

STELLAR CONTENT IN DUMBBELL GALAXIES

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RESUMEN. Investigamos el contenido estelar de galaxias dumbbell y otras galaxias masivas en el centro de cumulos. Analizamos espectros de 45 de estos sistemas, comparandolos con un conjunto de templates apropiados. Nuestro trabajo muestra que la mayoria de estos sistemas son tipicamente rojos con lineas metalicas intensas, del tipo de los nucleos de galaxias elipticas vecinas. Algunos objetos muestran signos de formacion estelar reciente.

ABSTRACT. We investigate the stellar content of dumbbell galaxies and other central massive galaxies in clusters. Spectra of 45 such systems were analyzed by means of a comparison with nearby galaxy templates. The results show that the typical stellar population in dumbbell galaxies is red strong-lined like those of nearby giant galaxy nuclei, but evidence of recent stellar formation was also found in a few systems.

Key words: GALAXIES-STELLAR CONTENT

INTRODUCTION

Dumbbell galaxies are luminous massive interacting systems, which are composed of two elliptical nuclei of similar brightness with an extensive common halo of stars. In general, the dumbbells are central galaxies in clusters and may be related to X ray and radio sources. Up to now, spectral studies of cluster members have been mostly dedicated to the determination of redshifts and velocity dispersions (e. g. Havlen and Quintana 1978, Dressler and Gunn 1982). Dressler and Gunn (1983) analyzed spectroscopically the stellar population in members of the 3C295 cluster. They found six blue galaxies: three with active nuclei and three showing large bursts of star formation. Spectral analyses of gas and stellar content in dumbbells are few (e. g. Hu et al. 1985). The objective of the present work is to investigate spectroscopically the stellar content of a large sample of dumbbell galaxies.

OBSERVATIONS

We analyze spectra between $3700 < \lambda(\text{A}) < 5500$ of 45 objects which are dumbbell (db) components and other bright central galaxies from groups or clusters in the radial velocity range $4000 < V_r(\text{km/s}) < 50000$. The observations were made in 5 nights at the CTIO 4m telescope with the B&C spectrograph, using a SIT Vidicon detector. The slit width was $225\mu\text{m} = 1.5''$, the resolution 5A and the dispersion 1.7-1.8 A/pix. Exposures range from 10 to 45 minutes. The slit was oriented so as to obtain both db nuclei in a single

exposure. The TVRed package was used in the reductions. Sky subtracted spectra from 2D images were obtained including typically several pixels (1.2"/pix.) from the db nuclei along the slit.

III. METHOD OF ANALYSIS

We group spectra with similar properties in 15 redshift ranges and compare them with those of nearby galaxy nuclei. We have followed the method of Wirth (1985) which consists of the division of an unknown spectrum by a reference one with known properties. We employed the following reference spectra of Bica (1988): E1, which is an average spectrum of the central 1-2 kpc of giant E/SO galaxies; E7, E/SO galaxy nuclei with a strong contribution of intermediate age components; and S5, spiral nuclei with a significant young stellar population.

Table 1 shows the components and properties of the 15 dumbbell spectral groups. Figures 1 to 3 show examples of spectra in the sample and comparisons with their suitable templates.

IV. RESULTS AND CONCLUSIONS

One third of the dumbbell groups (DB5, 7, 11, 13 and 15) are nicely represented by E1 (e. g. Figure 2); this is also true for DB8 except for the emission lines [OII]3727 and H β . Four groups (DB2, 4, 9 and 12) are slightly bluer than E1 for $\lambda < 4000\text{\AA}$.

The strongest metallic absorptions in the sample are observed in DB1, corresponding to the bridge of the system NGC4782/3 (Figure 1). This galaxy system is known to be in strong tidal interaction. Further work must be carried out to establish the nature of this peculiar spectrum.

DB3, which is a companion to the dumbbell 0622-35, was well represented by E7, suggesting the presence of an intermediate age component.

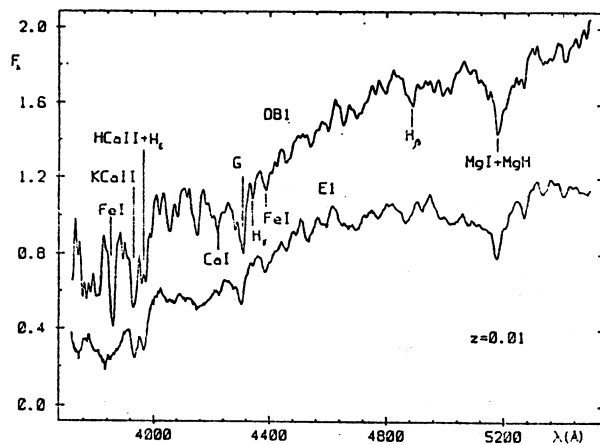


Figure 1a. The spectrum DB1 of the NGC4782/3 bridge (from a region $\approx 0.6 \times 2.5$ kpc), the highest metallicity group of the sample, compared to E1, an average spectrum of the central 1-2 kpc of giant E-SO galaxies. The spectra are normalized at 4570 \AA ; DB1 is shifted by a constant. Note the deep metallic lines and the strong blanketing in the DB1 spectrum.

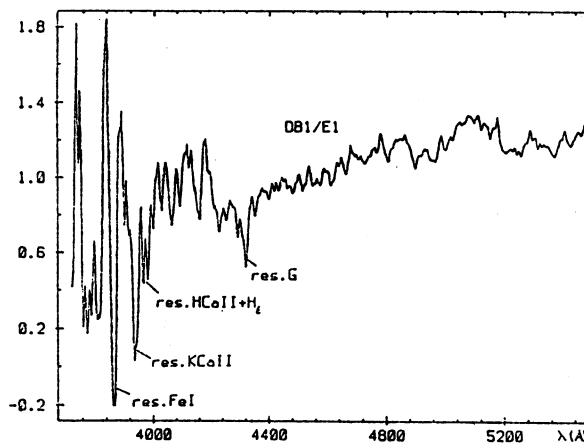


Figure 1b. The ratio DB1/E1 showing the residual of metallic features and the slope due to the blanketing. The scale is the same as in Fig. 1a.

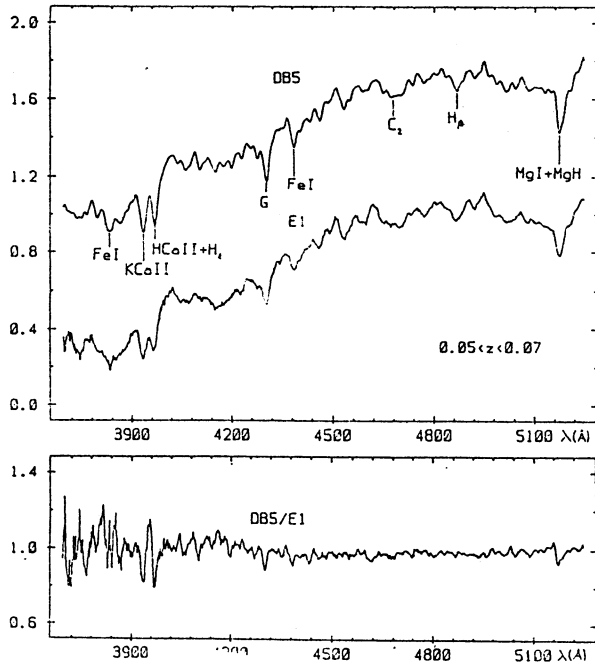
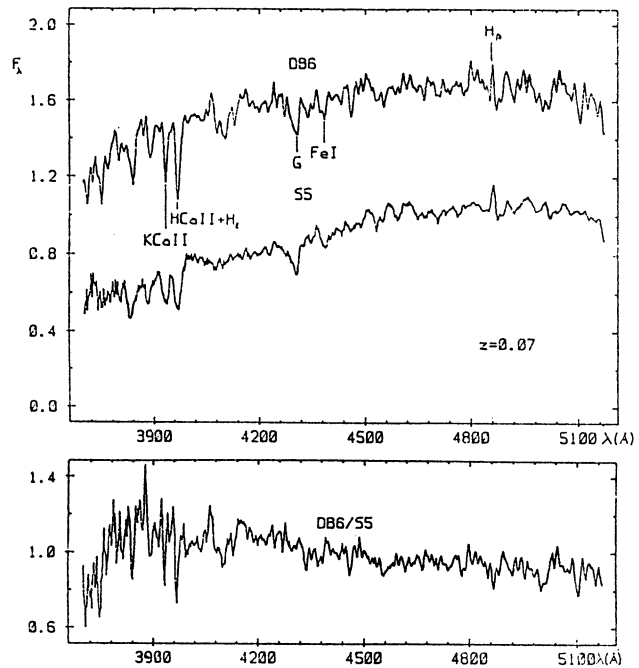


Figure 2a. DB5, a typical spectral group in our sample, is compared to E1. DB5 and E1 are approximately at the same distance, the central 2 kpc being sampled in both spectra. Some features in the DB5 spectrum are indicated.

Figure 2b. The ratio DB5/E1 showing the excellent agreement of the spectra. It is possible to note

Figure 3a. The spectrum of the central 1 kpc of the eastern component of the dumbbell system in A883, DB6, is presented together with S5, which characterizes a blue stellar content of DB6 in emission as well as the significant contribution of the blue stellar content in DB6.

Figure 3b. The ratio DB6/S5 showing a small blue residual, indicating the important young component of the stellar population in DB6, whose presence is more conspicuous than in S5. The metallicity of both spectra are very similar.



DB6 presents evidence of an important young stellar population within the observed central 3 kpc and was very well reproduced by S5 (Figure 3). This implies that 15% of the visible flux arises from components younger than 1 Gyr.

The metallic absorptions in E1 (central 1-2 kpc) are stronger than in E10 ($r < 4$ kpc) and DB14 ($r < 7$ kpc) suggesting the dilution of metallic features in the latter cases by the presence of metal poor halo population in the aperture for distant systems.

We conclude that the typical stellar populations in dumbbells are red strong-lined like those of nearby giant galaxy nuclei. Young stellar components (DB6) and emission lines (DB8) are exceptions in the sample. Further investigation of the stellar content in dumbbell systems by means of a population synthesis technique is in progress.

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