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Raman q-plates for Singular Atom Optics JUSTIN T. SCHULTZ, AZURE HANSEN, JOSEPH D. MURPHREE, MAITREYI JAYASEELAN, NICHOLAS P. BIGELOW, University of Rochester — We use a coherent two-photon Raman interaction as the atom-optic equivalent of a birefringent optical q-plate to facilitate spin-to-orbital angular momentum conversion in a pseudo-spin-1/2 BEC. A q-plate is a waveplate with a fixed retardance but a spatially varying fast axis orientation angle. We derive the time evolution operator for the system and compare it to a Jones matrix for an optical waveplate to show that in our Raman q-plate, the equivalent orientation of the fast axis is described by the relative phase of the Raman beams and the retardance is determined by the pulse area. The charge of the Raman q-plate is determined by the orbital angular momentum of the Raman beams, and the beams contain umbilic C-point polarization singularities which are imprinted into the condensate as spin singularities: lemons, stars, spirals, and saddles. By tuning the optical beam parameters, we can create a full-Bloch BEC, which is a coreless vortex that contains every possible superposition of two spin states, that is, it covers the Bloch sphere.

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