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Heavy Ion's Mini-me: Strong Radial Flow in p+p Collisions at RHIC

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The phenomenon of collective, hydrodynamic-like flow plays a central role in the present understanding of the new state of matter (the quark-gluon plasma) produced in high-energy collisions between gold nuclei at the Relativistic Heavy Ion Collider (RHIC). It has long been assumed that collisions between protons produce insufficient particle multiplicity and energy density to produce a collective, bulk system; thus, these collisions are a natural "reference" against which to compare signals from heavy systems, measured at the same energy, in the same detectors, and with identical techniques. Significant differences in bulk signals from these systems have, indeed, been observed. These differences are usually taken to confirm the assumption that proton collisions produce no flow. We challenge this interpretation, and the assumption in general. We show that, when simple effects of conservation law-induced phasespace constraints are taken into account, the single-particle spectra and two-pion correlation functions exhibit radial flow signals quantitatively identical to those seen in Au+Au collisions. We discuss possible driving physics behind–and potential implications of–this surprising finding, as well as future measurements at RHIC and the LHC.

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