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Progress Report On "Exploitation of Vertex Detection at the Tevatron"

I was recently appointed to be co-leader of the CDF working group responsible for optimizing the power of B hadron tags in the upcoming top quark search. This B tag will rely crucially on the use of the CDF Silicon Vertex Detector (SVX), and this activity is thus exactly what I had in mind when I proposed to "Exploit Vertex Detection at the Tevatron"! A very preliminary result, shown in Fig. 1, suggests efficiencies of order 50% for tagging at least 1 B meson in the decay of a heavy top pair. This tag rate will enhance the signal to background ratio in the lepton + jets top decay channel by a factor of ten or more. The B tag working group is one of three that will direct all physics analysis pertinent to our hope of observating the long awaited top quark at CDF in the coming year.

Several members of the Michigan group are already collaborating in the construction and commissioning of the SVX at CDF. Our responsibilities include offline tracking software and radiation protection. Work on the offline tracking involves the integration of the device into the large CDF code package, as well as attention to the various details necessary for the optimization of the resolution. Work so far has concentrated on understanding the contribution of multiple coulomb scattering to the resolution function, as well as a broad based regimen of systematic checks on the algorithm.

The promise of the SVX will be lost if the device cannot be protected from degradation by radiation. The present SVX readout chip, mounted on the detector, suffers in gain and noise starting at integrated exposures of about 15 kRad. Measurements made in CDF during the last data cycle suggest that this level of exposure is possible in the next data run, but the mechanisms by which the dose is created are unclear. We have therefore erected a system of radiation monitors near the beam pipe at CDF, and, with the assistance of the FNAL Accelerator Division, we have used them in a preliminary way to ascertain correlations between beam loss and certain Tevatron activities. An example is shown in Fig 2. This shows recorded counting rates on three redundant monitor systems during execution of an accelerator operation to eliminate out-of-time beam bunches. The total dose expected at the SVX inner layer from this operation is measured to be about 1 rad. We expect that further such studies at the Tevatron will allow us to explicate the sources of excess radiation dose from the accelerator, and either eliminate them, or engage a clean

beam abort when these conditions arise. We believe that by this close control of accelerator conditions we can limit the dose received by the SVX to that from beam-beam interactions alone, expected to be a safe 4 kRad for the entire run.

I point out that radiation protection for close in detectors is an important issue for the SSC, that this work provides the first hard data for use in extrapolating to SSC conditions, and may be prototypical of protection schemes that can be implemented there.

Publications

During the past year, I was principle author for the following publications:

"Vertex Detection at The Tevatron", Proceedings of the 1990 Summer Study on High Energy Physics, Snowmass, CO (1990)

"Study of Vector Boson Decay and Determination of the Standard Model Parameters at Hadronic Colliders", Proceedings of the Xth International Conference on Physics in Collision, Duke University, Durham, NC (1990).

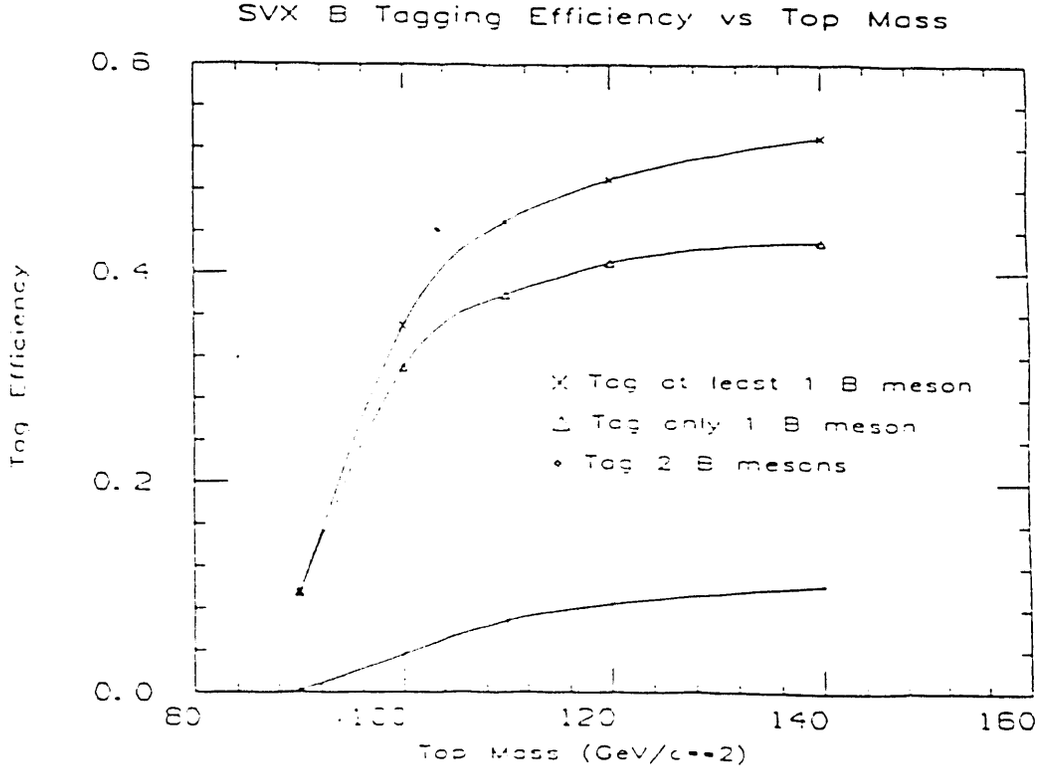
SVX B Tagging Efficiency vs Top Mass
Tag Efficiency
0.6
0.4
0.2
0.0
X Tag at least 1 B meson
Δ Tag only 1 B meson
◦ Tag 2 B mesons
80
120
140
160
Top Mass (GeV/c**2)

Fig. 1

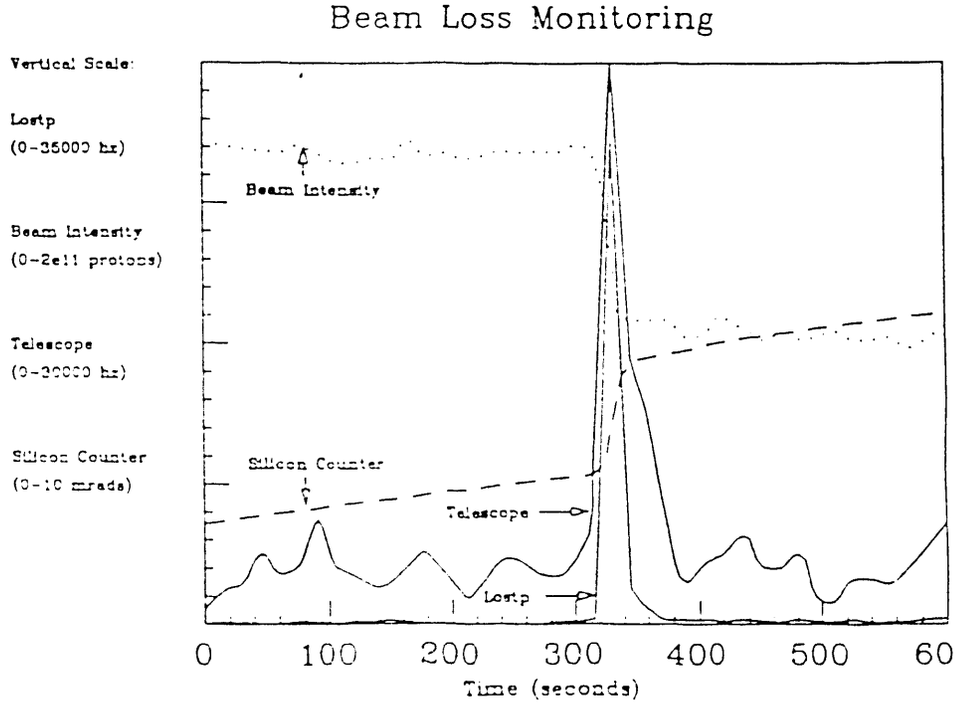
Beam Loss Monitoring
Vertical Scale:
Lostp
(0-35000 hz)
Beam Intensity
(0-2e11 protons)
Telescope
(0-30000 hz)
Silicon Counter
(0-10 mrads)
Beam Intensity
Silicon Counter
Telescope
Lostp
0
100
200
300
400
500
60
Time (seconds)

Fig. 2

END

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