Minutes of the 120th Energy Calibration Meeting held on 14 February 1997

The first part of the meeting concerned the 1996 analysis. The discussion then turned to the plans for finalising the 1993–1995 analysis (see separate document).

1 Simulation of k modulation

Frank Tecker summarised the simulations of the benefits of k modulation in the LEP arcs for increasing the maximum energy at which a resonant depolarisation measurement can be made. Harmonic spin matching (HSM) can be used to decrease the strength of depolarising resonances. The most important are the integers either side of the spin tune. The real and imaginary component of each of these must be measured and cancelled, so that four amplitudes must be determined in total ("sin" and "cos" of the upper and lower integer). In deterministic HSM, the resonance amplitudes are computed from the orbit measurements. The precision is limited by the beam pick up and quadrupole alignments, presently 180 and 150 microns respectively. For empirical HSM, the amplitudes are varied around the nominal values, and the optimal settings found. This is limited by having a measurable variation in polarisation as the parameters are varied, but if this condition is satisfied gives a better result than deterministic HSM.

Using MAD and SITF (which makes a linear simulation of polarisation), with realistic alignment uncertainties, Frank found that at 55 GeV we would expect 12% polarisation with no HSM, 26% with deterministic HSM and 64% with empirical HSM. The figure included in the minutes shows how this varies when the BPM uncertainty is improved by k modulation, and when the quadrupole alignment uncertainty is improved by taking into account survey information to 50 microns. Including the effect of Qs, Qx and Qy side bands in an attempt to be more realistic ("isolated resonance model"), the predicted polarisation without HSM is reduced to 8%, compared to the 2% observed in MD. Plots were also shown from Bernd Dehning indicating the probability of empirical HSM working as a function of energy (and therefore of the maximum polarisation.)

In summary, including the measured quadrupole positions, k modulation is then expected to improve the performance of deterministic HSM by a factor of 2. This would in turn increase the probability of empirical HSM working.

The cost estimates for different solutions are currently between 200 and 450 kSF. The experiments are asked whether they would be able to offer any assistance from technicians in the coming months for pulling cables (20km of control cables and 7km of backleg windings are required.)

This proposal will be shown at the next SLTC, with the strong support of the energy working gorup.

2 NMR / flux-loop comparisons

Enrico Bravin showed the conclusion of his studies of the NMR/flux-loop comparison. He fits a straight line to all the B(NMR) vs. B(flux-loop) data for each NMR probe. Plots can then be made with the residuals for the three available flux loop measurements for each NMR, and with the mean and sigma of the residuals over all the NMR's. Two of these measurements are in the same fill, and show very similar behaviour. The third was taken shortly after a "reverse-polarity" flux loop, and shows slightly different behaviour. Fitting a line through the average residuals, the slopes vary by 10^{-4}, which is within the expected precision.

3 Status of the 1996 writeup

Paul Bright-Thomas explained the problems with putting together a table listing resonant depolarisation measurements and the corresponding (calibrated) NMR data for 1996. The polarisation data used are corrected to the physics RF frequency, and for tides. 7 NMR's are available for all four depolarisation measurements. Paul repeated the test of non-linearity for the two energies in fill 3719, using only these 7 NMR's instead of the 11 NMR's available in this fill. These gave a consistent estimate of the deviation, taking the calibration from 45 GeV and predicting the energy at 50 GeV. They predict a correction of -10 ± 17 MeV at 80 GeV. He then repeated the exercise including all 4 polarisation points, and found a correction of 16 ± 22 MeV at 80 GeV. This is quite a large shift, given that more than half of the depolarisation measurements in the second study are those of the first study. Fill 3599 is largely responsible for the anomolous behaviour. For the 7 common probes, the apparent energy from NMR's is about 12 MeV different for fill 3599 compared to fill 3719 at 50 GeV. Differences of up to 2MeV could be explained by long term drifts of the central frequency inferred from xarc measurements. However, Guy Wilkinson previously showed that the normalisation procedure was sensitive to the treatment of fill 3599. Further investigation will be made to verify that Paul's observations are consistent with those of Guy, and to try to understand the origin of the deviation.

Draft 1.0 of the 1996 writeup awaits this table of polarisation results, and a description of the NMR flux-loop comparisons.

4 Next meeting

The next meeting will be on Friday 21 February at a time to be decided.

Pippa Wells, 17 February 1997.