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Abstract

A muon collider is a particle accelerator that collides subatomic particles known as muons, rather than the more typical protons or electrons. The muons for such a collider would be produced in collisions of a proton beam with a stationary target. These muons are generated with a high emittance (spread in position and momentum) which must be reduced in a process called cooling before they can be used in an accelerator. In the last stage of this process, called final 4D cooling, emittance in the transverse axes (perpendicular to the direction of travel) is reduced, while emittance in the longitudinal axis (parallel to direction of travel) is allowed to grow. I used computer simulations to model and optimize a design for a final 4D cooling channel consisting of two solid wedges that the muon beam is passed through, each reducing the emittance in one transverse axis, and a RF cavity between them to control momentum spread through phase rotation. I used the simulation software G4Beamline to model this channel. I characterized the effects of various parameters of the initial beam, wedges, and RF cavity on the performance of this system, and optimized the design parameters of the channel for maximum reduction in emittance while remaining within constraints imposed by technical limitations. I produced two conceptual designs for the cooling channel (corresponding to two possible starting points for the input beam) which achieve transverse cooling by a factor of 3.5. These channels achieve a lower transverse and longitudinal emittance than the best previously published design.