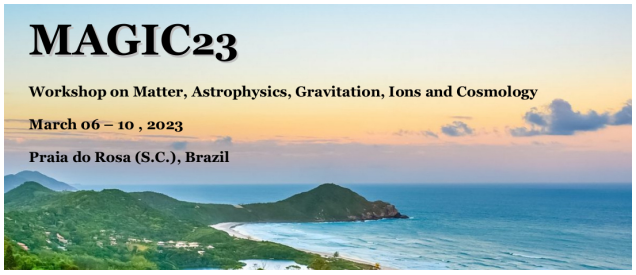

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Uncertainty relation in viscous hydrodynamics and its effects in collective flow observables

It is considered that the uncertainty relation is one of key features
of quantum mechanics which distinguishes quantum and classical systems.
Recently, we developed a new formulation of the uncertainty relations based on the generalized scheme of variational principle, the stochastic variational method [1]. In this method, the uncertainty relation is related to the non-differentiability of observables and thus can be obtained even in classical stochastic systems [2,3,4]. This new formulation resolves the famous paradox in quantum mechanics, the angular uncertainty relation without introducing artificial assumptions [5].

In this presentation, we show that the fluctuations of position and momentum for a non-relativistic viscous fluid element satisfies the uncertainty relation analogous to the corresponding quantum mechanical one. Such a fluctuation is sensitive to the temperature gradient at the freezeout surface and can affect the collective flow anisotropy in relativistic heavy-ion collisions [6].

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