

Galactic Warp Study and Prospects on KaVA/EAVN Astrometry

Sakai et al. 2019b, submitted to a journal

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Warp structure in disk galaxies

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S-shaped warp (e.g. ESO 510-13); **U-shaped warp** (e.g. EGCE 565)

ESO 510-13



(C) Hubble Heritage Team (STScI/AURA), C. Conselice et al.

Mechanism ?

- ① **Gravity** (Dark matter sub-halos; Satellite galaxies, etc.)
- ② & ③ **Magnetic/Hydrodynamic forces**

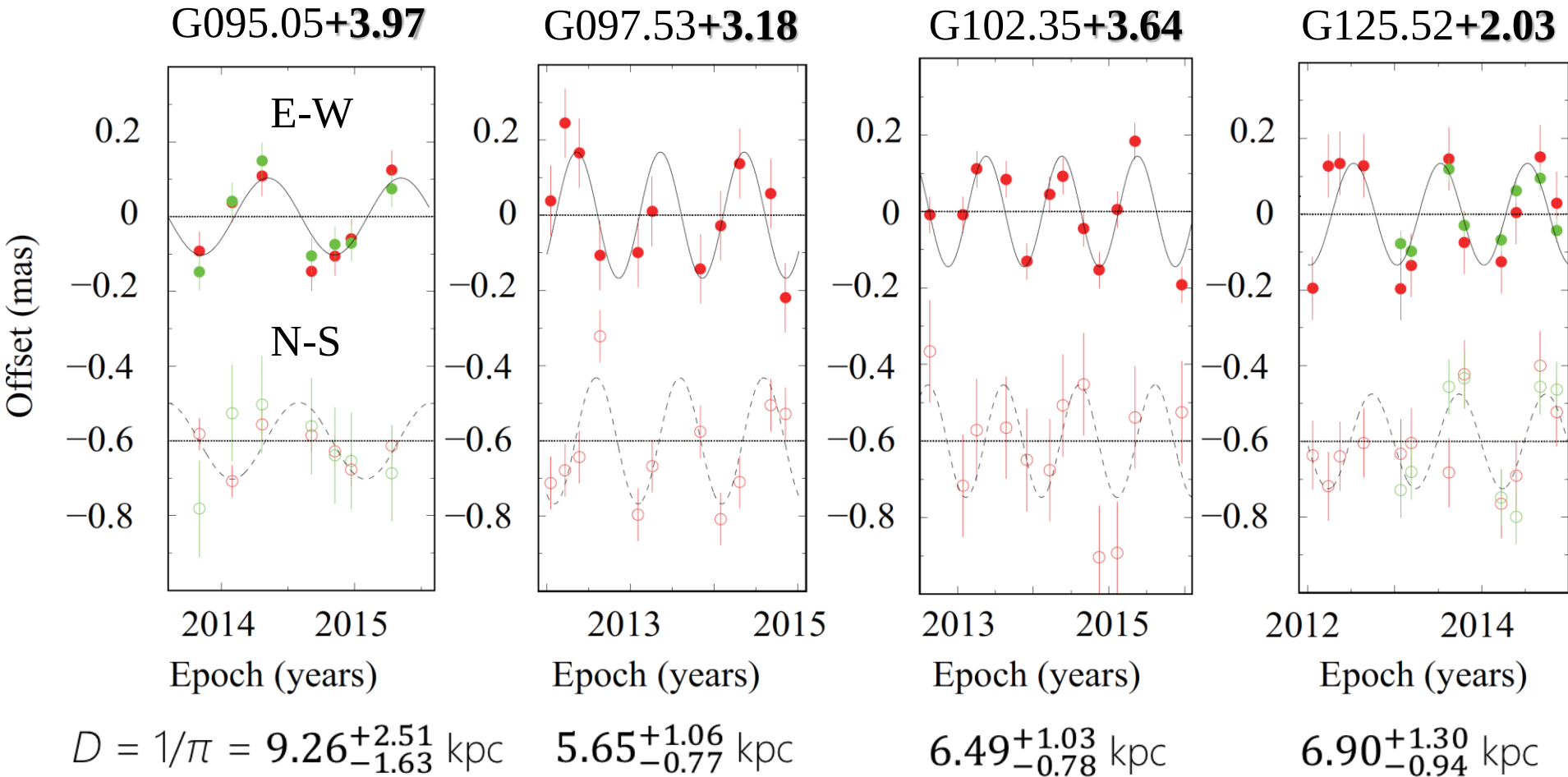
How about Milky Way ?



Recently, astrometric studies are starting to become significant !

Trigonometric parallaxes with VERA

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Galactic Warp Sources

Structure and Kinematics of the Warp

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Structure and Kinematics of the Warp

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Oscillatory behavior ?



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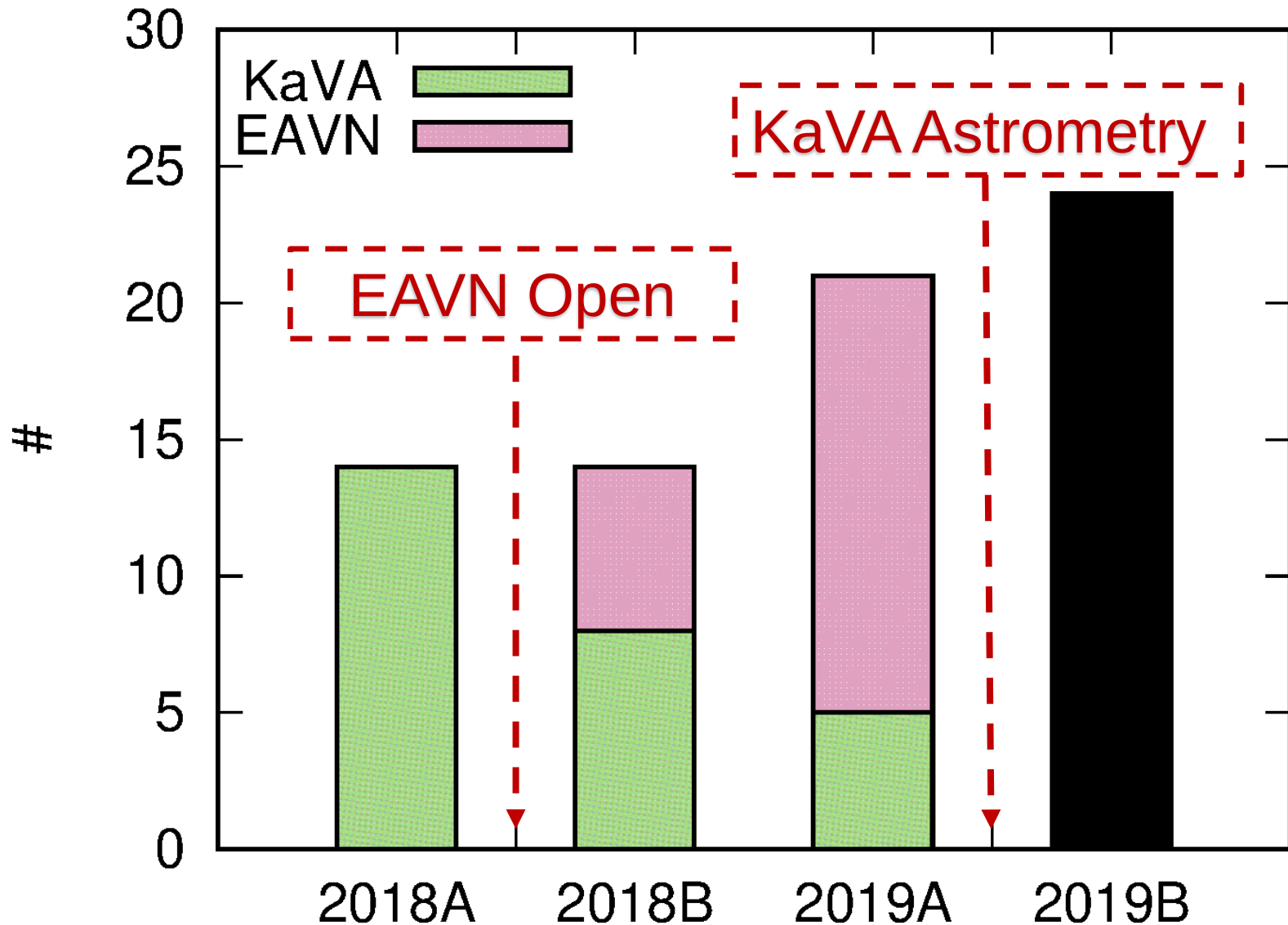
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Number of proposals for EAVN/KaVA

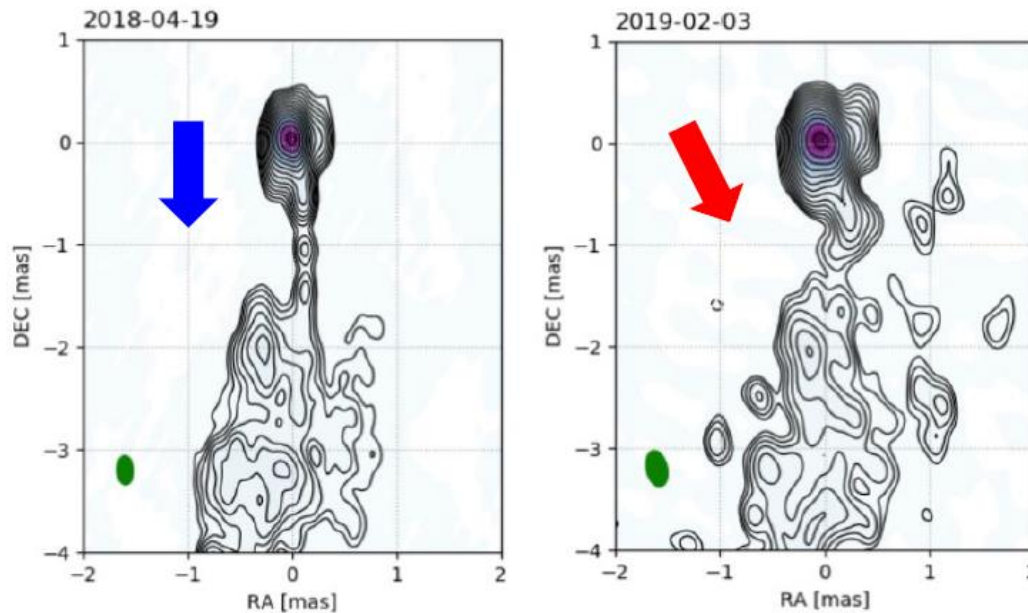
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Science cases : AGN jet' s astrometry

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Jet swinging in 3C84



- VLBA 43 GHz, BU blazar group

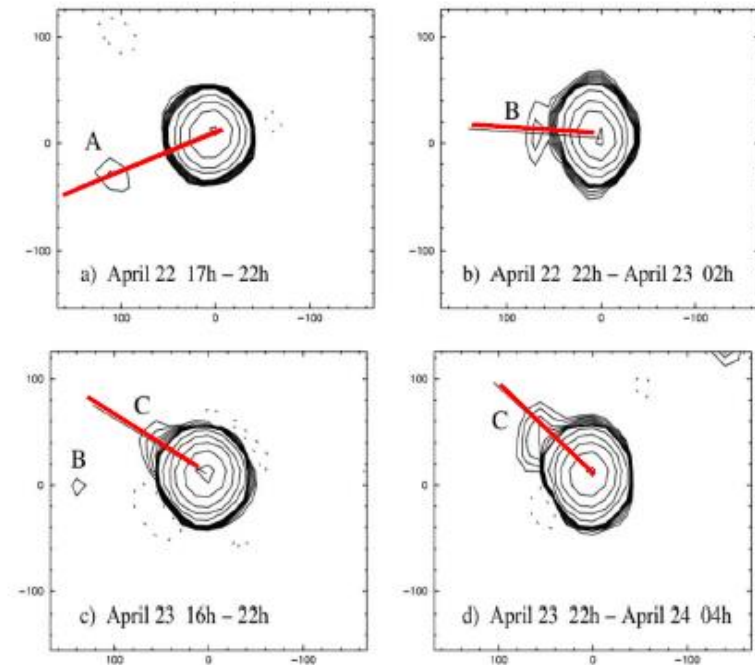
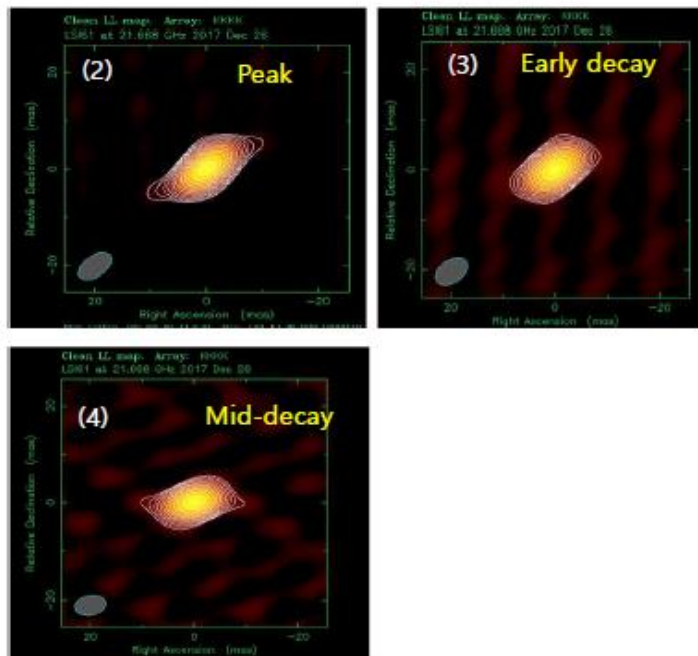
- Radical/abrupt change of jet direction ($\sim 14^\circ$ / year)
- Heading to “C2” region
- No significant flux / polarization change
- Proposed astrometric observation with KaVA at 22 and 43 GHz

Science cases: Astrometry for BH binary 10/12

Precessing Jets in microquasar:

KVN wide band at 22 GHz (7hrs) vs. Previous MERLIN at 5 GHz (2days)

Two components in model fit



- Successful detect fringe at 22, 44 and 86 GHz through KVN wide band observations.
- We would be first present a possible precession at 22 GHz.

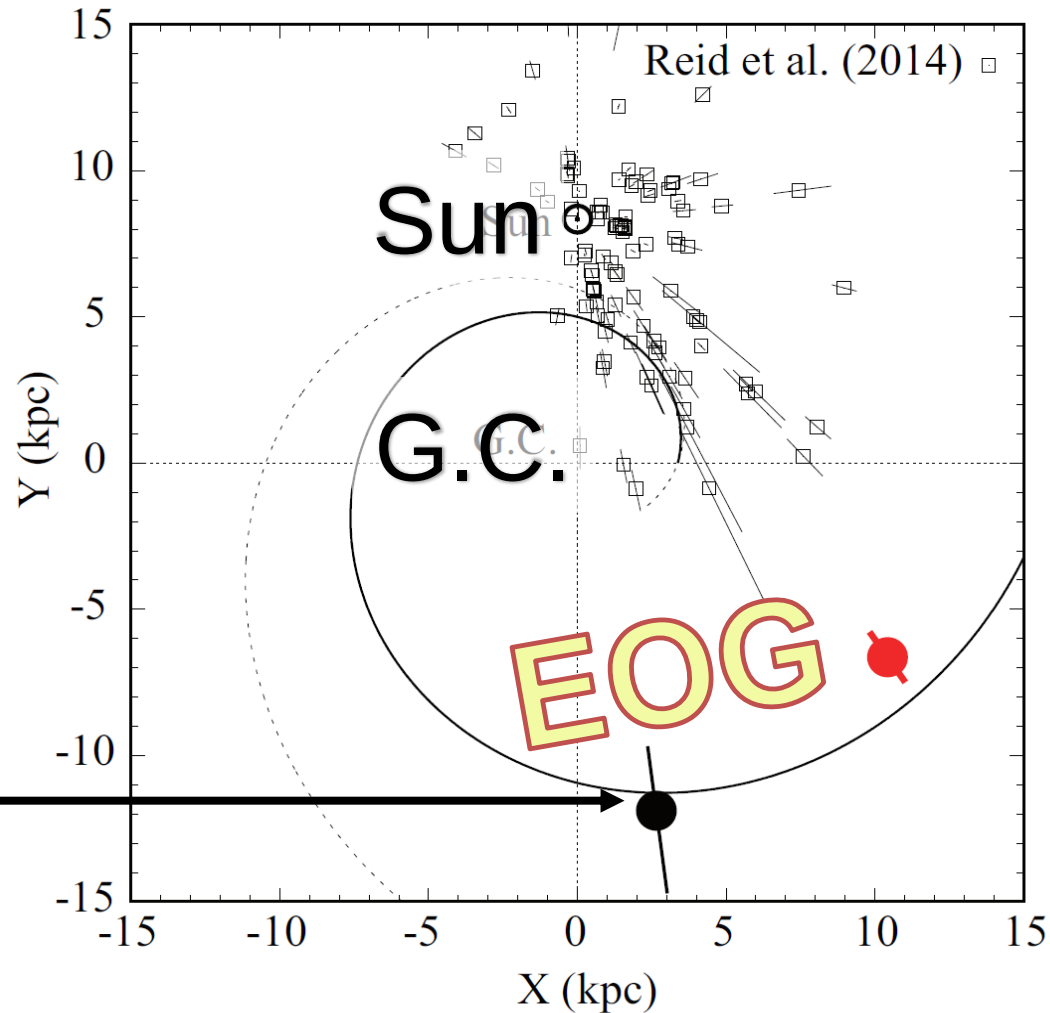
Science cases: Astrometry for EOG

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Extremely Outer Galaxy

Region beyond the
Outer Spiral Arm

⇒ Only one astrometric
result in the EOG
(Sanna+17, *Science*)



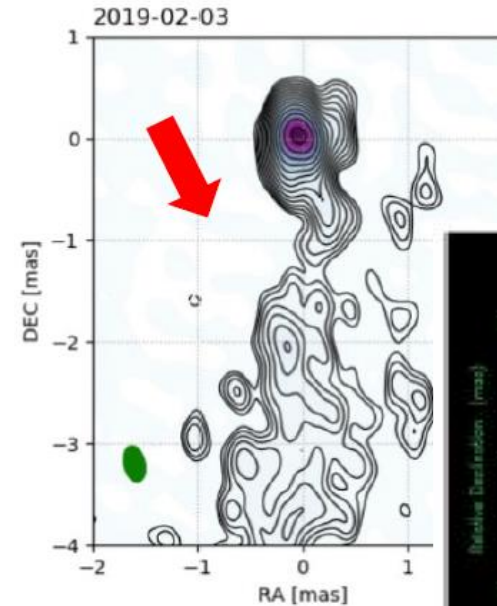
G034.84-00.95 (This proposal) ●

G007.47+00.06 (Sanna et al. 2017) ●

The age of astrometric exploration !

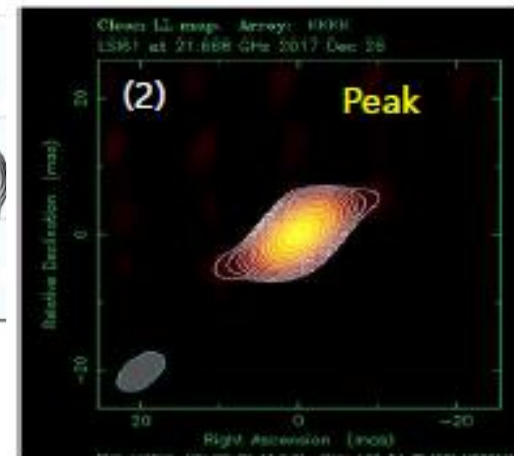
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MicroQSO

Jet swinging



**EOG
astrometry**

