Determining the Conditions of Triggered SF Near Massive Stars
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Abstract
We are beginning a study to determine the conditions under which feedback from massive stars becomes an efficient triggering mechanism. We use a combination of IR, millimeter and radio wavelength observations to identify young stellar objects and locate them within the molecular cloud. Using the SED of Robitaille et al. (2006, 2007a), we will statistically determine YSO masses and ages. YSO ages assist in determining the likelihood that triggering occurred, and YSO masses are used to investigate the IMF of the region. We will also look for trends by comparing the masses of individual YSOs to the column density of the cloud in its immediate vicinity. Our program will examine several HII regions, encompassing a range of exciting source properties and molecular cloud properties. Our main goal is to determine if there is a range of stellar and cloud properties over which triggered SF is most efficient. We will also compare how the outcomes of triggered SF (e.g. the IMF) compare to ‘normal’, non-triggered SF. Here we present the initial results from the SF region N132 (Sh2-90).

N132 a.k.a. Sh2-90
Churchwell et al. (2006) identified 322 IR bright bubbles including N132 (l = 63.15, b = 0.45, d ~ 3') and N133 (l = 63.12, b = 0.38, d ~ 1'). These regions are located ~ 2.1 kpc away (Watson et al. 2010, in prep). We have identified 51 Stage I, 3 Stage II, and 1 Stage III YSOs in this field using YSO model fits (Robitaille et al. 2006). Table 1 lists YSO properties given by the average of all YSO models that satisfy the condition ($\chi^2_{best} - \chi^2$) < 2. Errors given by the standard deviation of the properties, except in cases where there is only one acceptable fit.

Table 1

<table>
<thead>
<tr>
<th>GL MGPS 081230.00-081500.00</th>
<th>Stage</th>
<th>YSO Mass (M☉)</th>
<th>Age (Myr)</th>
<th>Distance (pc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S132GC003 081230.00-081500.00</td>
<td>I</td>
<td>0.10 ± 0.03</td>
<td>9.8 ± 1.2</td>
<td>2.3 ± 0.1</td>
</tr>
<tr>
<td>S132GC005 081230.00-081500.00</td>
<td>II</td>
<td>0.50 ± 0.20</td>
<td>15.4 ± 3.6</td>
<td>2.3 ± 0.1</td>
</tr>
<tr>
<td>S132GC006 081230.00-081500.00</td>
<td>III</td>
<td>0.20 ± 0.05</td>
<td>11.2 ± 2.5</td>
<td>2.3 ± 0.1</td>
</tr>
</tbody>
</table>

Figure 1: N132 in GLIMPSE 3.6 (blue), 4.5 (green), and 8.0 (red) μm. Circles mark Stage I (red), Stage II (green), and Stage III (blue) YSOs.

Figure 2: N132 in 1.1 mm (blue), 8.0 μm (green), and 24 μm (red). YSOs as in Fig. 1. White contours outline Hi continuum levels every 8 K from 8 to 128 K. There is definite clustering of YSOs near the two mm emission peaks.

Figure 3: Histogram of YSOs identified by the model fitter of Robitaille et al. (2006). Solid lines are masses for YSO models with the best $\chi^2$ fit, dotted lines are average masses for all models with ($\chi^2_{best} - \chi^2$) < 2. The dashed line indicates our estimated detection limit taken from model YSO luminosities at the distance of N132 (~2.3 kpc).

Future
We will be extending our study of SF to include a total of five northern and five southern Galactic HII regions. For each region we will: identify YSOs, identify possible exciting sources, and calculate cloud densities/masses. We will use this information to search for evidence of triggered SF, and explore possible trends in cloud, YSO and exciting source properties. By performing identical studies over ten regions, we hope to build a statistically significant sample of these properties that will allow us to fully understand how massive stars affect SF.