VERA status and future

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VERA

http://veraserver.mtk.nao.ac.jp/index.html

Antenna Diameter 20m (250 μm)
Observing band 2,8,22,43GHz
Maximum baseline 2273km
Minimum baseline 1000km
2 beam phase referencing
→ Inst. Path error <0.1 mm

Construction: 2000-2002
Operation: 2002-
Regular observation: 2004-
Concept of the dual-beam receiving system
Galactic astrometry in 2012

Combined with VLBA/EVN data, we have determined Galactic parameters using 52 sources.

Galactic parameter can be determined by using more than 50 sources with VLBI astrometry
VLBI astrometry results for Galactic masers
Revising Galactic constants

New (preliminary) \hspace{1cm} Previous

(Honma+12) \hspace{1cm} 

$N_{\text{src}} = 114$ sources \hspace{1cm} (52 sources)

$R_0 = 7.95 \pm 0.21$ kpc \hspace{1cm} (8.05+/-0.45 kpc)

$\Omega_0 = 28.95 \pm 0.43$ kpc \hspace{1cm} (29.57 +/− 0.78 kpc)
Spiral Arms

Location and non-circular motion in spiral arm

Outer galaxy objects (in l-b diagram)
VERA vs VLBA in parallax

- ~10 sources observed with both VERA and VLBA (in some cases different bands)
- Generally consistency, no systematic offset
- Discrepancy seen in a few sources. Needs to be checked.
Motion of VERA station
Operation time of VERA
Open use

- VERA with Nobeyama (45m) and Kashima (34m) is opened for global users.
  - Open time is 700 hours/year including KaVA.
- KaVA (KVN and VERA array) is opened to East-Asian astronomy communities at current stage, which will be open to the world near future.
  - Current open time is 500 hours/year.
- Deadline of proposal is twice per year.

http://veraserver.mtk.nao.ac.jp/restricted/index.html
Number of proposals for VERA and KaVA
Developments

- **High speed data recording using disk system**
  - Usual operation of OCTAVE system + Soft Corr (1～8Gbps) will be started at 2015.
  - VSREC (12Gpbs by PC recording) is under developing.
- K/Q dual polarization is under testing.
- Ultra high speed sampler (<50GHz) is under studying.
- K/Q simultaneous receivers are under studying under the collaboration with KVN.
OCTAVE
(8Gbps Disc recorder)

-> 3 times sensitive

1 or 2 Gbps × 4 I/O

VSI-H — 10 GbE Converter OCTAVIA

10 GbE Hub

2Gbps x 4

10 GbE

Ethernet transmission

Disk Server

Disk Server

Disk Server

Disk Server

Disk Server

OCTDVIA

VSI-H
# New observing mode by using Disk systems

<table>
<thead>
<tr>
<th></th>
<th>Recording rate</th>
<th>Recorder</th>
<th>HDD</th>
<th>Correlator</th>
<th>KJJVC</th>
<th>2beam (phase-ref)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VERA (KaVA)</strong></td>
<td>1 Gbps</td>
<td>OCTADISK</td>
<td>All</td>
<td>Mitaka-FX Soft corr</td>
<td>◯</td>
<td>○</td>
</tr>
<tr>
<td><strong>VERA</strong></td>
<td>4 Gbps (A=B=2G)</td>
<td>OCTADISK</td>
<td>80h</td>
<td>Soft corr</td>
<td>○</td>
<td>Under testing</td>
</tr>
<tr>
<td><strong>VERA (test)</strong></td>
<td>12 Gbps (A=2G, B=10G)</td>
<td>VSREC</td>
<td>100h</td>
<td>Soft corr</td>
<td>○</td>
<td>Under development</td>
</tr>
<tr>
<td><strong>NRO45</strong></td>
<td>4 Gbps (1Gbps)</td>
<td>OCTADISK</td>
<td>50h</td>
<td>Mitaka-FX Soft corr</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td><strong>JVN-OCTAVE</strong></td>
<td>2 or 4 Gbps</td>
<td>OCTADISK</td>
<td>K5VSI</td>
<td>Soft corr</td>
<td>○</td>
<td></td>
</tr>
</tbody>
</table>
Verification of software correlator

CLEAN map for r13264b-no1 (J0541-05)

CLEAN map for s13264b-no1 (J0541-05)

Tape > Mitaka-FX

Tape > Soft corr

Peak Intensity
0.539 Jy/beam

Peak Intensity
0.539 Jy/beam
Correlator

- Software correlator is almost verified with comparison current hardware correlator (Mitaka-FX).
- It will be moved to Mizusawa until 2015 Mar. and started regular operation.
- Mitaka-FX correlator will be closed in 2015 which means no correlation of tape based recording such as DIR1000 and 2000.
Simultaneous Multi-Frequency Obs. - Phase Compensation, mm-VLBI

Constructions of three stations were completed on Dec. 2008!
East Asian VLBI Network array
Future Plan

- NAOJ Director General requires the intensive review of VERA project at 2022, which should consider the termination or continuation of VERA program.
- After 2023, Mizusawa VLBI observatory is required a new project including VERA continuation.
- Possibility of future plans are
  - East Asian VLBI network will extend to Pacific and Global array.
  - Joining SKA
Summary

- VERA is a powerful tool for astrometry and made a significant contribution for Galactic parameter determinations.
- High speed disk recording and correlation system will be operational shortly and a more wide band system is under development.
- KaVA observation is operational and EAVN is testing.
- Discussion of future plan is just started seriously. It is also needed with the Japanese VLBI community.