Abstract Submitted
for the DNP10 Meeting of
The American Physical Society

Maximizing Ion Collider Luminosity Through Genetic Optimization of Beam Tunes[1] MATTHEW KRAMER, Jefferson Lab — In designing a particle collider, one goal is to achieve the maximum feasible luminosity, a measure of the rate of collision events. Luminosity depends, in part, on a set of parameters known as the betatron tune working points (oscillation frequencies) of the beam. The relationship is complicated and nonlinear, making optimization extremely difficult. Researchers have long sought viable algorithms for solving this problem. Here, a massively parallel genetic algorithm was developed and used to locate high-luminosity working points for the proposed Medium Energy Ion Collider currently being designed at Jefferson Lab. The algorithm made use of the BeamBeam3D package to perform beam-beam simulations and to then calculate the luminosity of each working point. It was found that after five or more generations, the algorithm successfully located working points with luminosities exceeding the proposed design luminosity of the collider. These results demonstrate that such algorithms provide a feasible solution to this type of problem. Owing to the parallel evaluation of working points, a large subset of tune space can be covered relatively quickly (one or two days). It is hoped that such methods may prove useful for various other difficult optimization problems in accelerator design.

[1]Sponsored by Old Dominion University through the NSF's REU program.

Matthew Kramer
Jefferson Lab

Date submitted: 02 Aug 2010 Electronic form version 1.4