci. Instrum., 86, 093904 (2015).
- W. Guo, J.D. Wright, S.B. Cahn, J.A. Nikkel, and D.N. McKinsey, "Metastable

helium molecules as tracers in superfluid $^4$He", Phys. Rev. Lett., 102, 235301 (2009).

(c) Accelerator Cryogenics:

- N. Garceau, S. Bao, and W. Guo†, "Heat and mass transfer during a sudden loss of vacuum in a liquid helium cooled tube - Part III: Heat deposition in He II", Int. J. Heat Mass Tran., **181**, 121885 (2021).
- S. Bao, N. Garceau, and W. Guo†, "Heat and mass transfer during a sudden loss of vacuum in a liquid helium cooled tube - Part II: Theoretical modeling", Int. J. Heat Mass Tran., 146, 118883 (2020).
- N. Garceau, S. Bao, and W. Guo†, "Heat and mass transfer during a sudden loss of vacuum in a liquid helium cooled tube - Part I: Interpretation of experimental observations", Int. J. Heat Mass Tran., 129, 1144-1150 (2019).
- S. Bao, T. Kanai, Y. Zhang, L. N. Cattafesta III, W. Guo†, "Stereoscopic detection of hot spots in superfluid helium-4 for accelerator-cavity diagnosis", Int. J. Heat Mass Tran., **161**, 120259 (2020).
- S. Bao and W. Guo†, "Quench spot detection for superconducting accelerator cavities via flow visualization in superfluid helium-4", Phys. Rev. Applied, 11, 044003 (2019).

(d) Helium-based Dark Matter Detection:

- SPICE/HeRALD Collaboration: R. Anthony-Petersen, A. Biekert, H. Birch, T.K. Bui, C.L. Chang, Y. Chang, L. Chaplinsky,G. Cline, A. Dushkin, C.W. Fink, M. Garcia-Sciveres, G. Gilchriese, W. Guo, S.A. Hertel, et al., "Applying Superfluid Helium to Light Dark Matter Searches: Demonstration of the HeRALD Detector Concept", to appear in Phys. Rev. D, (2023). (arXiv:2307.11877)
- SPICE/HeRALD Collaboration: A. Biekert, C. Chang, C. W. Fink, M. Garcia-Sciveres, E. C. Glazer, W. Guo, *et al.*, "Scintillation yield from electronic and nuclear recoils in superfluid $^4$He", Phys. Rev. D 105, 092005 (2022).
- SPICE/HeRALD Collaboration: A. Biekert, L. Chaplinsky, C.W. Fink, M. Garcia-Sciveres, W. C. Gillis, W. Guo, *et al.*, "A backing detector for order-keV neutrons", Nucl. Instrum. Methods Phys. Res. A, **1039** 166981 (2022).
- W. Guo†, D.N. McKinsey, "Concept for A Dark Matter Detector Using Liquid Helium-4", Phys. Rev. D, 87, 115011 (2013).
- W. Guo†, M. Dufault, S.B. Cahn, J.A. Nikkel, Y. Shin and D.N. McKinsey, "Scintillation and charge extraction from the tracks of energetic electrons in superfluid helium-4", JINST, **7**, P01002 (2012).

(e) Novel devices:

- X. Zhou, G. Koolstra, X. Zhang, G. Yang, X. Han, B. Dizdar, D. Ralu, W. Guo, K. W. Murch†, D. I. Schuster, D. Jin†, "Single electrons on solid neon as a solid-state qubit platform", Nature, **605**, 46-50 (2022).
- H. Sanavandi and W. Guo†, "A magnetic levitation based low-gravity simulator with an unprecedented large functional volume", npj Microgravity, **7**, 40 (2021).

**Synergistic Activities:**

- Conducted various departmental and university service work, including: 1) ME department secretary; 2) ME Graduate Committee Chair; 3) Search committee chair and member; 4) FSU faculty senator; 5) FSU sabbatical review committee member.
- Organized a number of workshops on quantum fluid dynamics at major international conferences (i.e., Quantum Turbulence workshops at QFS19, QFS18 and at the Maglab in 2017) and served as a scientific advisory committee member for various international conferences.
- Co-organizer (with Prof. Yoonseok Lee) of the 2024 International Conference on Quantum Fluids and Solids.
- Proposal reviewer for DOE, NSF, NASA, Czech Science Foundation, German Research Foundation, United Kingdom EPSRC, and Cottrell Scholar Award.
- Paper reviewer for numerous journals, including Nature Materials, PNAS, PRL, JFM, etc.
- Served as a guest editor for 2019 Cryogenic Engineering Conference.
- Persistent contribution in outreach and educational programs such as the annual Maglab Open House and the NSF REU program.

**Supervised Students and Postdocs**

- Supervised and supported 11 PhD students.
- Supervised and supported 4 MS students.
- Supervised and supported over 30 undergraduate students and visiting students.
- Supervised and supported 8 postdoctoral researchers: Dr. S. Bao, Dr. Y. Tang, Dr. M. Vanderlaan, Dr. R. Dhuley, Dr. S. Inui, Dr. Y. Zhang, Dr. Y. Xing, Dr. Y. Qi

**Ph.D and Postdoc Supervisors:**

Ph.D. adviser: Prof. H.J. Maris, Brown University;
Postdoc advisor: Prof. D.N. McKinsey, Yale University (now at UC Berkeley)

**Courses Offered at FSU:**

- Undergraduate courses: Thermodynamics (EML3100), ME-Tools (EML3002), Thermal Fluids II (EML3016C).
- Graduate courses: Fundamentals of Heat Transfer (EML5152); Cryogenics (EML4161); Convective Heat Transfer (EML5155).

**Selected Presentations at Major International Conferences:**

- Invited talk: W. Guo, " Visualization study of the law of wall in superfluid helium-4", 2023 International Conference on Quantum Fluids and Solids, Manchester, UK, 8/9-13 (2023).
- Invited talk: W. Guo, "Watching the decay of quantized vortex rings in superfluid helium-4", 29th International Low Temperature Physics Conference, Sapporo, Japan, 8/18-23 (2022).

- Invited talk: W. Guo, "Visualization study of the law of wall in superfluid helium-4", 2022 International Cryogenic Engineering Conference (ICEC/ICMC), Online (organized by Zhejiang University), 4/25-29 (2022).
- Invited half-plenary talk: W. Guo, "Studying quantum turbulence in superfluid helium-4 using particle tracking velocimetry", 2021 International Conference on Quantum Fluids and Solids, Online, Organized by Indian Institute of Science(IISc), 8/10 (2021).
- Invited short course: W. Guo, "Helium cryogenics", 2020 International Applied Superconductivity Conference, online, organized by FSU, 10/25 (2020).
- Invited talk: W. Guo, "Solving the puzzle of second-sound triangulation for hot-spot detection in superfluid helium-4", 2019 International Conference on Quantum Fluids and Solids, Edmonton, Canada, 8/7 (2019).
- Invited talk: W. Guo, "Locating quench spot of SRF cavities using $He_2$ molecular tracer-line tracking technique in superfluid helium", 27th International Cryogenic Engineering Conference (ICEC), Oxford University, United Kingdom, 9/5 (2018).
- Invited plenary talk: W. Guo, "Visualization study of quantum turbulence in superfluid helium-4: progress and future development", 2018 International Conference on Quantum Fluids and Solids, Tokyo, Japan, 7/25 (2018).
- Invited talk: W. Guo, "Flow visualization in superfluid helium-4 using $He_2$ molecules as tracers", American Physical Society March Meeting, Baltimore, MD, United States, 3/16 (2016).
- Invited talk: W. Guo, "Simultaneous study of the superfluid and the normal fluid in counterflowing superfluid helium-4", 2015 International Conference on Quantum Fluids and Solids, Niagara Falls, NY, United States, 8/9 (2015).
- Invited talk: W. Guo, "Flow Visualization in Superfluid Helium-4 Using a Thin Line of $He_2$ Excimer Tracers", 27th International Conference on Low Temperature Physics, Buenos Aires, Argentina, 8/10 (2014).
- Invited talk: W. Guo, "Flow visualization in superfluid He-4 using metastable helium molecules as tracers", 26th International Conference on Low Temperature Physics, Beijing, China, 8/14 (2011).