



MULTIPLE MIRROR TELESCOPE OBSERVATORY

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MMTO Internal Technical Memorandum 89-1

Subject: Primary Mirror Emissivity Measurements with the Thermographic Camera

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Date: June 26, 1989

Attempts made on June 7 to measure the emissivity of primary mirrors A and B with the thermographic camera were moderately successful. A and B appeared to be, respectively, the cleanest and dirtiest mirrors of the lot, although both had noticeably suffered from the dust of recent construction. Here, we give a brief description of the setup and results. A more complete analysis of the reference object technique for emissivity measurements is forthcoming in another memo.

The setup (Figure 1) consists of viewing two 1.0" wide coated microscope slides (silver and aluminum) taped onto the primary mirror with 1.0" of primary showing in between. The camera (about 30" away) sees the emitted power of the primary and the slides (all at the same temperature) against the reflected image of a plastic container of LN₂ ($\epsilon > .90$). The LN₂ is placed adjacent to the camera and has little effect on the temperature of the mirrors (mirror temperatures were just over 12°C).

Previous tests have shown this method to be valid but subject to small errors due to orientation, background, and frost. The setup is not optimized but some difficulties are circumvented by requiring that, for a particular camera orientation, the silver register a lower emissivity than the aluminum for that slide arrangement and also when the slides are exchanged. Although this is a useful criterion for a credible measurement, it does not represent the best choice of reference objects for the technique and there is, consequently, a fair amount of scatter in the calculated emissivities of the primaries.

It is obvious in every shot, however, that A and B have a higher emissivity than the aluminum slide and less obvious, but still clear, that B has a higher emissivity than A (Figure 2). The emissivities of the silver and aluminum reference slides are unknown but, assuming that they are respectively 0.01 and 0.02, we get (using equation 9 of Reference 1) a range of 0.03 - 0.04 for mirror A and 0.04 - 0.05 for mirror B.

Improvements in the technique are possible. A much larger flat container of LN₂ with $\epsilon \sim 1.0$ and with a hole for the camera lens should eliminate the reflection of the camera body heat and other background from the LN₂ container. An additional container of LN₂ can be placed next to the slides after initial measurements to serve as a shot-to-shot reference. Also, if necessary, a cloth shroud can be hung up and sprayed with LN₂ from the pressurized dewar immediately prior to measurements to eliminate further background.

These improvements would be expected to improve shot-to-shot consistency and may also enhance the resolution to some extent, although the camera is already operating close to its natural limit.

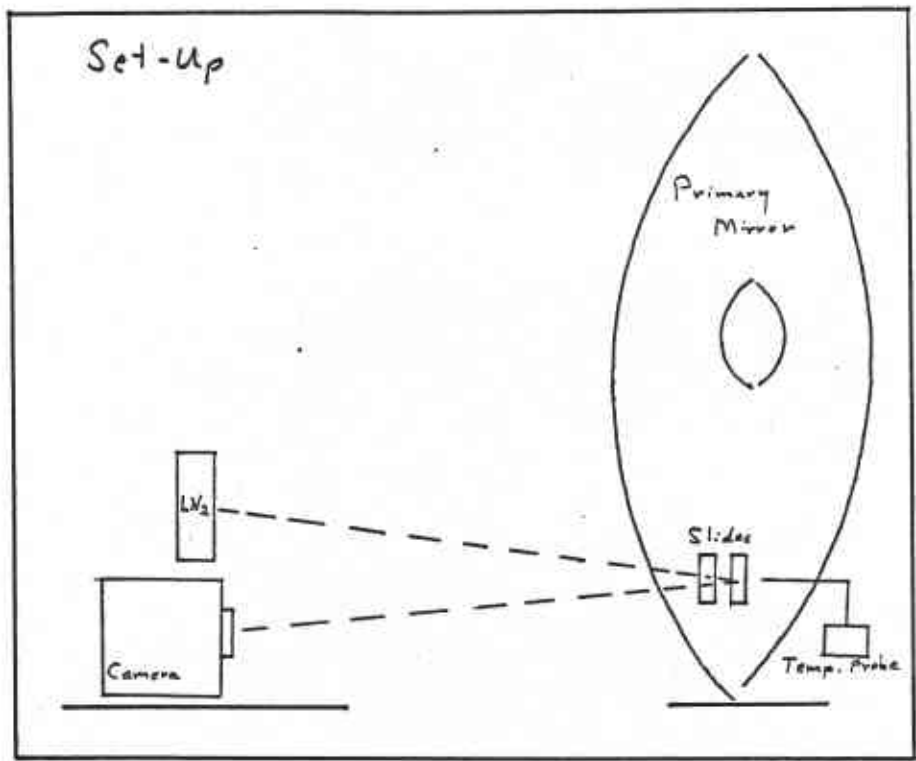
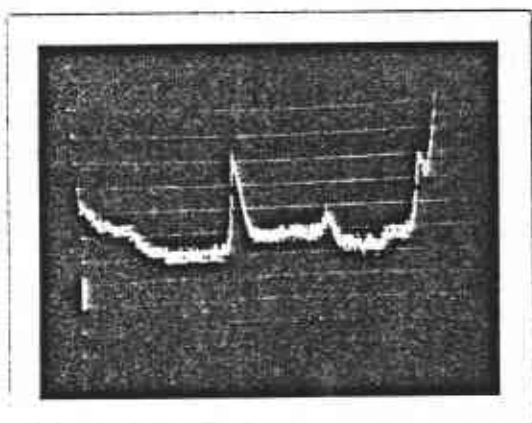


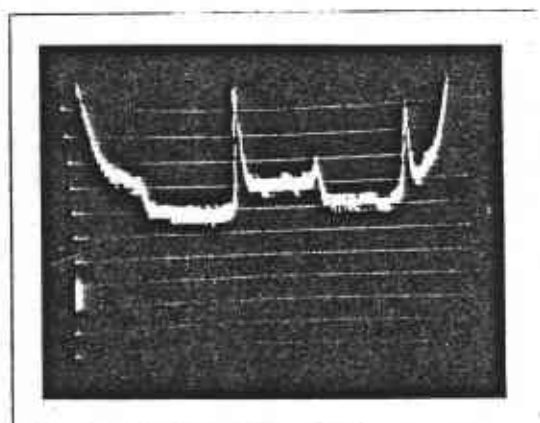
Figure 1



↑ Silver Slide ↑ Primary A^{*} ↑ Aluminum slide

10° Scale - Line Scan

Primary A



↑ Silver Slide ↑ Primary B ↑ Aluminum slide

10° Scale - Line Scan

Primary B

Baselines are Arbitrary

Figure 2