Contribution ID: **167** Type: **not specified**

Relativistic perfect fluid hydrodynamics of particles with spin 1/2

Thursday 11 May 2017 18:30 (30 minutes)

Starting from local equilibrium distribution functions for particles and antiparticles with spin 1/2, which are generalised to two by two hermitian matrices to include spin degrees of freedom, and using the conservation laws for energy, momentum and angular momentum, we derive hydrodynamic equations for the local temperature, chemical potential and hydrodynamic flow, as well as for the spin tensor. The resulting framework results in a set of differential equations which, in the minimal way, extend the standard picture of perfect-fluid hydrodynamics with the entropy current conserved. They can be used in space-time analyses of spin and polarisation evolution for various physical systems including high-energy nuclear collisions. As a special solution of the obtained approach, we find a stationary vortex-like solution which exhibits the vorticity-spin alignment and has been found in earlier studies of fluids at global equilibrium.

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Session Classification: Thursday Afternoon (20min talks + 10min discussions)