VLBI Special Session

Walter Brisken
Raghvendra Sahai
Ciriaco Goddi
Keiichi Asada
R.Craig Walker

VLBI's key qualities

- (sub-) milliarcsecond resolution
  - AU-scale in MW, pc-scale extragalactic
  - Astrometry at 10s of microarcsecond precision
- Requires **high** surface brightness
  - Brightness temperatures > 10e5 K
  - No thermal molecular emission observable
- Special relationship to gamma-ray telescopes
  - Unresolved gamma-ray objects likely detectable with VLBI: pulsars, AGNe, GRB, ...

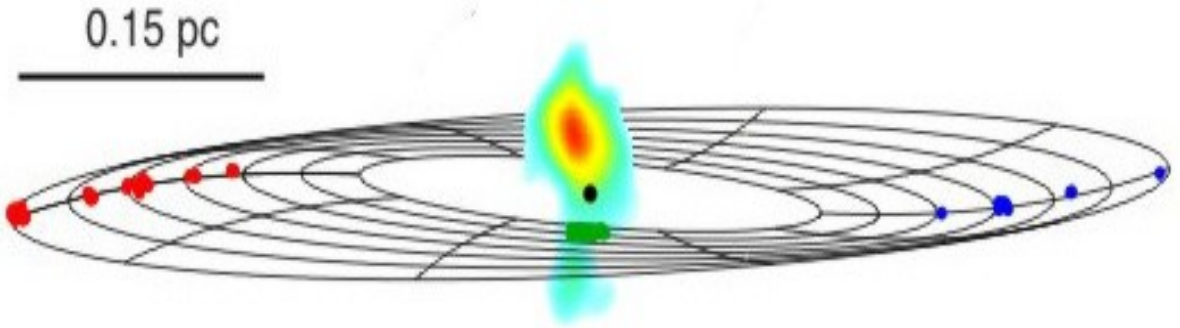
VLBI Capability/Target Matrix

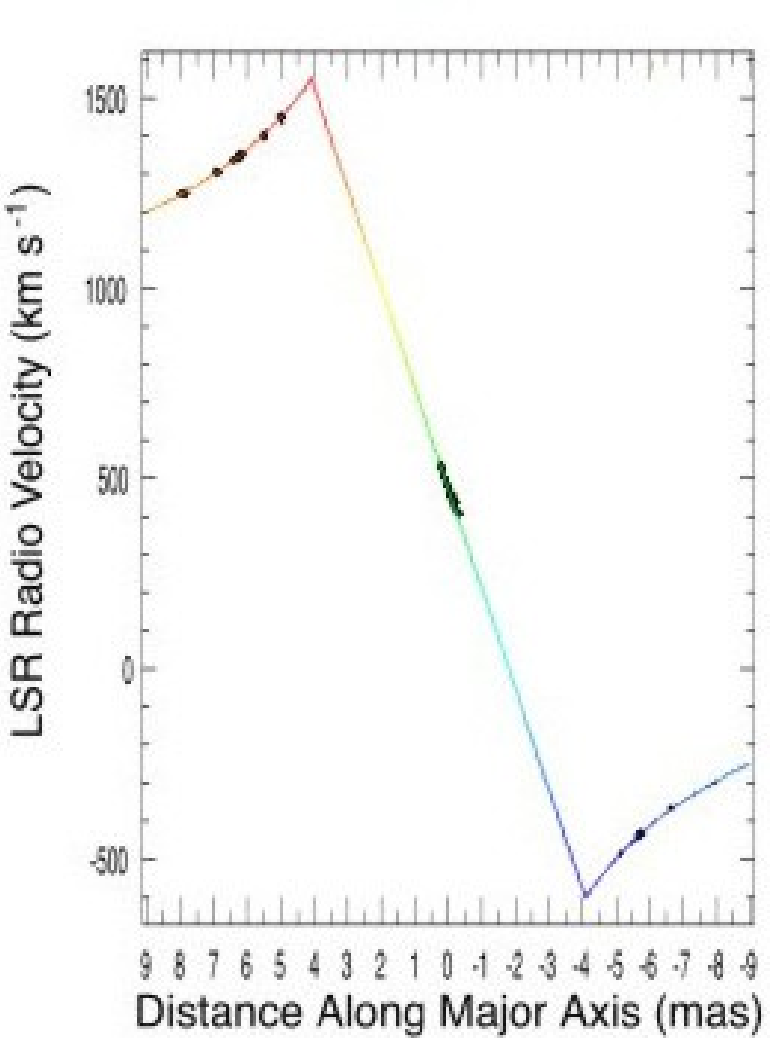
Target	Time evolution	Astrometry	Imaging	Polar'n	Wide-field	Spect'y
AGNe						
Masers						
SN, GRB, TDE						
Colliding winds						
MicroQSO						
Active stars						
Pulsar, bow shock						

Critical capability Of secondary importance Not very relevant

NGC 4258 Distance

- Example of multiple capabilities being used together
  - Spectroscopy → physical velocity
  - Astrometry → angular velocity
  - Together a distance is determined



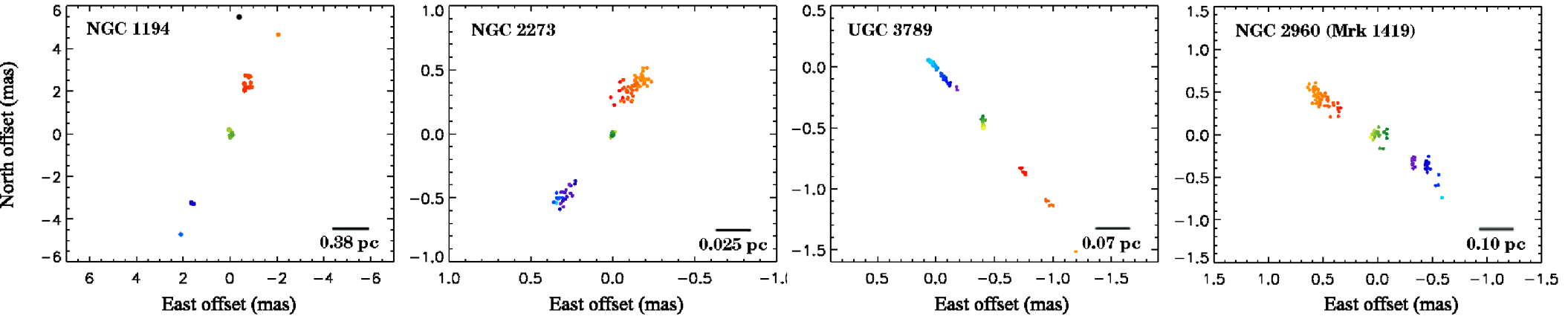


Herrnstein et al. 1998

Megamaser cosmology project

Braats, Kuo et al.

- Builds on NGC4258 result; extends to other sources
- Goal: Measure Hubble constant
  - Determine geometric distance to AGNs hosting water maser disk through orbit modeling high velocity maser motions
  - Couple to redshift determined from systemic maser velocity
- Goal: Measure black hole masses precisely
- 1st results from galaxies within the Hubble flow: H_0=69±11 km/s



AGNe as resources

- AGNe form the most important class of VLBI calibrator sources
  - Used for VLBI astrometric and polarization references
  - Understanding of their time evolution is crucial for accurate results
  - VLBA archive is teeming with calibrator data of scientific quality
- AGNe form the basis of the International Celestial Reference Frame

New/upcoming instrumentation

- Phased-array ALMA
  - 10x sensitivity, 2x resolution improvement in mm
  - To probe the accretion disk of Sgr A*, M87
- RadioAstron (space-ground VLBI)
  - Baselines up to 50,000 km
  - To probe AGNe at 50 microarcsecond resolution
  - To measure or limit the highest brightness temperature sources (10e14K)
- VLBI2010
  - AGN core stability (in freq, time, pol)

Next speaker...

Key questions to ask of VLBI

- AGB → PPN
  - Structure/evolution of water fountains
  - Nature of mass loss and its evolution during transition
- YSOs
  - Does collimation depend on YSO age? Or mass?
  - Can a massive YSO still accrete once a HC HII region has formed?
- AGN jets
  - Acceleration/formation/collimation mechanism?
  - Why do AGN jets exist at all? Why not ubiquitous?
  - Origin of circular polarization?
- General
  - Distances (via trigonometric parallax or other?)