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Latest results at Amplitude on high average power PW laser.

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Abstract: We will present in this paper the latest development made in the frame of High repetition rate PW laser. Increasing the repetition rate in high energy laser requires to master a lot of different parameters and especially the cooling and the reliability.
We have worked in this direction in the frame of two projects: ELI ALPS in hungaria and HIBEF in Germany.
We will show in the talk the developments that we have accomplished to reach at the same time a high energy and a high average power: specific pump laser (50J at 10Hz), High average power cryo cooling.
We will also focus on the reliability of these systems and present the results gathered during the last months.

September 2014, Amplitude Technologies has been selected for the supply and commissioning of the HF laser system at the ELI Attosecond Light Source Pulse Source (ELI-ALPS) facility in Szeged, Hungary, one of the three pillars of the ELI program in Europe dedicated to attosecond science with light sources delivering ultrashort pulses between THz and X-ray frequency range at high repetition rate [1].

HF laser system will provide 2 PW laser pulses with duration down to 17 fs at a repetition rate of 10 Hz. In this presentation we will introduce the different R&D programs launched within the Amplitude Laser Group to develop this innovative industrialized laser solution. As a matter of fact, HF laser system follow a typical architecture based on a OPCPA front-end (R&D program with FASTLITE, Institut d'Optique, CEA and Amplitude Systèmes) which seed the PW-class CPA-Ti:Sa laser with broadband pulses and ultra-high temporal contrast (10 µJ at 4 kHz, 16.5 fs FTL, ASE at 1012). A separated front-end output provides 1 mJ, 10 fs laser pulses at 100 Hz. Besides, to deliver around 50 J pulses before compression at 10 Hz, we have developed new generation of pump laser providing 50 J at 10 Hz in one single beam. This new generation of pump laser is also designed to be compatible with OPCPA amplifier.

We will focus on the results obtained on the kW class pump laser and the demonstration of his behavior over months
The pump laser is based on an innovative design using an active mirror configuration and taking advantage of the low cost flashlamps pumping. A great care has been given on the design to overcome the thermal issues and obtained a reliable and industrial product. Figure 2 presents some of the results obtained on the pump laser.

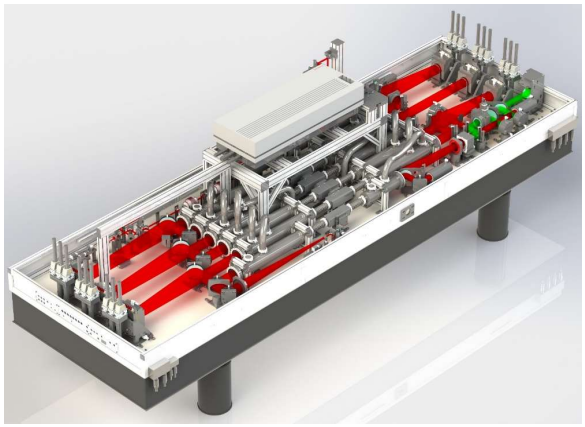

Fig. 1 : 3D view of the 50J pump laser

We will also present the design and the results obtained on the HIBEF system. This 500TW / 5Hz system has been designed to ensure reliable performances that are required in the frame of accelerator programs. In order to obtain stable parameters on the target (beam size, pointing, energy) we have developed a Twin amplifier design using cryocooled crystals. A special care has been taken in the design of the cooling to minimize the mechanical constraint (thus keeping the wavefront deformation as low as possible) and avoid the transverse lasing. This system has been successfully commissioned in 2019 and we will present some of the results (Fig.2).

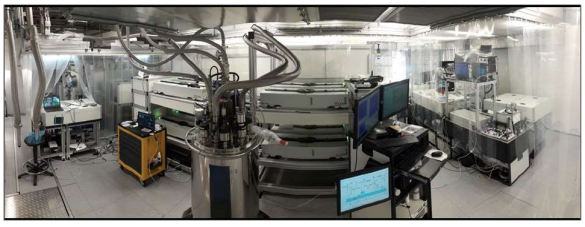

Fig. 2 : Picture of the HIBEF laser

[1] http://www.eli-hu.hu/