The intriguing life of massive galaxies
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The intriguing life of cD galaxies

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cD galaxies are supergiant elliptical galaxies found generally in the central parts of rich clusters, which have an extended halo-like component (envelope) in addition to the underlying de Vaucouleurs-Sérsic elliptical galaxy-like component. This envelope can extend to radial distances of > 500 kpc (Oemler 1976, Schombert 1988). There have been many theories to explain the formation of these envelopes. These include tidal stripping, where material is stripped from neighbouring galaxies; mergers and fusions, where the envelope is built up hierarchically by successive mergers with large and small galaxies; primordial origin, where the envelope is formed at the same time as the rest of the elliptical galaxy (which appears to be related to theories of early formation of the largest galaxies); and cooling flows: in clusters with X-ray emission there is often a minimum temperature in the centre interpreted as a flow of cooling gas towards the centre of the cluster, where the gas can cool sufficiently, forming stars. The colours of the stars in the envelopes will be affected by their process of formation and subsequent evolution.

We carried out a programme of deep surface photometry on a sample of 10 cD envelopes using the 2.1m and 1.5m telescopes at San Pedro Mártir, Baja California, México, obtaining 30-90 min total exposure per filter (Kemp *et al.* 2009). For the majority of the galaxies we obtained generally flat colour profiles within the errors, varying by no more than ± 0.1 mag in $B-V$. The profiles of 6 cDs do not show appreciable gradients. About 30% of the galaxies do have gradients, generally with bluer centres, implying some star formation activity may result from mergers (A2199) or cooling flows (A426). The flat profiles imply stellar populations with similar ages in the underlying galaxy and the envelope, which could favour the primordial origin or downsizing hypothesis, suggesting that any subsequent evolution that the galaxy experiences does not usually dominate its global colours. Variations of age and metallicity of the stellar populations with position could result in similar colours. To investigate this possibility, we are carrying out a programme of medium-resolution spectroscopy of cDs at the 2.1m in San Pedro Mártir and with OSIRIS/GTC to obtain age and metallicity of stellar populations. We are also carrying out a 2D analysis of surface brightness profiles with GALFIT to fit components to the underlying galaxy and envelopes. The main result so far is that the extended halo component frequently has a Sérsic index $n \sim 1$, i.e. an exponential fall-off with radius.

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