General Relativity and Quantum Cosmology

A WKB-like approach to Unruh Radiation

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Unruh radiation is the thermal flux seen by an accelerated observer moving through Minkowski spacetime. In this article we study Unruh radiation as tunneling through a barrier. We use a WKB-like method to obtain the tunneling rate and the temperature of the Unruh radiation. This derivation brings together many topics into a single problem - classical mechanics, relativity, relativistic field theory, quantum mechanics, thermodynamics and mathematical physics. Moreover, this gravitational WKB method helps to highlight the following subtle points: (i) the tunneling rate strictly should be written as the closed path integral of the canonical momentum; (ii) for the case of the gravitational WKB problem, there is a time-like contribution to the tunneling rate arising from an imaginary change of the time coordinate upon crossing the horizon. This temporal contribution to the tunneling rate has no analog in the ordinary quantum mechanical WKB calculation.

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