[48.11] Improving Spectrograph Resolution Six-fold using Interferometry

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The effective spectral resolution of an optical grating spectrograph was boosted by a factor of six, from R = 25,000 to R = 140,000 by placing a small unequal-arm interferometer in the beam path. This "externally dispersed interferometer" creates a grid of precise sinusoidal wavelength fiducials over the entire spectrograph bandwidth. Interaction with narrow spectral features of the input spectrum creates moiré patterns that are recorded in combination with the conventional spectrum. The conventional spectrum and moiré patterns are separated algebraically using a phase stepping method. Narrow spectral features, otherwise unresolvable by the grating alone, can be recovered from the moiré patterns. Single delay recordings can boost spectrograph resolution by a factor of a few. We demonstrate that resolution can be improved by even larger factors by compositing recordings taken with several different interferometer delays. 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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