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AMO Instrumentation for the LCLS Free Electron Laser

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The Linac Coherent Light Source (LCLS) at the SLAC National Accelerator Laboratory is the world's first x-ray free electron laser (FEL) providing short (3-300 fs) intense ($\leq 10^{13}$ photons) pulses of x-rays in the 800-8000eV photon energy range. The x-ray FEL beam is produced when a short pulse of electrons from the SLAC linac is passed through up to 100m of undulator. A suite of instrumentation for AMO studies using the LCLS beam was developed and installed in the first experiment hutch of the LCLS. The first component of this instrumentation is a set of focusing optics that are used to produce an extremely high intensity in the $\sim 1\mu\text{m}$ focus of the x-ray beam. Two experimental chambers follow. The first has a pulsed supersonic gas jet with a set of electron and ion time-of-flight spectrometers arrayed around the intersection between the gas jet and the focused x-ray FEL beam. The second chamber is built to support a high collection efficiency magnetic bottle electron spectrometer designed to measure a full electron energy spectrum on each FEL pulse. Additional diagnostics in the second chamber are designed to measure the pulse intensity and beam profile. The instrumentation was successfully commissioned in the summer of 2009 and first user experiments began in October 2009.