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The evolution of electromagnetic fields in relativistic heavy-ion collisions

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The electromagnetic fields produced by non-central heavy ion collisions are extremely powerful and give rise to a plethora of fascinating subjects in strongly interacting matter. Their evolution is a significant and unresolved issues. Because the relaxation time of the hot QCD matter to the electromagnetic fields is comparable with the lifetime of external electromagnetic field, we question, for the first time, the use of the Ohm's law directly to compute the Faraday current and further induced magnetic field. By calculations employing the parton transport model combined with the solution of Maxwell's equations, we focus on the generation of the induced electric current and examine the validity of Ohm's law. We find that the electric current builds from zero and then relaxes towards the value given by Ohm's law. The relaxation time is not so short that can be neglected. The real Faraday current is much lower than expected. And this significantly suppresses the induced magnetic field. We call this incomplete electromagnetic response.In addition, we will present recent results about the electromagnetic evolution in the pre-equilibrium stages after the collisions. Also, we discuss the formation time of quarks to the electromagnetic development.

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