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Corrections from space-time dependent electromagnetic fields to Wigner functions and spin polarization

We have derived the Wigner equations at global equilibrium with constant vorticity but space-time dependent electromagnetic fields up to second order in semiclassical expansion. We obtain the new second-order contributions to the charge currents and energy-momentum tensor from the varying electromagnetic fields. We also compute the new corrections to the spin polarization pesudo-vector from both contant and varying electromagnetic fields. We also find that the space-time dependent
electromagnetic field provides a tighter constraint on the solutions of Wigner functions in global equilibrium compared with constant electromagnetic field.

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