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Fossil Galaxy Groups; Scaling Relations, Galaxy Properties and Formation of BCGs

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Abstract. We study fossil galaxy groups, their hot gas and the galaxy properties. Fossils are more X-ray luminous than non-fossil groups, however, they fall comfortably on the conventional L-T relation of galaxy groups and clusters indicating that their X-ray luminosity and temperature are both boosted, arguably, as a result of their early formation. The central dominant galaxy in fossils have optical luminosity comparable to the brightest cluster galaxies (BCGs), however, the isophotal shapes of the central galaxy in fossils are non-boxy in contrast to the isophotes of majority of the BCGs.

Keywords. galaxies: evolution, galaxies: structure, X-rays: galaxies: clusters

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Galaxy groups are rapidly evolving and diverse systems, therefore studying a sample of well-characterised groups can help to address some of the complexities in galaxy groups including their scaling relations. Fossil groups are known to be the end-result of galaxy mergers within a group in the absence of recent mergers and are therefore primary candidates for virialised galaxy systems. Fossils are dominated, optically, by a single giant elliptical galaxy surrounded by a highly regular and symmetric group-scale X-ray emission. We study the largest sample of fossil galaxy groups using their Chandra X-ray observations and deep ground based optical photometry and spectroscopy.

We find that, for a given total optical luminosity of the group, fossils are more X-ray luminous than non-fossil groups. However, they fall comfortably on the conventional L-T relation of galaxy groups and clusters indicating that their X-ray luminosity and temperature are both boosted, arguably, as a result of their early formation. The dark matter distribution in fossils is also more concentrated compared to non-fossils (Khosroshahi, Ponman & Jones 2006a).

The central dominant galaxy in fossils have optical luminosity comparable to the brightest cluster galaxies (BCGs), raising immediate interest in their link to the formation of the BCGs. This is further motivated by observational estimates suggesting that the fossils are as numerous as poor and rich clusters, combined. Despite apparent similarities, we find that the isophotal shapes of the central galaxy in fossils are non-boxy in contrast to the isophotes of majority of the BCGs (Khosroshahi, Ponman & Jones 2006b) . If the fossils form from the mergers of major galaxies including late-types within a group, then their disky nature is consistent with the results of numerical simulations which suggest that gas rich mergers result in disky isophote ellipticals (Khochfar & Burkert 2005). This is discussed in the context of the BCG formation modes (Khosroshahi, Ponman & Jones 2006b).

References

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