Applications of Precision Astrometry to Studies of <u>Massive YSOs</u>

María José Rioja Luca Moscadelli Riccardo Cesaroni 1-epoch VLBA and <u>multiepoch</u> GLOBAL observations of water masers towards IRAS 20126+4104





1-Epoch VLBA : Nov 21 1997

3-Epochs GLOBAL : Nov 9, Nov 26 2000 and Mar 1 2001 8 EVN antennas : Eb, Mc, Nt, On, Jb, Mh, Sh, Ro VLBA : All

Phase-referencing mode to derive absolute maser positions







measured

 $\bigcirc$  model



## Galactic



Encouraging results for IRAS20126+4104 Call for a larger number of observations of That kind of objects.

1st epoch EVN observations of a selection Of 5 high mass YSOs, in February 2004

9 antennas: Cm, Jb, Eb, Nt, On, Mh, Sh

Aim: Asses the precise association of maser spots and molecular outflows

Follow up with proper motion measurements.

<u>NGC281-W</u>



<u>GGD12-15</u>



## CONCLUSIONS AND FUTURE WORK

- •) The results obtained towards IRAS 20126+4104 demonstrate that sensitive, multiepoch, phase-reference VLBI of water masers can unveil the gas kinematics near a high-mass YSO.
- Towards IRAS 20126+4104, water masers are clearly tracing a well collimated outflow, which remains similar, also in position angle, at a distance from the origin ranging from 0".1 to 10".
- We have extended the observations to a larger sample (5) of high-mass protostars in order to asses the association of the maser spots with the bipolar outflows and study the velocity field on scales of ca. 100 AU, in other sources.
- •) We plan to follow up the study of these new sources with proper motion measurements.