



# Constraining the non-thermal emission from young stars in Orion

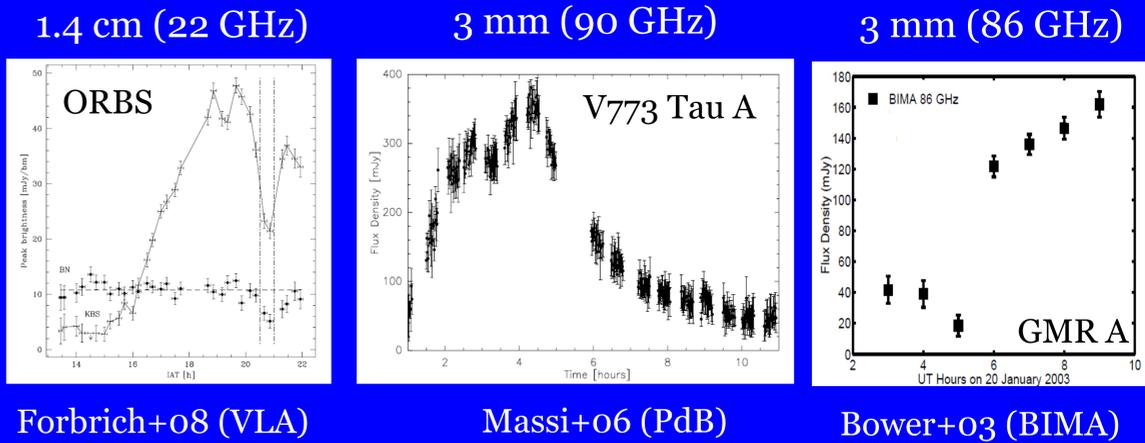
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- Young stars are expected to produce highly-variable (flaring) non-thermal emission related with magnetic events.
- However, the physics and geometry associated with non-thermal cm/(sub)mm emission from young stars are still poorly constrained.

## SCIENTIFIC BACKGROUND

- **LONG-TERM VARIABILITY** (timescales months to years) have been detected in cm monitorings (2-6 cm; Felli+93, Zapata+04).
- Only a few serendipitously detected impressive flares with **SHORT TERM VARIABILITY** on timescales of hours to days have been reported.

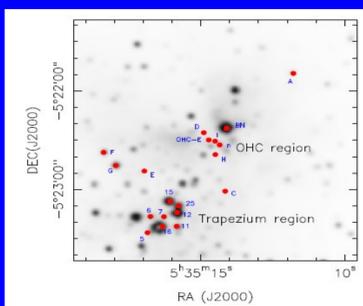


## ARE THEY RARE EVENTS? OR WERE WE LIMITED BY SENSITIVITY?

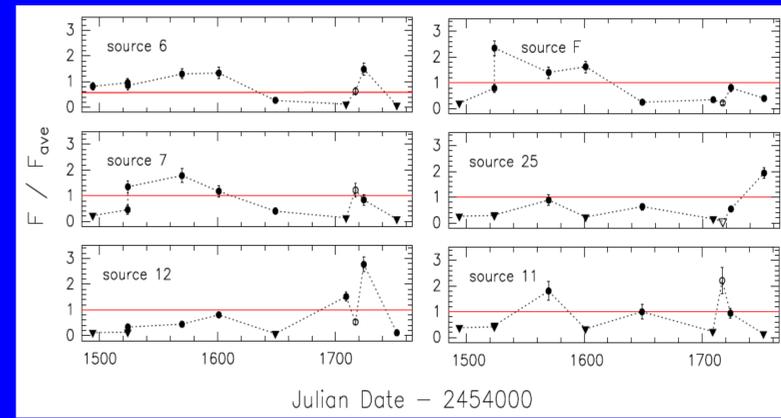
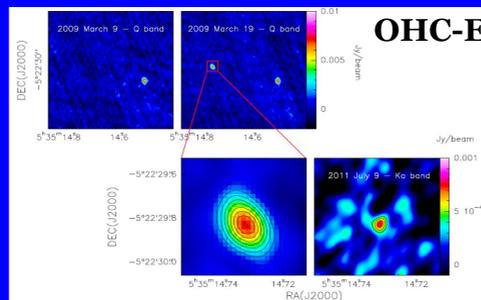
### NEW MONITORING OF ORION AT 7 & 9 mm (Rivilla et al., submitted)

- VLA observations of 19 sources in Orion reveal that variability (in timescales down to hours) is very common.

### 9 mm flux density curves

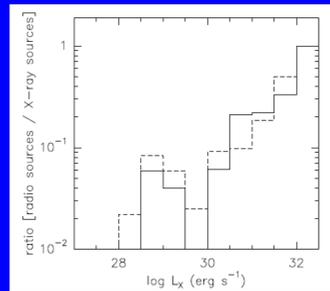


### NEW RADIO DETECTION



## COMPARISON WITH X-RAYS

- The non-thermal emission is expected to arise from the same magnetic reconnection events that produce X-ray emission.
- The cross-correlation between radio and X-ray stars show that the **radio detections correspond with the brighter X-ray stars.**



Detections at cm/sub(mm) wavelengths have been **STRONGLY LIMITED BY SENSITIVITY**

## INCREASE OF SENSITIVITY WITH NEW VLA

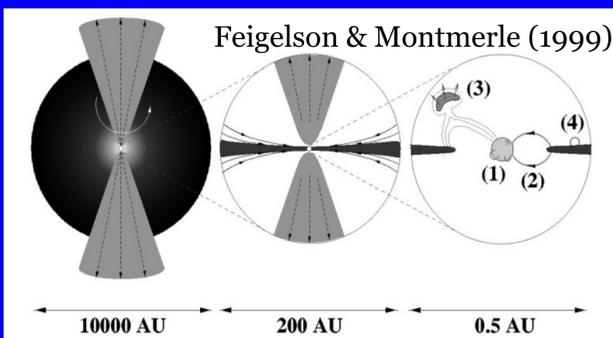
- VLA and ALMA are capable now to significantly increase the number of cm/(sub)mm detections of flares from young stars.

Orion Nebula Cluster and Orion Molecular Cloud



## NEXT STEP: GO TO ALMA + mm-VLBI OBSERVATIONS (3,2,1 mm)

- ALMA observations to obtain a complete catalogue of young stars with mm emission.
- Selection of the best potential sources to study in detail with mm-VLBI.



**NEED OF VLBI TO DISENTANGLE THE GEOMETRY**  
 Only mm-VLBI (including ALMA) provides the needed sensitivity and spatial resolution to resolve the small-scales (<0.1 AU; << 1 mas) of magnetic loops involving the central star and the circumstellar disk.

ADDITIONAL IMPLICATIONS: high energy irradiation of protoplanetary disks, impact on planet formation, improvement of previous derivations of parallax distances, effects on interferometric imaging techniques...

