Thomas Roman
Central Connecticut State University

Probability Distributions of Quantum Stress Tensors in Two and Four Dimensions

Authors: Chris Fewster, Larry Ford, and Tom Roman

This talk discusses recent work with Chris Fewster and Larry Ford on probability distributions for smeared quantum fields in the vacuum in two and four-dimensional Minkowski spacetime. These distributions have the feature that there is a lower bound at a finite negative value, but no upper bound. The lower bound of the distribution gives the optimal quantum inequality bound, thus illustrating a deep connection between these probability distributions and quantum inequalities. However, arbitrarily large positive energy density fluctuations are possible. In two dimensions, the unique exact analytic form for the distribution has been found for the stress tensor of a massless scalar field in the vacuum state. In four dimensions, we are not able to give closed form expressions for the probability distribution, but rather use calculations of a finite number of moments to estimate the lower bounds, the asymptotic forms for large positive argument, and possible fits to the intermediate region. All of our four-dimensional results are subject to the caveat that these distributions are not uniquely determined by the moments. We apply the asymptotic form of the electromagnetic energy density distribution to estimate the nucleation rates of black holes and of Boltzmann brains.