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Magnetihydrodynamics and charged flow in non-central heavy ion collisions

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Strong magnetic fields produced in any non-central heavy ion collision are expected to affect the dynamics of the hot QCD matter produced in this collision. The magnetic field is time-dependent and the conducting medium is expanding, which leads to the induction of charged currents due to the combination of Faraday and Hall effects. We extend our previous work by studying the imprint of the magnetic fields produced in non-central heavy ion collisions on the azimuthal distributions and correlations of the produced charged hadrons by employing a hydrodynamic description of the expanding cooling droplet of liquid produced in a heavy ion collision combined with the electromagnetic effects in a perturbative fashion. We use the Cooper-Frye freeze-out procedure to obtain the azimuthal hadron distributions. We find that the charged currents induced by the presence of the electromagnetic fields result in a charge-dependent directed flow v_1, elliptic flow v_2 and triangular flow v_3 that is respectively odd, even, odd in rapidity and always odd under charge exchange. It can be detected by measuring correlations between the directed, elliptic and triangular flow of charged hadrons at different rapidities, $\langle v_i(y_1)v_i(y_2)\rangle$. We also investigate the dependence of our model on the various parameters and make estimates of the magnitude of the charge-dependent flow observables expected at RHIC and the LHC.

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