**TITLE**
ASP Conference Series, Vol. **VOLUME**, **PUBLICATION YEAR**
**EDITORS**

# Dust and Molecular Emission from the S235 Star Forming Region

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**Abstract.** We present the results of a multi-faceted study of the high-mass star-forming region S235. With the CalTech Submillimeter Observatory (CSO), we have observed and/or mapped over fifty molecular transitions and 350 $\mu$m dust emission in an attempt to learn more about the chemistry, kinematics, and mass distribution within this rich region. We have found two dust cores that are not resolved in our molecular line observations and suggest that one of these is a less evolved star-forming core.

## 1. Introduction

The S235 star-forming region includes small optical nebulosities (S235A, S235B, and S235C), and it is located about $10'$ south of S235, which is a well known HII region. This star-forming region has been identified by $H_2O$ maser (Lo et al. 1975, Genzel & Downes 1977), infrared emission (Krassner et al. 1997, Evans et al. 1981, Felli et al.1997), radio continuum (Krassner et al. 1979, Felli et al. 1997), and molecular line spectra (Evans et al. 1981, Makoto et al. 1986, Snell et al. 1990, Felli et al. 1997). According to previous results, the region has several components with somewhat different spatial distributions. We present the initial findings of a major observing campaign aimed at understanding the complexity of S235 with greater lucidity.

## 2. Dust Continuum Emission and Molecular Spectra

We observed the dust emission from S235 at 350 $\mu$m with the Submillimeter High Angular Resolution Camera (SHARC) at the CSO during December 1997 and show the resulting map, with a resolution of about $11''$, in Figure 1. There are two dust cores; the northern one is close to and, presumably, related to the compact HII region, S235A, and the infrared source, IRS3. Krassner et al. (1979) found two 2.2 $\mu$m point source in S235A, and Felli et al. (1997) observed molecular hydrogen emission distributed around the HII region. This $H_2$ emission is along the southeast edge of our northern dust core. Several infrared point sources observed at 2.2$\mu$m (Felli et al. 1997) are located between the two dust cores. On the other hand, the southern dust core is not associated with any optical nebula, HII region, or NIR point source to heat it. S235B and

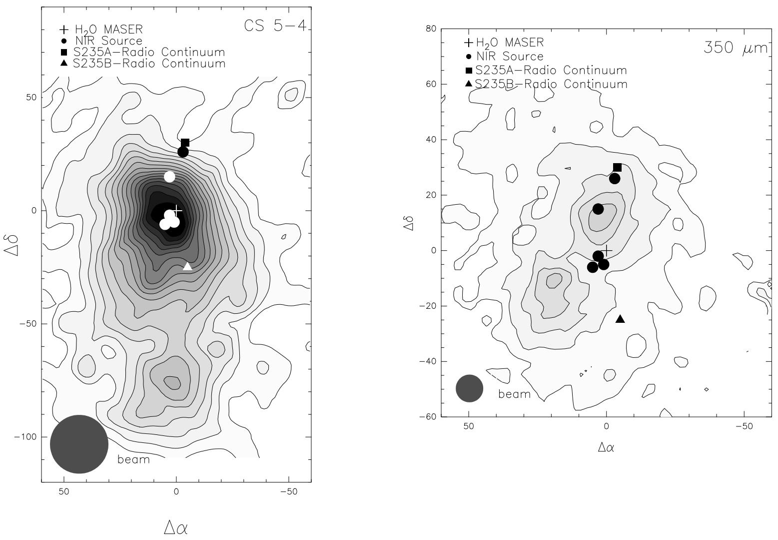


Figure 1. In the left figure, we show the CS5 $\rightarrow$ 4 map of S235 and, on the right, a map of the dust continuum emission. The central position for each is $\alpha_{1950} = 05h37m31.8s$ and $\delta_{1950} = 35°40'18''$. Note that the two peaks in the dust map are not resolved by our molecular line observations.

IRS4, the nearest signposts of activity, are about 0.3 pc away from the peak of this core. Therefore, we suggest that this is a less evolved star-forming core.

We observed over 50 transitions of 23 molecules (CS, $C^{34}S$, $^{13}CS$, $C^{17}O$, $C^{18}O$, HCN, $H^{13}CN$, $HC^{15}N$, DCN, HNC, $HN^{13}C$, DNC, $HCO^+$, $H^{13}CO^+$, $HC^{18}O^+$, $DCO^+$, $HCS^+$, SO, $CH_3CCH$, $CH_3CN$, $CH_3OH$, $H_2CO$, and $SO_2$) at the CSO from 1998 to 2000. The typical line width of these molecular spectra is about 3kms$^{-1}$ at the peak for the northern molecular core. The CS $J = 5 \rightarrow 4$ integrated intensity map (Figure 1) clearly resolves two molecular cores, of which the southern core is less pronounced. The two dust cores, however, are not resolved due to poorer angular resolution ($25''$), but we do see a slight extension of the northern molecular core in the direction of the southern dust core. Further molecular line observations with better angular resolution are needed to study gas components associated with the two dust components.

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