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<p>Detailed multi-wavelength, near-infrared maps and polarimetry have been made of AFGL 2591, AFGL 490, Cep A, S140, AFGL 618, and OH 0739-14, stars embedded in dust that absorbs starlight and reradiates strongly in the mid-infrared. A general Mie scattering model has been coded to yield intensity and polarization maps of bipolar nebulae in the infrared and visible parts of the spectrum. Hat Creek Millimeter Interferometer maps of AFGL 618 and NGC 7027 have been obtained which are being reproduced and combined with data taken at the Wyoming Infrared Observatory to produce detailed studies of these objects. The construction and testing of a photoelastic modulator data acquisition system was completed and is currently being used to acquire polarimetry of dust-enshrouded stars.</p>			
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Structure of Infrared-Bright Circumstellar Nebulae:
Final Report

August 1988

Results

Since the beginning of our grant period (Feb. 1, 1985) we have spent over 50 nights at the Wyoming Infrared Observatory on this project, approximately 20% of which were clear enough to work. Besides the P-I, Paul Johnson, and Co-I, Harley Thronson, Jr., four people actively worked on this research. Dr. M. Shane Burns was hired on August 1, 1985 by this grant as a post-doctoral research associate and worked with us until June of 1987 full-time on the project. David Harpe, a senior electrical engineering student, used the design and fabrication of our polarimeter data acquisition system for his senior thesis. We also have had three graduate students participating in this research (Karl Klett, Thomas Hayward, and Charles Wilton). Our accomplishments to date are summarized below.

1.) Detailed multi-wavelength, near-infrared maps and polarimetry have been made of AFGL 2591, AFGL 490, Cep A, S140, AFGL 618, and OH 0739-14, stars embedded in dust that absorbs starlight and reradiates strongly in the mid-infrared. The linear polarization of light from AFGL 2591 shows this source to be an infrared reflection nebula. We were unable to spatially resolve AFGL 490. The other sources have yet to be analyzed.

2.) A general Mie scattering model has been coded to yield intensity and polarization maps of bipolar nebulae in the infrared and visible parts of the spectrum. The basic models are currently being used in a production mode to generate output for a grid of input parameters (including grain composition, grain size distribution, optical depth, and nebula geometry). Using Principal Component Analysis we will shortly examine what parameters can be uniquely determined from intensity and polarization spectra in the visible and near-infrared. We are able to produce both pseudo-images and pseudo-spectra from this model. We will compare our model output with spectra and images of objects with large angular size (from our own data as well as that found in the literature).

3.) We have obtained Hat Creek Millimeter Interferometer maps of AFGL 618 and NGC 7027 which we are reducing and combining with data taken at the Wyoming Infrared Observatory to produce detailed studies of these objects.

4.) The construction and testing of a photoelastic modulator data acquisition system was completed and is currently being used to acquire polarimetry of dust-enshrouded stars.

Publications

Burns, M.S., Johnson, P.E., Thronson, H.A., and Hayward, T.,
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Burns, M.S., Johnson, P.E., and Thronson, H.A., "Models of
Polarized Infrared Emission from Bipolar Nebulae", Summer
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P.E., "Imaging Polarimetry of AFGL 2591 and its Associated
Reflection Nebula", submitted to Ap.J., 1988.



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