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Particle creation in a dynamical gravitational wave background

We attempt a computation of the spectrum of scalar particles produced in the background of a spherical gravitational wave. The idea was adopted form the great work by Parker in 1976 where he showed the phenomenon of particle creation in the background of an early expanding universe, the spectrum of which was found to be thermal. In fact, any dynamical spacetime, which is a spacetime having no time like isometries, should result in a non-zero early time vacuum expectation value of the late time number operator in the language of quantum field theory. The dynamical nature of the fabric of spacetime results in the aforementioned particle creation. The exact mathematical treatment in our case of particle creation at the LIGO observatory requires the consideration of gravitational wave pulses, but for the sake of simplification and also to make the physics more suited to the problem, we have worked with spherical gravitational waves, the dynamical nature of which is solely carried by the gauge invariant degrees of freedom of the incoming wave. Using the methodology of perturbation theory, we indeed get a non-zero value for the amplitude of the created particles.

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