A new setup for measuring partial photoion-yields was developed and build at the Synchrotron Radiation Center. The chamber, which accomodates an ion Time-of-Flight (TOF) spectrometer, a metal vapor oven, and a cooling trap, consists mainly of a standard conflat 6" 6-way cross and a 6" tee. The base pressure of the chamber is in the 10^{-9} mbar region and rises into the 10^{-8} mbar region when the oven is hot. The ion TOF measures the mass-over-charge ratio (m/q) and is operated in the pulsed extraction mode, i.e., a pulsed (positive) voltage is applied to the “pusher” plate of the ion TOF pushing all ions though the “extractor” plate into the drift tube. The holes in the plates are covered with a high-transmission Ni mesh to preserve the shape of the electric fields between the plates. The pulse applied to the “pusher” plate serves as the "start" pulse of the flight time measurement. A Z-stack MCP-mounting, which detects the ions, is located at the end of the drift tube and provides the "stop" pulse. The start- and stop-signals are processed by a time-to-amplitude converter and the output signal is sent to a PC data-acquisition board.

In order to study metal vapors, an oven for lower-temperature (<1000 °C) applications was built and can be used in combination with the ion TOF. The crucible is well insulated so that a temperature of 426 °C was achieved with a low power of 12 W. The heating wire is bifilar such that the total magnetic field generated by the current is zero. The oven is wrapped in a water-cooled jacket and a thermocouple wire measures the temperature of the crucible. The orifice of the oven can be aligned under vacuum in order to optimize the detector signal. A cooling trap, filled with liquid nitrogen, is facing the orifice to collect the vaporized metal vapor after crossing the interaction region.

First experiments with this apparatus were performed using noble gases and lithium. Of particular interest were the triple photoionization cross-section and the triple-to-single photoionization ratio of lithium as a function of photon energy. Since lithium has only three electrons, it is ideally suited for studies of the simultaneous ejection of three electrons by a single photon [1]. Sequential ejection of all three electrons via Auger decay can not take place. It is planned to design and build an electron spectrometer that will be used in conjunction with the ion TOF. Our goal is to measure electron-ion coincidences; i.e., photoelectron spectra of a particular final charge state are taken, similar to a previous experiment [2].

References
