CONTRAST ENHANCEMENTS TO THE CPA BEAMLINES OF THE ORION LASER FACILITY

D.I. Hillier, D.A. Egan, S.P. Elsmere, M.T. Girling, N.W. Hopps, J.J. McLoughlin, S.J.F. Parker, P.A. Treadwell, D.N. Winter, and T.H. Bett
[1]AWE Plc. Reading, Berkshire UK
David.hillier@awe.co.uk

High peak power, high temporal contrast, laser pulses are the only way to generate the conditions required for a range of plasma physics experiments. Any light that reaches target before the main laser pulse can pre-heat heat the target reducing its density or even destroy it.

The two Orion chirped pulse amplification beamlines[1] consist of a common mode locked oscillator, stretcher, optical parametric amplifier (OPA), Nd:Glass rod and disc amplifiers, compressor and focusing optics each generating 500 J in 0.5 ps. The original beamline design had a nanojoule pulse from the oscillator stretched to ~6ns then amplified in the OPA. Parametric fluorescence from the OPA propagated along the system causing the main laser pulse to be proceeded by a pre-pulse/pedestal of ~3 ns duration at $\sim 10^{7\text{-}8}$ of its intensity.

In order to reduce the energy within this pedestal we have installed a short pulse (picosecond) optical parametric amplifier (SPOPA) between the modelocked oscillator and nanosecond stretcher. The SPOPA[2] is designed as a modular unit which stretches the seed pulse to ~5ps and amplifies it to 30uJ using an OPA with a pump seeded form the same source. This allows the gain of the nanosecond OPA to be decreased thereby reducing the parametric fluorescence proportionately and enhancing the nanosecond contrast to $\sim 10^{12}$.

It is also possible to run the SPOPA in conjunction with the frequency doubling system which we have previously reported[3]. By running these systems together we realize an estimated contrast of 10^{18} which is well beyond our current measurement capabilities.

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[1] Hopps et al "Overview of laser systems for the Orion facility at the AWE," App. Opt. 52, p3597 (2013).
[2] Hillier et al "Contrast enhancements to petawatt lasers using short pulse optical parametric amplifiers and frequency doubling" App. Opt 53 p6938 (2014)
[3] Hillier et al "Ultrahigh contrast from a frequency-doubled chirped-pulse amplification beam line," Appl. Opt. 52, p4258 (2013).