Contribution ID: **4** Type: **not specified**

Simulating Collisional Dark Matter

Tuesday 31 July 2018 09:30 (30 minutes)

The search for dark matter is a joint quest between particle physics and astrophysics.
From astrophysical evidence we know that the dark matter particle should be outside the standard model.
Nevertheless, the dark matter particle should have well defined particle properties including its cross section.
This means that dark matter must be collissional to some degree.
However, dark matter has been simulated as a collisionless fluid.
This approximation has been successful at explaining large scale properties of the Universe.
But when it comes to smaller scales some inconsistencies are observed, provinding further evidence that dark matter should be collisional.
In this talk, I will present the first results of a simulation that takes explicitly into account the collisional nature of dark matter.
We do this with an integer lattice method to solve the Boltzmann equation, this allows us to simulate the phase space of a
collisional dark matter fluid.
We report results from 1D numerical simulations that model a simplified version of the Bullet Cluster.
This allows us to obtain information about the velocity distribution, which is also of interest to dark matter direct detection efforts.
We finalize by describing the extension of this work to develop 3D simulations that will also recreate more realistic initial conditions.

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Session Classification: Dark Matter