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Toward a microscopic description for polarization in particle scatterings

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We propose a microscopic description for the polarization from the first principle through the spin-orbit coupling in particle collisions. The model is different from previous ones based on local equilibrium assumptions for the spin degree of freedom. It is based on scatterings of particles as wave packets, an effective method to deal with particle scatterings at specified impact parameters. The polarization is then the consequence of particle collisions in a non-equilibrium state of spins. The spin-vorticity coupling naturally emerges from the spin-orbit one encoded in polarized scattering amplitudes of collisional integrals when one assumes local equilibrium in momentum but not in spin.

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