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Proton and Ion Acceleration on the Contrast Upgraded Texas Petawatt Laser EDWARD MCCARY, REBECCA ROYCROFT, XUEJING JIAO, ROTEM KUPFER, GANESH TIWARI, CRAIG WAGNER, ANDREW YANDOW, PHILIP FRANKE, GILLISS DYER, ERHARD GAUL, TOMA TONCIAN, TODD DITMIRE, BJORN HEGELICH, Univ of Texas, Austin, CENTER FOR HIGH ENERGY DENSITY SCIENCE TEAM — Recent upgrades to the Texas Petawatt (TPW) laser system have eliminated pre-pulses and reduced the laser pedestal, resulting in improved laser contrast. Previously unwanted pre-pulses and amplified spontaneous emission (ASE) would ionize targets thinner than 1 micron, leaving an under-dense plasma which was not capable of accelerating ions to high energies. After the upgrade the contrast was drastically improved allowing us to successfully shoot targets as thin as 20 nm without plasma mirrors. We have also observed evidence of relativistic transparency and Break-Out Afterburner (BOA) ion acceleration when shooting ultra-thin, nanometer scale targets. Data taken with a wide angle ion spectrometer (IWASP) showed the characteristic asymmetry of BOA in the plane orthogonal to the laser polarization on thin targets but not on micron scale targets. Thick micron scale targets saw improvement as well; shots on 2 μm thick gold targets saw ions with energies up to 100 MeV, which broke the former record proton energy on the TPW. Switching the focusing optic from an f/3 parabolic mirror to an f/40 spherical mirror showed improvement in the number of low energy protons created, and provided a source for hundreds of picosecond heating of aluminum foils for warm dense matter measurements.

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