# Muon Accelerators for Particle Physics

*Abstract:*

Muon accelerators offer unique potential for particle physics applications.
The decay of muon beams within a storage ring can provide pure, well-characterized and intense neutrino beams for short- and long‑baseline neutrino-oscillation studies – thus providing measurements of key parameters such as the CP-violating phase of unmatched precision and uniquely-sensitive probes for new physics. Muon beams are not subject to the synchrotron radiation and beamstrahlung limits imposed on electron-positron colliders because the muon mass is 200 times that of the electron. Thus muon beams can be accelerated to TeV-scale energies and stored in collider rings where the beams can interact for many revolutions. For center-of-mass energies >1 TeV, muon colliders provide the most power efficient route to providing a high luminosity lepton collider.

The concept of the muon collider (MC) was first proposed in 1969[[1]](#footnote-1), while the concept for the neutrino factory (NF) appeared in 1997[[2]](#footnote-2). The original design concepts have been developed through a series of design studies and a program of accelerator R&D has been carried out to lay the groundwork for deploying these next-generation particle physics capabilities. This volume summarizes work that has been carried out by the U.S. Muon Accelerator Program (MAP)[[3]](#footnote-3), the International Design Study for a Neutrino Factory (IDS-NF)[[4]](#footnote-4), and the international Muon Ionization Cooling Experiment (MICE)[[5]](#footnote-5) to establish the design concepts and to carry out the required feasibility R&D for these machines. It summarizes the current state of the designs for short- and long-baseline neutrino factories (including the nuSTORM short-baseline NF, the IDS-NF reference design and the NuMAX long-baseline concept) as well as the current collider concepts. It also summarizes the status of the technology R&D that has been carried out to allow these capabilities to be deployed and, in particular, the efforts underway at MICE to demonstrate the feasibility of producing cooled muon beams.

1. G. Budker, Proc. Int. Conf. High-Energy Accel., 7th, Yerevan, p. 33. Yerevan: Publ. House Acad. Sci. Armen. SSR (1970). [↑](#footnote-ref-1)
2. S. Geer, Phys. Rev. D 57:6989 (1998) [↑](#footnote-ref-2)
3. map.fnal.gov [↑](#footnote-ref-3)
4. https://www.ids-nf.org/ [↑](#footnote-ref-4)
5. http://mice.iit.edu/ [↑](#footnote-ref-5)