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Direct flow of heavy mesons as unique probes of the initial Electro-Magnetic fields in Ultra-Relativistic Heavy Ion collisions

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In Ultra-relativistic Heavy-Ion Collision (HIC) very strong initial electro-magnetic (e.m.) fields are created inducing a vorticity in the reaction plane that is odd under charge exchange, allowing to distinguish it from the large vorticity of the bulk matter due to the initial angular momentum conservation. Conjointly thanks to its mass, $M_{b,c} >> \Lambda_{QCD}$, there should be no mixing with the chiral magnetic dynamics. We show that such e.m. field entails a transverse motion of both heavy quarks (HQ), bottom and charm, resulting in a splitting of directed flow v_1 of D(B) and anti-D (anti-B) of few percent, i.e. much larger compared to pions. The considerable effect is due to a combination of several favorable conditions for HQ, mainly: (i) unlike light quarks formation time scale of HQ is comparable to the time scale when the e.m. field attains its maximum value and (ii) the kinetic relaxation time is similar to the QGP lifetime, which allows the HQ to retain the initial kick picked up from the electromagnetic field in the transverse direction. Hence HQs provide very crucial and independent information on the strength of the electro-magnetic field produced in HIC, moreover the effect comes out of a delicate balance between the magnetic and the electric field supplying a novel probe of the electric conductivity of the QGP. Moreover, the impact of a Langevin vs a Boltzmann transport of HQ in the medium is also investigated.

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