PROCEEDINGS OF SCIENCE

Formation and evolution of massive elliptical galaxies in clusters: a consistent picture from optical and X-ray properties

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We present a new chemical evolution model meant to be a first step in the self-consistent study of both optical and X-ray properties of elliptical galaxies in cluster of galaxies. Detailed cooling and heating processes in the interstellar medium are taken into account using a mono-phase one-zone treatment which allows a more reliable modelling of the galactic wind regime with respect to previous work. The model successfully reproduces simultaneously the mass-metallicity, colour-magnitude and the L_X - L_B relations, as well as the observed trend of the [Mg/Fe] ratio as a function of sigma, by assuming that the gas infall and star formation timescales are shorter for brighter objects. We found that a late secondary accretion of gas from the environment plays a fundamental role in driving the L_X - L_B and L_X - T relations and can explain their large observational scatter. The iron discrepancy, namely the too high predicted iron abundance in X-ray haloes of ellipticals compared to observations, still persists. On the other hand, we predict [O/Fe] in the ISM which is in good agreement with the most recent observations. New predictions for the amounts of iron, oxygen and energy ejected into the intracluster medium are presented and we conclude that Type Ia supernovae play a fundamental role in the ICM enrichment. SNe Ia activity, in fact, may power a galactic wind lasting for a considerable amount of the galactic lifetime, even in the case for which the efficiency of energy transfer into the ISM per SN Ia event is much less than unity.

BDMH 2004 – Baryons in Dark Matter Halos
5–9 October 2004
Novigrad (Croatia)

Published by SISSA http://jhep.sissa.it/archive/prhep/preproceeding/010/061/AHEPh.pdf