

STATUS REPORT

Continuation of Reconstruction Studies for the SiD Barrel Outer Tracker

Personnel and Institution(s) requesting funding

Frederic Blanc, Richard Clancy, Stephen R. Wagner - University of Colorado, Boulder

Collaborators

None at current time

Project Leader

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Project Overview

Further development of tracking code for SiD Barrel Outer Tracker. Finish development of simple (Kalman) fitter to properly take into account material scattering in detector, and compare with results from existing weight-matrix fitter. Incorporate elements of light-weight fitter into pattern recognition studies, and produce and support a SiD barrel reconstruction package that inter-operates with the other standard classes and packages to produce tracks which can be used by other groups for detector optimization and physics justification studies. Contribute to the improvement of base tracking classes in **org.lcsim**, the Java/JAS-based Monte Carlo (MC) reconstruction package, to make them more functional for tracking developers and those doing detailed physics analysis studies. Bring experience gained working on CMS tracking detector in next two years to SiD track reconstruction, as the detectors and problems faced are very similar.

Status Report

Project Leader's FY05 activities related to this project:

- Attended 2005 International Linear Collider Physics and Detector Workshop and Second ILC Accelerator Workshop at Snowmass; presented talk at SiD Track/Vertex Parallel Session.
- Member of Organizing Committee, American Linear Collider Physics Group Detector Simulation Workshop at University of Colorado, January 9-11, 2006.
- Finished porting code used for previous studies from **hep.lcd** to **org.lcsim** framework.

The talk presented by Wagner at the Snowmass workshop was mostly a repeat of previous work, which dealt with pattern recognition in the SiD outer barrel in the presence of large backgrounds. However, there were several new results included. One of these was a measurement of the two-track resolution of the outer barrel, determined by embedding the hits for two $p_T = 50$ GeV/c at fixed angles with respect to each other near the core of a $q\bar{q}$ event. The results of this study are shown in Figure 1, and demonstrates that the inefficiency seen in previous studies is due to the track stub which is projected out from the pixel vertex detector latching onto the entire wrong track in the outer detector.

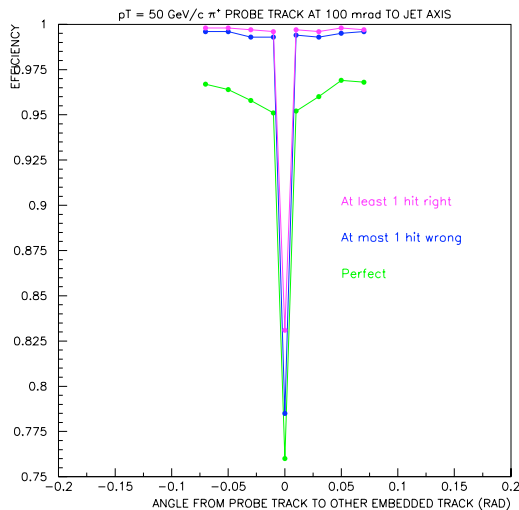


Figure 1: Two-track efficiency studies from Snowmass 2005.

Another study reported at Snowmass used two muon tracks embedded in $\sqrt{s} = 500$ GeV $q\bar{q}$ events to simulate a $p_T = 41$ GeV/c $Z^0 \rightarrow \mu^+\mu^-$ decay. This study allows one to sidestep the MC truth question of whether or not a track is correctly reconstructed if it shares hits with another track, or just happens to lie within errors of an expect track, and just ask if the Z^0 is properly reconstructed. Figure 2 shows that other than in the angular regions near the jet axes, the efficiency for reconstructing *both* tracks is $> 99\%$, and this efficiency averages to 99.1% over all ϕ (in this study no background hits were embedded, but all hits from the $q\bar{q}$ events were included).

The FY05 funding (\$27K) spent so far (\sim \$4K) has gone for travel to Snowmass and registration for the Simulation Workshop, and one month's employment of an undergraduate (Richard Clancy) who worked on this project as a volunteer during Summer 2005. The remaining FY05 funding will pay for approximately 25% of the effort of a senior Colorado post-doc (Frederic Blanc). Blanc began working on this project in November 2005, shortly after the FY05 funds became available. Most of Blanc's time so far have been spent learning Java (he is an experienced C++ programmer), installing JAS3 and **org.lcsim** software and

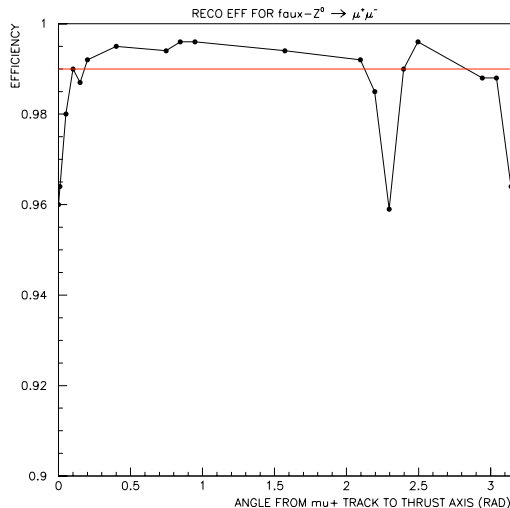


Figure 2: $Z^0 \rightarrow \mu^+ \mu^-$ reconstruction efficiency studies from Snowmass 2005.

running tutorials, but he is now (January 2006) in a position to begin contributing significantly to this work. The simulation workshop will provide an opportunity for Blanc and Wagner to interact with the other SiD tracking developers and define goals for short-term activity.

FY2006 Project Activities and Deliverables

Release beta version of track finding package for other groups to test. Compare simulation of SiD strip detector hit response to that determined from CMS cosmic-ray magnet-on tests, as both the CMS and SiD tracking detectors (inner pixel and outer strips) and magnet fields (4T vs 5T) are very similar. Also investigate whether tracking improvements being developed for CMS, such as simulated annealing fitters, are appropriate for SiD tracking. This synergy between SiD and CMS tracking is made possible by Wagner's recent joining of CMS and heavy involvement with the CMS tracking effort (he is now co-convener of the LPC tracking group).

FY2007 Project Activities and Deliverables

Participate in final optimization of SiD detector for LOI/TDR using developed tools. Continue to develop track finders and fitters in **org.lcsim** framework and to support others using these tools.

Budget justification: University of Colorado, Boulder

The majority of the funding being requested is for half of a post-doc's salary for the remaining two years. It is expected the remainder of this post-doc's salary will come from the CU base

DOE grant (as is the case with Blanc now), and that they will spend the remainder of their time on one of that grant's funded projects (most probably CMS, but possibly BaBar or the neutrino program).

There is also a line to hire one undergraduate (at a time) for 10 hours/week during the school years and 40 hours/week during the summers. While we would like to get more undergraduates involved, we assume any additional ones will be funded through the CU Undergraduate Research Opportunities Program (UROP).

The Equipment funds are to provide desktop computing for those working on this project. The Travel request assumes one US conference or workshop and one foreign conference per year, and includes the travel of the the Project Leader for the work proposed.

Inflation is calculated at 4% per year, benefits are calculated at 21.6% of salary for the post-doc and 0.9% for the undergraduate, and indirect costs are calculated at 49% of direct costs. These rates are those used in the CU base grant.

Two-year budget, in then-year K\$

Institution: University of Colorado, Boulder

Item	FY2006	FY2007	Total
Post-Doctoral Research Associate	23.4	24.3	47.7
Undergraduate Students	7.8	8.1	15.9
Total Salaries and Wages	31.2	32.4	63.6
Fringe Benefits	5.1	5.3	10.4
Total Salaries, Wages and Fringe Benefits	36.3	37.7	74.0
Equipment	2	2	4
Travel	3	3	6
Total direct costs	41.3	42.7	84.0
Indirect costs	20.2	20.9	41.1
Total direct and indirect costs	61.5	63.6	125.1