MULTIPLE MIRROR TELESCOPE OBSERVATORY

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MMT Technical Memorandum 85-4

Subject: Progress Report on Using Etalons for Wavelength Calibration

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INTRODUCTION: The installation of the New Top Box with its comparison lamp illumination scheme has provided us with the flexibility needed to experiment with alternative sources for wavelength and flatfield calibrations. Unfortunately, the wide field of the illumination has caused the projected surface brightness of the Thorium-Argon (Th-Ar) lamp to decrease by a factor of 2.5 from the only-adequate level in the old top box. In an attempt both to alleviate this problem and to provide a better wavelength-calibration source, we are experimenting with using the Edser-Butler bands produced when parallel plates (Etalon) are illuminated with collimated white light as wavelength calibration features. These experiments were begun in the Winter of 1984-5, were not productive until the New Top Box was installed. The purpose of this memo is to report on some recent experiments which we believe demonstrate the promise of using etalons for wavelength calibration.

BASIC DEFINITIONS: For the purpose of this discussion, we consider an etalon to be composed of two flat, partially transmitting mirrors which are parallel to each other. In the case considered here we use an etalon from one of the PEPSIOS triplets (generously loaned to us by Dr. N. Carleton). The etalon is composed of two plates separated by air. Each plate has a partially-transmitting coating on one surface and an anti-reflection coating on its other surface. The latter surface is slightly wedged with respect to the former to avoid forming additional cavities.

When the cavity formed by the two partially-transmitting surfaces is illuminated with a beam of coherent monochromatic light, it will transmit the beam when the optical path length between the surfaces is such that constructive interference occurs. Conversely, illumination with parallel white light produces an output spectrum of fringes with near-constant spacing (the so-called Edser-Butler bands). The condition for constructive interference for a transmitted wavefront is:

$$2nd\cos\theta = m\lambda \qquad (1)$$

where:

n = the refractive index of the medium between the reflecting surfaces,
d = the spacing between the reflective surfaces,