EQUATION OF MOTION FOR SPIN IN ELECTROMAGNETIC FIELD

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The equation of motion for spin $\boldsymbol{s}$ in continuum in absence of the electromagnetic field has been considered. In the present paper the equation for $\boldsymbol{s}$ in presence of the electromagnetic field is derived on the basis of the conservation law of the total angular momentum (orbital and spin) of the continuum and electromagnetic field .This equation has the form

$$\rho\dot{s} + \mathbf{R}_{n,n} = \mathbf{N}^P + \mathbf{N}^D + \mathbf{N}^A + \mathbf{N}^G,$$

where ρ is the continuum mass density, $\mathbf{R}_n$ is the surface torque, $\mathbf{N}^P=\mathbf{e}_i e_{irk} P_{nk}$ is the volume torque due to nonsymmetrical stress tensor $\mathbf{P}_n$, e_{irk} is the unit antisymmetric tensor, $\mathbf{e}_i$ is the base vector, $\mathbf{N}^D=[\mathbf{PE}]+[\mathbf{MB}]$ is the electromagnetic torque, $\mathbf{E}$ and $\mathbf{B}$ are the electric and magnetic fields, $\mathbf{P}$ and $\mathbf{M}$ are the polarization and magnetization, $\mathbf{N}^A=c^{-1}[\mathbf{J}^{eff}\mathbf{A}]$ is the torque due to vector potential $\mathbf{A}$, $\mathbf{J}^{eff}=\mathbf{J}+\mathbf{P}_{,t}+\mathrm{crot}\mathbf{M}$ is the effective current, $\mathbf{N}^G=\mathbf{N}^L+\mathbf{N}^{AD}$ is the torque existing without Lorenz gauge, $\mathbf{N}^L=z^A\mathbf{B}-c^{-1}[\mathbf{J}^A\mathbf{E}]$ and $\mathbf{N}^{AD}=(4\pi)^{-1}A_n\nabla B_n$ are the torques in a form similar to Lorenz force and electromagnetodipole force, $z^A=\mathrm{div}\mathbf{A}/4\pi$, $\mathbf{J}^A=(c/4\pi)\nabla\varphi$, φ is the scalar potential. The parameters z^A and $\mathbf{J}^A$ are related by the equation of continuity $z^A{}_{,t}+J^A{}_{n,n}=-c(z-P_{n,n})$, where z is the electric charge. Therefore J^A is the flux of z^A.