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IT-8-P-1895 Design of the novel flange-on high lateral and energy resolution ultrashort electron pulse compression system for ultrafast microscopy

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An instrumental realization of the idea [1,2] for the ultrashort electron pulse source based on the newly developed imaging energy filter called α -SDA (Spherical Deflector Analyzer) [3] is reported. Its compact design enables the realization of the flange-on instrument concept. It consists of six independent subsystems: photocathode/immersion lens, primary electron column, pass energy tuning element, α -SDA as a central part, focusing/ compression column and detector/target with XY-stage, Fig1. The ultrashort photoelectron bunch created by an attosecond laser pulse propagates through the primary column towards the mirror plane of the α -SDA, where according to simulations, the focusing and temporal reversion occurs [2]. As a consequence, the time-divergent primary electrons at the mirror plane are transformed to a time-convergent pulse at the same plane after 2π deflection. It has been also previously shown, that the aberration free imaging properties of the α -SDA assure a very high lateral ($\ll 1\text{nm}$) and energy ($\Delta E/E < 10^{-3}$) resolution. In the symmetric case with the first time compression exactly at π , the shortest electron pulse behind the α -SDA analyzer is mirror symmetric to the original electron pulse at the photocathode [2]. As a consequence, an extremely dense: ultrashort ($\ll 1\text{fs}$) and perfectly focused ($\ll 1\text{nm}$) high energy (10^4 - 10^5 eV) electron bunch strikes the target.

1 K.P. Grzelakowski, US Patent Nr. 7,126,117

2 K. P. Grzelakowski, R. M. Tromp, Ultramicroscopy, 130 (2013) 36

3 K.P. Grzelakowski, Ultramicroscopy 116 (2012) 95

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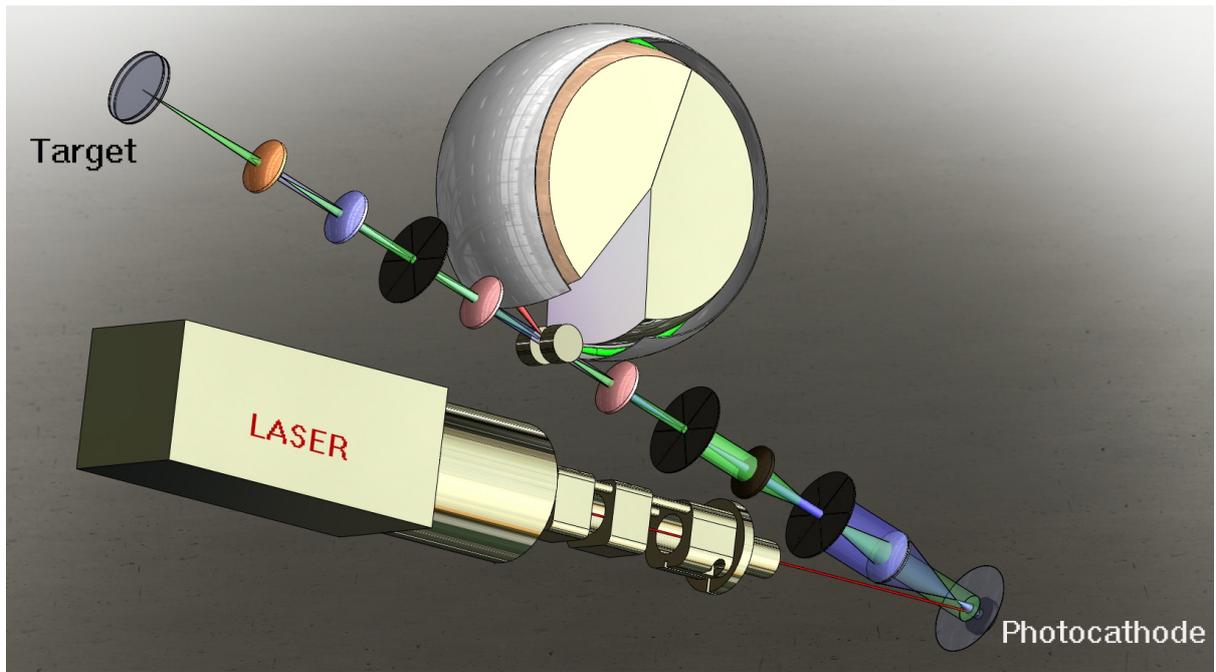


Fig. 1: General outlook of the electron pulse compression system