Contribution ID: **70** Type: **Poster presentation**

Recovery-Time Determination of Liquid-Leaf Targets under Ultra-Short Laser Irradiation for High-Repetition-Rate Applications

To support high-repetition-rate particle production for applications such as radioisotope production, hadron therapy or neutron production, liquid targets are being developed at ELI-NP. With increasing repetition-rates achieved by lasers, liquid targets must regenerate rapidly to ensure consistent interaction conditions. In this study, we investigated the regeneration dynamics of a water pellicle formed in low vacuum by two colliding 70 µm liquid jets. A pump-probe setup was employed, where the pump arm (5 mJ, 60 fs, 800 nm) created a transient aperture in the pellicle, while the probe arm (6 ns, λ = 640 nm) monitored its evolution over delays ranging from 10 ns to 800 µs. The regeneration process was analyzed by tracking the size and position of the aperture as a function of the liquid flow rate. While no significant variations were noticed between different flow rates for the size of the aperture, the velocity of the aperture increases linearly with the flow rate, full recovery being reached after ~ 300 µs. These results provide a lower boundary for the achievable repetition-rate for mJ level pulses.

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Session Classification: Poster Session