Chiral Magnetic Effect with Wigner Functions

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In heavy-ion collisions, where the nuclei collide with low centrality, the resulting strong magnetic fields can interplay with the gluonic fields to create an unexpected electric current orthogonal to the reaction plane. The effect is at the edge of experimental capabilities and detailed theoretical understanding is necessary to interpret it.

We propose a Wigner-function based model to reproduce the expected characteristics of the anomalous current, give an easy to interpret view on its time evolution and to describe the collision energy dependence of the effect.

The evolution equations for the Wigner function form a complicated set of partial differential equations that is solved with pseudo-spectral collocation and turned into dense linear algebra over 3 dimensional tensors. The computationally intensive tensor operations are written in OpenCL and lead to a factor of 30x speed-up on AMD Radeon cards at the Wigner GPU Lab.