

# Ti:Sapphire CPA booster amplifier for a 5 PW laser system

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## Introduction

In the recent years, 10 Peta-watt (PW) laser system is a hot topic in the field of laser technology. The Ti:sapphire (Ti:S) CPA system is still the main method to achieve PW and 10 PW-levels laser pulse amplification for its high efficiency and stability. However, the transverse amplified spontaneous emission (TASE) and parasitic lasing (PL) within the booster amplifier volume are the main barriers to achieve a higher energy amplification when the larger-aperture Ti:S crystals are pumped at higher pump fluence and energy. In this poster, we reports on the energy amplification for a 5 PW laser system based on Ti:S CPA by using a new method to restrain the PL and TASE in Ti:S CPA booster amplifier.

## Experimental setup

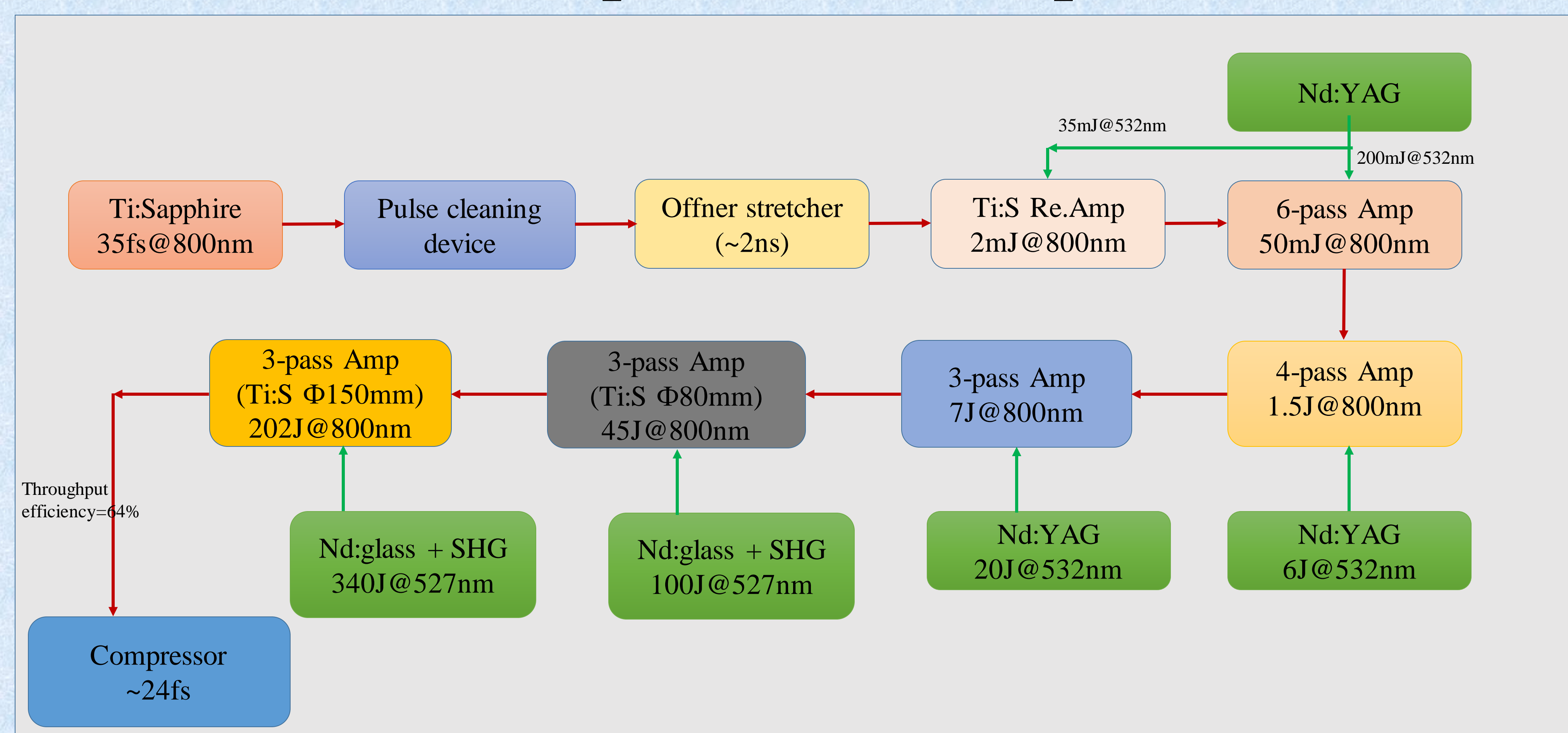


Fig 1. Schematic of Ti:S CPA 5 PW laser system

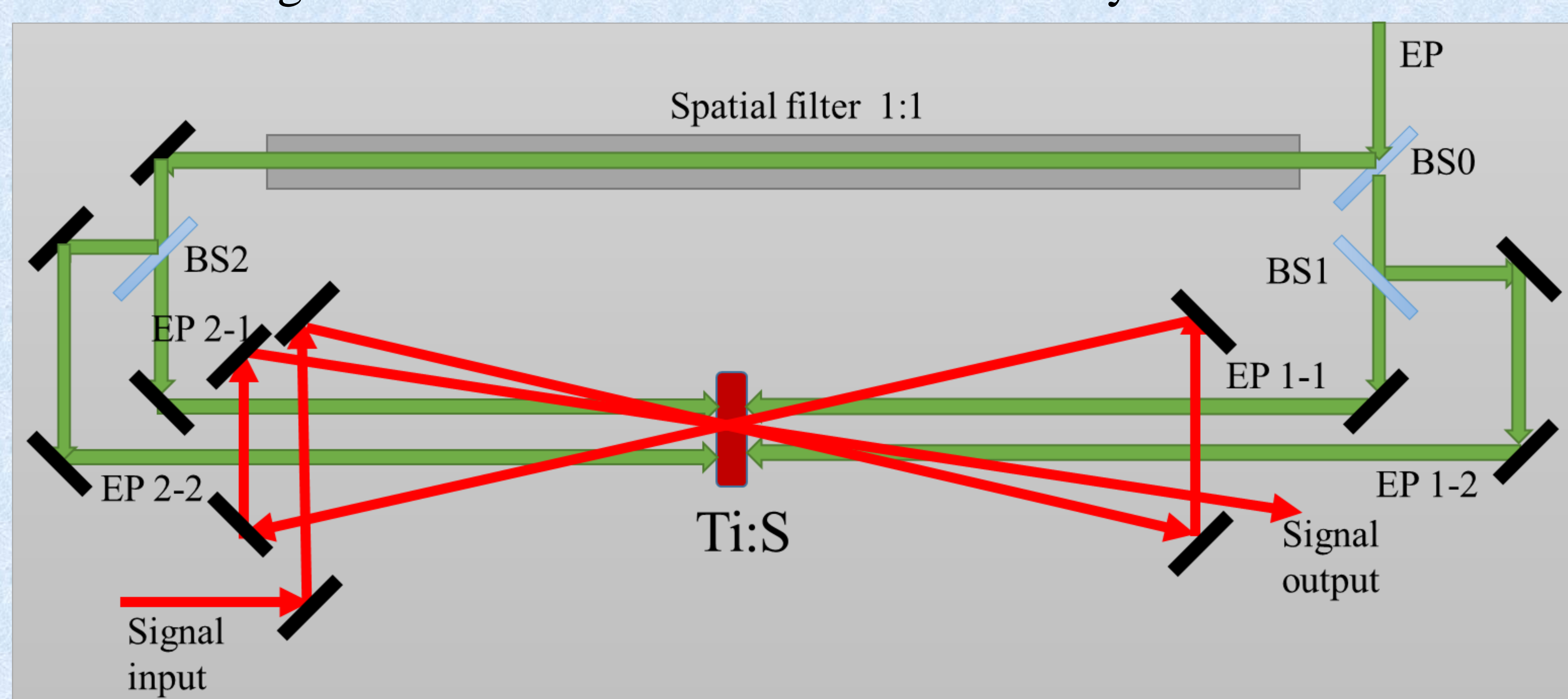
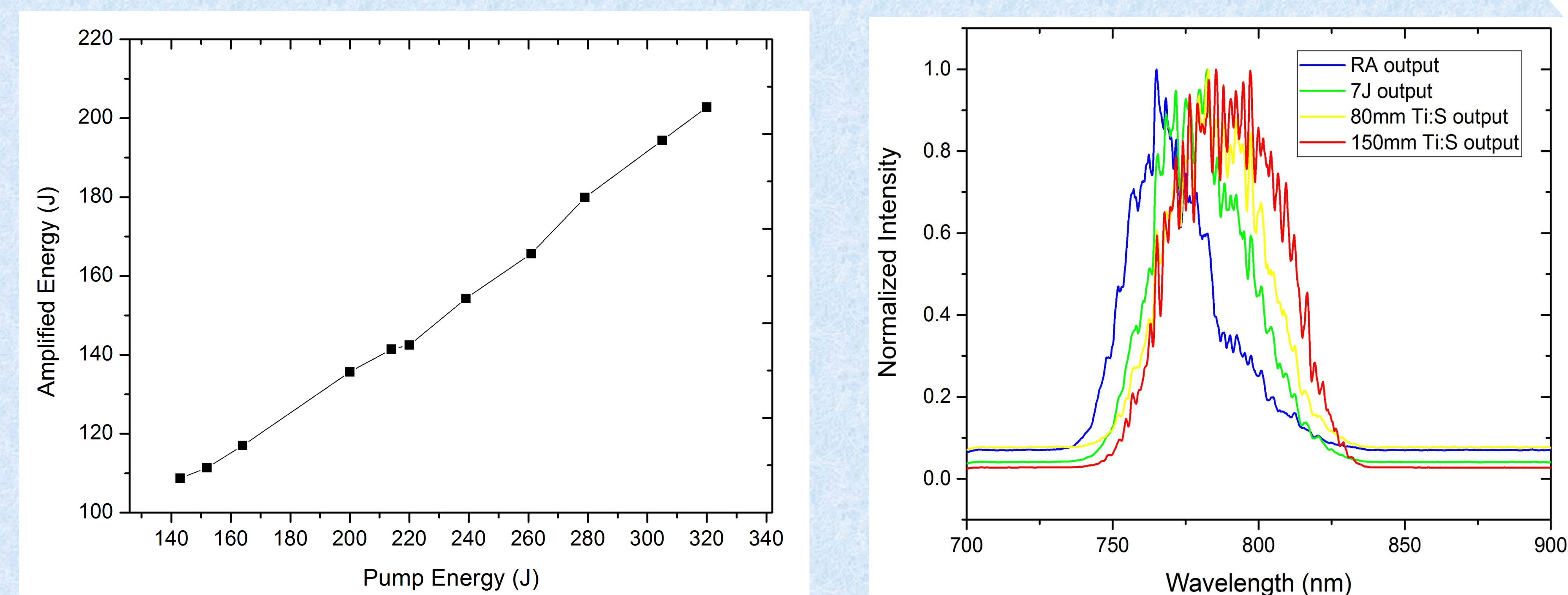


Fig 2. Schematic of booster amplifier pumped by temporal dual-pulse pump scheme

A novel temporal dual-pulse pump scheme was used to suppress the PL and the TASE of booster Ti:S amplifier with diameter of 150 mm. This energetic pump pulse (EP) with energy of 320J was divided into two pulses with identical energy by the beamsplitter BS0. Each of the two pulse was then further divided into two individual pulses respectively by beamsplitters BS1 and BS2. The reflectivity of the BS1 and BS2 were 30% and 55%.

The relative time delay between each individual pump pulses was controlled by carefully adjusting the optical path difference.

## Results



(a)

(b)

Fig. 3. (a) The output energy as a function of pump energy.

(b) Spectral evolution throughout amplification, RA (solid blue line), 7J output (solid green line), 80mm Ti:S output (solid yellow line), 150mm Ti:S (solid red line)

The output signal energies and conversion efficiencies increased with the pump energy. A maximum amplified output energy of 202.8 J was obtained at pump energy of 320 J, which corresponded to a conversion efficiency of 49.3%.

The amplified spectrum width from booster amplifier was about 85 nm from 750 nm to 835 nm. The pulse was compressed to 24 fs and the peak power was up to 5.3 PW.

## Conclusion

In this report, we present a experimental and theoretical study of large aperture Ti:S amplifier with a novel temporal dual-pulse pump scheme to achieve high-energy chirped-pulse amplification. The PL and TASE were successfully suppressed by the novel scheme and the output energy from the booster amplifier was 202 J, which is the highest amplified energy for the Ti:S CPA laser system. After being compressed, the pulse duration was 24fs and the peak power was 5.3PW. This novel temporal dual-pulse pump technique has a potential application for the 10PW CPA laser system.

## References

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