A VECTOR NEAR–FIELD SCANNER FOR INTER–BAND ILLUMINATION AND BEAM CO–ALIGNMENT

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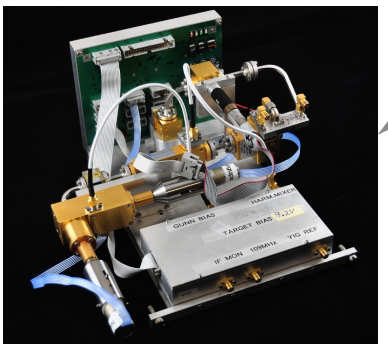
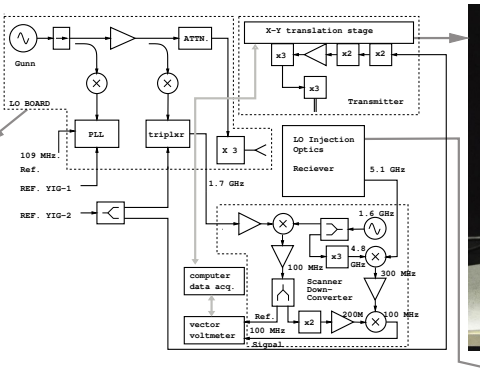
The Submillimeter Array (SMA) operates in three bands: 200 (180–250 GHz) or 300 (266–355 GHz) and 400 (320–420 GHz). Overlapping coverage in the orthogonally polarized 300 and 400 bands allows full Stokes operation. Co–alignment of the beams in all bands, 300/400 in particular, is important. A vector near–field scanner is used to measure and correct misalignments arising from receiver replacements in the field.

The scanner measures the aperture E–field by scanning a WR–3 open wave–guide transmitter probe in a plane in the beam–wave–guide system where images of the subreflector and the reciever feed–horns are formed. The 10–dB point in this plane is ~ 25 mm. A square raster, up to 50 mm, can be scanned on–the–fly, typical maps being 35–mm, made in ~ 6 minutes. The signal is received by the standard science receivers.

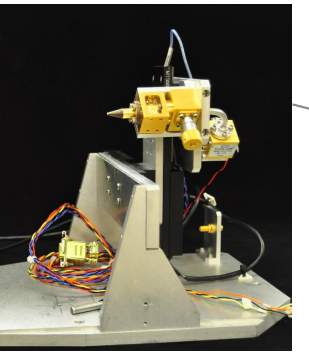
SPECIAL LO BOARD



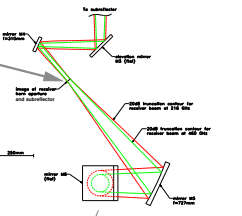
BLOCK DIAGRAM



SCANNED TRANSMITTER

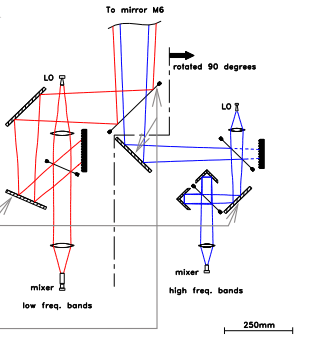


BEAM WAVE–GUIDE



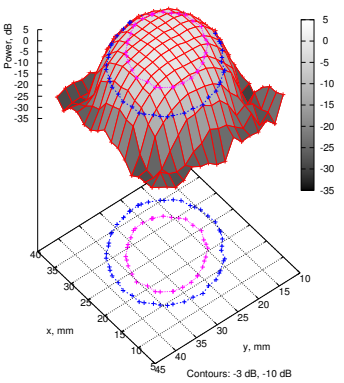
The system uses existing YIG references in the cabin: YIG1(/2) for locking the receiver LO; YIG2(/1) is multiplied up (x 36) to generate the transmitted tone in the 200/300 band.

To acheive coherence needed for phase measurements, a 1.7 GHz reference tone is generated in the special LO system by mixing the Gunn output and YIG2. This reference is used in the scanner down converter to produce a 100 MHz tone to lock a vector–voltmeter. The transmitter signal from the receiver at 5.1 GHz is down converted to 100 MHz using the same reference to feed the signal channel of the vector–voltmeter.



optical elements adjusted : optics insert mirrors, combiner / grid

SMA Near Field Scanner, Amplitude



The resulting amplitude map is directly used to assess the centration of the illumination. The measurements also verify the 10–dB size of ~ 25 mm.

A spherical wave front and a gradient are fitted to the phase map. The gradients measure the pointing offsets.

Co–alignment is acheived by adjusting the optical elements identified above and verified by a new map.

The turn around time for an adjustment and mapping is ~ 30 minutes.

Pointing co–alignment to better than 5" has been acheived on one antenna (No. 8) and measurements on more antennas are under way.

SMA Near Field Scanner, Phase