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Fully relativistic spin torques and spin currents[1] PETER WEINBERGER, ANDRAS VERNES, CMS, TU-Vienna, BALAZS L. GYORFFY, U-Bristol & CMS, TU-Vienna — In using the one-particle Dirac equation in the presence of an external electro-magnetic field an exact equation of motion for the density of the four-component Bargmann-Wigner polarization operator $T_\mu = (\vec{T}, T_4)$ is presented, the various occuring terms of which can be viewed as the relativistic counterparts of *ad hoc* defined non- relativistic spin-currents and spin-transfer torques. Based on the properties of the Berry phase the particle and the magnetization density can be formulated in terms of a instantanous resolvent $G(z;t)$ of the time dependent Dirac equation by means of contour integrations. The corresponding Greens function $G(\mathbf{r}, \mathbf{r}',\ z;t)$ can in turn be evaluated within a multiple scattering scheme by solving at each given time t a "quasi-stationary" problem. In terms of this Greens function the time evolution of any single-particle density, i.e., also of $T_\mu = (\vec{T}, T_4)$ can be evaluated. As a first application the case of a single Fe atom is considered, for which very easily a comparison with a time- dependent first order perturbational scheme can be given.

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