Abstract Submitted
for the DPP16 Meeting of
The American Physical Society

Energy Density in Aligned Nanowire Arrays Irradiated with Relativistic Intensities: Path to Terabar Pressure Plasmas[1] J ROCCA, C BARGSTEN, R HOLLINGER, V SHYLAPTSEV, S WANG, A ROCKWOOD, Y WANG, D KEISS, Colo State Univ, M CAPELUTO, Departamento de Fsica, Universidad de Buenos Aires, V KAYMAK, A PUKHOV, Institut frTheoretischePhysik,Heinrich-Heine-Universitt Dsseldorf, R TOMMASINI, R LONDON, J PARK, LLNL, Livermore, CA — Ultra-high-energy-density (UHED) plasmas, characterized by energy densities >1 x 10^8 J cm^{-3} and pressures greater than a gigabar are encountered in the center of stars and in inertial confinement fusion capsules driven by the world's largest lasers. Similar conditions can be obtained with compact, ultra-high contrast, femtosecond lasers focused to relativistic intensities onto aligned nanowire array targets. Here we report the measurement of the key physical process in determining the energy density deposited in high aspect ratio nanowire array plasmas: the energy penetration. By monitoring the x-ray emission from buried Co tracer segments in Ni nanowire arrays irradiated at an intensity of 4 x 10^{19} W cm^{-2}, we demonstrate energy penetration depths of several μm, leading to UHED plasmas of that size. Relativistic 3D particle-in-cell-simulations validated by these measurements predict that irradiation of nanostructures at increased intensity will lead to a virtually unexplored extreme UHED plasma regime characterized by energy densities in excess of 8 x 10^{10} J cm^{-3}, equivalent to a pressure of 0.35 Tbar.

[1]This work was supported by the Fusion Energy Program, Office of Science of the U.S Department of Energy, and by the Defense Threat Reduction Agency.

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Date submitted: 18 Jul 2016 Electronic form version 1.4