



Contribution ID: 868

Type: Poster

## Universal Expansion Anisotropy from Cold Atoms to Hot Quark-Gluon Plasma

Azimuthal anisotropy is by now a standard observation in relativistic heavy-ion collisions, believed to primarily result from hydrodynamic expansion of the created hot and dense quark-gluon plasma (QGP). Ubiquitous observations of azimuthal anisotropy have also been made in small-system (proton-proton, proton-nucleus, and deuteron/ $^3\text{He}$ -nucleus) collisions. These observations, while prompting the exciting possibility of QGP droplet formation in those small systems, provoke skepticism on the belief that those anisotropies must stem from hydrodynamic origins. Unfortunately, the interaction strength cannot be arbitrarily tuned in nuclear collisions, which would elucidate the physics mechanisms of azimuthal anisotropy. We report an experimental research [1] on the anisotropic expansion of cold  $^6\text{Li}$  Fermi gases, initially trapped in a harmonic potential of an elliptic shape, where the interactions can be readily tuned by an external magnetic field. We also explore higher-order harmonic anisotropies, such as triangular anisotropy by preparing an initial triangular shape of the harmonic potential. It is found that the expansion anisotropy of cold atoms builds up quickly at small interaction strength, indicating that strong hydrodynamic interactions are not a prerequisite. A universal behavior of the expansion anisotropy as a function of the interaction strength is observed, quantitatively comparable between cold-atom and heavy-ion systems, despite their vast differences in physics [1]. This observation suggests a universality in the expansion dynamics in interacting systems, independent of the physics nature of those interactions. The universality potentially unifies a variety of disciplines in nature, spanning from the weakly interacting dilute systems of gases to the strongly interacting QGP of the early universe.

### Reference

[1] Li K., Song H-F., Sun Y-L., Xu H-J., Wang F-Q., Observation of Universal Expansion Anisotropy from Cold Atoms to Hot Quark-Gluon Plasma, arXiv:2405.02847.

### Category

Experiment

### Collaboration (if applicable)

**Authors:** LI, Ke (Huzhou University); Dr SONG, Hong-Fang (Huzhou University); Dr XU, Haojie (Huzhou University); WANG, Fuqiang (Purdue University (US))

**Presenter:** LI, Ke (Huzhou University)

**Session Classification:** Poster session 2

**Track Classification:** Collective dynamics & small systems