Contribution ID: **525** Type: **Poster**

Analysis of the emission spectra of an evaporating Schwarzschild black hole

Many early universe theories predict the creation of Primordial Black Holes (PBHs) that could have sufficient mass to be expiring today with a final burst of Hawking radiation. A Black Hole (BH) has a Hawking temperature inversely proportional to its mass. Hence, a sufficiently small BH will quasi-thermally radiate particles at an ever-increasing rate as it evaporates and raises its temperature. Detection of this radiation would provide insight into many areas of physics, including the early universe, high-energy physics, and the interplay between gravitation and thermodynamics.

In this work, we analyze the emission spectra of a Schwarzschild black hole using quantum field theory in curved spacetimes. We examine the gravitational effects on particles emitted near the event horizon and demonstrate that the effective emission region extends beyond the black hole's size. This behavior is closely related to the critical impact parameter derived from the geometrical optics approximation, offering deeper insights into the quantum-classical interplay in black hole evaporation.

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Session Classification: Poster session