Collisional operator from non perturbative guiding center transformation

The Boltzmann equation assumes a different form of the collision operator once the non-perturbative guiding center transformation is adopted for the description of the dynamics.
It has been recently demonstrated [1] that the lagrangian describing the interactions between particles and electromagnetic field, both in the presence or in the absence of gravitational forces, shows a Hilbert-Einstein term deriving from the geometry of the phase space modified by the presence of a distribution of charges and their energies. When the non-perturbative guiding center transformation is applied, it is possible to recognize the same mechanism used in the Kaluza-Klein model.
Firstly, it is worth noticing that a description of eletrodynamics in terms of a general relativity theory extended to the phase space, prevents the constitution of the problem of the BBGKY hierarchy, in fact the particle-particle interaction is only a weak field approximation which is not valid, generally.
As a second observation, it is possible to arrive at a Boltzmann equation with a collision term due to the geometry of the phase space.
Finally, with the hypothesis that this term is a Fokker-Planck collisional operator, it is possible to deduce the relation between distribution function that reaches equilibrium and the geometry of the phase space that becomes homogeneous with respect to the action variable. In such a way that it is possible to move from the Boltzmann equation to the Vlasov equation up to the gyrokinetic equation and their solutions [2].

[1] Di Troia C., Journal Of Modern Physics, **9** (2018) 701
[2] Di Troia C., Physics of Plasmas, **22** (2015) 042103