Passive coherent combining of large-beam high-Energy Nd:glass laser amplifiers in a Sagnac interferometer configuration

Pierre Lebegue[1,2,*], Joanna De Sousa[2], Cyril Rapeneau[2], Doina Badarau[2], Jordan Andrieu[2], Patrick Audebert[2], Frédéric Druon[1], Dimitrios N. Papadopoulos[2]

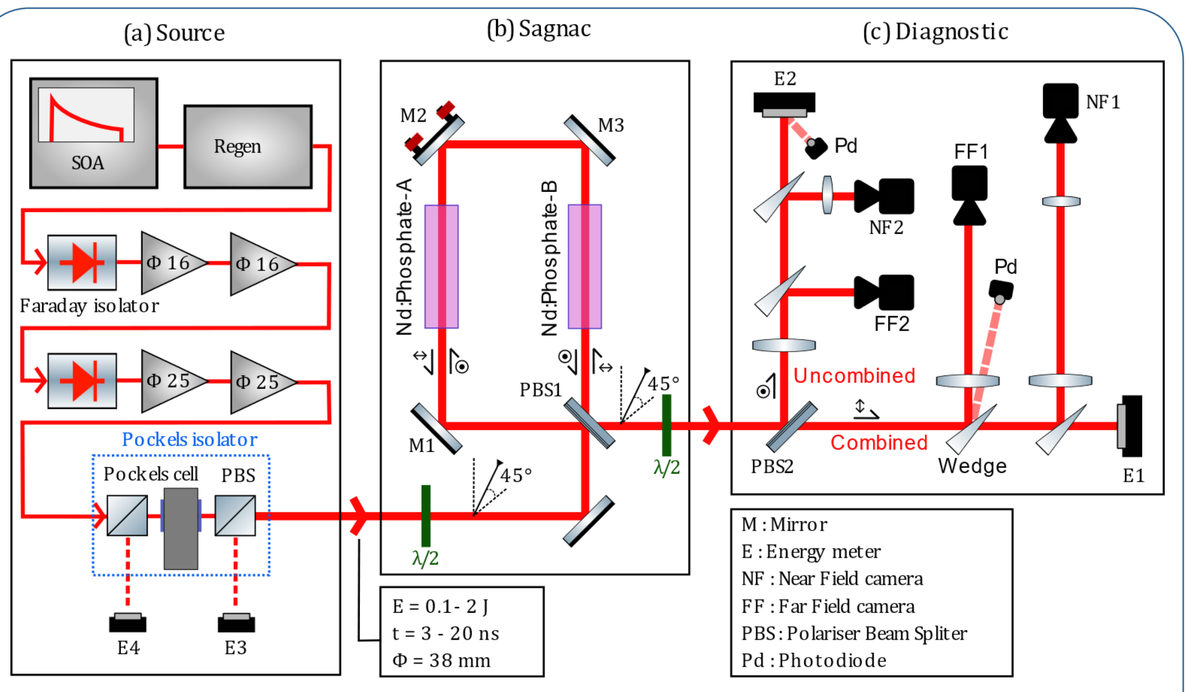
[1]Université Paris-Saclay, Institut d'Optique Graduate School, CNRS, Laboratoire Charles Fabry, 91127 Palaiseau, France

[2]Laboratoire pour l'Utilisation des Lasers Intenses, Laboratoire Charles Fabry, CNRS, Ecole Polytechnique, France

Interest

Coherent beam combining (CBC) [1,2] : method for increasing
- ➔ Energy
- ➔ Repetition rate on smaller aperture systems.

Study on large-beam (> cm) never validated up to now

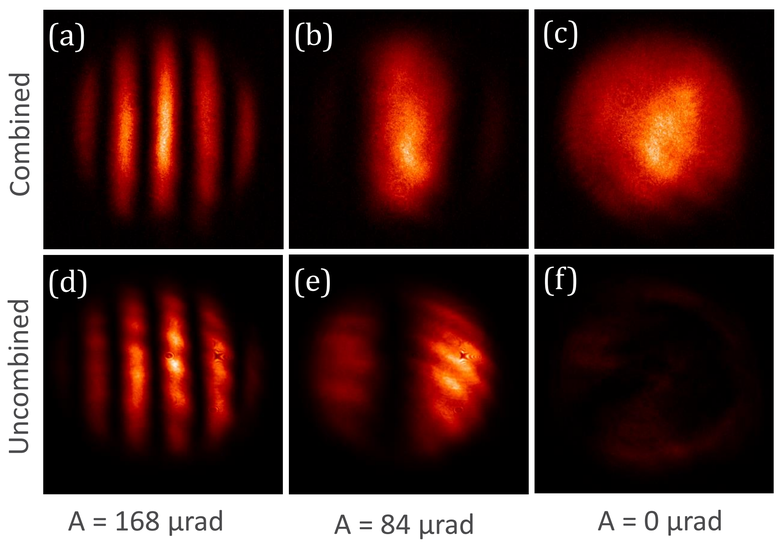


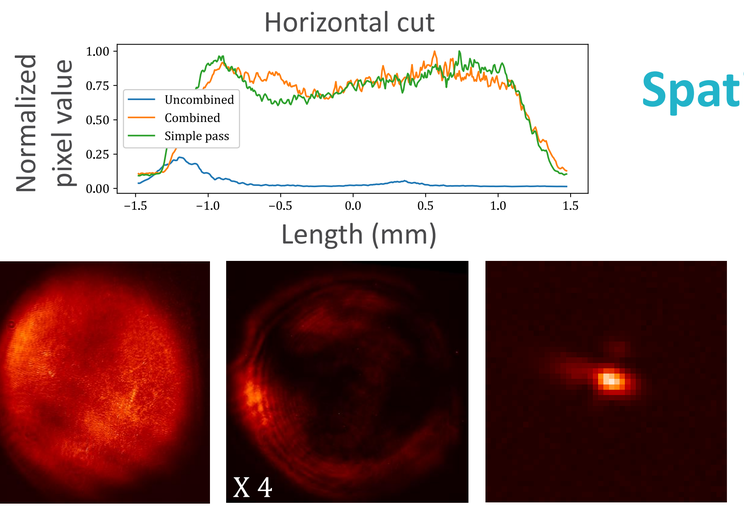
Experimental setup

- HERA-LULI laser facility (2x200J) [3]
- CBC at the 2 x10 J level (rods Φ = 45 mm, Nd:glass N31)
- Single shot polyvalent diagnostic

Calibration procedure

M2 : pico-motorized mirror fine-tuning
- ➔ Horizontal tilt
- ➔ Vertical piston



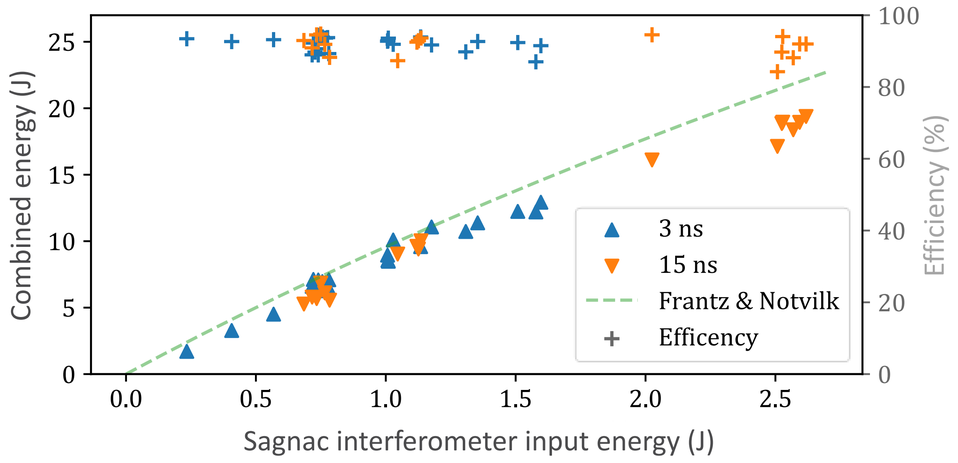


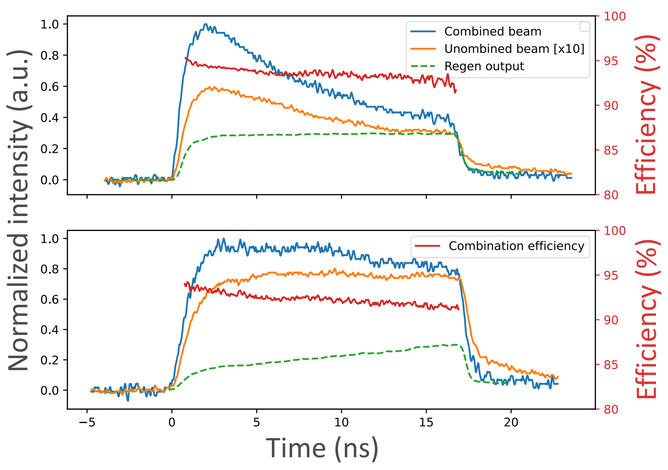
Spatial characterization

- No spatial degradation
- Combination discrepancy mainly on the periphery
- Similar spots at focus

Extracted Energy

- Backward energy measured < 0.1%
- Average efficiency of 92 %
- Up to 20 J

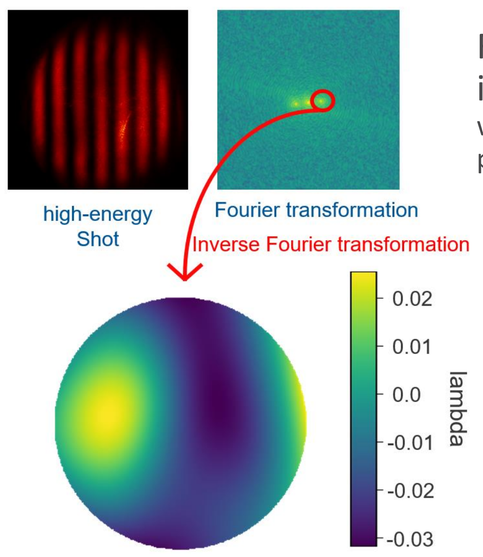




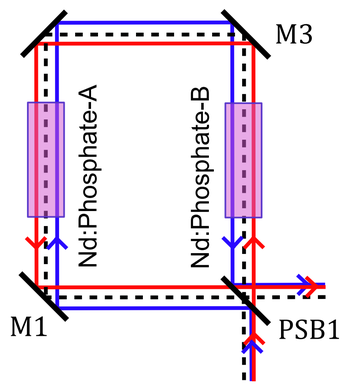
Temporal characterization

- Compatible with pulse shaping
- Combination efficiency is not time-dependent

Wavefront analysis



Relative wavefront distortion impact on efficiency : < 1%.
without taking into account tilt and piston (removed in the measurement)



The sides of the clockwise beam follow a different path than the sides of the anticlockwise beam
- ➔ Wavefront analysis demonstrates its negligible impact
- ➔ Extra advantage : Spatial averaging, smoothing of potential hotspots

Conclusion

- First demonstration of CBC for cm beam size (38 mm)
  - ➔ Efficiency : 92 %, energy record : 20 J
  - ➔ Spatial and temporal profiles preservation
- Validation of CBC on an already operating system

Contact: Pierre Lebegue
Pierre.lebegue@institutoptique.fr

References

[1] M. Hanna et al., 2016 J. Phys. B: At. Mol. Opt. Phys. 49 062004 (2016)
[2] D. N. Papadopoulos et al., IEEE JSTQE 2344039 (2014)
[3] https://luli.ip-paris.fr/en/facilities/hera

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