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Ultrarelativistic spinning objects in nonlocal ghost-free gravity

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We study the gravitational field of ultrarelativistic spinning objects (gyratons) in a modified gravity theory with higher derivatives. In particular, we focus on a special class of such theories with an infinite number of derivatives known as "ghost-free gravity" that include a nonlocal form factor such as exp(-\Box\ell^2), where \ell is the scale of nonlocality. First, we obtain solutions of the linearized ghost-free equations for stationary spinning objects. To obtain gyraton solutions we boost these metrics and take their Penrose limit. This approach allows us to perform calculations for any number of spacetime dimensions. All solutions are regular at the gyraton axis. In four dimensions, when the scale nonlocality \ell tends to zero, the obtained gyraton solutions correctly reproduce the Aichelburg–Sexl metric and its generalization to spinning sources found earlier by Bonnor. We also study the properties of the obtained four-dimensional and higher-dimensional ghost-free gyraton metrics and briefly discuss their possible applications.

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