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Using the Heterodyne Method to Measure Velocities on Shock Physics Experiments[1]

OLIVER STRAND, Lawrence Livermore National Laboratory

Velocimetry is an important diagnostic for shock physics experiments. Velocities for these types of experiments can be in the kilometer-per-second range. We have developed a new velocimetry diagnostic for use on shock physics experiments that is based upon the heterodyne method. This diagnostic is easily assembled from commercially available parts developed for the telecommunication industry. The entire system uses single mode fibers to transport the signals from the laser to the probes and back to the detectors. We mix the Doppler-shifted light from the moving surface with non-shifted light from the laser itself to generate a beat signal at the detector. For this system using 1550 nm lasers, a velocity of 1 km/s generates a beat signal of 1.29 GHz. The detectors and the digitizers must have high-bandwidth capabilities to faithfully follow the beat waveform to allow a determination of the frequency as a function of time. Our current system has a maximum velocity capability of over 5 km/s. This paper will describe the heterodyne velocimeter and will present some of the data that has been taken with it. 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.

[1]In collaboration with Tony Whitworth, Lawrence Livermore National Laboratory.