

High-Mass Matter-Wave Interference of Metal Clusters and Biomolecules

The quantum superposition principle underpins modern quantum science and technology, yet its applicability to increasingly complex systems remains an experimental frontier. Matter-wave interferometry provides a stringent test by delocalizing massive particles over distances far exceeding their size. I report on a novel experimental platform that extends interferometry to a qualitatively new material class - large metal clusters - and present the first observation of quantum interference of sodium nanoparticles containing more than 7,000 atoms with masses exceeding 170 kDa [1]. The corresponding Schrödinger-cat state reaches a macroscopicity of $\mu = 15.5$, surpassing previous records by an order of magnitude and yielding the most restrictive bounds to date on generic macrorealistic modifications of quantum mechanics. I will also highlight applications in molecular metrology and current efforts toward quantum interferometry with biomolecules, including proteins, enabled by advances in source control and decoherence shielding. Looking ahead, deep-UV laser systems promise enhanced beam manipulation and detection contrast, enabling further scalability in mass and complexity and expanding the reach of matter-wave tests of quantum theory.

[1] S. Pedalino et al., (2025), arXiv:2507.21211 [quant-ph]