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Relaxation Time for the Chiral Vortical Effect and Spin Polarization in Strongly Coupled Plasma

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Anomalous transport phenomena arising from chiral anomaly such as the Chiral Magnetic Effect have recently attracted much attention. One such phenomenon, the Chiral Vortical Effect, that is an induced current along fluid vorticity, is somewhat special because it is related to chiral anomaly on one hand, while on the other hand its microscopic origin is the spin polarization of chiral quarks in the fluid vorticity, whose physics is more general and applicable even for massive spinful particles such as Lambda baryon. In theoretical understanding of recently measured Lambda polarization in off-central heavy-ion collisions at RHIC, it is vitally important to know the dynamical time scale of this spin polarization, that is, the relaxation time it takes to achieve the equilibrium with Lambda spins polarized in a finite fluid vorticity. Therefore, by studying the relaxation time of the Chiral Vortical Effect in massless chiral limit, we can get a useful proxy for this time scale for Lambda spin polarization.
We first derive the correct Kubo formula for the relaxation time of the Chiral Vortical Effect from the energy-momentum and current two point functions, pointing out that some of the previous claims for a zero relaxation time of the Chiral Vortical Effect is due to an incorrect identification of the Kubo formula for the relaxation time of the Chiral Vortical Effect. Using our Kubo formula, we compute the correct and finite relaxation time of the Chiral Vortical Effect for the first time in strongly coupled plasma using the AdS/CFT correspondence.

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