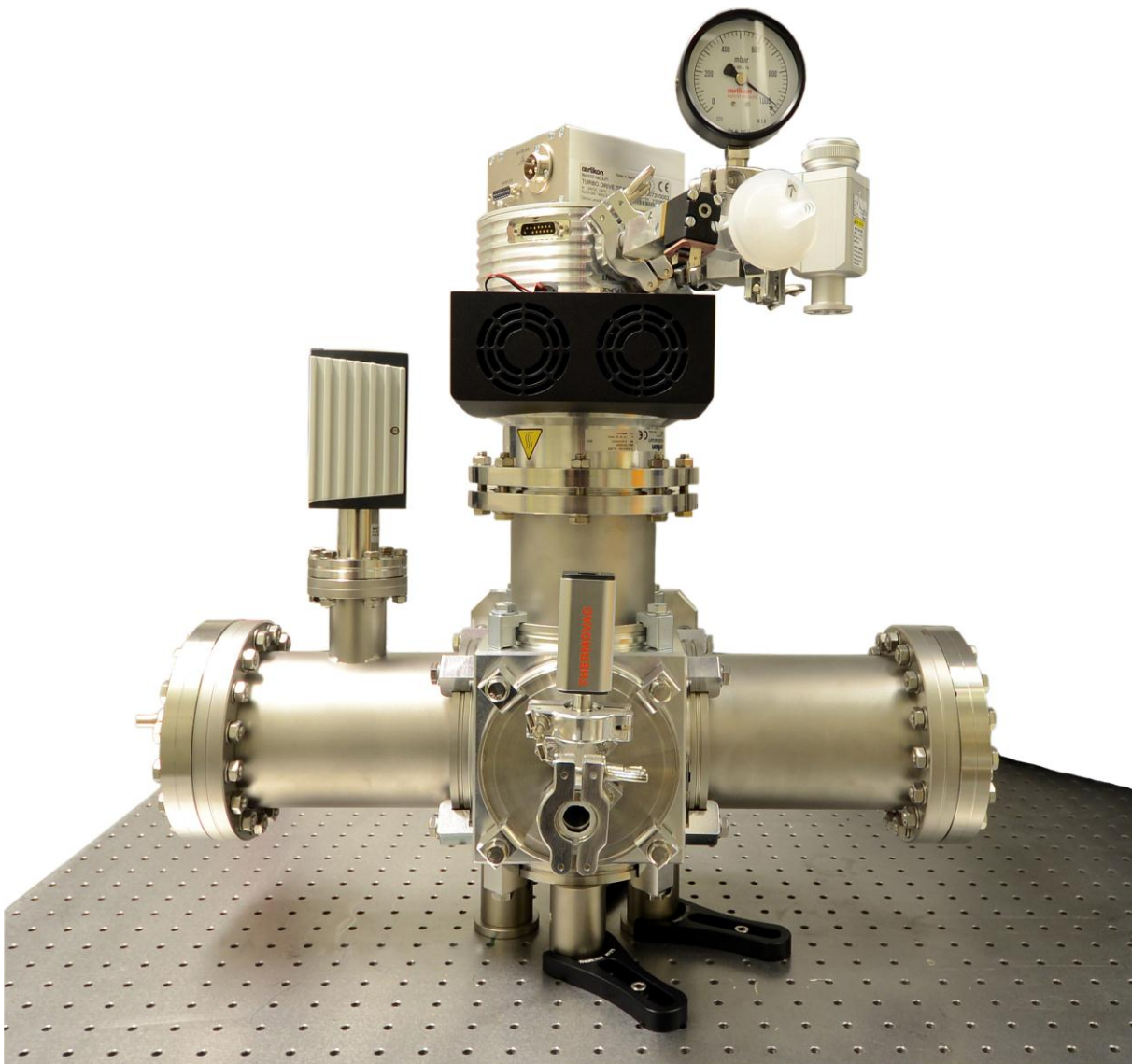


Single-shot stereo-ATI phasemeter

The single-shot stereo-ATI phasemeter is a robust and widely adopted technique for measuring the carrier-envelope phase (CEP) of few-cycle mid-infrared laser pulses consecutively at multi-kHz repetition rates. The phasemeter is a stereo time-of-flight (TOF) detector which detects the left and right TOF spectra of rescattered electrons in the above-threshold ionization (ATI) process, and exploits their highphase sensitivity for the measurement of the CEP.



The schematic arrangement of the phasemeter apparatus is the following: xenon atoms are ionized by the few-cycle laser field in the center of the apparatus and their left and right TOF spectra are recorded by ideally identical TOF detectors. The detectors symmetrically face each other along the polarization axis of the laser beam. Technically this is performed by a pair of MCP detectors, which detect and amplify the TOF signals of the ATI electrons, and their signals are then further amplified in broad bandwidth pre-amplifiers. The MCPs are chosen to be matching pairs to reduce measurement distortions. The interaction volume filled with xenon gas is at the center of the apparatus at an equal distance between the two opposing MCP detectors. The interaction volume is differentially pumped by a turbomolecular pump to maintain the pressure of the xenon gas at a constant low level. The laser pulses are focused by a spherical mirror onto the center of the interaction volume to ionize the xenon atoms close to the focal region. The optimal laser intensity is several times of 10^{13} W/cm². Under those conditions a large number of ATI electrons are emitted along the polarization axis in left and right directions. The electrons leave the interaction volume through two vertical slits and after some flight in the electrically and magnetically shielded TOF tubes reach the MCP detectors. To extend the lifetime of the MCPs, high transmission metallic rare meshes under a negative DC potential are placed in front of the detectors to prevent non-phase sensitive ATI electrons from reaching the detectors.

