Ultrafast detector for *XUV*-pulse-driven photoelectron spectroscopy

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Photoemission is exploited in Angle Resolved Photoelectron Spectroscopy (*ARPES*), which allows the study of electronic structures of solids thus obtaining energy-momentum dispersions in the lattice. The photoemission has been so far driven with both *UV* and *X-rays* radiation sources, often of large scale. However, the possibility of lab-scale sources for *ARPES* is attractive. These sources can be realized using plasmas emission at short-wavelengths, e.g. *XUV*. Plasma-driven *XUV* emission has state-of-art specifications like high cut-off of the *ARPES* spectra, prompt electrons emission, the spatial resolution that can be achieved (0.01-1 mm) and the short pulse duration that allows temporal resolutions in the range of 0.1-1 ns.

Considering the ns duration of the *XUV* pulses and the fast emission of the photoelectrons, a high pass detector must be used to detect the emitted fast signals without distortion. Our novel photoemission detector design is based on a solenoid coil through which the photo-current to be measured is passed, inducing an image current which is measured. The output voltage in this "image-current detector" (*ICD*) is dictated by the rate of change of photo-current, i.e. becoming increasingly sensitive to faster signals. Other advantages are related with the non-saturation, simple circuitry and ultrafast response to photo-currents of either polarity.

A calibration law between input and output was statistically analyzed in different geometries, e.g. number of coil turns, coil dimensions etc. Also the frequency-resolved response was characterized experimentally using a pulse generator with a 300 kHz – 3 GHz working range. The analysis of the *XUV* signal profiles originated from a gas-discharge plasma source allowed the determination of the required band-width of the *ICD* detector.

As a forthcoming work, starting from these achievements we will implement the ultrafast *ICD* for measuring photo-currents from *XUV*-irradiated samples.