Identification of a Binary System by CCD Photometry and Analysis on the Physical Properties of Asteroid (39) Laetitia

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The study of asteroids provides valuable insights regarding the formation of our solar system and potential strategies for addressing the threat posed by PHOs(Potentially Hazardous Objects). For example, the objective of the DART(Double Asteroid Redirection Test) mission was to assess an asteroid; deflection via spacecraft impact and the resulting kinetic energy transfer. Modifying trajectory of 68503 Didymos therefore required a meticulous observation of its physical characteristics. The process of retrieving different types of data from asteroids varies depending on their system; however, there is a significant lack of research on binary asteroids. In this research, we analyzed the aperture photometric observation data obtained by the DOAO NYSC telescope and presented corroborating evidence for the hypothesis of 39 Laetitia's binarity. Many researchers have speculated Laetitia to exhibit binary characteristics based merely on its flat maximum value, rapid changes in amplitude, and shape of magnitude curves from uncalibrated data. In order to address this issue, the observed data was preprocessed by considering the phase and error, and then compared to known values such as color index, rotation axis, and aspect ratio. Physical properties and diagrams including light curve and color indices graphs were extracted, and multiple peaks that are challenging to interpret within the context of a single asteroid condition in the Lomb-Scargle periodogram were shown. In conclusion, we expect the preprocessed data and extracted diagrams will function as a valuable resource for a database, with the potential application to a wider range of celestial bodies.