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Galactic rotation curves in the light of extended theories of electromagnetism

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Electromagnetism is one of the pillars of modern physics and until very recently was nature's sole messenger. The avenue of multi-messenger astronomy in the recent year is opening a whole new world of observations and promises great advances for science, but nonetheless still relies on electromagnetic waves as a core component.

Extended theories of electromagnetism impact thus directly our observations and interpretations of astrophysical phenomena as they modify the core ingredient in our measurements. Extended models where non-linear interactions (notably photon-background EM field) occur, exhibit a violation of the conservation of their energy momentum tensor, regardless of the nature of the model (massive, SME, Non-linear etc). Said violations hints towards the loss of translational symmetry and by extension that frequencies are not necessarily conserved. This lead us to describe what we will call frequency shifts that are usually due to the passage of a radiation in an external non-dynamical electromagnetic field. These effects while very small on a local scale, could lead to non negligible effects on larger ones.

In this presentation, we will consider these effects on a galactic scale and attempt to shed a new light on the issue of excess velocities in galaxies, and offer an alternative/complementary description to the dark matter/modified gravity paradigms. We will notably highlight a correlation between additional velocities and magnetic fields within galaxies and then derive a path from modified Maxwellian models to a contribution of magnetic origin to the observed velocities for galaxies. We will conclude by discussing two possible mechanisms that would explain such a contribution.

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