NASCENT-stars: A Multi-wavelength Characterization of fragmentation in the Massive Dense Core CygX-N53

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The origin of stellar clusters and massive stars is still not fully understood in modern astrophysics. The recent NASCENT-stars large program, observing 17 massive dense cores in the Cygnus-X molecular cloud at 1mm and 3mm with NOEMA, helps in statistical analysis of the structure and evolutionary stages of the embedded envelopes in these cores. Thanks to its homogeneous, wide-band (~46.5 GHz), high-resolution (250 kHz) spectral coverage and unprecedented sensitivity, we can obtain nearly a full molecular inventory of individual protostellar envelopes, along with their physical conditions, e.g., excitation temperature and column densities. Here, we present both the continuum and spectral analysis of the CygX-N53 MDC. Our continuum analysis resolved 38 and 24 compact fragments at 1mm and 3mm, respectively at ~0.8" (1200au) resolution. This is more than three times the detections reported in the literature. A detailed comparison of near- and mid-IR emission from the Spitzer Cygnus-X Legacy survey reveals 12 fragments with infrared counterparts. Spectral energy distribution analysis allows us to identify a handful of Class 0 protostars, as well as 4 Class I and 1 potentially Class II object.

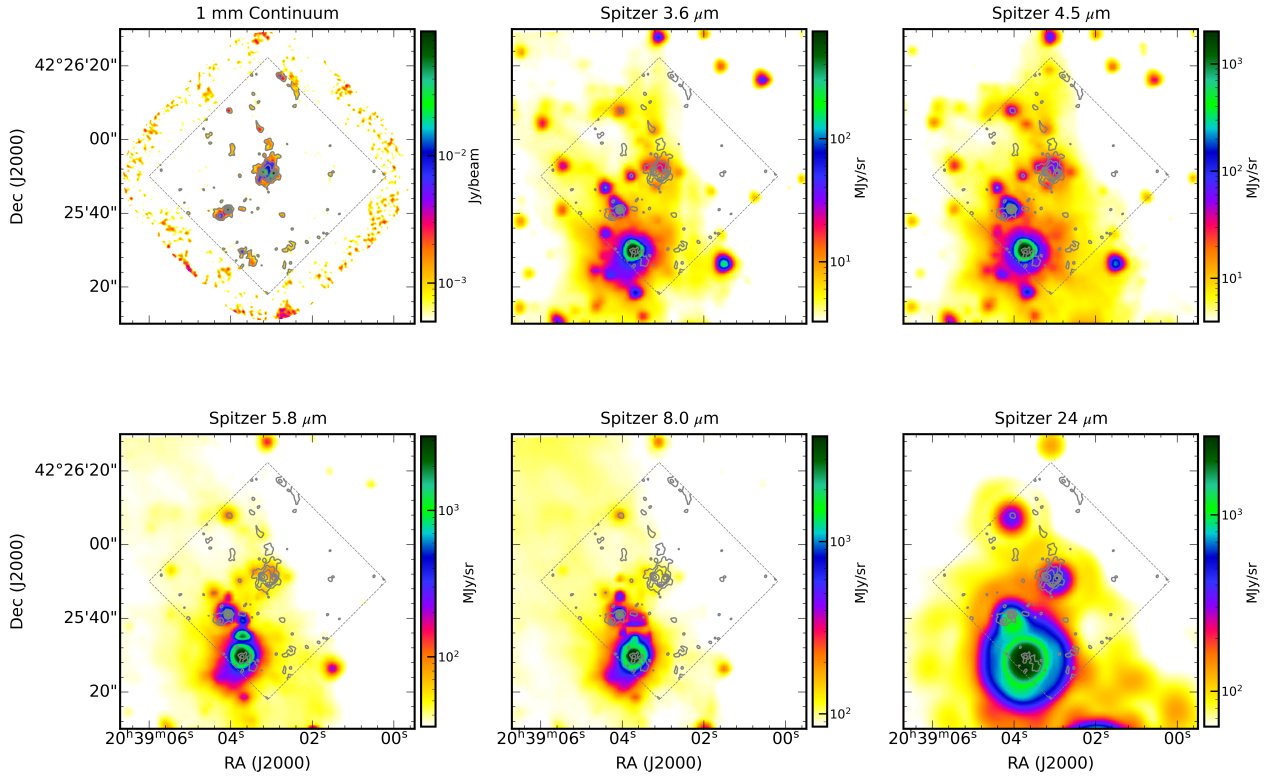

Figure 1: The top-left panel displays the 1 mm continuum emission of CygX-N53. The remaining five panels show the corresponding region in the four Spitzer/IRAC bands (3.6, 4.5, 5.8, and 8.0 μm) and the MIPS band (24 μm). Gray contours represent the 1 mm continuum emission and are overlaid on the Spitzer images to highlight the correlation between millimeter sources and infrared counterparts.

The two most massive fragments lack infrared counterparts even at 24 microns, and the GLOSTAR survey at 6 GHz shows no corresponding radio emission toward them, confirming that they are at the earliest stage of evolution. Spatial clustering analysis suggests that the N53 core fragments into two clusters, towards moderately massive objects and several low-mass sources around them. The two youngest and most massive millimeter sources exhibit rich spectral line emission at 3mm and 1mm, that provides insights into their physical and chemical conditions.