Self-compression of few-millijoule laser pulses in non-linear plasma waves\textsuperscript{1} ZHAOHAN HE, BIXUE HOU, JOHN NEES, KARL KRUSHEL-NICK, ALEXANDER THOMAS, Center for Ultrafast Optical Science, University of Michigan Ann Arbor — Study of relativistic short laser pulse propagation in under-dense plasma is of great interest in high field science, attosecond physics and applications such as plasma based accelerators. Temporal shortening of a laser pulse that drives nonlinear plasma wakefield has been observed using 100TW-class lasers interacting with millimeter scale plasma [1,2]. Here we report on experiments performed using the high repetition rate Lambda-cubed laser at the University of Michigan - a table-top sub-TW power laser systems operating at 500 Hz. The laser (pulse energy up to 8 mJ) was tightly focused (peak intensity $\sim 3 \times 10^{18} W/cm^2$) into a 100 $\mu$m scale length gas jet to generate a plasma with electron density $\sim 10^{19} cm^{-3}$. The temporal and spectral intensity and phase of the transmitted pulse was measured using second-harmonic-generation (SHG) frequency-resolved optical gating (FROG). The laser pulse was shortened from 37 fs to 16 fs with >90% energy transmittance. The dependence on focusing condition, laser intensity and plasma density will be discussed.


\textsuperscript{1}This work was funded by NSF/DOE under grant (PHY-09-03557).