Despite their paucity, massive hot stars are real cosmic engines of fundamental importance in shaping our Universe, from its very early stages up to its current appearance. Understanding the physics of massive stars is then a key issue for many relevant astrophysical phenomena. Their spectra provide constraints required for stellar and galactic evolution calculations, such as mass-loss rates, degree of chemical evolution at different evolutionary stages, star formation history (through $[\alpha/\text{Fe}]$ ratios) and spatial distribution of different species. Probing the massive stellar population of nearby galaxies by means of quantitative spectroscopy allows us to unveil a wealth of information that will aid our current understanding of stellar and galaxy evolution. In addition, blue luminous stars can be used as standard candles for extragalactic distances up to 10 Mpc.

Two main factors have contributed in recent years to mature the field of extragalactic stellar astronomy. On the one hand, new observational facilities, in particular ground-based large aperture telescopes equipped with very efficient multi-object optical spectrographs, which make it possible to collect data for a sensible number of stars in different galaxies. On the other hand, enormous advances on model atmosphere techniques allow for the first time the analysis of these large datasets by means of highly sophisticated and detailed models. In this contribution, we present a brief overview of recent steps we have undertaken in this exciting research field.

1 Quantitative spectroscopy of blue supergiant stars

The information about the physical properties of extragalactic massive stars is obtained through the comparison of the observed spectra with synthetic model atmospheres. In contrast to cooler spectral types, the physical processes in the atmospheres of blue supergiant stars are basically dominated by non-LTE conditions, due to the huge radiation field and the low density environment. As previously quoted, the most recent generation of model atmospheres ([7], [12],
are able to cope with the tremendous challenge posed by these conditions in the presence of supersonic outflows (the stellar wind). The application of such models to the analysis of samples of extragalactic stars, generally observed at lower spectral resolutions, requires first a detailed study of stars in the Milky Way and nearby galaxies to characterize the models and to assess our ability of reproducing the observations ([15], [11]). To illustrate the quality than can be achieved, we show in Fig. 1 selected parts of the observed spectrum (ESI/Keck) of an early A Sg in M 33 and the best fitting model.

![Figure 1](image)

**Fig. 1.** Comparison of selected parts of the observed (ESI/KeckII, R~10000) spectrum of the early A supergiant M33-0755 and the best model. Most prominent spectral features are identified.

Observation of stars in galaxies beyond the Local Group implies the use of low spectral resolution ([1], [2]). However, as we have shown in recent years ([13], [14], [4], [6]), it is possible to get information from these objects even at these low resolutions, provided that the signal-to-noise is high enough (about ~50). In the case of OB supergiants (~O9I–B3I) it is possible to follow the classic techniques used with high-res data since the fundamental diagnostic lines are still available. In the case of BA supergiants (~B4I–A3I), we have developed an alternative technique that enables the analysis of these spectral types even when it is impossible to use the classic methods ([9]).
2 Blue supergiants’ applications

2.1 Chemical abundances in nearby galaxies

To date, studies of the spatial distribution of chemical species in galaxies have been mainly based on oxygen abundances in H II regions. As an alternative, and in some cases complementary, method, oxygen abundances can be determined from B- and A-type supergiant stars, by means of a solid and self-consistent methodology, based on detailed analyses of the atmospheres of such stars. The optical spectra of B- and A-type supergiants are rich in metal absorption lines from several elements (C, N, O, Mg, Al, S, Si, Ti, Fe, among others). As young objects they represent probes of the current composition of the inter-stellar medium (except for those species that are affected by the evolution of the star: C and N), hence these objects can be used to trace the present day abundance pattern in galaxies, with the ultimate goal of recovering its chemical and dynamical evolution history.

We would like to stress that not only oxygen abundances, but a large number of chemical species, in particular Fe-group elements (see Fig. 1), are available through stellar spectroscopy. In our recent work we have demonstrated how quantitative spectroscopy of blue supergiants can render accurate and relevant information about the spatial distribution of different species in several nearby galaxies: WLM ([4]), IC 1613 ([5]), NGC 3109 ([6]), M 33 ([15]) and NGC 300 ([14]). For the Local Group galaxies studied so far, our results are consistent with nebular abundances obtained by the application of the direct method, while in the more distant NGC 300 (~2 Mpc), our results support some empirical calibrations, while ruling out some others.

2.2 The FGLR and distances in the local Universe

The best established stellar distance indicators, such as Cepheids, RR Lyrae and RGB stars, suffer from two major problems, extinction and metallicity dependence, both of which are difficult to determine for these objects with sufficient precision. In order to improve distance determinations in the local Universe and to assess the influence of systematic errors there is a need for alternative distance indicators, which are at least as accurate but are not affected by uncertainties arising from extinction or metallicity.

Blue supergiants are ideal objects for this purpose, because of their enormous intrinsic brightness, which makes them available for accurate quantitative spectroscopic studies even far beyond the Local Group. Quantitative spectroscopy allows us to determine stellar parameters and thus the intrinsic spectral energy distribution, which can be used to measure reddening and the extinction law. In addition, metallicity can be derived from the spectra.

Theoretical calculations predict that massive stars evolve from the Main Sequence, in their way to the red, at almost constant luminosity and mass.
During this brief transitionary period, the ratio of the effective temperature and the effective gravity remains constant. The relationship between the mass and luminosity of supergiants means that the luminosity of blue supergiants in this phase can be inferred from measurements of the effective temperature and effective gravity alone. This means that spectroscopic observations of blue supergiants in other galaxies may be used, through the Flux-weighted Gravity – Luminosity Relationship, FGLR, to determine distances to these galaxies. This technique is robust, we have shown how observations of at least 10–15 blue supergiants may provide a distance modulus with an uncertainty of 0.1 mag ([8]). We have also shown, from observations of blue supergiants in NGC 300, that the photometric variability has negligible effect on the distances determined through the FGLR ([3]). The advantage of the FGLR-technique is the fact that individual metallicity, reddening and extinction can be determined for each star directly from spectroscopy combined with photometry.

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