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Optical SBFs of shell galaxies

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Abstract. We measure $F814W$ Surface Brightness Fluctuations (SBFs) for a sample of distant shell galaxies observed with the Advanced Camera for Survey (ACS) on board of HST. To evaluate the distance at galaxies, theoretical SBF magnitudes for the ACS@HST filters are computed for single-burst stellar populations covering a wide range of ages ($1.5 \div 14$ Gyr) and metallicities ($Z = 0.008 \div 0.04$). Using these stellar population models we provide the first $\overline{M}_{F814W}$ versus $(F475W - F814W)_0$ calibration. The results suggest that *optical* SBFs can be measured at $d \geq 100$ Mpc using high-resolution optical data.

Key words. galaxies: elliptical and lenticular, cD — galaxies: distances — galaxies: photometry — galaxies: fundamental parameters — cosmology: distance scale

1. Introduction

The SBF method is a powerful technique to derive distance to galaxies as far as 150 Mpc with uncertainties lower than 10%. The SBFs can be evaluated for ellipticals, spiral galaxies with prominent bulge and dwarf galaxies. An interesting case is represented by shell-elliptical galaxies. Shell structures are considered robust indicator of past interaction events and the stellar population in the shell depends on the galaxy with which the merger has taken place (e.g. Malin & Carter 1983) and on the time spent since the shell structure has formed. Then, it is reasonable to expect that the presence of shells might influence the SBF signal of the galaxy. In this respect, the high quality of ACS images is crucial to allow the measurement of SBF of the galaxy, even at high distances.

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2. Data analysis

To derive the SBF measurements from ACS images, we follow the procedure adopted in Cantiello et al. (2005, 2007) and Biscardi et al. (2008), that we can summarize as follow: *a*) Sky and galaxy-model subtraction; *b*) Removal of large residual background and shell features (residual frames determination); *c*) Photometry of external sources (globular clusters and background galaxies); *d*) Mask of the most prominent unsubtracted shell, if necessary; *e*) Evaluation of the residual frame power spectrum, and its fitting using a PSF template power spectrum.

3. Models and calibrations

We provide new SBF predictions together with new calibrations of absolute SBF magnitudes for the ACS HST filters. These models,

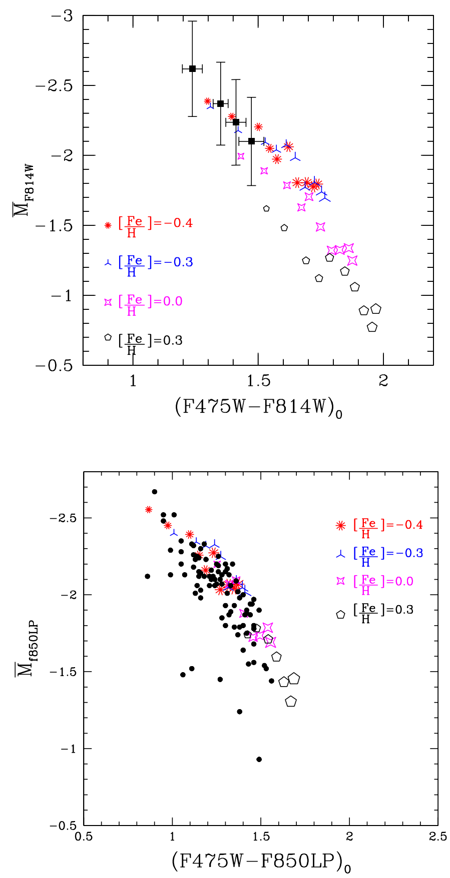

Fig. 1. Upper panel: SSP models of different metallicities (as labeled) and ages (1.5 ÷ 14 Gyr). Symbols with increasing size mark models of older age. Black squares are observed galaxies. Lower panel: The new SBF models in the ACS photometric system, shifted to a Virgo distance modulus of 31.1 mag (symbols are as in the upper panel) compared with observational data (full dots) from ACS Virgo Survey (Mei et al. 2007).

showed in Fig. 1, are the most updated version of the code SPoT (Stellar POpulation Tools, Raimondo et al. 2005)[1] and they are based on single-burst stellar population models of age ranging from 1.5 Gyr up to 14 Gyr and metallicity from $Z = 0.008$ to $Z = 0.04$. Using these SSP (simple stellar population) models we derive the following theoretical calibrations:

$$\overline{M}_{F814W} = (-0.94 \pm 0.20) + (2.2 \pm 0.2) \times[(F475W - F814W)_0 - 2.0] \quad (1)$$

$$\overline{M}_{F850LP} = (-2.1 \pm 0.2) + (1.4 \pm 0.2) \times[(F475W - F850LP)_0 - 1.3] \quad (2)$$

$$\overline{M}_{I} = (-1.6 \pm 0.1) + (4.5 \pm 0.2) \times[(V - I)_0 - 1.15] \quad (3)$$

which provide a very good agreement when compared with observational data (Fig. 1).

[1] http://www.oa-teramo.inaf.it/SPoT

Table 1. Estimated distance moduli (DM).

Galaxy	DM (mag)
PGC 6510	33.7 ± 0.25
PGC 10922	34.2 ± 0.25
PGC 42871	34.7 ± 0.25
PGC 6240	35.2 ± 0.25

4. Distance and H_0 determination

Coupling theoretical calibration (Eq. 1) and $F814W$ SBF measurements, the distance moduli are derived for the first time for the galaxies in Table 1. The present measurements show that distances of galaxies beyond 100 Mpc can be derived in optical filters, with the SBF method. An estimation of $H_0 = 76 \pm 6 \pm 5$ km s^{-1} Mpc^{-1} is also obtained.

References

Biscardi, I., Raimondo, G., Cantiello, M., & Brocato, E., 2008, ApJ, 678, 168

Cantiello, M., Blakeslee, J. P., Raimondo, G., Mei, S., Brocato, E., & Capaccioli, M. 2005, ApJ, 634, 239

Cantiello, M., Raimondo, G., Blakeslee, J. P., Brocato, E., & Capaccioli, M. 2007, ApJ, 662, 940

Malin, D. F., & Carter, D. 1983, ApJ, 274, 534

Mei, S. et al. 2007, ApJ, 655, 144

Raimondo, G., Brocato, E., Cantiello, M., & Capaccioli, M. 2005, AJ, 130, 2625