Search for planets yields shockwave breakthrough

By Anne M. Stark

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The idea started out as a 1998 Laboratory Directed Research and Development pilot project put together by physicist David Erskine, of the Photonics and Associated Technology Directorate. The concept involved using a long baseline interferometer that is sensitive to Doppler shifts in the light emitted by a star. The instrument truly helped reduce the uncertainty in the speed of a star relative to the observer.

While taking a year off for a sabbatical, Erskine worked on the theoretical aspect of the EDI and began to think of other applications for the device. Soon, he realized it could be used to boost the time resolution and stability of streak cameras recording high-speed phenomena, such as in shockwave physics experiments conducted at the National Ignition Facility. The time resolution boosting is analogous to a two-times spectral resolution boost he and UC Berkeley collaborators have recently demonstrated at the Lick Observatory spectrograph.

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By David Erskine in front of the 10-meter-diameter South African Large Telescope (SALT). The telescope designers are interested in using Erskine's EDI technique to boost the performance of their spectrograph.

The moiré effect is a heterodyning effect caused by the interference of two or more spatially overlapping patterns. In the case of the EDI, the moiré pattern shifts transversely, proportional to the Doppler velocity. Spectrograph distortions can prevent a precision measurement of the Doppler shift, but by using the EDI, the small Doppler shifts of exoplanets can be measured.

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The motion of a planet around a star causes a Doppler shift in the wavelength of the light. Light passing through the periodic fringes of an interferometer (and then into the spectrograph) creates a moiré pattern. The moiré pattern shifts transversely, proportional to the Doppler velocity. Spectrograph distortions can prevent a precision measurement of the Doppler shift, but by using the EDI, the small Doppler shifts of exoplanets can be measured.

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