



SURVEY and ALIGNMENT OF THE BOOSTER FOR THE DUKE FREE ELECTRON LASER STORAGE RING



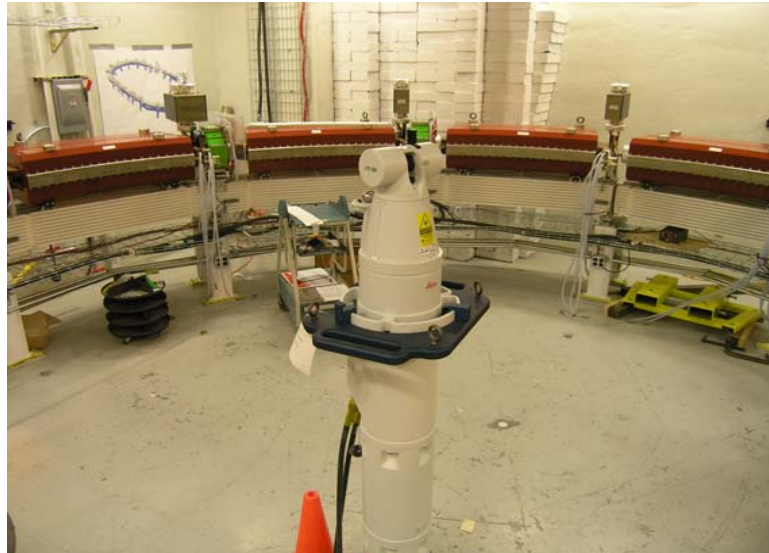
INTRODUCTION

Duke Free Electron Laser Laboratory (DFEL) Booster Ring facility is located in an approximately 1200 SF building adjacent to the north east corner of the main FEL laboratory. Upon completion of the installation of all magnets in last May, final alignment of the booster magnets began. Shortly after commissioning of the booster in July, an injection beam of 270 MeV (by using an existing linac as an injector) was successfully stored. Currently, we are commissioning the booster with low current. Beam energy ramping from 0.27 GeV to 1.2 GeV is accomplished in 0.6 second at 1.3 second of repetition rate.

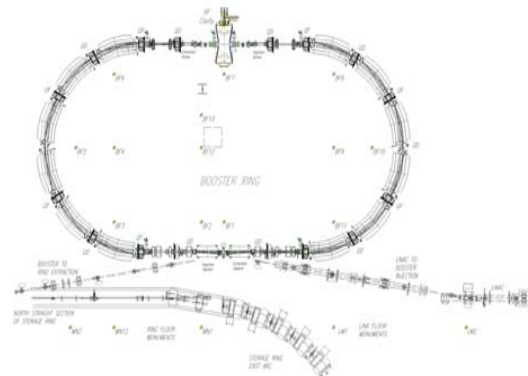
The booster ring is a compact 31.9 m circumference machine consisting of twelve dipole magnets; eight focusing (QF), eight defocusing (QD) quadrupoles; eight sextupoles, eight horizontal and vertical trim dipoles; one 178.55 MHz RF cavity for ramping electron bunches to 1.2 GeV; one injection and one extraction septum magnet; two kicker magnets. Each arc in the booster ring consists of 6 magnet clusters which are supported by individual extruded aluminum strong backs.

This article presents the methodology and results for mechanical alignment of the booster magnets. All magnets and vacuum chambers in the arcs have been designed such that a laser tracker can be best utilized for alignment. A parametric 3D design package has been used to determine target coordinates. By utilizing the functionality of the laser tracker system and a parametric 3D modeler, a direct and efficient measurement and alignment technique has been developed for the booster ring's complex geometry. For alignment, a Leica LTD 500 laser tracker and a Leica digital sight level DNA 2003 were used to accomplish this task.

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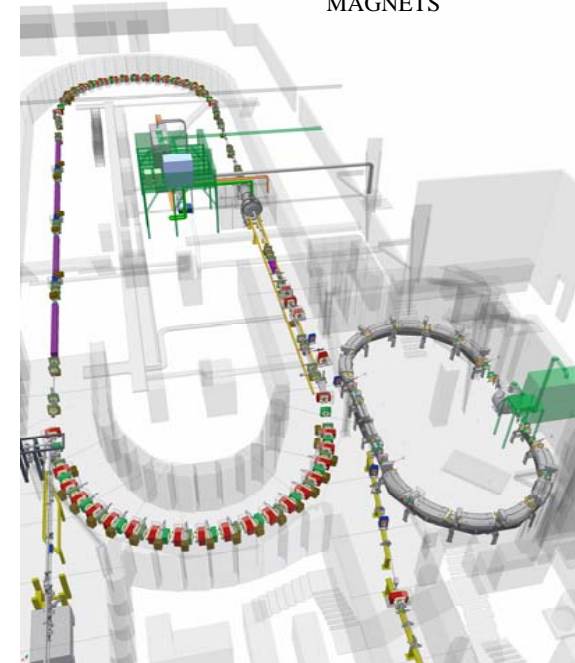
ALIGNING MAGNETS IN THE EAST ARC WITH A LEICA LTD500 LASER TRACKER



LAYOUT OF THE BOOSTER RING FACILITY



QUADRUPOLE AND DIPOLE MAGNETS



COMPLETED FACILITY LAYOUT