Formation and Evolution of Galaxy Outskirts
Proceedings IAU Symposium No. 321, 2016
A. Gil de Paz, J.H. Knapen & J.C. Lee, eds.

doi:10.1017/S1743921316011728

Evolving sparse stellar populations

Gustavo Bruzual[1], Gladis Magris C.[2] and Fabiola Hernández-Pérez[3]

[1]IRyA, UNAM, Campus Morelia, Morelia, México
email: `g.bruzual@crya.unam.mx`

[2]CIDA, Apartado Postal 264, Mérida, Venezuela
email: `magris@cida.gob.ve`

[3]Dpto. de Física, Grupo de Astrofísica Teórica, Fac. de Ciencias, Universidad de Los Andes, Mérida, Venezuela
email: `fabiolah@ula.ve`

Abstract. We examine the role that stochastic fluctuations in the IMF and in the number of interacting binaries have on the spectro-photometric properties of sparse stellar populations as a function of age and metallicity.

Keywords. Stellar populations, Galaxy evolution, Binary evolution

1. Introduction

In the outskirts of galaxies, and in low density environments in general, stars may form in clusters and associations of lower mass than those formed in high mass density environments. The spectroscopic and photometric properties of sparse stellar populations cannot be derived straightforwardly from models designed to study high mass galaxies. Statistical fluctuations in the number of stars populating critical positions in the HR diagram may change quite dramatically the integrated spectral energy distribution (SED) of clusters of mass $< 10^4$ $M_\odot$, compared to the SED of a massive galaxy of the same age and metal content. Population synthesis models of massive galaxies assume a smoothly populated initial mass function (IMF) that follows an analytical expression. Fulfilling this condition requieres in practice a galaxy of infinite mass. Fig. 1 shows the dispersion expected in the SED as a function of the mass of the stellar population. Fig. 2 shows details on how these fluctuations can affect the emitted flux in specific spectral ranges. In Fig. 3 we show the effects of these fluctuations on the UVr colours of populations of different mass and age. In addition, we show how the evolution of interacting binaries affects these colours. Fig. 4 compares schematically the effects of binary evolution and stochastic fluctuations with the standard evolution of massive galaxies for different colours. For details see Bruzual (2007) and Hernández-Pérez & Bruzual (2013, 2014). The figures in colour can be found in the electronic version of this book.

References

Bruzual, G. 2007, *IAU Symposium No. 241 "Stellar Populations as Building Blocks of Galaxies" eds. A. Vazdekis and R. F. Peletier, Cambridge: Cambridge University Press, p.125*
Hernández-Pérez, F. & Bruzual, G. 2013, *MNRAS*, 431, 2612
Hernández-Pérez, F. & Bruzual, G. 2014, *MNRAS*, 444, 2571

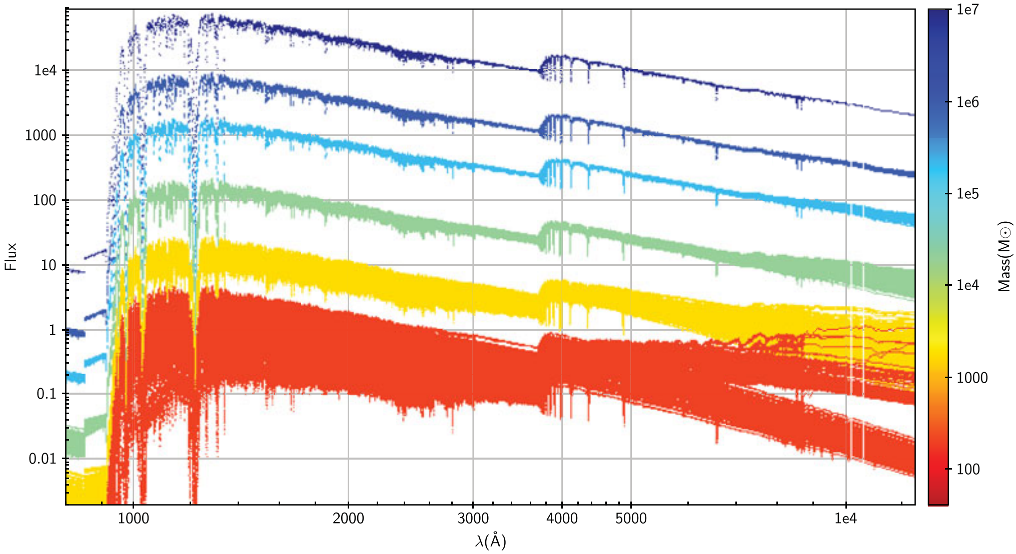

Figure 1. SED of stellar populations of $Z_\odot$ at age 100 Myr as a function of galaxy mass (see auxiliary axis) computed for the Chabrier IMF, but populated stochastically. The line at the top corresponds to the standard model (infinite mass) scaled appropriately. The vertical separation among each spectral band is due to the mass of the population increasing in steps of 10.

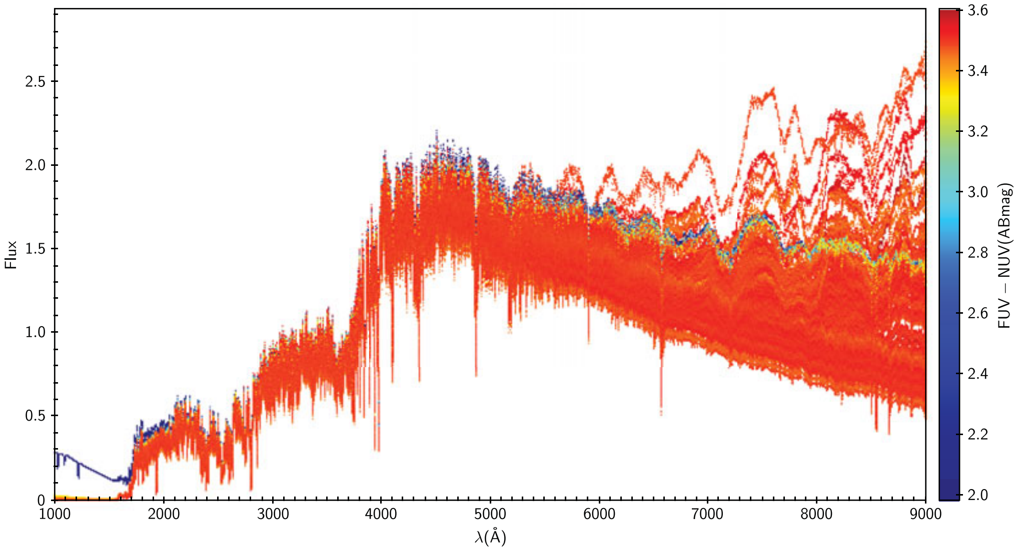

Figure 2. SED of a 1 Gyr stellar population of mass 5000 $M_\odot$ and $Z_\odot$ computed for the Chabrier IMF, populated stochastically. The lines are colour coded according to the *GALEX* color index $FUV - NUV$ (auxiliary axis). A higher number of CSPN stars than usual is responsible of the XUV seen in one of the spectra. Fluctuations in the number of AGB and TP-AGB stars produce the variations seen longward of 6000Å.

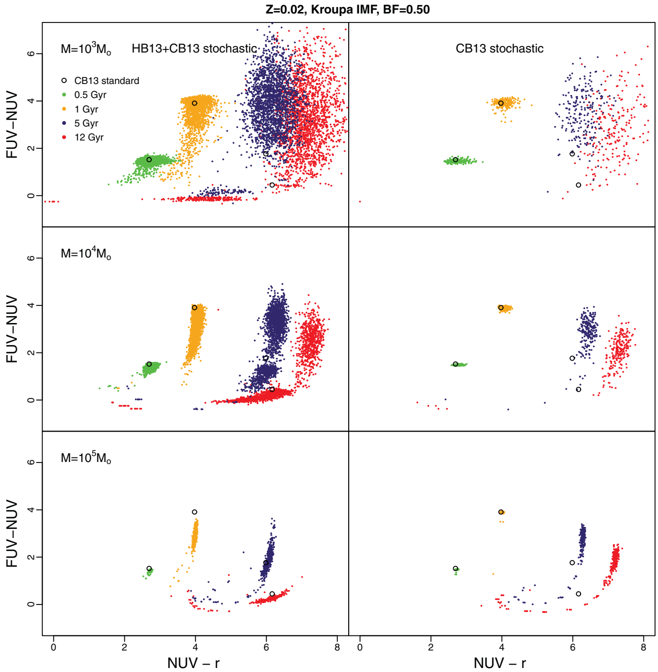

Figure 3. Effect of IMF stochastic fluctuations on the UVr colours of galaxies. The open circles show the standard model for a smoothly populated Kroupa IMF. The models in the left-hand side include binary evolution in addition to IMF fluctuations. Binary pairs form stochastically in the stellar populations shown in the right-hand side. For each model in the right-hand side, 10 models with a binary fraction BF = 0.50 were generated.

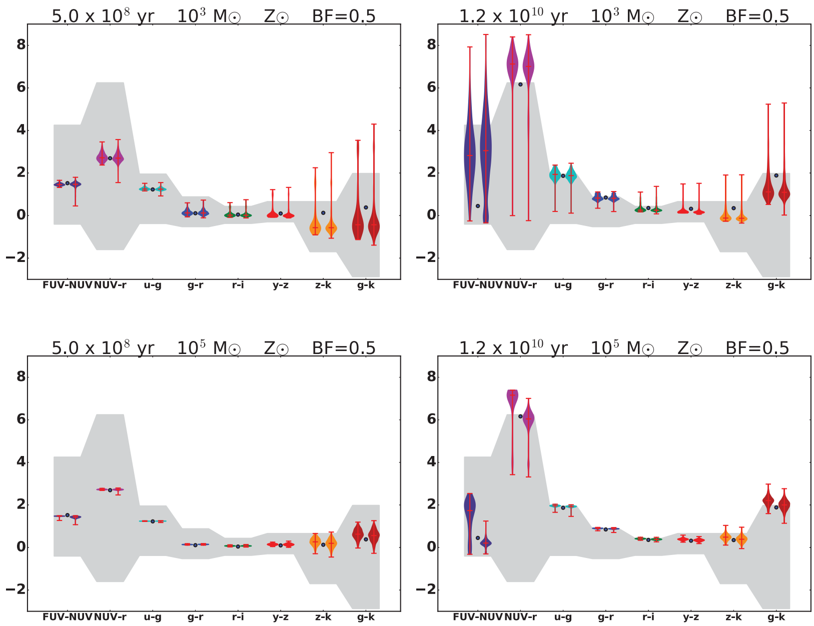

Figure 4. Schematic representation of the spread in colours produced by stochastic fluctuations in the IMF and binary evolution. The grey background represents the range of colour covered by the population when it ages. The binary fraction BF is assumed to be 0.5. The properties of each population are indicated at the top of each frame.

https://doi.org/10.1017/S1743921316011728 Published online by Cambridge University Press