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On the gravitational wave emission in the magnetic field of a heavy-ion collision

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In the classic 1961 paper of Gertsenshtein [1] he demonstrated that an electromagnetic wave can be transformed into a gravitational wave when propagating through an external, transverse magnetic field. Later in 1973, Zel'dovich calculated the fraction of energy of the electromagnetic wave transformed into the energy of the gravitational wave in such a process in astrophysical situations [2].

In the following, we investigate a possibility of a transition of an electromagnetic wave into a gravitational wave in the high magnetic field expected to be formed in heavy-ion collisions.

Electromagnetic radiation, emitted in all stages of a heavy-ion collision, reflects the evolution of the latter and encodes the information on the properties of the created medium, such as fireball lifetime, temperature, acceleration, and polarization. This information can be decoded by studying di-lepton spectra by means of their invariant mass reconstruction. The slope of the di-lepton excess spectrum measured in the intermediate-mass region provides information on the temperature of the emitting medium.

In the poster, we discuss the modification of a slope value due to the excitation of a gravitational wave by light emitted from the medium in the magnetic field generated in a non-central heavy-ion collision. Based on several simplifications, we estimate the possible redshift and conclude the effect is not detectable with heavy-ion experiments planned in the foreseeable future. However, with this contribution, we also want to trigger a discussion on the emerging field of ultra-high-frequency gravitational waves physics and its possible relation to high-energy heavy-ion collision physics.

References:

- [1] M. E. Gertsenshtein, J. Exptl. Theoret. Phys. (U.S.S.R.) 41, 113-114 (July 1961)
- [2] Ya. B. Zel'dovich, Zh. Eksp. Teor. Fiz. 65, 1311-1315 (October 1973)

Category

Experiment

Collaboration (if applicable)

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