Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

The Dirac Equation in Curved Space-Time and the Nonrelativistic Limit JONATHAN NOBLE, ULRICH JENTSCHURA, Missouri Univ of Sci & Tech — The Foldy-Wouthuysen transformation is applied to a number of generalized Dirac particles in curved space-times. The Dirac-Schwarzschild Hamiltonian is covariantly coupled to a central gravitational field (black hole) within general relativity. We identify the averaged trajectory (after the elimination of the zitterbewegung which proceeds at the velocity of light). The transformed Hamiltonian is much easier to understand as it clearly displays the gravitational correction terms. These include terms describing the kinetic corrections to the gravitational coupling, a Darwin (zitterbewegung) term, and a spin orbit coupling term. Additionally, we apply the transformation to the transition current, and find a gravitational kinetic correction as well as gravitational corrections to the magnetic coupling. We also obtain results for a few other phenomenologically interesting generalized Dirac Hamiltonians, such as those describing a Dirac particle in a non-inertial frame. Finally, we discuss the possible pitfalls which one can encounter when preforming the transformation, including the "chiral" method which has some elegant analytic properties, but does break the fundamental symmetries of the original Hamiltonian, as well as change the physical interpretation.

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Date submitted: 15 Nov 2013 Electronic form version 1.4