

Atef Sheekhoon

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RESEARCH PROFILE

Experimental physicist specializing in nanoparticle physics, photoionization spectroscopy, and high-vacuum instrumentation. Developed high-precision methods to measure temperature-dependent ionization energies and work functions of free metal nanoparticles. Experienced in molecular beam experiments, cryogenic and ultra-high vacuum systems, mass spectrometry, optical spectroscopy, and instrument design. Proficient in precision optical alignment, experimental automation, and quantitative data analysis using Mathematica, Python, C++, MATLAB, and NI LabVIEW. Research focuses on probing structural, thermodynamic, and quantum phenomena in finite systems through electronic measurements.

TECHNICAL SKILLS

- **Software, FPGA & AI Development:** Verilog (HDL), AI-Assisted Development (LLMs & Prompt Engineering), Python, C/C++, Mathematica, MATLAB.
- **Instrumentation, Control & Design:** NI LabVIEW, Arduino, Analog/Digital Electronics, Pressure Systems, SolidWorks (CAD, Thermal & Stress FEA), Fusion 360, Custom FPGA DAQ Systems (Gowin EDA, BSRAM), Zemax.
- **Hardware, Vacuum & Experimental Physics:** High-Vacuum Infrastructure & Cryogenics, Ion Optics, Precision Optical Alignment (Pinholes/Telescopes), Laser-Based & UV Grating Ionization Systems.

RESEARCH EXPERIENCE

Graduate Research Assistant | Nanocluster Physics Laboratory, University of Southern California
May 2021 – Aug. 2026

- Lead and execute experimental campaigns in nanocluster physics, troubleshooting custom vacuum hardware to extract actionable knowledge from sub-module to full-system levels.
- Automated the full data acquisition pipeline using NI LabVIEW and Arduino, increasing experimental throughput by $\sim 50\times$.
- Designed and fabricated heat shields and crucibles for highly reactive metals (e.g., Lithium).
- Initiated and developed scientific models and computational simulations using Mathematica and MATLAB to evaluate complex experimental data.
- Performed high-accuracy alignment of optical paths and vacuum chambers using pinholes and telescopes to optimize beam transmission.
- Led a team of 3 researchers, defining technical direction, coordinating execution, and effectively communicating findings to multidisciplinary audiences.
- Architected and deployed OpenMCS, a zero-dead-time FPGA multichannel scaler (Verilog); leveraged generative AI and LLM workflows to accelerate HDL development.

Visiting Researcher | Quantum Nanophysics, University of Vienna (Austria) *May 2025*

- Optimized laser-based ionization systems (OPO), significantly improving measurement accuracy and stability.
- Conducted precision ionization measurements on large sodium clusters, advancing technology maturity through experimental proof of concept.

Invited Researcher | Nano-Bio Physics, University of Innsbruck (Austria) Oct. 2025 – Dec. 2025

- Drove architectural innovation from concept to prototype by designing and implementing a pickup source for high vapor pressure molecules.
- Designed and built a cryogenic trapping system to improve vacuum conditions and system stability, demonstrating strong hands-on complex system build capabilities.
- Bridged the gap between modeling and experiments by modeling computational results for the first-ever experimental realization of the Thomson problem.

Undergraduate Research Assistant | Nanocluster Physics Laboratory, University of Southern California June 2019 – May 2021

- Maintained high-vacuum infrastructure and repaired high-voltage components, directly supporting the troubleshooting of complex hardware test rigs.
- Conducted extensive characterization and metrology using atomic force microscopy (AFM) and four-point probe measurements.
- Conducted experiments involving the generation and deposition of size-selected nanoclusters via DC magnetron sputtering.

EDUCATION

Ph.D., Physics | University of Southern California (August 2026)

- Advisor: Vitaly V. Kresin
- Dissertation: “Temperature-Dependent Photoionization of Metal Nanoparticles: Phase Transitions, Isotope Effects, and Quantum Phenomena”

B.S., Physics (Minor in Mathematics) | University of Southern California (May 2020)

PUBLICATIONS

A.A. Sheekhoon, A.O. Haridy, S. Pedalino, and V.V. Kresin, “Photoionization of temperature-controlled nanoparticles in a beam: Accurate and efficient determination of ionization energies and work functions,” *Rev. Sci. Instrum.* **96**, 123705 (2025).

A.O. Haridy, **A.A. Sheekhoon**, and V.V. Kresin, “Temperature-dependent photoionization thresholds of alkali-metal nanoparticles reveal thermal expansion and the melting transition,” *Phys. Rev. B* **113**, L041404 (2026).

- Selected as “Editors’ Suggestion.”
- Highlighted in *APS Physics* magazine: “A New Probe of Nanoparticle Melting”.
- Described as a “Research Highlight” in *Nature* magazine: “Not just a chip off the old block: nanoparticles reveal odd traits.”

A.A. Sheekhoon, A.O. Haridy, and V.V. Kresin “Isotope effect in the work function of lithium,” *Phys. Rev. B* **113**, 235407 (2026)

TEACHING EXPERIENCE

Graduate Teaching Assistant

May 2021 – June 2026

Department of Physics, University of Southern California—Los Angeles, CA

- Led 5 laboratory sections (≈80 students total) in physics and astronomy
- Held weekly office hours and provided individualized academic support.