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Stellar Content of Ultra-Compact H II Regions Using Spitzer/MIPS

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Abstract. We report new *Spitzer* observations which are used to constrain the stellar content of 28 UC H II regions. High spatial resolution MIPS 70μm observations sample the peak of the re-radiated dust energy distribution from UC H II regions. From these we produce refined IR luminosities which are used to deduce the multiplicity of source in the UC H II region. We find that stellar clusters with a high-mass Salpeter initial mass function are the most likely sources of these regions.

1. Introduction

The earliest signature of hot, luminous stars occurs during the ultra-compact H II (UC H II) region phase (Wood & Churchwell 1989). Theory predicts that massive stars form at the centre of massive clusters, rather than in isolation. However, high extinction, a result of material left over from the starbirth process prevents direct observation of the stellar content, so that an indirect approach is necessary. In order to verify the cluster nature of UC H II regions, the bolometric luminosity of all massive stars (re-radiated in the far-IR) may be compared to the Lyman continuum flux from the most massive star (via its radio continuum). Unfortunately the only previous far-IR mission, *IRAS*, suffered from a low spatial resolution, severely hindering such an approach.

2. Observations

The 28 UC H II regions were drawn from the *VLA* selected sample of Wood & Churchwell (1989) and Kurtz et al. (1994). We used the *Spitzer* Multi-band Imaging Photometer for Spitzer (MIPS) instrument, which provides a major spatial improvement over *IRAS* (see Conti et al., these proc.). Observations were taken with either the wide or fine scale photometry mode depending on the predicted peak brightness of the object. MIPS provides a 70μm spatial resolution (18 arcsec) far superior to the IRAS 60μm resolution of 2 arcmin. Fluxes measured using aperture photometry were generally a factor of three smaller than those from *IRAS* (Crowther & Conti 2003), with significant scatter depending upon the degree of crowding in the vicinity of the UC H II region. Some of the sources were saturated, from which only a lower estimate of their IR luminosity can be established.

3. Analysis

Recent work of Indebetouw et al. (2006) on the expected spectral energy distribution (SED) from UC H II regions utilised dust radiative transfer models to create hundreds of different SEDs as would be seen along different sight-lines. This full 3D treatment incorporates varying extinction along different lines of sight due to clumping of the dust and gas. However, at 70μm the variation in flux is minimal and an average SED was used to estimate the contribution of $\sim$ 1/17 of the total far-IR flux from the 70μm flux.

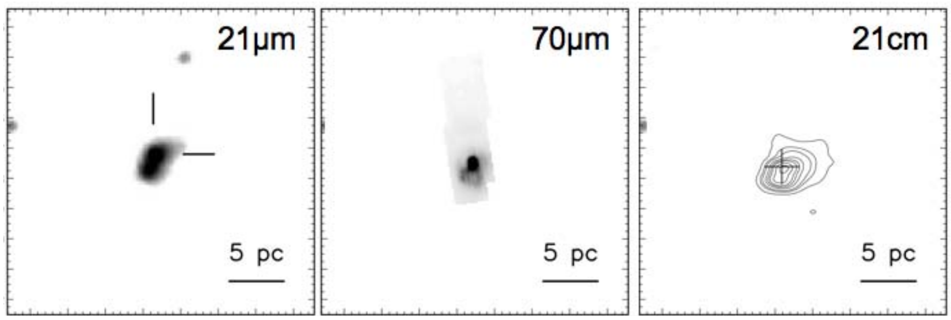

Figure 1. UC H II region G23.711+0.171 in three bands from (l-r); *MSX* (Crowther & Conti 2003); *Spitzer*/MIPS (this work); *VLA* (Kim & Koo 2001). All images are 10 x 10 arcmin with north up and east to the left.

For a sufficiently high envelope mass around the UC H II region, it is assumed that *all* of the UV radiation is absorbed and re-emitted in the IR. Radio derived Lyman continuum fluxes were taken from Wood & Churchwell (1989) and Kurtz et al. (1994) (high resolution *VLA* data). Where available, values from Araya et al. (2002) and Kim & Koo (2001) are used, with spatial resolutions of 60 and 20 arcsec respectively. The lower resolution data are sensitive to extended radio emission in the same region for which the 70μm flux is measured.

Based on the predictions of Lumsden et al. (2003), preliminary results suggest an excess of IR luminosity with respect to the single high mass star case, indicating the presence of a cluster with a high-mass Salpeter initial mass function in most cases.

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