

# Design for an aberration-corrected, ultrafast spin-polarized LEEM with multiple electron sources

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We describe a high resolution aberration-corrected LEEM/PEEM combined with a high temperature Scanning Tunnelling Microscopy (HT-STM) platform. A key feature of this microscope is the addition of spin-polarized ultrafast electron sources to complement the standard cold field emission electron source and to expand the analytical capabilities of the system. To facilitate the inclusion of these new capabilities, we have added a third magnetic prism array to the system, taking advantage of the high modularity of the standard AC-LEEM with two prism arrays. The additional prism can be used to switch between up to three different electron guns. We present our design of an ultrafast spin-polarized electron gun with the necessary ancillary electron optical components, to realize time resolved aberration-corrected spin-polarized LEEM (TR-AC-SPLEEM) at high spatial (2nm) and temporal (10ps) resolution. This design takes advantage of the high degree of symmetry of the AC-LEEM design to minimize deleterious effects of space-charge energy and time broadening, while maintaining full control of electron spin. Initial results with the cold FE source show an excellent spatial resolution below 2 nm, while also achieving atomic resolution with the HT-STM running concurrently with the LEEM instrument.

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