Exploring the chirality and criticality of QCD matter with effective field theory for fluctuating hydrodynamics

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Quark Matter 2022, Poster session, April 6

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Main targets of this presentation

1. Baryon fluctuations near the QCD critical point
   - Small system in heavy-ion collisions \(\longrightarrow\) “Non-Gaussian”\(^{M.\,\,\text{Stephanov}\,\,(2009)}\)
   - Need a systematic dynamical framework under expanding background

2. Anomaly-related chiral transport phenomena
   - The chiral magnetic effect (CME), etc.
   - Few studies on the fluctuation effects of hydrodynamic modes, c.f., long-time tails \(^{P.\,\,\text{Kovtun}\,\,\,\,\text{and}\,\,L.G.\,\,\text{Yaffe}\,\,(2003)\,\,\,\,\text{etc.}}\)
Effective field theory (EFT) for fluctuating hydrodynamics

F.M. Haehl, R. Loganayagam, M. Rangamani (2016)

- Symmetries & constraints from microscopic Schwinger-Keldysh formalism
- A systematic approach to long-range & long-timescale dynamics

Application to the QCD matter for the first time

NS, N. Yamamoto, and Yi Yin, JHEP 2021, 131 (2021)
NS and Yi Yin, JHEP 2022, 124 (2022)
In this talk, I will discuss

Applications of EFT for fluctuating hydrodynamics to

1. Non-Gaussian fluctuation dynamics near the QCD critical point
   - Evolution equations as Schwinger-Dyson equations
   - A closed-form solution to the leading order fluctuations
     
     NS and Yi Yin, JHEP **2022**, 124 (2022)

2. Chiral media under external magnetic field
   - Positive magnetoresistance induced by the CME and hydrodynamic fluctuations
     
     NS, N. Yamamoto, and Yi Yin, JHEP **2021**, 131 (2021)