Progress on Design and Fabrication of a New Inflector for Muon g-2

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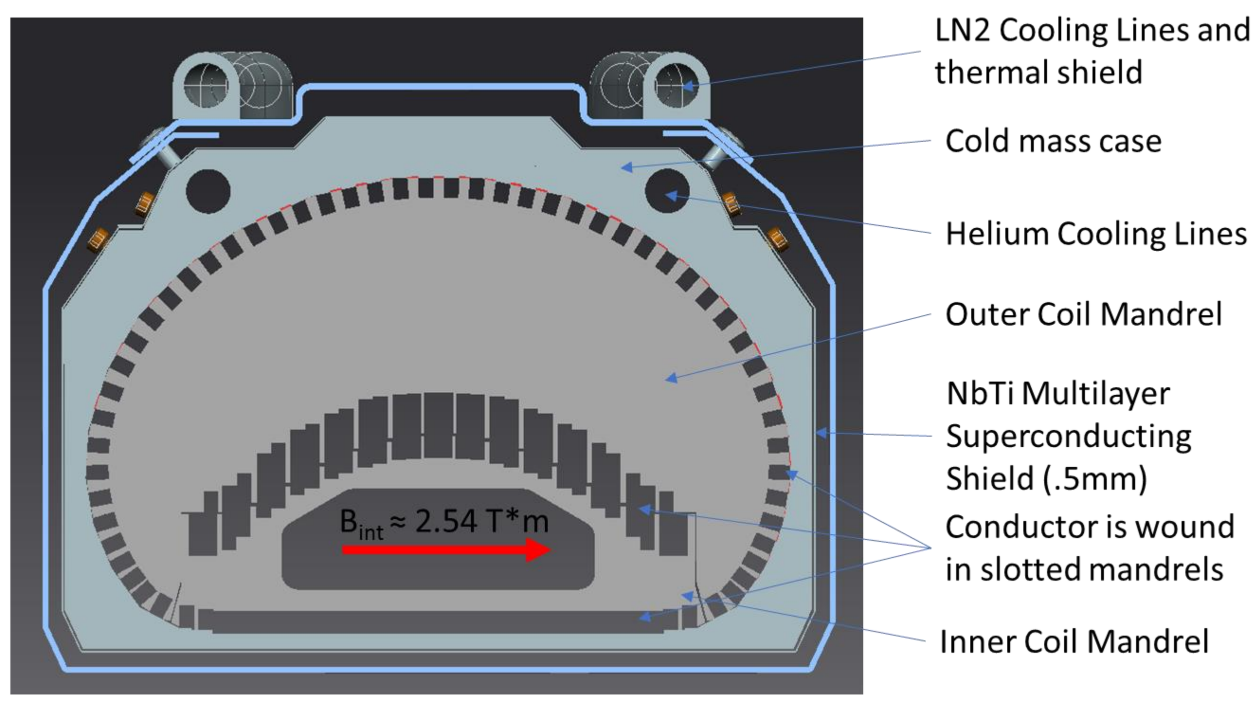
Introduction

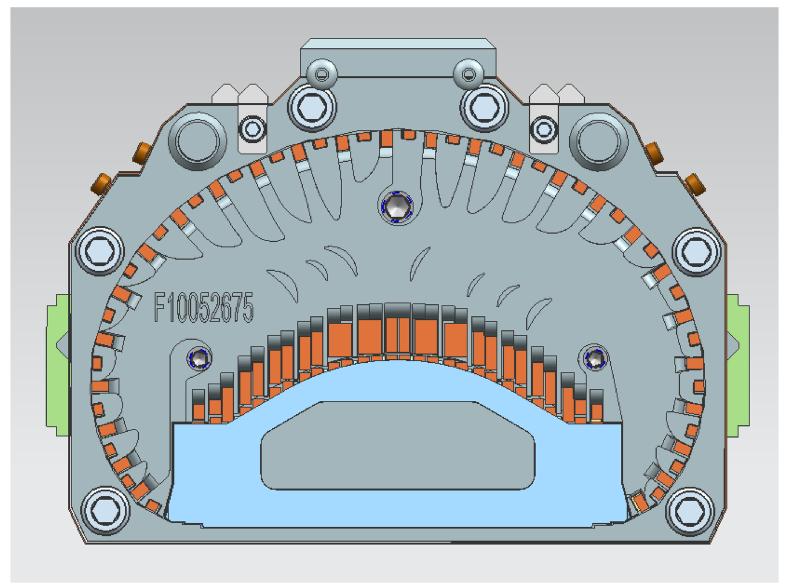
The superconducting Inflector is based on a KEK designed magnet using the same cross section currently being installed in the g-2 experiment. The magnet locally cancels the 1.45 T dipole field of the large iron dominated storage ring magnet, while imposing minimal perturbation to the circulating beam field, on the order of a few ppm. This is achieved through two approaches, first through design, and second through the use of a high performance superconducting magnetic shield.



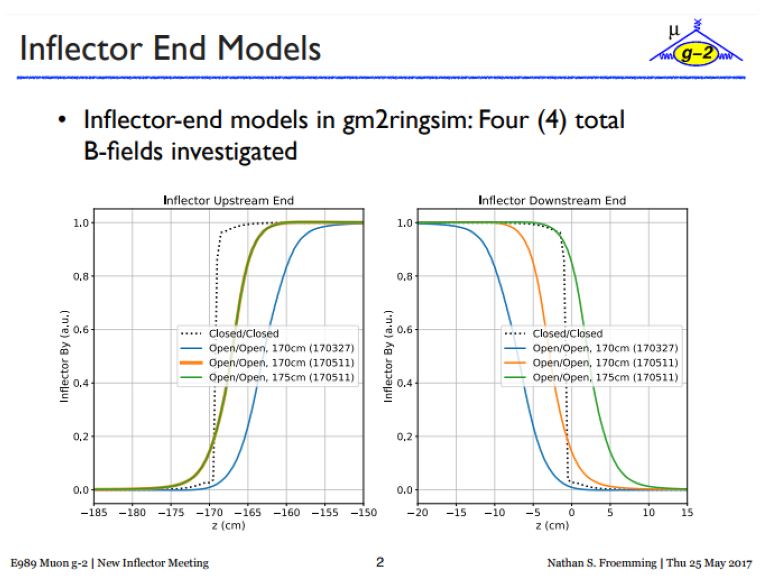
Inflector Cross Section

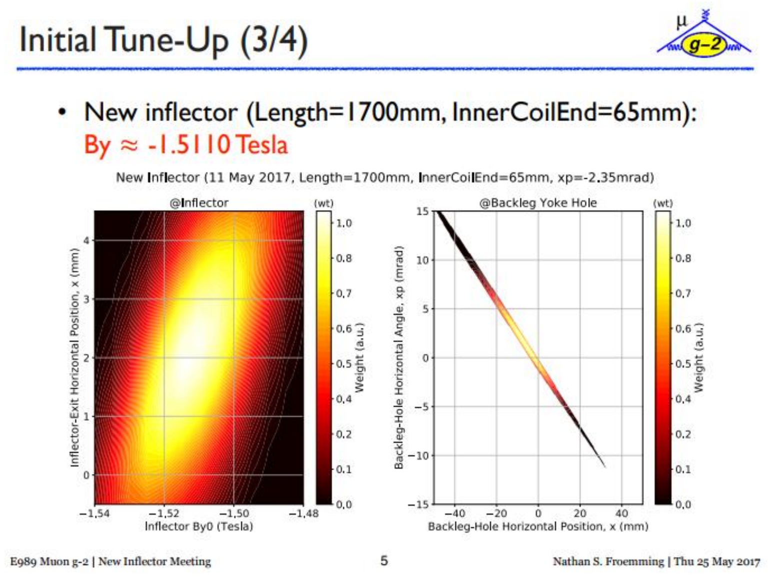
Evolution of Inflector Magnet

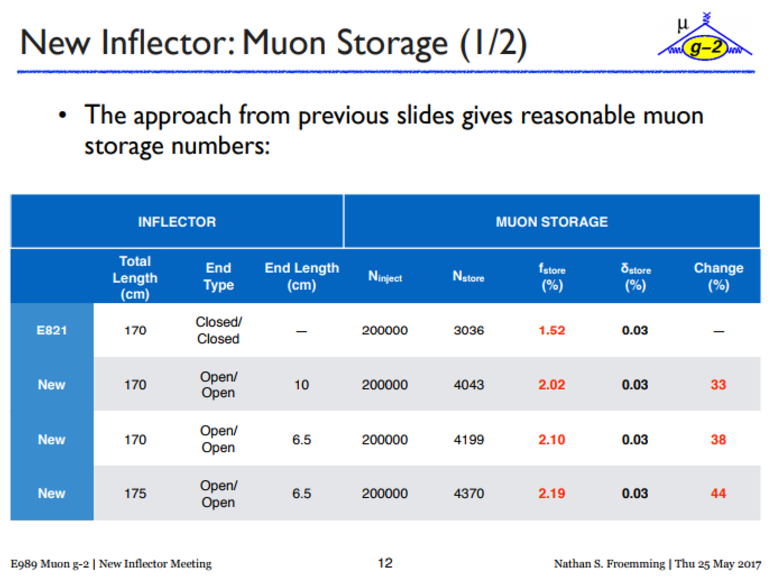
The existing inflector has been fabricated with a closed aperture with the conductor wound directly across the beam channel. This results in significant beam losses as the beam traverses the inflector. The current inflector is being fabricated using an open ended design which simulations show resulting in significantly improved muon storage efficiency.

Original inflector with closed aperture (left) and new design showing open aperture (right)



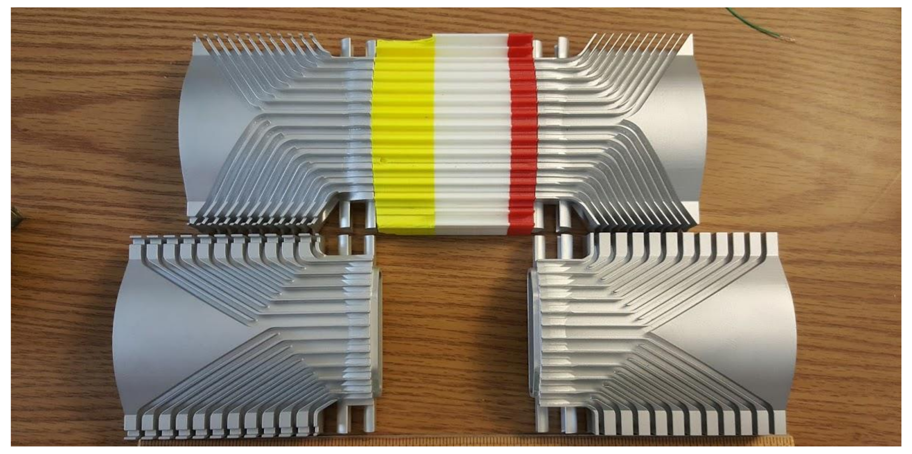




INFLECTOR				MUON STORAGE				
	Total Length (cm)	End Type	End Length (cm)	N_{inject}	N_{store}	f_{store} (%)	δ_{store} (%)	Change (%)
E821	170	Closed/ Closed	—	200000	3036	1.52	0.03	—
New	170	Open/ Open	10	200000	4043	2.02	0.03	33
New	170	Open/ Open	6.5	200000	4199	2.10	0.03	38
New	175	Open/ Open	6.5	200000	4370	2.19	0.03	44

Excerpts from inflector beam storage efficiency studies for various configurations by N. Froemming

Several iterations of inner coil end geometry have occurred to improve reduce beam "wiggle" as it passes through the inflector, increase storage efficiency, and ease fabrication challenges. Each inner coil end length has an optimal outer coil length. The final iteration led to an inflector straight section of 1594mm, with "reduced length" inner coil end parts. Inner coil end parts have been manufactured and are in the process of being hard anodized for additional ground insulation.

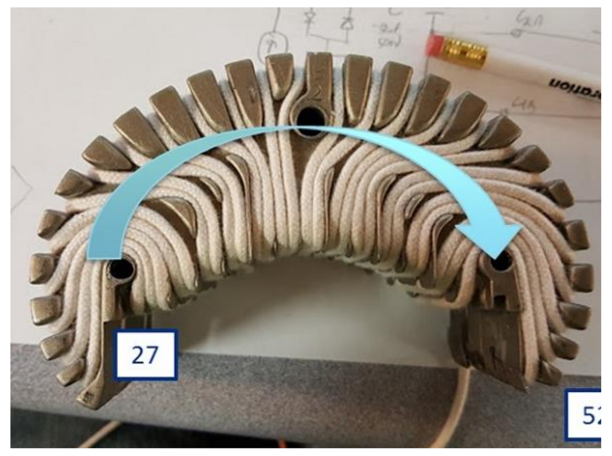


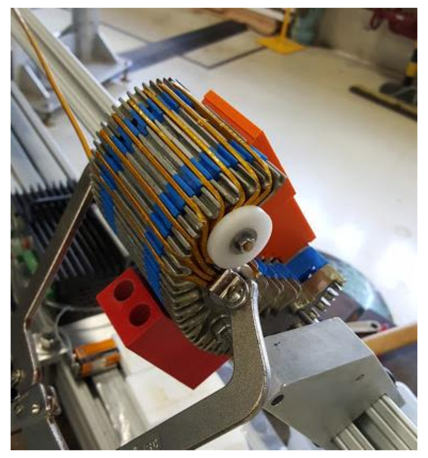
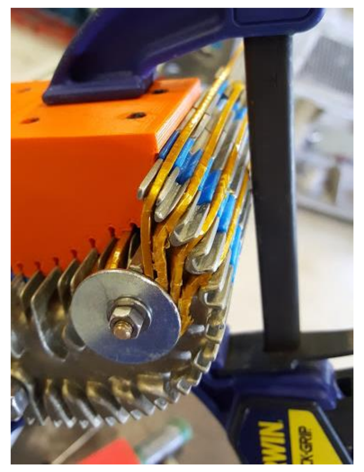
Two most recent inner coil end geometries with new (top) and older (bottom). The newer parts reduce the number of bends per turn by eight as well as increase bend radii.

Coil Winding

Inflector coil winding has started, albeit with some challenges. Some additional lengths of original enamel insulated aluminum stabilized conductor from the original inflector have been obtained and insulated in the same fashion as the previous inflector magnets.

Many iterations of tooling have been generated in order to minimize damage to conductor insulation in the winding process. 3d printing has been heavily leveraged to provide rapid, accurate tooling. The models shown have since been removed and setup is in progress to wind the outer coil.




Images from various practice windings, focusing on the tight beginning and end windings from flexible model conductor to less forgiving Al Stabilized NbTi.