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The Study of Variability in Four Oxygen-Rich Proto-Planetary Nebulae

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This summer, I have been working on a project to study the variability of four proto-planetary nebulae. Proto-planetary nebulae (PPNe) are evolved stellar objects that are in the process of losing their outer layers and in transition from a red giant star to a planetary nebula. Oxygen-rich PPNe, specifically, have a higher oxygen content in their nebula than they do carbon, and this occurs mainly in lower mass stars. This project includes combining our data from the VU Observatory with other published data, analyzing light curves of brightness versus time and looking for patterns, and performing period analysis using a sophisticated period search program. I began this project last summer, and I have successfully analyzed two of the four objects. Over the sixteen-year observing interval, both of these objects show clear cyclical variations (due to internal pulsation), with periods of 102 and 114 days; there is also evidence that suggests additional beat periods. Both also show a long-term increase in brightness of approximately twenty percent. I am currently completing the study of the other two objects to determine their periods of variation.

Information about the Authors:
I am a senior astrophysics and mathematics major and have been working with Professor Hrivnak on the study of proto-planetary nebulae for three years.

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