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Direct measurements of pulse-front steepening and erosion in a laser wakefield accelerator at laser powers up to 150 TW S.P.D. MANGLES, J. SCHREIBER, C. BELLEI, S. KNEIP, S.R. NAGEL, C.A.J. PALMER, Z. NAJMDUDIN, Imperial College London, T. IBBOTSON, N. BOURGEOIS, S. HOOKER, University of Oxford, M. STREETER, D.R. SYMES, P.P. RAJEEV, Rutherford Appleton Laboratory — We report on the direct observation of pulse front erosion and compression due to the propagation of intense laser pulses (55 - 70 fs, 1 - 10 J) in centimeter scale plasmas at densities relevant for laser wakefield acceleration experiments. Pulse front erosion affects the group velocity of the pulse and ultimately the energy gain in the wakefield accelerator. The measurements were performed on the Astra Gemini laser at RAL using a frequency resolved optical gating technique. Particle-in-cell simulations are used to support the results. At high pulse energies (up to 10 J) the generation of a high-amplitude plasma wave leads to significant pulse compression and pulse front steepening, resulting in highly asymmetric laser pulses of sub-20 fs duration. Aspects of the pulse shape indicate that cavitation has occurred in the first wave period, i.e. that the bubble or blow out regime has been reached.

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