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Extending "Postage-Stamp PIV" to MHz Rates for Measurement of Turbulent Velocity Spectra STEVEN BERESH, RUSSELL SPILLERS, MELISSA SOEHNEL, SETH SPITZER, Sandia National Laboratories — Previously, time-resolved particle image velocimetry using a pulse-burst laser demonstrated direct measurement of turbulent velocity spectra at very high frequencies without frozen turbulence assumptions. By accepting reduced laser pulse energy and confining the measurement to a field of view of only 128 x 120 pixels, sequences of 4000 images at 400 kHz were acquired, giving rise to the moniker of "postage-stamp PIV." Still, the data reached frequency limitations of approximately 120 kHz due to noise interference. To raise the effective frequency response, the increased speeds of the most recently available cameras obtained data at a sampling rate of 990 kHz, but require overcoming drawbacks in these cameras that can have unfortunate properties for accurate PIV measurements. The increased framing rate oversamples the data and therefore a conventional image-pair correlation can be replaced by multiple-frame image interrogation. The increased accuracy of multiple-frame methods lowers the noise floor and therefore reveals higher-frequency content showing deviation from the theoretical -5/3 power law of the inertial subrange, likely because the turbulent fluctuations have not reached isotropy.

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