Fixed Target White Paper
Organizational Meeting

Introduction

Aug. 4

Heidi Schellman
Janet Conrad

We are proposing a study of:

The physics case for a Tev-based Fixed Target Program

This is a unique machine…
We should be asking:

- What unique physics can we do with it?
- Is that physics interesting?
- Does this effort complement identified goals of the community?
- Is the program affordable?

Plan: produce a white paper with some answers…

There is already one experiment on the table: NuSOnG
The NuSOnG group plans to keep working on the idea…

The purpose of this study is to identify other opportunities.
Ideas on the table as of the June Project X meeting:

- Nu Tau Experiments
- Charm Experiments
- General Relativity Experiments
- Searches For Exotic Neutrino Properties
- HiResMuNu (charm)

New to this discussion:

- Study of the HyperCP anomaly

Question to return to: what other topics?

For each topic, we will want to make a strong physics case.
This will need help from the theory community.

We need to match ideas to interested theorists.
Members of the FNAL theory group are willing to help.

Developing a physics good case is likely to take time…

Realistically, getting out a good whitepaper
is probably a year-long project.

Side Goal to make the time-investment worth it:

aim to publish the results as one or several papers
in International Journal of Modern Physics A

Truth-in-advertising slide…

Is the Directorate interested in pursuing this question?
Signals are unclear -- probably because the situation is unclear.

A lot will happen within the next year:

- LHC will begin running
- The P5 plan will “shake out”
- Community interests may solidify around new projects
- Some long-term funding questions may be clarified.

All of this affects whether future Tev running can fit into a Fermilab program…

If it doesn't fit Fermilab,
where else could this program go?

Around 2016-2020, there may be an upgrade to the CERN SPS to a superconducting machine.

It will operate at ~1 TeV, 10^{15} protons/spill, 10 s cycle time.

50% of the time it may be useable for FT operation.

Next slides are from a 2005 talk about LHC upgrades…
Several people have now told me this is still in the plans.

We need to make some contacts at CERN.

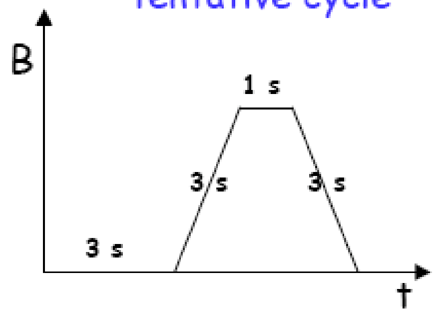
luminosity and energy upgrade

Phase 2: steps to reach maximum performance with major hardware changes:

- equip the SPS with SC magnets, upgrade transfer lines to LHC and the injector chain, to inject into the LHC at 1 TeV (➔ super-SPS option)
  - ➔ beam luminosity should increase
  - ➔ first step in view of an LHC energy upgrade
  - for a given mechanic and dynamic apertures at injection, this option can double the beam intensity (at constant beam-beam parameter $\Delta Q_{bb} \propto N_b/\varepsilon_n$) increasing the LHC peak luminosity by nearly a factor two, in conjunction with long range beam-beam compensation schemes
  - LHC energy swing is reduced by a factor 2, hence the SC transient phenomena should be smaller and the turnaround time to fill LHC should decrease
  - interesting alternative ➔ cheap, compact low-field booster rings in the LHC tunnel
- install in LHC new dipoles with a operational field of 15 T considered a reasonable target for 2015 ÷ 2020 ➔ beam energy around 12.5 TeV
  - ➔ luminosity should increase with beam energy
  - ➔ major upgrade in several LHC hardware components

pulsed SC magnets for the super-SPS

tentative cycle



- with the present SPS dipole packing factor, at 1 TeV we need SC dipole with $B_{peak} \approx 4.5$ T
- to reduce dynamic effects of persistent current, the energy swing should not exceeds $\times 10$
- the optimal injection energy is of about 100÷150 GeV
- a repetition rate of 10 s should halve the LHC filling time

repetition rate 10s

SPS beam size:

- normalized emittance: $\varepsilon^* = 2\times 3.5\ \mu m$ (2 factor is related to the higher bunch intensity)
- peak-beta: $\beta_{max} \approx 100$ m (assuming the same focussing structure of the present SPS)
- rms beam size at injection: $\sigma_{150GeV} \approx 2.2$ mm $\sigma_{1000GeV} \approx 0.8$ mm

SPS aperture

- peak closed orbit: $CO_{max} = 5$ mm
- dispersive beam size $D\times\delta = 12$ mm (assuming D = 4 m, $\delta_{bucket} = 3\times 10^{-3}$)
- betatron beam size $6\times\sigma_{150GeV} = 12$ mm and $6\times\sigma_{1000GeV} = 5$ mm
- separatrix size for slow extraction 20 mm
- clearance of 6 mm

adding in quadrature the betatron and the dispersive beam size and linearly the closed orbit, the separatrix size, and the clearance one will need a radial aperture of at least 29 mm at injection and 44 mm at top energy.

inner coil aperture 70÷100 mm

My guess is that in the end,
What we come up with will be used somewhere!

This project is worth doing.

Connecting people to study groups:

If you want to work on a specific topic please contact:
- Nu Tau Experiments -- heller@physics.umn.edu
- Charm Experiments -- alan.schwartz2@uc.edu
- General Relativity Experiments -- kopeikins@missouri.edu
- Exotic Neutrino Properties -- vannucci@in2p3.fr
- HiResMuNu -- mishra@barney.physics.sc.edu
- HyperCP anomaly -- dave@fnal.gov

Please also cc conrad@mit.edu