RevMexAA (Serie de Conferencias), **17**, 251–251 (2003)

OPTIMIZING FUTURE SURVEYS ON GALAXY EVOLUTION

A. Gil de Paz[1,2,3] and B. F. Madore[1,3]

Galaxy Evolution: Theory and Observations (Cozumel, Quintana Roo, México, 8-12 April 2002)
Editors: Vladimir Avila-Reese, Claudio Firmani, Carlos S. Frenk & Christine Allen

We present new results on the optimization of broad-band photometry observations designed to analyze the physical properties of galaxies at different redshifts. We have computed the uncertainties expected in the derivation of the star formation history (SFH), age, metallicity, and reddening of galaxies when comparing broad-band photometry with the predictions of evolutionary synthesis models as a function of (1) the observables available, (2) the observing errors, and (3) the galaxy properties themselves.

We have generated a large number (9000) of synthetic galaxy colors parametrized by different SFH ($0.2<\tau<6$ Gyr), ages (3 Myr<t<12 Gyr), metallicities ($1/5\,Z_\odot<Z<5\,Z_\odot$), reddenings ($0.0<E(B-V)<1.0$ mag), and redshifts (z=0.0, 0.7, 1.4). We determined the luminosity in different bands and the colors for each individual galaxy in the sample using the predictions of the GISSEL99 evolutionary synthesis models (Bruzual & Charlot 1993). Johnson/Cousins and SDSS optical bands, JHK nIR bands, and GALEX UV-bands were considered. Using the number of ionizing Lyman photons predicted we also computed the contribution of the nebular continuum and most intense emission-lines to these bands. Finally, the colors obtained were reddened using the corresponding $E(B-V)$ values.

Grouping the colors deduced for these galaxies in different sets and comparing them with the evolutionary synthesis models allows us to explore systematics and determine the set of observables that result in minimum differences between the actual (input) galaxy properties and the derived (output) properties. This comparison is done using a combination of Monte Carlo simulations, a maximum likelihood estimator, and a PCA algorithm (Gil de Paz et al. 2000; Gil de Paz & Madore 2002). This procedure provides us with the mean derived properties, the 1-sigma errors, the PC1 vector, and the input properties of all galaxies in the sample.

[1]NASA/IPAC Extragalactic Database, California Institute of Technology, MS 100-22, Pasadena, CA 91125, USA (agpaz, barry@ipac.caltech.edu).

[2]Jet Propulsion Laboratory, Pasadena, CA 91109, USA.

[3]Observatories of the Carnegie Institution of Washington, Pasadena, CA 91101, USA.

The analysis of the dependence of these quantities upon (1) the set of bands available, (2) the observing errors, and (3) the galaxy properties shows:

- **At low-z:** In order to determine the SFH, age, and dust extinction with relatively small uncertainties the use of U-band data is fundamental. The availability of K-band data also allows a reduction in the age and metallicity uncertainty, but the use of additional J and H-band data is redundant.
- **At intermediate-z:** The age uncertainty is smaller than in the nearby-galaxies' case and shows a strong bias toward younger ages. A significant reduction of this effect and of the metallicity uncertainty can be achieved when JHK data are used. The dust-extinction uncertainty is larger for larger values of the dust extinction itself. The use of U-band data provides an important reduction of this dependence and of the mean dust-extinction uncertainty.
- **At high-z:** The uncertainty in the determination of the timescale for galaxy formation is larger than at lower redshifts. The age of the stellar population is also derived with a large uncertainty, only reduced when JHK data are available. The dust-extinction in these galaxies can be derived to a very high accuracy even when only optical data are available. The use of JHK data is fundamental in order to improve both the age and metallicity determinations.

Some of the conclusions drawn above can also be found through the literature expressed in a qualitative way. However, this work constitutes the first systematic and quantitative study on the optimization of broad-band photometry for galaxy evolution studies. Beyond the results shown in this paper, we can also derive, upon request, the uncertainties and degeneracies in the galaxy properties for a given set of filters, observing errors, and galaxy redshifts.

REFERENCES

Bruzual, A. G., & Charlot, S. 1993, ApJ, 405, 538

Gil de Paz, A., & Madore, B. F. 2002, AJ, 123, 1864

Gil de Paz, A., Aragón-Salamanca, A., Gallego, J., Alonso-Herrero, A., Zamorano, J., & Kauffmann, G. 2000, MNRAS, 316, 357