The Beams and Applications Seminar Series

Electron Optical Scheme Optimization of TOF Electron Spectrometers

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Bldg. 401, rm B2100
Friday, September 24, 1:30 pm

Host: K. Harkay, ASD

Pulsed laser or x-ray sources of synchrotron radiation provide a new opportunity for time-of-flight (TOF) photoelectron spectroscopy. They allow for increased sensitivity and energy resolution, analysis of the fast processes on surfaces and gas targets, and transfer from qualitative to high-resolution quantitative electron energy analysis. The electron optical design principals of TOF Electron Energy Analyzer (TOF-EEA), temporal and temporal-geometrical aberration, and optimal electron beam formation and transport are discussed. Based on the "thin" lens model, a new form of temporal aberrations, which allows for the use of an effective matrix approach, is presented. Time-to-energy conversions are expressed as series polynomial approximations in the time-energy domain. Criteria for electron optical scheme optimization of TOF-EEA at maximum energy resolution and sensitivity were formulated. As an example of this approach, four TOF instruments for laser and x-ray photoelectron spectroscopy are in development and used in experiments at the Advanced Light Source at LBNL: (1) Spin-resolved photoemission spectrometer with low-energy exchange-scattering (LEX) polarimetry; (2) Complete Momentum- and Energy-Resolved TOF Electron Spectrometer (TOF ARPES) with XY+Time (Energy) delay line detector for high resolution imaging in momentum space; (3) Ambient Pressure Photoemission Spectrometer, a TOF electron spectrometer with differential pumping for electron spectroscopy at pressures up to 10 mbar in the sample area; and (4) TOF Photoemission Electron Microscope (TOF-PEEM) with submillivolt energy and nanometer spatial resolution. The analysis of simulated and experimental parameters of these instruments is presented and discussed.

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