# AN ON-DISH 430 MHZ INTERFEROMETER AND ASSOCIATED SIGNAL PROCESSING FOR RADAR METEOR OBSERVATIONS AT ARECIBO.

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**ABSTRACT**

Radar meteor observations at Arecibo Observatory are characterized by excellent Doppler and range resolution but, until recently, with only a dynamics-inferred indication of the meteoroid trajectory through the beam. The location of the meteoroid in the beam has in fact been the largest unknown for typical events even though the beam is only 300 m in diameter in the meteor zone. The only viable solution to this dilemma is construction of a multi-element interferometer mounted on the carriage house that supports the 29.25 meter linefeed above the 305 meter dish. The size and layout of the horn-feed in the Gregorian system precludes mounting additional feed horns there. To begin testing an interferometer system, a crossed-linear, 4-element Yagi of exceptional mechanical stiffness and pattern appropriate to illuminating the dish with little vignetting was designed, constructed, and mounted near the paraxial surface for validation tests in late 2004. As will be shown, the appropriate mount-point for each Yagi is ~6 wavelengths (4.2 meters) from the center of the linefeed and 3 meters below the paraxial surface—132.5 m above the 70° spherical "cap" dish. The Yagi antennas are phased to yield the same circular polarization as the linefeed on receive. Low-power was applied to the linefeed determining the isolation between the linefeed and the Yagi antennas to be at least 58 dB. The Yagi antennas are connected to modern room-temperature receive systems with just a limiter as protection against the nominal 2 MW transmitter power yielding system temperatures of ~120 K and a radio astronomy gain of about 55 dBi. We give modeling results demonstrating optimal illumination of a spherical dish for both the linefeed and point-sources (Yagi) as well as corresponding gains, antenna patterns, and the bi-static pattern of the linefeed/Yagi, transmit/receive antenna system.

The prototype interferometer system has been used to collect data nearly 60 hours of data with many meteor events observed simultaneously in both the linefeed and Yagi systems. We report on further calibrations of this system, the real-time data processing system that is being prepared, and the first multi-axis meteoroid trajectory studies resulting from these recent observations. Operationally a 2 MHz bandwidth is sampled for each receiver presenting a difficult signal processing environment with a final total of 4 receivers. As the linefeed is the most sensitive of the receive systems, we process this data in real time for probable meteor events and, upon event detection, data from FIFO (First-In, First-Out) buffers for each receiver is forwarded for further processing as will be described. The full linefeed data-stream and the "event-frames" from each Yagi receiver are forwarded for down-stream processing and archiving. The back-end receiver system consists of 4 IF-sampling digital receivers based on commercial (EchoTek) integrated analog input, PCI (14-bit sampling at 105 MHz) digital receiver cards that yield ~86 dB dynamic range.