

Status of VERA

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VERA(VLBI Exploration of Radio Astrometry) is a VLBI network consisting of 4 stations, namely, Mizusawa, Iriki, Ogasawara and Ishigakijima. Its main scientific target is to reveal structure and dynamics of our Galaxy by precisely determining positions of Galactic maser source in a 6-dimensional phase space. Phase-referenced differential VLBI is used for this purpose. Three stations, namely, Mizusawa, Iriki and Ogasawara are under construction and are to be completed by the end of FY2000. The remaining station, Ishigakijima, will be completed in FY2001. VERA system is very unique in the respect that it is specially designed for the phase-referenced VLBI. The VERA system and current status of the construction will be presented.

VERA is a network of four radio telescopes which are located at Mizusawa, Iriki, Ogasawara and Ishigakijima. The diameter of each telescope is 20m and receiving frequency bands are 2/8, 22 and 43GHz bands. The main scientific target of VERA is to determine 3-dimensional structure of our Galaxy by determining positions in a 6-dimensional phase space, that is, positions in the celestial sphere, trigonometric parallaxes, proper motions and radial velocities, of Galactic maser sources with the accuracy of 10 micro-arcseconds in position determination.

The budget of VERA was approved for Mizusawa, Iriki and Ogasawara stations in FY1999, and for Ishigakijima in FY2000. The first three stations are to be completed by the end of FY2000 and the construction of the whole network will be completed in FY2001.

The major error source in VLBI is phase fluctuations due to the atmospheric turbulence. This prevents direct use of fringe phases. However, the relative fringe phase between two closely separated radio sources is almost free from the atmospheric phase fluctuation and is suitable for high precision astrometry. In fact, the proper motion of the Galactic center(Sgr A*) has been detected with the VLBA operated in such a way that target(Sgr A*) and reference source(QSO) are alternately observed. Another example is the detection of the proper motions of water maser sources in star forming regions in the distance range of a few kpc. These proper motions are considered to be due to the Galactic rotation. However, the accuracy attained is far below the one needed to determine annual parallaxes.

VERA system is specially designed to achieve highest accuracy in observing differential fringe phase between target and reference radio sources. The most unique devise is a 2-beam receiving system with which two radio sources slightly apart(<2.2deg) can be observed simultaneously. There are two freely movable platforms(Stewart platforms) near the Cassegrain focus. The receivers are fixed on the platforms and movable along the surface of maximum efficiency with the change of separation angle. The platform can move about 1m and this enables to observe radio source pairs up to 2.2degrees in separation. Setting errors of receiver positions in space and phase differences originated in receivers can be calibrated by receiving artificial noise emitted from transmitters placed on a main reflector. All errors except for the one due to deformation of a main reflector can be calibrated with this method.

In order to minimize phase errors due to difference of routes of analog signal transfer, high speed samplers are placed in the upper cabin where receivers are also placed and analog signals are digitized. The digital signals are transferred to recording systems in observing house.

In addition to 22 and 43 GHz bands, simultaneous reception in 2 and 8 GHz is possible and VERA is usable for ordinary geodetic observations. The K4 data acquisition terminal is available only at Mizusawa, but geodetic observations using 1Gbps recorder is possible in 2/8, 22 and 43GHz bands.

Status of VERA project, VERA system and schedule toward regular operation will be outlined.