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QGP smoke rings in relativistic p+A collisions

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Observations of strong azimuthal anisotropies (v_n)– and their agreement with some hydrodynamic calculations– in p+A collisions at RHIC and LHC have led to the suggestion that such collisions produce the smallest droplets of QGP. This hypothesis may be tested from a different angle through hyperon polarization measurements. In particular, central p+A collisions may naturally produce an initial state in which the longitudinal flow pattern depends on the transverse radial coordinate. The generic response of any fluid to such an initial condition is the generation of expanding vortical toroids–smoke rings. We use 3D viscous hydrodynamics (implemented in the MUSIC framework) to explore these unique structures in p+A collisions. We present an experimental observable which probes for their existence and provide quantitative predictions as a function of collision energy and system size. The effects of "lumpy" initial states, various definitions of vorticity, and newly-discovered symmetric shear terms will be discussed. Finally, experimental challenges for observing this unique structure will be discussed.

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