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Frequency-Domain Tomography for Single-shot, Ultrafast Imaging of Evolving Laser-Plasma Accelerators ZHENGYAN LI, RAFAL ZGADZAJ, XIAOMING WANG, MICHAEL DOWNER, University of Texas at Austin — Intense laser pulses propagating through plasma create plasma wakefields that often evolve significantly, e.g. by expanding and contracting. However, such dynamics are known in detail only through intensive simulations. Laboratory visualization of evolving plasma wakes in the "bubble" regime is important for optimizing and scaling laser-plasma accelerators. Recently snap-shots of quasi-static wakes were recorded using frequency-domain holography (FDH). To visualize the wake's evolution, we have generalized FDH to frequency-domain tomography (FDT), which uses multiple probes propagating at different angles with respect to the pump pulse. Each probe records a phase streak, imprinting a partial record of the evolution of pump-created structures. We then topographically reconstruct the full evolution from all phase streaks. To prove the concept, a prototype experiment visualizing nonlinear index evolution in glass is demonstrated. Four probes propagating at 0, 0.6, 2, 14 degrees to the index "bubble" are angularly and temporally multiplexed to a single spectrometer to achieve cost-effective FDT. From these four phase streaks, an FDT algorithm analogous to conventional CT yields a single-shot movie of the pump's self-focusing dynamics.

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