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MULTIWAVELENGTH STUDY OF IR DUST BUBBLES: S 21 AND N 5

C. E. Cappa[1,2], N. U. Duronea[1], V. Firpo[3], C. H. López-Caraballo[4], M. Rubio[5], L. Bronfman[5], J. Borisova[6], M. Gromadzki[6], and J. Vasquez[2]

We report the analysis in several wavelengths of the infrared dust bubbles S 21 and N5 in order to identify the material associated with them, characterize the interstellar medium in which they evolve and study the surrounding stellar formation regions.

More than 5000 infrared (IR) dust bubbles have been identified at 8 μm with the Spitzer-GLIMPSE survey (Churchwell et al. 2006, 2007; Simpson et al. 2012). We analyze the IR bubbles S 21 and N 5 as part of a project aimed at characterizing the gas and dust linked to IR bubbles and investigating the presence of star forming regions in their environs.

S 21. This bubble, of 45 arcsec in radius, is located at 3.7 kpc and belongs to the same complex as S 24 (Cappa et al. 2016). The molecular emission in the CO(2-1), ^{13}CO(2-1), and C^{18}O(2-1) lines obtained with the APEX telescope revealed a molecular shell (with a radius of ∼1.4 pc) in the velocity range [−45.8,−42.6] km s^{-1}, which encircles the bubble and is partially coincident with the PDR identified at 8 μm. Five clumps are present in the molecular shell, with radii in the range 0.64-0.75 pc, LTE masses of 350-880 $M_\odot$, and volume densities of (4.5-7)×10^3 cm^{-3}. The bubble has been evolving in an interstellar medium with an original ambient density of 2100 cm^{-3}.

Both the radio continuum emission and the emission at 24 μm from MIPS coincides with the interior of the bubble, showing the presence of warm dust and ionized gas. In contrast, the emission in the far-IR from Herschel and ATLASGAL matches the 8 μm bubble and the molecular shell indicating the existence of a cold dust component. A dust temperature map computed from 250 and 350 μm shows values in the range 21-33 K.

We identified many candidate young stellar objects (YSOs) projected onto the molecular clumps. Although it is not clear if all the candidates are associated with the molecular clumps, it seems that star formation has been active recently. The dynamical age of the HII region suggests that it is very young for the collect and collapse process to be active.

N 5 (=Sh2-39). This HII region is 3.5 arcmin in radius and is located at 4.1 kpc. To investigate the spatial distribution and characteristics of the molecular gas linked to this IR bubble we used CO(3-2) and HCO$^+$(4-3) molecular line data obtained with the ASTE telescope. These observations allowed the identification of the molecular component of the bubble in the velocity interval [+30,+46] km s^{-1}, which borders its western and southwestern sections and suggests that the ionized gas is expanding against its parental molecular cloud. We have identified four molecular clumps, likely formed by the expansion of the ionization front. Clumps having HCO$^+$ counterparts show evidence of gravitational collapse.

The spatial distribution of the emission in the far IR, from Herschel and ATLASGAL, shows the cold dust counterparts of three of the four clumps.

The HII region, whose exciting star/s are unknown, is also linked to the stellar cluster [BDS2003]6, placed over one of the collapsing clumps. The distance to the cluster is similar to that of the HII region indicating that the cluster is linked to the nebula. An IR spectrum of the brightest star in the cluster obtained with the ARCoIRIS spectrograph, mounted on Blanco 4-m Telescope at CTIO, indicates a O8-9V type star.

We also identified several candidate YSOs projected onto the molecular shell. The dynamical age of the bubble and the age of the cluster indicates that massive star formation might have been triggered by the expansion of the nebula via the collect and collapse mechanism.

REFERENCES

Cappa, C. E., Duronea, N., Firpo, V., Vasquez, J., López-Caraballo, C. H., Rubio, M., Vazzano, M. M., et al. 2016, A&A, 585, A30
Churchwell, E., et al. 2006, ApJ, 649, 759
Churchwell, E., et al. 2007, ApJ, 670, 428
Simpson, R. J., et al. 2012, MNRAS, 424, 2442

[1]IAR, CONICET, Argentina (ccappa@fcaglp.unlp.edu.ar).
[2]FCAG, UNLP, Argentina.
[3]U. de la Serena and Gemini Observatory, Chile.
[4]Pontificia Universidad Católica, Chile.
[5]U. de Chile, Chile.
[6]U. de Valparaiso and Milenium Institute of Astrophysics, Chile.