Subsystem

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ABSTRACT:

Keck Differential Phase planet detection system requires a picometer accuracy, large (2 um to 4 um) amplitude optical path-length modulator that can operate at fairly high frequencies (250 Hz, 750 Hz, and 1250 Hz, a partial, triangular wave motion).

The path-length modulator consists of a large (5") aperture, open faced retro-reflector mounted on a magnetic, voice-coil type drive system. The corner of the retro-reflector, which is avoided by the modulated starlight is ground off, and a flat laser line partial reflector is mounted on the retro-reflector to align its reflecting surface with the virtual corner of the open faced retro-reflector.

The gauge probe beam, which is launched behind the retro-reflector, strikes the flat partial reflector. A large part of the beam is reflected back towards the gauge and it is used to control the motion of the retro-reflector. The smaller part of the beam that goes through the partial reflector bonded to the ground-off corner of the retro-reflector is used to align the direction of starlight beam that reflects of the faces of the hollow retro-reflector to the direction of the motion of the retro-reflector path modulation.

We have developed a gauge which is capable of reaching a sensitivity of at least 3 pm per sqrt(Hz) with a band width of 1 Hz at 250 Hz, 750 Hz, and 1250 Hz. Two of these gauges are being built. The gauges will be compared to each other while monitoring a common optical path-length modulator to determine their accuracy.

In this paper, the gauge construction details, the results of the gauge accuracy tests as well as the final path-length modulator performance details will be presented.

The research described is performed at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

KEY WORDS: Ground-based stellar interferometry, high precision metrology, picometer metrology

BRIEF BIOGRAPHY:

The author is a member of the technical staff in the Interferometry Metrology and Optics group of the Interferometry and Large Optical Systems section at JPL. After getting his Ph. D. from Caltech, he has worked in the Gravitational Physics Group at Caltech, in the Artificial Intelligence Laboratory at MIT and in the LIGO Project at Caltech as a Staff Scientist.
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