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MULTIWAVELENGTH STUDY OF STAR-FORMING GALAXIES IN THE LOCAL UNIVERSE

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We have studied in detail the properties of local active star-forming galaxies from the UCM survey, and in particular their star-formation histories. We have quantified the relative importance of the current episode of star formation in comparison to the underlying older stellar populations. We have also determined the total stellar mass function and burst mass function for the UCM sample using the $\mathcal{M}/L$ calculated for each galaxy. Integrating this mass function we obtained the contribution of the star-forming galaxies to the total stellar mass density of the local Universe.

Stellar populations

The main goal of our work (Pérez-González 2003a) is studying the main properties of the stellar populations embedded in a statistically complete sample of active star-forming galaxies: the Universidad Complutense de Madrid (UCM) Survey of emission-line galaxies [5]. This sample contains 191 local star-forming galaxies at an average redshift of 0.026. The galaxies were selected by the presence of the Hα nebular emission-line.

We have compiled an extensive multi-wavelength (from the optical to the near infrared) photometric (in narrow and broad band filters) and spectroscopic dataset for all the galaxies in the sample. The analysis of this dataset has been centered on the characterization of the morphology of the objects, on the comparison of the global properties of the sample with those of other galaxy samples at several redshifts, and on the study of the stellar content of the UCM galaxies. In the latter research topic, a special attention has been paid to the most recent star-forming bursts, which are the main characteristic of our objects. We have also developed (and tested with the dataset for the UCM sample) a powerful stellar population synthesis tool (which is able to obtain robust estimates of the stellar mass, a very important parameter in the study of the evolution of galaxies), and a technique to calculate luminosity and stellar mass functions (Pérez-González et al. 2003a,b). These techniques may be easily used in the characterization of samples of galaxies at any redshift.

Main results

The location of the star-forming knots, their intensity and concentration, and the relationship of these properties with those of the host galaxy have been studied. We estimate that the amount of Hα emission that arises from the diffuse ionized gas is about 15%-30% of the total Hα flux for a typical UCM galaxy. This percentage seems to be independent of the Hubble type. Conversely, we find that an 'average' UCM galaxy harbors a star formation event with 30% of its Hα luminosity arising from a nuclear component (Pérez-González et al. 2003c).

The main results obtained in this work point out that the UCM Survey galaxies span a broad range in properties (among others, the total stellar mass and the star formation rate per stellar mass unit) between those of galaxies completely dominated by current/recent star formation (e.g., extreme dwarf HII galaxies or starburst galaxies) and those of 'normal' quiescent spirals. The UCM objects present intermediate-late Hubble type spiral morphologies and a recent instantaneous burst of star formation (occurred about 5 Myr ago) with sub-solar metallicity. These bursts involved ≈5% of the total stellar mass of the UCM galaxies. An 'average' UCM galaxy has a total stellar mass of 10^{10} solar masses, i.e., about a factor of 7-10 lower than a typical local spiral galaxy.

Figure 1 shows the distribution of total stellar masses for our sample. The top panel refers to HII-*like* galaxies and the grey histogram in the lower panel to disk-*like* objects. The lower panel also presents the distribution of masses for the entire sample as well as the histogram of the mass uncertainties. There is a segregation in mass between HII-

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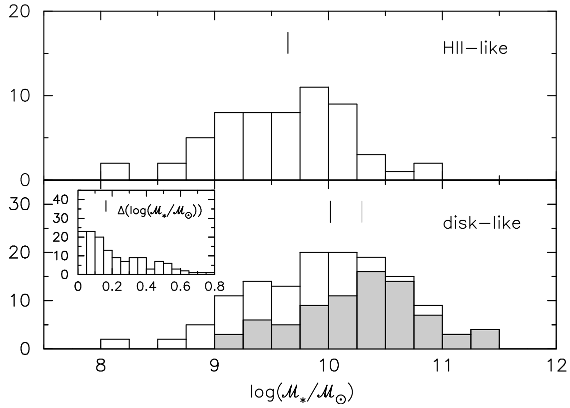

Fig. 1. Distribution of the total stellar masses (in solar units) of the UCM Survey galaxies. The top histogram corresponds to the HII-*like* galaxies, while the bottom one corresponds to the whole sample with the disk-*like* objects shown as the grey histogram. Median values are indicated. A histogram of the mass uncertainties for the whole sample is shown as an inset.

like and disk-*like* galaxies, with the former being less massive than the latter.

We have determined the total stellar mass function (SMF) and burst mass function for the local star-forming galaxies. Instead of using the mean $\mathcal{M}/L$ ratio for the whole sample (simple estimate), the masses have been obtained using the $\mathcal{M}/L$ calculated for each galaxy by stellar population. At high masses, this simple estimate of the SMF coincides with the one obtained using individual $\mathcal{M}/L_{K_s}$ values. However, large differences appear for low mass galaxies: these objects harbor the most intense bursts which have a major influence in the $\mathcal{M}/L_{K_s}$ ratios. The errors introduced by using a constant $\mathcal{M}/L_{K_s}$ are expected to be much larger at high-z where the burst strengths are higher.

Integrating this mass function we obtained the contribution of the star-forming galaxies to the total stellar mass density of the local Universe (Pérez-González et al. 2003d). We estimate that $13 \pm 3\%$ of the total baryon mass density in the form of stars in the local Universe is associated with star-forming galaxies. Because our galaxies are selected based on star formation (via Hα emission), our data are directly comparable to high redshift survey galaxies, commonly dominated by intense burst of star formation (Calura & Matteuci 2003).

Work in progress

We are currently adding to our modeling technique specific data to constrain the solution in three different parameters: metallicity, extinction, and age. For that, we are obtaining two dimensional spectroscopy which will allow us to separate the regions where there is active star formation from the ones dominated by more evolved stars. In addition, Johnson U and 1500 and 2800 Å images (from GALEX) will be expand the baseline in wavelength of our data, and they will provide with a better understanding of the extinction properties. The U and GALEX data will also be combined with Hα imaging and [OII], $H\beta$ 2-D spectroscopy to obtain a consistent view on UV/optical SFR indicators.

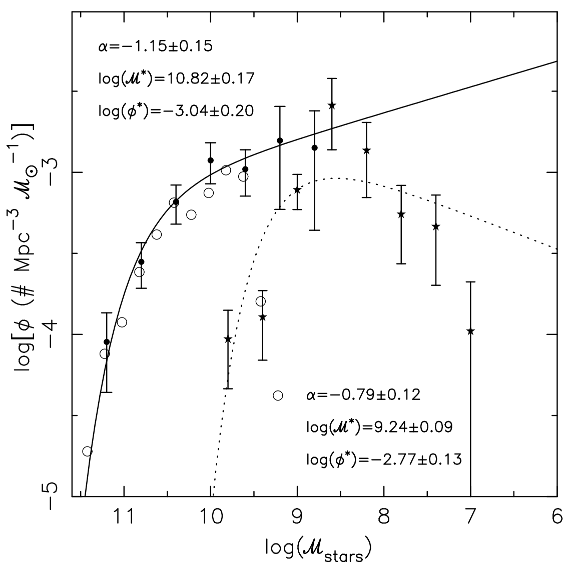

Fig. 2. Total stellar mass function (filled circles and solid line) and burst mass function (stars and dotted line) for the UCM sample. Open symbols show the mass function calculated by multiplying the K_s-band LF by a constant $\mathcal{M}/L_{K_s} = 0.78$. The Schechter fit parameters are given for the total masses (upper-left corner) and burst masses (lower-right corner). Masses are in solar units and ϕ^* in Mpc^{-3}.

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