ADONIS unveils Ultra-compact H II Regions Morphology

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Until recently, the spatial resolution of infrared observations did not permit us to decide whether a single star or a dense stellar cluster powers the Ultra-compact H II regions (UCHRs). From radio interferometric observations, there is evidence for the presence of binary or multiple systems of massive stars. Conventional near-infrared (NIR) imaging has great difficulty in resolving this issue. The typical distance of several kiloparsecs to UCHRs implies that very high angular resolution is required to resolve the star forming complex into single stars. Furthermore, the diffuse radiation (due to thermal emission, recombination lines, and scattering) from the UCHR enhances the background against which the embedded stars have to be detected.

The advent of ADONIS (Adaptive Optics Near Infrared System) at the 3.6m telescope now allows us to disclose UCHR morphology. As an example, we show the first results obtained for one such object in August 1995. The object (G45.45+0.06) is a cometary UCHR (Wood and Churchwell 1989) with a sharp ionisation front almost east-west aligned. A single star of spectral type O 7.5 can account for the observed radio flux. The detection of NH_3 emission indicates the presence of dense molecular gas (Churchwell et al. 1990). The kinematic distance to G45.5+0.06 is 6.6kpc.

The displayed image was obtained with the SHARP II camera (Hofmann et al. 1991) through the K' filter. The FWHM of the stellar profiles is 0.4 (during the observations the seeing monitor reported 1 seeing). This image reveals a cluster of stars, embedded in nebulosity, at the position of the UCHR. A chain of six stars almost coincides with the ionisation front. South of this arc, there is an object with a head-tail structure that does not have an obvious counterpart at radio wavelengths. Deconvolution of this image discloses that a jet like feature emerges from this star which is associated with H emission. The very good spatial resolution could be achieved because it was possible to close the loop on a bright star in the field.

Other targets of our UCHR sample share similar properties which supports the suggestion that the morphology of ionised gas and warm dust are often very different (Hayward et al. 1994). Our adaptive optics and MIR imaging suggests that UCHRs are very compact star clusters with members of different mass and evolutionary state.

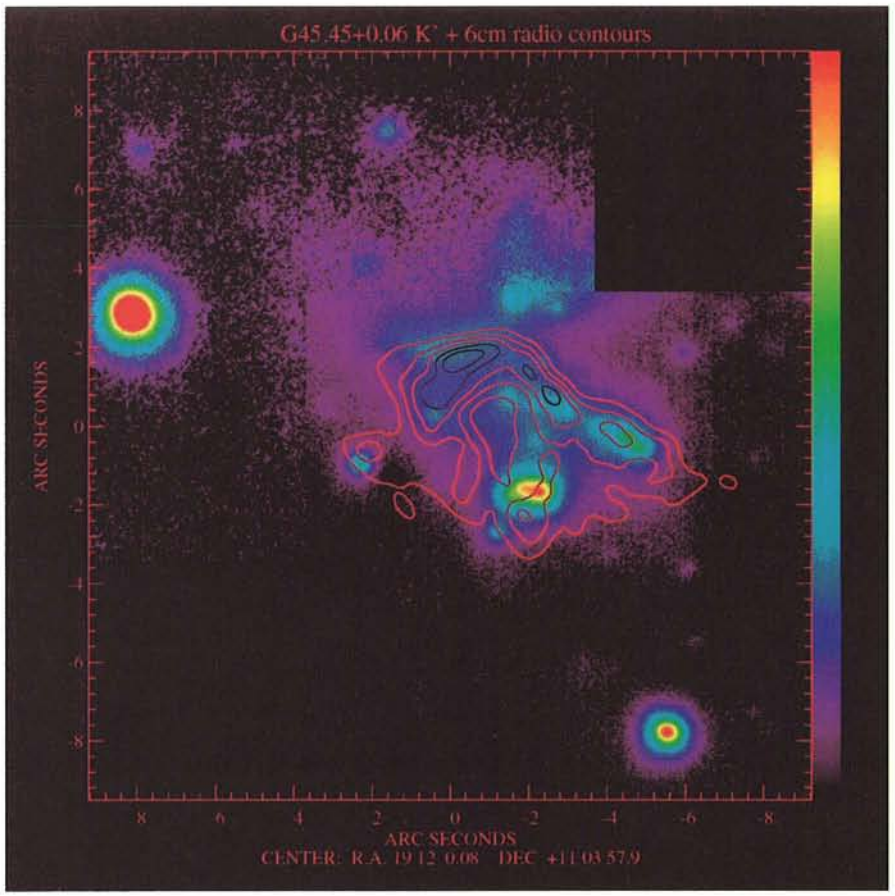

Figure 1.

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First Light on COMIC and SHARP II+

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COMIC and SHARP II+, the new high resolution cameras for the ESO adaptive optics system ADONIS, were commissioned in November 1995.

COMIC, developed by a group from Meudon Observatory, operates between 1 and 5μm but is optimized for the 3 to 5μm wavelength region. Two image scales are available: 35 mas/pixel (for J, H

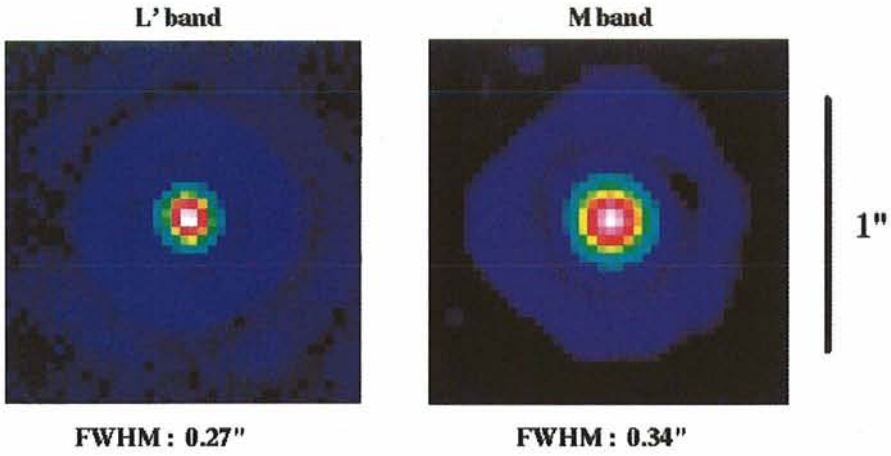

Figure 1: *51 Pegasus with COMIC.*

and K) and 100 mas/pixel (for L and M), leading to a field-of-view of 4.5 x 4.5 arcsec and 12.8 x 12.8 arcsec, respectively. Several narrow band filters and 2 CVFs covering the 1.3–2.5 μm and 2.5–4.5 μm ranges, respectively, are available. A 128 x 128 array manufactured by LIR is used as detector, and its associated electronics was built by Grenoble Observatory.

The first astronomical object which was observed with COMIC is the bright solar type star 51 Pegasus. Radial velocity studies by Mayor and Queloz (1995) provide convincing evidence for the presence of a planet with a mass of the order of that of Jupiter. The L and M images, displayed above, do not show any structure around the star.

SHARP II$^+$ operates between 1 and 2.5μm. It was developed by the Max Plank Institut für Extraterrestrische Physik (MPE) on the basis of the IR camera which was used until now with ADONIS. SHARP II$^+$ is equipped with an Atmospheric Dispersion Compensator unit (ADC), a Polarimeter, and two Fabry-Perot etalons covering the K-band with spectral resolutions of 950 and 2600 and an effective finesse of 40 and 51, respectively. The standard J, H, K and K' and various narrow band filters are available, as well as a CVF covering the H and K bands. The detector is a 256 x 256 NICMOS 3 array manufactured by Rockwell. Three image scales are available for the whole 1–2.5 μm wavelength range: 35 mas/pixel, 50 mas/pixel, and 100 mas/pixel, leading to a field-of-view of 9 x 9 arcsec, 12.8 x 12.8 arcsec and 25.6 x 25.6 arcsec, respectively.

In order to compare the performance of the new camera with the old SHARP II, previously used with ADONIS, we have observed the object G45.45+0.06, described above in the note from Stecklum et al. The image shown below was obtained through the K'filter, with a pixel size of 50 mas, which is the same as that used by Stecklum et al. The ADONIS correction is not as good as that obtained by Stecklum, however, as the object was already at an airmass of 2.6 when it was observed! The exposure time was 100 seconds on the object and 100 seconds on the star (three time less than for the Stecklum et al. image). The new image shows a clear brightening of the extended source.

Together with the two new cameras, a new user interface and a new data acquisition programme were installed and debugged. The new software, and SHARP II$^+$, are now being offered to visitors on a regular basis. A more detailed technical description of COMIC will be included in a future issue of The Messenger.

References

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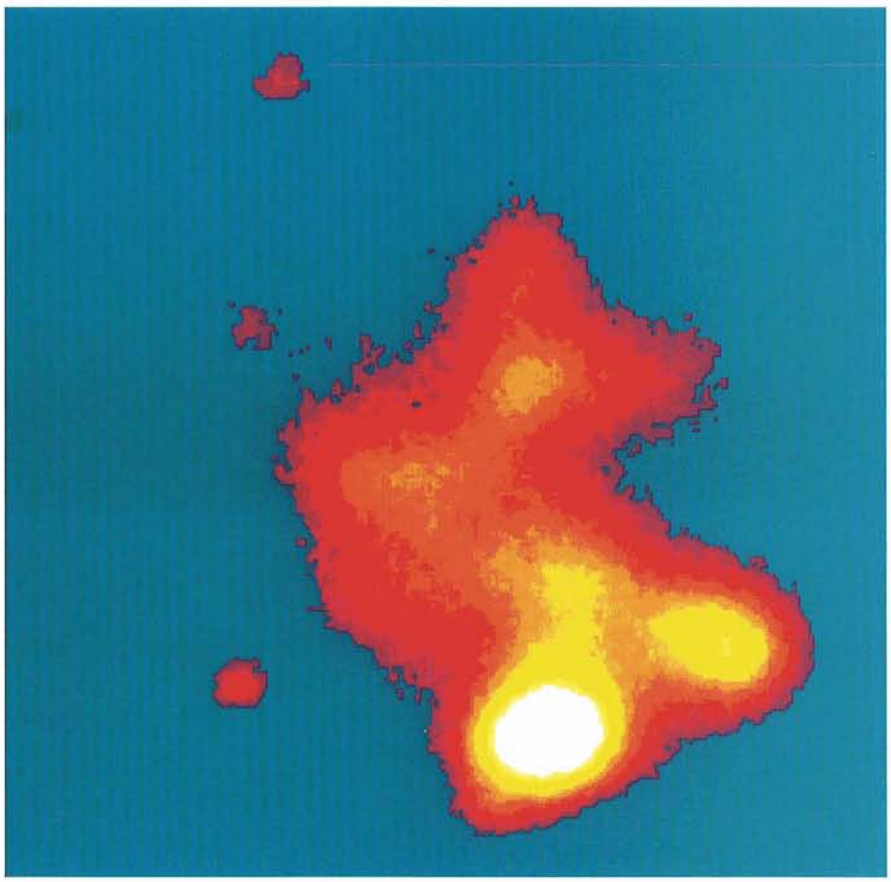

Figure 2: *G45.45+0.06 with SHARP II$^+$.*