The On-Axis Beam at Jicamarca: Is It Pointing Correctly?

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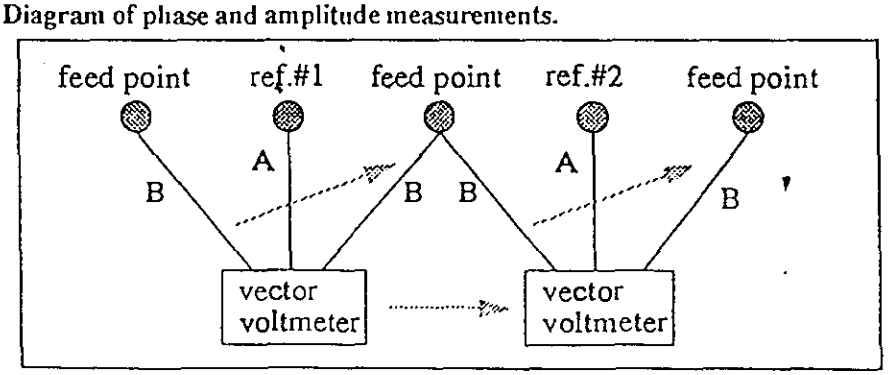
Vertical velocity measurements of atmospheric winds are becoming increasingly important. To obtain the long-term mean vertical motion of the atmosphere is difficult to do, both because of the small velocities involved and because of the finite width of the antenna beam. Since the vertical wind measurement is very sensitive to the tilt of the vertically-directed antenna beam, we decided to get the Jicamarca beam direction by measuring the phase and amplitude of a reference signal at each of the antenna feed points. Our results tell us that, while the antenna pointing direction is already good, there is room for improvement.

1.0 Description of the measurements.

We used a HP vector volmeter to measure the phase and amplitude of each feed points (i.e. ends of 6-inch coaxial transmission line for both polarizations). A 49.920 MHz was fed directly to all feed points from a single point near the hybrid "combiners". Thus the phase and amplitude of this signal distributed to the individual points (relative to a reference source) can be used to determine the resulting beam shape and direction.

Due to the large dimensions of the antenna, it was necessary to use a moving reference. That is, we used a short cable from a selected feed point of a module as a reference (channel A), and then we used a longer cable (channel B) to measure the modules close to that reference. In these modules we measured both polarizations (i.e. UP and DOWN). We then selected another reference for nearly points. In this way we were able to intercompare to some of the modules, using both references. This technique allowed us to compare measurements throughout the entire antenna. In Fig. 1 we show simple diagram of the procedure described above.

FIGURE 1. Diagram of phase and amplitude measurements.



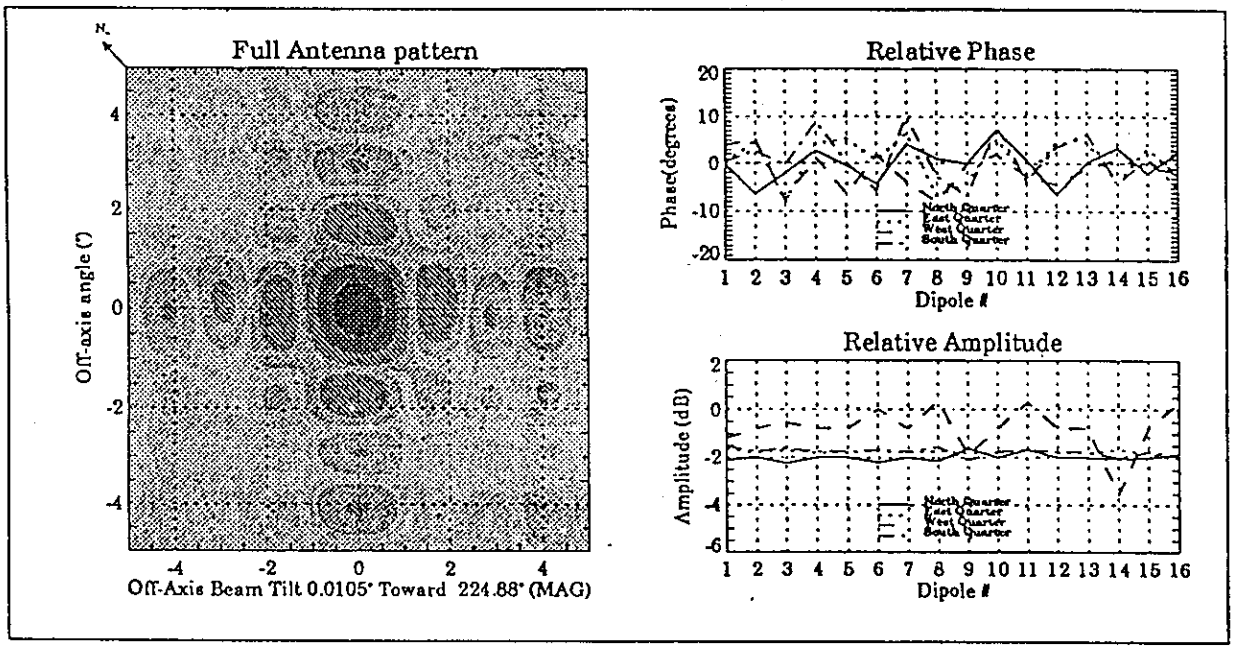
With the vector voltmeter we measured the phase difference (between channels A and B), and also the amplitude at each feed point. Once the phases and amplitudes were measured, the antenna pattern could be calculated.

The tilt of the main beam as described below, was calculated from the "center of mass" of the half-power region.

2.0 Results

In Fig. 2 we present the calculated pattern of the "Down" antenna polarization, along with the relative phases and amplitudes of each module. This result gives a tilt angle of 0.0105° relative to "on-axis".

FIGURE 2. Measurements at the end of 6-inch coaxial transmission line (Down polarization)

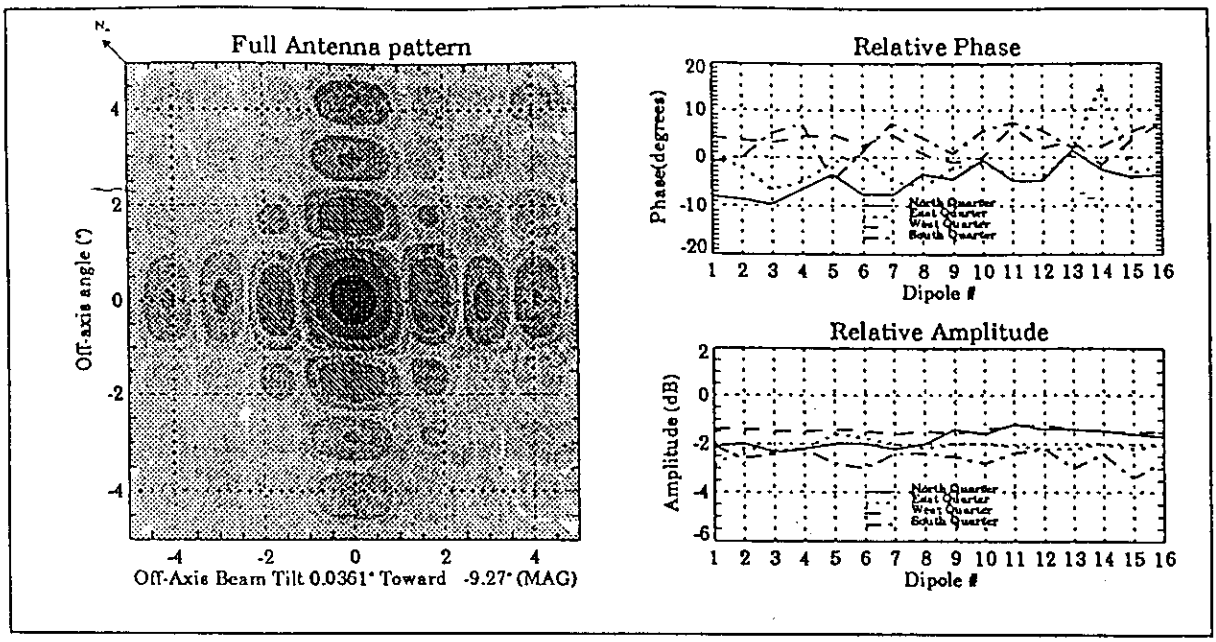


The Off-Axis pointing angles of each quarter for both UP and DOWN polarizations are shown in Table 1.

TABLE 1. Off-Axis angles

	Antenna	
Quarter	Down	Up
North	0.0293°	0.0516°
West	0.0373°	0.0246°
South	0.0308°	0.0669°
East	0.0285°	0.0700°

FIGURE 3. Measurements at the end of 6-inch coaxial transmission line (Up polarization)



Comparable results for the UP polarization are shown in Fig. 3. In this case an off-axis angle of 0.0361^{o} was obtained. Note the existence of a small but definite slope in the phase and amplitude values of the North quarter (solid line).

3.0 Conclusions

We have shown that the off-axis angles of both antennas are only a few hundredth of a degree off their design position. This is very acceptable, for example, for ionospheric measurements and for instantaneous vertical velocity in lower atmosphere. On the other hand, it could cause problems for *long term* vertical velocities in the lower atmosphere (Huaman and Balsley, 1994).

Finally, these results are based on our initial measurements. We suggest that new measurements should be made with better equipment.

4.0 References

Huaman, M.M., Balsley B.B. (1994), "Long-term Average Vertical Motions Observed by VHF wind Profilers: The Effect of Slight Antenna Pointing Inaccuracies", in review.

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