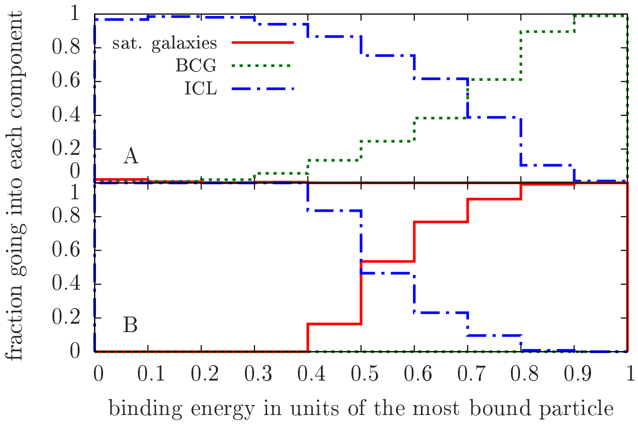


**Figure 15.** Distribution of binding energies in their host halos at $z = 1$ of the stars that end up the cluster's satellite galaxies, BCG, and ICL at $z = 0$. Results are shown for the stars that are part of the objects A (*upper panel*) and B (*lower panel*) indicated in Fig. 14. *Method 4* was used for making a distinction between BCG and ICL.

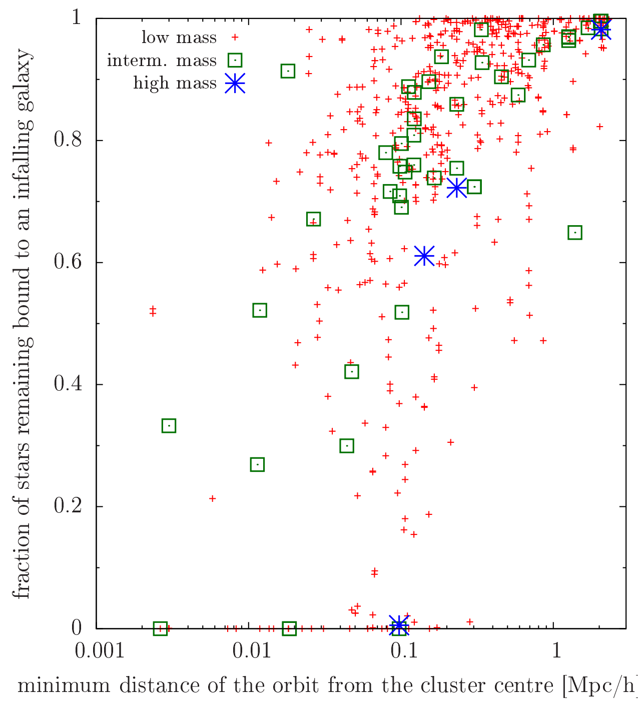


**Figure 16.** Fraction of stars that remain bound to a satellite galaxy as a function of the minimum distance of its orbit from the cluster centre. All galaxies that fell into the main progenitor of a $3 \times 10^{14}\,h^{-1}M_\odot$ cluster between redshift $z = 1.5$ and $z = 1$ are plotted. The minimum distance was found by interpolating the galaxy's orbit based on all simulation snapshots between the time of the infall and $z = 0$. Different symbols are used for *low mass* galaxies (stellar mass before infall into the cluster $M_*$ in the range $5 \times 10^9\,h^{-1}M_\odot \leqslant M_* < 5 \times 10^{10}\,h^{-1}M_\odot$), *intermediate mass* galaxies ($5 \times 10^{10}\,h^{-1}M_\odot \leqslant M_* < 5 \times 10^{11}\,h^{-1}M_\odot$) and *high mass* galaxies ($M_* \geqslant 5 \times 10^{11}\,h^{-1}M_\odot$). Galaxies with a fraction of 0 have either merged with the BCG or have been completely tidally disrupted.

of the cluster centre were interpolated using all simulation snapshots between the time of the galaxy's infall and $z = 0$, using a cubic interpolation between each pair of successive snapshots based on the halo positions and velocities determined by SUBFIND. The results are shown for three different stellar mass ranges of the infalling galaxy. We see that only few stars are stripped from galaxies that never come close to the cluster centre. On the other hand, galaxies that closely approach the cluster centre are often substantially stripped, completely tidally disrupted, or merge with the BCG. This confirms the expectation that most of the tidal interactions that liberate intracluster stars happen close to the cluster centre and the BCG.

## 4 SUMMARY AND CONCLUSIONS

The intracluster light in clusters of galaxies represents an interesting and significant component of their total stellar mass. While the observational constraints on the ICL are still uncertain, some studies have reported intracluster star fractions of up to $\sim 50\%$. Even if the true fraction is significantly lower, it is therefore clear that the ICL can not be neglected in the baryon and stellar mass budgets of clusters. Furthermore, the radial profile of the ICL and the mass contained in it may pose interesting constraints on galaxy cluster formation models. Yet, comparatively little theoretical work has been carried out thus far on the formation of the ICL. In fact, most semi-analytic models of galaxy formation have hitherto ignored this component entirely.

In this work we have therefore studied the origin of intracluster stars in a set of high-resolution hydrodynamical simulations of the formation of clusters of galaxies, embedded in their appropriate cosmological setting. Our sample of resimulations has been randomly drawn from the Millennium simulation, with the only selection criterion being to provide a wide coverage of group and cluster masses, of roughly two orders of magnitude in halo mass. Thanks to the very high mass and force resolution of our resimulations, our simulations provide a powerful and representative sample of the whole cluster population. Another very timely aspect of our simulations is that we not only account for hydrodynamics, radiative cooling, heating by a UV background, star formation and supernovae feedback, but also incorporate a state-of-the-art model for the growth of supermassive black holes and for feedback from AGN. Because we simulated each cluster both with and without AGN physics, this allows us to pinpoint the impact of AGN heating on the cluster galaxy populations, and in particular on the ICL.

Our results clearly confirm the importance of AGN feedback in galaxy clusters. AGN lead to a reduction of the amount of stars in our clusters and groups by about one third, roughly independent of cluster mass. Especially the stellar masses and luminosities of BCGs are greatly reduced by AGN feedback, and their stellar populations become much older. As a consequence, the BCGs are in much better agreement with observational constraints. Furthermore, in poor clusters and groups, the total baryon fractions within $r_{500}^{\rm crit}$ become significantly lower when AGN heating is included.

The primary focus of our analysis has been on the amount and the origin of the ICL component in our simulated groups and clusters. In order to allow a meaningful comparison of our simulation results with observations of