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Planar Carrollian dynamics

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Abstract: It is known that the effective dynamics of a system restricted to a plane are in a sense richer than those in the "bulk" thanks to the observation of effective quasi particles in the plane, anyons. While this is a condensed matter result, one may wonder if similar effects arise in General Relativity on some hypersurfaces. A good candidate for the study of this phenomenon is Carroll geometry, as it turns out that important physical structures in Lorentzian spacetimes carry such geometry, such as black hole horizons, conformal null infinity, or even some hypersurfaces inside gravitational waves. Hence, we will look at the effective dynamics on such structures by considering intrinsic motions on 2+1 dimensional Carroll geometries. The distinct behavior of the planar case is due to the presence of two non trivial central extensions of the Carroll algebra. Elementary particles thus feature two additional (effective) physical parameters. Without these parameters (for instance in higher dimensions), it is known that Carroll particles have trivial motions, they do not move. However, we will show that these parameters lead to non trivial motions when particles are coupled to an external electromagnetic field.

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