

## YOUNG STELLAR OBJECTS IN GY 2-18 (IRAS 05439+3035)

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**We present the results of optical and near-IR spectra and mid-infrared images of the star-forming region Gy 2-18, which is associated with IRAS 05439+3035.**

Gy 2-18 is a peculiar nebulosity suspected to be an Herbig-Haro (HH) object (Gyulbudaghian 1983) embedded in a molecular cloud marked by CO ( $J=1-0$ ) in emission (Wouterloot & Brand 1989). The *IRAS* source 05439+3035 is associated with this nebulosity, and its 1 to 100  $\mu\text{m}$  spectral energy distribution (SED) is characteristic of a young stellar object (YSO; Persi et al. 1988). CCD images of Gy 2-18 revealed an optically visible star with strong H $\alpha$  emission illuminating a faint reflection nebula. In addition, ten infrared sources with significant excess emission at  $\lambda \geq 2 \mu\text{m}$  from *JHK* images were found by Tapia et al. (1997). Three of these (#9, #11, and #13) are within the *IRAS* positional ellipsoid. Source #11 coincides with the visible star.

The narrow-band images at 8.7, 9.7, and 12.5  $\mu\text{m}$  of Gy 2-18 were taken on 2001 January 14 with the mid-infrared camera CID (Salas et al. 2003) at the 2.1 m telescope of the Observatorio Astronómico Nacional at San Pedro Mártir, B. C., Mexico (OAN-SPM). This camera is equipped with a Rockwell 128  $\times$  128 pixel Si:As BIB detector array, and delivers an effective scale of  $0''.55 \text{ pix}^{-1}$ . The mid-IR images and a 2.2  $\mu\text{m}$  image of the region (shown for comparison) are displayed in Figure 1. Two point sources separated by  $3''.8$  in R.A. and  $0''.8$  in Dec. and surrounded by diffuse emission are present in all mid-IR images. These sources are IRS 9 and IRS 11, and they are marked in the 2.2  $\mu\text{m}$  frame. The weakest of the two at 8.7 and 12.5  $\mu\text{m}$  has been identified with IRS 11 and its visible counterpart. IRS 9 appears very red with a deep silicate band at 9.7  $\mu\text{m}$  in absorption.

Optical and near-IR spectra of the visible star IRS 11 have been obtained in the 4000 to 9000  $\text{\AA}$  range with the Loiano 1.52 m telescope with the Bologna Faint Objects Spectrometer and Camera, and between 1.15 and 2.4  $\mu\text{m}$  with the Infrared Camera/Spectrograph CAMILA (Cruz-González et al. 1994) mounted at the 2.1 m telescope at OAN-SPM.

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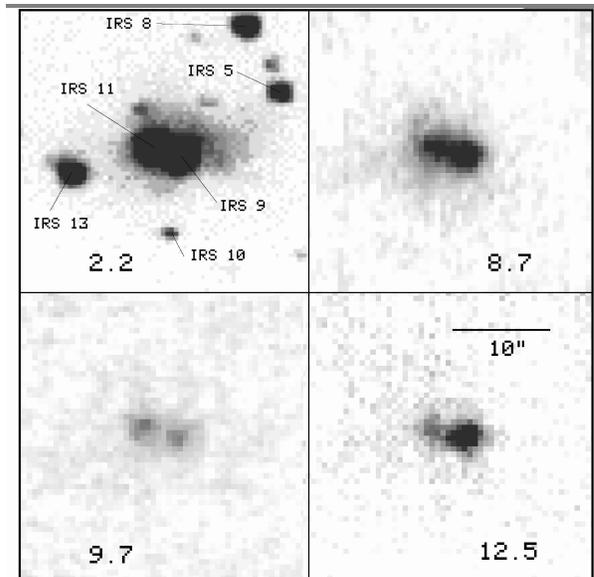


Fig. 1. Near- and mid-infrared images of Gy 2-18. The brightest near-IR sources in the field are indicated on the *K*-band image. The scale is shown by a horizontal bar. North is to the top and east to the left.

From the analysis of these spectra, we deduce that IRS 11 is a reddened ( $A_V = 7.5$ ) early type star (B0–B2), probably a Herbig Be star illuminating a reflection nebula observed in the optical and near-IR. A stellar wind is associated with the star, and the mid-IR observations suggest the presence of a circumstellar dust disk. More deeply embedded in the cloud is IRS 9 ( $A_V = 40$ ). The observed very steep energy distribution ( $\alpha_{\text{IR}} = 1.9$ ) indicates that this object is a massive protostar with  $L_{\text{BOL}} = 8.6 \times 10^3 L_{\odot}$ . Most of the *IRAS* far-IR flux comes from this YSO. We estimated the distance to the region to be  $\leq 5.7$  kpc. A detailed discussion of the observations of Gy 2-18 is given in Persi et al. (2002).

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