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The kinetic gas universe - Lifting the Einstein Vlasov system to the tangent bundle

Saturday, 26 September 2020 18:30 (15 minutes)

In this talk I will present a new model for the description of a gravitating kinetic gas, by coupling the 1-particle distribution function (1PDF) of the gas directly to the gravitational field, lifted to the tangent bundle of spacetime. This procedure takes the influence of the velocity distribution of the kinetic gas particles on their gravitational field fully into account, instead of only on average, as it is the case for the Einstein-Vlasov system.

By using Finsler spacetime geometry I construct an action for the kinetic gas on the tangent bundle, which is added as matter action to a canonical Finslerian generalisation of the Einstein-Hilbert action. The invariance of the kinetic gas action under coordinate changes gives rise to a new notion of energy-momentum conservation of a kinetic gas in terms of an energy-momentum distribution tensor. The variation of the total action with respect to the spacetime geometry defining Finsler Lagrangian yields a gravitational field equation on the tangent bundle, which determines the geometry of spacetime directly from the full non-averaged 1PDF. This equation can be regarded as generalisation of the Einstein-Vlasov system, which takes all features of the kinetic gas into account.

The talk will be based on the essay The Kinetic Gas Universe and the article Relativistic kinetic gases as direct sources of gravity.

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