Highlights of Spanish Astrophysics VII, Proceedings of the X Scientific Meeting of the Spanish Astronomical Society held on July 9 - 13, 2012, in Valencia, Spain. J. C. Guirado, L.M. Lara, V. Quilis, and J. Gorgas (eds.)

Baryon census in hydrodynamical simulations of galaxy clusters

S. Planelles[1,2], S. Borgani[1,2,3], G. Murante[4], L. Tornatore[1], K. Dolag[5,6], and D. Fabjan[3,7,8]

[1] Astronomy Unit, Department of Physics, University of Trieste, via Tiepolo 11, I-34131 Trieste, Italy
[2] INAF, Osservatorio Astronomico di Trieste, via Tiepolo 11, I-34131 Trieste, Italy
[3] INFN – National Institute for Nuclear Physics, Trieste,Italy
[4] INAF, Osservatorio Astronomico di Torino, Str. Osservatorio 25, I-10025, Pino Torinese, Torino, Italy
[5] Universitätssternwarte München, München, Germany
[6] Max-Planck-Institut für Astrophysik, Garching, Germany
[7] Center of Excellence SPACE-SI, Aškerčeva 12, 1000 Ljubljana, Slovenia
[8] Faculty of Mathematics and Physics, University of Ljubljana, Jadranska 19, 1000 Ljubljana, Slovenia

Abstract

The global baryon content of the largest galaxy clusters is expected to trace accurately the matter content of the universe and, therefore, it can be used to reliably determine the matter density parameter $\Omega_{\rm m}$. However, this fundamental assumption is challenged by the growing evidence from optical and X-ray observations that the total baryon mass fraction increases towards rich clusters. In this context, we investigate the dependence of stellar, hot gas, and total baryon mass fractions as a function of cluster mass. To do so, we study the baryon mass fraction in a set of hydrodynamical simulations of galaxy clusters performed using the Tree+SPH code GADGET-3. These clusters have been re-simulated using various subsets of baryonic processes including radiative cooling, star formation, galactic winds and AGN feedback. We investigate the dependence of the baryon fraction upon the different models of baryon physics and we find that, although none of our models is able to fully reproduce the observed strong trend of the stellar mass fraction with cluster mass, both the gas and stellar mass fractions of the whole sample of our set of simulated clusters are in much better agreement with observations when AGN feedback is included. We also analyse the consequences of these results in calibrating the baryonic depletion factors, necessary in the determination of cosmological parameters from observations of the baryon content within clusters.