HUBBLE OPTICS

Delivers One-Meter Lightweight Sandwich Mirror to NASA; To Launch One-Meter Line of Mirrors and Telescopes in 2015

Hubble Optics has announced that it has recently delivered a diffraction-limited one-meter parabolic lightweight sandwich mirror to NASA. The large primary mirror is indeed lightweight at just 90 kilograms (198.4 pounds).

The primary mirror is the first delivery in Hubble Optics' new line of very-large (up to one-meter) sandwich mirrors that Hubble Optics will offer in 2015. These mirrors will be available individually, as well as part of Hubble's offerings of Dobsonians and CDKs. The company will first release a UL24 f/3.3 soon after the first of the year and a UL32 f/3.3 around mid-spring 2015. Hubble Optics is also planning to launch its UL40 f/3.3 (one-meter Dob) in the fall of 2015, if not sooner.

The lightweight sandwich mirror delivered to NASA is constructed of plate glass, however new sandwich-mirror options will be available in either plate or Pyrex glass. These mirrors offer a thermally and structurally optimized open core with a dynamically-stable closed-back design. The design's rapid thermal response allows these mirrors to cool down up to 10 times faster than solid mirrors of similar thickness, while offering weight savings of up to 20 percent.

Hubble Optics Tong Liu provided the following explanation of the advantages of his mirror design:

Our telescope mirrors are manufactured in a strictly controlled temperature and humidity environment. Each mirror is carefully measured after it has reached equilibrium in our laboratory. While cooling, gradients in the mirror will cause deformation of the surface, and the aberrations induced by these gradients will be proportional to the CTE of the substrate. These gradient-induced aberrations die out as the mirror cools and equilibrates.

The main problem is not the aberrations due to deformation, but the layer of warm air in front of the primary mirror. This layer of warm air is the main cause of the image distortion called "mirror seeing," which is caused by the non-uniform index of diffraction in the cooler air over the warm mirror surface. No mirror, regardless of the type of glass used, will perform adequately until the mirror is close to the temperature of the ambient air. This occurs when the temperature difference between the glass and air is less than one degree centigrade (°C), and best performance is achieved when this difference is less than 0.2 °C.

Therefore, the goal is to bring the temperature of the mirror to within 0.2 °C of the ambient air temperature as quickly as possible. This will greatly reduce image distortion due to mirror seeing. This is why all large professional mirrors, regardless of the type of glass used, employ complicated cooling systems to cool the primary mirror. For example, the Advanced Technology Solar Telescope (ATST) 4.24-meter primary mirror uses a jet cooling system.

For any mirror, cross-section thickness of the glass is the primary factor in determining the thermal time temperatures during observing or imaging; your full-thickness mirror may never reach equilibrium and never reach its full optical potential. This is one of the major reasons why our lightweight-sandwich mirror has superior optical performance in real world situations, even without an active cooling system. (Active cooling systems, such as fans, introduce their own serious problems, such as micro vibration, which can seriously degrade the image quality if not done correctly.) Our mirrors reach equilibrium extremely fast, and without aid.

So, with our lightweight-sandwich mirror, what is measured in the laboratory is observed in the field.

To learn more, please visit www.hubbleoptics.com.