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Can relativistic effects explain galactic dynamics without dark matter?

In a growing number of recent works, it has been claimed that “gravitomagnetism”/frame-dragging and/or non-linear general relativistic effects can play a leading role in galactic dynamics, partially or totally replacing dark matter. Using the 1+3 “quasi-Maxwell” formalism (and generalizing it for null geodesics), we show, on general grounds, such hypothesis to be impossible. We demonstrate that (i) the observed gravitational lensing effects rule out any galactic model (linear or non-linear) based on gravitomagnetism, and (ii) non-linear contributions to the gravitational field actually weaken gravitational attraction, thereby only aggravating the need for dark matter. I shall also briefly dissect the misunderstandings at the origin of the recently proposed relativistic “galactic” models, most notably the Balasin-Grumiller solution, which serves as an archetypal example for the two key observations above.

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