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Single and Double Bracewell Nulling Interferometer in Space

T. Velusamy[1] , R.P. Angel[2] , A. Eatchel [2], D. Tenerelli [3], N.J Woolf [2]
[1]Jet Propulsion Laboratory/Caltech
[2] University of Arizona, Tucson
[3]Lockheed Martin Missiles and Space

As part of a NASA NRA study we have examined the design and use of a small Bracewell nulling interferometer for space observations of jovian and terrestrial planets in the 4-12 micron spectral region. Bracewell originally considered such an interferometer for observation of jovian planets at wavelengths near 40 microns where the star planet contrast is about 2. 10^{-5}. At the shorter wavelengths the contrast is more typically 10^{-7} for most planets though younger and/or more massive Jovian planets may have a contrast as much as 100 times better. Also, planets further from their star than Earth may be better nulled because the interferometer does not appreciably resolve the stellar disk. We find that discrimination against local zodiacal background and thermal fluctuation of the interferometer can be well determined by dithering or chopping. Distinguishing the planet from the star and local zodiacal background is much harder, and requires both high stability and gain for the IR detectors, and high stability of nulling over periods of hours. While massive/young "Jupiters" far from their star are not difficult to observe, a scientific program to study planetary systems is much harder. We are currently comparing the difficulties of a two telescope nuller with those of a dual Bracewell nuller using four telescopes.