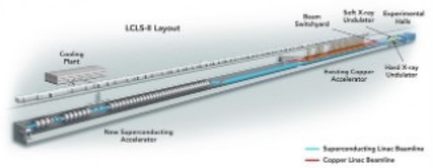
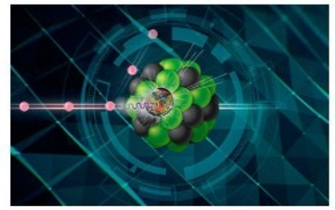
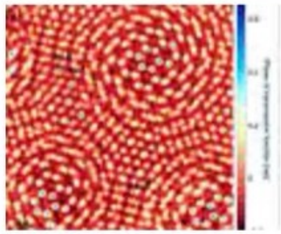
BEAM DYNAMICS AND CONTROL Roadmap 2022

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)*.

FY 22 FY 23 FY 24 FY 25 FY 26

Objectives	Deliverables	Legacy
Probe the limits of brightness conservation in the presence of collective effects in low MTE photoinjectors *(Conserve)*	Demonstration of sub-nm emittance line at low bunch current with annual improvements thereafter ID of beamlines for a potential demo of low ε and high Q Characterization of the performance of photocathodes at high field or high current	 Increased scientific reach in X-ray FELs
Develop methods for cooling beams using optical stochastic cooling *(Cool)*	Proof-of-princip OSC demos Proof-of-principle demonstrations of *active* OSC at IOTA or CESR Configurations capable of very high cooling rates for future colliders	 Higher luminosity electron-ion collider
Investigate advanced optimization schemes for precision phase-space control of particle accelerator systems *(Control)*	EM tuning comparable to operator tuning using ML Higher-order EM aberration tuning, replacing intervention by company reps. Methods for efficiently tuning accelerators Summary of the boundaries of applicability of ML in accelerators	 Active accelerator tuning and aberration control in electron microscopes