A New VHF ("4-Band") Feed System for the Very Large Array

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The Very Large Array (VLA) has had an operational "4-band" (~74 MHz) feed system since the early 1990s (Kassim *et al*. 2007, *ApJS*, 172, 686). This system consists of thin dipoles suspended between the main reflector and the cassegrain subreflector, which is used in this scheme as a rudimentary ground plane. However this system degrades the performance of higher-frequency systems by reducing sensitivity through blockage, and also by introducing a time-varying response due to gravitational deformation (sagging) that depends on pointing direction. For these reasons the 4-band dipole feeds are normally removed from the dishes and are only intermittently deployed.

The National Radio Astronomy Observatory (NRAO), in collaboration with Virginia Tech, has developed an alternative system which does not suffer from these limitations, exhibits comparable or better performance, and may be permanently installed. The scheme is based on the "strut straddling" concept of Harun & Ellingson (2011, *Radio Sci.*, 46, RS0M04). The system consists of 4 end-fed "modified J-pole" (MJP) antennas (Ellingson, Coffey & Merteley 2013, EVLA Memo 172) which are suspended from the four struts supporting the subreflector, so as to form a ring around the rotation axis of the dish (Ellingson *et al.* 2013, EVLA Memo 173). The MJP signals are combined to form orthogonal linear polarizations. This placement of feed elements is effective because the focal region is very large at meter wavelengths, so the combination of 4 MJPs is able to capture a total amount of power comparable to the legacy 2-dipole on-axis system. Because the MJPs are rigid and located outside the optical path between the main reflector and the subreflector, the impact on higher-frequency systems is negligible and the system may be permanently installed. MJPs offer the additional benefit of having significantly increased bandwidth relative to the previous thin-dipole system.

The new feed system has been permanently installed on 6 of the 27 VLA dishes since August 2014. Tests performed performed in April 2015 indicate imaging performance comparable to or better than the legacy system in 54-84 MHz (Owen & Intema 2015, *EVLA Memo Series*, in prep.). Installation of the system on an additional 7 dishes is planned to be completed by February 2016.