Contribution ID: **206** Type: **Invited talk in a parallel session**

Quantum Impulsive Null Geometries

Tuesday, 9 July 2024 15:00 (25 minutes)

Gravitational waves propagate at the speed of light. If we take an ultra-short distributional pulse of gravitational radiation, the resulting wavefront will move along a co-dimension one light-like (null) surface in spacetime. The question of how to describe the quantum geometry of such impulsive null initial data is an important physical problem shared across different approaches. In my presentation, I report on three new results on this frontier. First, a new mathematical technique is introduced to characterize the phase space of the radiative modes of impulsive null initial data at the full non-perturbative level. Second, we take the description to the quantum level, using a non-perturbative polymer quantization familiar from Loop Quantum Gravity. Third, an immediate physical implication is found: in the model, the Planck luminosity separates the eigenvalues of the radiated power. Below the Planck power, the spectrum of the radiated power is discrete. Above the Planck power, the spectrum is continuous and the resulting physical states contain caustics that can spoil the semi-classical limit. The bound depends on the Barbero–Immirzi parameter, which sets the fundamental scale in Loop Quantum Gravity relative to the Planck scale. The talk is based on arXiv:2402.12578, arXiv:2401.17491, arXiv:2104.05803.

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Session Classification: Loop quantum gravity: cosmology and black holes

Track Classification: Quantum Gravity (QG): Loop quantum gravity: cosmology and black holes