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Particle Creation in a Linear Gravitational Wave Background

Inspired by the pioneering 1968 work of L Parker, demonstrating matter quanta production in a dynamical spacetime background, we consider production of scalar quanta in a gravitational wave background. Choosing the spacetime to be a flat spacetime perturbed linearly by a linear gravitational wave, we show that scalar particles may indeed be produced in a perturbative manner. Our formulation is valid for any linear gravitational wave background profile, and is by no means restricted to monochromatic plane waves, in contrast to much of the earlier work on this topic. Thus, our work is directly applicable to gravitational wave signals from compact binary coalescence detected at LIGO, where they are of a pulsed character rather than monochromatic plane waves. We also briefly outline generalizing our approach for photon creation in a gravitational wave background. In this aspect, irrespective of the astrophysical nature of the binary merger sourcing the gravitational wave signal, one expects the dynamical nature of the spacetime to produce all species of light particles. Thus, any binary coalescence is in effect a source of multi-messenger astrophysics.

Primary author: CHAKRABORTY, Tanmoy (Indian Association for the Cultivation of Science)

Co-author: Prof. MAJUMDAR, Parthasarathi (Indian Association for the Cultivation of Science)

Presenter: CHAKRABORTY, Tanmoy (Indian Association for the Cultivation of Science)

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