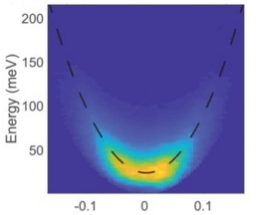
BEAM DYNAMICS AND CONTROL Roadmap

Brightness conservation of beams from extreme-low MTE linac sources subject to intense Coulomb interactions *(Conserve)*, increased brightness of beams in storage rings *(Cool)*, and advanced techniques for the optimization of many-parameter accelerators *(Control)*.

TARGET DATES	FY 22	FY 23	FY 24	FY 25	FY 26
OBJECTIVES	DELIVERABLES				APPLICATIONS

(Conserve): Probe the ultimate limits of brightness conservation in the presence of collective effects in low MTE photoinjector beamlines

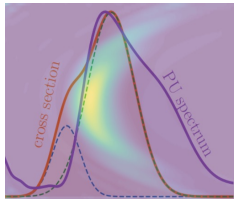
- List of parameters that determine emittance growth
- Sources of emittance growth
- Cathode longevity testing capability



Surface state of Ag(111) measured at the photoemission threshold using the meV scale energy analyzer

(Cool): Develop methods for cooling beams using optical stochastic cooling to increase beam luminosity in next-generation colliders

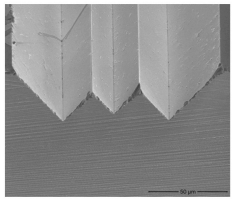
- Proof of principle demonstrations
- Configurations capable of very high cooling rates needed in future colliders
- Single-pass correction of beam distortion



The angular-spectral fluence (color map) of the pick-up undulator (PU) at IOTA with its spectrum (purple trace) and lase-amplifier cross-section (orange trance) planned for optical stochastic cooling at IOTA.

(Control): Investigate advanced optimization schemes, including ML and parameter reduction techniques, for precision phase-space control of particle accelerator systems

- Methods for efficiently tuning accelerators
- Summary of the boundaries of applicability of ML in accelerators



Images of the wet-etched gold-coated nano-blade cathodes using scanning electron microscopy (SEM). Note the double-blade geometry. Photo at 100 micron scale and 45 degrees relative to surface normal.