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Towards stabilizing laser-plasma accelerators through single-shot non-perturbative monitoring of the high-power final focus properties of 100-TW-class laser pulses[1] FUMIKA ISONO, JEROEN VAN TILBORG, SAM BARBER, JOSEPH NATAL, CURTIS BERGER, HAI-EN TSAI, TOBIAS OSTERMAYR, CAMERON GEDDES, ERIC ESAREY, Lawrence Berkeley National Laboratory — High-power laser systems are now routinely employed at labs all over the world, ranging from peak powers of 10s of TW (teraWatt) to multi-PW (petaWatt) and beyond. While attracting great interest due to their compact footprint compared to alternative technologies, the non-linear physics at play in the high-power laser-plasma interactions makes the applications highly sensitive to shot-to-shot fluctuations. Here, we present an on-line non-perturbative monitoring of the high-power laser focus position using a weaker back-surface-reflected fully-correlated copy of the high-power beam (the "witness beam"). This system works both for the 5 Hz amplified pulses as well as for the kHz background pulse train. . The kHz diagnostic revealed a pointing jitter spectrum dominated by environmental fluctuations below 100 Hz, which thus has the potential to be corrected by fast piezo feedback. We also found that the centroids between the 1-Hz amplified pulses and the temporally-adjacent 1-kHz background pulses were well correlated, which suggests that the pointing of the 100-TW-class laser can be actively controlled through stabilization of the kHz beam.

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