

# A DISFORMAL AFFAIR: HOW DARK MATTER MIMICS LORENTZ VIOLATION

Guillem Domenech<sup>1,2</sup>, Apostolos Tsampodimos<sup>1,5</sup>, Nathaniel Sherrill<sup>1</sup>, Alexander Ganz<sup>1</sup>, Fiona Kirk<sup>1,3,4</sup>

<sup>1</sup>Institute for Theoretical Physics, Leibniz University Hannover, Appelstraße 2, 30167 Hannover, Germany

<sup>2</sup>Max Planck Institute for Gravitational Physics, Albert Einstein Institute, 30167 Hannover, Germany

<sup>3</sup>Physikalisch-Technische Bundesanstalt, Bundesallee 100, Braunschweig, 38116, Germany

<sup>4</sup>Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot, Israel 7610001

<sup>5</sup>Center for Physical Sciences and Technology, Sauletekio 3, 10257 Vilnius, Lithuania

[apostolos.tsampodimos@ftmc.lt](mailto:apostolos.tsampodimos@ftmc.lt)

In this work the impact of general disformal metric transformations on fermions was studied, which shift the gravitational metric by an additional rank-2 tensor. This tensor can in principle be constructed from scalar-field gradients, vector fields, or field-strength contractions. It was shown that this transformation results in the conventional Dirac action being modified by additional kinetic and axial-current couplings that are quadratic in the shifted field. When the field sourcing the metric shift takes on a nontrivial background value, apparent Lorentz-violating effects can result, which were identified as terms in an effective field theory. Assuming the well-motivated cases of scalar and vector ultralight dark matter, it was demonstrated that experimental tests of rotation and boost violation imply constraints on the additional kinetic coupling. Even under conservative assumptions, the constraints for vector ultralight dark matter are extremely stringent.