

# Astrometric comparison between maser emission and *Gaia*



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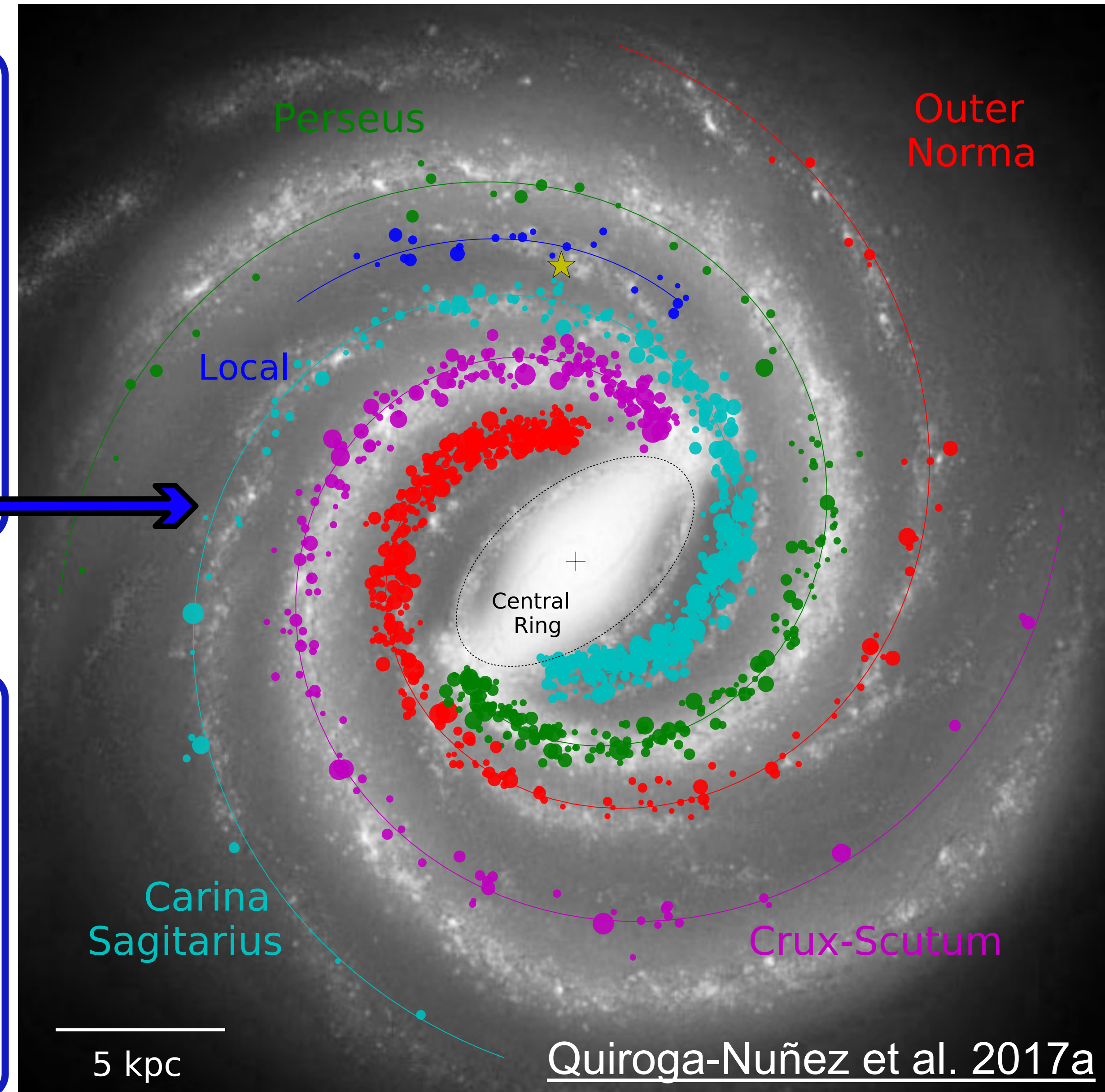
## Bar and Spiral Legacy Survey: BeSSeL

- Study the spiral structure and kinematics of the Milky Way.
- Positions, distance, proper motions &  $V_{\text{los}}$  for ~250 HMSFRs associated with  $\text{H}_2\text{O}$  &  $\text{CH}_3\text{OH}$  masers: [Reid et al. 2014](#).
- Relative accuracy reached: ~10  $\mu\text{as}$ .
- 3,500 hours over 5 years using the VLBA, EVN & VERA.
- Simulated data confirm the accuracy of Galactic parameters values found. Also, simulations can predict future simulations

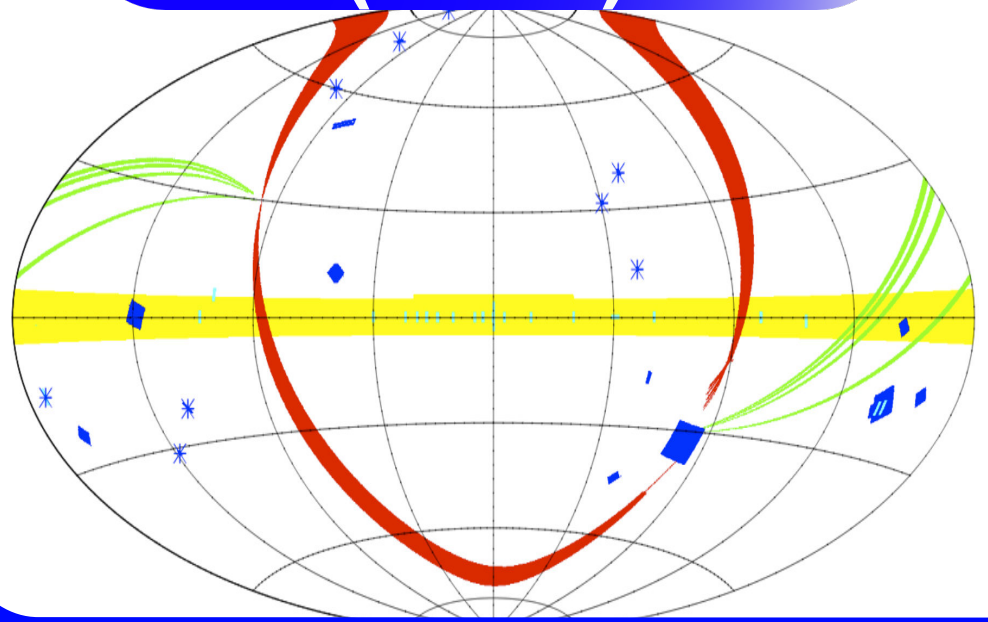
## Now we go for the inner Galaxy!

### Bulge Asymmetries & Dynamical Evolution: BAaDE

- Large SiO maser survey in the Galactic Plane (mainly the Bulge) using IR color selected evolved stars with VLA & ALMA.
- Thousands of line-of-sight velocities expected.
- Where optical surveys do not reach ( $|b| < 5^\circ$ ) and the dynamics are most revealing: [Sjouwerman et al. 2015](#).
- VLBI astrometry constrained by availability of 43 GHz calibrators.



BAaDE Targets (MSX)

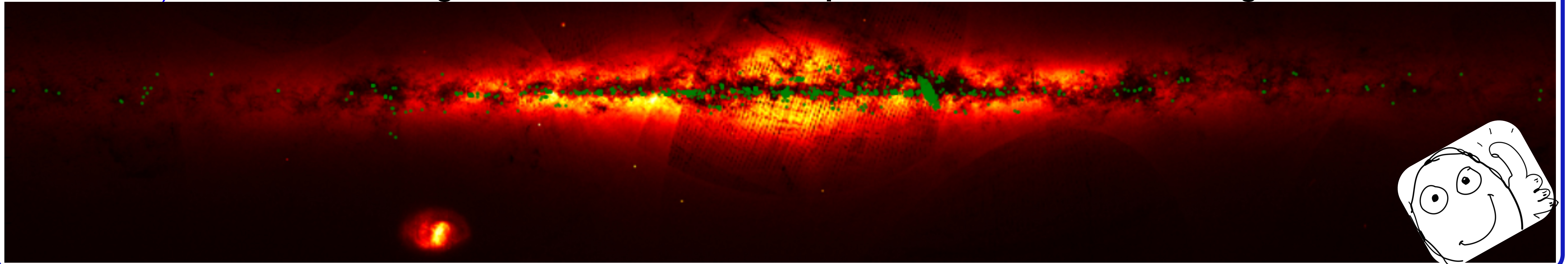


## BAaDE-IR-Gaia X-match



>2,000 coincidences: Unique sample to characterize the evolved population in the inner Galaxy. What are we planning to do?

- 1 Confirm the matches using distance estimates, color analysis and flux variability ([Quiroga-Nuñez et al. 2017b](#)). Note: BAaDE targets without Gaia counterpart clear correlated with high extinction areas.



- 2 Using radio (BAaDE), IR (MSX, 2MASS & WISE) and optical (*Gaia*) data, we will characterize the stellar population in the Galactic bulge: mass, age, metallicity, period, luminosity. Individual stars can be studied.

- 3 VLBI astrometric proposals using phase referencing at bright SiO masers looking for parallaxes & 3D orbits (~50  $\mu\text{as}$  accuracy estimated). We can study the Galactic bar dynamics and signatures of past mergers.

- 4 Direct comparison of the parallax technique between *Gaia* (DR2) and VLBI which will align stellar image with SiO maser rings. An initial comparison can be done with TGAS ([Quiroga-Nuñez et al. 2017c](#)).

### More info

- **BeSSeL:**  
[bessel.vlbi-astrometry.org](http://bessel.vlbi-astrometry.org)
- **BAaDE:**  
[phys.unm.edu/~baade](http://phys.unm.edu/~baade)
- **Gaia:**  
[gaia.esac.esa.int](http://gaia.esac.esa.int)



### References

- Quiroga-Nuñez et al. 2017a A&A **604**, 72.
- Quiroga-Nuñez et al. 2017b IAUS **330** in press
- Quiroga-Nuñez et al. 2017c IAUS **334** submitted
- Reid et al. 2014 ApJ **783**, 130.
- Sjouwerman et al. 2015 ASPC **497**, 501.