RADIAL VELOCITY SPECTROMETERS ON THE DOMINION ASTROPHYSICAL OBSERVATORY 1.2m AND 0.4m TELESCOPES

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1. 1.2m COUDE SPECTROMETER

A photoelectric radial velocity spectrometer has been in operation for several years at the coudé focus of the 1.2m telescope of the Dominion Astrophysical Observatory (DAO). The design of this instrument has been described by Fletcher et al. (1982) and by McClure et al. (1984). These papers discuss the similarities and differences between this spectrometer and others of its type such as that constructed by Griffin and Gunn (1974) at Palomar. The spectrum mask in the present instrument consists of more than 700 transparent slots on an opaque background, representing the spectrum of a K giant star, plus a few slots to coincide with the argon lines in a cadmium-argon discharge tube for use in obtaining comparison arc velocities. By progressively tilting the slots an appropriate amount along the mask and scanning by moving the mask relative to the stellar spectrum at 45° to the dispersion it is possible to retain a spectral match at non-zero velocities. The masks are produced using a standard measuring engine modified with stepping motors controlled by a computer to position and tilt the slots. Since guiding errors are our major source of error we hope to make a significant improvement in this area in the following manner. By inserting an image rotating prism behind the slit a 180° rotation of the slit will occur when the prism is rotated. Although this has not yet been tested, it is hoped that by making this rotation every few scans the effects of guiding errors due to uneven illumination of the slit and collimator will be vastly reduced.

One of the main uses of the 1.2m radial velocity spectrometer has been to accurately monitor the velocities of carbon and related stars such as Ba II and CH stars. The significance of this work has been discussed recently by McClure (1985); to summarize, the Ba II and CH stars appear to be almost all spectroscopic binaries, whereas the R type carbon stars appear to exhibit a normal frequency of multiplicity. Numerous other spectroscopic binary programs are also being pursued by various observers, the instrument being especially suited for such work where an approximate velocity can be predicted beforehand so that an inordinate range of velocity need not be scanned. Another research area for which the instrument is being used extensively is in cluster velocity dispersion and membership studies. Numerous velocities have

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been obtained in the old open clusters NGC 188 and NGC 7789 and in the globular clusters M 71 and M 3 among others.

2. 0.4m SPECTROMETER

A second photoelectric radial velocity spectrometer has recently been constructed at the DAO for operation at the cassegrain focus of the 0.4m telescope. This telescope has a small off-axis spectrograph designed by Richardson and Brealey (1973), which has been modified to incorporate a Pechan roof prism which can be scanned behind the slit. This has the effect of scanning the spectrum back and forth at the focus of the spectrograph where a stationary spectrum mask is placed. The prism is scanned at 45° to the spectrum dispersion and the tilt of the slots in the mask again provides a match to the spectral dispersion as in the coudé instrument. The mask includes over 300 lines in the wavelength region 415-485 nm based on the spectrum of a K giant star, plus a few argon lines to match a cadmium-argon comparison spectrum. The light is collected at the photocathode of a photomultiplier tube, the grating being imaged by a simple fabry lens. The modifications to the spectrograph to make this velocity spectrometer were accomplished by the purchase of a few components such as a photomultiplier tube chamber, accurate bearings to hold the scanning screw, and the Pechan prism, and by a modest amount of machining in the observatory instrument shop. The control of the scanning and photon counting is done with an Apple II computer.

This velocity scanner has recently been tried on the 0.4m telescope with very promising results, but it is not yet in use. The accuracy appears to be about 2 km s^{-1} if care is taken to obtain comparison velocities before and after each stellar observation. The instrument is inconvenient to use in this form, however, because flexure in the spectrograph moves the zero point of the velocities significantly with position in the sky. As with photographic velocity measurements, therefore, an observation of the comparison spectrum must be made before and after the stellar observation. To eliminate many observations of the comparison and reduce guiding errors, we have been experimenting with feeding the spectrograph by an optical fiber so that the spectrograph can be placed in a stationary position nearby. We do not have extensive observations, but from preliminary measurements it appears that the end result will be an improvement in the accuracy of the velocities to about 1 km s^{-1}.

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