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A Fixed Field Alternating Gradient Lattice Design for Acceleration to energies as high as 5 TeV

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I describe a fixed field alternating gradient (FFA) lattice design to accelerate muons final energy for a muon collider. Ideally the muons would be accelerated to 5 TeV to reach the desired energy for physics studies*. An FFA allows the acceleration of muons over a large energy range without changing magnetic fields. It is an alternative to a pulsed synchrotron in which magnet fields must be varied very rapidly to minimize muon decays. I present a design for a linear non-scaling FFA which is optimized to minimize the required magnet fields. That optimization target is chosen since magnet fields are limited by magnet technology, and those technological limits will therefore limit the energy reach or bound the minimum size of the accelerator. I consider a design that would fit on the Fermilab site as well as a design with an unconstrained but minimized size. I compare the FFA design to a pulsed synchrotron design with similar technology limitations. I discuss longitudinal dynamics for acceleration, benefits of adding nonlinearity to the magnets, and the challenges of extraction from the FFA ring.

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Footnotes

*K. M. Black et al., eds., Muon Collider Forum Report, arXiv:2209.01318.

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