Looking in the cradle of new-born low mass stars

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During the past 20 years, observational evidence has been established that the binary frequency among young stars is impressively high, varying from values similar to field (i.e., $\sim 60\%$) up to $\sim 80\%$ in some star-forming regions. The physical reasons behind the differences in the binary fractions observed are still to be explained. Nevertheless, the low-mass star formation scenarios in vogue suggest that molecular cloud cores might fragment into N-body clusters (where typically $N \lesssim 10$). Dynamical interactions among the fragments will cause these bodies to pair into bound multiple systems. Although the main aspect of the (multiple) stellar formation scenario seem to have been identified, many questions remain to be answered: when does the core fragmentation occur, or, in other words, how early is binarity established? Is the outcome of the fragmentation scenario dependent on the grain dust properties? Does metallicity play a role in this process?

At the very early stages, the huge amount of gas and dust in which protostars are embedded prevent their detection in optical or even in the IR domain. These objects are known as class 0 objects and can only be seen in the millimeter and sub-millimeter domain. Later, when the central proto-stars have become hot enough to heat their circumstellar disks or shells, they become visible in the mid-IR. These are the class I objects. Thanks to the **exceptional spatial resolution** of VISIR, we are able to look into the low-mass star cradles and investigate the multiplicity of class I objects. In order to assess VISIR capabilities, we have chosen 3 multiple proto-star systems discovered by high-angular resolution interferometric observations at mm with the VLA. All of them are bright enough to be detected with VISIR (i.e., 12μm-IRAS fluxes higher than 1Jy), and will allow a detailled morphological study.

- **L1551 IRS 5** (IRAS-$F_{12\mu m} = 13 Jy$). Located in Taurus star-forming regions, it is one of the most extensively studied young stellar object. Observations collected in a broad range of wavelengths (from mm to optical) pointed out to a very complex environment where all components related to the star-formation process seem to be present, i.e., two proto-stars separated by 0.3" (Rodriguez et al. 1998, Nature 395, 355) each of them having a circumstellar disk and both encircled by a circumbinary disks, with all disks surrounded by an extended, infalling envelope. Jets associated with the central sources have also been observed (Mayra Osorio et al. 2003, ApJ 586,1148).

- **L1551 NE** (IRAS-$F_{12\mu m} = 1.2 Jy$). Located close to L1551 IRS 5, L1551 NE was suggested to be a binary source by Rodriguez et al. (1995, ApJ 454, L149). Moriarty-Schieven et al. (2000, ApJ 533, L143) however have detected Rodriguez et al. A source but not their B source which was supposed to lie 0.6" east of A. Instead these authors found a companion at 1.43" to the southeast of the A source. Our observations can reveal weather L1551 NE is a binary or a triple system.

- **L1630 or SSV 63** (IRAS-$F_{12\mu m} = 2.05 Jy$). Located in Orion. Several parsec-scale flows (HH 24J/HH 19, HH 24K/HH 27, HH 24C/HH 20, HH 24E/HH 24M) are located in the L1630 cloud and emanate from the SSV 63 source region (Eisloffel & Mundt 1997, AJ, 114, 280). The source was detected in the radio continuum by Bieging, Cohen, & Schwartz (1984, ApJ, 282, 699) and later resolved into two radio sources (e.g., Bontemps et al. 1996, A&A, 311, 858). Near-infrared images have revealed that SSV 63E and 63W, separated by 8", both consist of close binaries or triple systems, so that together they comprise a hierarchical system of at least four infrared sources. Additional mid-IR VISIR observations can reveal other companions undetected so far.

We suggest to perform N-band (and eventually Q-band) imaging of all three sources in order to map the morphological structure of these embedded multiple systems for the first time in the mid-IR and demonstrate the potential of VISIR for mutiplicity studies of proto-stars. In a second step, low-resolution spectroscopy will enable us to spatially trace the dust size and composition variation by analyzing the silicate feature in these very young multiples. (5 hours in total).