Recent Activities of the KVN

Chung-Sik Oh (KASI)
VERA User’s Meeting 2015
KaVA : KVN and VERA Array

**KVN**
Baseline 300-500 km

**VERA (VLBI Exploration of Radio Astrometry)**
Four 20m antennas, Baseline 1000-2300 km

Correlated by Daejeon HW Correlator at KJCC
Multi-Frequency Receiving System of KVN

- Simultaneous Multi-frequency Observation
  - @ 22/43/86/129GHz (Aperture Efficiencies: 60 – 30%)
  - integration time > 5 min @ 130GHz
- Dual Pol : LCP & RCP
  - Simultaneous 2 freq bands w/ full stokes
Science using KVN Multi-Freq. Capability

• Weak source detection
• Chromatic Astrometry
  – AGN Core Shift
  – Registration of multi-transition maser maps
    : Water + SiO Masers of Evolved Star
    : Water + Methanol Masers of Massive SFR

• AGN Jets
  – Spectral Index Distribution
  – Faraday Rotation Measurement (Polarization)
**KVN Operation Time**

**Operation Time**
- $> 3000$ h/yr for VLBI, $3 \times 600$ h/yr for SD
- KVN KSP: 1000h/yr, KaVA Science WG: 500h/yr

**Common Use (~1100h/yr)**
- 600h/yr for KVN (Open to Global from 2015B)
- 500h/yr for KaVA (Open to Global from 2016A)
• 5 VLBI + 6 SD papers in 2014
VLBI Publications in 2014

- Early Science with the KVN: Evaluation of System Performance - S.S. Lee + (AJ)
- Verification of the Astrometric Performance of the Korean VLBI Network using comparative SFPR studies with the VLBA at 14/7 mm – M. Rioja + (AJ)
- Astrometrically Registered Simultaneous Observations of the 22 GHz H2O and the 43GHz SiO masers towards R Leonis Minoris using KVN and Source/Frequency Phase Referencing – R. Dodson + (AJ)

- The First VLBI Image of a 44 GHz Methanol Maser with the KaVA – N. Matsumoto + (ApJL)
- VLBI observations of bright AGN jets with KaVA: Evaluation of Imaging Capability – K. Niinuma + (PASJ)
Key Science Projects (KSP)

- 1\textsuperscript{st} KSP Phase (2015-2018)
  - KSP time \sim 1000 \text{ h/yr } +\alpha

- 2 KSP projects + ( 2-3 Candidates )
  - Interferometric MOntoring of GAmma-ray Bright AGN : iMOGABA (P.I.: Sang-Sung Lee)
  - Simultaneous Monitoring of KVN 4 Bands toward Evolved Stars (P.I.: Se-Hyung Cho)
KSP1: iMOGABA
by Sang-Sung Lee

- ~30 Sources
- 22/43/86/129GHz
- Snap Shot Imaging
  3-5 5-min scans/source
- 1 month interval
+ SD Polarization ToO
FPT Evaluation for iMOGABA

- Imaging at 129 GHz

Standard Method: 18 successful images among 30
Frequency Phase Transfer Method: 28 successful images
KSP2: KVN 4 band monitoring of Evolved Stars

- Spatial structure and dynamical effect from SiO to 22 GHz H$_2$O maser regions according to stellar pulsation through simultaneous monitoring obs. of KVN 4 bands (~15 Objects)
  - Pulsation and shock wave propagation effect: development of outflow motion and asymmetry ➤ Mass loss mechanism

- Correlation and difference of maser properties (spatio-kinematic properties etc) among SiO J=1-0, J=2-1, J=3-2 masers
  - Constraints on SiO maser excitation and pumping models (collisional and/or radiative)

- Dynamical evolution from AGB to post-AGB stars: Morphology & mechanism, characteristics of SiO and H$_2$O maser properties
  - Synergy with KaVA Evolved Star Large Program and ALMA Observations
Recent Upgrade Activities

• Astrometry with the KVN (and KaVA)
  – KaVA K-band geodesy observations
  – Multi-Frequency P-Cal / New HVAC
  – Wet Delay Correction using GPS data

• Wideband Operations
  – KVN: 4 IFs x 2 Gbps with (Fila10G+) Mark6 Recorder
  – VERA: 2 IFs x 2Gbps with OctaDisk

• Collaboration for Multi-Frequency Operation
  – VERA Miz & Iriki, Yebes 40m, ATCA sub array, Sejong 22m

• High Speed Network Connection
  – YS (10GbE), US & TN (3GbE)
  – e-Shipping (e-transfer) or e-VLBI for Fringe Check
First 8Gbps Operation Fringes

- 22L/R, 43L/R
- 4 x 2 Gbps (512MHz)
- Yonsei-Ulsan
- Fila10G+Mark6
- DiFX Corr

- Fringes from All 4 IFs
- Corruption in 22RCP

- 4-8Gbps for Common Use from 2016
Sejong Geodesy Station

- 22-m Diameter
- Frequency: 2/8/22/43GHz
- Location: ~20km North from Daejeon
- Baselines between SJ-KVN

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- K5 VLBI terminal
- 22/43 Simultaneous Quasi-Optics
- Trx: 50K / 80K @ K/Q
- Aeff: 59% / 53% @ K/Q
K/Q Fringe between Sejong and KVN

- Simultaneous K/Q Fringe
  Top: before Fringe Fitting, Bottom: After Fringe Fitting

![Image of Sejong and KVN LCP setup]

Sejong - KVN Yonsei LCP

- IF 1(LL) - IF 4(LL)
- Channels
Summary

• Steady VLBI Operation
  – VLBI Operation Time > 3000 h/yr (incl. KaVA > 500h/yr)

• KVN Key Science Projects were launched
  – AGN Monitoring (iMOGABA)
  – Evolved Star Monitoring using (Source) Frequency Phase Transfer Technique

• (Source) Frequency Phase Transfer Technique are successful both for continuum and maser sources
  – First 4 bands overlap image (VY-CMa)

• Collaboration for Multi-Frequency Capability
• K/Q fringes between Sejong and KVN