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Pump-Probe Study of Relativistic Transparency[1] A. ZINGALE, D. M. NASIR, N. CZAPLA, P. POZDERAC, G. TISCARENO, R. L. DASKALOVA, N. RAHMAN, D. W. SCHUMACHER, Ohio State Univ - Columbus — When a relativistically intense laser interacts with an over-dense plasma, the electrons will be accelerated to relativistic velocities within a single optical cycle. The associated mass increase leads to a reduction of the critical plasma frequency, allowing the laser to propagate through the plasma. This effect, often referred to as relativistic induced transparency (RIT), plays an important role in many solid density laser-plasma experiments. Despite its prevalence, few direct experimental studies of the dynamics of this effect exist (for example, Bagnoud et al. PRL 118 255003(2017) and Palaniyappan et al. Nat. Phys. 8, 763–769(2012)), and none for <100 fs pulses. Here we present results of a pump-probe study of RIT carried out at the Scarlet Laser Facility at The Ohio State University. A p-polarized pump with peak intensity $>10^{21}$ W/cm^2 was incident on ˜23 nm liquid crystal targets at 45 degrees, simultaneously a 200 mJ pick-off with linear 45 degree polarization probed the target from the rear side at near normal incidence. The transmission of the pump and probe (resolving s and p polarized components) was measured over a delay range of 15 ps. An increase in probe transmission was observed at zero delay which persists for ˜300 fs. The plasma then becomes opaque again before expansion leads to classical transparency after about 2.5 ps. This is the first direct measure of temporal dynamics of RT in the <100 fs regime.

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