SLD MEMORANDUM

February 21, 2000

TO: The SLD Unified Physics Group

FROM: David Muller

SUBJECT: Proceedings of the Unified Physics Meeting, February 18, 2000

Present (27): K. Abe, H. Akimoto, D. Aston, K. Baird, G. Bower, P. Burrows' voice, A. Chou, M. Convery, N. deGroot, D. Dong, M. Iwasaki, J. Jaros, H. Kang, R. Kofler, V. Lia, C. Lin, T. Maruyama, D. Muller, G. Nesom's voice, L. Rochester, V. Serbo, H. Staengle, D. Su, B. Ward, J. Wittlin, T. Wright.

Announcements:

• **New Meeting Format:** This was the first meeting of the newly unified SLD physics group, intended to review all current and future SLD analysis, replacing the Heavy-Flavor, QCD, and EW group meetings. It will be organized by our new Analysis Coordinator, **Tracy Usher**, and will be held at 10:00 a.m. on Fridays in the Group A conference room. Tracy was kind enough to make the transition easy on the QCDers by leaving town this week (see www-user.slac.stanford.edu/usher/SailPics.html), but look for news of the future meeting schedule, arrangements for remote access, etc., in an upcoming e-mail. The minutes of these meetings will NOT be distributed in hardcopy, but will be posted to the sld-news list (text only) and available on the web.

• **Status of Publications:** Very positive referee's reports have been received from PRL on the B fragmentation paper. Phil will make the minor changes required, run it by the heavy QCD subgroup, and resubmit with the expectation of prompt acceptance.

• **SLD Seminars:** Dan has just returned from Cornell, where he gave a seminar on B fragmentation. It went very well, generated much interest, and prepared him for his impending Orange Room talk (to be scheduled).

Vertex Charge with R17 – Thomas Wright

Tom reviewed his recent work on using the features of R17 to measure R_b, R_c, A_b and A_c. At a previous HF meeting he had discussed his work in optimizing the selection of topological vertices and track attachment using neural networks. He has since pared down these nets to use minimal inputs and showed the associated results. To select seed vertices he first runs ZVTOP with a loosened set of track quality cuts, then uses the flight distance, the normalized flight distance, and the angle between the vertex flight direction and the total vertex momentum as inputs to a neural net; a cut on the neural net output gives a very clean sample of true secondary vertices. He attaches tracks using a net with the standard inputs T, L and L/D, as well as the angle between the track and the vertex flight direction, and the normalized impact parameter wrt to the IP; he then attaches VXD-only vectors using the first four of these.

It is possible to have more than one vertex in a hemisphere, with some track overlap, giving a little additional flexibility. The p_t-corrected mass is calculated for each selected vertex, excluding the VXD-only vectors, and its distribution shows nicer separation than before; a cut at 2 GeV/c^2 has an improved hemisphere efficiency of 57% for the standard purity of 98%. Most of the improvement comes from loosening the initial track selection. The distributions of the inputs to the nets are modelled reasonably well, but not perfectly, which is fine for a self-calibrating analysis, but requires caution for anything else.

The use of the first two neural nets does not improve the charge purity, but the increase in efficiency helps the self-calibration quite a bit. The addition of the vectors improves the simulated charge purity from 79% to 82% (a 15% relative reduction in wrong assignments), although the MC charge distributions are marginal. The MC-data agreement in the vertex multiplicity is improved substantially, suggesting that part of the difference is due to an optimistic simulation of CDC tracking or extrapolation.

Applying all this to the vertex-charge measurement of A_b, Tom selects only vertices with nonzero charge and is able to calibrate the charge purity to a relative precision of 1%. He showed an ultra-preliminary pair of angular distributions, which look very nice, and did a fit to get a predicted error for the method of ± 0.016 (stat.) ± 0.011 (calib.), a substantial improvement over the current errors of ± 0.027 (stat.) and ± 0.035 (syst.), which should give us the world's best measurement by far. There is still much work to do in understanding the correlations, the dependence on $\cos\theta$, etc., however Tom was encouraged to lose all the sleep necessary to get a preliminary version of this excellent result in time for Moriond.

B hadron Lifetimes – Kenneth Baird

Ken gave us an update on the analysis of charged and neutral B hadron lifetimes. The basics of the analysis are unchanged – ZVTOP is used to select charged and neutral vertices and the MC is fitted to the two decay length distribution in the data, with events weighted using m_{pt}, vertex charge and the thrust axis polar angle plus beam polarization to enhance the effective charge purity. Ken discovered an interesting feature of the analysis, in that this 'weighting' sometimes results in events being moved from the charged sample into the neutral sample, since a vertex with the 'wrong' charge given the beam polarization is more likely to be a misreconstructed neutral vertex than a correctly reconstructed charged vertex. An improvement over the summer result is that the analysis is now entirely based on R16, resulting in very small changes to the central values.

The dominant systematic error in the two individual lifetimes is due to uncertainties in B hadron fragmentation, which cancel (presumably) in the ratio. Using Dan's most recent measurement of the average B energy reduces this, but the issue of the shape needs more work. Using Dan's central value leads to a shift in the measured lifetime that is uncomfortably large, and the JETSET shape with that average energy is not consistent with Dan's data.

In an effort to get around this, Ken has also done the analysis using the average impact parameter of the tracks in a vertex rather than their decay length. In the high energy limit, the average impact parameter is insensitive to the energy, and hence the analysis has smaller dependence on B fragmentation. First results are encouraging, although the fits in the 2D impact parameter case look marginal. The systematic from B fragmentation is indeed reduced, as is the total systematic, although some other components increase slightly.

Ken then showed the B lifetimes as a function of the average B energy for the two methods. The bands have different slopes and their intersection could be interpreted as a simultaneous measurement of the lifetime and average energy. L3 have published such a 'measurement', which has been subject to considerable criticism. Ken's fit gives a lower value of the average than Dan's, but it is not yet clear that the statistical error is correct, and the dependence on the shape of the fragmentation function needs to be studied. He plans to try to do much of this and begin looking at R17 in time for review at the next SLD week. An almost final result is anticipated for the summer, with a PRL to follow.

Transverse Λ^0 Polarization – Vincenzo Lia

Vincenzo showed us some new results on the transverse polarization of Λ^0 baryons in hadronic events. He has previously looked at longitudinal polarization in high-momentum Λs, which is expected from the polarization of the initial quarks and has been seen at LEP, but concluded that our measurement could not compete with theirs. The whole topic of transverse polarization is more complex, and motivated by the long-standing mystery of observed polarization of baryons in fixed target experiments.

Searching for polarization of non-leading Λs transverse to any reasonable plane might shed light on this issue, and there is one interesting model due to the Lund group that predicts polarization in a string model that is transverse to the plane $\vec{p}_\Lambda \times \vec{p}_{quark}$. Since we need to know the quark (vs. antiquark) direction to test this model and can use the beam polarization to do so, we should do a better job than could be done at LEP, and this will be Vincenzo's baseline analysis.

The analysis flow follows that he has shown previously for longitudinal polarization. He considers the distribution of $\cos\phi^*$, where ϕ^* is the angle between the proton momentum and the direction defined by the Λ momentum crossed into the thrust axis (unsigned for now) in the Λ rest frame, in a signal region as well as in three $m_{p\pi}$ sidebands. The MC true Λs in the signal region show a nice distribution that is symmetric (unlike the case for longitudinal polarization) and almost flat; the MC has no polarization in it, and the small deviations from flatness are due to acceptance. The three backgrounds, from K_s^0 decays, γ conversions and fakes all show distinct $\cos\phi^*$ distributions that differ among the four mass regions. Their sum can be checked against data in the three sidebands, and look good within a few percent.

The backgrounds in the signal region should be related to those in the sidebands by kinematics, so the MC predictions there were parametrized, along with the acceptance for signal, and a likelihood fit done to the data. The fit looks reasonable and gives a statistical error of ± 0.05 absolute, indicating that the analysis is sensitive to sizable polarizations in the data. For the above model we expect experimental dilutions of about 0.8 and 0.4 from the resolution on the thrust axis direction and the forward-backward asymmetries, respectively.

It is clear that this analysis will give publishable results, and Vincenzo is encouraged to try to put together a preliminary result for Moriond. This will involve making quantitative checks of the backgrounds from the sidebands, looking at ways to increase the statistics and the polar angle coverage, and perhaps adding jet charge to the quark direction tagging. He will then explore cuts on the Λ transverse momentum, angle to the thrust axis, number of jets in the event, etc., to look for any signal. Some systematic studies will need to be done, but any effects are expected to be much smaller than the statistical error. He will finish up the study of this model first, then move on to consider other transverse axes.

Future Meetings:

Friday, February 25, 2000

- Announcements
- The Final A_{LR} Result – Peter Rowson
- ZVTOP on 3-Jet Events – Hidemi Akimoto and Hyejoo Kang
- B Semi-Leptonic BR Systematics – Aurel Trandafir
- Other Reports TBA

Meetings will take place at 10:00 a.m. in the Group A Conference Room.

Please subscribe to the sld-news mailing list to receive e-mail announcements of upcoming meetings and text of the minutes. If this is a problem, please send a message to usher@slac.stanford.edu.