A LONG-TERM RADIAL VELOCITY PROGRAM OF HIGH ACCURACY WITH A SMALL TELESCOPE

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We are making accurate observations of the change in Doppler shift of stellar absorption lines. The purpose is to detect the oscillatory reflex motion due to planets orbiting stars. The scrambling of incident light by an optical fiber and the stability of wavelength calibration by a Fabry-Perot etalon provide immunity to systematic errors. Selecting several echelle diffraction orders in the vicinity of 4250-4600 A, which are imaged on a CCD, about 350 points on the profile of the stellar spectrum are sampled by successive orders of interferometric transmission through the etalon. At 4300 A each interference order is 47 milliangstroms wide and the sample points are 0.64 A apart, causing distinct, widely-spaced monochromatic images of the entrance aperture to be formed in the focal plane of the camera. Changes in Doppler shift modify the relative intensities of these images, according to the slope of the spectral profile at each point sampled. To simplify operation and enhance sensitivity, the instrument is being operated as a null-measurement accelerometer, responding only to changes in radial velocity. With an argon emission line lamp the interferometer is calibrated to two parts in 100 million; this corresponds to $\pm$ 6 meters/sec in Doppler shift. These calibrations show instrumental variations of $\pm$ 27 meters/sec on a time scale of months; observations of stars are corrected for such changes. The internal repeatability of observations of the differential Doppler shift of Arcturus (K1 IIIb; B=1.19) is $\pm$ 6 meters/sec for each exposure of 600 square meter-seconds. These exposures are obtained in 15-20 minutes with a 0.9-meter telescope. The external repeatability (day-to-day differential accuracy) of nightly averages of stellar observations is $\pm$ 20 meters/second.

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