Abstract Submitted
for the APR21 Meeting of
The American Physical Society

Experimental Studies of Beam Dynamics in Integrable Storage Rings[1] NIKITA KUKLEV, University of Chicago, ALEXANDER VALISHEV, ALEXANDER ROMANOV, SERGEI NAGAITSEV, Fermilab, YOUNGKEE KIM, University of Chicago — One of key challenges in increasing particle accelerator beam intensity is the limit imposed by losses due to collective instabilities. Recently, integrable optics has been proposed as a novel method to suppress these effects. It relies on a precise placement of a set of electromagnetic fields, such that the overall Hamiltonian describing beam dynamics is integrable. To experimentally test this concept, a new research storage ring, the Integrable Optics Test Accelerator (IOTA), has been constructed at the Fermilab Accelerator Science and Technology (FAST) facility. IOTA has completed scientific run 2 in 2020, incorporating many improvements - better lattice alignment, instrumentation system overhaul, and addition of sextupoles. We present run 2 results of the two integrable optics experiments - the quasi-integrable Henon-Heiles type system and the fully integrable Danilov-Nagaitsev system. Tune footprints and Poincar surfaces of section are compared with theoretical and simulation results, and remaining disagreements highlighted. An extensive error analysis treatment is presented, quantifying impact of fundamental effects such as beam decoherence as well as experimental systematics. Related efforts in machine learning and lattice optimization are also highlighted.

[1]This work was supported by the U.S. National Science Foundation under award PHY-1549132, the Center for Bright Beams. Fermi Research Alliance, LLC operates Fermilab under Contract DE-AC02-07CH11359 with the US Department of Energy.

Nikita Kuklev
University of Chicago

Date submitted: 08 Jan 2021 Electronic form version 1.4