**Six-dimensional ionization cooling: options, issues and R&D (MICE)**

**Abstract:**

Six-dimensional (6D) cooling of the muon beam is required for the Muon Collider and benefits the Neutrino Factory. Ionization cooling is the only feasible technique to cool within muon lifetime. 6D ionization cooling options and issues are discussed, along with the status of the Muon Ionization Cooling Experiment (MICE).

**Summary:**

Reduction of the size of the muon beam prior to acceleration, commonly referred to as "cooling", is required for the Muon Collider (six orders of magnitude in 6D). Both transverse and longitudinal beam sizes need to be reduced (six-dimensional cooling). Neutrino Factory benefits from initial cooling. Ionization cooling is the only technique fast enough to cool within muon lifetime. Transverse phase space is reduced via ionization in material followed by energy recovery in the RF cavities. Longitudinal phase space is reduced using emittance exchange. Cooling for the Muon Collider is done in stages: initial cooling that accepts both signs of muons followed by particle separation by charge, intense 6D cooling with bunch merge in the middle combining multiple bunches into one, final cooling stage bringing the transverse emittance to the smallest possible value. An overview of 6D ionization cooling options and issues is given, along with the status and progress of the Muon Ionization Cooling Experiment (MICE) R&D that aims to demonstrate muon ionization cooling in 2015.