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Towards a Stable and Application-Oriented Laser-Driven Proton Source at CALA

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Over the last few years, research at the laser-driven ion acceleration (LION) beamline at the Centre for Advanced Laser Applications (CALA) in Garching near Munich has been established. The setup is powered by the Petawatt-class ATLAS-3000 Ti:Sa laser operating at 1 Hz. Currently, up to 13 J in 28 fs are focused to a 5 μm FWHM focal spot, reaching peak intensities $> 10^{20}$ W/cm^2. To harness the high repetition rate of the laser system, a liquid leaf target system using water is implemented, routinely generating protons with maximum energies > 25 MeV. First experiments were conducted to transport and focus these particles using an energy-selective doublet of permanent quadrupole magnets to a small focal spot on our application platform in air. For diagnostics, a set of electromagnetic pulse-resistant detectors based on the ionoacoustic principle is available. These are capable of diagnosing the three-dimensional properties of the particle bunch, including particle number, even at high repetition rates. Current projects focus on employing Machine Learning to optimize the proton source, supported by the "Tango Controls" software framework and a highly automated experimental setup in cooperation with leading expertise at CALA.

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