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Spectrophotometric Characterization of galaxies

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The 'Tuning Fork' classification scheme of galaxies was conceived by Hubble in the early '20; nowadays this classification criterion is still well-grounded but, in spite of the plenty new discoveries, the whole issue of galaxy evolution is still far from settled.

At present there are two opposing theoretical scenarios for the formation of galaxies. The first is the *hierarchical model*, according to which primeval spiral galaxies of small mass were born at early epochs and more massive objects grew up subsequently due to merging of smaller entities. The second is the so-called *Close-box model* (or monolithic model), which describes galaxies as the product of the collapse of gaseous protogalaxies of a broad range of masses, occurred at some common early cosmological epoch.

Observations will shortly contribute disentangling among these two models. In particular data at $z=0$ will provide their boundary conditions.

The present work contains an approach to constrain the evolution of galaxies based on a model fitting of their observed spectral energy distributions.

Synthetic spectral models can be created using stellar population models and assuming a star formation history. We used the Bruzual & Charlot (2001) population synthesis models, which depend on the age of galaxies (T), on the initial metallicity (Z) and on the assumed star formation history (SFH). In the present application we assume a delayed exponential form, named 'à la Sandage' with a rise of star formation rate up to a maximum, followed by an exponential decrease, whose delay and steepness are regulated by a single parameter τ .

Our approach is to study if such a simple toy-model, with a fixed age for all galaxies, produces galaxies that compare with the real ones, without pretending to verify or falsify other more sophisticated theories.

We have used the monolithic model because it depends on few parameters, setting a common age of 13 Gyrs for all galaxies. By doing so we remove the degeneracy observed between T and τ , or, in other words the fact that identical galaxies are obtained for very different combinations of T and τ .

We have fitted 170 nearby spiral galaxies selected according to whether there is enough information for computing and correcting their measured photometry as a function of frequency (see Fig. 1) for the effects of extinction by dust (i.e. availability of ultraviolet and Far- Infrared measurements).

One of the clear-cut results of our analysis is the presence of a significant correlation between τ and the galactic mass, as derived from the H-band luminosity according to Gavazzi et al (1996). More massive galaxies are characterized by an older stellar population than less massive ones (i.e. they have smaller values of τ). This is consistent with the idea that high mass galaxies develop a deeper potential well, thus they suffer a more efficient, early gravitationally collapse.

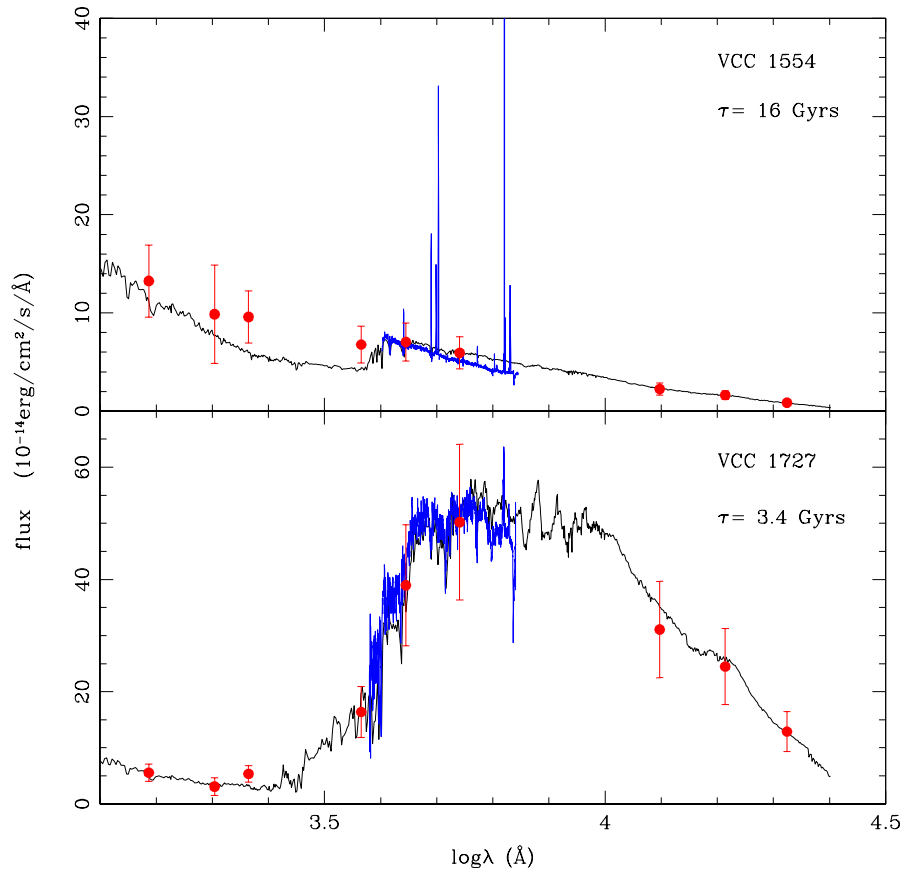


Figure 1: Spectral Energy Distribution (SED), from the UV to the Near-IR, of two galaxies belonging to the Virgo cluster. The top panel shows the “young” object VCC 1554, fitted with a τ of 16 Gyr. The bottom panel shows a much more “red” SED that requires a much shorter star formation history of approximately 3.5 Gyr. The measured photometry is represented by red dots; the optical spectrum is given in blue and the synthetic model that fit the data is represented by the black line.