



Polarization Phase-Compensating Coats for Metallic Mirrors

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A method of compensating for or minimizing phase differences between orthogonal polarizations of light reflected from metallic mirrors at oblique incidence, as, for example, from weakly curved mirrors, is undergoing development. The method is intended to satisfy a need to maintain precise polarization phase relationships or minimum polarization differences needed for proper operation of telescopes and other scientific instruments that include single or multiple mirrors. The basic idea of the method is to optimally coat mirrors with thin engineered layers of materials that introduce phase differences that, as nearly precisely as possible, are opposite of

the undesired phase differences arising in reflection with non-optimum coatings. Depending on the specific optical system, the method could involve any or all of the following elements:

- Optimization of a single coat on all the mirrors in the system.
- Optimization of a unique coat for each mirror such that the polarization phase effects of the coat on one mirror compensate, to an acceptably high degree over an acceptably wide wavelength range, for those of the coat on another mirror.
- Tapering the coat on each mirror. Optimization could involve the choice

of a single dielectric coating material and its thickness, or design of a more-complex coat consisting of multiple layers of different dielectric materials and possibly some metallic materials. Such designs and coatings are particularly significant and needed for obtaining very high quality of wavefront required in high-contrast imaging instruments such as the NASA Terrestrial Planet Finder Coronagraph.

This work was done by Kunjithapatham Balasubramanian of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-41396

Tunable-Bandwidth Filter System

Pass bands can be tuned rapidly across the visible and near infrared spectrum.

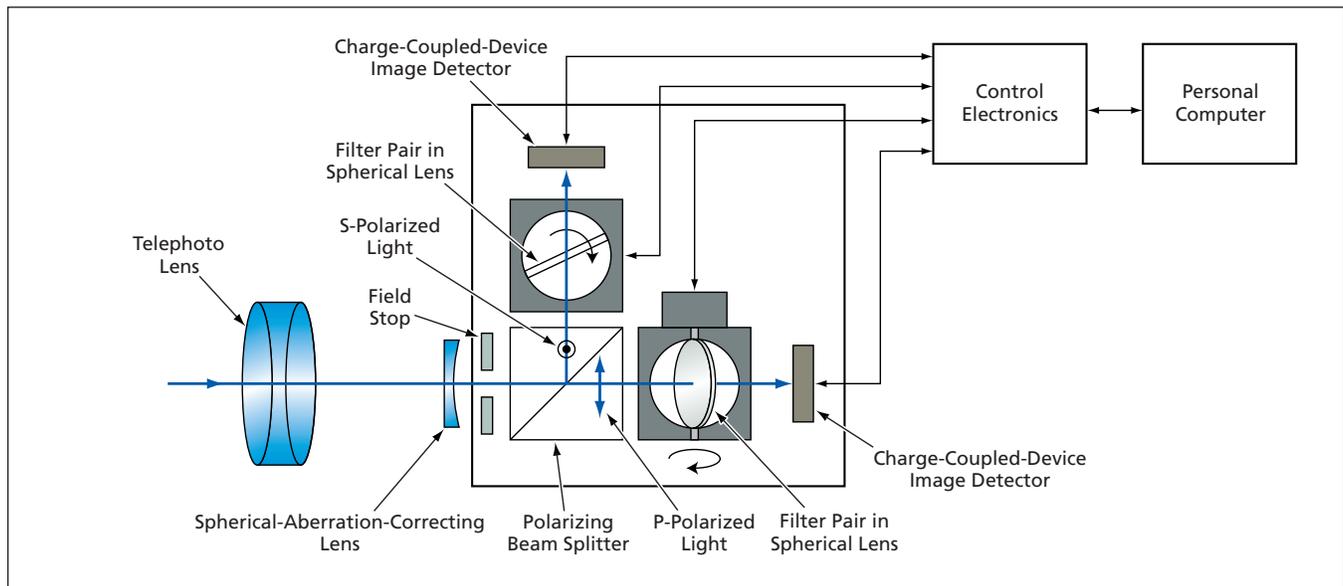
Stennis Space Center, Mississippi

A tunable-bandwidth filter system (TBFS), now undergoing development, is intended to be part of a remote-sensing multispectral imaging system that will operate in the visible and near infrared spectral region (wavelengths from 400 to 900 nm). Attributes of the TBFS include

rapid tunability of the pass band over a wide wavelength range and high transmission efficiency. The TBFS is based on a unique integration of two pairs of broadband Raman reflection holographic filters with two rotating spherical lenses. In experiments, a prototype of the

TBFS was shown to be capable of spectral sampling of images in the visible range over a 200-nm spectral range with a spectral resolution of ≈ 30 nm.

The figure depicts the optical layout of a prototype of the TBFS as part of a laboratory multispectral imaging sys-



A Laboratory Prototype of the TBFS contains two rotating spherical lenses containing broadband Raman reflection holographic filters. The pass band of each filter varies with the angle of incidence. Hence, the rotations are coordinated to obtain coordinated variations of the pass bands with time.

tem for the spectral sampling of color test images in two orthogonal polarizations. Each pair of broadband Raman reflection holographic filters is mounted at an equatorial plane between two halves of a spherical lens. The two filters in each pair are characterized by steep spectral slopes (equivalently, narrow spectral edges), no ripple or side lobes in their pass bands, and a few nanometers of non-overlapping wavelength range between their pass bands. Each spherical lens and thus the filter pair within it is rotated in order to rapidly tune its pass band. The rotations of the lenses are effected by electronically controlled, programmable,

high-precision rotation stages. The rotations are coordinated by electronic circuits operating under overall supervision of a personal computer in order to obtain the desired variation of the overall pass bands with time.

Embedding the filters inside the spherical lenses increases the range of the hologram incidence angles, making it possible to continuously tune the pass and stop bands of the filters over a wider wavelength range. In addition, each spherical lens also serves as part of the imaging optics: The telephoto lens focuses incoming light to a field stop that is also a focal point of each spherical lens. A correcting lens in front of the

field stop compensates for the spherical aberration of the spherical lenses. The front surface of each spherical lens collimates the light coming from the field stop. After the collimated light passes through the filter in the spherical lens, the rear surface of the lens focuses the light onto a charge-coupled-device image detector.

This work was done by Tin Aye, Kevin Yu, Fedor Dimov, and Gajendra Savant of Physical Optics Corp. for Stennis Space Center.

Inquiries concerning rights for the commercial use of this invention should be addressed to the Intellectual Property Manager, Stennis Space Center, (228) 688-1929. Refer to SSC-00210-1.