

THE 1.4 METER TELESCOPE DESIGN FOR THE Q/U IMAGING  
EXPERIMENT

William A. Imbriale

JPL, California Institute of Technology

This paper describes the optics design of the 1.4 meter telescope for the Q/U Imaging Experiment (QUIET) intended to image the polarization of the cosmic microwave background (CMB) with detectors at two frequencies with unprecedented sensitivity. Observing the polarization of the CMB demands exquisite sensitivity to both Q and U Stokes parameters and freedom from systematic errors. QUIET makes use of recent breakthroughs in millimeter-wave circuit packaging to enable large arrays of radiometers or polarimeters for modest cost. Modules based on IC-style packaging with waveguide inputs provide fully functional pseudo correlation polarimeters capable of detecting Q and U simultaneously. The feeds themselves are corrugated horns built up from stacked platelets, each with an array of holes, defining one groove in each feed.

This paper is follow-on to Imbriale, RF Optics Design for the Q/U Imaging Experiment, URSI 2005, which described a one and two-meter telescope design. A 1.4 meter minor axis is the largest mirror that can be accommodated on the available milling machine and will be the most cost effective prototype telescope. In addition, the window on the cryostat is now 18 cm thick, necessitating a telescope redesign to keep the rays on the main mirror from vignetting. The 1.4 meter design will accommodate 200 feeds at W-band (80-105 GHz) and 37 at Q-band (38-40 GHz). The corrugated horn feeds have a 1.4 inch (3.55 cm) outer diameter at W-band and a 3 inch (7.62cm) outer diameter at Q-band.

A side fed Cassegrainian design was selected because of its excellent cross-polarization and wide angle scan performance. An extremely large and flat field of view is realized with an angular extent of over 12 on the sky. At W-band the beam size is 0.22 degrees and at Q-band the beam size is 0.5 degrees.

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1. (a)  
William Imbriale  
4800 Oak Grove Dr.  
M/S 238-737  
Pasadena, CA  
91109 USA  
imbriale@jpl.nasa.gov  
(b) 818-354-5172  
(c) 818-354-2825
2. J - Radio Astronomy
3. (a) S-J/B2
4. I - Invited Paper, Program chair:  
Chris Walker Y. Rahmat-Samii
5. No special instructions