FERMILAB-CRADA-FRA-2014-0008

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Integrable Optics Design Principles for Beam Halo Suppression in Accelerator Rings at the Intensity Frontier

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2014-0008

Fermilab Technical Contact: Sergei Nagaitsev

Summary Report
29 November 2016

NOTICE

In accordance with Requirements set forth in Article X of the CRADA, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

CRADA number: FRA-2014-0008

CRADA Title: Integrable Optics Design Principles for Beam Halo Suppression in Accelerator Rings at the Intensity Frontier

Parties to the Agreement: RadiaSoft, LLC and Fermi Research Alliance, LLC

Abstract of CRADA work:

The project was dedicated to quantifying the possibilities and limitations of the integrable optics, a fundamentally new approach to high-intensity accelerator ring design, using the parallel Synergia framework for simulations. The following topics were studied: a) the effects of space charge forces, field errors, magnet misalignments, and other sources of parametric resonance; b) the effect of controlled nonlinearities, such as sextupoles for chromaticity control; c) the effect of longitudinal dynamics driven by finite bunch length and rf cavities; and d) reexamination of relevant lattices in present accelerators to explore potential benefits of these new design principles.

Summary of Research Results:

A subroutine for particle tracking through nonlinear magnets from the existing Fermilab-owned software was imported into the Synergia software package (also Fermilab-owned). The effects of space charge, magnet field errors, sextupole magnets, and energy deviation on the stability of integrable system was studied on the example of the IOTA ring. The results were incorporated in the machine design and specifications. The work was reported at major accelerator conferences and published in the literature.

Related Reports, Publications, and Presentations:

IPAC2015 – MOPM028 (ISBN: 978-3-95458-168-7) “Chromaticity & Dispersion in Nonlinear Integrable Optics”, S.D. Webb et al

Subject Inventions listing:

None

Report Date: 11/29/2016

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