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STAR FORMATION IN COOLING FLOW GALAXIES

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ABSTRACT

Spectroscopic observations of central dominant galaxies are reviewed. Through the analysis of absorption spectral features (mainly the strength of the Mg triplet at 5175 Å and the break in 4000 Å), both in the galaxy centers and along the radii, we will be able to impose limits on the ongoing star formation as the ultimate fate for the large amounst of acoreted gas. With the same aim we will carry out a dynamical study based on velocity dispersion measurements.

INTRODUCTION

X-ray observations have shown that some cluster dominant galaxies are accreting large amounts of gas (cooling flows) from the intracluster medium at typical rates of 100 $M_\odot$/yr. It is estimated that this gas accretion could have persisted for 1-10 Gyr. Therefore, such galaxies could have accreted a total mass of 10^{11}-10^{12} $M_\odot$, comparable with their estimated masses (Sarazin 1986, and O'Connell and McNamara 1989).

ABSORPTION FEATURES AND STELLAR FORMATION

Several studies have pointed out that the only plausible fate for the large amounts of gas accreted is the formation of new stars. However, the spectra of these galaxies are roughly similar to those of galaxies without accretion, and the studies devoted to detect such star formation have produced contradictory results so far. Whilst some galaxies exhibit evidences of ongbing star formation, in other objects with important cooling flows, no signs of an accretion population have been found.

A direct approach to this problem, almost not employed in previous works, is the study of spectral absorption features in cooling flow galaxies. In a preceding work (Gorgas, Efstathiou and Aragon, 1990), we have analyzed the line strengths in the central regions of a sample of cD galaxies. It should be noted that the Mg_2 index is very sensitive to changes in the stellar population and, therefore, to any possible recent star formation. Since both the velocity dispersion and Mg_2 decrease with radius in early-type galaxies (Gorgas and Efstathiou, 1987), these measurements must be corrected to the same lineal aperture. The corrected data show that there is no firm evidence that the Mg_2 indices for cooling flow galaxies differ from those of normal ellipticals at the same velocity dispersion (roughly same absolute magnitude). However, it should be remarked that the mean gradients for elliptical galaxies have been used to perform the aperture corrections. Using long slit observations of 3 cD galaxies, Carter *et al.* (1985) and Gorgas *et al.* (1990) found,

respectively, that the gradients in σ and Mg_2 are, in the mean, smaller than those found in ellipticals. Therefore such corrections could be overestimated and conclusive results can not be extracted until asystematic study with spatial resolution of cooling flow galaxies can be performed. Such study is essential to get information about the radial distribution of mass deposition. The comparison of the line-strength gradients in cooling flow galaxies with those found in giant ellipticals could help to determine whether the star formation is concentrated in the central regions (lower gradients for cooling flow galaxies) or whether the mass is deposited gradually along the galaxy radius (higher gradients). Our former results contrast with those found by Johnstone, Fabian and Nulsen (1987). These authors found evidences of star formation in cooling flow galaxies, showing a correlation between the depth of the break at 4000 Å, and the gas accretion rate. In order to compare these results with ours we have modelled, using an evolutionary synthesis technique, the expected changes in Mg_2 and D_{4000} for a range of ongoing star formation rates (Gorgas *et al.* 1990). The model predictions show that the changes in D_{4000} measured by Johnstone *et al* ($D_{4000} \approx 0.2$-1.2) should involve large variations in the Mg_2 index, not detected in our sample. It is important to note that the D_{4000} values from the correlation of Johnstone *et al.* are strongly correlated with the redshift of the objects, indicating the existence of an aperture effect analogous to that described for Mg_2. The measurement of radial gradients for both features in cooling flow galaxies is therefore hardly needed to confirm or not the existence of such a correlation.

Another information source is the analysis of emission lines frequentely found in these objects, which allow to know the possible ionization mechanisms (massive young stars, collisions) (Heckman *et al.* 1988), and the radial distribution of the accretion population.

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