

# MAXIMUM MAGNITUDE VS. RATE OF DECLINE FOR NOVAE OF THE LMC

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## Abstract

We derive the distance modulus of the Large Magellanic Cloud (LMC) by applying the new calibrated relationship between maximum magnitude and rate of decline (MMRD). The result,  $(m - M)_0 = 18.70^{+0.20}_{-0.25}$ , is in close agreement with the most recent determinations based on RR Lyrae and Cepheids. We also discuss the properties of the MMRD of M31 and of the LMC.

## MMRD and Distance Modulus of the LMC

The study of the maximum magnitude *vs.* rate of decline relation, for novae in extragalactic systems, has a twofold importance. On the one hand, the MMRD provides a good distance indicator, while on the other it is a test of the nova population.

The MMRD for Galactic novae has recently been calibrated by Capaccioli *et al.* (1989a) and used to determine the distance modulus of M31 and the Virgo Cluster (Capaccioli *et al.* 1989b).

To further investigate the properties of the MMRD, we decided to review the LMC nova population, in order to give an independent estimate of the distance modulus through the new re-calibrated relationship and to look at possible differences with the well established MMRD of M31.

Despite the low rate ( $\sim 2 \div 3$  novae yr<sup>-1</sup>) and the more discontinuous nature of the surveys, the Large Magellanic Cloud (LMC) provides us with another fair sample of novae.

We have critically reviewed the determinations of  $m_{max}$  and  $v_d$  for 15 LMC novae: together with the six objects already discussed by Buscombe and de Vaucouleurs (1955), they constitute, to the best of our knowledge, the entire sample of novae discovered in the LMC up to date.

Magnitudes were reduced to the V-band (see Capaccioli *et al.* 1989c) and corrected for the global absorption. The total absorption  $A_V$  has been evaluated through observations of Cepheids and young associations, with  $\langle E(B - V) \rangle = 0.09 \pm 0.03$  and with the classical relation  $A_V = 3.3 \times E(B - V)$ .

The best fit to the data shown in Fig. 1 is represented by the equation:

$$m_V(max) = 11.12 - 0.81 \times \arctan \left\{ [1.32 - \log(t_2)] / 0.19 \right\}$$

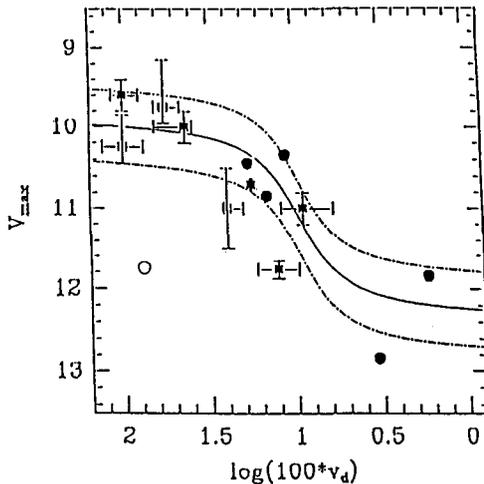
which gives an absolute distance modulus  $(m - M)_{LMC} = 18.70^{+0.20}_{-0.25}$ .

Our result is in agreement, within the errors, to Walker and Mack's (1988), who obtained  $18.42 \pm 0.06$  mag from CCD photometry of RR Lyrae, and Feast and Walker's (1987), whose revised calibration of the Cepheids yields  $18.47 \pm 0.15$  mag.

Fig. 1 suggests that the LMC novae share the same properties of Galactic and M31 novae. In particular, it is confirmed the existence of a class of extremely fast novae, which is responsible of defining one of the shoulders in the MMRD. The existence of the second shoulder of the MMRD, at fainter luminosities and lower rates of decline, is instead marginally supported by two objects only (LMC-1926, LMC-1948).

The frequency distribution of  $v_d$  suggests, at  $2.3\sigma$  level, an unexpected overpopulation of objects in the bright-fast part of the LMC-MMRD:  $\sim 30\%$  compared to  $\sim 10\%$  for M31 in the range  $1.5 \lesssim \log(100 \times v_d) \lesssim 2$ . At the same time, however, it is worth noting that the difference between the MMRD of the LMC and that of M31 might merely reflect a selection effect acting on M31; very fast novae, may be lost in M31 because of their rapid decline, whereas they might be easily discovered in the LMC.

In conclusion, we confirm the 'universality' of the MMRD for the novae of spiral and irregular galaxies, and the successful application of this relation to the problem of the cosmic distance scale.



## REFERENCES

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