**Pulsed Synchrotrons for Very Rapid Acceleration**

**Abstract:**

We discuss synchrotrons with very short pulse times that are ideal for accelerating muons. We describe particular aspects their lattice design. We show a magnet design that can achieve high fields with short pulse times and tolerable losses. We discuss important challenges, including computational limitations and understanding material properties.

**Summary:**

When rapid acceleration is important, synchrotrons with very short pulse times can be used to accelerate particle beams. Our talk will describe rapidly pulsed synchrotrons and their distinction from ordinary synchrotrons. We will introduce a hybrid synchrotron which interleaves pulsed magnets with superconducting dipoles to allow rapid acceleration while still maintaining a high average bending field. We will show that pulsed synchrotrons are particularly well suited for muon acceleration. We will then describe particular characteristics of the lattice design for these machines. We will describe how to design magnets to limit power consumption while still maintaining high fields. We will discuss the impact of the choice and properties of magnetic materials on the magnet performance, including areas where we think better understanding is needed. We show a magnet design that limits losses in the core while giving a high field by using multiple materials: 6.5\% silicon steel for the back yoke due to its low losses at high frequencies, and 3\% silicon steel in the pole for its high saturation field. We simulate the magnet, computing the losses and field quality. We show eddy current simulation results for a unique coil configuration which reduces self field losses. We list some computational challenges that, if addressed, could enable the simulation of better performing rapidly pulsed magnets.