

A transmission ionization chamber for online monitoring of ion - bunch fluence and trajectory

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Laser-driven ion acceleration is a pillar of the research at the Centre for Advanced Laser Applications (CALA). Since laser-driven ion bunches have unique properties such as short durations, large particle numbers and a broad energy spectrum, a fundamental part of this research is the development and investigation of online-instrumentation tailored to the challenges imposed by laser-ion acceleration. We particularly aim to monitor shot-to-shot fluence fluctuations, i.e. at a 1 Hz repetition rate, in a minimally invasive manner.

Being a transmission monitor for ionizing radiation the Foil Electrode Ionization Chamber with Red Light Emission for Laser-Driven Ions (FIREFLI) has the potential to fulfill these challenging goals. A gated integrator registers the ionization charge produced by an ion bunch while traversing the detector. This integrator is placed inside the conductive housing to improve the robustness of the detector against electromagnetic pulses generated in the laser-plasma interaction. The entrance and exit windows as well as the two electrodes of the ionization chamber consist of 2 μm thin aluminized Mylar foils, thus ensuring a minimal material budget for transmitted ions. Simultaneously, the scintillation light produced locally in the interaction between the detector gas (Ar:CF₄ 80:20 vol %) and the ion-bunch will be recorded with a camera looking perpendicularly on the beam axis. FIREFLI will thus provide a measure for the overall bunch charge as well as the bunch trajectory in the detector from a lateral view.

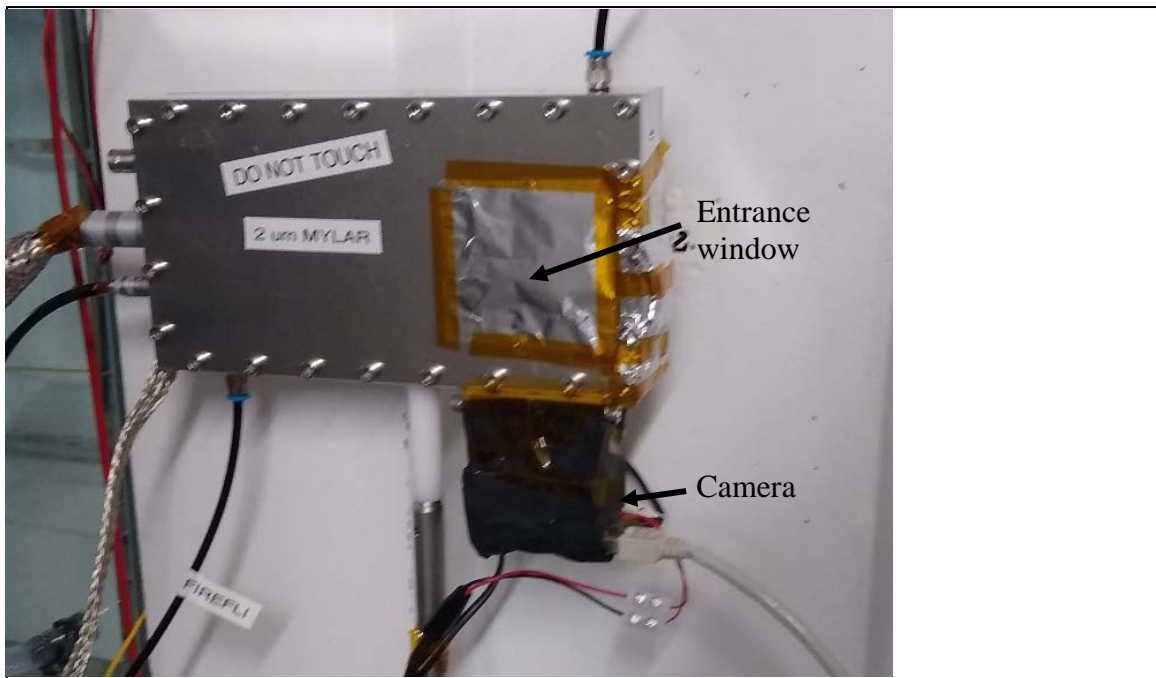


Figure 1: The ionization chamber (FIREFLI) with a protective aluminum foil in front of the entrance window. The camera is shielded from scattered light (seen in black). The gated integrator is positioned left inside the detector housing.