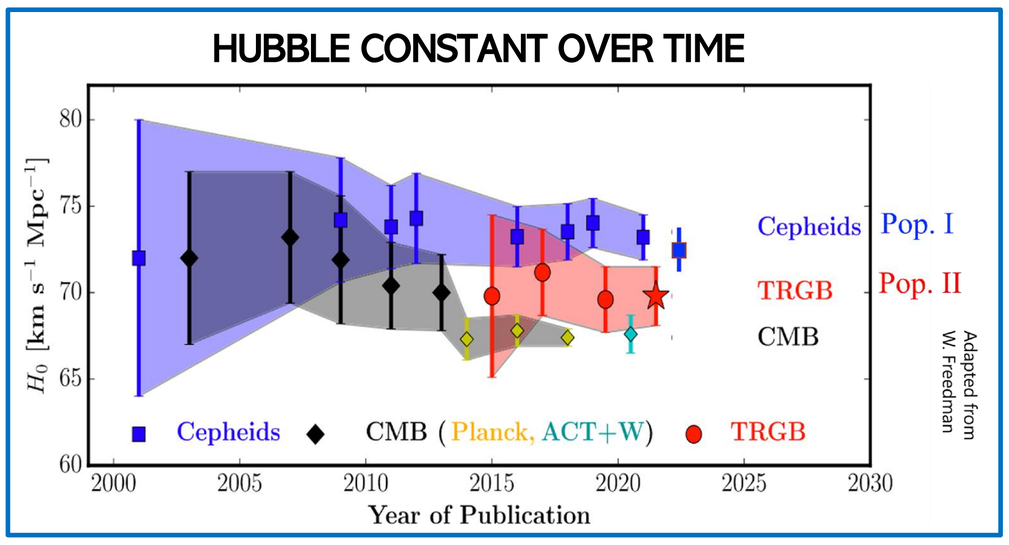
Teresa Sicignano

The distance scale of Type II Cepheids from near-infrared observations in the Magellanic Clouds



The HUBBLE TENSION between Early and Late Universe determinations. Note that the values derived using TRGB in the extra-galictic distance scale could reduce the tension.

In the era of the **Hubble Tension**, Type II Cepheids (T2C) variables together with the RR Lyrae stars and the tip of the red giant branch (TRGB) can potentially provide an alternative route to the calibration of the cosmic ladder.

T2C, as the most famous Classical Cepheids, following tight and linear Period-Luminosity (PL), Period-Luminosity-Color (PLC) and Period-Wesenheit (PW), can be used as distance indicators in the extra-galactic distance scale.

OBSERVATIONS AND DATA ANALYSIS:

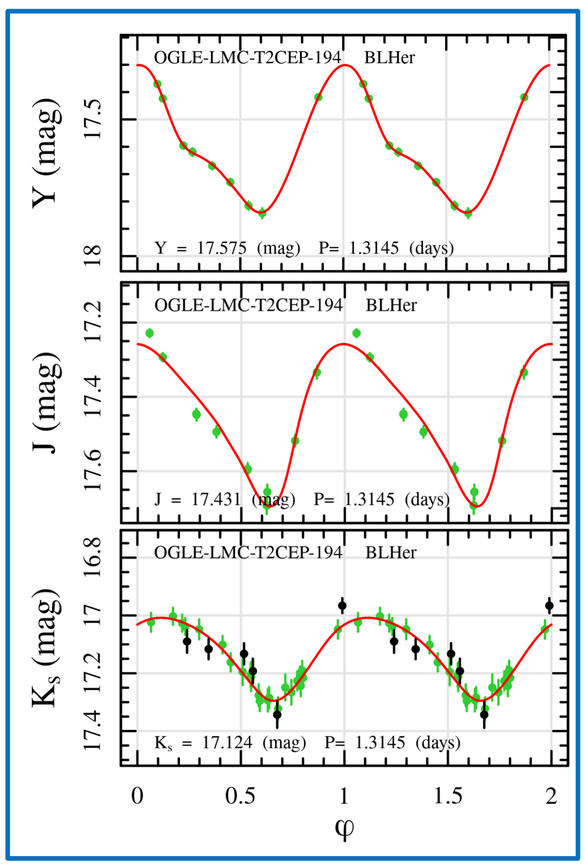
Time-series photometry in the near-infrared (NIR, Y, J and Ks) bands for a sample of about 300 T2Cs in the Magellanic Clouds collected by the VMC* survey.

Template light curves were used to derive accurate Y, J, Ks intensity-averaged mean magnitudes.

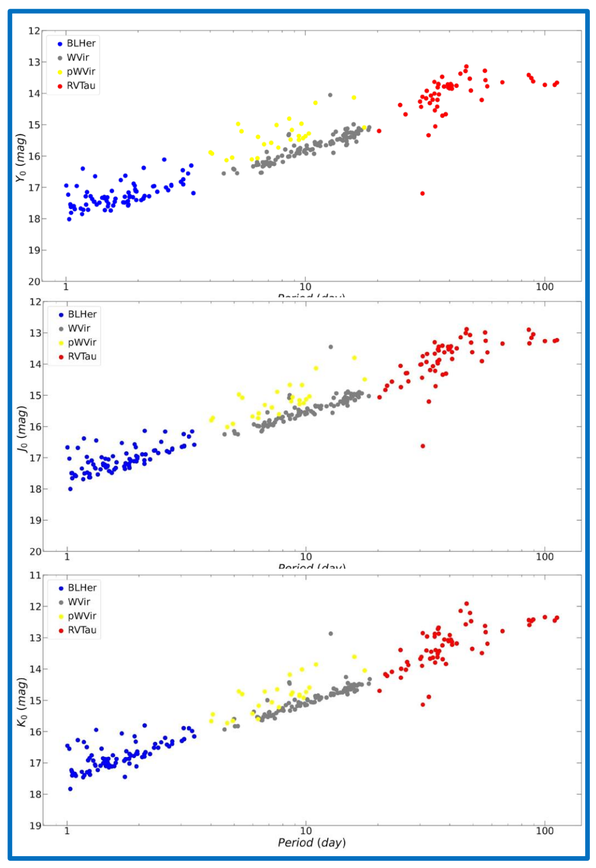
Multiband PL/PW/PW derived for a variety of T2Cs subtypes combinations.

Zero points of the multibands PL/PW/PLC calibrated in absolute magnitudes using the geometric distance of LMC (18,477 ±0.026 mag, Pietrzynski et al.,2019) and Gaia EDR3 parallaxes of a sample of about 1000 Galactic T2Cs.

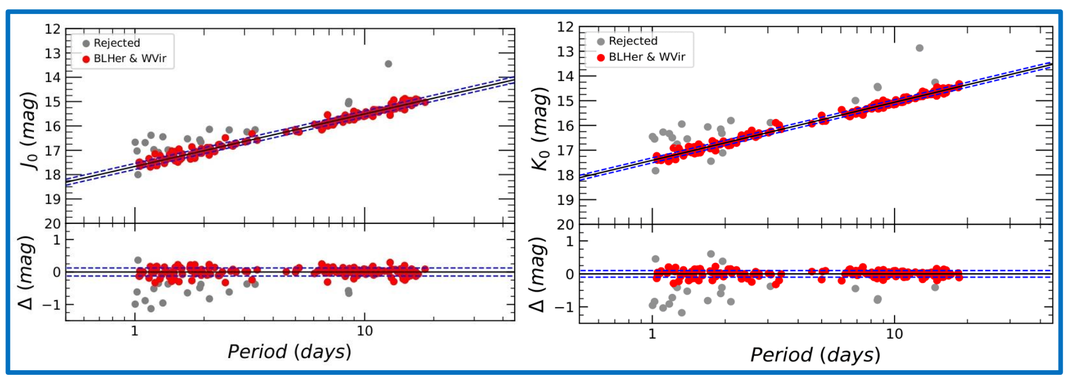
Best PL/PW used to calculate distances of Galactic Globular clusters (GGCs) hosting T2Cs and/or of the LMC.



Examples of observed light curves for a LMC BL Her star in Y, J and Ks bands. The green filled circles are the observations. The red solid line is the best template for the light curve. The black filled circles are the outliers data not used in the fit.



Examples of observed PL relations of the T2Cs in LMC in Y, J, Ks bands. T2Cs are classified in different subclasses based on periods: BL Her, W Vir, peculiar W Vir and RV Tau.



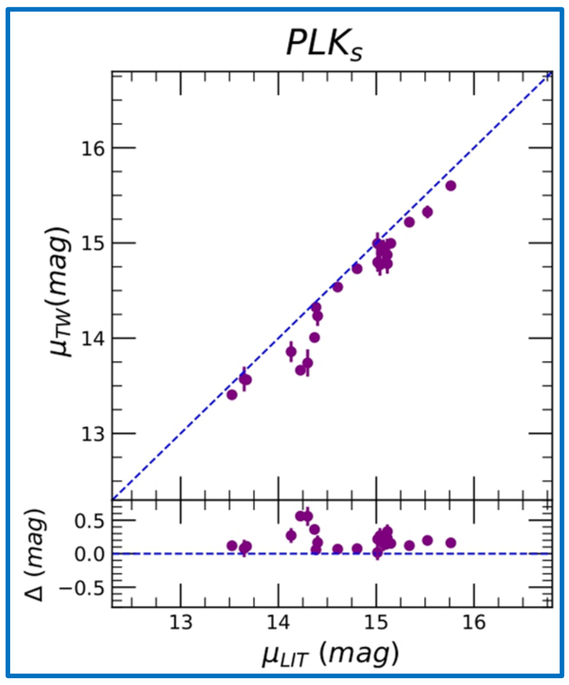
Example of PL fitting in the J and the Ks band for BL Her and W Vir pulsators in the LMC.

RESULTS:

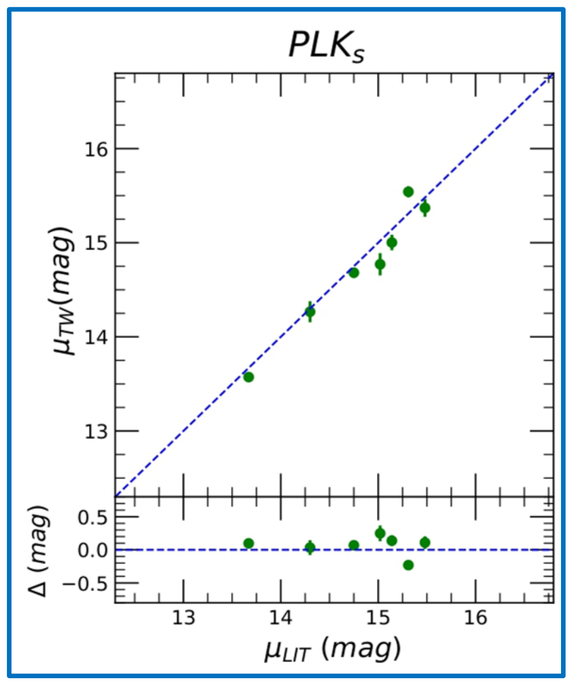
LMC distance derived in this work larger than the geometric distance by ~4% on average.

Derived distances of GGCs shorter than the distances by Baumbgardt & Vasiliev (2021) by 3%-6%.
Derived distances of GGCs shorter than the distances by Bhardwaj et al. (2023) by 1%-2%.

Metallicity may play a role in explaining these discrepancies.



Example of a comparison between distance moduli of GGCs derived on this work using PL in the Ks band and the distances by Baumbgardt & Vasiliev (2021) based on different methods,
Δ stands for (Baumbgardt & Vasiliev 2021) – (This Work).



Example of a comparison between distance moduli of GGCs derived on this work using PL in the Ks band and the distances by Bhardwaj et al. (2023) based on RR Lyrae.
Δ stands for (Bhardwaj et al. 2023) – (This Work).

FUTURE DEVELOPMENTS:

Calibrate the TRGB in an alternative route with both RR Lyrae and T2C pulsators.

Investigate the role of metallicity in our results, specially thanks to large spectroscopic surveys, such as the WEAVE and 4MOST.

Re-calibration of the zero points thanks to the next availability of Gaia DR4 parallaxes.

This work was carried out in collaboration with: V. Ripepi, R. Molinaro, M. Marconi, A. Bhardwaj, M.R. Cioni & the VMC team.

*__VMC__ (Vista Magellanic Cloud) survey is an ESO public survey with P.I. M.-R. Cioni. It was specifically designed to have a good sampling of RR Lyrae and Cepheid light curves with observations in YJKs with VIRCAM@VISTA 4 m (Paranal, Chile).