# Muon Collider Physics and Detector Goals

The Physics and Detector effort for the Muon Collider is intended to access the physics potential of a Muon Collider by understanding the challenges posed by the large beam backgrounds, providing a simulation environment, simulating selected physics processes, and defining the associated detector challenges. This note is intended to define a set of goals to be accomplished by the 2013 "Snowmass" meeting and outline the resources needed to achieve those goals.

## Simulation Environment

Our work will focus on the development of the LCSIM framework, while we continue to utilize and extend the work already done using the ILCROOT system. Fermilab is in the process of submitting a Fieldwork Proposal with SLAC to provide support to implement the changes needed in LCSIM to support future lepton collider simulation.

Tasks:

- Implementation of MCD01 – A model with double layer silicon tracking, larger tracker mass, dual readout calorimetry.
- Implementation of MCD02 – A model similar to MCD01, but with fine sampling calorimetry.
- Incorporation of MARS background into LCSIM with muon decay-based file structure and proper timing.
- Comparison of LCSIM and ILCROOT background analysis
- Simulation of a full background event.

## Background Analysis

The large background at the Muon collider is the primary experimental challenge. Providing a framework to generate and utilize the background events is a significant computing challenge. It is also important to understand the background in sufficient detail to provide an efficient parameterization of the backgrounds suitable for fast simulation.

Tasks:

- Provide a procedure for utilizing weighted individual muon decay events produced by MARS
- Define a framework and procedure for full background event simulation
- Use full background simulation to understand how events can be simulated using parameterization of backgrounds in the tracking and calorimeter detectors. Can the backgrounds be separated into "parametrizable" and full simulation components? What are the event-to-event fluctuations?

## Detector Response

A result of our initial studies is that time resolution will be crucial to a successful Muon Collider detector. A set of studies will be needed to understand how to implement detectors with appropriate time and position resolution and what resolution is needed.

Tasks:

- Study the effects of timing on resolution for dual readout hadron calorimeters.
- Study the effects of timing for fine samping calorimeters. Investigate PFA schemes with Muon Collider background.
- Study tracker background rejection for fast timing systems and the effects of double correlated layers

**Physics Studies**

A few physics processes should be studied, both in fast and full simulation. A set of these studies were described at Telluride. The focus may change as data becomes available from LHC. Initial fast simulation studies would be limited to studying the effects of the forward "nose" and more massive tracker. Full simulation studies would include MARS event backgrounds. An intermediate set might include parameterized backgrounds.

Physics topics:

- Z'
- Slepton
- Heavy Higgs
- WW fusion?
- (others as interest and time dictate)