# Novel, 1Joule Class, 2.5Hz, Broadband OPCPA Front End for High Intensity Laser Systems

**Mikael Martinez*, Erhard Gaul, Joel Blakeney, Axel Jochmann, T. Borger, D. Hammond, R. Escamilla, M. Ringuette and Todd Ditmire**
Department of Physics, The University of Texas at Austin USA *mikaelm@physics.utexas.edu

## Background & Motivation

We report on a 1 J class, 2.5 Hz OPCPA centered at 1057 nm with greater than 35 nm bandwidth. This system seeds the Texas Petawatt Laser, a 200 J, 150 fs OPCPA , Mixed Nd:glass system currently in operation.

Optical Chirped Pulse Amplification (OPCPA) offers exciting new possibilities for high intensity lasers.

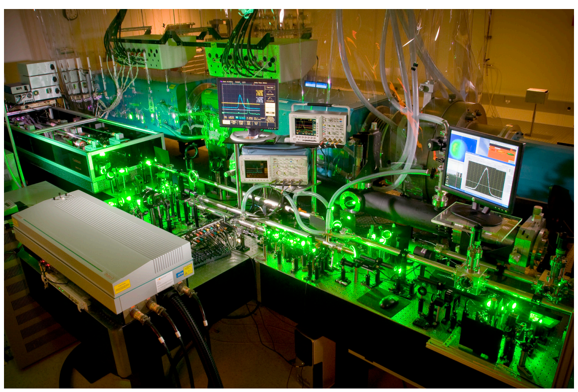
High optical gain ($10^9$) and broadband amplification (>35 nm) makes OPCPA a good candidate for seeding high intensity petawatt lasers.

OPCPA's broad bandwidth and ability to spectrally tailor pulses is attractive for seeding energetic, Nd:glass based petawatt lasers. This technique can pre-compensate for limited gain bandwidth and gain narrowing which limits pulse compression in this architecture.

This approach enables Nd:glass based lasers to break the 400 fs barrier and compress to around 150 fs.

I. Ross, P. Matousek *et al., Analysis and optimization of optical chirped pulse amplification, JOSA B* ***19, 2945-1956.***

M.D. Perry, D. Pennington, B.C. Stuart, G. Tietbohl, J.A. Britten, *et al, Petawatt Laser Pulses Optics Letters Vol. 24, No. 30.*



## System Design & Technical Approach

Our system is composed of three amplifier stages. Each stage uses a pair of walk off compensated crystals in a non-collinear, near degenerate configuration with one degree of separation between pump and seed.

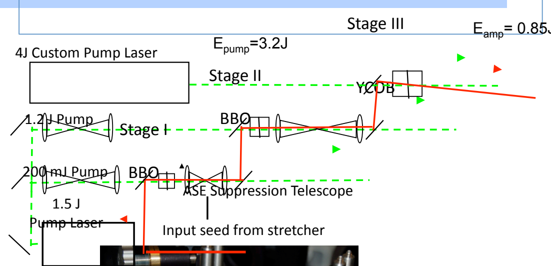
These amplifiers are pumped at 300MW/cm2 by two frequency doubled Nd:YAG lasers at 532 nm.

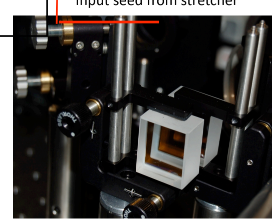
7 X 7 mm and 10 X 10 mm BBO crystals are used in Stages I & II. Stage III with apertures > 20mm, uses YCOB, a newly developed crystal.

YCOB is an extremely attractive solution for high average power and large aperture OPCPA . It offers gain close to BBO with the scalability of KDP.

The first two stages are pumped by a commercial, 1.5 J, 8 ns laser. The third stage is pumped by a custom laser specifically designed for OPCPA. It delivers a 2.5 Hz, 4 J, 4 ns pulses that are spatially uniform with user control of the pulseshape.

Parametric Amplified Spontaneous Emission (ASE) is problematic and mitigated using tight spatial filters and wedged crystals.

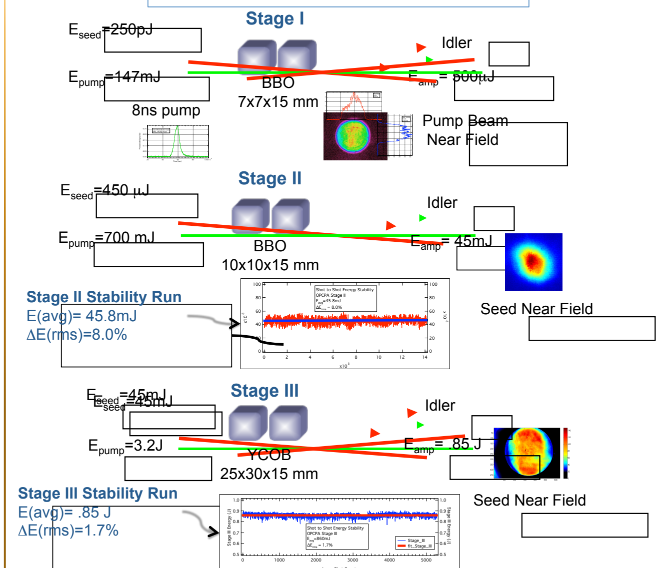


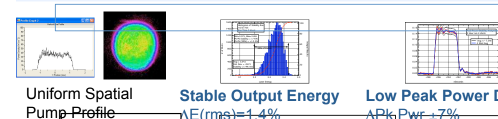
25 mm X 30 mm YCOB developed at LLNL, enables scaling of OPCPA apertures

Z Liao, I Javonovic, C. Ebbers, Y. Fei and B. Chai; *Energy and average power scalable optical parametric chirped pulse amplification in yttrium calcium oxyborate; Optics Letters, Vol. 31, No. 9.*

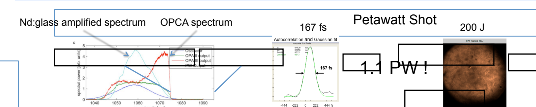
## Performance Results




High fidelity OPCPA pump lasers are critical for efficient amplification.




Using OPCPA for spectral compensation enables Nd:glass based peteawatts.




## Conclusion

We have demonstrated a spectrally controlled, stable, high energy OPCPA as a petawatt front end. We have demonstrated a 200 J 167 fs, 1.1 PW laser based on this front end.