The Evolutionary Picture of Type II Cepheids

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In this paper, we present the first results of our study of the properties and evolution of Galactic Type II Cepheids. We have composed a sample of 7232 RR Lyrae ($P \geq 0.7$ d) and Cepheids from published catalogues and constructed spectral energy distributions for 3304 stars from the sample so far. Though our results are preliminary, they suggest that roughly 10 % of Type II Cepheids have near-infrared excess indicating the presence of hot dust.

1 Introduction

The classical evolutionary picture of Type II Cepheids (see e.g. Wallerstein, 2002) has been challenged by recent research. The blue loop timescales of low-mass AGB stars are too short to explain the amount of W Virginis stars, and the period increase observed in many RV Tauri stars is inconsistent with the evolutionary status of these objects (Groenewegen & Jurkovic, 2017a). Also, the mass estimates for RV Tauri stars derived from pulsational models do not agree well with the mass expected from single-star evolution (Groenewegen & Jurkovic, 2017b). The near-infrared excess seen in many RV Tauri stars has been linked to binarity (Gezer et al., 2015; Manick et al., 2017), as is the existence of dusty post-RGB stars (Kamath et al., 2016).

These questions about the origin and nature of Type II Cepheids motivate our research. We aim to clarify the role of short and intermediate-period Type II Cepheids in low-mass single and binary star evolution by studying the chemical and pulsational properties of these variables in the Galaxy and the prevalence of dust and binarity amongst them.

2 Sample

The initial selection of our target sample was liberal in order to minimise the effect of misclassification. We selected RR Lyrae and Cepheids from the General Catalogue of Variable Stars (GCVS, Samus et al., 2017) and Variable Star Index (VSX) catalogues. All objects present in either catalogue with a variability type associated with RR Lyrae or Cepheid variability were selected. To avoid saturating the sample with RR Lyrae stars, RR Lyrae stars with pulsation periods less than 0.7 days were removed. Also objects with positional association with the Magellanic Clouds were excluded, leaving 7232 Galactic stars. The composition of the sample is presented in Table 1.

Table 1: Sample per variability type

Type	Count	Type	Count
Type II Cepheids	1307	Non-specified Cepheids	626
RR Lyrae	3552	Anomalous Cepheids	164
Classical Cepheids	1583	Total	7232

3 SED Analysis

Photometric data were downloaded from online catalogues for 3304 stars. The spectral energy distributions (SEDs) constructed from these data were visually inspected for near-infrared excess. Of these SEDs, 1439 (43.6 %) have such a low quality that the shape of the near-infrared continuum could not be determined, 1819 (55.1 %) do not show near-infrared excess, and 46 (1.4 %) have either a prominent or a possible near-infrared excess. We find 43 of the objects with NIR excess to belong to the Type II Cepheid and 3 to the non-specified Cepheid class of Table 1. These values represent 9.0 % and 1.3 % of the populations with good data, respectively. The period distribution is strongly biased towards longer periods, and we only detect an excess in 8 Type II Cepheids with a period of less than 30 days.

4 Discussion

Our first results show that the NIR excess is more commonly observed in RV Tauri stars than in shorter-period Type II Cepheids, as expected. A major problem for the reliability of our results is the incompleteness of our data, which we suspect is caused by incorrect cross-matching between catalogues. In total, 80 % of our sample do not have enough data to draw a conclusion of the shape of their SEDs. More robust cross-matching, currently under development, will improve the data quality and the completeness of our SED analysis.

Acknowledgements. This research has made use of the International Variable Star Index (VSX) database, operated at AAVSO, Cambridge, Massachusetts, USA.

References

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