

Fermi National Accelerator Laboratory LDRD Project Data Sheet - FY15

Project ID: FNAL-LDRD-2015-031

Project title: A comprehensive investigation of a transformational integrable optics storage ring as a “smart” rapid cycling synchrotron for high-intensity beams

Principal investigator: Alexander Valishev

Project description: (short description and explanation of cutting edge, high-risk, high-potential science or engineering)

This proposal seeks to enhance Fermilab’s strategic vision via engaging in a comprehensive feasibility study and investigation of an integrable optics “smart” rapid cycling synchrotron (RCS) as an essential component of a potential future multi-megawatt (MW) facility to advance neutrino science. The high-level project objective over a 3-year period is a full analytical, computational and technical evaluation of a scenario for multi-MW neutrino facility based on an innovative high intensity RCS.

Tie to Mission: (explain the project’s relevance or anticipated benefits to Fermilab’s and DOE’s missions)

A future multi-MW accelerator would be an enabling new device for research at the forefront of the intensity frontier with possible application to high luminosity hadron machines at the energy frontier. If successful, the study will result in significant cost reduction for a planned new RCS aimed to attain the beam power in excess of 2 MW for the future long baseline neutrino program.

Previous year’s accomplishments: (as applicable)

This past year saw design of the integrable RCS lattice with demonstrated compatibility between modern RCS features and the lattice requirements for integrable optics. An example lattice was developed. The design has harmonic cancellation of sextupoles and a chicane for the injection/extraction region. The simulation incorporates space-charge forces and the integrable optics. There has been evaluation in collaboration with LBNL.

Work proposed for current fiscal year and anticipated / desired results:

In this current year, space charge effects will be modeled in greater precision. The effects of the initial distribution, comparison with dynamics in IOTA, and stability will all be evaluated. The expected beam halo will be modeled with attention paid to lattice resonances and applying the results and techniques to the possible future Booster at Fermilab. Talks and write-ups will be the main deliverables.

Project funding profile: (costs, budgets, projected budgets, and total)

Prior year(s) costs	FY16	FY17	FY18	FY19 (4 mo.)	Total
N/A	110,171	169,508	190,000	65,000	534,679

Project Start Data: 2/01/2016

Total Approved Project funds: \$ 935,600