Infrared Observations of Massive Young Stellar Objects in the RMS Survey

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The Red MSX Source Survey

The Red MSX Source Survey began by using colour selection criteria to identify ~2000 candidate Massive Young Stellar Objects (MYSOs) from the Mid-course Space Experiment (MSX) Point Source Catalogue[1]. In order to separate the other sources which have similar mid-IR colours (UCHII regions, Evolved Stars, Proto-PNe, PNe) from the YSOs, we have undertaken a campaign of ground-based follow up observations[2].

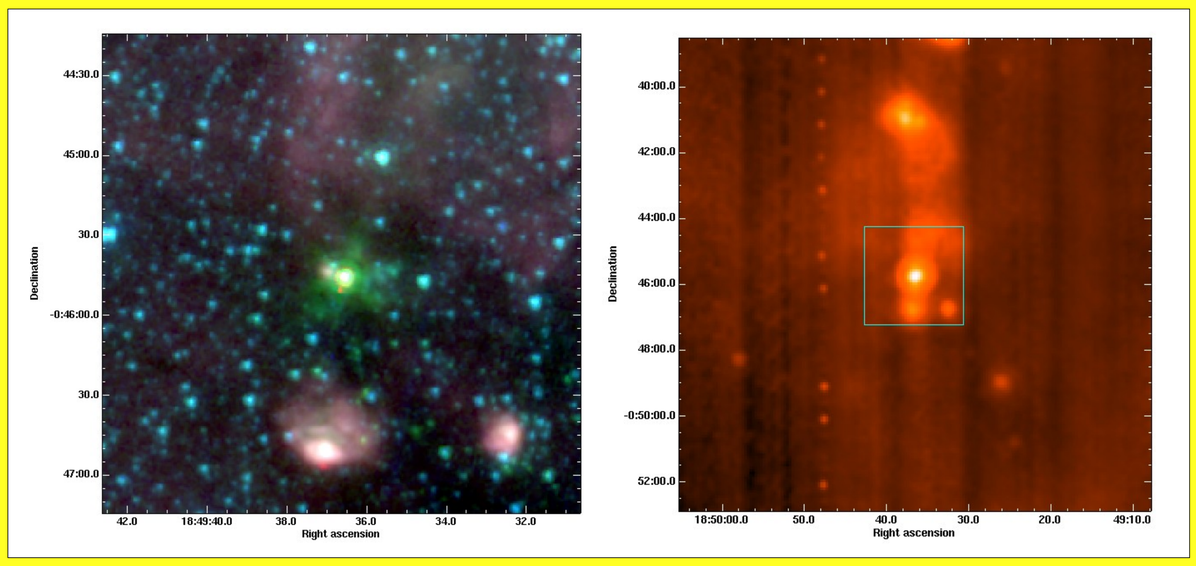

Figure 1:Left – 3´×3´ GLIMPSE 3.6 (blue), 4.5 (green) and 8.0 (red) μm image of MYSO G032.0451+00.0589. Right – 15´×15´ MIPSGAL 70μm image with the blue box showing the region covered by the GLIMPSE image

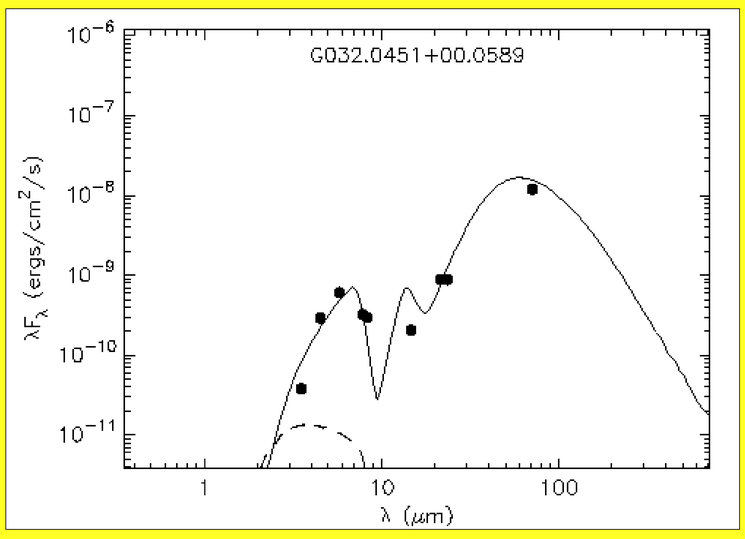

Figure 2: Fit to the SED of the MYSO G032.0451+00.0589 using GLIMPSE, MSX and MIPSGAL fluxes

Examples of RMS Survey MYSOs

We expect to return a catalogue of order 400 MYSOs within our Galaxy. G032.0451+00.0589 is one such MYSO, the Spitzer GLIMPSE and MIPSGAL images of which are shown above. The 3-colour GLIMPSE image shows that, unlike the nearby compact HII to the south, the MYSO does not have strong 8μm PAH emission. This is consistent with the idea that MYSOs do not yet have a strong UV continuum, which is also supported by the fact that this source is radio quiet. G032.0451+00.0589 also has strong molecular ^{13}CO (J=1-0) emission.

Using our own photometry from the MIPS images, along with GLIMPSE and MSX PSC fluxes, we can then examine the SED of this source (see Fig. 2).

Spectral Energy Distributions

We have used the model fitter of [7] to fit the SED. This allows us to ascertain the luminosity of the source, given our kinematic distance determination of 8.3kpc from molecular line data. For G032.0451+00.0589 this comes out at $4.3\times10^4\,L_\odot$. If we consider the IRAS PSC fluxes and increase the aperture for our 70μm MIPSGAL photometry to simulate the IRAS 60μm beam size, the resultant luminosity is higher ($7.6\times10^4 L_\odot$, see Fig. 3). However this also includes the far-IR flux from the nearby HII regions and other sources as well. Therefore, as modern satellites allow for better resolution at far-IR wavelengths, the luminosity of individual MYSOs is likely to come down.

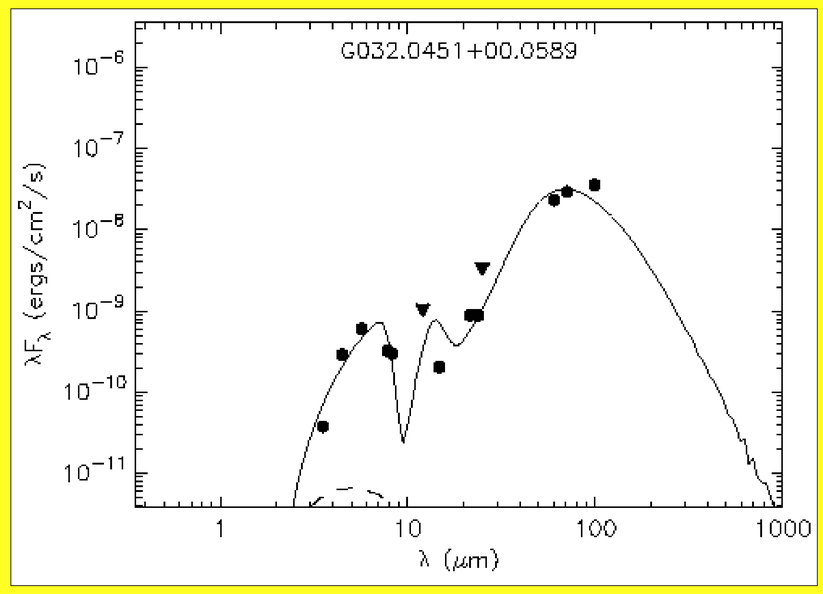

Figure 3: Fit to the SED of G032.0451+00.0589 including the IRAS PSC fluxes and 70μm MIPSGAL flux in a 1.51´ aperture around the source in order to approximate the larger IRAS 60μm beam (4.75´×1.51´).

Status and Future Developments

- We have completed mid-IR and radio continuum imaging and ^{13}CO molecular line observations in the Southern Hemisphere[6,3,4]. Analysis of similar observations in the Northern Hemisphere is currently underway.
- Near-IR spectroscopy to confirm and characterise sources is ongoing[5].
- Formal identification of sources is nearing completion. We are investigating photometry of IRIS, IGA and MIPS images in order to provide accurate far-IR fluxes. SED fitting in order to determine source luminosities will begin soon.
- Our database is available to the general community from the RMS Survey web page: http://www.ast.leeds.ac.uk/RMS
- We expect to publish a catalogue of MYSOs, along with information about contaminant objects.

References

[1] – Lumsden et al., 2002, MNRAS, 336, 621
[2] – Hoare et al., 2005, IAUS Symp. 227, 370
[3] – Urquhart et al., 2007a, A&A, 461, 11
[4] – Urquhart et al., 2007b, Accepted to A&A, astro-ph/0705.4597
[5] – Clarke et al., 2006, A&A, 457, 183
[6] – Mottram et al., 2007, A&A, Accepted
[7] – Robitaille et al., 2007, ApJS, 169, 328