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ORIGINAL ARTICLE

The Large Magellanic Cloud and the distance scale

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Abstract The Magellanic Clouds, especially the Large Magellanic Cloud, are places where multiple distance indicators can be compared with each other in a straight-forward manner at considerable precision. We here review the distances derived from Cepheids, Red Variables, RR Lyraes, Red Clump Stars and Eclipsing Binaries, and show that the results from these distance indicators generally agree to within their errors, and the distance modulus to the Large Magellanic Cloud appears to be defined to ±3% with a mean value $(m - M)_0 = 18.48$ mag, corresponding to 49.7 kpc. The utility of the Magellanic Clouds in constructing and testing the distance scale will remain as we move into the era of Gaia.

Keywords Distance scale · Magellanic Clouds

1 Introduction

The Magellanic Clouds (MC) are the closest populous galaxies to our own, and as such contain significant numbers of most of the indicators used to make up the distance ladder that transfers geometrically measured distances for nearby stars to the far universe via multiple overlapping steps. Both galaxies are now realized to be complex systems interacting with each other but not perhaps as-yet with the Galaxy (Nidever et al. 2010; Olsen et al. 2011; Besla et al. 2010).

The main structures of the Large Magellanic Cloud (LMC) lie reasonably close to the plane of the sky (Nikolaev et al. 2004), but the Small Magellanic Cloud (SMC) has long been realized (Caldwell and Coulson 1986) to form an extended structure almost in the line of sight. Although at times a Galaxy-LMC-SMC comparison is useful to test the metallicity dependence of some particular distance indicator, in general the SMC is of rather less utility than the LMC for distance scale work. The approximation that the LMC is sufficiently compact and distant that its contents are all at the same distance from us—and yet close enough that crowding and faintness are usually not issues—is a highly valuable attribute, although when pushing for distance comparisons at the few percent level the effects of sample size and spatial distribution will be important, and corrections for the geometry of the LMC, should be carefully considered. For small samples the possible line of sight variation in distance to any particular star must be taken into account as it may be significantly different from the mean distance, and for unique distance indicators such as SN 1987A the distance determined is of course that for the object itself and to go from that distance to the mean distance of the corresponding galaxy requires an extra step with its own associated error. In some cases the latter may be difficult to determine (Saha et al. 2010; Olsen et al. 2011).

Over the past decade the controversy over the "long versus short" distance scale has largely been resolved, with the corresponding values of the Hubble Constant (∼50 vs. ∼100 respectively), settling to an intermediate value, with rather small errors usually quoted (Freedman and Madore 2010; Riess et al. 2011). Although the range of LMC distances given by all available indicators in an oft-quoted compendium by Benedict et al. (2002) is large, some of the more notable outliers (e.g. RGB clump stars) are now better understood and more nuanced evaluations have generally been consistent for the distance indicators considered most reliable (Walker 2003; Alves 2005; Clementini 2008),

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