

[18.14] Externally Dispersed Interferometry with the Lick Observatory Echelle Spectrograph

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We demonstrate stellar and solar measurements of full-bandwidth echelle spectra using an externally dispersed interferometer (EDI). Spectral resolution of $\sim 120k$ has been obtained using the $\sim 60k$ resolution CAT facility at the Lick Observatory. The EDI is a series combination of a fixed delay interferometer and a grating spectrograph that increases the spectrograph's effective resolution by factors of 2 to 3. EDI uses a heterodyning effect to shift the input spectrum's high spectral resolution information to lower spatial frequencies that are less sensitive to the resolution limit caused by the spectrograph slit size and by the Nyquist limit of the detector. The resolution-boosted spectra is obtained by numerically reversing the heterodyning effect and combining these data with the ordinary spectrum simultaneously acquired within the EDI data. The interferometer fringes imprinted on the spectrum are exactly periodic in frequency space and acts as a fiducial net that uniformly covers the entire echelle bandwidth. Instrumental distortions that deviate the stellar signal also deviate these fiducial fringes, so the measurement, in comparison to a classical echelle data, is extremely robust to beam profile errors. Our method uses a uniform-phase interferometer fringe at the spectrograph entrance slit. Therefore the spectrograph may use either a 2d-echelle or slit-imaging format. The EDI has applications in Doppler radial velocimetry and high resolution spectroscopy. Work was partially supported by CalSpace/Lockheed, and NASA SARA research grants NAG5-9091 and NAG5-3051. This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

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