Shanghai Astronomical Observatory, Chinese Academy of Sciences

Exploring weak targets with simultaneous multi-band observations and an update of the triple band receivers for Tianma-65m and CVN

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in collaboration with
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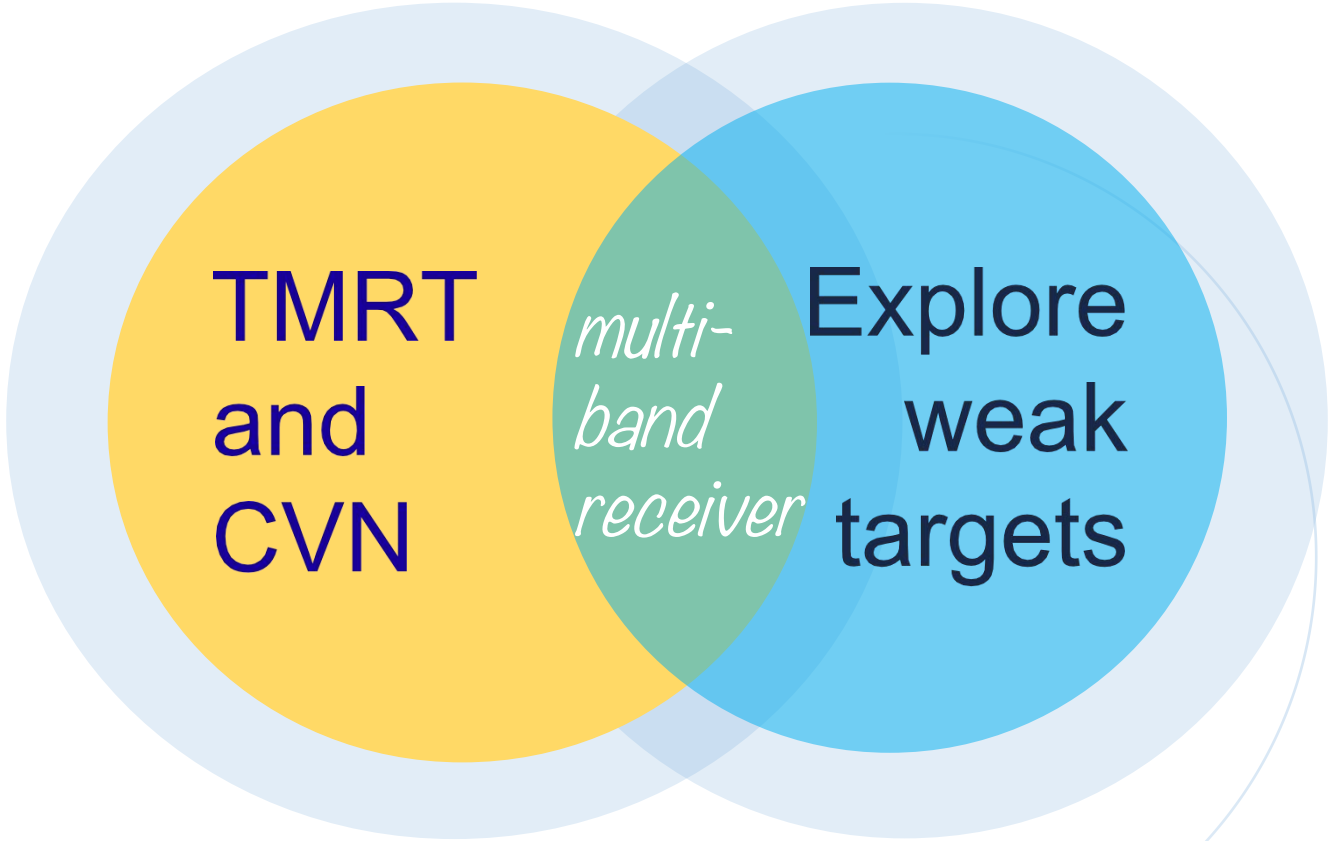
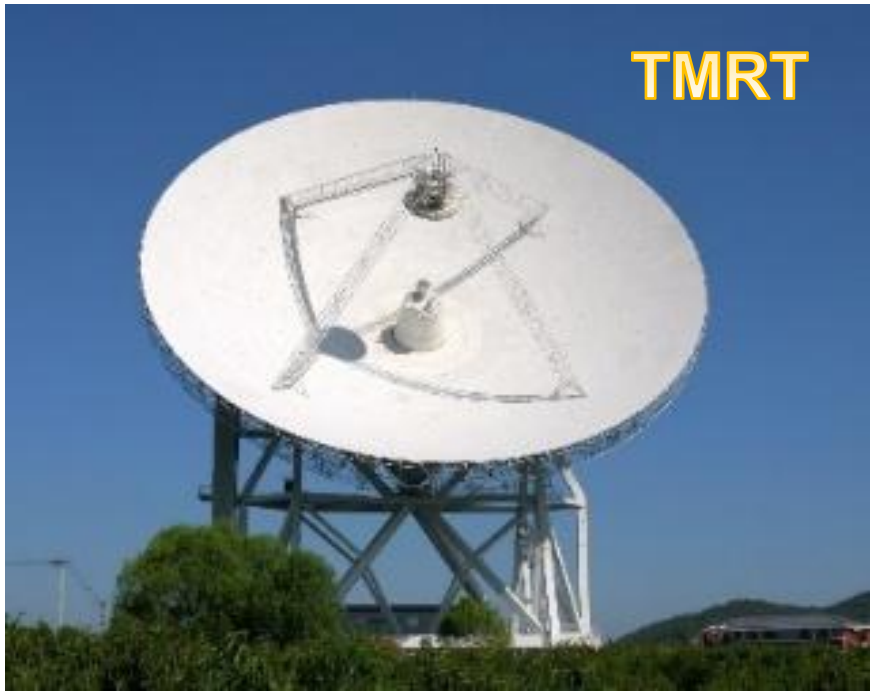
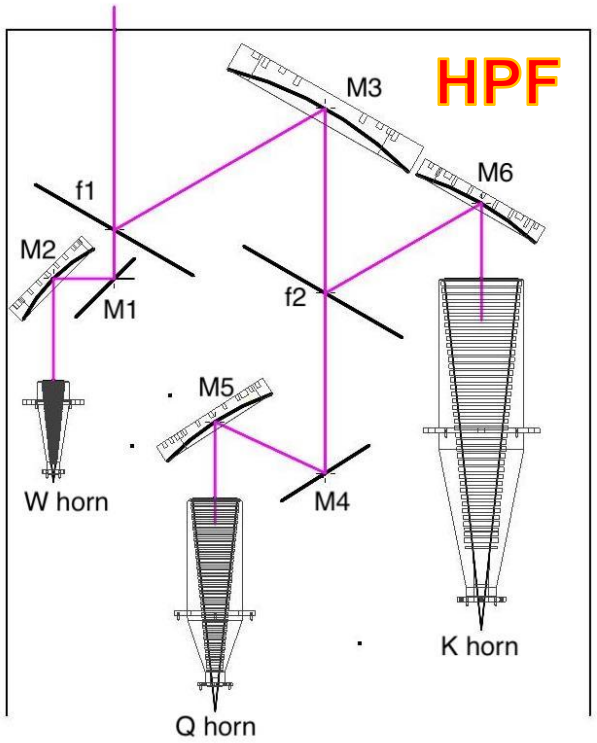
Ivan Martí-Vidal (Univ. Valencia), Guangyao Zhao (MPIfR), María Rioja, Richard Dodson (ICRAR), Ilje Cho (KASI) and others
2025/10/28

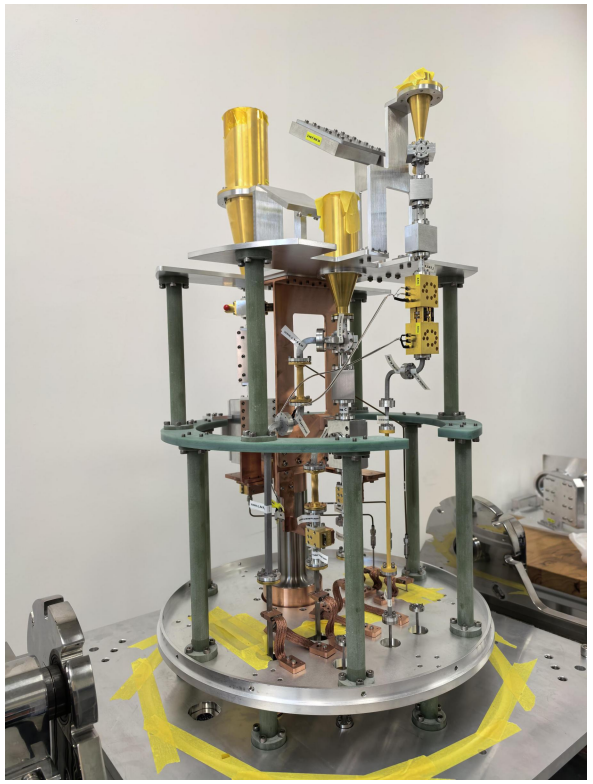
Outline



Compact triple-band Rx







Param.	K–Band	Q–Band	W–Band
Frequency	18–26 GHz	34–50 GHz	80–110 GHz
Trev	⩽ 40 K	⩽ 50 K	⩽ 120 K
Gain	30 dB	30 dB	25 dB

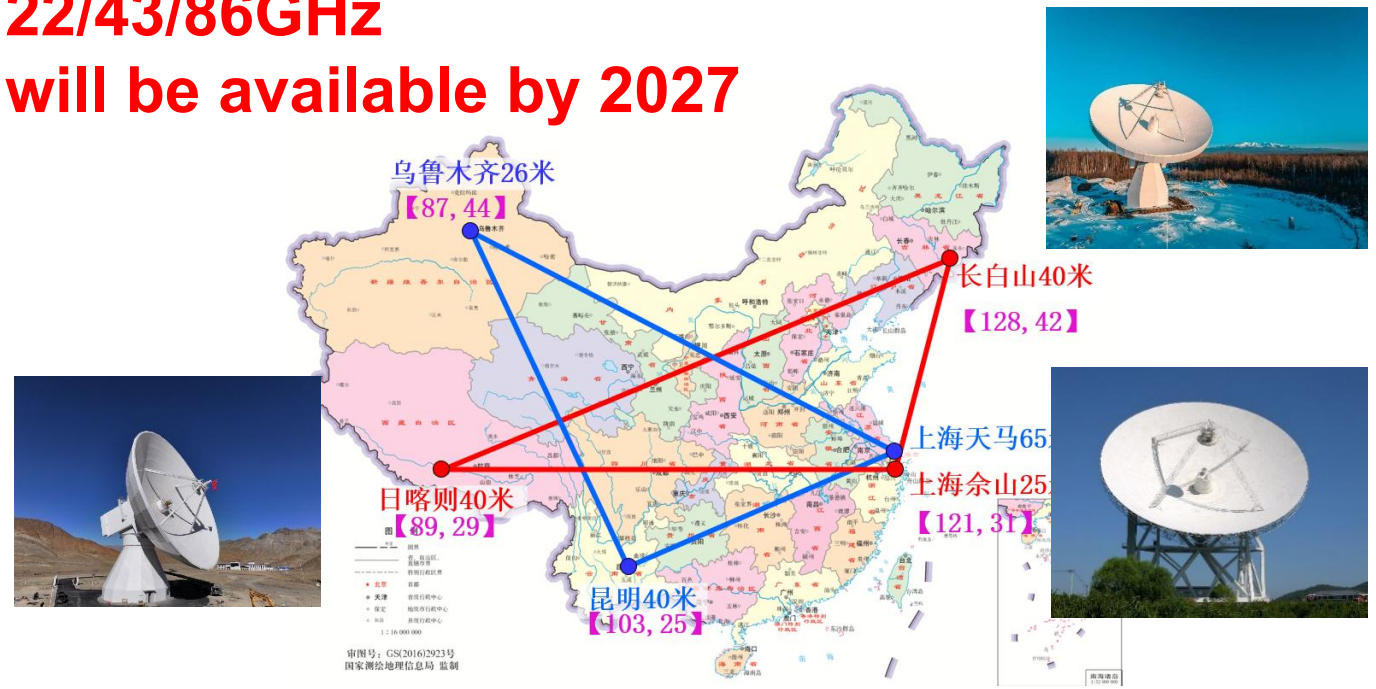
Triple band Rx (22/43/86 GHz) @TMRT, **2025/Q4**
Weiye Zhong'talk this afternoon.

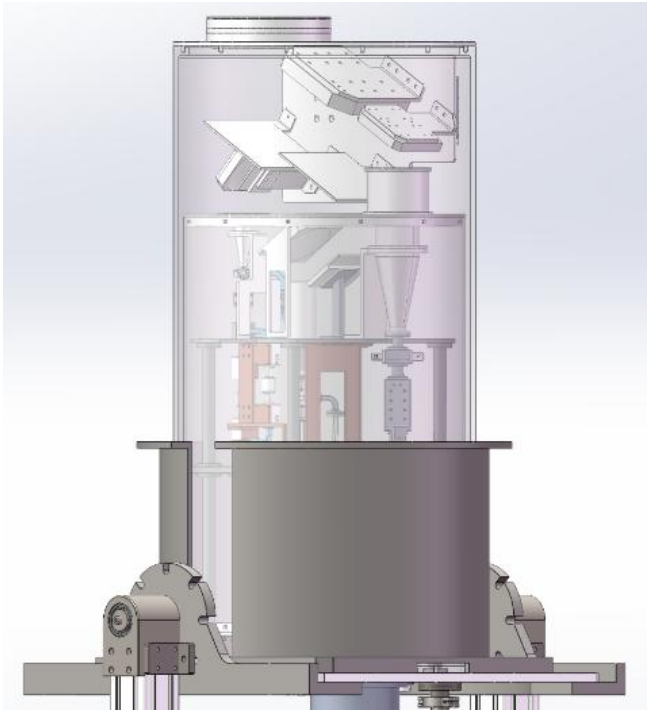
Two new 40-m telescopes

Diamter 40m
Surface RMS < 0.3mm
Efficency > 60% (P-Q)
Pointing < 5 arcsec
Freq range 0.7-50 GHz, up to 86GHz
SEFD 80 Jy (S/X,C) —— 800 Jy (W)
Triple Rx 2027/Q4

Simultaneous multi-freq mm-VLBI

22/43/86GHz
will be available by 2027

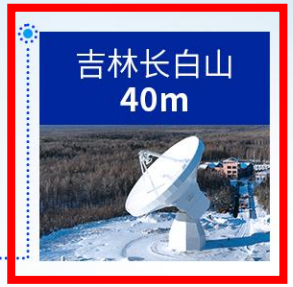


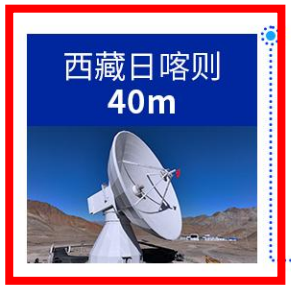


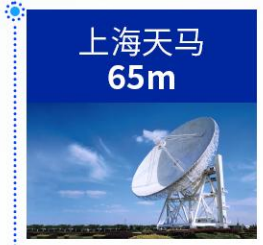
Param.	K–Band	Q–Band	W–Band
Frequency	18–26 GHz	34–50 GHz	80–110 GHz
Trev	⩽ 40 K	⩽ 50 K	⩽ 100 K
Gain	30 dB	30 dB	25 dB

CVN in 2025

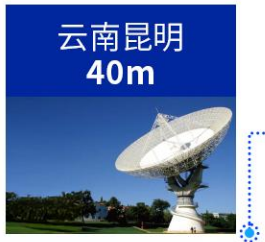

新疆乌鲁木齐
26m


吉林长白山
40m


西藏日喀则
40m

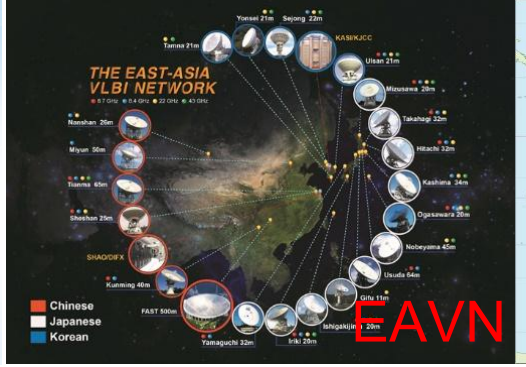

上海天马
65m

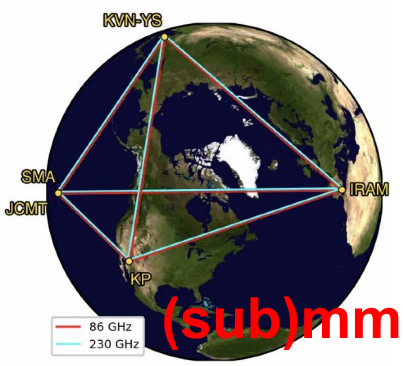

上海
VLBI中心


云南昆明
40m


上海佘山
25m

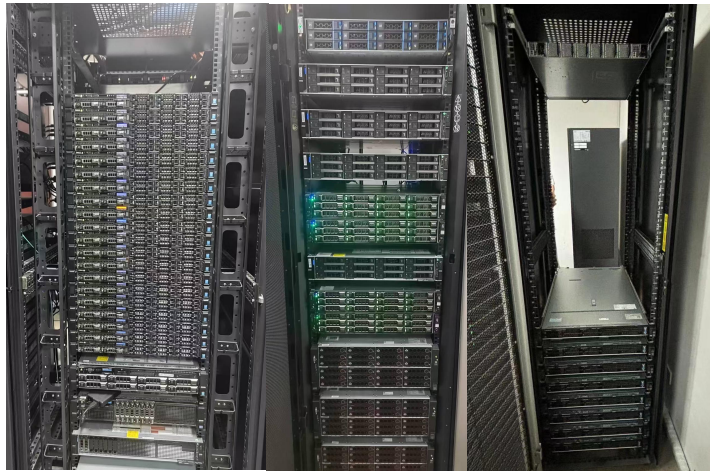

香港
台湾岛
海口
东沙群岛
海南岛
西沙群岛
永兴岛
南
中沙群岛
黄岩岛
海南沙群岛
曾母暗沙
南海诸岛
1:32 000 000



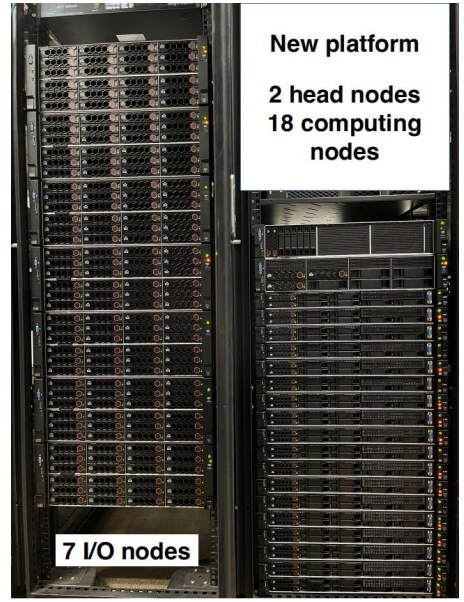


Correlator	DiFX-**2.6.2**
Post processing	HOPS-**3.22**

2014, 400 cores, 430TB



2025 Astrophysics
+800 cores, 2PB

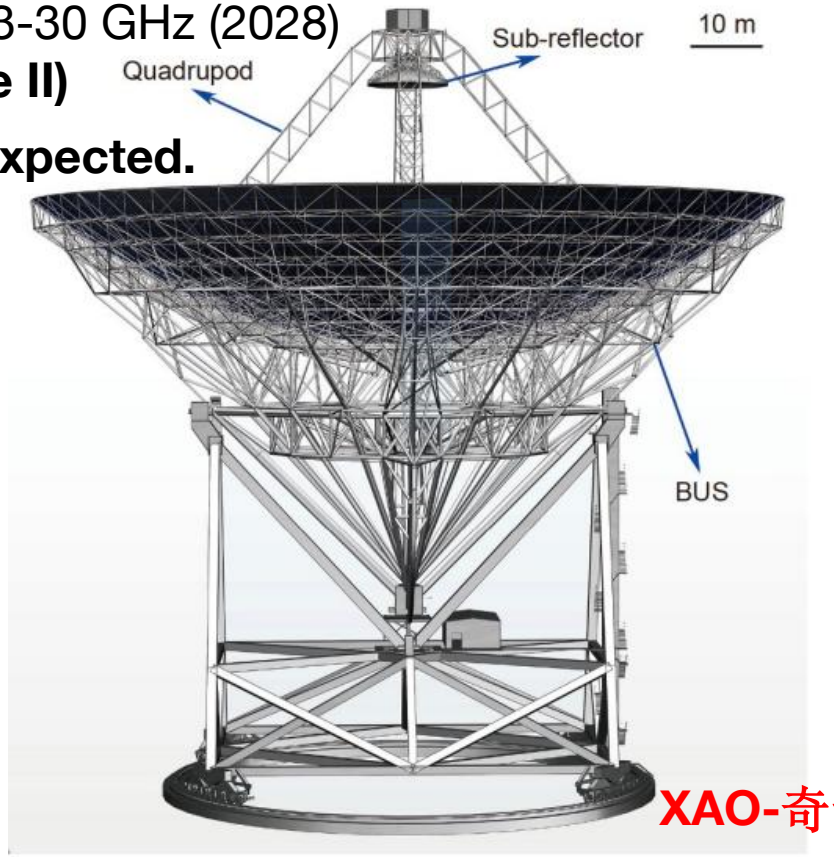


Geodesy
864 cores, 3.6PB

Two new 100+ m telescopes under building

Diamter **110m**
Surface RMS < 0.2mm
Pointing < 5 arcsec, (1.5 arcsec)
Freq range 0.3-30 GHz (2028)
(86G in phase II)

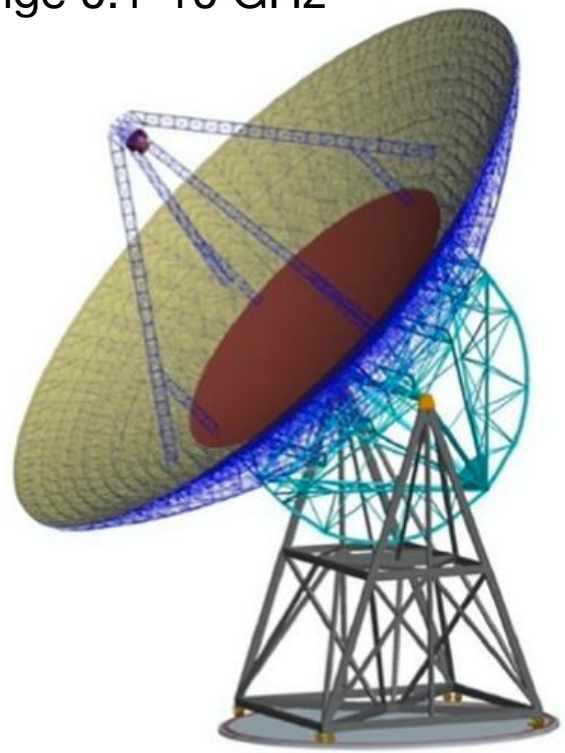
Triple Rx is expected.



XAO-奇台，QTT

Wang N. et al. 2023

Diamter **120m**
Surface RMS < 3mm
Efficency > 60%
Pointing < 10 arcsec
Freq range 0.1-10 GHz

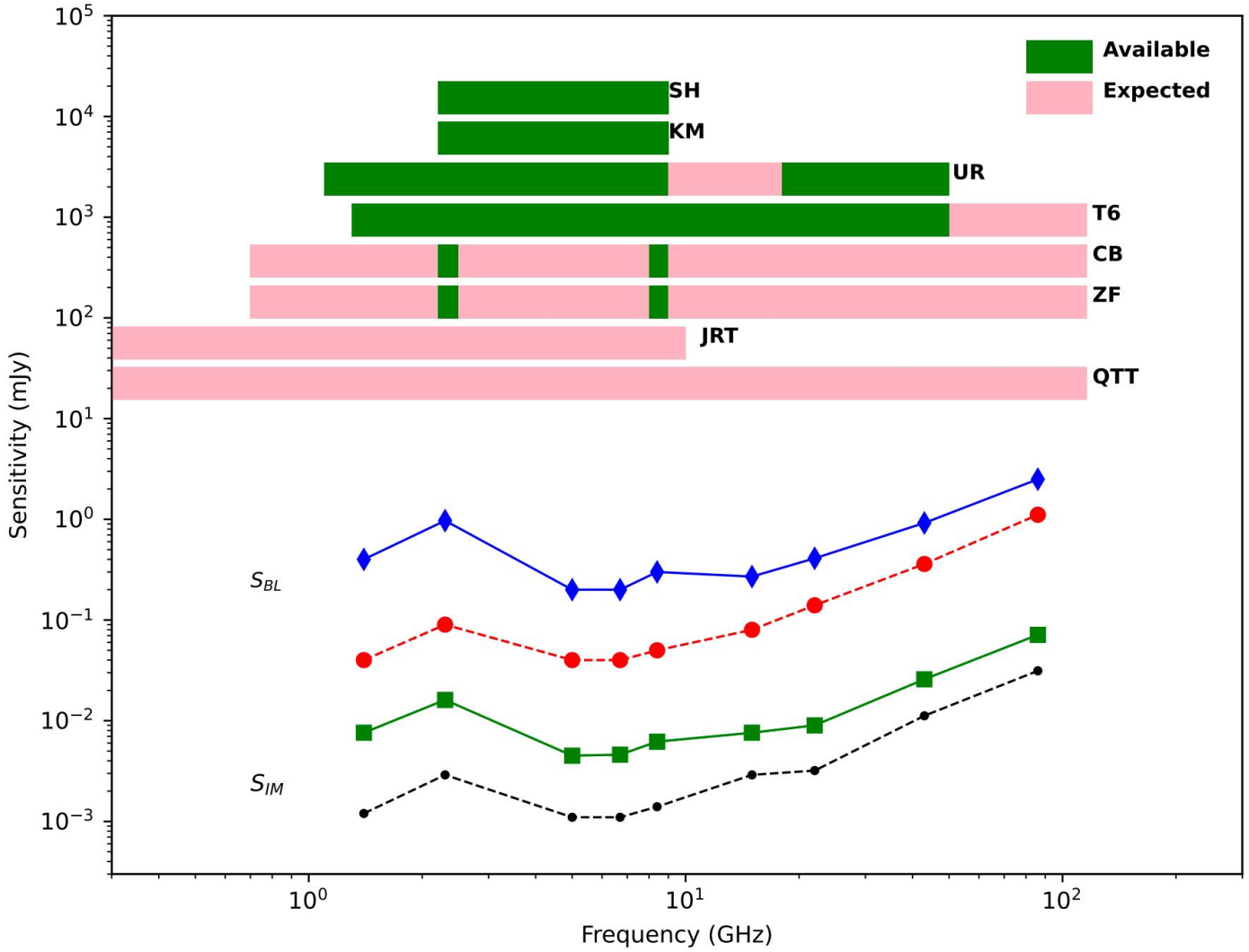


YNAO-景东，JDT

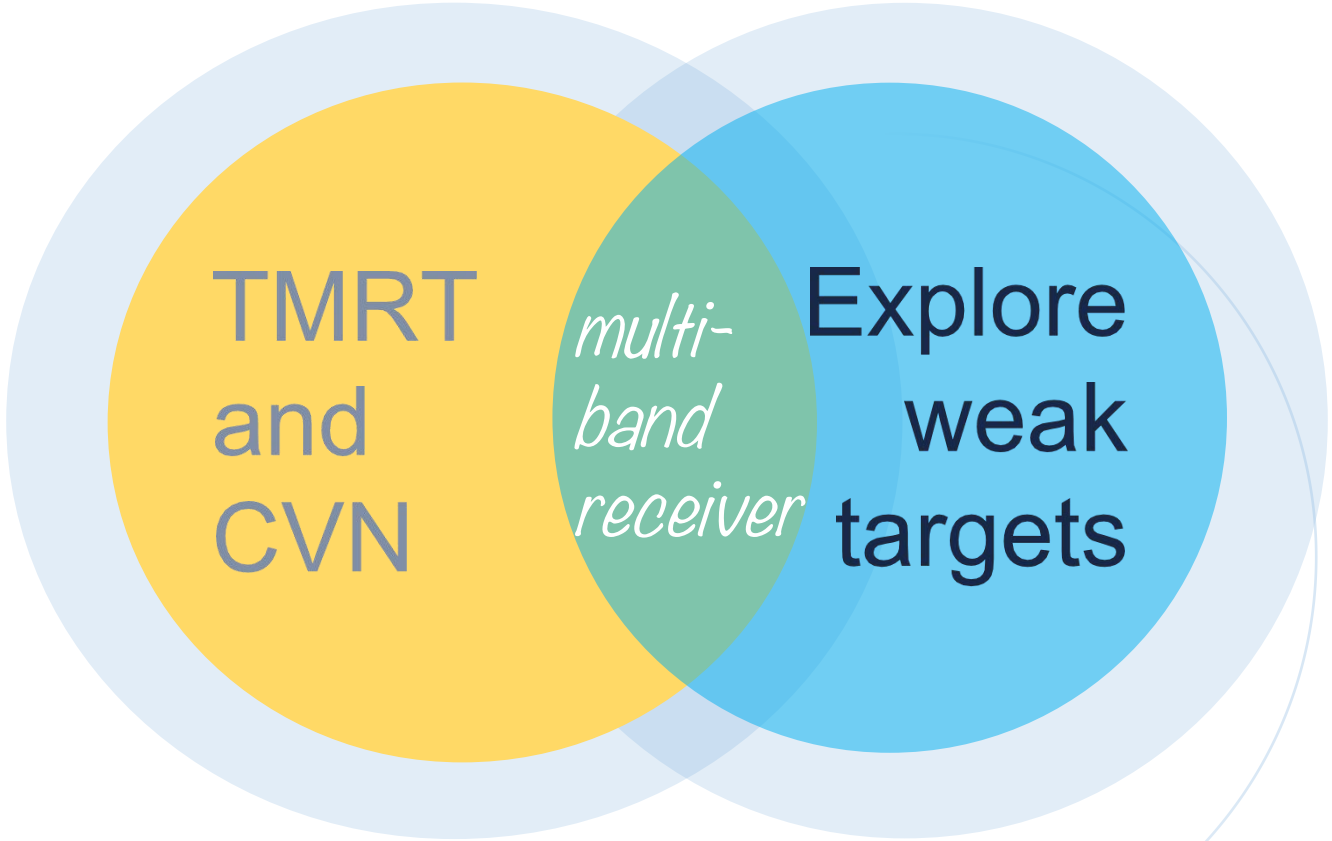
Wang M. et al. 2022

Frequency coverage and Sensitivity

- Freq covering from the P band to W band
- Baseline sensivity ->0.1mJy@60s, imaging sensitivity ->1uJy@8hr

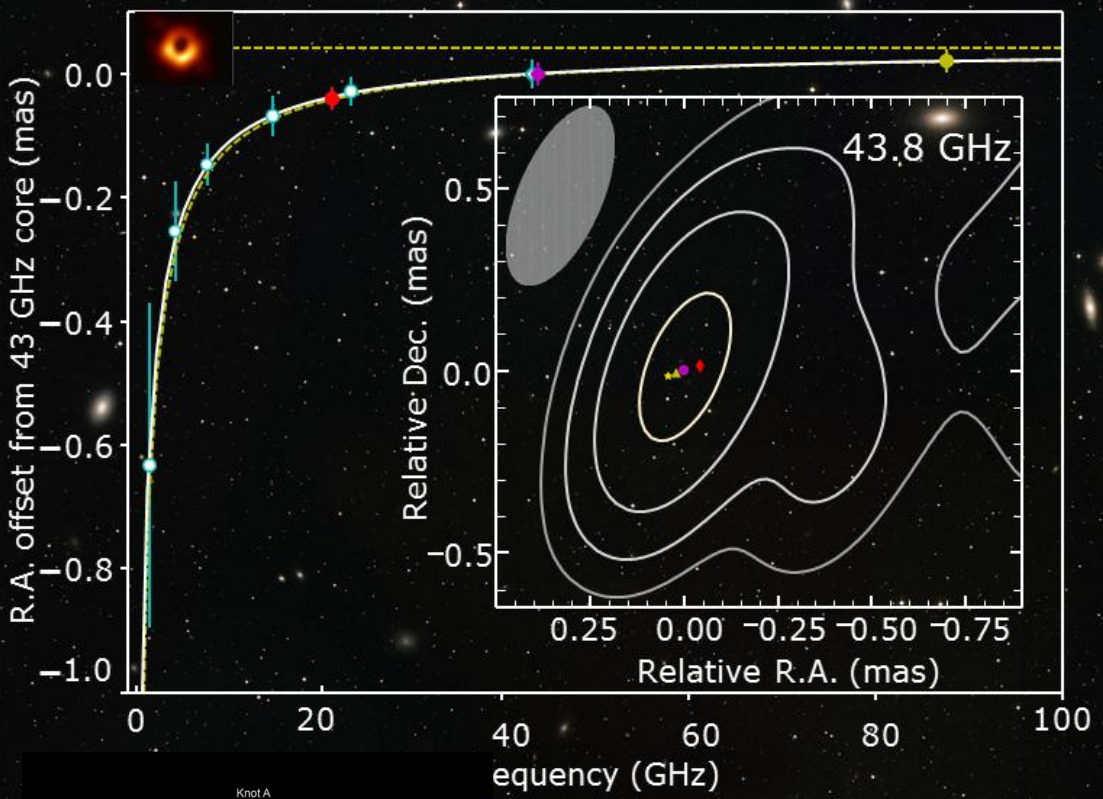


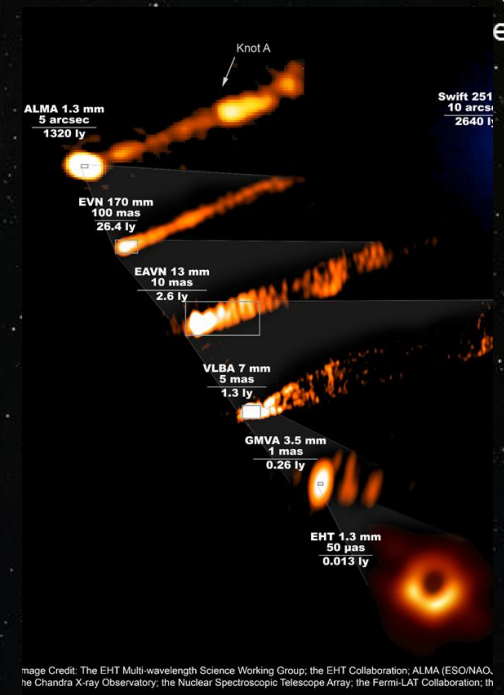
Outline



SFPR on black hole pairs

(Jiang, et al. ApJL, 2021)

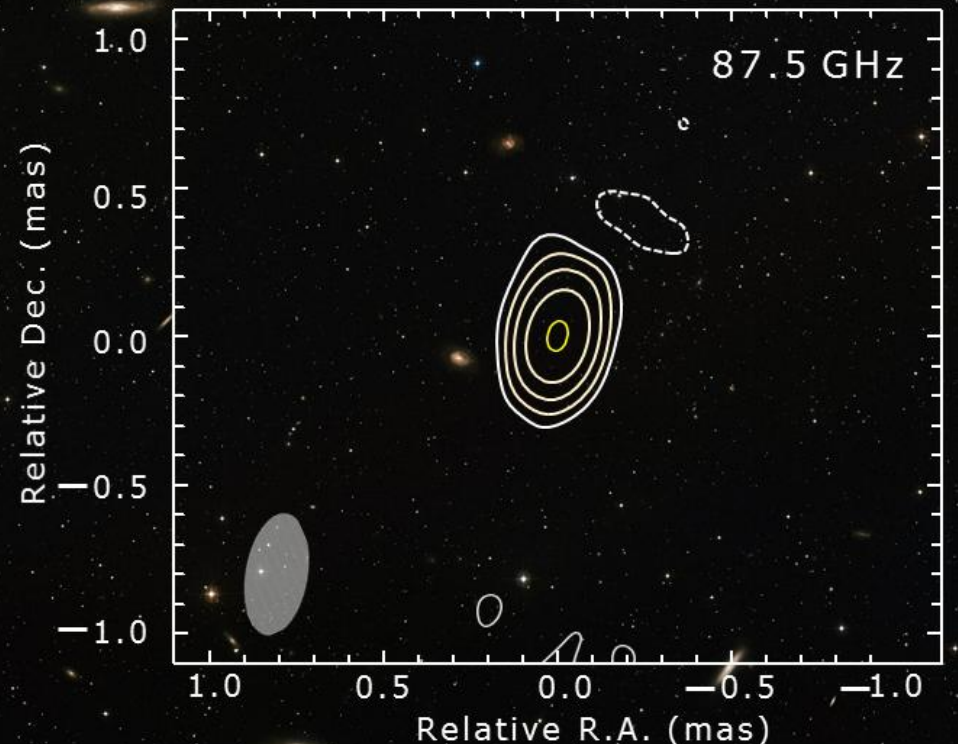




M84

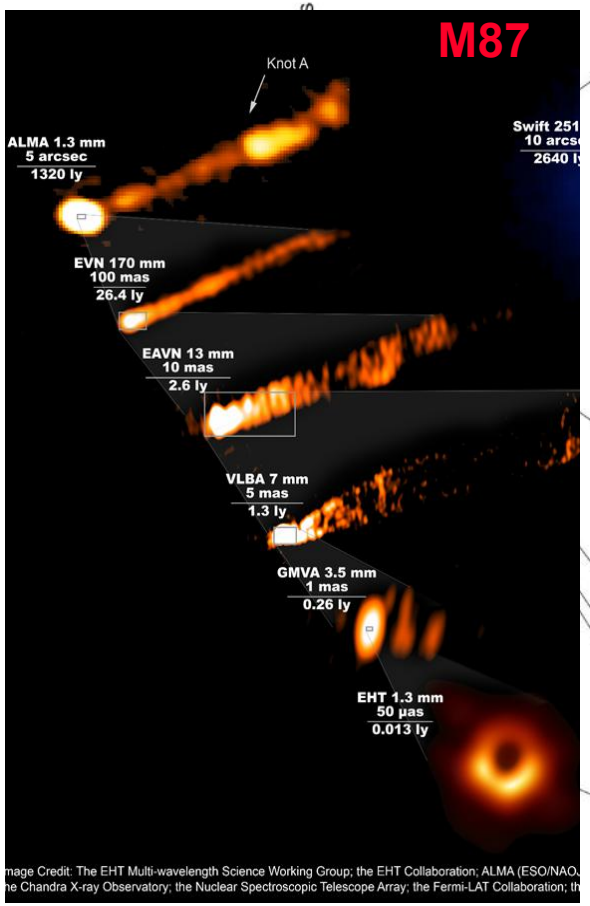
1.5°

M87

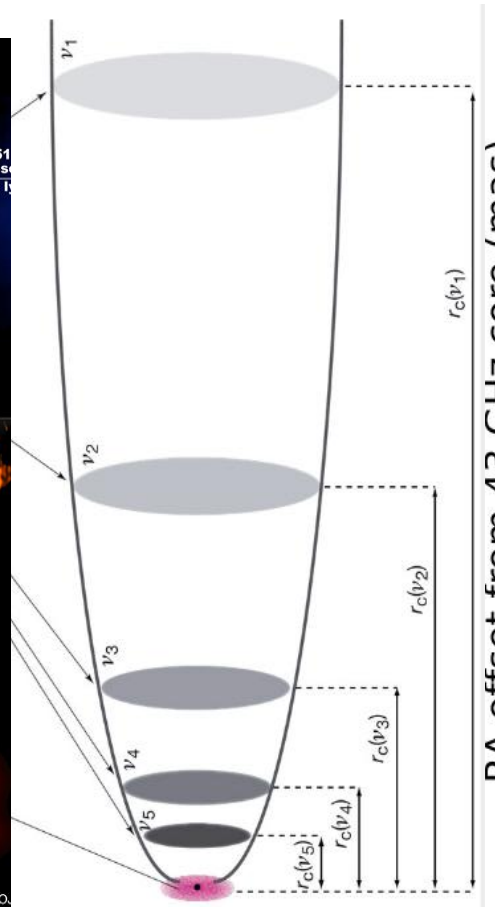


Positioning black hole

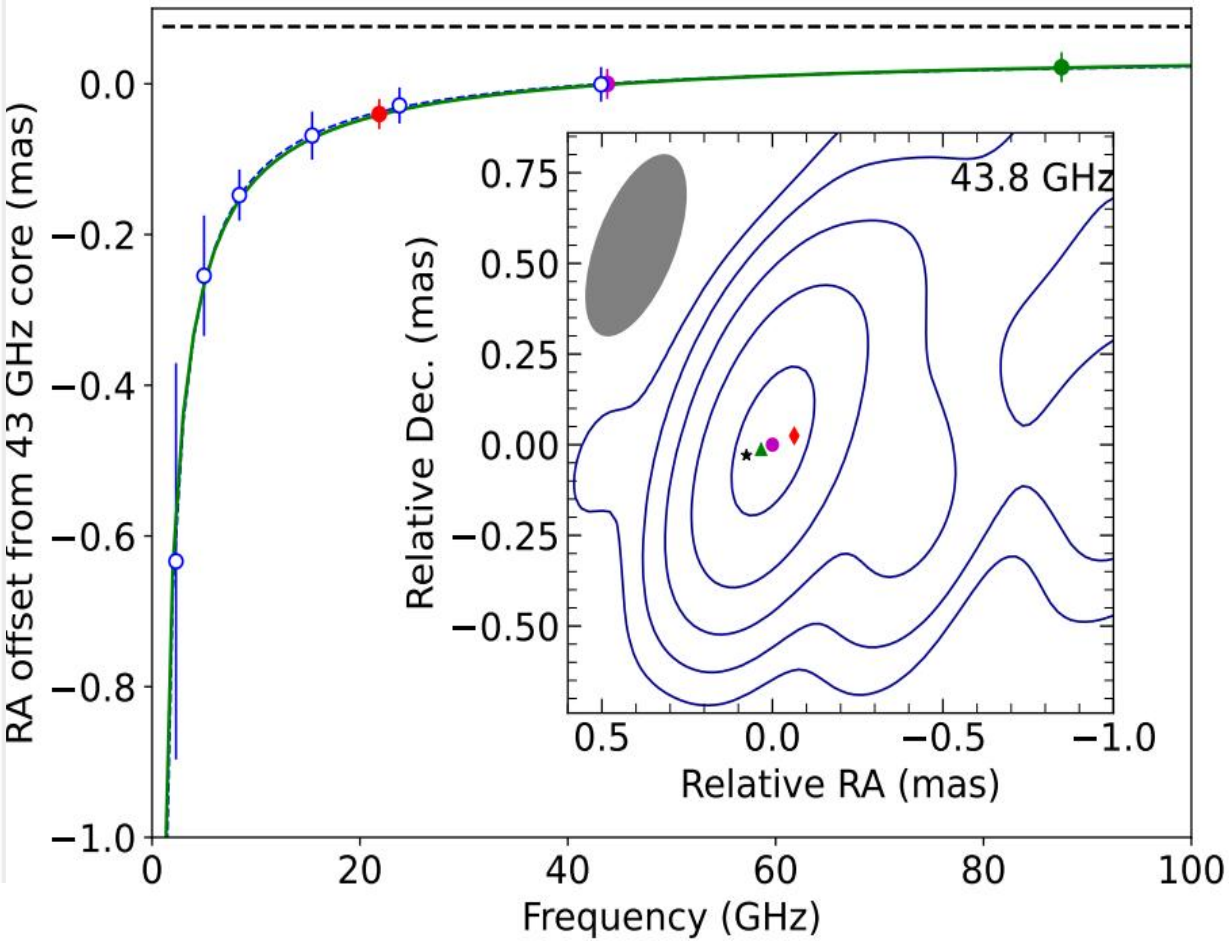
Astrometric precision ~20 uas



EHT MWL et al. 2021

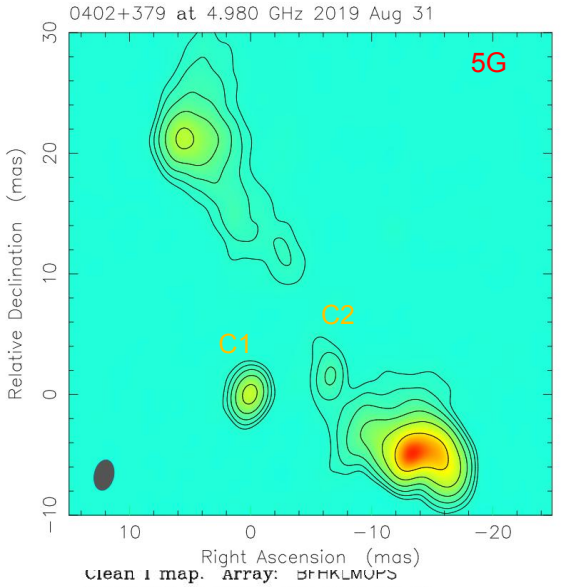


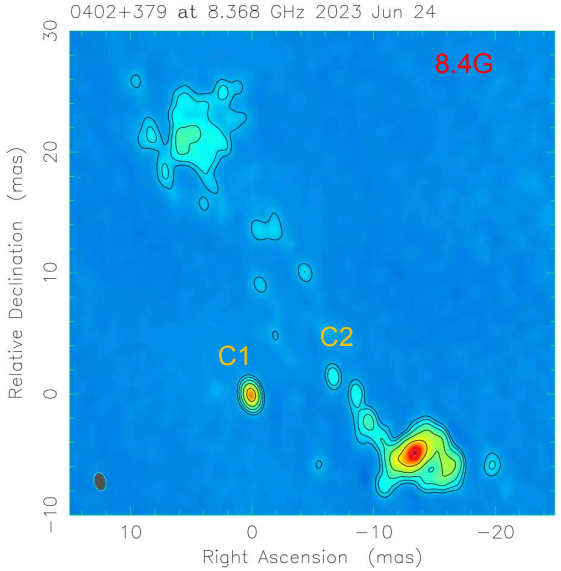
Hada et al. 2011

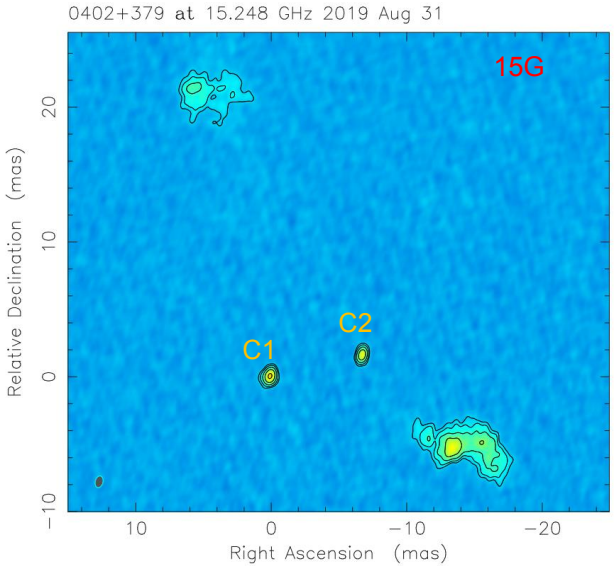


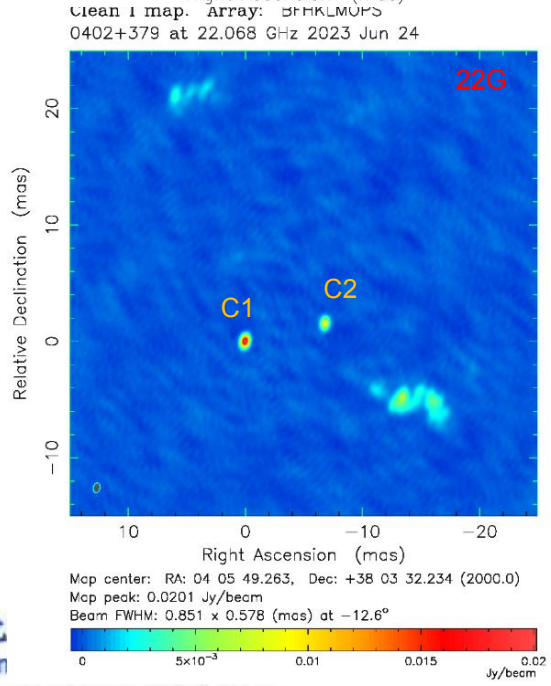
Jiang et al. 2021

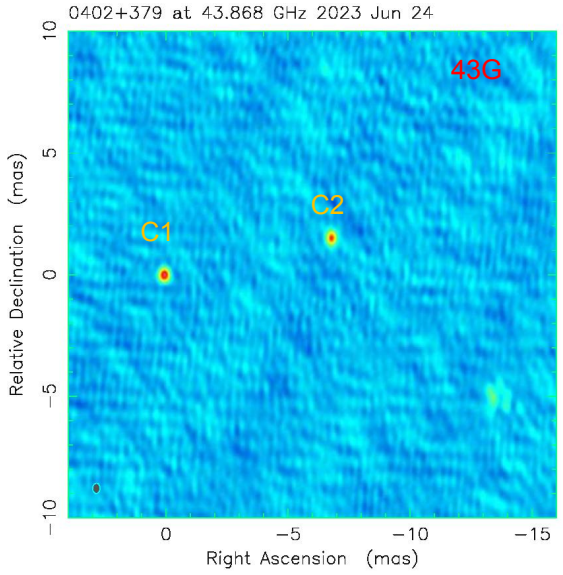
Visual view of BHB 0402+379 at mm-VLBI

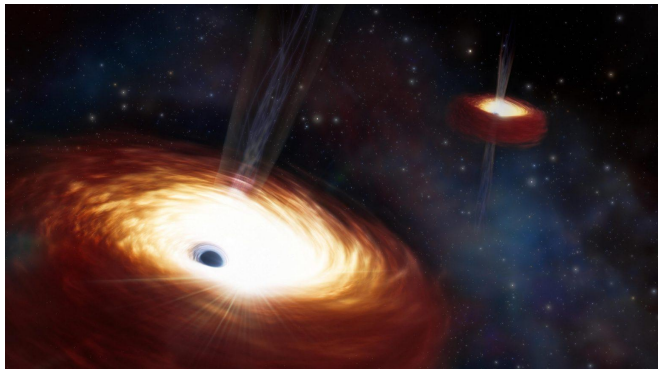








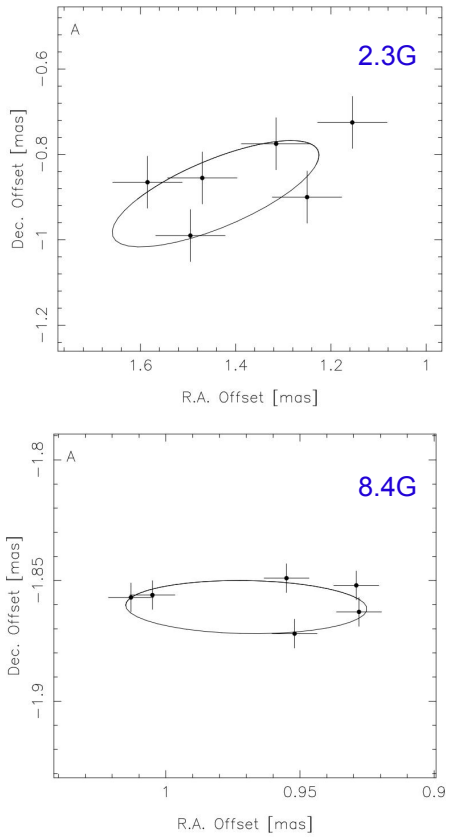




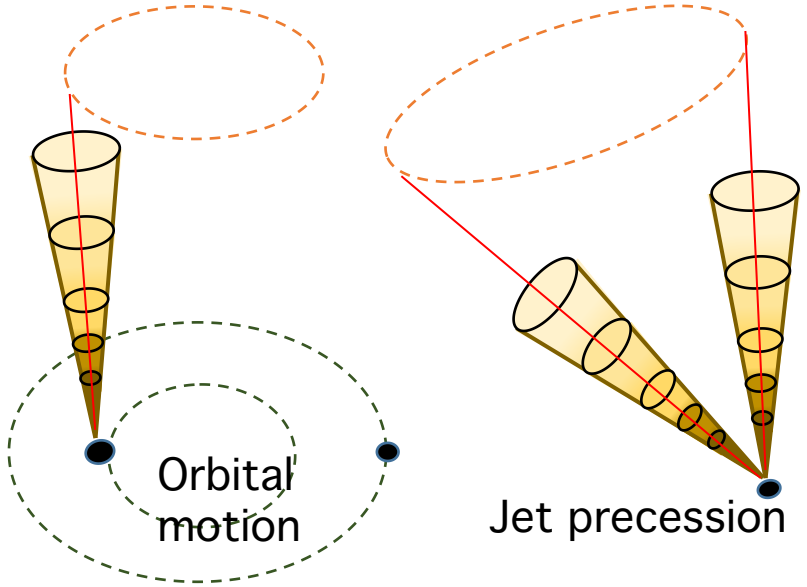
Jiang et al. in prep

3C66B:Jet precession or orbital motion?

SFPR & PR at multi-frequency bands (2.3-88GHz, 7 bands)

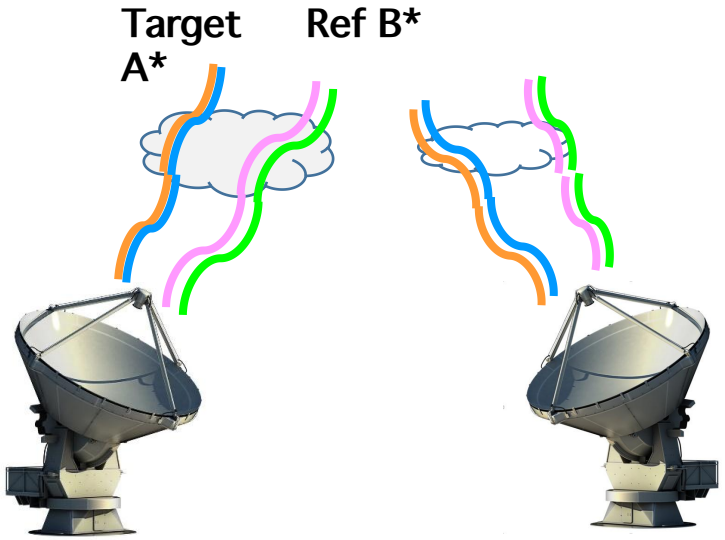


Sudou et al. 2003

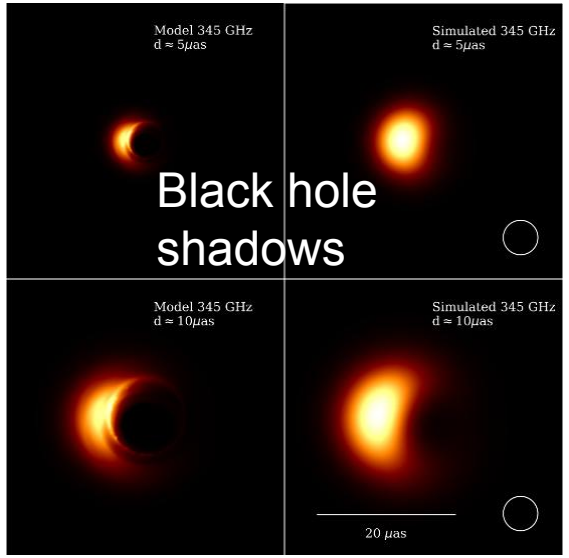


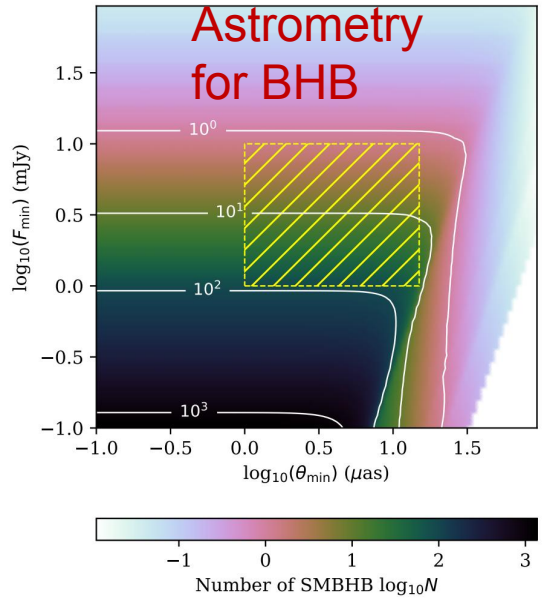
All 4 epochs (2022-2025) were finished.
Jiang W, et al.

SFPR at submm



Source Frequency Phase Reference





Article

Applications of the Source-Frequency Phase-Referencing Technique for ngEHT Observations

Wu Jiang [1,2,*], Guang-Yao Zhao [3,*], Zhi-Qiang Shen [1,2], María J. Rioja [4,5,6], Richard Dodson [4], Ilje Cho [3], Shan-Shan Zhao [1,2], Marshall Eubanks [7] and Ru-Sen Lu [1,2,8]

[1] Shanghai Astronomical Observatory, Chinese Academy of Sciences, Shanghai 200030, China

Summary

- Compact triple band receiver (22/43/86GHz) has being developed for Tianma by 2025.
- CTR will be installed for other two new 40m telescopes of CVN by 2027.
- Great advantages have been demonstrated for interesting scientific targets e.g. black hole pairs / binaries.
- Collaborations both in technology and sciences are welcome.

Thank you for your attention!