

Sergei Sheludiakov
Research Assistant Professor
Department of Physics and Astronomy
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Education

- 2010 Immanuel Kant Baltic Federal University, Kaliningrad, Russia
Specialist degree in Radiophysics and Electronics, June 2010
“Electron spin resonance study of atomic hydrogen gas”
- 2011 University of Turku, Turku, Finland
Master Degree in Physics, December 2011
“Thermometry below 1 K”
- 2017 University of Turku, Turku, Finland (Supervised by Dr. Sergey Vasiliev, opponent: Prof. Markku Räsänen, University of Helsinki)
Doctoral Degree in Physics, March 2017
“Magnetic resonance study of atomic hydrogen stabilized in matrices of hydrogen isotopes below 1 K”

Academic Positions

- 2017-2021 Postdoctoral research associate, Texas A&M University, USA (PI: Prof. David M. Lee (Nobel Laureate in Physics, 1996), Co-PI: Prof. Vladimir V. Khmelenko)
- 2021-2023 Research Assistant Professor, Department of Physics and Astronomy, Cryogenics Facility Director, Shared Research Support Services, University of Pittsburgh, USA
- 2023- Research Assistant Professor, Department of Physics and Astronomy, University of Notre Dame, USA

Research experience and interests

- Experimental low-temperature physics
- Quantum fluids and solids
- Magnetic resonance
- Low-noise measurements
- Low-temperature instrumentation
- Cavity-QED quantum computing

Research Publications

1. **S. Sheludiakov**, J. Ahokas, O. Vainio, J. Järvinen, D. Zvezdov, S. Vasiliev, V. V. Khmelenko, S. Mao, D. M. Lee, Experimental cell for molecular beam deposition and magnetic resonance studies of matrix isolated radicals at temperatures below 1K. *Rev. Sci. Instrum.* **85**, 053902 (2014).
2. **S. Sheludiakov**, J. Ahokas, J. Järvinen, D. Zvezdov, O. Vainio, L. Lehtonen, S. Vasiliev, S. Mao, V. V. Khmelenko, D. M. Lee, Dynamic Nuclear Polarization of High-Density Atomic Hydrogen in Solid Mixtures of Molecular Hydrogen Isotopes, *Phys. Rev. Lett.*, **113**, 265303 (2014).
3. **S. Sheludiakov**, J. Ahokas, J. Järvinen, O. Vainio, L. Lehtonen, D. Zvezdov, V. V. Khmelenko, D. M. Lee, Electron spin resonance study of electrons trapped in solid molecular hydrogen films, *J. Low Temp. Phys.* **183**, 120 (2016).
4. **S. Sheludiakov**, J. Ahokas, J. Järvinen, D. Zvezdov, L. Lehtonen, O. Vainio, S. Vasiliev, D. M. Lee, and V. V. Khmelenko, Tunneling chemical exchange reaction $D+HD=D_2+H$ in solid HD and D_2 at temperatures below 1K, *Phys. Chem. Chem. Phys.* **18**, 29600 (2016).
5. **S. Sheludiakov**, J. Ahokas, J. Järvinen, O. Vainio, L. Lehtonen, S. Vasiliev, D. M. Lee and V. V. Khmelenko, Dynamic nuclear polarization and relaxation of H and D atoms in solid mixtures of hydrogen isotopes, *J. Low Temp. Phys.*, **187**, 43 (2017)
6. **S. Sheludiakov**, J. Ahokas, J. Järvinen, L. Lehtonen, O. Vainio, S. Vasiliev, D. M. Lee and V. V. Khmelenko, ESR study of atomic hydrogen and tritium in solid T_2 and $T_2:H_2$ matrices below 1K, *Phys. Chem. Chem. Phys.* **19**, 2834 (2017).
7. **S. Sheludiakov**, J. Ahokas, J. Järvinen, L. Lehtonen, S. Vasiliev, Yu. A. Dmitriev, D. M. Lee and V. V. Khmelenko, Electron spin resonance study of atomic hydrogen stabilized in solid neon below 1 K, *Phys. Rev. B* **97**, 104108 (2018)
8. **S. Sheludiakov**, J. Ahokas, J. Järvinen, L. Lehtonen, S. Vasiliev, Yu. A. Dmitriev, D. M. Lee, V. V. Khmelenko, Electrons Trapped in Solid Neon–Hydrogen Mixtures Below 1K, *J. Low Temp. Phys.* **195**, 365 (2019).
9. **S. Sheludiakov**, P. T. McColgan, D. M. Lee, V. V. Khmelenko, J. Järvinen, J. Ahokas, and S. Vasiliev, Formation of nuclear polarized phases of H atoms embedded in solid H_2 films, *Phys. Rev. Lett.* **122**, 225301 (2019).
10. **S. Sheludiakov**, J. Ahokas, J. Järvinen, L. Lehtonen, and S. Vasiliev, Yu. A. Dmitriev, D. M. Lee and V. V. Khmelenko, Evidence for melting of HD and D_2 clusters in solid neon below 1 K, *Phys. Rev. B* **99**, 174514 (2019).
11. **S. Sheludiakov**, D. M. Lee, V. V. Khmelenko, J. Ahokas, J. Järvinen, and S. Vasiliev, Studies of nuclear polarization of hydrogen atoms embedded in solid molecular hydrogen and hydrogen deuteride films, *Low Temp. Phys.* **46**, 139 (2020).
12. **S. Sheludiakov**, D. M. Lee, V. V. Khmelenko, J. Järvinen, J. Ahokas, S. Vasiliev, Experimental cell with a Fabry-Perot resonator tuned in situ for magnetic resonance studies of matrix-isolated radicals at temperatures below 1 K, *Rev. Sci. Instrum.* **91**, 063901 (2020).
13. **S. Sheludiakov**, D. M. Lee, V. V. Khmelenko, J. Järvinen, J. Ahokas, and S. Vasiliev, Purely spatial quantum diffusion of H atoms in solid H_2 at temperatures below 1 K, *Phys. Rev. Lett.* **126**, 195301 (2021).
14. **S. Sheludiakov**, D. M. Lee, V. V. Khmelenko, J. Ahokas, J. Järvinen, and S. Vasiliev, Nuclear polarized phases of H atoms embedded in solid molecular hydrogen films, *J. Low Temp. Phys.* **208**, 67 (2022).

15. **S. Sheludiakov**, D. M. Lee, V. V. Khmelenko, Yu. A. Dmitriev, J. Järvinen, J. Ahokas, and S. Vasiliev, Purely spatial diffusion of H atoms in solid normal and para-hydrogen films, *Phys. Rev. B* **105**, 144102 (2022).
16. **S. Sheludiakov**, C. K. Wetzel, D. M. Lee, V. V. Khmelenko, J. Järvinen, J. Ahokas, and S. Vasiliev, Studies of accumulation rate of H atoms in solid H₂ films exposed to 0.1 and 5.7 keV, *Phys. Rev. B* **107**, 134110 (2023)
17. O. Vainio, J. Ahokas, S. Novotny, **S. Sheludyakov**, D. Zvezdov, K.-A. Suominen, and S. Vasiliev, Guiding and Trapping of Electron Spin Waves in Atomic Hydrogen Gas, *Phys. Rev. Lett.* **108**, 185304 (2012).
18. J. Järvinen, J. Ahokas, **S. Sheludyakov**, O. Vainio, L. Lehtonen, S. Vasiliev, D. Zvezdov, Y. Fujii, S. Mitsudo, T. Mizusaki, M. Gwak, Sang Gap Lee, Soonchil Lee, L. Vlasenko, Efficient dynamic nuclear polarization of phosphorus in silicon in strong magnetic fields and at low temperatures, *Phys. Rev. B* **90**, 214401 (2014).
19. J. Järvinen, D. Zvezdov, J. Ahokas, **S. Sheludyakov**, O. Vainio, L. Lehtonen, S. Vasiliev, Y. Fujii, S. Mitsudo, T. Mizusaki, M. Gwak, SangGap Lee, Soonchil Lee, and L. Vlasenko, Microscopic control of ²⁹Si nuclear spins near phosphorus donors in silicon, *Phys. Rev. B* **92**, 121202(R) (2015).
20. O. Vainio, J. Ahokas, J. Järvinen, L. Lehtonen, S. Novotny, **S. Sheludiakov**, K.-A. Suominen, S. Vasiliev, D. Zvezdov, V. V. Khmelenko, D. M. Lee, Bose-Einstein Condensation of Magnons in Atomic Hydrogen Gas, *Phys. Rev. Lett.*, **114**, 125304 (2015).
21. J. Järvinen, J. Ahokas, **S. Sheludyakov**, D. Zvezdov, O. Vainio, L. Lehtonen, L. Vlasenko, S. Vasiliev, Dynamic Polarization and Relaxation of ⁷⁵As Nuclei in Silicon at High Magnetic Field and Low Temperature, *Appl. Magn. Reson.*, **48**, 473 (2017).
22. L. Lehtonen, O. Vainio, J. Ahokas, J. Järvinen, S. Novotny, **S. Sheludyakov**, K.-A. Suominen, S. Vasiliev, V. V. Khmelenko and D. M. Lee, Identical spin rotation effect and electron spin waves in quantum gas of atomic hydrogen, *New J. Phys.*, **20**, 055010 (2018).
23. L. Lehtonen, O. Vainio, J. Ahokas, J. Järvinen, **S. Sheludyakov**, K-A Suominen, S Vasiliev, V. V. Khmelenko and D. M. Lee, Spin waves in quantum gases—the quality factor of the identical spin rotation effect, *Phys. Scr.* **93**, 094002, (2018).
24. P. T. McColgan, A. Meraki, R. E. Boltnev, **S. Sheludiakov**, D. M. Lee and V. V. Khmelenko, Luminescence of molecular nitrogen nanoclusters containing stabilized nitrogen, oxygen, hydrogen, and deuterium atoms, *J. Phys.: Conf. Ser.* **969**, 012007 (2018).
25. Patrick T. McColgan, **Sergei Sheludiakov**, Roman E. Boltnev, David M. Lee, Vladimir V. Khmelenko, Luminescence of ND radicals during the destruction of molecular nitrogen nanoclusters, *Chem. Phys.*, **516**, 33 (2019).
26. P.T. McColgan, **S. Sheludiakov**, P.M. Rentzepis, D.M. Lee, and, V.V. Khmelenko, Rotationally induced luminescence of nanoclusters immersed in superfluid helium, *Low Temp. Phys.* **45**, 310 (2019).
27. Adil Meraki, Patrick M. McColgan, **Sergei Sheludiakov**, David M. Lee, Vladimir V. Khmelenko, Thermoluminescence of nitrogen-neon and nitrogen-argon nanoclusters immersed in superfluid helium, *Low Temp. Phys.*, **45**, 862 (2019).
28. R.E. Boltnev, I. B. Bykhalo, V.V. Khmelenko, I.N. Krushinskaya, D.M. Lee, P.T. McColgan, **S. Sheludiakov**, and A.A. Pelmenev, Luminescence of molecular nitrogen in cryogenic plasma, *Low Temp. Phys.*, **45**, 856 (2019).
29. J. Järvinen, D. Zvezdov, J. Ahokas, **S. Sheludiakov**, L. Lehtonen, S. Vasiliev, L. Vlasenko, Y. Ishikawa and Y. Fujii, Dynamic nuclear polarization and ESR hole burning in As doped silicon, *Phys. Chem. Chem. Phys.*, **22**, 10227 (2020).

30. L. Lehtonen., O. Vainio, J. Ahokas, J. Järvinen, **S. Sheludyakov**, K.-A. Suominen and S. Vasiliev, Searching for magnetostatic modes in spin-polarized atomic hydrogen, *Phys. Scr.* **95**, 045405 (2020).
31. Yusef Maleki, **Sergei Sheludiakov**, Vladimir V. Khmelenko, Marlan O. Scully, David M. Lee, and Aleksei M. Zheltikov, Natural and magnetically induced entanglement of hyperfine-structure states in atomic hydrogen, *Phys. Rev. A* **103**, 052804 (2021).
32. R. E. Boltnev, V. Atrazhev, N. Bonjfaci, I. Bykhalo, I. Krushinskaya, V. V. Khmelenko, D.M. Lee, A. Pelmenev, **S. Sheludiakov**, N. Sadeghi, Oxygen atoms and nitrogen molecules as spectroscopic probes for the temperature determination in non-equilibrium cryogenic helium plasma jets, *Plasma Sources Sci. Technol.* **30** 075032 (2021).

Workshops, conferences and symposia

Oral presentations and contributed talks:

1. Magnetic resonance studies of H and D atoms in solid H₂ and D₂ films at temperatures below 1 K. International conference on magnetic resonance in condensed matter, Saint Petersburg, Russia (2014).
2. Magnetic resonance study of solid hydrogen and tritium stabilized in solid tritium matrices below 1K. International conference on cryocrystals and quantum crystals, Turku, Finland (2016).
3. Formation of a highly nuclear polarized state of H atoms embedded in solid H₂ films. International conference on cryocrystals and quantum crystals, Wroclaw, Poland (2018).
4. Nuclear polarized phases of H atoms in solid H₂, Institute for Quantum Science and Engineering, Seminar Series, Texas A&M University, College Station, TX, USA (2018).
5. Towards voltage-controlled superconducting qubits based on hybrid nanowires. next-NEQST21, conference and grant review, Annapolis, MD (2022)

Poster presentations:

1. Cyclotron resonance of free electrons in a Fabry-Perot cavity, Workshop on strongly correlated electron systems, Okinawa Institute of Science and Technology, Okinawa, Japan (2012).
2. Electron spin resonance study of H and D atoms in solid H₂ and D₂ films at temperatures below 1 K. International Conference on Magnetic Resonance in Condensed Matter, Saint Petersburg, Russia (2013).
3. Magnetic resonance studies of H and D atoms in solid H₂ and D₂ films at temperatures below 1 K. International Conference on Cryocrystals and Quantum Crystals, Almaty, Kazakhstan (2014).
4. Magnetic resonance study of high-density atomic hydrogen and tritium stabilized in solid tritium matrices below 1K. International Conference on Quantum Fluids and Solids, Prague, Czech Republic (2016).
5. Electron spin resonance study of atomic hydrogen stabilized in solid neon below 1K. International Conference on Low Temperature Physics, LT-28, Gothenburg, Sweden (2017).
6. Rotationally induced luminescence of nanoclusters containing high concentrations of nitrogen atoms immersed in superfluid helium. International conference on cryocrystals and quantum crystals, Wroclaw, Poland (2018).

Workshops:

1. Marie Curie Advanced Cryogenics Course, Grenoble, France (2011).
2. International Summer School on Nanoscience and Nanofabrication, Jyväskylä, Finland (2013).
3. Winter School on Magnetic Resonance, Saint Petersburg, Russia (2015).