Investigating Proto-Planetary Nebulae through Angular Differential Imaging

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Studying the Proto-Planetary Nebula (PPN) stage of a star's life sheds light on the critical mass-loss mechanism that leads to the morphological change from spherically symmetric to axisymmetric circumstellar material. However, when studying material very faint in reflection so close to a star, the brightness of the star itself becomes prohibitive. Therefore, in order to study the circumstellar material more effectively, it is necessary to block out the central star. The method of Angular Differential Imaging (ADI), used in this research, takes advantage of altitude-azimuth telescopes by turning off the telescope rotator and allowing a series of images to be taken that are slightly rotated with respect to each other. This creates a better characterization of the point-spread-function (PSF) of the central star for more effective subtraction than previous PSF subtraction techniques. ADI has successfully been used to verify extrasolar planets, but this is one of the first attempts at adopting ADI techniques for extended structures as opposed to point sources. In this study, ADI techniques were applied to PPN observations to better study the most recent mass-loss histories of PPNs. Data for the PPNs were taken at the Near Infrared Coronographic Imager (NICI) at Gemini South between March and September 2012. Due to the low contrast of the objects studied, this research truly pushes the boundaries of ADI methods. New details on the circumstellar structure of 6 PPNs will be presented.