



TOWARDS
HIGH-PERFORMANCE
mm-VLBI
SCIENCE OPERATIONS
WITH MULTI-BAND RECEIVERS

AREA DELLA RICERCA CNR-INAf
VIA GOBETTI 101, BOLOGNA

28 – 31 OCTOBER 2025

INVITED SPEAKERS

Pietro Bolli (INAF-OAA)

Alberto Colombo (INFN)

Pablo de Vicente (Yebes Observatory, IGN)

Richard Dodson (ICRAR)

Mareki Honma (NAOJ)

Giulia Illuminati (INFN)

Hiroshi Imai (Kagoshima University)

Taehyun Jung (KASI)

Wu Jiang (Shanghai Astronomical Observatory)

Micheal Lindqvist (Onsala Space Observatory)

Tuomas Savolainen (Aalto University)

Roberta Zanin (CTAO)

Guang-Yao Zhao (MPFIR)

SCIENTIFIC ORGANIZING COMMITTEE

Marcello Giroletti (chair) | John Conway

Federica Govoni | Andrei Lobanov

María Rioja | Eduardo Ros

Bong Won Sohn | Corrado Trigilio

Tiziana Venturi (co-chair)

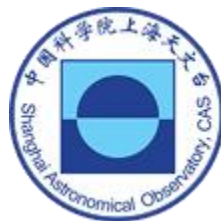
LOCAL ORGANIZING COMMITTEE

Marcello Giroletti | Rocco Lico

Cristiana Spingola | Matteo Stagni

Alice Tabellini | Tiziana Venturi

IMAGE CREDITS: MIT, DOUBLESLIT EXPERIMENT



中国科学院上海天文台

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

Wu Jiang (SHAO)

in collaboration with

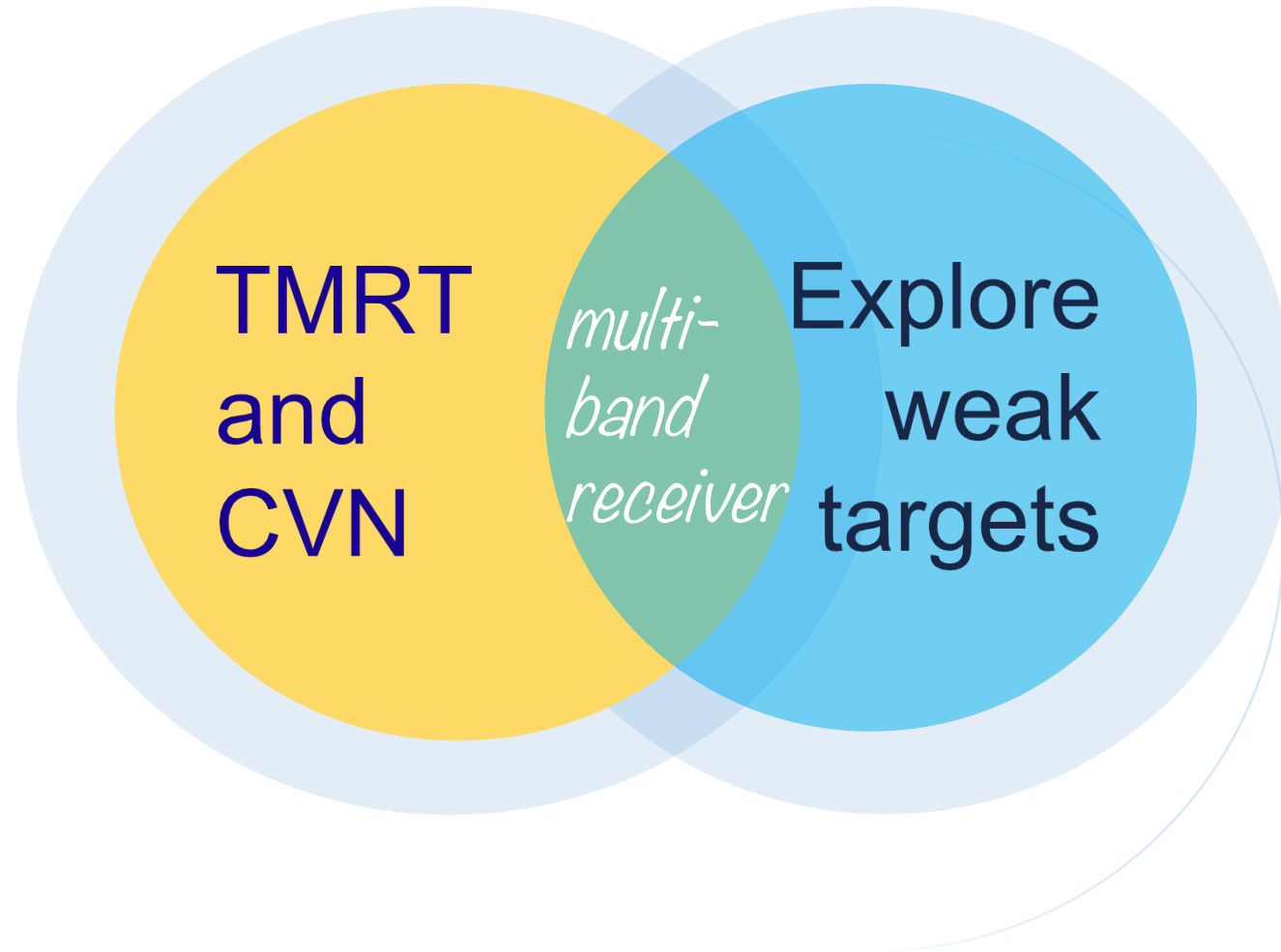
Zhiqiang Shen, Weiye Zhong, Bin Li, Shan-Shan Zhao (SHAO)

Ivan Martí-Vidal (Univ. Valencia), Guangyao Zhao (MPIfR), María Rioja, Richard Dodson (ICRAR), Ilje Cho (KASI) and others

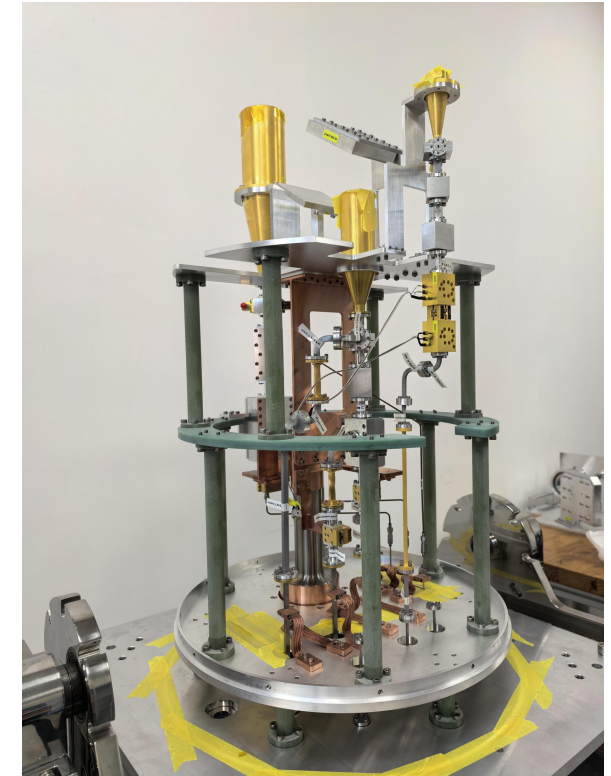
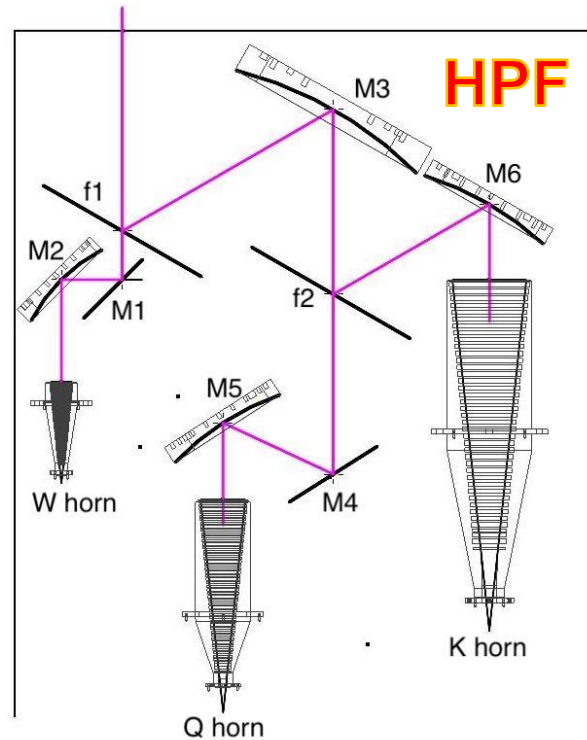
2025/10/28



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

Diameter 40m

Surface RMS < 0.3mm

Efficiency > 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

日喀则, ZF

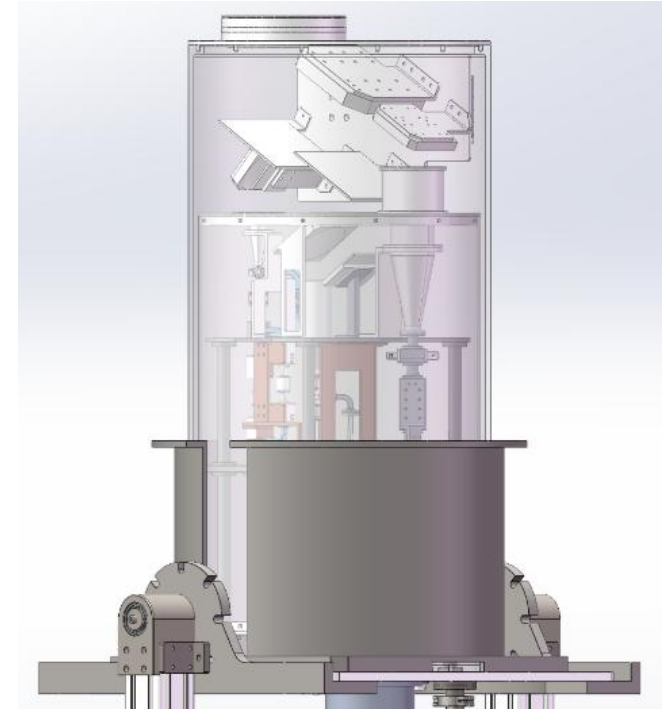
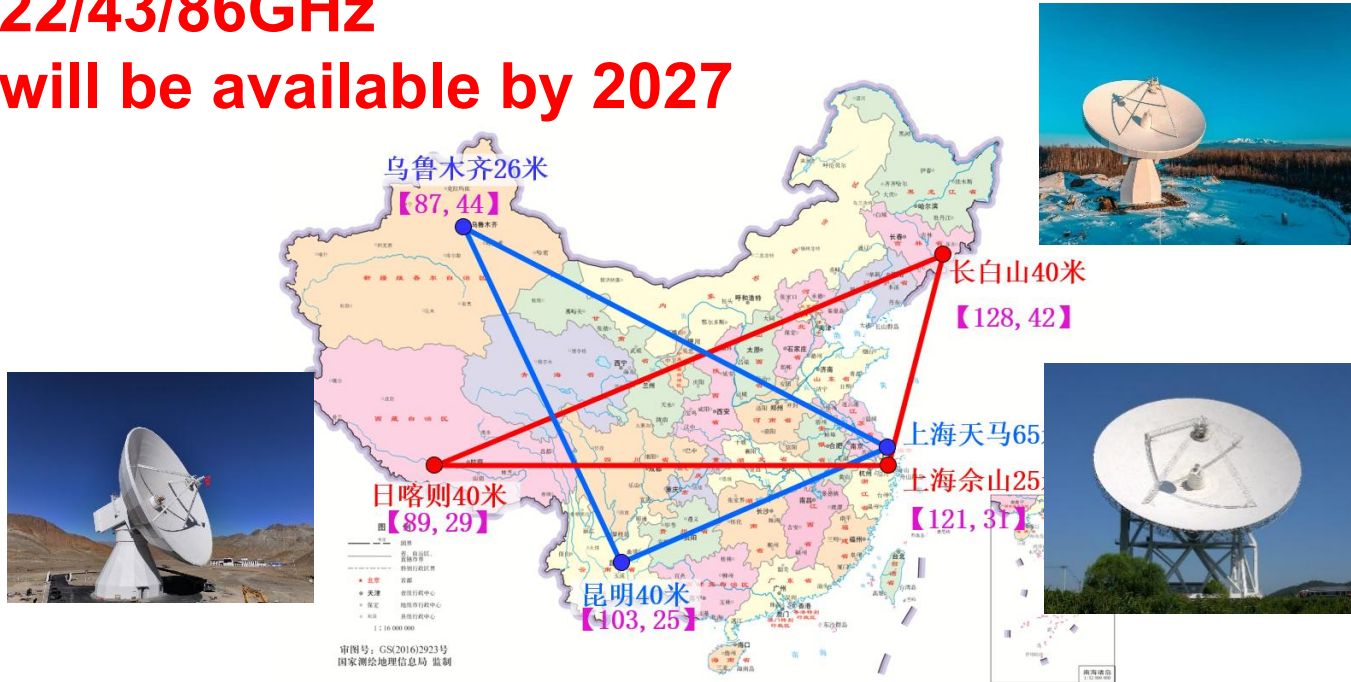


长白山, CB



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



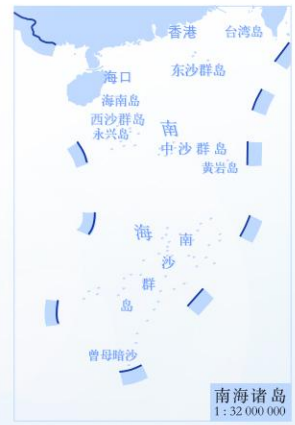

上海
VLBI中心

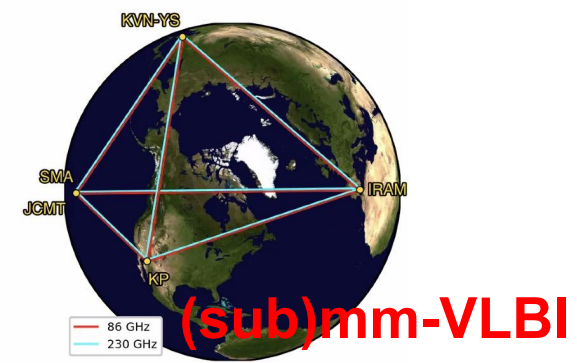


云南昆明
40m



上海佘山
25m





Correlator

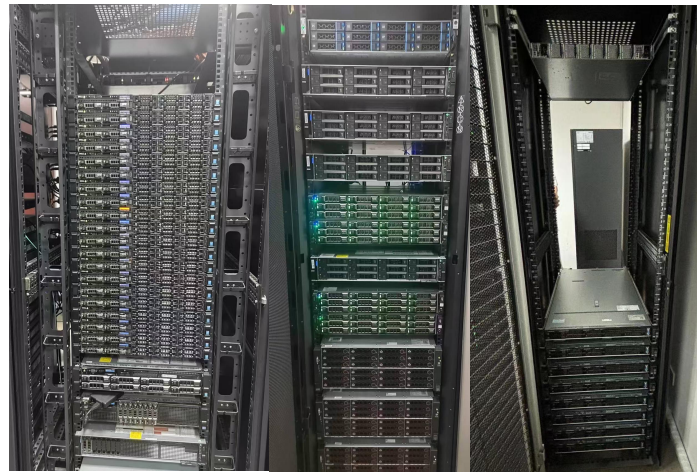
DiFX-2.6.2

Post processing

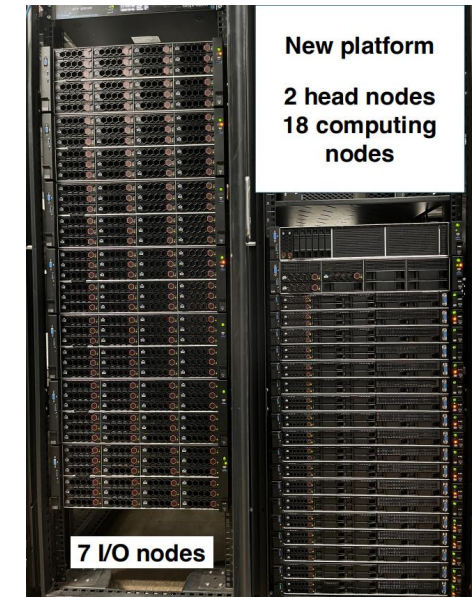
HOPS-3.22



2014, 400 cores, 430TB



2025 Astrophysics
+800 cores, 2PB



Geodesy
864 cores, 3.6PB



Two new 100+ m telescopes under building

Diameter **110m**

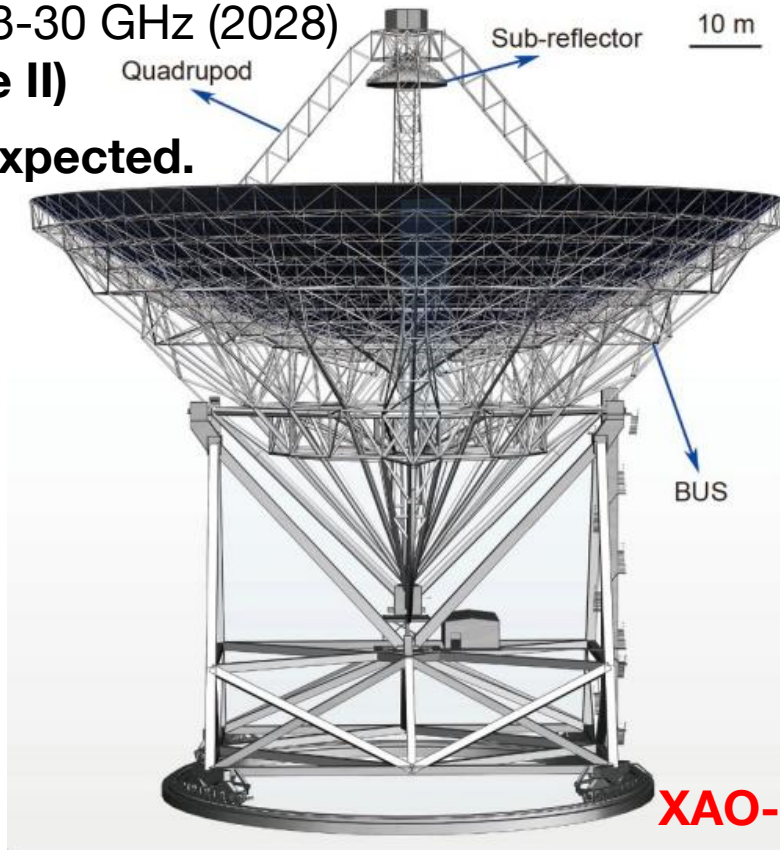
Surface RMS < 0.2mm

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

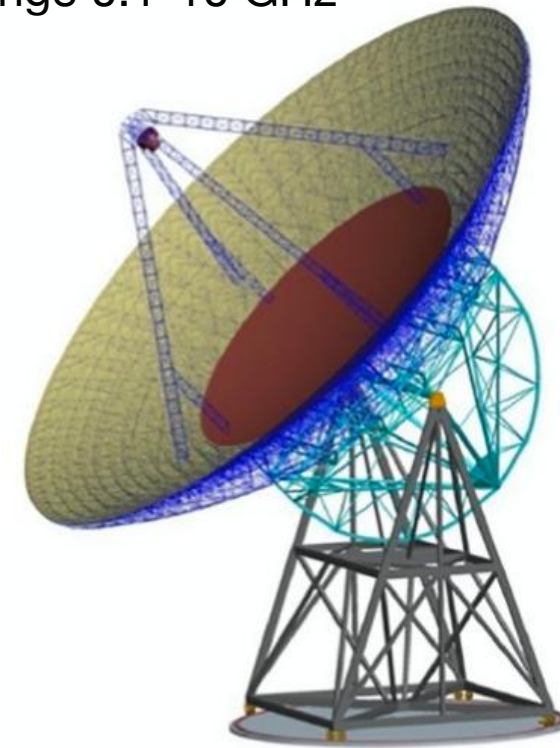
Diameter **120m**

Surface RMS < 3mm

Efficiency > 60%

Pointing < 10 arcsec

Freq range 0.1-10 GHz

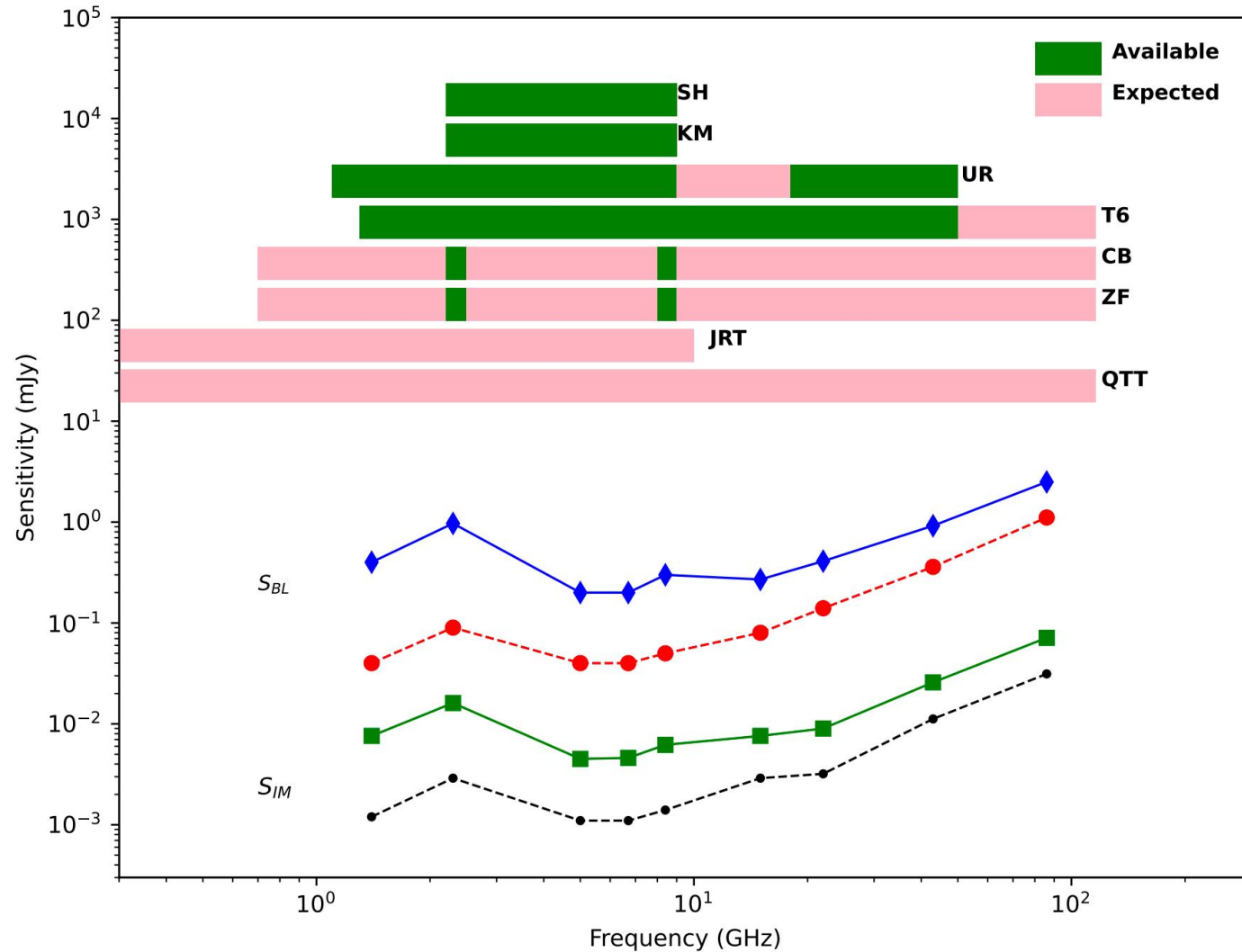


YNAO-景东, JDT

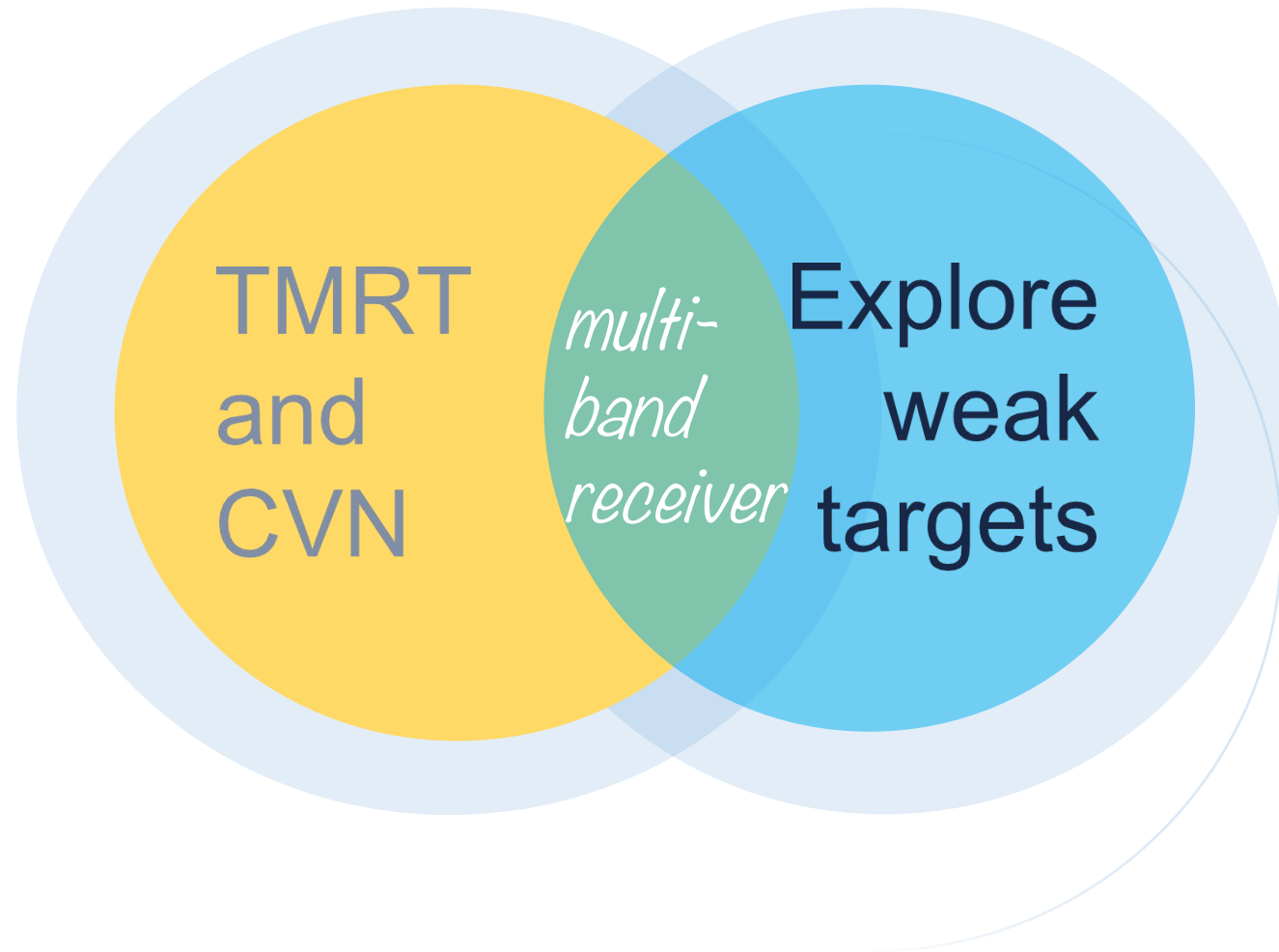
Wang M. et al. 2022

Frequency coverage and Sensitivity

- Freq covering from the P band to W band
- Baseline sensitivity $\rightarrow 0.1 \text{ mJy@60s}$, imaging sensitivity $\rightarrow 1 \text{ uJy@8hr}$

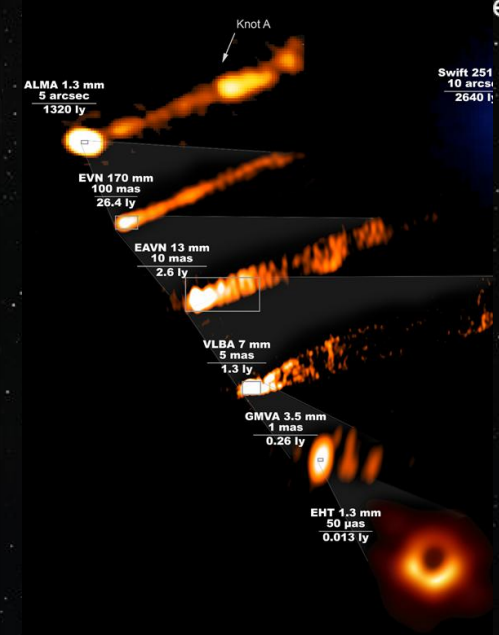
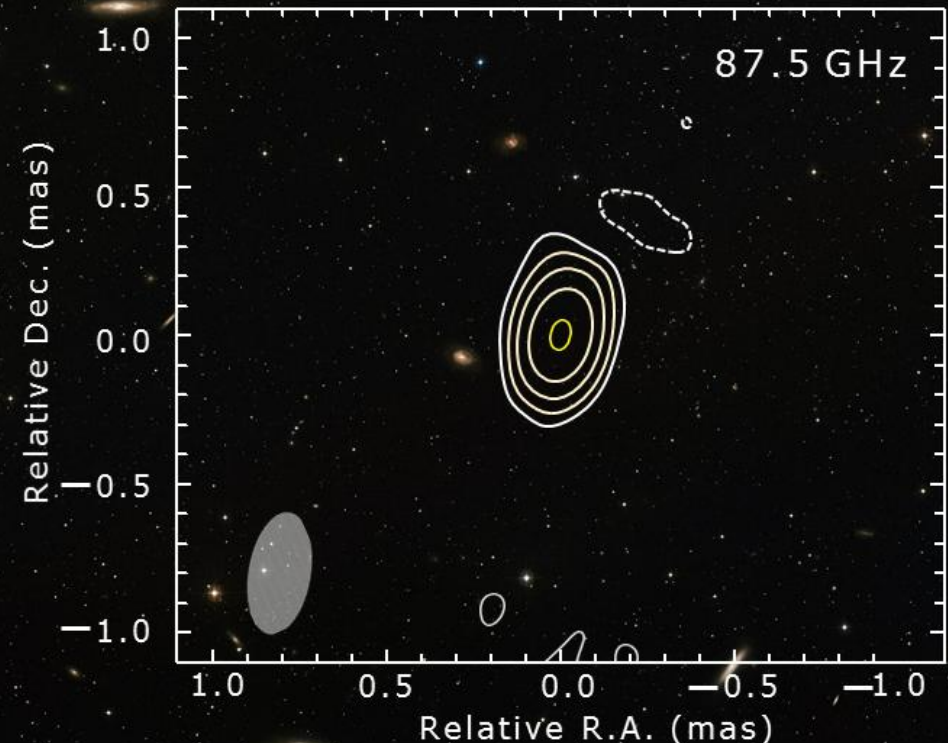
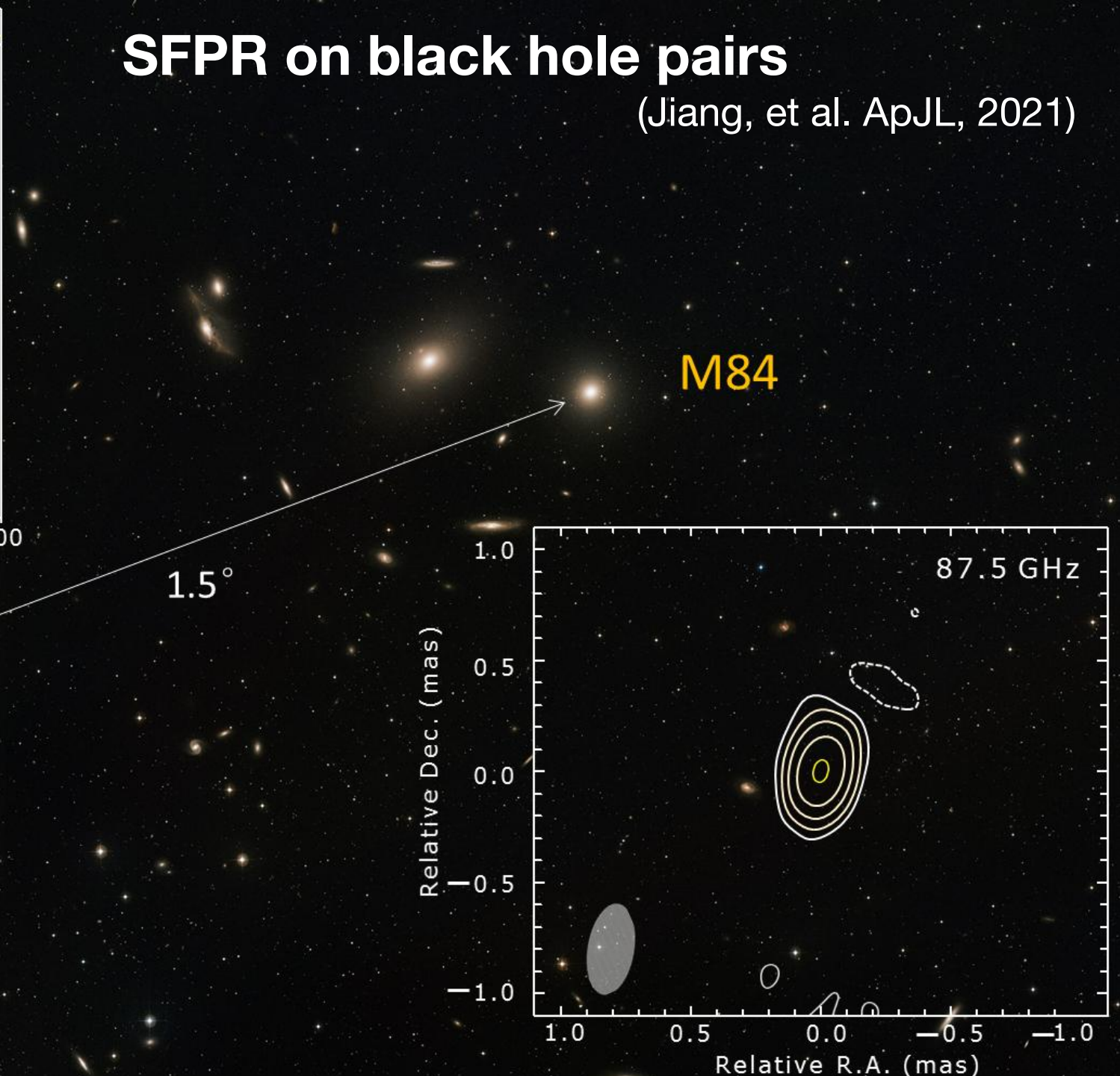
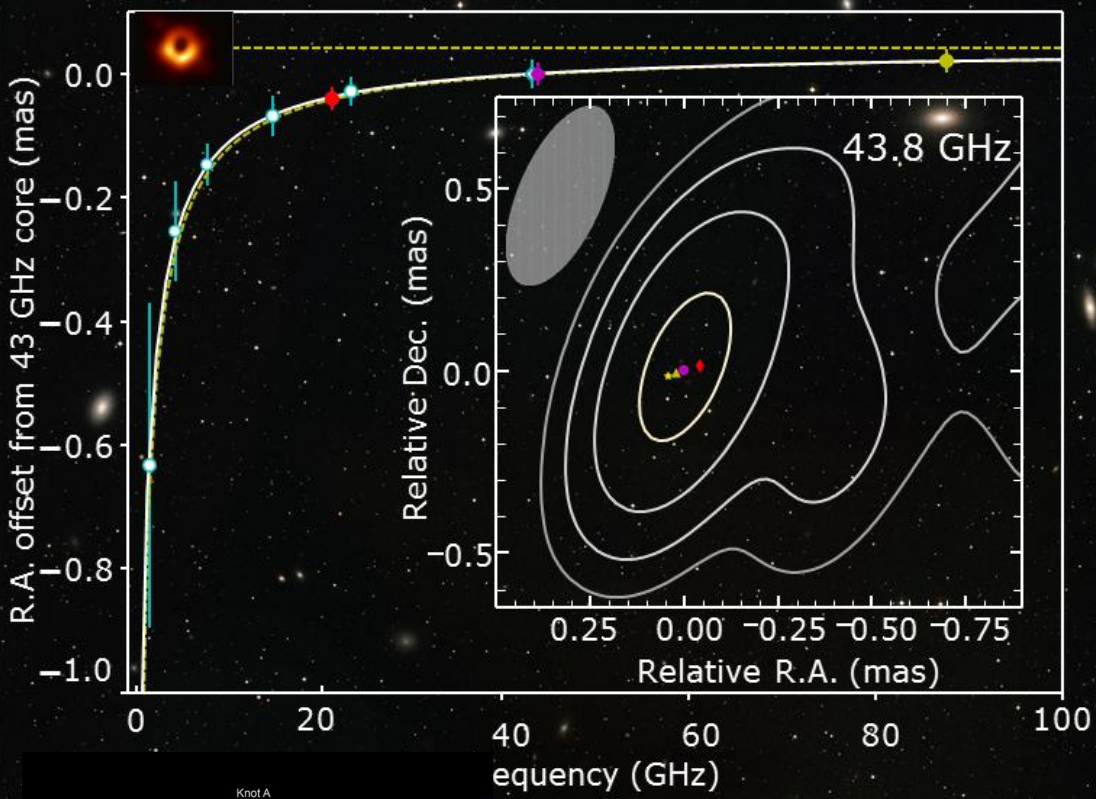


Outline



SFPR on black hole pairs

(Jiang, et al. ApJL, 2021)

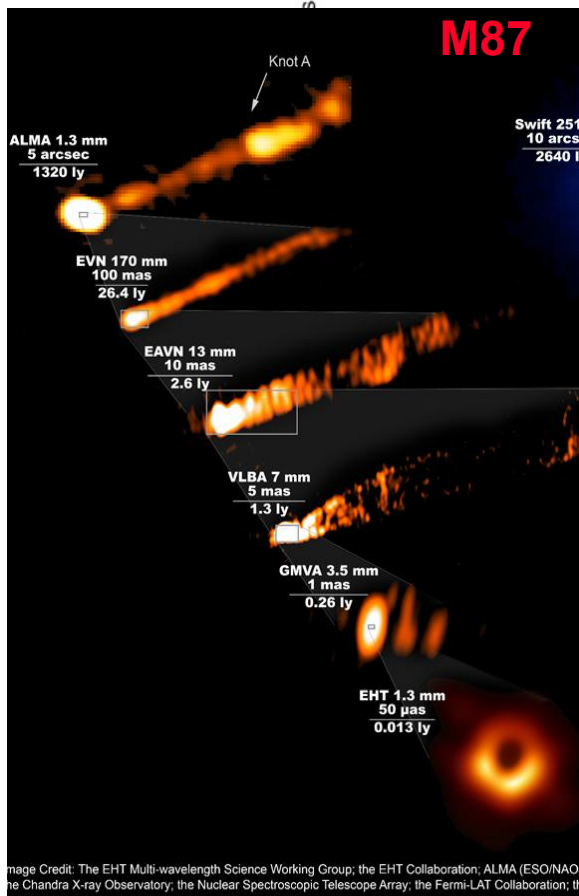


M87

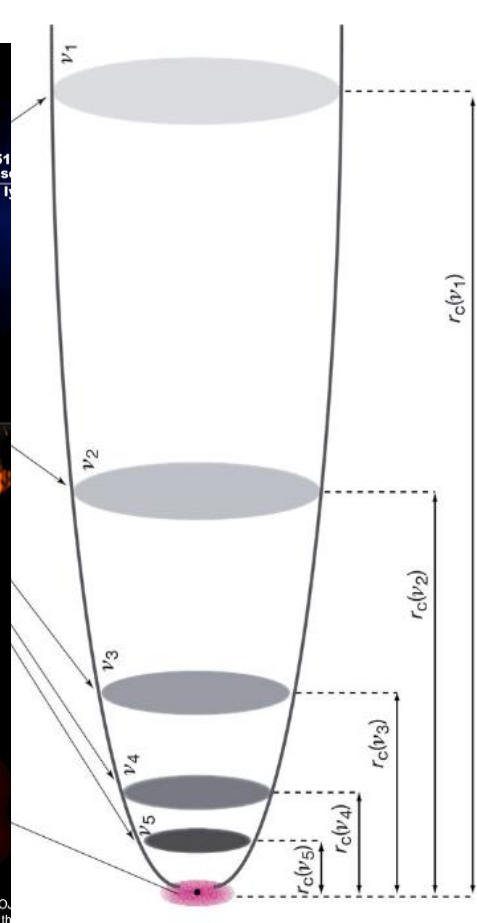
Image Credit: The EHT Multi-wavelength Science Working Group; the EHT Collaboration; ALMA (ESO/NAOJ/CNRS in cooperation with the European Southern Observatory); the Chandra X-ray Observatory; the Nuclear Spectroscopic Telescope Array; the Fermi-LAT Collaboration; the

Positioning black hole

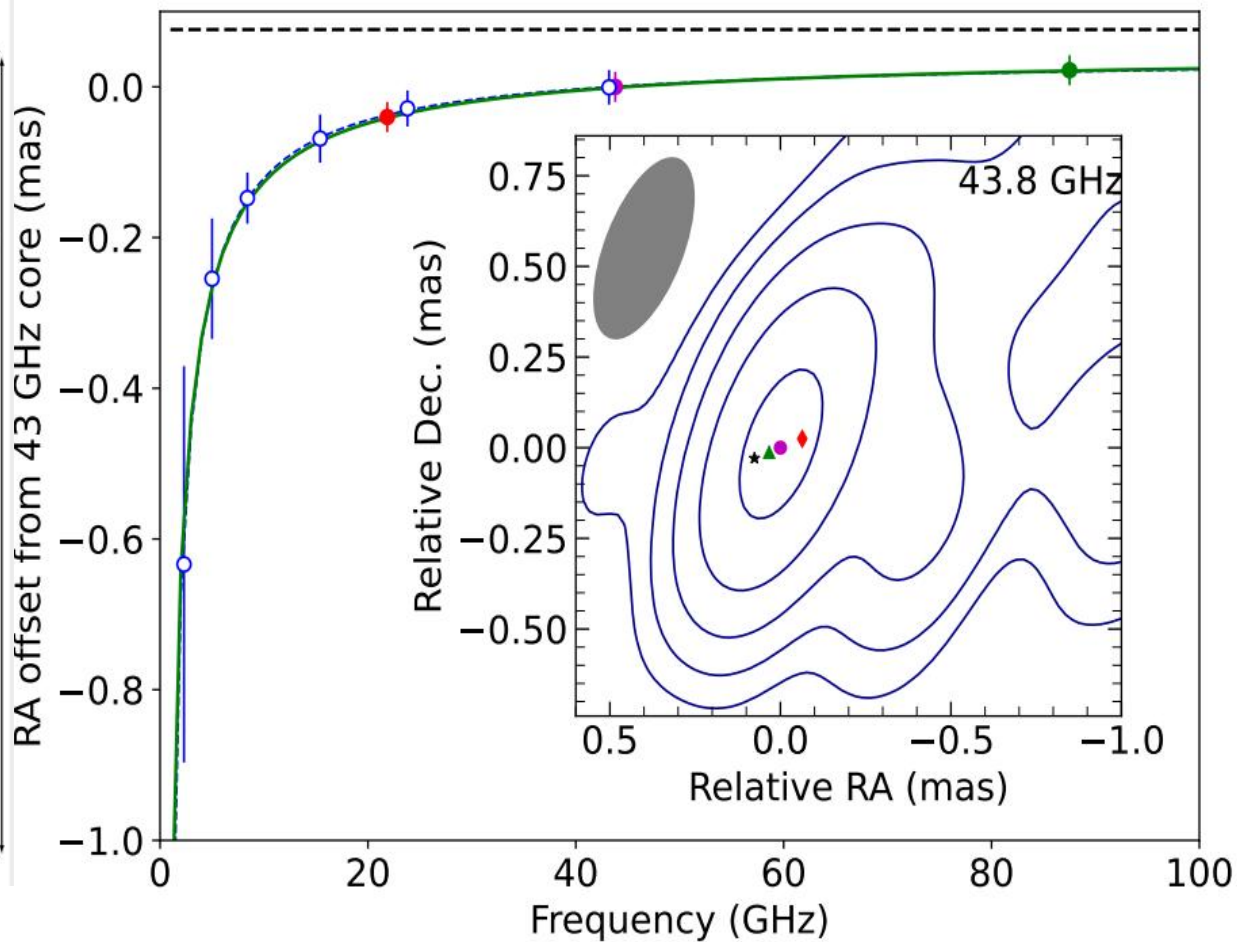
Astrometric precision $\sim 20 \mu\text{as}$



EHT MWL et al. 2021

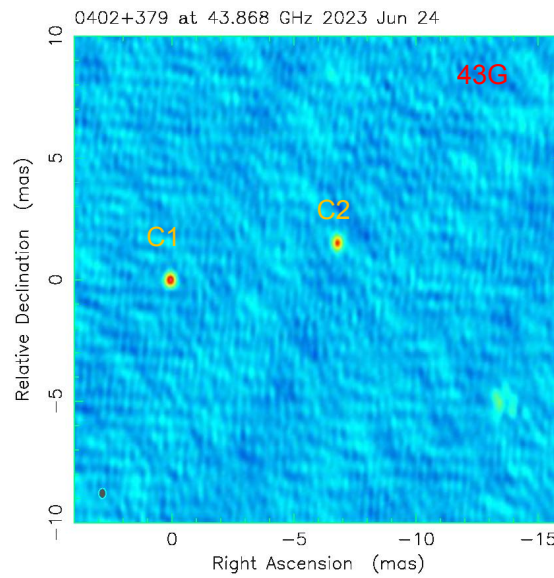
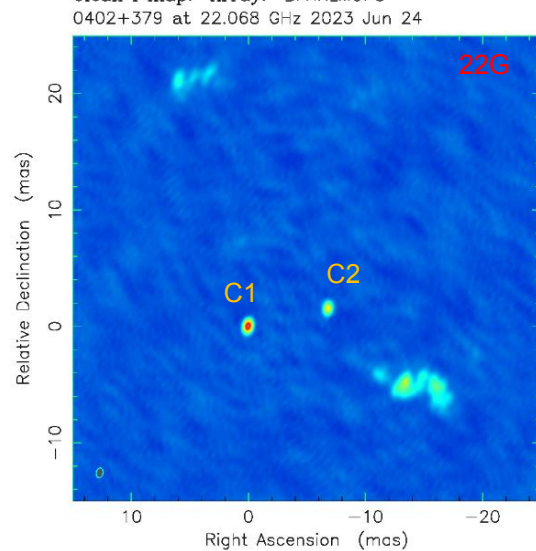
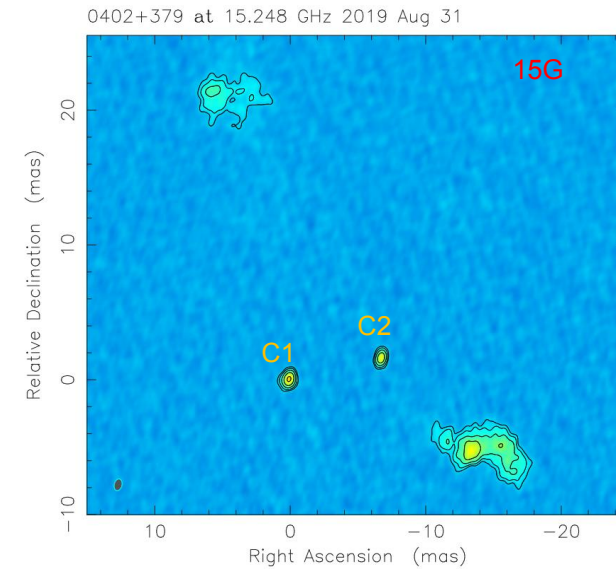
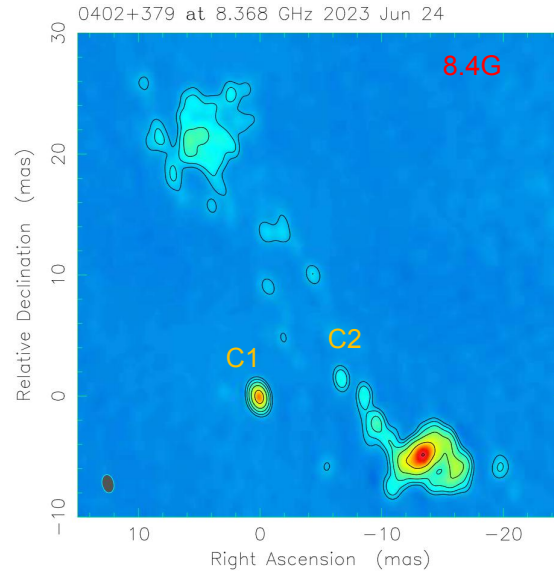
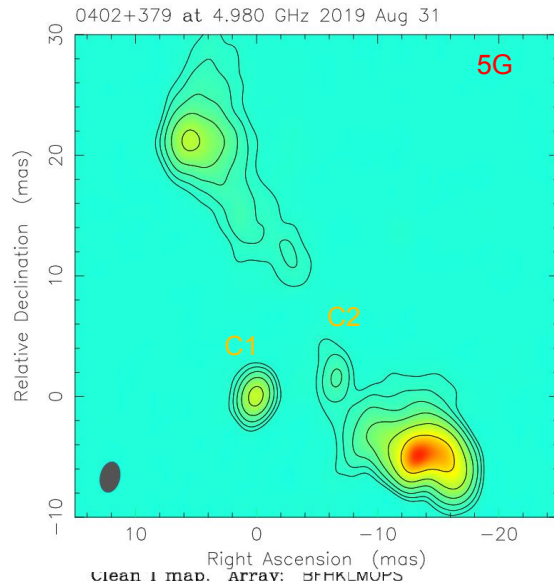


Hada et al. 2011



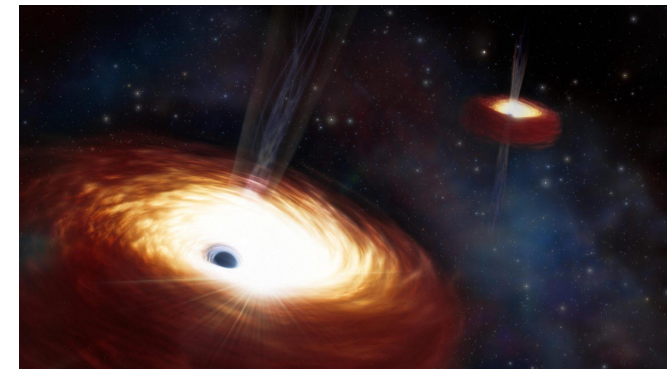
Jiang et al. 2021

Visual view of BHB 0402+379 at mm-VLBI



Mcp center: RA: 04 05 49.263, Dec: +38 03 32.234 (2000.0)
Mcp peak: 0.0201 Jy/beam
Beam FWHM: 0.851 x 0.578 (mas) at -12.6°

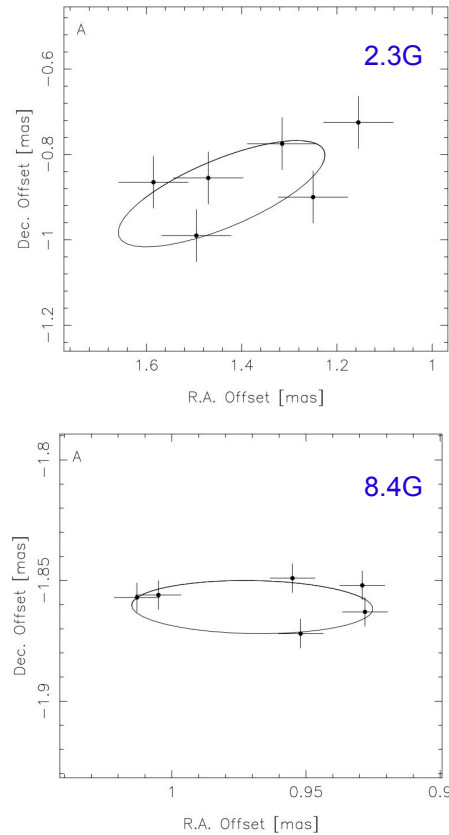
0 5x10⁻³ 0.01 0.015 0.02
Jy/beam



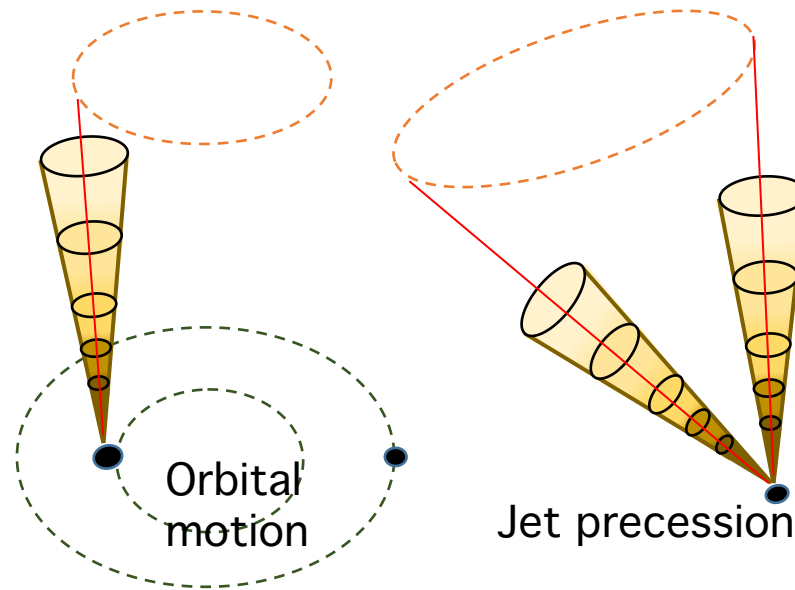
Jiang et al. in prep

3C66B: Jet precession or orbital motion?

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

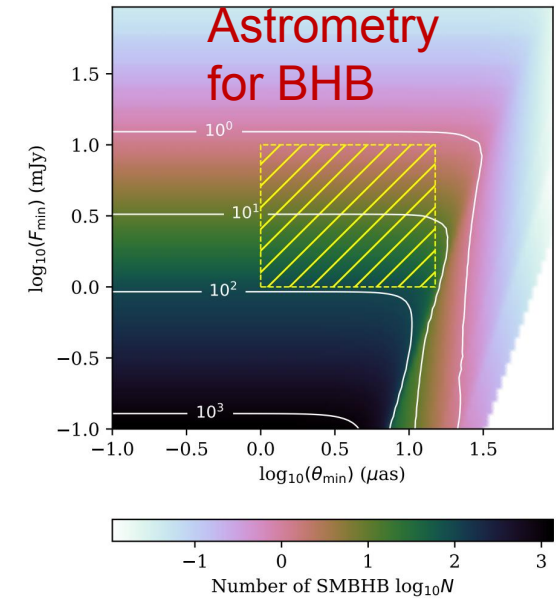
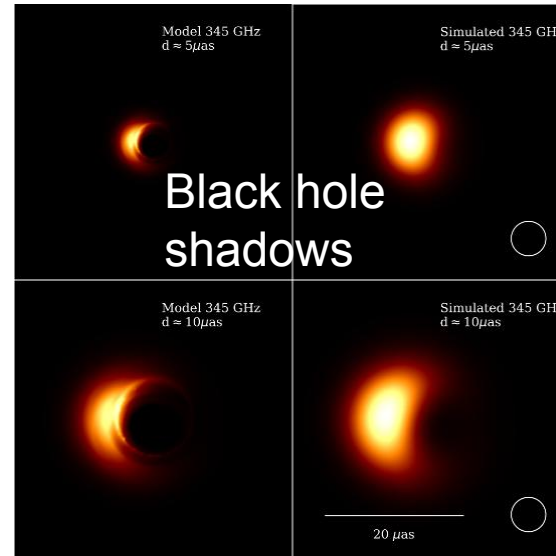
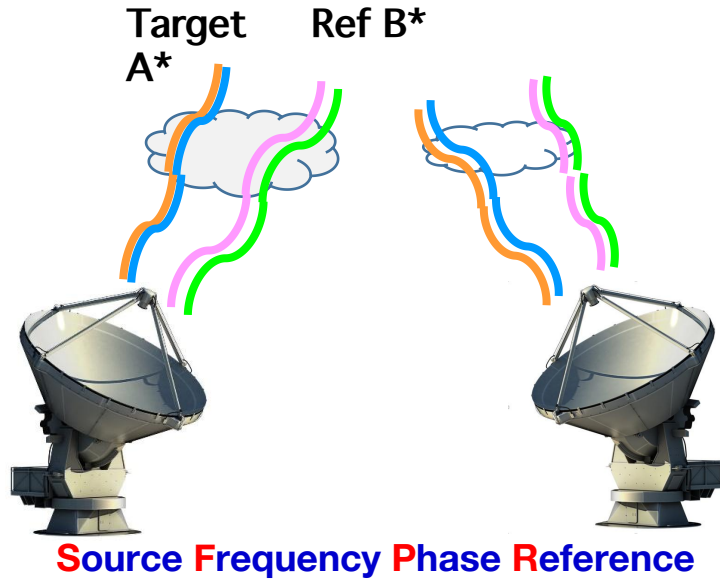


Sudou et al. 2003












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

SFPR at submm



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 Dodson⁴ , Ilje Cho³ ,
Shan-Shan Zhao^{1,2} , Marshall Eubanks⁷  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 been 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!