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Charged-particle multiplicities, pseudorapidity and transverse-momentum distributions, and two- and four-particle correlations in O+O, Ne+Ne, and p+O collisions with the ATLAS detector

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This presentation reports new ATLAS measurements of soft-particle production and collective flow in light-ion collisions at the LHC. Charged-particle pseudorapidity densities ($dn/d\eta$) and average transverse momenta ($\langle p_T \rangle$) are measured in O+O and Ne+Ne collisions at $\sqrt{s_{NN}} = 5.36$ TeV over the fiducial range $|\eta| < 2.5$ and $0.27 < p_T < 5$ GeV. Fits to the measured transverse-momentum spectra are employed to extrapolate these observables to $p_T = 0$ GeV. Results for $dn/d\eta$ and $\langle p_T \rangle$ are presented as functions of pseudorapidity and collision centrality for both fiducial and fully extrapolated p_T intervals. Ratios of Ne+Ne to O+O $dn/d\eta$ and differences in $\langle p_T \rangle$, which significantly reduce correlated systematic uncertainties, are also reported. These measurements are compared with hydrodynamic calculations incorporating different initial-state models to assess the role of nuclear geometry in particle-production dynamics.

Complementary measurements of collective flow further probe the initial-state structure of these light-ion systems. Using charged-particle tracks, ATLAS extracts azimuthal anisotropy coefficients v_n2 and v_n4 in O+O and Ne+Ne collisions, revealing clear signatures of collectivity and demonstrating that the elongated nuclear structure of neon enhances v_2k in the most central events relative to oxygen. In addition, measurements of v_n2 for $n = 2$–4 in p+O collisions, compared with corresponding p+Pb results, provide stringent constraints on the geometry and initial-state conditions of highly asymmetric systems. Together, these new light-ion measurements deliver a high-precision dataset that advances the understanding of collective dynamics, particle production, and initial-state effects in small collision systems.

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