Near-infrared observations of a massive cluster in the making

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Observations

Deep VLT/HAWKI J, H, and Ks band observations were obtained in service mode under good seeing conditions in the spring of 2011 and in may 2012. The field of view of HAWKI is 7.5*7.5 arcminutes but an extended mosaic was observed. Here is presented a 7.6*7 arcminute square region covering the molecular infall region and an adjacent cluster. Observations were performed with DIT=10second and NDIT=6 per frame. The total integration time per pixel is 6000s, 1500, and 1500s in the J, H, and Ks band, respectively. Source detection and aperture photometry were performed on the individual frames. Due to the large amount of extinction towards this region the observations are limited by the depth of the J band. All sources were independently identified in each filter. The photometry has then been transformed into the 2MASS system (Skrukskie et al. 2000).

Scientific rationale

Star clusters is the birthplace of most stars and yet the clustered star formation process is poorly understood. This is partly driven by our lack of observations of very young clusters where the initial positioning of the stars and their initial relative velocities are known. Especially for the massive clusters is our knowledge limited due to their generally large distances and the low number of objects to study. A comprehensive survey of massive molecular cores in transitions around 3 mm (Barnes et al. 2011, ApJS, 196, 12). One particular source was found remarkable. BYF73 has an extremely large infall rate estimated to be 3.4*10^-2 Msun/yr (Barnes et al. 2010, MNRAS, 402, 73) which is among the highest observed. With a total clump mass of 20000 Msun this could be a forming massive cluster. Several embedded populations have previously been identified within the clump but the sensitivity and resolution was not sufficient to resolved the individual low-mass stars to obtain a census of the current star formation in the cluster. Here we present preliminary results of the stellar content of the region. We identify a deeply embedded cluster coinciding with the center of the infall.

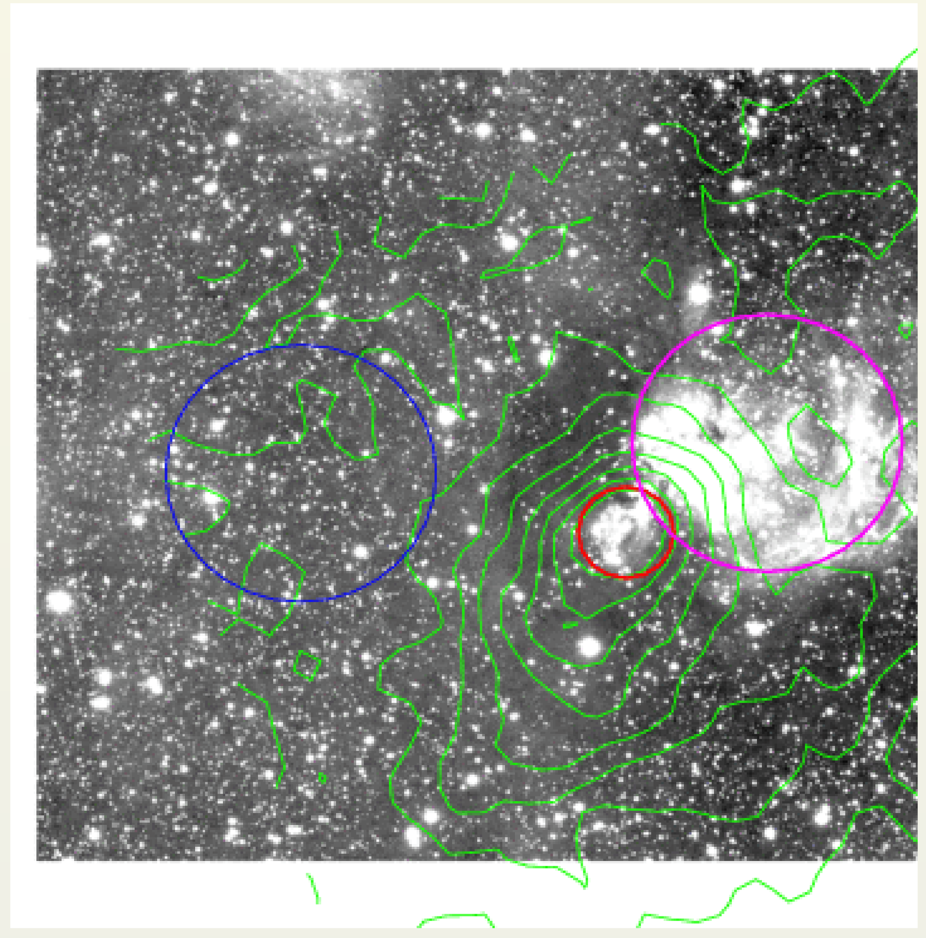

Figure 2: A comparison of the Ks band emission with the HCO+ contours from Barnes et al. 2010. The peak of the HCO+ emission coincides very well with the deeply embedded cluster. The three regions discussed below are marked

Figure 1: VLT/HAWK-I J, H, Ks band mosaic covering BYF73. North is 10 degrees counterclockwise from up. The field of view is 7.6*7 arcminutes, corresponding to 5.5*5.1pc for a distance of 2.5 kpc. Several star formation events are evident, most notably the exposed cluster to the west and the cluster of very red objects to the south-east of the exposed cluster. The colour stretch is linear and the faintest stars visible with this colour table is J~22 mag.

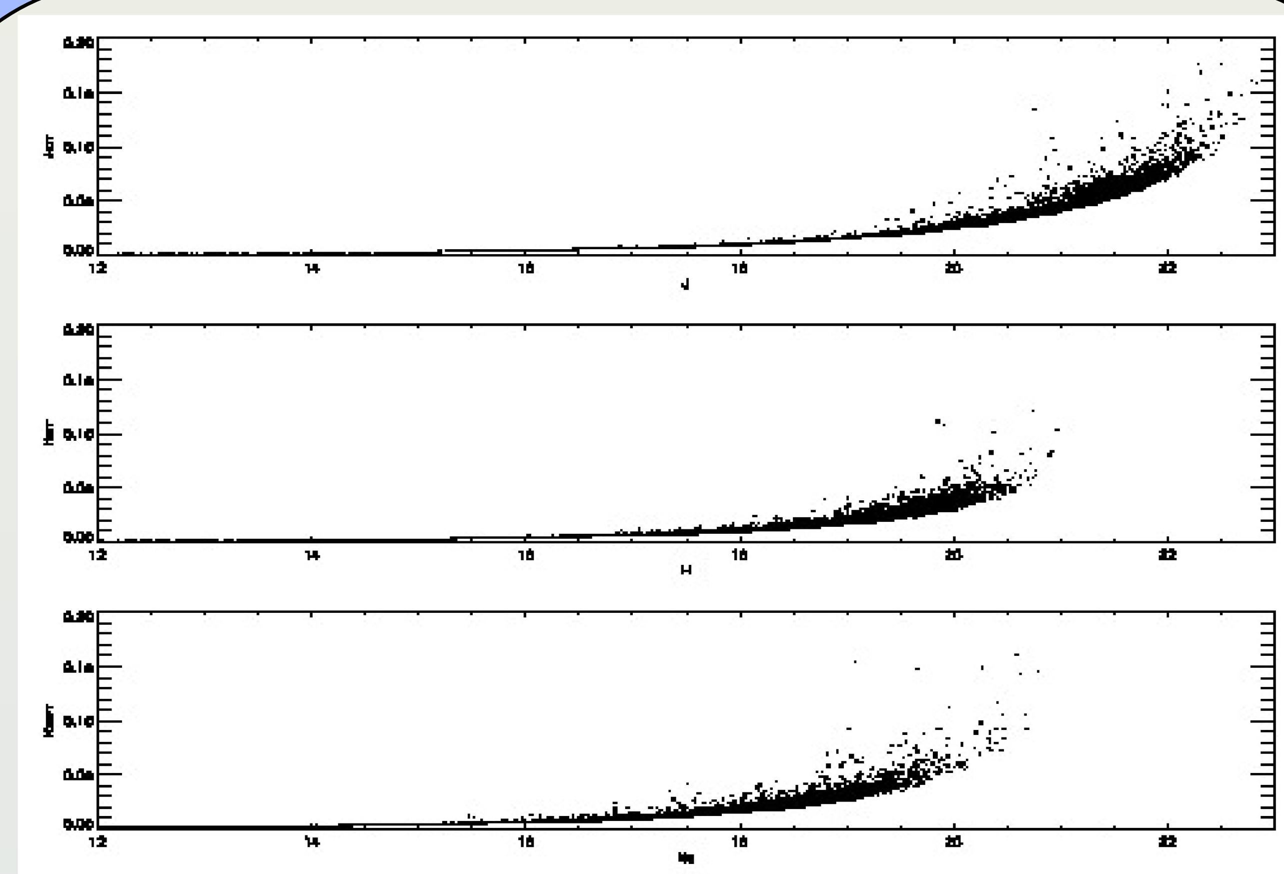

Figure 3: The magnitude versus magnitude error diagrams for J, H, and Ks, respectively from top to bottom. The J band observations were designed to be substantially deeper than the H and Ks band observations to compensate for the large amount of extinction towards the cloud core.

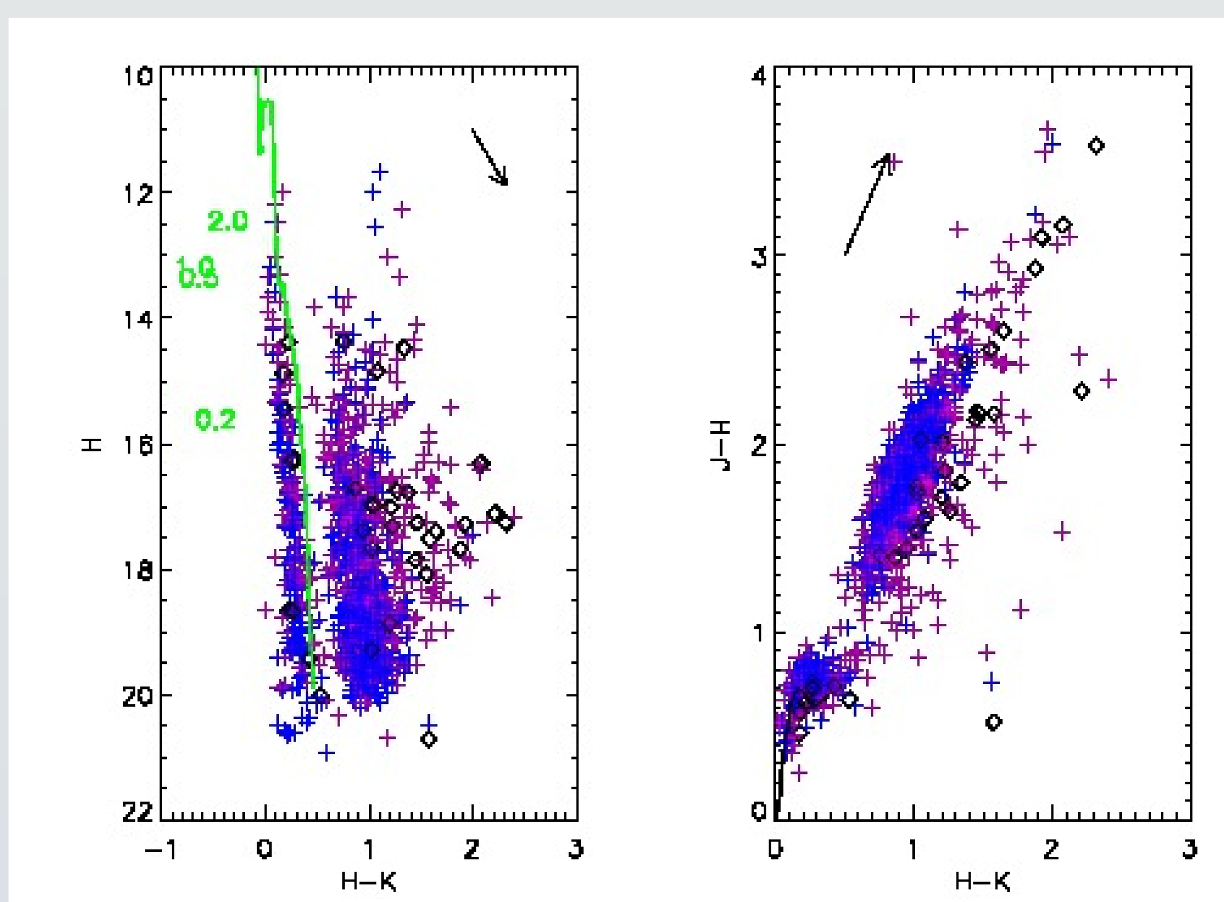

Figure 4: Left: J-H versus H colour-magnitude diagram for the three identified regions in Fig. 2. Blue stars are in the “field” region to the east, magenta are associated with the exposed cluster to the west and black diamonds are associated with the embedded cluster. For comparison is shown a 1 Myr isochrone adopted from the Tognelli and Baraffe models. Foreground stars are clearly separated from the cluster population. Right: the JHK colour-colour- diagram for the same regions. Overlayed are the colours of main sequence stars.