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The Muon Collider design challenges

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The International Muon Collider Collaboration (IMCC) was established following the 2020 Update of the European Strategy for Particle Physics, with the aim of assessing the feasibility of a muon collider operating at a centre-of-mass energy of ~ 10 TeV. The concept of colliding beams of oppositely charged muons dates back to the late 1960s, with foundational work by F.F. Tikhonin, G.I. Budker, and A.N. Skrinski. Interest in muon colliders has recently been revitalized due to technological advances that address longstanding obstacles, many of which were first tackled by the Muon Accelerator Program (MAP-US) in the United States (2010–2017) and have since been advanced by the IMCC. The large mass of the muon (207 times that of the electron) suppresses synchrotron radiation, making circular colliders feasible. However, the short muon lifetime ($2.2\mu\text{s}$ at rest) constrains the number of usable turns, making the design and operation of such a collider uniquely challenging. Despite the many hurdles linked to the muon decay, no fundamental showstopper has been identified to date. A muon collider thus remains a highly promising candidate for the next-generation high-energy physics facility.

Footnotes

Funding Agency

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