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Newton-Cartan Gravity in Noninertial Reference Frames[1] LEO RODRIGUEZ, Assumption College, JAMES ST. GERMAINE-FULLER, SUJEEV WICKRAMASEKARA, Grinnell College — We study Newton-Cartan gravity under transformations into all noninertial, nonrelativistic reference frames. These transformations form an infinite dimensional Lie group, called the Galilean line group, which contains as a subgroup the Galilei group. The fictitious forces of noninertial reference frames are encoded in the Cartan connection transformed under the Galilean line group. These fictitious forces, which are coordinate effects, do not contribute to the Ricci tensor. Only the 00-component of the Ricci tensor is non-zero and equals (4π times) the matter density in all reference frames. While the Ricci field equation and Gauss' law are fulfilled by the physical matter density in inertial and linearly accelerating reference frames, in rotating reference frames Gauss' law holds for an effective mass density that differs from the physical matter density. This effective density has its origin in the simulated magnetic field of rotating frames, highlighting a striking difference between linearly and rotationally accelerating frames. The equations governing the simulated fields have the same form as Maxwell's equations, a surprising result given that these equations obey special relativity (and $U(1)$-gauge symmetry), rather than Galilean symmetry.

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