Fermilab PAC Recommendations on Tevatron Run Extension
June 22-26, 2010

Charege: Please comment on the physics value of an additional three years of running the Tevatron Collider program.

The proposed three-year extension of the Tevatron run, giving an additional 7 fb-1 of luminosity delivered to each experiment, provides a unique opportunity for Fermilab due to recent changes in the LHC schedule that could not have been foreseen.. The Tevatron Collider as well as the CDF and DZero detectors are currently operating at the peak of their performance, which gives confidence that this proposal can be successfully carried out.

Verification of the Higgs mechanism of electroweak symmetry breaking is one of the top goals of present-day high-energy physics and is the primary motivation for this run extension. Based on current understanding, a three-year extension offers a greater than 50% probability of obtaining evidence for a Standard Model Higgs at the three-sigma level over the full mass region favored by electroweak precision measurements, M_{Higgs} = 115 – 186 GeV. In particular, the opportunity in the low-mass region has been opened by the current projected luminosity and energy profile of the LHC. The extension of the current run would maintain the leading position of the Tevatron for this search over the next several years. The Tevatron has sensitivity to the dominant *b b*-bar decay channel which is complementary to the search modes at the LHC in this mass region. In the case that no evidence is observed, the full favored region could be excluded at high confidence level, which would be in contradiction with the Standard Model.

In addition to this primary motivation, there are a number of exciting measurements that would be enabled by the extended run. The Supersymmetric Higgs five-sigma discovery potential covers an interesting region of the SUSY parameter space and would be competitive over this time period. The *p p*-bar environment of the Tevatron is ideal for study of the forward-backward asymmetry of the top-quark; and there is also a clear advantage for the measurement of the di-muon charge asymmetry. Both of these results currently deviate from the Standard Model prediction at the two-to-three-sigma level and would benefit from an extension of the Tevatron operations. Further improvement could be obtained on the measurement of the top-quark and *W* boson masses, tightening the electroweak precision constraints. In all, the Tevatron boasts a very broad physics program which has the capability to foster numerous Ph.D. students.

The PAC considers this to be an exciting and compelling physics opportunity with potentially historic importance. However, before making a recommendation, the Committee would like to receive information on the following (in no special order) to address its concerns:

- Impact of the extended run on the physics capabilities of
- Impact of the extended run on the long-term program of the Laboratory
- Detailed impact on the Higgs analysis due to any detector degradation from the extended run

- Resolution on the Higgs mass that is achievable in case evidence for the SM Higgs is found. The current combined search shows an excess of one-sigma significance over the broad mass range 100 to 155 GeV. Is this consistent with the behavior expected for a true signal?
- More detailed and up-to-date full-time equivalent personnel commitments of the collaborations for an extended run
- Projected increase in sensitivity which depends strongly on the successful achievement of anticipated improvements in the Higgs analyses. The PAC encourages the collaborations to report on the improvements that have already been accomplished compared to the presentations made to the PAC, and to provide updated projections.

Given this information, the PAC would be able to make a recommendation by early fall.