Current Status of Korean VLBI Network

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Characteristics of Korean VLBI Network

- National Facility dedicated to exclusive mm-VLBI (KVN 21 m x 3 + TRAO 14 m)

- *Simultaneous* multi-frequency observation from 22GHz up to 129GHz

- Multi-frequency phase-referencing and fast-switching phase-referencing capabilities → Faint sources, weak lines at mm wavelengths

- Compact network with a few hundred km baselines
KVN Schedule

■ Observatory Building
  ● KVN Ulsan, Yonsei, Tamna obs. building was completed

■ Antenna Installation
  ● First antenna at Ulsan observatory
    - Installation and panel adjustment was completed in Sep. 2007
      (total rms of main reflector ~ 58 µm)
    - Test observation of 100 GHz band for acceptance as a single dish: Dec. 10–Dec. 21, 2007
  ● Second antenna at Yonsei observatory
    - Panel adjustment and test observation for acceptance will be completed within Feb. 2008
  ● Third antenna at Tamna observatory
    - Installation and acceptance will be completed within March 2008
KVN Schedule

- **Receiver Development and Installation**
  - One set of 22, 43 GHz band receiver at the 1st stage will be developed and installed within Dec. 2007 and two sets of 22, 43 GHz band receiver will be developed and installed within the latter half of 2008
  - 86, 129 GHz band receivers at the 2nd stage
    - Under design work in 2007
    - Development and installation will be completed until 2010

- **Correlator Development and Installation**
  - Contract for manufacturing in Aug. 2007, Korea-Japan working group and review committee are in activity since 2006
  - Assemble whole correlator system and start of experimental operation in 2009
  - Practical use for KVN and K-J joint VLBI network in 2010
Panel adjustment by Photogrammetric method
→ total rms of 21m reflector :
~ 58 μm (Sept. 3, 2007)
KVN
Tamna

May 2007

Nov. 2007

Sept. 2007

Bird’s - eye View

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Quasi-optic System

KVN Multi-Channel Receiver Optical Bench

Beam Deviation between 22 & 43GHz

without LPF1 & with LPF2
22GHz 43GHz
### Receiver system & DAS

<table>
<thead>
<tr>
<th>Freq. Band</th>
<th>S Band</th>
<th>X Band</th>
<th>K Band</th>
<th>Q Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq. Range</td>
<td>2.2 ~ 2.8 GHz</td>
<td>8 ~ 9 GHz</td>
<td>21.5 ~ 23.5 GHz</td>
<td>42 ~ 44 GHz</td>
</tr>
<tr>
<td>Rx Noise</td>
<td>&lt; 25 K</td>
<td>&lt; 25 K</td>
<td>&lt; 30 K</td>
<td>&lt; 50 K</td>
</tr>
<tr>
<td>1st IF / BW</td>
<td>2.5G/600MHz</td>
<td>8.5G/1GHz</td>
<td>8.5G/2GHz</td>
<td>8.5G/2GHz</td>
</tr>
<tr>
<td>IF Power</td>
<td>-20 dBm</td>
<td>-20 dBm</td>
<td>-20 dBm</td>
<td>-20 dBm</td>
</tr>
<tr>
<td>Polarization</td>
<td>LCP/RCP</td>
<td>LCP/RCP</td>
<td>LCP/RCP</td>
<td>LCP/RCP</td>
</tr>
</tbody>
</table>

![Diagram of Receiver system & DAS]

**Reception Room**
- IF1: Sampler 1Gsp, 2bits
- IF2: Sampler 1Gsp, 2bits
- IF3: Sampler 1Gsp, 2bits
- IF4: Sampler 1Gsp, 2bits

**Control Room**
- Digital Filters (16 Filters)
- 256MHz: 1 stream
- 8MHz: 16 streams

- Mack5B 1Gbps
- Digital Spectrometer
- DIR-1000
Receiver system

22 GHz Band RX

43 GHz Band RX

100 GHz Band RX

22 GHz Band IF
## Specification and Framework of Korea–Japan Correlator

### Key Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td># of Antennas</td>
<td>16</td>
</tr>
<tr>
<td># of Inputs / Antenna</td>
<td>4 bands (4Fx1P, 2Fx2P, 1Fx2P+2Fx1P)</td>
</tr>
<tr>
<td>Max. # of Correlations / Input</td>
<td>120 Cross + 16 Auto</td>
</tr>
<tr>
<td>Subarray</td>
<td>2 case (12 + 4, 8 + 8)</td>
</tr>
<tr>
<td>Bandwidth for each Input</td>
<td>512 MHz</td>
</tr>
<tr>
<td>Digitization for each Input</td>
<td>1 Gsps by 2bits/ sample</td>
</tr>
<tr>
<td>Clock for Input data</td>
<td>128 MHz</td>
</tr>
<tr>
<td>Max. Delay compensation</td>
<td>&lt;32,000 km</td>
</tr>
<tr>
<td>Max. Fringe Tracking</td>
<td>&lt;860 kHz</td>
</tr>
<tr>
<td>FFT points</td>
<td>1,048,576, w.r.t. multi-channel stream</td>
</tr>
<tr>
<td>Word length in FFT</td>
<td>16+16 bits fixed point for real &amp; imag.</td>
</tr>
<tr>
<td></td>
<td>Re-quantization to 4+4 bits fixed point</td>
</tr>
<tr>
<td>Integration</td>
<td>&lt; 25 msec</td>
</tr>
<tr>
<td>Data compression (Flexible Binning)</td>
<td>8,192 channels</td>
</tr>
</tbody>
</table>

### Diagram

- **Mark5B**
- **DIR-2000**
- **K-5**
- **Optical Fiber**
- **Correlation Subsystem**
- **Data Archive**
- **Raw VLBI Data Buffer**

**Correlator Control & Operation**

**KASI Mission**  **NAOJ Mission**
Korea-Japan Correlator in 2007


- 4 times WG meetings every 2-3 months: discussion on specification and correlator developing work etc.

- Third review committee meeting in Nov. 15-16 at NAOJ, Tokyo

- Practical use for K-J Joint VLBI network and establishment K-J Joint Correlation Data Center in 2010
Multi-frequency and multi-epoch observational study for

Star forming region, late-type stars, Galactic center, AGN, detection of core shift, variability of microquasars, gravitational lens objects

- Maser mini workshop: July 2006 at KASI
- AGN mini workshop: Aug. 2006, AGN Summer School: July 2007 at KASI

Workshop in Dec. 2007 by Radio Astronomy Sectional Committee of Korean Astronomical Society:
KVN key science will be also discussed
Plan of 2008

- Complete installation and panel adjustment of telescope at Yonsei and Tamna in Feb. and March 2008
  - Test observations of 100 GHz band for acceptance (confirming total rms of 21 m reflector within 60 μm)

- One station of KVN can be used for VLBI test observation with VERA/JVN (Scheduling etc. will be discussed)
  - KVN Yonsei tel. equipped with first one set of 22/43 GHz RX since March will be used as a test bed

- Manufacture two sets of 22/43 GHz RX within autumn

- Request budget for construction of KVN Research Center Building again
  - Budget: $15M (~8,250 m² = 2,500 坪)
  - Construction period: 2009 ~ 2011
Construction Plan of KVN Research Center Building toward East Asian VLBI Research Center

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Location of KVN Research Center Building at Yonsei Campus
Role of KVN Research Center Building

- **Space for National VLBI Research Center**
  - Institute-University Cooperation in Korea
  - Korea-Japan, East Asia, and International Collaboration

- **Correlator Operation Center**
  - like Socorro and JIVE correlation center

- **Infra-structure for East-Asian VLBI Research**
Future Plan of KVN

2007

Ulsan Radio Obs.
KVN Yonsei Radio Obs.
Tamna Radio Obs.

2008

1 Station of KVN:
VLBI Test Obs. with VERA

2009

3 Stations of KVN:
VLBI Test Obs.

Completion of K-J Correlator
Completion of mm VLBI (86 & 129 GHz)
Construction of KVN Research Center Building

2010

KVN

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