

## High Power Laser System for ELI NP - 10PW laser system results

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### Abstract:

We report the generation of unprecedented 10 PetaWatt laser pulses obtained from each of the 2 beamlines of the High Power Laser System (HPLS) of ELI-NP (Extreme Light Infrastructure – Nuclear Physics) research infrastructure. The laser system is an hybrid system made of a double CPA based on amplification within Titanium Sapphire crystals combined with an OPCPA with a parametric amplification stage boosting the energy to 10 mJ at the entrance of the second CPA . A XPW filter is also inserted between the 2 CPA and in combination with the OPCPA improves the temporal contrast of the pulses by typically 7 orders of magnitude. The spectral effects occurring during amplification such as gain narrowing and wavelength shifting are compensated through the use of spectral filters. Final amplification stages are involving large aperture TiSa crystals (up to 200 mm) which are pumped by high energy frequency-doubled Nd:Glass lasers delivering each 100 J of green light. Laser beams have been amplified respectively up to 332 J and to 342 J of pulse energy at 1 shot per minute without any occurrence of ASE and transverse lasing thanks to index matching fluid surrounding the crystal over its entire length and pump deposition split over the time before each beam pass within the TiSa crystal. We have demonstrated full aperture compression by metric gratings of these amplified pulses down to 22.3 fs and therefore made the full demonstration for the first time ever of 10 PW capability from a laser system.

### Biography:

Dr. Matras Guillaume joined Thales Laser (Orsay, France) in 2004 as PhD student to develop a high repetition rate Ti:Sa laser system for micro-processing applications in collaboration with Hubert Curien Laboratory (Saint-Etienne, France). He received his PhD in 2008 and continued in the same company to work on several and complex Ti:Sa laser systems (mJ-kHz, TW and PW systems) for scientific customers, firstly as laser engineer and progressively as project manager. In 2013, he was called to manage the development and the delivering of the stretchers and compressors of the High Power Laser System for ELI-NP. In 2016, he was appointed as technical solution leader to ensure the good technical implementation of the laser system in ELI-NP facility. The HPLS has been delivered in October 2019 with full performances. In parallel (2017-2018), he had the opportunity to work with ICFO laboratory of Barcelona to develop a mid-IR OPCPA source at 7 $\mu$ m.