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# Kinetic theory for massive spin-1 particles

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We derive a semi-classical kinetic theory for massive spin-1 particles from the Wigner-function formalism.

Starting from an interacting Proca Lagrangian, we obtain equations of motion for the Wigner function of massive charged vector bosons in classical electromagnetic fields. Performing a power-expansion up to first order in the Planck constant $\hbar$, we then derive generalized Boltzmann equations and mass-shell contraints, in which quantum effects are pertubatively included. In particular, we obtain an equation of motion for the tensor polarization. If the latter is neglected, we recover known results for the kinetic equations of scalar distribution and vector polarization of spin-1/2 particles.

As a next step, we study the collision kernel emerging from a general interaction. Analogous to spin-1/2 particles, the collision term contains local and nonlocal contributions, allowing for the exchange of spin and orbital angular momentum, providing a mechanism for spin polarization from vorticity.

Our framework can be used describe polarization phenomena of spin-1 particles, e.g. $\rho$ mesons, in heavy-ion collisions.

**Primary authors:** WAGNER, David (Goethe University Frankfurt); RISCHKE, Dirk (University Frankfurt); SPERANZA, Enrico (University of Illinois at Urbana-Champaign); WEICKGENANNT, Nora (Goethe University Frankfurt)

**Presenter:** WAGNER, David (Goethe University Frankfurt)

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