On the Optical-NIR Photometric Plane of Early-Type Galaxies at z=0.3

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The environments of galaxies: from Kiloparsecs to Megaparsecs - Crete 2004

We have undertaken a detailed photometric investigation of the galaxy populations in MS1008.1-1224, a massive cluster of galaxies at redshift z=0.3. Cluster galaxies have been selected on the basis of a large photometric data-set, including archive photometry in the UBVRIJHK bands taken with ESO-VLT and ESO-NTT telescopes.

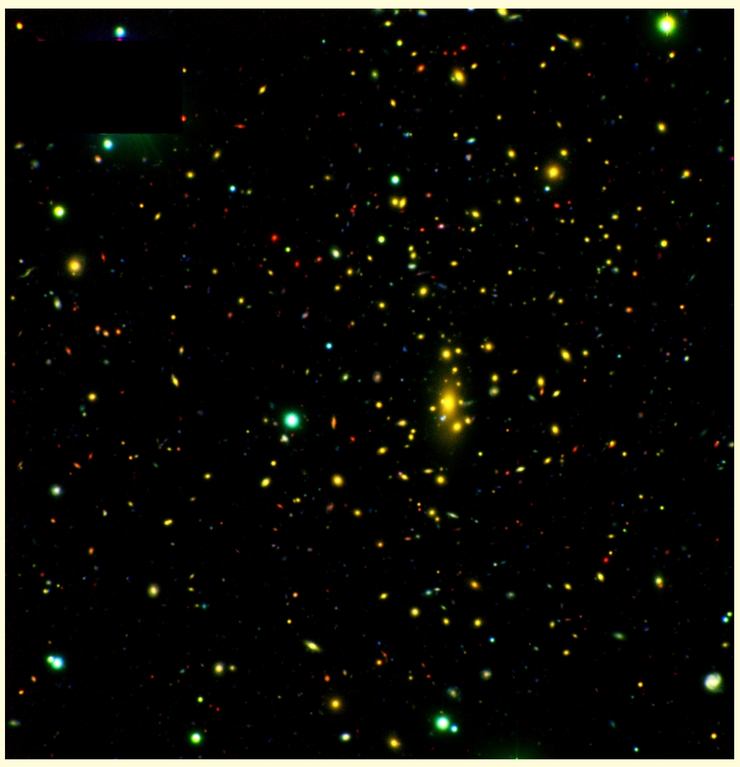

FIG. 1

Surface photometry has been derived in the R-, I- and K- bands for galaxies brighter than R=22, I=21.3 (+3.5) and K=17.8(+2.5), respectively. We derive structural parameters (half light radius r_e, mean surface brightness $<\ >_e$ and Sersic index n) by using the 2D fitting method, modelling galaxy images with seeing convolved Sersic models. Early-type galaxies (ETGs) are selected ion the basis of the Sersic index, as the objects with n>2.

We study the correlation among $\log r_e$, $<\ >_e$ and logn, also known as Photometric Plane (PHP), in the optical and NIR wavebands for N and N ETGs, respectively. The following representation of the PHP is adopted:

$\log r_e = a\cdot\log n + b\cdot<\ >_e + c$,

where a and are the slopes and c is the zeropoint of the relation.

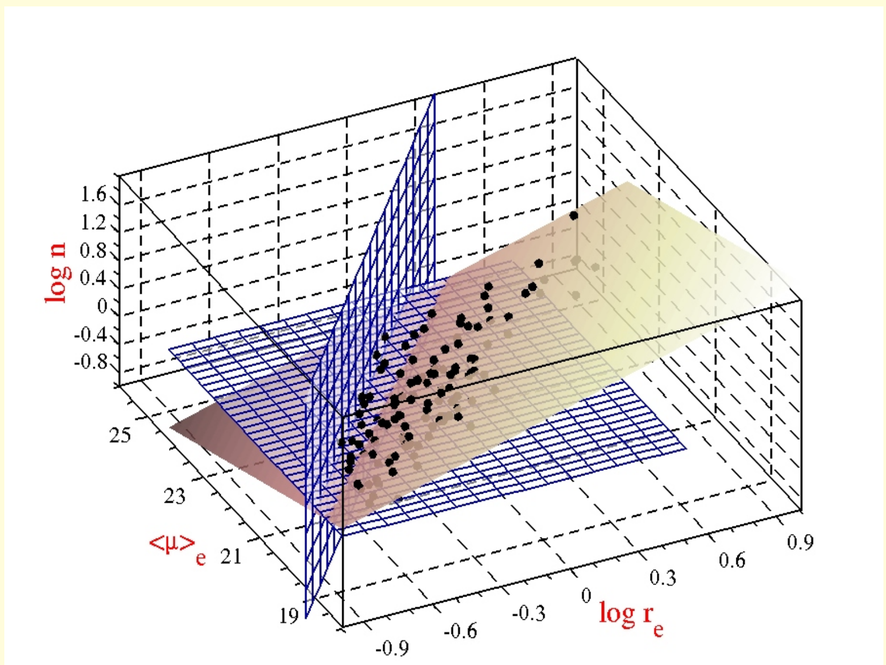

FIG. 2a

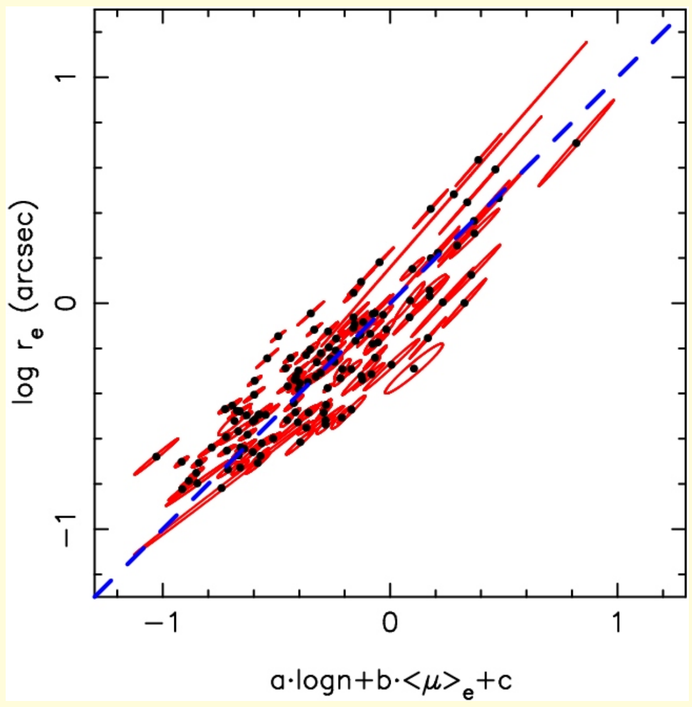

FIG. 2b

Fig.2a shows a 3D view of the space of R-band structural parameters, where the PHP is represented by a shaded surface while two blu grids depict selection effects. It turns out that galaxies follow a well defined PHP relation at z=0.3, with Sersic indices that increase at larger radii and lower surface brightnesses. An edge-on projection of the photometric plane in plotted in Fig.2b, where ellipses mark confidence contours of uncertainties on structural parameters.Taking into account measurement uncertainties, we find that the intrinsic dispersion about the plane amounts only to 0.14dex(32%).

PHP coefficients are derived by using different fitting methods and are corrected for selection effects (magnitude and Sersic index cuts) by using numerical simulations, To this aim, we construct distrubutions of points in the space of structural parameters that resemble those of real galaxies and we estimate the bias on the PHP coefficients when the same selection cuts of real samples are applied.

Fig.3 compares the corrected PHP coefficients in R-,I- and K- bands. Results of fitting procedures are marked by different colours. We find that, whatever the regression method is, the coefficients of the PHP do not depend significantly on waveband. This implies that variation in the distribution and concentration of stellar populations in galaxies do not change significantly along the galaxy (i.e.with galaxy mass).

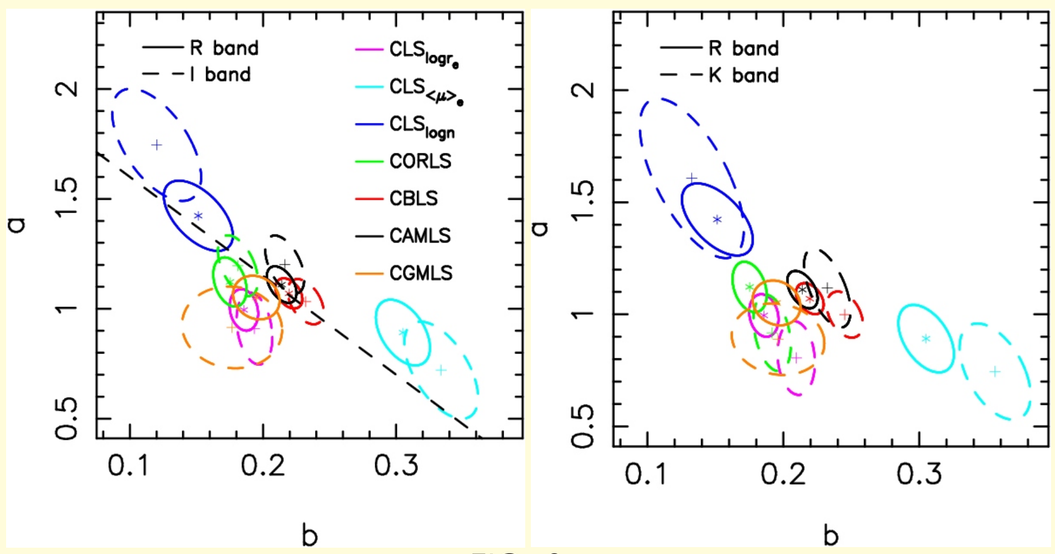

FIG. 3

In Fig. 4 we compare the coefficients of the PHP at z=0.3 with those of the PHP at z 0, which were derived by using the sample of N=38 ETGs from Graham 2002, MNRAS, 334. The coefficients at z 0 were obtained by the same fitting and correction procedures adopted for the samples of MS1008.

We find that the slopes and the intrinsic dispersiobn of the PHP do not evolve significantly with redshift, while the variation of the PHP zero-point (Fig.5) is consistent with cosmological dimming+pure luminosity evolution of an old stellar population (formation redshift z_f 1).

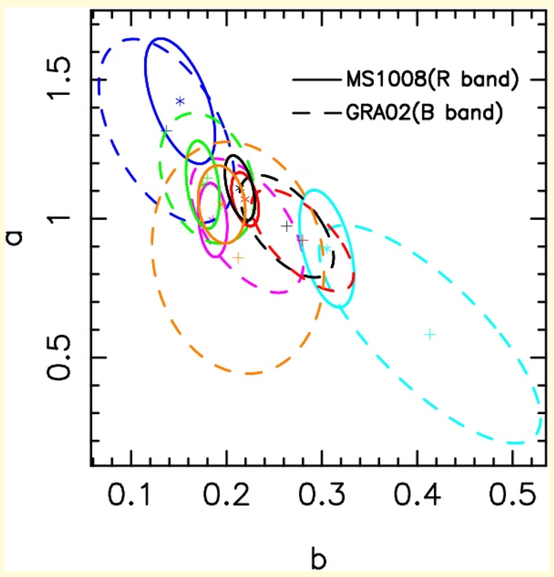

FIG. 4

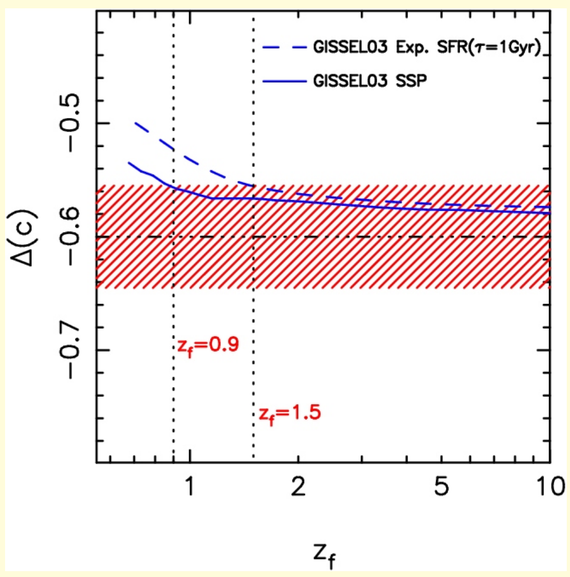

FIG. 5

Conclusions. we find that cluster early-type galaxies follow a tight PHP relationat at z=0.3. The slopes of the plane do not depend on waveband, implying that properties of stellar populations inside galaxies do not change significantly lwith galaxy mass. The zeropoint of PHP evolves with redshift according to cosmological dimming+pure luminosity evolution of an old stellar population.