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Impact of the initial electromagnetic field on heavy quarks and leptons from Z0 decay and Z0 leptonic invariant mass

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Ultra-relativistic heavy ion collisions are expected to generate a huge electromagnetic (e.m.) field that is envisaged to induce several effects on hot QCD matter including the possibility of local parity and local parity and charge conjugation symmetry violations. A direct signature of such e.m. fields and a first quantitative measurement of its strength and lifetime are still missing.
We will discuss why it is expected to generate a splitting of the directed flow of charged particles and anti-particles, which allow to constraint the e.m. field and can be considered also as a possible probe of the formation of the quark-gluon plasma phase. Moreover, we have found a general formula for all possible charge dependent flow observables that can be generated by the strong electromagnetic fields in non-central relativistic heavy ion collisions. The formula has a very simple form at pT larger than several GeV/c, which can be treated as the signature of charged dependent flow observables induced by e.m. fields. Furthermore, we found that the v1 splitting depends critically on the time evolution of the magnetic field. Based on this study, we finally discuss why the measurement of leptons from Z0 decay and its correlation to the charmed mesons are better in probing e.m. fields and thus opening a new way to constrain the EM field.
The second topic we want to discuss is the modification of the Z0 leptonic invariant mass in the presence of EM fields. We found that EM fields will decrease the Z0 leptonic invariant mass and increase the width of it by few hundred MeV if the large of D0 and anti-D0 measured by ALICE is all due to EM fields. Moreover, both the invariant mass and its width are found to approximately depend on the integral of magnetic field quadratically. This provides an independent way to constrain the EM field.

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