

Results of the 10 PW commissioning campaigns of ELI-NP with long and short focusing mirrors

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The 10 PW arm of the high-power laser system of ELI-NP and the related target areas began the commissioning at the end of 2022, with the first ever 10 PW shot focused on target in April 2023.

Two commissioning campaigns were performed, one employing the short and the other using the long focal mirrors. The short focal parabolic mirror allowed to focus the laser beam of 230 J and 23 fs to an intensity on target of the order of several 10^{22} Wcm⁻². Such intensity was employed to investigate the acceleration of ions in a TNSA-RPA fashion. Several diagnostics were employed to extensively characterize the interaction, and investigate the laser performance. Interesting results have been obtained, as for instance, a record high proton energy of about 150 MeV.

The campaign with the long focal mirror of about 30 meters was devoted to electron acceleration via the LWFA mechanism with gas targets. As a target, a gas-jet with a mixture of He with 1%N₂ and a length up to 40mm was employed. Laser power and gas density scans were performed to study the interaction and electron acceleration in the bubble regime with self-injection without guiding. A maximum electron energy of about 4 GeV was achieved in this regime.

The laser system has exhibited very good performances, although also existing issues have been exposed, as for instance, pre-pulses in the picoseconds and nanoseconds range.

Further investigation and optimization of laser-matter interaction with the 10 PW laser will be performed this year, meanwhile, some improvement in the HPLS will be also made.