Extended KVN Project

Do-Young Byun (KASI)

17 Jan 2022

- Survey Science Group Workshop 2023

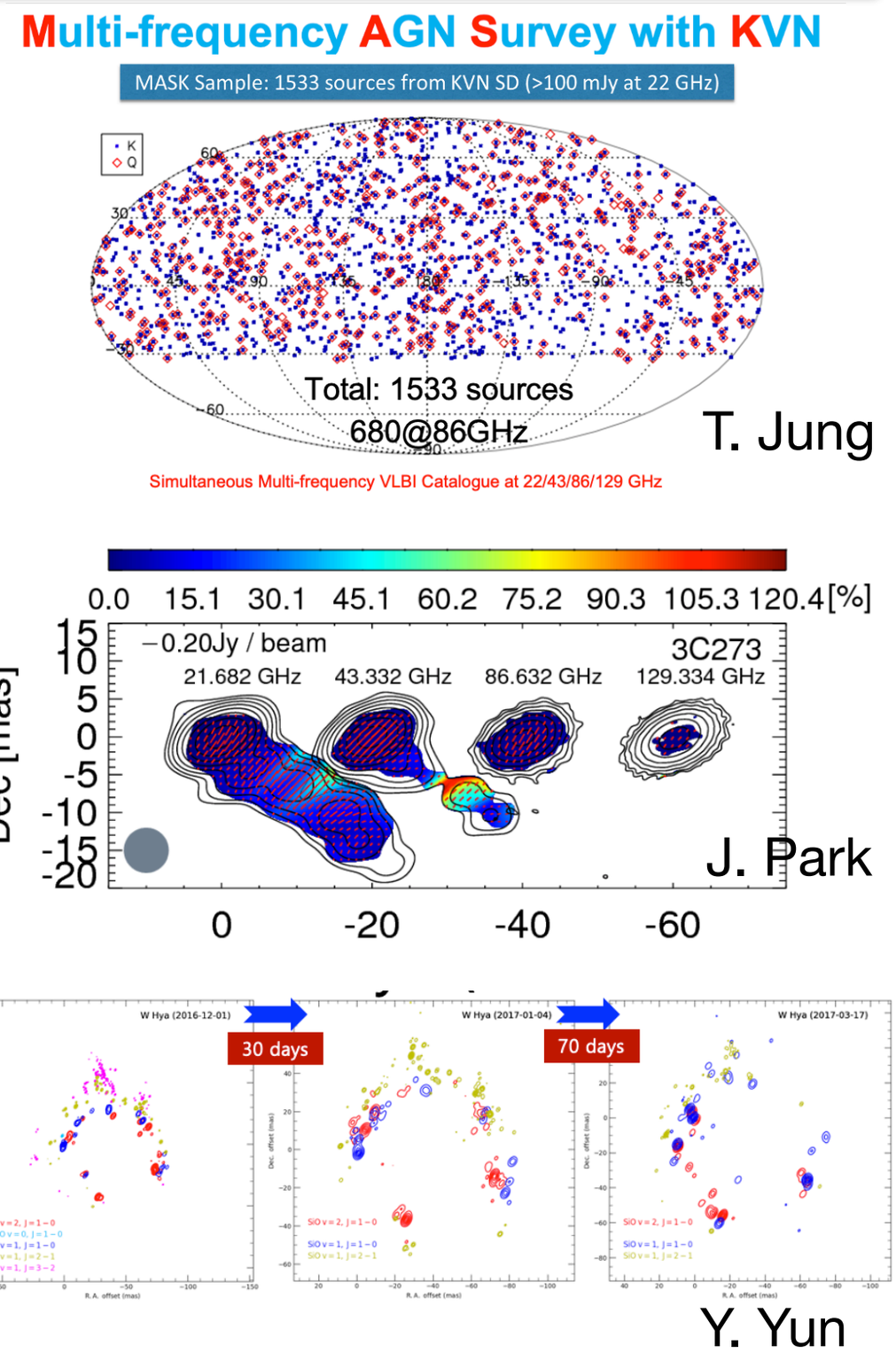
Korean VLBI Network

- First VLBI facility in Korea
- Three 21m antennas
- First simultaneous multi-frequency (22/43/86/129 GHz) receiving system
- EAVN, EVN, GMVA



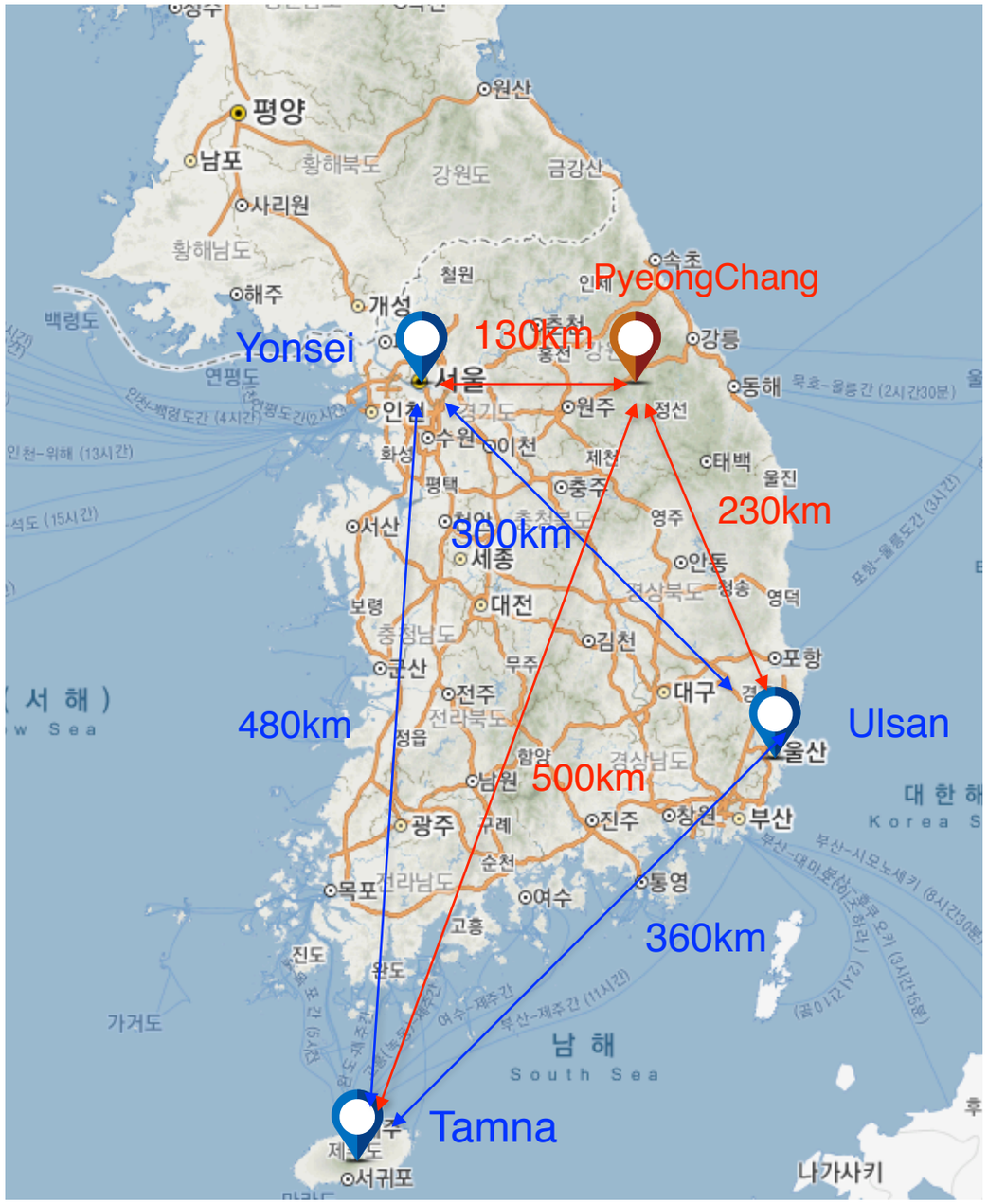
(E)KVN Sciences

- Weak Source Detection
  - using Freq. Phase Transfer
  - 680 sources @ 86GHz
- Wideband Polarization to understand AGN Jets
  - Rotation Measure
- Mass loss of late-type stars using multi-frequency maser images
  - Chromatic Astrometry
- New results in 86 and 129GHz but Limitation due to lack of baselines



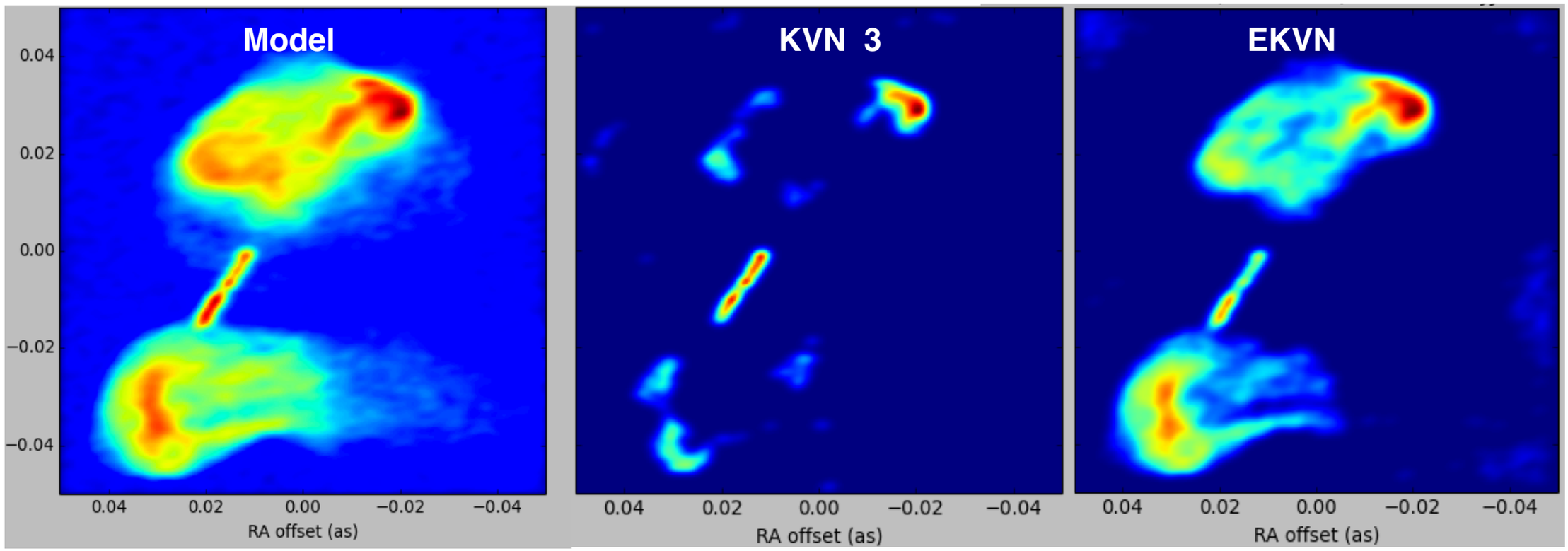
Extended KVN Project

- Upgrade KVN performance & Science using M/F VLBI
  - 1st Phase (2020~ 2023)
    - Construction of KVN 4th Telescope
      - 100-200 km baselines
      - 230GHz Operation
    - Multi-frequency receivers
      - CTR (22/43/86GHz-bands)
      - 150/230GHz SIS mixer receiver
    - New GPU-base VLBI Correlator
  - 2nd Phase (2024 ~ 2027)
    - 3rd generation KVN Key Science
    - Global MF Network
    - 230GHz Upgrade of KVN



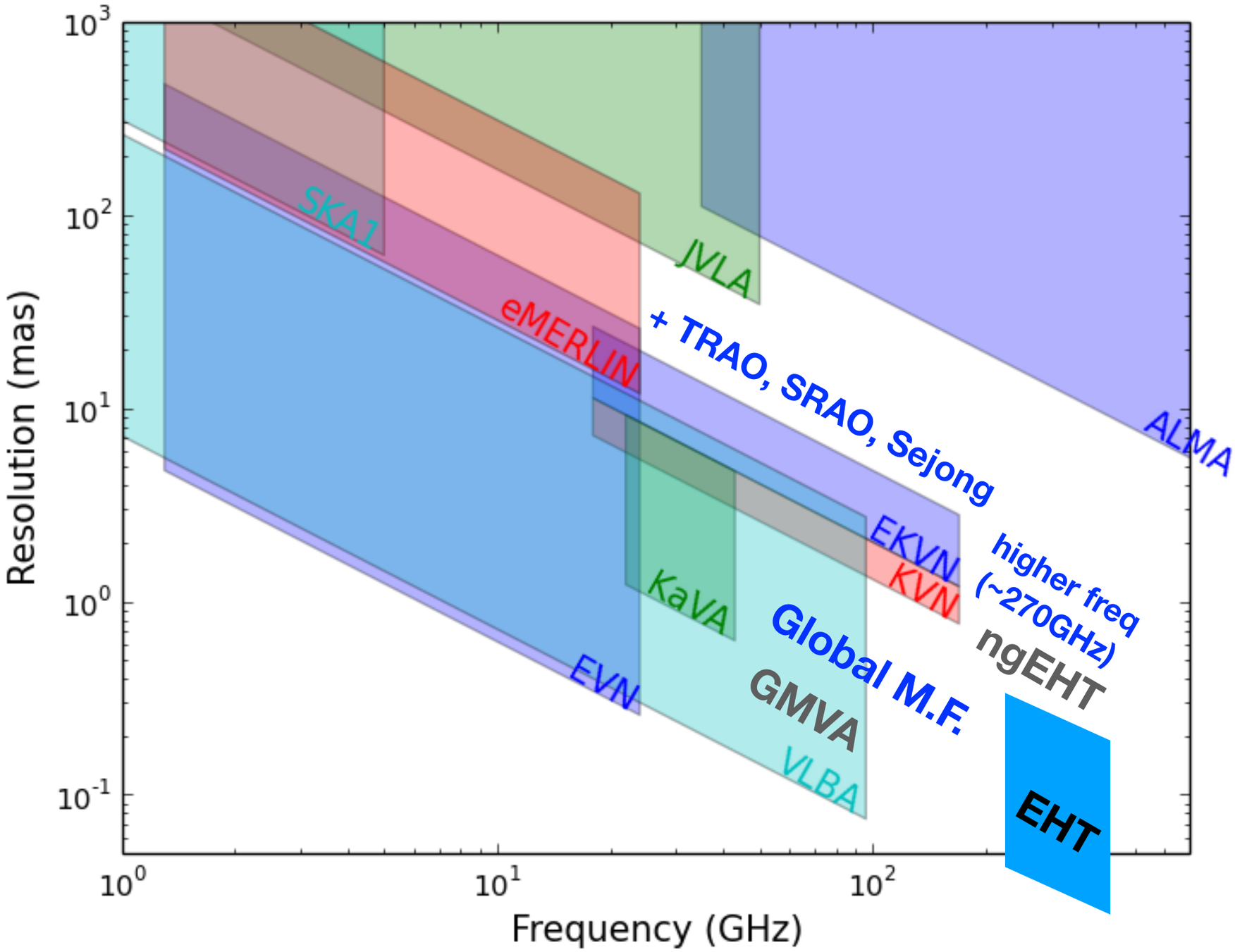
Imaging Performance of M/F EKVN

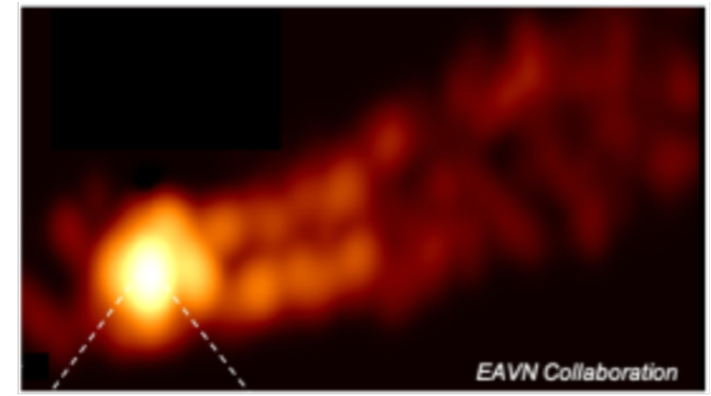
- 6 baselines
- Amplitude self-calibration is available
- Multi-Frequency Image Synthesis over 18-170GHz

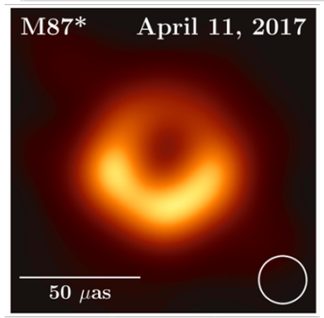


Simulation assuming flat spectrum over 18- 170GHz

Frequency - Angular Resolution Diagram







처녀자리 은하
M87 블랙홀

EHT Collaboration

Site for a New Telescope

- Gangwon Province for 100 km EW baseline
- SNU Pyeongchang Campus
  - Selection : Feb 2020
  - Low Temperature, Good Infra structure
  - Active VLBI Group
  - KASI-SNU MOA : Dec 2020
    - 30-year contract
    - 5% of full (E)KVN time (~200h/yr)





Specification of Pyeongchang Antenna

- D = 21m (same) KVN YS:()
- Aperture Efficiencies
  - ≥60% @ 100GHz (55%)
  - ≥30% @ 230GHz (15%)
- Total Surface Accuracy ≤ 100㎛ (130㎛)
  - Main reflector panel ~ 40㎛ (65㎛)
  - Panel Alignment ~ 40㎛ (60㎛)
  - Sub reflector ~ 20㎛ (50㎛)
- Enhanced BUS for less gravitational deformation
- Pointing Accuracy ≤ 3″ (~ 5″)

- contraction with High Gain Antenna Co.
  - May 2020



KVN Ulsan Telescope

Antenna Ground Work and Piling (2021.12.13)



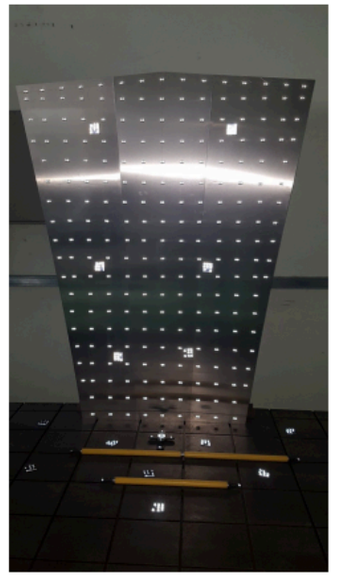
Mouting Wheel and Girder (2023.1.5)

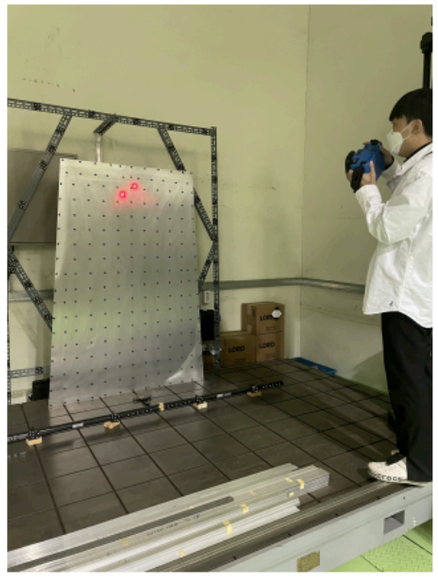


Main Reflector Panels and Back-up Structure(BUS)

- Panels
  - 120 panels among 200
  - Measured Accuracies ~ 40μm
    - using Photogrammetry







- Reflector BUS
  - Factory Assembly Test (Dec 22)

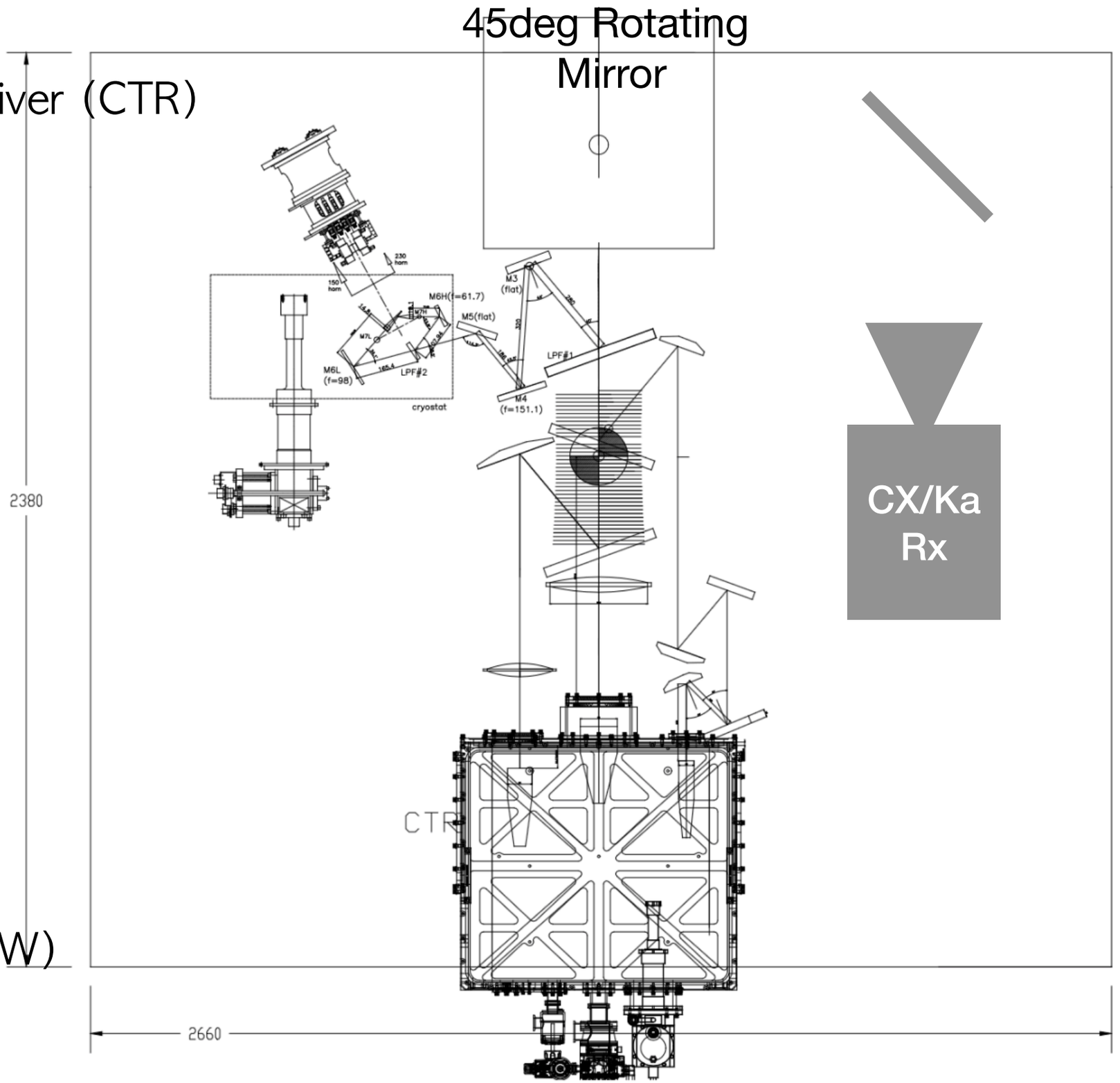
- Schedule
  - Lifting Main Reflector (May)
  - Panel Alignment (June)
  - Servo Test (July)
  - Test Observation (Sep-Dec)



Pyeongchang Receiving System

- Compact Tripple-band Receiver (CTR)
  - 18-26GHz
  - 35-50GHz
  - 82-116GHz
- 2Ch SIS Mixer Receiver
  - 125-170GHz
  - 210-270GHz
- CX/Ka-band Receiver
  - 6-9GHz
  - 28-34GHz

- VLBI Backends
  - 2 OCTAD (32Gbps)
  - 2 VLBI Recorders
  - 64Gbps Rate (16GHz BW)



Milestones

- Completion of antenna structure assembly : May
- Servo Test : July
- Antenna Acceptance Test : Sep - Dec
  - 100GHz Room Temperature Receiver (Sep)
  - CTR (22/43/86GHz) (Sep-Oct)
  - 230GHz Receiver (Nov-Dec)
- VLBI Test (Dec -)
- Pyeongchang Openning Ceremony : Mar or Apr 2024
  - after successful VLBI fringe detection
- EKVN Operation from 2024B (Shared Risk)
  - correlation using EKVN GPU correlator

EKVN Phase2

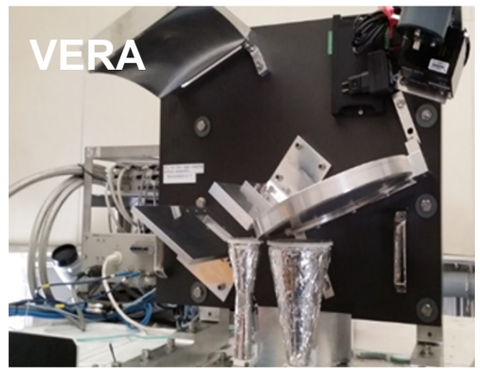
- Phase 2 : Evaluation & Science
  - 2024 ~ 2027
  - Evaluation of the new GPU correlation
  - 3rd generation KVN Key Science Program (KSP)
  - High angular resolution sciences using Global MF VLBI (+ Yebes, NRO, Italian, Mopra..)
  - Upgrade of KY (and/or KU) for 230GHz

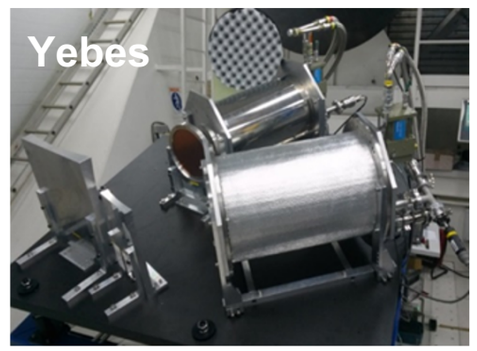
- EKVN Workshop (May 2023)
  - 3rd generation (E)KVN KSP
  - Plan for Global M.F. and 230GHz VLBI sciences

Simultaneous Multi-Free. VLBI System in Globe



- **Red**: implemented
- **Orange**: on-going
- **Green**: future?

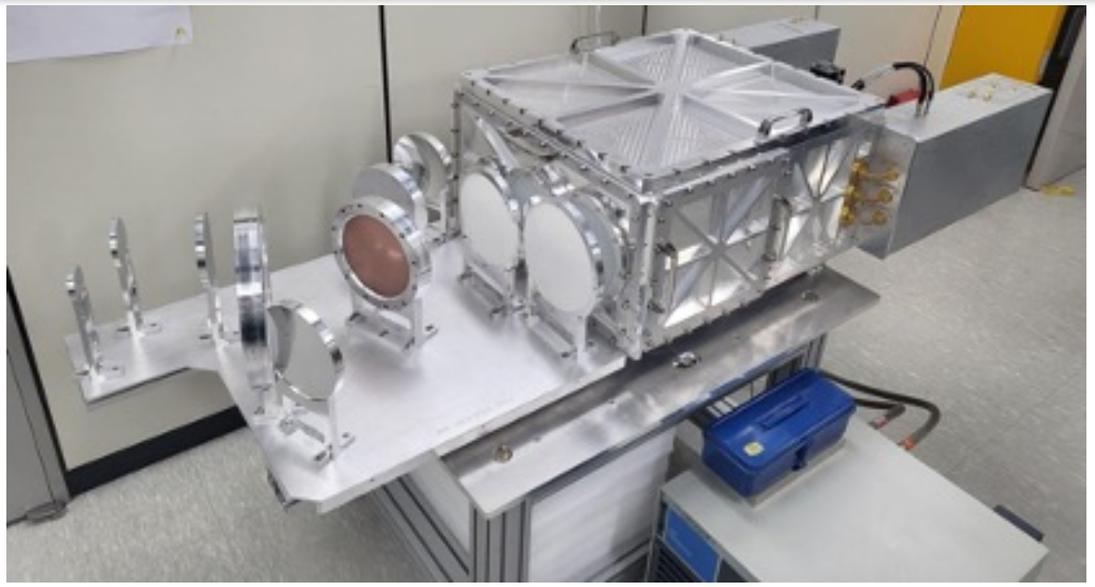






CTR for Italian Telescopes (2020.3-2022.6)

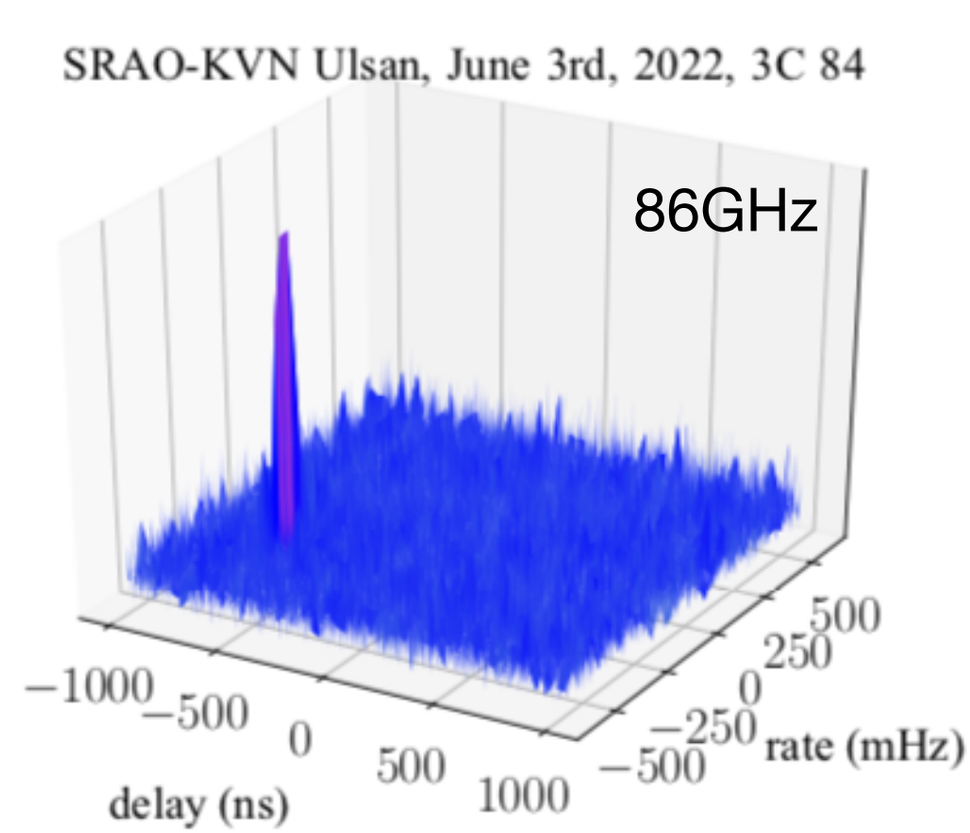
- KASI developed three CTRs
  - Sardinia 64m, Medicina 32m, Noto 32m
  - Shipped in June 2022
- Installation and Test :
  - SR & NT in Aug 2023, MD in Dec 2023



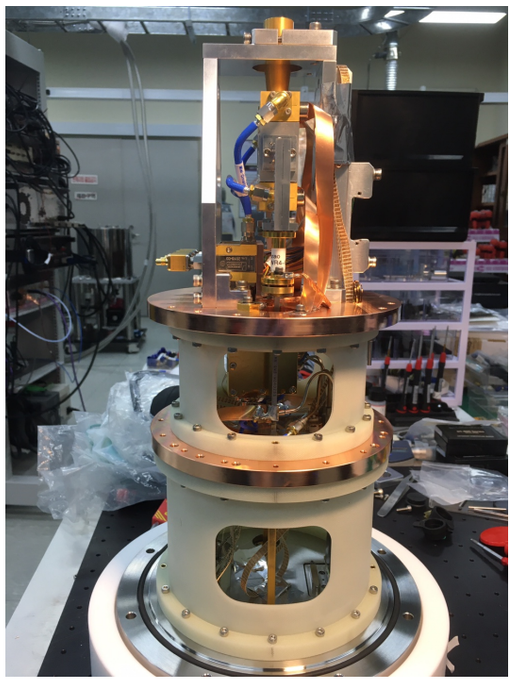


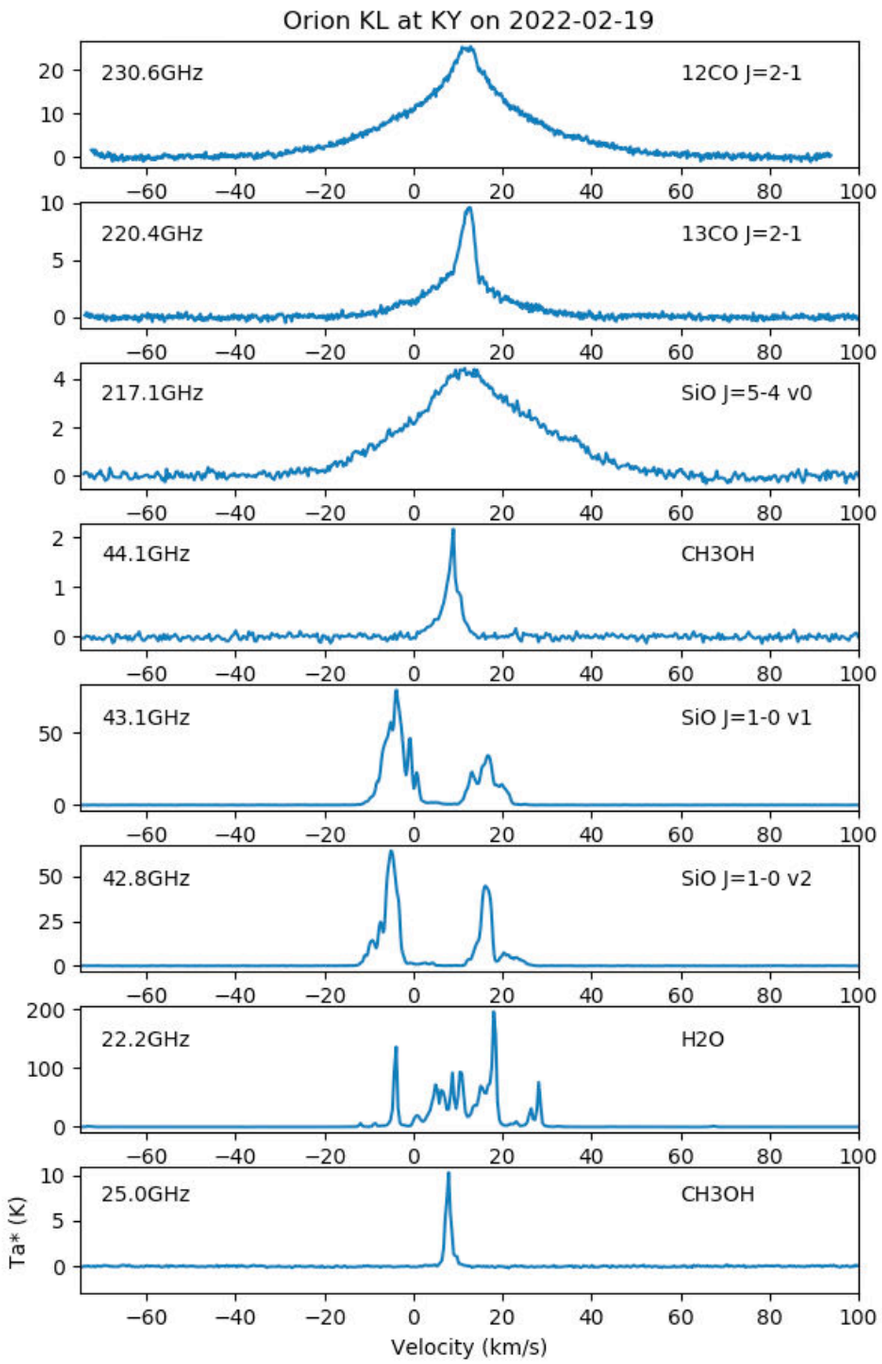
Recent Activities

- M87 Fringes from KVN - Mopra baselines at 86GHz
- KY 230GHz Single Dish in Feb 2022
  - Aperture Efficiency 15% , Tsys ~ 300K
- SRAO - KU 86GHz Fringe Detection
  - June 2022
- KY - IRAM30 - JCMT+SMA : 86/230GHz VLBI Test in Nov 2022 (ngEHT path finder)



230GHz Test Receiver





Thanks for your attention

Korea Astronomy and Space Science Institute

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