Minutes of the 112th Energy Calibration Meeting held on 29 November 1996

1 Flux-loop comparisons

Joerg Wenninger showed various comparisons of the flux loop measurements with other energy measures. The nominal energy is the energy the beam should have according to the measured magnet calibration curves. The correspondence of a certain dipole current and energy changed at the beginning of 1996 when the magnet cycles switched to a larger range. It will change again in 1997 by rescaling to make the setting energy closer to the true energy.

In order to compare flux loop and polarisation measurements, the central rf frequency is needed. The central rf frequency from specific measurements and inferred from BOM measurements agrees to about 1.5 Hz. The energy sawtooth at 86 GeV is expected to shift the measured central frequency by about 0.4 Hz. The relative alignment of quadrupoles and sextupoles addes a further error of about 0.9 Hz.

The measured energies from polarisation at peak-2 and 50 GeV are corrected for temperature, the observed NMR rise, the absence of QF/QD compensation and the central rf frequency. They can then be compared with the flux loop measurement.

The flux loop is calibrated with the Epol data according to $E_{pol} = (1+\delta)E_{FL} + \Delta$ where the fitted values are $\delta = 8.5 \times 10^{-4}$ and $\Delta = -36.3$ MeV. The calibrated flux loop data can then be compared to the nominal beam energy. Above 40 GeV there seems to be a constant 1.5 per mil offset. The calibrated flux loop therefore predicts that E(FL) = 80.626 GeV for E(nom) = 80.5 and E(FL) = 86.140 for E(nom) = 86 GeV.

Finally the flux loop is compared with the NMR measurements in the dedicated "slow" flux loop test (where there was a pause at several energies to give the NMR's time to lock). The difference in measured B field between peak-2 and higher energies is compared for Flux loop and NMR. All the NMR data agree with the FL within a 9 MeV (0.1 G) window (except for the point at maximum current where the scatter is larger). The B field measured by the NMR's is 2% higher because of the field plates.

2 Recent polarisation MD

Massimo Placidi reported that in the last polarisation MD of the year an attempt was made to measure the energy with depolarisation at 55GeV using a special 90/60 unsqueezed optics. 2% polarisation was observed, but all efforts to increase this level with HSM failed. No energy measurement was possible.

3 Status of the RF corrections

Mike Hildreth reported that the RF analysis has been brought up to date for the 1994 data. The errors are the same as for the 1993 data, except that the improved measurement of the path length difference between IP2 and IP6 via ALEPH or via DELPHI reduces that error.

For the 1996 data, there is poor agreement between the predicted and measured Rbom quantities, total and IP specific. This indicates a problem with the sawtooth calculation in the RF model, and hinders cross checks of the RF phasing. A comparison with the online sawtooth calculation will be made, since the online agreement with orbit measurements was said to be good. Alternative quantities to study misphasing that are less sensitive to the sawtooth are being investigated.

4 A combined temperature and TGV model

Enrico Bravin et al. have been investigating an empirical TGV and temperature model with the ISR test dipole. A recording of genuine beam pipe currents is played back at the same time as the temperature is varied. The temperature part of the model is the same as before. In addition, the observed B field is found to be a function of the maximum B field, either due to temperature or due to current spikes. The model can be made either using the maximum measured B field, or the maximum B field inferred from the current reading plus temperature effects. The hypothesis is that the current spikes cause an increase in B field, and there is then no further rise until the temperature effect "catches up", or there is another big current spike that achieves an even higher Bmax. Several long term tests were shown. The model describes many features, apart from the occasional "mystery jump" which could be due to other activities in the ISR tunnel affecting the magnet.

In each of the slides shown, the first plot shows the raw NMR reading, the second shows various terms in the model such as the measured Bmax, and the Bmax calculated from temperature and current. The third shows the temperature profile during the experiment, with Tmax and Tmin also indicated. The fourth shows the NMR data with the current spikes subtracted, and then with the various corrections of the model applied.

5 LEP tunnel temperature test

Enrico also showed the results of a temperature test in the LEP tunnel that was carried out on 26 November during the SL controls group work after the last beam. The temperature increased by 0.5 degrees and then decreased by 1.5 degrees. A spike in the NMR readings is due to the quadrupoles being switched off shortly before the cooling was restarted. (The quadrupoles were powered to increase the heating in the tunnel for the first part of the test.) The NMR's all show a clear increase in B field while the temperature was decreasing, which supports the Enrico style temperature model instead of the classical model. A fit of the new model to the LEP tunnel data has not yet been performed. No bend modulation was made at the beginning of the experiment.

6 Temperature Coefficientes

Mike Koratzinos has continued to examine the temperature coefficients, this time using 172 GeV data. It is difficult to untangle train and temperature effects in this data. The CT measured in octant 1 was found to be the smallest; this is also the octant with the smallest noise. The CT of octant 8 is sensitive to the cut made to veto jumps.

In order to reduce the sensitivity to noise and trains Mike also tried looking at the difference in temperature coefficients between two magnets. The results show some strange behaviour. Mike also tried subtracting a predicted train rise and then fitting the temperature coefficient with the corrected data, which underlined the problems of distinguishing the two effects. A table of coefficientes to be compared with those shown by Guy W. in the previous meeting was not yet available.

7 Discussion

Tiziano Camporesi reminded the groups concerned of his request to have a detailed table of data from fills with beginning and end of fill polarisation calibration, including temperatures.

Joerg Wenninger commented that some of the tide experiments take into account the rise seen in the reference magnet, which should now be taken out for comparison with the predicted rise from the full model.

For the next meeting, we need better estimates of the intrinsic precision of the flux loop and NMR measurements, including the error from fringe fields etc., since this will be needed to bound the extrapolation uncertainty for the 1996 data.

8 Next Meeting

The next meeting will be at 14:00 on Friday 6 December in the pavillon.

Pippa Wells, 2 December 1996.