



Contribution ID: 182

Type: Talk

Reading off correlation of spacetime fluctuations from interferometric output

Monday 23 June 2025 14:30 (15 minutes)

To understand the fundamental nature of gravity, high-precision interferometers, namely, Holometer (Fermilab), QUEST (Cardiff) and GQuEST (CalTech), seek possible evidence of spacetime fluctuations. These spacetime fluctuations, a feature common to both quantum and semiclassical models of gravity, could be characterised by two-point correlation functions. A two-point correlation function of any typical physical process dictates the correlation to decay as the separation increases, with the decay being either exponential or an inverse power law. This leads to two possible classes of correlation functions. We compute the spectral densities of interferometric output signal from a single Michelson interferometer, corresponding to when the light beam traverses through spacetime fluctuations with different correlation functions. From the high and low frequency behaviours of such spectral densities, we identify the characteristic signatures of each class of these correlation functions. We show that detection of these characteristic signatures in the interferometric output, in turn, will help identifying the underlying correlation function. To fully capture these signatures, we find that interferometers require sensitivity in a frequency range between $O(0.1)$ and $O(10)$ times the light round-trip frequency $c/2\mathcal{L}$, for an interferometer with arm length $\mathcal{L}$. We also find the high and low frequency trends of the spectral density for more sophisticated setups such as Holometer-type colocated interferometers and LIGO-type interferometers with Fabry-Perot arm cavities. Comparing such findings allow us to identify from current interferometers, setups best suited for investigating spacetime fluctuations. Our work can also be used to guide the design of future interferometers.

Authors: DATTA, Animesh (University of Warwick); BALAMURUGAN, Sharmila (University of Warwick)

Presenter: BALAMURUGAN, Sharmila (University of Warwick)

Session Classification: Monday Parallel Session F