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Matter-Wave Interferometry with Helium Atoms in Low-Angular-Momentum Rydberg States[1] JAKE TOMMEY, STEPHEN HOGAN, University College London — Atoms in Rydberg states with high principal quantum number can possess large induced electric dipole moments which allow forces to be exerted on them using inhomogeneous electric fields. For atoms prepared in superpositions of Rydberg states with different electric dipole moments these forces can be exploited to realize an electric analogue of the Stern-Gerlach matter-wave interferometer. In this talk we will describe experiments in which helium atoms traveling in pulsed supersonic beams were laser photoexcited to the triplet $|56s\rangle$ Rydberg state. They were then prepared in a superposition of the $|56s\rangle$ and $|57s\rangle$ states by a pulse of microwave radiation resonant with the two-photon transition between these states. In this internal-state superposition they were subjected to a sequence of electric field gradient and further microwave pulses to realize an electric Rydberg-atom matter-wave interferometer with internal-state labeling. The Rydberg states used in the experiments had dimensions on the order of 500 nm, given by the spatial extent of the Rydberg electron charge distribution. This work opens new opportunities for studies of quantum phases for particles with large electric dipole moments, and gravity measurements with Rydberg positronium atoms.

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