# AbstractID: 4937 Title: A laser system and target design for proton acceleration

**Purpose:** The interaction of powerful laser pulses with solid-state targets has recently been demonstrated to produce beams of energetic protons. The generation and characterization of laser accelerated protons is nowadays one of the most rapidly developing fields in accelerator physics. On the application side, the development of a cost-effective and energy efficient way of producing proton beams represents a major breakthrough in hadron therapy. In this work we present a detailed study of the requirements imposed on the laser system in order to achieve extremely high peak intensities, necessary for proton acceleration. Different target designs are experimentally investigated.

**Method and Materials:** The laser system consists of a chain of commercial lasers and amplifiers, based on Titanium doped sapphire crystal as active medium, followed by a custom-design power amplifier. The technique of chirped-pulse amplification is employed as the most efficient amplification scheme for ultra-short laser pulses developed to date. Sharp focusing is achieved by an off-axis parabolic mirror designed for low losses and minimal aberrations. Frequency resolved optical gating measurements provide the complete laser pulse characterization.

**Results:** After pulse compression in vacuum we achieved 40 fs pulse duration with 1.1 J in each pulse at 10 Hz repetition rate. Focused beam spot size of 8 µm has been accurately measured. We demonstrate capability of obtaining pulses with characteristics suitable for proton acceleration. All stages of the pulse generation, amplification, compression, and conditioning are discussed in detail in this study. Different regimes of acceleration are discussed along with experimental evidence for their realization.

**Conclusion:** We present a detailed characterization of the current state of our laser system and a novel target chamber design. The implications for proton acceleration along with optimization strategies for enhanced proton yield and collimation are discussed as well.