Communications of BAO, Vol. 72, Issue 2, 2025, pp. 444-446

M type Periodic Variables from Catalina Sky Survey

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Abstract

In this paper, we continue spectral class determinations for optically faint periodic variables from the Catalina Sky Survey (CSS) database. Based on Gaia Data Release 3 (DR3) BP/RP spectroscopic database, 169 objects are confirmed as G and K-type stars, while 78 objects are confirmed as M-type stars.

Keywords: *Astronomical Data: Surveys: Catalogs: M type stars*

1. Introduction

The investigation of periodic variable stars extends over several centuries. These objects are generally classified into pulsating stars, eclipsing binaries, and rotating stars, all of which exhibit luminosity changes that are either regular, semi-regular or irregular.

In 2021 (Gigoyan et al., 2021), we presented the catalogue which contains the spectral class determinations for faint PVs at high Galactic latitudes. The catalogue includes 1142 PVs selected from CSS DR1 and 96 from the Lincoln Near-Earth Asteroid Research survey (LINEAR) [7] datasets. 54 LINEAR PVs are also included in the CSS DR1 database. Spectral classes are confirmed for 626 PV stars based on the Hamburg Quasar Survey (HQS), Hamburg/ESO (HES) survey, and LAMOST (Large Sky Area Multi-Object Fiber Spectroscopic Telescope), which consist of faint pulsating Long Period Variables (LPV), M and N-class evolved giants, and Asymptotic Giant Branch (AGB) stars at high latitudes. Meanwhile, 558 objects remain unconfirmed with respect to their spectral classification. In this paper, the main goal is to continue spectral class determinations for the remaining 558 optically faint PVs. The spectral classes of these stars are determined using the Gaia Data Release 3 (DR3) (Vallenari et al., 2023) low-resolution (lr) spectral database.

2. GAIA DR3 spectroscopy

Spectral class confirmation was carried out for 558 CRTS and LINEAR objects by cross-matching them with the Gaia DR3 BP/RP spectroscopic database. There are spectra for only 247 stars in the Gaia DR3 database. In total, 169 objects are confirmed as G and K-type stars, and 78 objects are confirmed as M-type stars. Although the Gaia DR3 spectra are of relatively lr, M-type stars can be easily identified through the TiO molecular absorption bands at 6500 - 8500 Å (Gigoyan et al., 2025).

This study primarily focuses on M-type stars. Figure 1 presents Gaia DR3 lr spectra for only four confirmed M giants.

3. Luminosity classification.

We have used the distance information derived from Gaia EDR3 (Bailer-Jones et al., 2021) and Gaia DR3 BP and RP photometry to plot the color-absolute M(G) magnitude (CaMD) diagram for new 78 M-type stars

Figure 2 presents the M(G) versus BP-RP color CaMD for our stars. Different colors indicate the various types of variability. The absolute brightness of the vast majority of our targets corresponds to stars on the

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doi:https://doi.org/10.52526/25792776-25.72.2-444

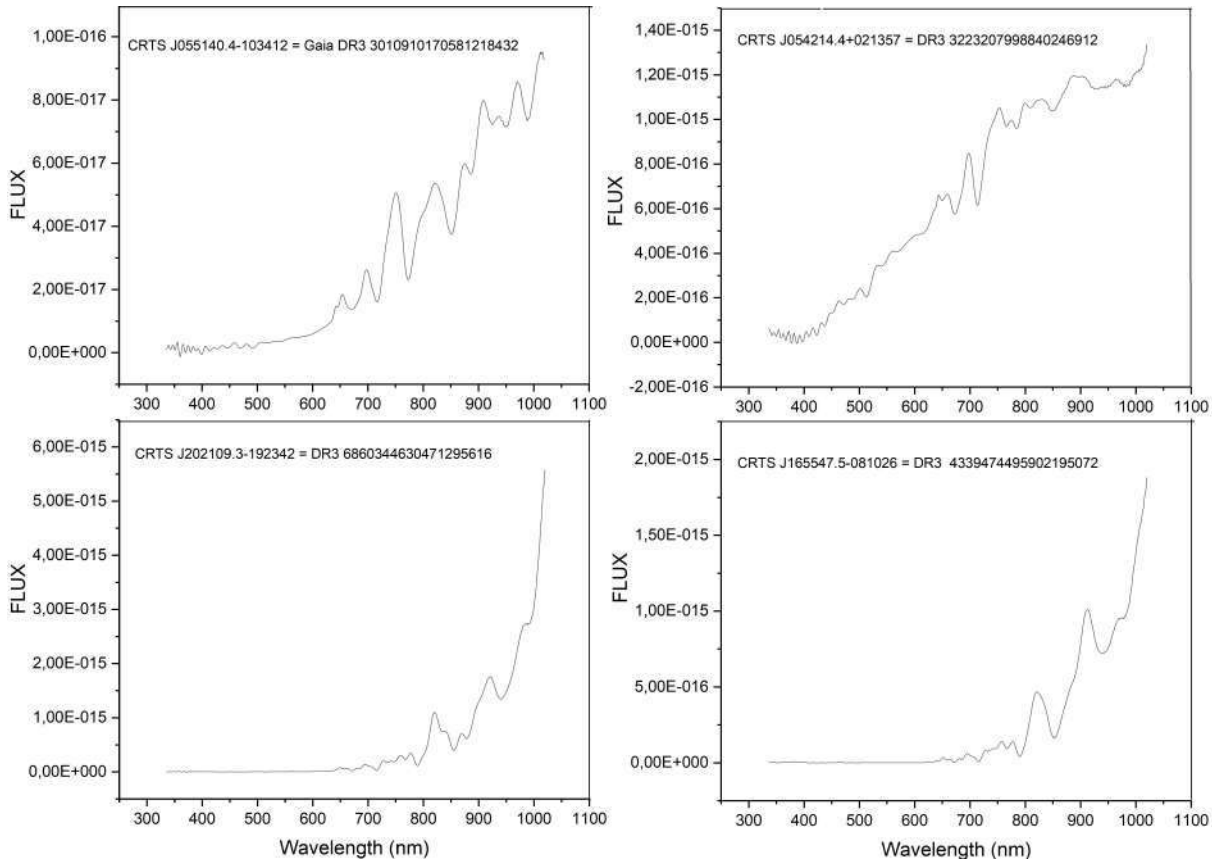

Figure 1. Gaia DR3 low-resolution spectra for new confirmed M-type stars.

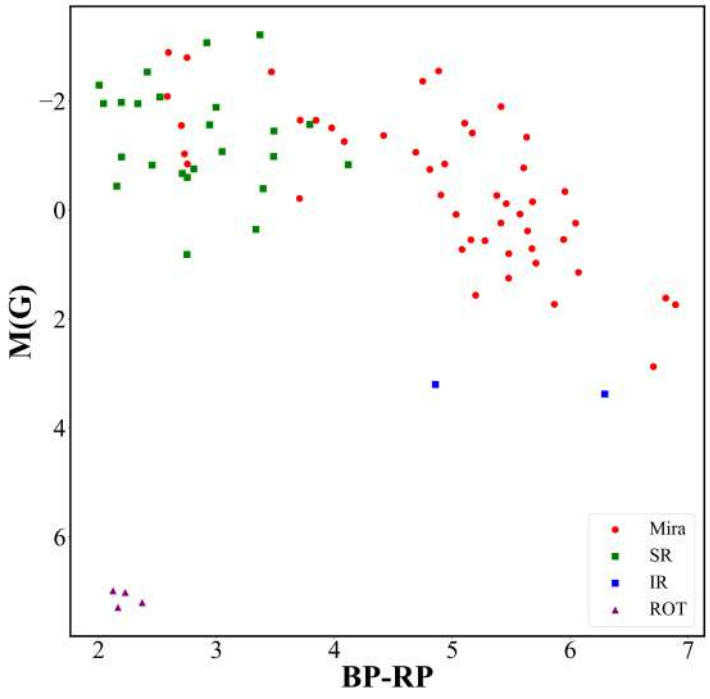

Figure 2. The M(G) versus BP-RP color CaMD for 78 M-type stars.

giant branch. The absolute brightness of M dwarfs corresponds to main-sequence stars. Analyzing the CaMD, we confirm that 74 objects are M giants and 4 objects are M dwarfs.

4. Variability

To study the variability of the CRTS PV M-type stars, we used data from the All-Sky Automated Survey for Supernovae (ASAS-SN). The light curve analysis confirms 47 stars as Mira-type variables, 25 – as Semi-Regulars (SR) with very well expressed periodicity, 2 objects – as Irregular (IR)-type variables, and 3 – as Rotating variables (ROT).

5. Conclusion

This paper presents the continuation of spectral classification confirmation for 558 optically faint PVs from the CSS and LINEAR databases. The spectral classes of these stars are determined using Gaia DR3 lr spectral database. A total of 169 objects were confirmed as G- and K-type stars, and 78 objects were classified as M-type stars. Analyzing the CaMD, we confirm that 74 objects are M giants and 4 objects are M dwarfs. The ASAS-SN light curve analysis confirms 47 stars as Mira-type variables, 25 – as SR with very well expressed periodicity, 2 objects – as IR-type variables and 3 – as Rotating variables.

Acknowledgements

This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France. This work has made use of data from the European Space Agency (ESA) mission Gaia (https://www.cosmos.esa.int/gaia), processed by the Gaia Data Processing and Analysis Consortium (DPAC).

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