GROUP 5

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"COLLIDERS BEYOND LHC and ILC"
a Preliminary report

H. Edwards, V. Shiltsev, M. Tigner, Young-Kee Kim ex officio

Charge: …develop a strategic roadmap that:

3. includes the steps necessary to explore higher energy colliders that might follow the ILC of be
needed should the results from LHC point toward a higher energy than planned for the ILC

Abstract

Steps needed to explore higher energy hadron and e+e- colliders are in train currently with results expected within five years. The exploration of the muon collider is a much different matter and will require considerable attention and significant resources.

LHC Energy Upgrade

Magnet technology needed to upgrade the LHC to 21 TeV CM is currently under development as part of the LARP program and of the DoE base funding for magnet technology development. This technology should be ready for application in a five year time frame.

VLHC

Likewise, the basic technology that could support construction of a VLHC will be in hand on the five year time scale should it be needed. Detailed magnet development would need to follow a reanalysis of the energy and optimum size of the machine once the physics objectives clarify.

CLIC

The current CERN mid-term plan includes efforts to demonstrate the CLIC technology for an e+e- collider up to 3 TeV CM by 2010.

Muon Collider

In contrast, many steps are needed to demonstrate the viability of a muon collider. These include exploration of various possible overall schemes, a specialized proton driver, various targeting and capture and phase rotation schemes, various possible 6D ionization cooling configurations, various methods of acceleration to high energy of the cooled muons, storage ring designs and detector configurations. Each of these may involve more than one technology development. Given the many unknowns it is not possible to predict with confidence when these explorations could be complete. In a technically limited schedule the overall result would be paced by the 6D cooling exploration. Significant trial of the current ideas could be in hand on the five to ten year time scale. (See Appendices for a more detailed description of the muon collider and R&D needs.

Schedule and Cost

As it is not known what difficulties will be encountered in mastering 6D ionization cooling it is not possible to state even a technically limited schedule with any precision. Nevertheless one might estimate that a significant evaluation of cooling and other feasibility items might be carried out in approximately five to seven years if a technically limited schedule could be supported. A rough comparison with the US ILC development intensity prior to the ITRP decision would indicate that a minimum of $20M annually and 100 FTE of appropriate skill set would need to be invested. Of course, should one decide to proceed, an integrated plan with a detailed cost and manpower estimate should be the first order of business. It should also be noted that the entire activity need not be carried out at FNAL but that other willing partners in US labs and universities are ready to engage. Further, it will be very advantageous to have more than one muon test facility where cooling

and the associated technologies can be carried out in a collaborative and coordinated fashion.

In terms of the (5) scenarios, the above indicates a strengthening of the R&D program over the next five years independent of the scenario. Should scenario (1) or (2) come to pass, one should reevaluate and adjust the effort as appropriate. Should scenarios (4) and (5) prove to be the case, then, if we have found a satisfactory cooling method and developed a concept design for the collider system, one would be in a position to ramp up the effort rapidly.