

Refined stellar modelling and V-band photometric calibration of the eclipsing δ Scuti binary system KIC 6629588

J.A.D.M. Dharmathilaka^{1,2*}, J. Adassuriya², K.P.S.C. Jayaratne² and J.L. Gutiérrez³

¹Department of Physical Sciences and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka

²Astronomy and Space Science Unit, Department of Physics, Faculty of Science, University of Colombo, Sri Lanka

³Department of Physics, Universitat Politècnica de Catalunya (UPC), Spain

Eclipsing binary systems with Delta (δ) Scuti-type pulsating components are valuable for studying both binary dynamics and stellar pulsations. To enable accurate analysis of these two fields, the disentanglement of the binary nature from the observed light curve must be performed successfully. Photometric data from the Kepler mission on the detached eclipsing binary system KIC 6629588, which contains a δ Scuti component, were used in this study. The binary modeling was carried out using the Wilson-Devinney (WD) program, demonstrating the application of the Differential Correction (DC2015) process within the WD program framework. This approach represents an improvement over previous studies that primarily employed only the Light Curve (LC2015) modelling process in the WD program. The Levenberg-Marquardt algorithm was employed in the DC2015 for parameter refinement. The refined model provides highly accurate stellar parameters, yielding effective temperatures of the primary and secondary stars of 7153.11 ± 1.28 K and 4438.30 ± 0.50 K respectively. The derived mass ratio is 0.7678 ± 0.0002 , inclination angle is 68.3668 ± 0.0062 degrees and the primary star luminosity is $9.7247 \pm 0.0014 L_{\odot}$. The DC2015 refinement significantly improves the disentanglement of the binary nature. In addition, this study provides the first identification of the Visual (V) band magnitude of KIC 6629588 as 14.115 ± 0.002 mag, by applying Gaia photometric data to polynomial transformations for the Johnson-Cousins system. The analysis was also extended to estimate the absolute magnitude in the V band as 2.32 mag. This combined study of WD modelling and photometric calibration offers a refined and comprehensive interpretation of the eclipsing binary system KIC 6629588.

Keywords: Delta Scuti stars, differential correction, KIC 6629588, visual band magnitude, WD modelling

*dinesha@appsc.sab.ac.lk
<https://orcid.org/0009-0001-7889-8442>