Different evolutionary stages of the massive star forming complex G10.3

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Abstract

We observed three high-mass star-forming regions in the G10.3 Complex with the Australia Telescope Compact Array (ATCA), combining them with the complementary MALT90 data, to study the star formation activities in this region. These regions, i.e. G10.3E, G10.3M and G10.3W, are in different evolutionary stages, from ultracompact HII to potential starless cores, and are located within the same large-scale environment, which allows us to study rotation and outflows as well as chemical properties in an evolutionary sense. While we find multiple millimeter continuum sources toward all regions, these three sub-regions exhibit different dynamical and chemical properties, characterizing their different evolutionary stages. Even within each subregion, massive cores of different ages are found.

Introduction

The massive star formation complex G10.3 lies in the giant Galactic HII complex W31. With the spatial resolution of 19.2″, ATLASGAL (Schuller et al. 2009) resolves an elongated dust filament at the edge of the HII region G10.3-0.1 with three dense cores. We name the three submm peaks as G10.3E, G10.3M and G10.3W from the east to the west (Fig. 1). The east region G10.3E is associated with the ultracompact HII (UCHII) region G10.3-0.15 (Wood & Churchwell 1989), and is considered to be the most evolved region among these three. We studied the three massive star formation regions G10.3E/M/W with the ATCA and Mopra telescope (data from MALT90 archive, http://malt90.bu.edu/data.html).

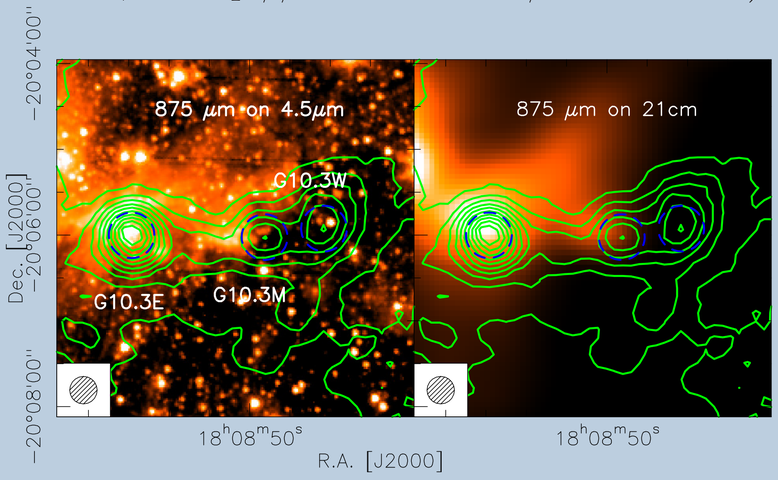

Figure. 1 ATLASGAL submm continuum contours overlaid on GLIMPSE 4.5 μm (Churchwell et al. 2009; Carey et al. 2009) and VLA 21 cm continuum (Kim & Koo 2002) images. The blue circles mark the three regions we observed with ATCA.

References

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Continuum and outflow maps

Figure 2 shows the dust continuum and the outflow maps of the three sub-regions. Three continuum sources were resolved toward this **G10.3E**, and they are all associated with the 8 GHz continuum emission. We assume optically thin free-free emission (spectral index ~ -0.1), and use the VLA 8 GHz flux to estimate the free-free flux at 90 GHz. The free-free flux we obtained is even larger than the dust continuum flux, which indicates these three continuum sources are part of the UCHII region G10.3–0.15. The SiO(2–1) emission shows blue-shifted in the east and red-shifted in the west. Other molecular lines we detected towards this region also show this velocity structure, which may be tracing the expanding shell of the UCHII region G10.3–0.15. We resolved two mm sources in the middle region **G10.3M** as shown in Figure 2. The extended emission in the east part of the region traces part of the emission from radio source G010.290-0.128, which could be a compact HII region associated with strong 24 μm point source. G10.3M-mm1 is associated with one EGO (Cyganowski et al. 2008), and the outflow map also shows a wide angle outflow associated with G10.3M-mm1. Four mm sources were resolved in the **G10.3W** region (Figure 2), G10.3W-mm1 is associated with the SiO outflow. All four mm sources are not associated with any infrared source.

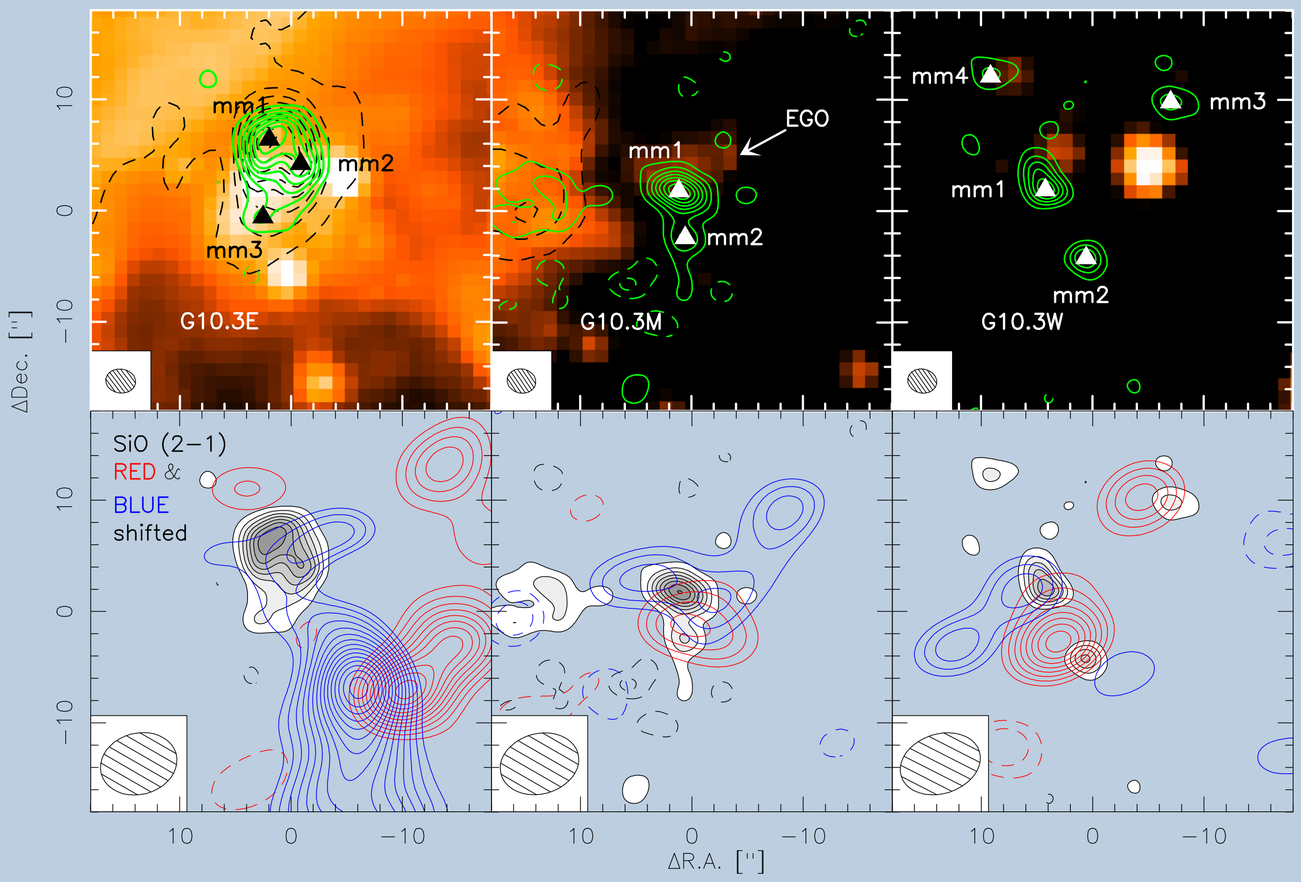

Figure. 2 *Top panels:* ATCA 3 mm continuum maps (green contours) and VLA 8 GHz continuum maps (black dashed contours) overlaid on GIMPSE 4.5 μm images. *Bottom panels:* Dust continuum maps overlaid with SiO(2–1) outflow contours.

N_2H^+(1–0) emissions

Figure 3 shows the N_2H^+(1–0) integrated intensity maps and the spectra towards the emission peaks. In G10.3E, the N_2H^+ emission were driven away from the UCHII and formed a shell like structure around it. While in the other two regions, the N_2H^+ emissions are mainly associated with the continuum sources. The N_2H^+(1–0) spectra towards G10.3M shows a complicated structure, and might be tracing multiple components.

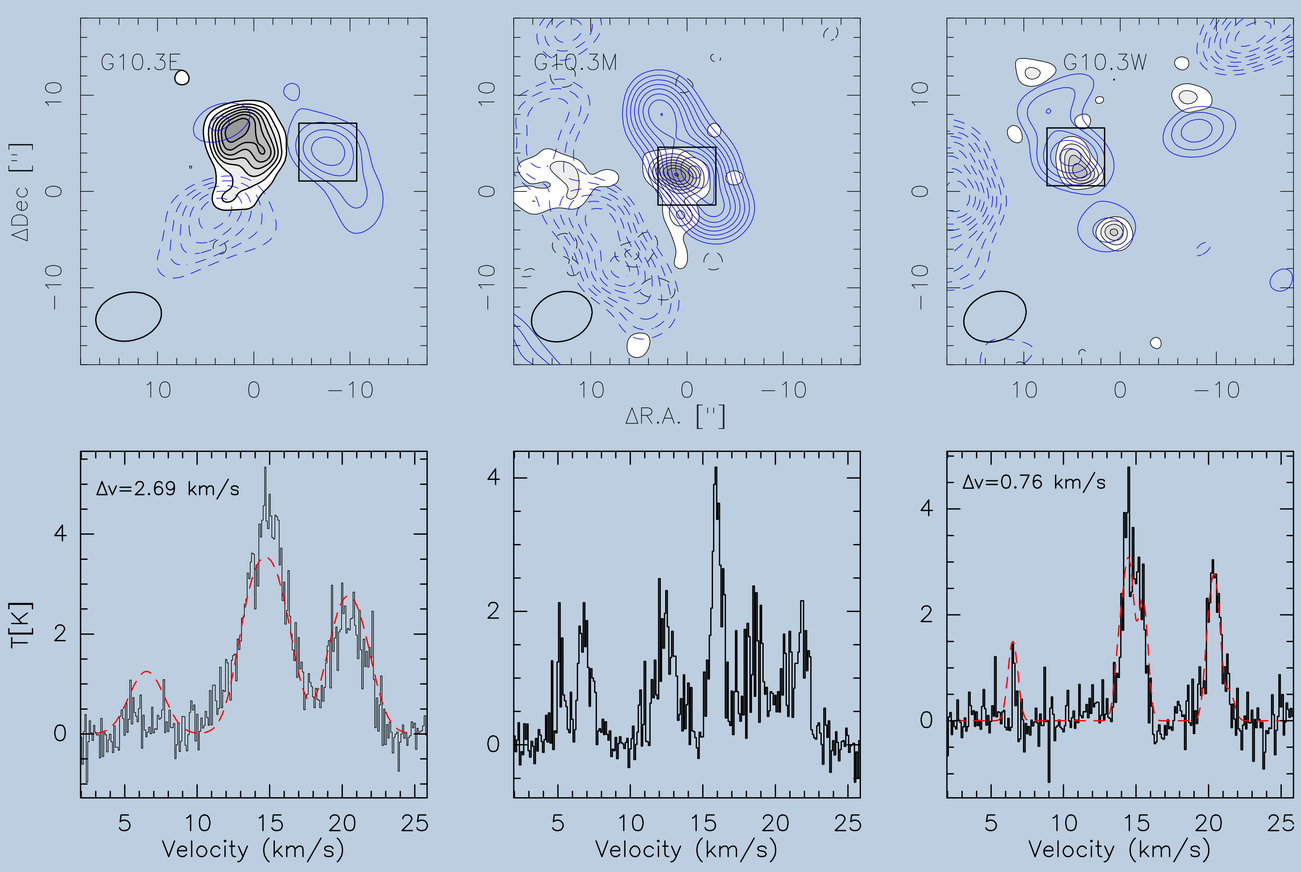

Figure. 3 *Top panels:* The N_2H^+(1–0) integrated intensity maps (blue contours) overlaid on the continuum images of each region. *Bottom panels:* The N_2H^+ spectra extract towards the regions which are marked with the black foursquares in the *top panels*. The dashed lines show the results of hyperfine-structure line fitting. The line width Δv we got from the fitting are in each panel.