Final Technical Report
NAG5-3360

Date:	August 22, 2000
PI:	Dr. Ron Allen, Space Science Telescope Institute
NASA Grant No:	NAG5-3360
Title:	*A Consolidated Block Grant Proposal to Carry Out the Analysis of Data from the ISO Satellite*
STScI Project No:	J0496
Performance Pd:	09/01/1996 - 03/31/1999
STScI Grant Administrator:	Larisa Dolhancryk 3700 San Martin Drive, Baltimore, MD 21218 Phone: 410.338.4364 Email: larisad@stsci.edu

This block grant covers the activities of three research groups at STScI. We proposed to group the efforts and resources available to several approved ISO projects in order to more efficiently deal with the data reduction and analysis. We give a brief description of primary objectives and scope of each project, along with the final status of the project as of the expiration date of the grant.

Owing to many delays on the part of the ISO Project, the calibrated data was received very late, which resulted in significant delays in deriving the results. In addition, for one of the components of this project, the ISO data was finally determined to be of too low a quality to be useful.

1. Search For Cold Molecular Hydrogen In The Galaxy (R. Allen)

This project aims to detect absorption from cold molecular hydrogen in the continuum spectra of several Galactic sources using the Fabry-Perot mode of the SWS on ISO, primarily at 28 microns. The PI of the observation is J. Koornneef from the Kapteyn Institute in Groningen, The Netherlands. A total of 100,000 seconds of ISO observing time was allocated to this difficult observation. Koornneef has carried out the initial data reductions. Several problems in the data stream were identified as interference from cosmic rays, which seriously degrade the S/N ratio.

Allen and Koornneef have spent a total of several weeks in the reporting period working together in Baltimore (at STScI) and in Groningen trying various techniques to deal with the cosmic ray problem, unfortunately all to no avail. The problems are so severe that, as far as we know, neither the cognizant ISO instrument scientist nor any other project PI has succeeded in obtaining useful data at the pre-flight-advertised S/N with the specific detector mode we have used.

This part of the Block Grant project has therefore been terminated.

2. Dust Characterization In Circumstellar Shells Around Evolved Massive Stars (M. Clampin):

This program uses ISO to investigate the presence, and characterize the physical properties of, dust around a selected sample of hot evolved stars populating the upper part of the HR Diagram: LBVs, Ofpe/WN9 and B[e] stars. Some of these stars are known to show the presence of dust in their circumstellar environment from ground-based near-IR and IRAS data. The fact that dust grains do exist in the winds and/or in the close vicinities of these hot objects suggests that the conditions are present which increase the chances for the formation and survival of grains. It is clear then that determining the distribution and the properties of grains in these circumstellar shells will provide vital clues on the stars' modes of losing mass and, therefore, vital clues on their evolution.

We have use ISOCAM to spatially resolve the dust population in the range 3-15 microns, and to study selected emission features, in order to characterize dust size and composition. Analysis of the data obtained during this program has recently been completed. The combination of bright sources surrounded by faint extended diffuse emission has proved to be very complicated to calibrate and analyze. Our initial analysis has focused on WRA751 and HD168625, two galactic Luminous Blue Variable (LBV) candidates, known to possess ejected circumstellar nebulae. In both cases we have acquired several ISO images at the best spatial resolution in the 8-12 micron bandpass, where we detect extended emission from warm dust in correspondence with the reflection nebulae visible in the optical images. For both objects we have been able to compute a dust mass which allows us to quantify the presence of neutral material in the circumstellar environment. In combination with the ionized gas mass derived from the optical emission lines these measurement provides the best estimate for the amount of total mass ejected by these LBV candidate during their past eruptions, to constrain quantitatively the stellar models which describe the post main-sequence evolution of stars with masses above 40 solar masses. In this mass regime mass loss is the key parameter which is so far observationally uncertain, but regulates the transition from an O star into a Wolf-Rayet star.

The results of these observations have been presented at meetings on hot stars, and two publications are now in the final stages of preparation.

3. The Relationship Between Dust Absorption And Emission In Galaxies (D. Calzetti)

This project is aimed at investigating the relative importance of the warm and cool dust emission, the dust opacity, and the characteristics of the dust-star geometrical distribution in actively star-forming galaxies. ISOPHOT C200 135 and 200 photometric data were obtained for a sample of 8 local starburst galaxies. These detections, supplemented by the IRAS measurements, have been used to model the cool ($T<30$ K) dust emission from the galaxies, and measure dust masses. The cool dust component represents a non-negligible contributor (up to ~60%) to the FIR emission of starburst galaxies, objects traditionally considered dominated by warm dust. With the addition of the cool dust mass, dust-to-gas ratios of starbursts are close to the Milky Way value. The 1-1000 micron FIR emission has also been used to measure the total opacity of the galaxies and refine the zero-point of the starburst reddening curve of Calzetti et al. Supplemented with UV-optical-nearIR data, our galaxies have finally been used to predict the detectability of the Lyman-break galaxies at $z=3$ with SCUBA. Under most circumstances, the Lyman-break galaxies are undetectable or barely (2 sigma)

detectable with the current sensitivity limits of SCUBA, and the conditions for detectability are strongly dependent on the FIR SED.

A paper containing the ISO results has just been published in the 20 April 2000 issue of the Astrophysical Journal (Calzetti et al. 2000, ApJ 533, 682 'The Dust Content and Opacity of Actively Star-Forming Galaxies').