Preliminary results on Water maser EVN observations and the Collimation of Protostellar Outflows

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Using the EVN network at 22 GHz, we studied the region where the protostellar outflow is accelerated via measurements of the collimation and the proper motion of the water maser spots at 22 GHz. In order to get the highest resolution (less than 10 AU), a sample of nearby molecular outflows connected with Class 0 protostars and associated with known H_2O sources was selected.

1. Introduction

During the last decade it has been established that the formation of a star, either with low or with high mass, is always accompanied by a period of strong mass ejection, an outflow, in which two lobes of supersonic gas move away from the newly born star (see Bachiller R., 1996). Outflows have been observed at different spatial scales. At small scales, in particular, the limits on outflow collimation start to approach the sizes inferred for circumstellar disks (less than 100 AU; e.g. Beckwith et al. 1996), and even the size of our own Solar System. VLBI observations of water maser emission can provide the needed angular resolutions of a few mas, for measuring outflow collimation.

Interstellar water masers have been proven to be effective tools for investigating the motion of gas around very compact objects, which are not accessible by any other tracers. Claussen et al. (1996) have shown that H_2O masers are not restricted to high mass outflows, and that also low luminosity young stellar objects can be associated with the same phenomenon. Until now very little work has been carried out on the low mass side. This is unfortunate because it is in these nearby, low mass outflows where we can achieve the highest spatial resolutions, and therefore probe the outflow properties at the smallest possible scales (see e.g. Chernin 1995 on the L1448 outflow or VLBA observations of Claussen et al. 1997 in the vicinity of IRAS 05413-0104).

2. Observations and results

The observations were made in October 1997 and February 1998 using all EVN antennas available at 22 GHz. The data were recorded using the MKIII system in mode C in dual polarisation and were correlated at the Bonn correlator. The averaging time was 2 seconds and the coherence time was around 2 minutes. The data were reduced using NRAO's Image Processing system AIPS. For each source a maser was chosen as a reference and the data was self calibrated on this feature. The reduction of data was conducted separately in each polarisation.

Out of the six sources observed only one, NGC1333, allowed us to made a map. For the other sources the dynamical range was too poor to allow us to map them. NGC1333 is a star-forming region in Perseus containing numerous embedded young stellar objects

(YSOs) and a high number of bipolar outflows. The source that we observed, IRAS4, is a very young low mass star (class 0 source). In Figure 1, we present the preliminary map of NGC1333-IRAS4 that we obtained in both polarisations. Only 4 antennas were used to produce the LCP and RCP maps.

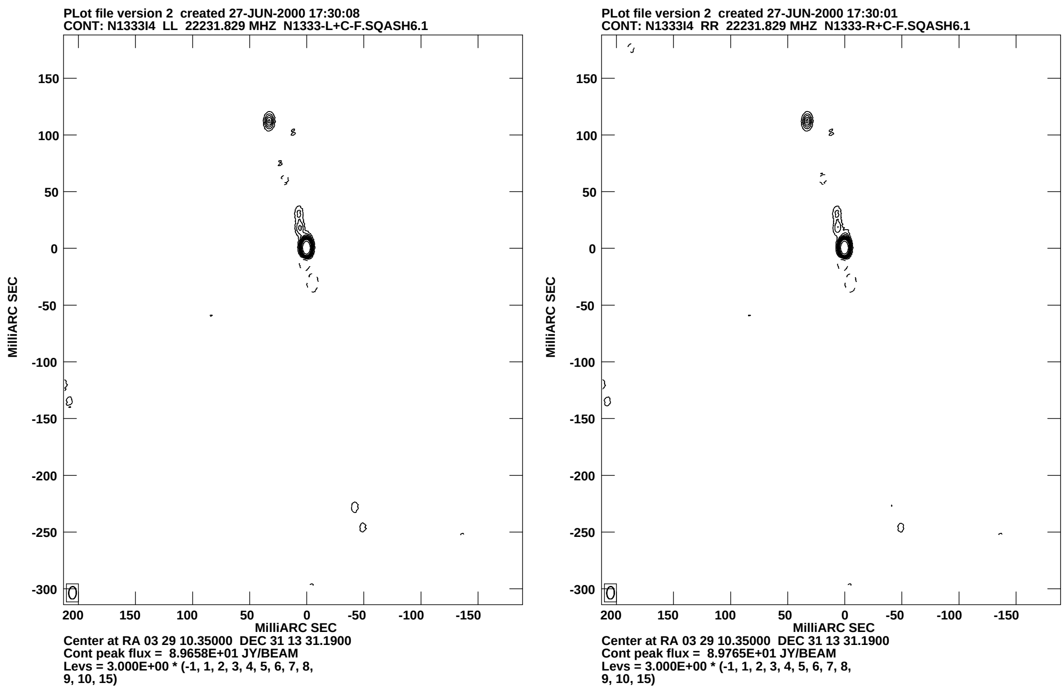

FIGURE 1. EVN map at 22 GHz of NGC 1333-IRAS 4 in both polarisation (LCP and RCP). Note the high degree of collimation, which is reminiscent that of the optical jets.

3. Preliminary Conclusions

Both polarization maps of NGC1333-IRAS 4 show a very good agreement. The morphology of the source is very suggestive of a highly collimated jet. The P.A. of the outflow ($\sim 15^o$) is in agreement with that of the CO flow observed by Girart et al. (1999). The projected size of the maser emission outflow is about $\sim$20 mas, or 6 AU at the assumed distance of 300 pc. A velocity gradient of $\sim$1.6 km s^{-1}arcsec^{-1} has been measured on the maps. Additional observations will allow to improve the quality of this detection and to study the proper motion of the maser spots.

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