Contribution ID: **69** Type: **not specified**

Method of moments for an interacting plasma, systematic expansion and convergence.

Tuesday, 19 September 2017 15:30 (20 minutes)

Relativistic hydrodynamics has been an invaluable tool for understanding the nature of many phenomena, from heavy ion collisions to astrophysical plasma. There is a mounting evidence that the Chapman-Enskog expansion has a vanishing radius of convergence but, on the other hand, the method of moments applied to weakly interacting gasses doesn't have such problems. The equations can be systematically improved and the convergence properties checked. If one introduces interactions in the form of a medium-dependent mass or a gauge field interacting with the plasma, the systematic expansion breaks down, since the sources of the successive moments become increasingly large, in fact diverging in the ultra-relativistic (mass-less) limit. We study therefore the simplest, non-trivial and exactly solvable system; namely, a plasma of mass-less particles interacting with an electromagnetic field and undergoing a boost invariant and transversely homogeneous expansion. We propose a method to re-sum the contribution of all the moments of the same rank. The resulting expansion is always well defined at any order, and we show the convergence properties compared to the exact solutions.

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Session Classification: Thermalization / Hydrodynamization