A non-ideal MHD Gadget: Simulating massive galaxy clusters

A. Bonafede, K. Dolag, F. Stasyszyn, G. Murante, S. Borgani

(Submitted on 5 Jul 2011)

Magnetic fields in the intra-cluster medium of galaxy clusters have been studied in the past years through different methods. In the next years the up-coming generation of radio telescopes is going to provide new data that have the potential of setting constraints on the properties of magnetic fields in galaxy clusters. Here we present zoomed-in simulations for a set of massive galaxy clusters (M_v > 10^15 M_sun/h). This is an ideal sample to study the evolution of magnetic field during the process of structure formation in detail. Turbulent motions of the gas within the ICM will manifest themselves in a macroscopic magnetic resistivity eta_m, which has to be taken explicitly into account, especially at scales below the resolution limit. We have adapted the MHD GADGET code by Dolag & Stasyszyn (2009) to include the treatment of the magnetic resistivity and for the first time we have included non-ideal MHD equations to better follow the evolution of the magnetic field within galaxy clusters. We investigate which value of the magnetic resistivity eta_m is required to match the magnetic field profile derived from radio observations. We find that a value of eta_m ~ 6 10^27 cm^2/s is necessary to recover the shape of the magnetic field profile inferred from radio observations of the Coma cluster. This value agrees well with the expected level of turbulent motions within the ICM at our resolution limit. The magnetic field profiles can be fitted by a beta-model like profile (Cavaliere & Fusco-Femiano 1976), with small dispersion of the parameters. We find also that that the temperature, density and entropy profiles of the clusters depend on the magnetic resistivity constant, having flatter profiles in the inner regions when the magnetic resistivity increases.

Comments: 19 pages, 11 figures. Resubmitted to MNRAS after referee report
Subjects: **Cosmology and Extragalactic Astrophysics (astro-ph.CO)**
Cite as: **arXiv:1107.0968 [astro-ph.CO]**
(or **arXiv:1107.0968v1 [astro-ph.CO]** for this version)

Submission history

From: Annalisa Bonafede [view email]
[v1] Tue, 5 Jul 2011 20:00:00 GMT (5230kb)

Which authors of this paper are endorsers?