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Spectroscopic Planetary Detection

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Strategy

One of the most promising methods for the detection of extra-solar planets is the spectroscopic method, where a small Doppler shift (~10 meters/sec) in the spectrum of the parent star reveals the presence of planetary companions. However, solar-type stars may show spurious Doppler shifts due to surface activity. If these effects are periodic, as is the solar activity cycle, then they may masquerade as planetary companions. The goal of this investigation is to determine whether the solar cycle affects the Doppler stability of integrated sunlight. Observations of integrated sunlight are made in the near infrared (~2 μm), using the Kitt Peak McMath Fourier transform spectrometer, with an N_2O gas absorption cell for calibration. We currently achieve an accuracy of ~5 meters/sec.

Progress and Accomplishments

We have been monitoring the apparent velocity of integrated sunlight since 1983. We initially saw a decrease of ~30 meters/sec in the integrated light velocity from 1983 through 1985, but after 1987 the integrated light velocity returned to its 1983 level. It is plausible that these changes are solar-cycle related, but it is still too early to be sure.

Projected Accomplishments

Wallace et al. (1988, Ap.J. **327**, 399) found that the relative wavelengths of lines in integrated light were stable over the solar cycle, and they concluded that planetary companions were detectable. However, in a recent analysis of the extensive Mt. Wilson data, Ulrich and coworkers found evidence for large scale flows with amplitudes up to 50 meters/sec. Since such flows will affect all lines, they will not be seen in relative line shifts, but they may have a significant impact on spectroscopic planetary detection. However, our continued monitoring of integrated sunlight will detect such effects if they are present, since our measurements are absolute. When solar maximum has passed (>1991), we should know whether the changes seen earlier in integrated light velocity are periodic with the solar cycle, and to what extent large scale flows present a limitation to spectroscopic planetary detection.

Publications

"On the Apparent Velocity of Integrated Sunlight," D. Deming, F. Espenak, D. E. Jennings, J. W. Brault and J. Wagner 1987, Ap.J. **316**, 771-787.