# High repetition rate attosecond beamline for photoemission spectroscopy


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**Synopsis** We present a new experimental setup dedicated to attosecond photoemission spectroscopy. A post-compressed high-power Ytterbium laser source enables the experiment to run at a high repetition rate while a 3 beam architecture allows a pre-excitation of the medium and its photoemission by an XUV attosecond pulse train in presence of an IR dressing beam.


The beamline is driven by a new 80-W Ytterbium laser source providing 340 fs pulses, each carrying 2 mJ of energy at a reprate of 40 kHz. A post compression stage based on a multi-pass cell filled with Argon shortens the pulses down to 25 fs with 1.6 mJ energy per pulse.

The optical setup primarily consists of a 3 arm Mach Zehnder interferometer. An amplitude division of the beam on a beamsplitter precedes a wavefront division on a drilled mirror (DM). The most energetic of the three beams generates high-order harmonics in the form of an attosecond pulse train. The intermediate power beam has an annular shape from its reflection onto the DM and will be used to pre-excite the medium, e.g., to induce molecular alignment. Finally, the weakest beam -that went through the DM- will be the dressing beam. The recombination of the beams is realised in two steps, each with a DM. The delays between all the pulses are controlled and actively stabilized using parts of the beams that are collected at the last DM.

The size and intensity of each beam at the key locations of HHG and photoemission foci were computed using propagation simulations and show satisfactory results with respect to the experimental conditions required to perform photoemission spectroscopy using RABBIT [1] and Mixed-FROG [2] techniques.

As for the end-stations, the inline two foci geometry [3,4] enables simultaneous measurements in two magnetic bottle electron spectrometers or replacing one of them by a velocity map imaging spectrometer to access the electron/ion angular distribution. RABBIT measurements can then be performed with a reference gas spatially separated from the studied gaseous molecule or liquid target.


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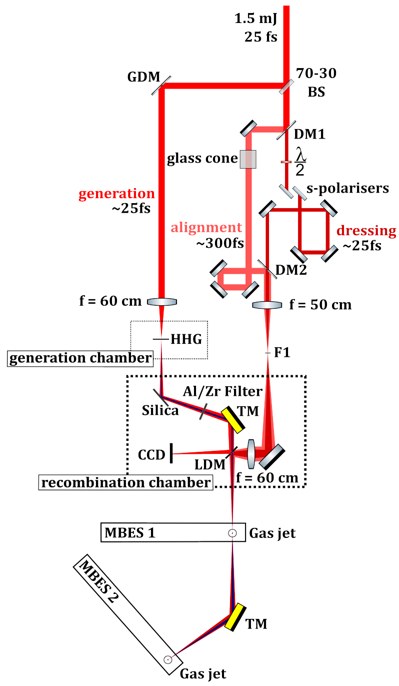


**Figure 1**. Experimental setup. DM : Drilled Mirror, GDM : Generation DM, LDM : Last DM, TM : Toroidal Mirror, MBES : Magnetic Bottle Electron Spectrometer.

## References


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