[94.14] Compact Mid-IR Emission from High-Mass Protostellar Candidates

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INTRODUCTION

- The theory of formation of high-mass stars is not well established.
- There are only a small number of high-mass protostellar objects (HMPOs) known that can be used to develop or test the theory.
- We have observed 22 new HMPO candidates in the mid-IR using the new camera/spectrometer MIRSI on the IRTF.
- 82% (18) of HMPO candidates were detected in N band (□=10.6□m, □□=4.9□m).
- Most N band sources were found to be at or near the diffraction limit of the IRTF, 0.9″
- 76 % of sources detected in N and observed at 20.6□m (□□=7.6□m) or 24.8□m (□□=2.0□m) were detected.
- Most 20 □m sources were near the diffraction limit of the IRTF.
- 8-13□m (□/□□=100) grism spectra were obtained for about half of the sources detected at N.

SELECTION CRITERIA

- Objects were chosen from the Sridharan et al. (2002) list of 69 candidate HMPOs from IRAS PSC. These objects' properties are that:
  - IRAS colors are similar to those of ultracompact HII regions.
  - Millimeter dust continuum emission is present.
  - High density millimeter molecular lines are present.
  - Weak or no cm continuum emission is observed.
  - Millimeter continuum and line emission is likely due to molecular clumps forming clusters containing HMPOs.

- Primary Criteria for Observation at IRTF were:
  - Bright, compact mid-IR emission in Bands C and E of MSX survey (12.1 and 20.3 □m, 20″ resolution).
  - Peaked 1.2 mm dust continuum emission (11″ resolution, Beuther et al. 2002)
  - Some sources were chosen for known indicators of hot molecular cores.

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MID-IR DETECTIONS

IRAS PSC	Spectrum?	Notes
05338+3543	No	2 sources in N band; 20 □m not ob'd
05531+1631	No	
18089-1732	No	
18151-1208	Yes	Results shown
18223-1243	No	20 □m not detected
18247-1147	Yes	
18337-0743	No	20 □m not ob'd
18348-0616	No	Very diffuse; 20 □m not ob'd
18488+0000	No	2 sources in N band; 20 □m not ob'd
18530+0215	Yes	
18553+0414	Yes	20 □m not detected
19410+2336	No	3 sources in N; 1 source at 20 □m
20216+4107	No	20 □m not ob'd
20343+4129	Yes	2 sources
22134+5834	Yes	2 sources
22570+5912	No	20 □m not detected
23033+5951	Yes	
23151+5912	Yes	

MID-IR NON-DETECTIONS

IRAS PSC	IRAS PSC
18264-1152	18566+0408
18445-0222	20293+3952

SAMPLE OBSERVATION: IRAS 18151-1208

- Mid-IR position is associated with eastern of two peaks in 1.2 mm dust emission (Beuther et al. 2002).
- Very sharply peaked 1.2 mm dust emission suggests that this object is dominated by a single massive central object (Beuther et al. 2002).
- <1 mJy cm continuum flux density (Sridharan et al (2002) indicates that the object has not formed an ultracompact HII region.
- H_2O maser and other tracers of high density molecules are present (Sridharan et al. 2002) suggesting the that object is a hot molecular core.

MID-IR IMAGE SIZE

- Images are diffraction limited at both wavelengths, N band and 24.8 □m.

- A radial plot made in IRAF of the N band image is shown at right. The FWHM of plot is consistent with the diffraction limit of telescope in N band (0.89″).

PHOTOMETRY OF IRAS18151-1208

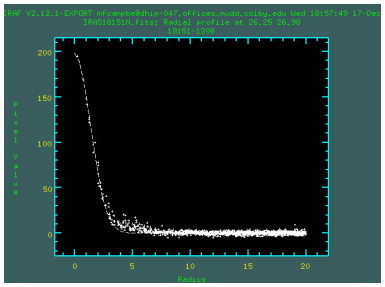
- Preliminary calibration has been made using □Aql, with no correction for atmospheric extinction.
- Results are shown in a table below.
- Accuracy is ±20%.
- IRTF flux densities are significant fractions of those from MSX and IRAS, indicating that we have identified the dominant source of mid-IR.
- Mid-IR source appears to be an embedded high-mass protostar.
- Campbell et al. (2003) previously reported preliminary sizes and flux densities for three of the survey objects (22134+5834, 23033+5951, & 23151+5912) that are also compact and contribute significant fractions of IRAS and MSX flux densities.

PHOTOMETRY OF IRAS 18151-1208

T'scope	□ □m	F_ν Jy	□ □m	F_ν Jy
IRTF	N(10.6)	11	24.8	70
MSX	8.3	10.5		
MSX	12.1	21	21.3	72
IRAS	12	19	25	99

IRAS 18151-1208

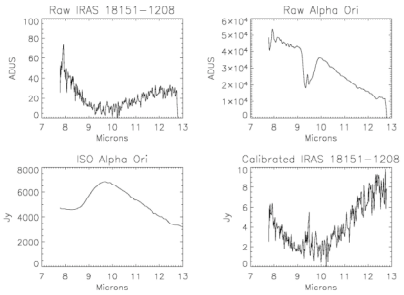
Image Profile in N Band (10.6□m)
Each pixel is 0.27″. The source is unresolved.



GRISM SPECTRUM OF IRAS 18151-1208

- Resolution is 100.
- Calibrated by ISO spectrum of □ Ori.
- Main feature is silicate absorption.
- Sharp features in final spectrum at 9.5□m are due to over correction for atmospheric absorption, possibly caused by incorrect background subtraction.
- Over correction for atmospheric absorption indicates that flux level at the center of the silicate absorption is too high.
- Absolute flux level is also uncertain due to difficulty centering the source on the grism entrance slit, and some loss of the source overfilling the 1.2″ wide slit.
- Approximate minimum silicate absorption optical depth is □$_s$=1.9 at 9.5□m.
- Silicate absorption is consistent with a deeply embedded protostar.

SPECTRUM OF IRAS 18151-1208



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MIRSI web site: http://cfa-www.harvard.edu/mirsi