Stellar Populations as Building Blocks of Galaxies
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Stellar populations in the Magellanic Clouds: looking through the dust

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Abstract. We present the first results of our study of stellar populations in the Large and Small Magellanic Clouds based on multi-band WFPC2 observations of "random" fields taken as part of the "pure parallel" programme carried out with the HST as a service to the community.

Keywords. Hertzsprung-Russell diagram; stars: fundamental parameters; dust, extinction

Summary

We have started a study of the stellar populations in the Large and Small Magellanic Clouds using data (U, B, V, I and Hα imaging) collected as part of the WFPC2 Pure Parallel Program (Wadadekar *et al.* 2006). We have considered a number of fields comprising both young and old stellar populations, with ages ranging from a few Myr to a few Gyr and where also pre-main-sequence objects are clearly identified. In addition to the properties of these populations, we have studied the characteristics of the dust present in these regions.

Using the properties of red giant stars of the so-called "red clump" (RC) in the various colour–magnitude diagrams, we have determined the extinction law in each field (Panagia & De Marchi 2005; De Marchi & Panagia 2007). The RC is populated by stars experiencing core He burning and its position in the CMD depends on: (1) the age and (2) metallicity of the population, (3) its distance and (4) the intervening absorption (A_λ). Our high precision and high resolution photometry in four or more bands allows us to disentangle the four effects and determine or constrain their values. For fields with large and variable extinction, the RC is particularly useful to derive the extinction value towards each individual RC star, i.e. the extinction towards old populations.

We find that not only the amount of extinction but also its wavelength dependence varies considerably from site to site, indicating that the physical properties of the absorbing dust are not uniform across the Clouds. For instance, we have determined the extinction law towards a region located 6′ SW of 30 Dor and derived the absolute value of A_λ for all RC stars. The extinction law compares well with that obtained spectroscopically in a region containing SN 1987A (Scuderi *et al.* 1996), but it is significantly shallower in the U and B bands (see Figure 1), thus implying the presence of relatively large dust grains. Analytically, our extinction law in that specific field is equivalent to the Galactic diffused ISM law ($R_V = 3.1$) multiplied by a power law $\lambda^{0.5}$.

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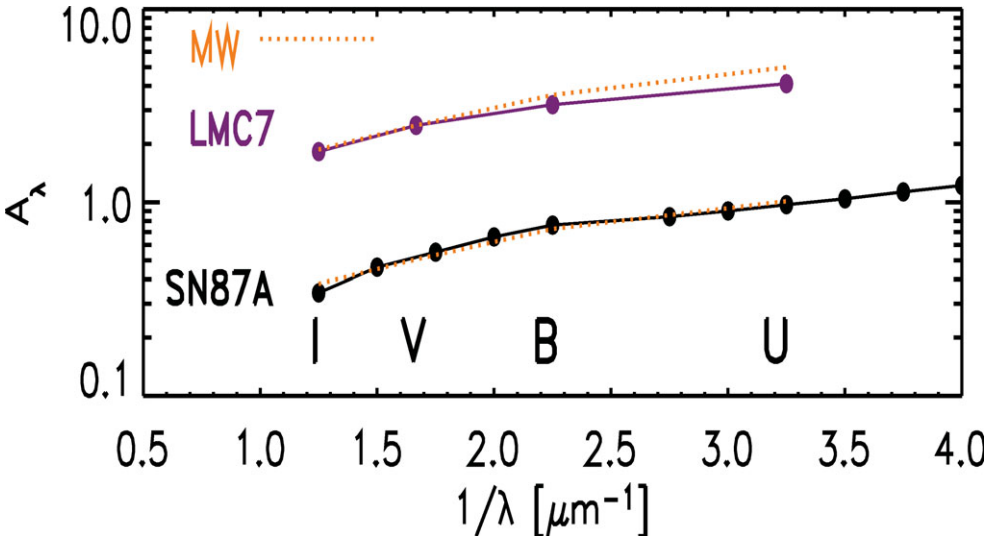

Figure 1. Photometrically determined extinction law in a field 6′ SW of 30 Dor (LMC7) is compared with that of the field containing SN1987A and to the Galactic law (dotted line).

This analysis also allows us to determine the relative three-dimensional distribution of the different populations as well as their location with respect to the absorbing dust clouds. For instance, in the field near 30 Dor mentioned above we find that all young stars lie behind a layer of dust with $E(B-V) \simeq 0.3$ and very few of them extend past $E(B-V) \simeq 0.7$, whereas the reddening towards RC stars spans the full range $0 \lesssim E(B-V) \lesssim 1$, indicating that the latter stars are evenly distributed along the line of sight. Furthermore, although the reddening distribution that we derive for all RC stars is compatible with that of Zaritsky *et al.* (2004) for the same field, it spans a considerably wider range of reddening.

Correcting for the appropriate extinction for each field *individually*, and following the procedures developed by Panagia *et al.* (2000), Romaniello *et al.* (2002), and Romaniello, Robberto & Panagia (2004), we determine the physical parameters, namely effective temperature and luminosity, of all stars present in the field (De Marchi *et al.* 2005). We find that, among young stars, those less massive than $2\,M_\odot$ are spatially more spread over each field than massive B type stars, whereas old stars are quite uniformly distributed. All young stars appear to be spatially associated with the nebular emission.

An important corollary of our investigation is that unaccounted patchy absorption or a variable extinction law are likely to contribute significantly to the present discrepancies between various distance indicators for the Magellanic Clouds.

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