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Disformal electrodynamics: from varying alpha to vacuum Cherenkov radiation

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In scalar-tensor theories the gravitational sector is extended by including an additional scalar degree of freedom. The most general metric that can be built in such a theory includes disformal terms so that standard model fields move on a metric which is the sum of the space time metric and a tensor constructed from first derivatives of the scalar. In such a theory gravitational waves and photons can propagate at different speeds, and these can in turn be different from the maximum speed limit for matter particles. As I will discuss, disformal couplings can cause charged particles to emit Cherenkov radiation and bremsstrahlung apparently in vacuum, depending on the background evolution of the scalar field. In addition, the fine structure constant becomes time-dependent. I will discuss the implications of such a model in detail and discuss the constraints that arise for models of dark energy with disformal couplings.

Summary

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