Demonstration of high quality laser-plasma acceleration is mandatory for future development of novel plasma-based radiation sources like the EuPRAXIA H2020 project. In this context we are developing a test electron beam-line based on laser-wakefield acceleration with the aim of driving a Free Electron Laser in the X-ray domain. Our developments include design of a novel injection and acceleration scheme named ReMPI [1] to produce low energy spread, low emittance bunches, and the experimental proof-of-principle demonstration of such a scheme, including a short wavelength injection pulse and a resonant pulse train, all starting from a single Ti:Sa laser pulse. These developments take advantage of the recent upgrade of the IIL-PW facility including the recent >100 TW scale laser upgrade and the commissioning of the new PW scale interaction area. A preliminary set of data was already acquired following the success of commissioning of the laser system. Data include output from a range of diagnostics designed to characterize gas target, laser-gas interaction stability and electron bunch characterization. An overview will be given of the design and of the relevant IIL-PW facility features.

**The Resonant Multi-Pulse Ionization injection [1,2] uses a single (e.g. Ti:Sa) 100-TW class laser system.** A minor portion of the pulse (about 100 mJ) is frequency doubled (or tripled) and tightly focuses on the target, thus acting as an “ionization-extraction” pulse that further ionise high-Z contaminants (e.g. Argon, or Nitrogen). The newborn electrons are subsequently trapped by the wake driven by the main portion of the pulse shaped as a train of resonant sub-pulses. Since a resonant train of pulses can drive plasma waves with large amplitude [3], the time-shaping procedure permits the generation of waves with amplitude large enough to trap the novel electrons, using pulses with peak intensities below the ionization threshold of the contaminant. Using Argon as a contaminant species, extremely good-quality bunches (<0.5% energy spread rms, <0.1 mm rad of norm. emittance, 1kA of peak current) can be generated.

**The Model**

The temporal pulse shaper passes through a set of ring-like data lines, each of them includes a different delay on the sub-pulse. The optimization of the masks radii is still ongoing, the goal being the generation of pulses with the same energy and minimum waist.

**References**

