Minutes of the 148th Energy Calibration Meeting held on 6 February 1998

1 Fluxloop NMR comparisons in the ISR test dipole

Enrico Bravin showed an extremely encouraging first experiment to reproduce the flux-loop/NMR comparison using the test dipole in the ISR tunnel.

Each set of four plots shows the result of a 12 point flux loop repeated 10 times. The lower two plots show the RMS of the fluxloop and NMR fields at each of the points in the fluxloops. These are combined to provide the error bars of the upper two plots. The upper plots show the residuals from fits to a line $B = a+bx$ and a quadratic $B = a+bx+cx^2$. The residuals from a line show a characteristic behaviour typical of one of the NMR's installed in LEP. There is an overall curve, and a local increase against the overall decrease in the region of physics energy where three points are sampled very close together.

The three sets of four plots correspond to repeating the whole exercise on three days. The behaviour is very well reproduced from day to day.

Plans include adding more NMR's to the set up, to see how the behaviour varies along the length of the magnet, and tests to see the effect of stopping at extra points in the middle of the range, or changing the distance between stopping points.

2 Prediction of physics energy from NMR-polarisation fits – Nading Qi

Nading Qi showed his progress with two parameter and one parameter fits to the polarisation data. Two problems remain in the present version of the analysis - the 90/60 physics optics and 60/60 polarisation optics have been treated together, while other analyses have observed a systematic difference, and the tide correction (etc.) has not yet been included. The errors shown are the spread over polarisation fills.

Plots are included showing the spread of energies at each high energy point. The 183 and 184 GeV data are of similar good quality, but the 182 GeV data shows a rather large spread (rms 30 MeV). This will be followed up.

The expected improvement from adding extra high or low energy points was also checked. Unfortunately a lower energy point is excluded by the NMR probes ability to lock at low field.

3 Further linearity studies - Pete Renton

Peter Renton recalled the plot shown at the last meeting with the residuals to straight line fits, averaged over NMR's. This shows a statistically significant banana shape, with amplitude ± 1 MeV.

The fitted physics energy using in turn the two polarisation fills wtih four measured energies differed by 12 MeV. Pete has now checked the correlation between the predicted energies from probe to probe, and found a high degree of correlation, so he expects little improvement in precision by fitting both fills together.

A quadratic fit to the four point fills was then attempted. The difference between the energy predicted with a linear fit and a quadratic fit was -80 or -70 MeV for the two fills, with rms over the NMR's of 81 and 118 MeV, leading to an estimated error of 24 or 36 MeV.

There is again a reasonable correlation between the fitted energies from probe to probe, comparing the two fills, although with increased scatter. There is not much sign of a correlation between the linear and quadratic results from probe to probe.

4 Strategy

In the next couple of weeks, Guy Wilkinson will attempt to produce central values to be used at Moriond, from a linear fit $E = a + bB$ to all NMR and polarisation data. Joerg Wenninger will take a quick look at the corrector data to assess if there is a big difference between the 90/60 polarisation and physics settings. If not, then a global correction to account for optics differences and corrector settings will be applied following this prescription:

- Measured energy difference $E(90/60) - E(60/60) = -4$ MeV
- Predicted difference from QFQD and horizontal corrector settings $E(90/60) - E(60/60) = -6 \pm 1$ MeV
- Assign uncertainty of 2 MeV from the discrepency between measurement and prediction
- Difference is expected to scale with energy, so the global correction at physics energy will be -8 ± 4 MeV

Mike Hildreth will provide the RF corrections. No correction for dispersion is needed. A conservative error estimate corresponding to these central values will be made.

The next steps are:

- Obtain the complete horizontal orbit corrector data.
- Make a proper comparison of the banana between polarisation data and fluxloop data. This can only be done using the two fluxloop measurements that extend down to 41 GeV (most start at peak-2). For those fluxloops, only 7 NMR's were working, so the average residuals between NMR and polarisation needs to be calculated using just those 7 NMR's. The banana for individual NMR's could also be compared for NMR-pol and NMR-fluxloop

- Use the NMR-fluxloop comparison for each probe to correct the extrapolation to high energy. Check whether the rms spread of extrapolated energies is reduced in this way to below the 40 MeV level. If the fluxloop were "perfect" this would give the correct extrapolation. The problems are:
  - We loose the cross check between NMR/fluxloop to test the NMR/polarisation extrapolation method
  - We might be correcting for biases of the fluxloop in addition to testing for problems in the NMR's. This would NOT necessarily show up in the rms scatter of NMR's, if we corrected each one in turn for a global flux loop bias.
- Continue NMR/fluxloop tests with the ISR test dipole to investigate fluxloop biasses and NMR scatter w.r.t. flux loop.

We aim to have concluded these studies by the 1998 startup. However, it is possible that we might then require some additional fluxloop measurements using the full ring to confirm a model. We should aim to have final central values and errors by the end of May, and to write a paper (ideally before we are running at high energy in 1998, but certainly well before the main Summer conference: Vancouver, 22-30 July 1998.

5 Next Meeting

The next meeting will be on Friday 20 February at 14:00 in the Pavillon.

Pippa Wells, 6 February 1997