A CSO SUBMILLIMETER ACTIVE OPTICS SYSTEM

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Active surface correction of the Caltech Submillimeter Observatory (CSO) primary mirror has been accomplished. The Dish Surface Optimization System (DSOS) has been designed and built to operate at the CSO, on Mauna Kea, Hawaii. The telescope consists, in part, of an 84-hexagonal paneled 10.4-meter primary dish designed by Robert Leighton. The DSOS corrects the dish surface figure for imperfections and gravitational deformations, as the dish moves in elevation during observations. This improvement in the telescope's aperture efficiency aids observations at the shorter wavelengths, specifically in the 350-μm-wavelength range.

There are 99 steel rod standoffs that interface the dish panels to its backing structure. Each standoff is now fitted with a heating/cooling assembly. Applying a controlled potential to each of the 99 assemblies adjusts the surface of the dish. Heating elongates and cooling shortens the standoffs, providing the push or pull on the primary's panel surface. The needed correction for each standoff, for a given elevation, is determined from stored holography maps of the dish surface.

The CSO's telescope, before corrections, has an optimum aperture efficiency of 33% at 350 μm. With a correctly adjusted DSOS, the telescope could have an improved efficiency of up to 66%. This improvement of a factor of 2 is the predicted limit determined by individual panel imperfections and other errors not accessible to the DSOS.

From holography, the latest measured optimum surface accuracy of the telescope is about 13 μm RMS, with the DSOS on. The decrease from 25 μm RMS (without the DSOS) to 13 μm RMS, translates to an improvement in aperture efficiency from 33% to 62% at the 350-μm-wavelength range. Further system improvements have been performed since these measurements.

The DSOS has been in operation on the CSO since February 2003. Observers using the SHARCII (a 384 pixel submillimeter high angular resolution camera) and the 850 GHz heterodyne receiver, have been able to detect new weak and/or distant objects with the help of this active optics system.

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