Minutes of the 149th Energy Calibration Meeting held on 20 February 1998

1 Energy of nominal 182 GeV fills

Nading Qi showed that the wide spread in energies in the nominal 182 GeV data is indeed due to whole fills with energies typically 30 MeV wrong in E_{beam}. Guy Wilkinson commented that there are also one or two fills in the 183 GeV nominal energy with strange initial energies.

Action: Joerg Wenninger will check the database to discover if these fills have strange main bend dipole currents, are missing bend modulation, or have some strange temperature.

2 RF corrections for 1997

Mike Hildreth showed the analysis of the RF corrections for the 1997 data. Missing data for the new units in IP2 (which were not properly logged at the beginning of the year) has been recovered from the RF group's private logging and patched into the DST's.

Orbit data has been used to evaluate the phase errors at each IP. This is achieved in an iterative procedure, to bring the measured and calculated sawtooth from the orbit data into agreement. Some fills show structure that is explained by known changes in the RF configuration, while the movements for other fills are attributed to sick beam orbit monitors. The fractional energy gain at each IP is proportional to Rbom(IP)/Rbom(Total) and can be used to fix the phase error at each IP.

The agreement between the measured and calculated Qs is reasonable for the high energy data, although not quite as good as in previous years. For the 102/90 data the discrepency is similar to the 90/60 high energy data, but of opposite sign. There is very poor agreement for the Z running, where are large uncertainty will be assigned at this stage.

The average centre of mass energy shifts for each IP are about 10 MeV for the high energy running.

3 Horizontal correctors

Some part of the measured difference between calibrations with 60/60 and 90/60 optics is understood as being from the effect of horizontal correctors. Joerg Wenninger has subsequently checked the effect of horizontal correctors for the 90/60 calibrations and 90/60 physics running. The effective orbit lengthening from the corrector configuration can be used to calculate the energy shift. The orbit length in calibrations was increased by 50 to 100 microns, but in physics by typically 600 microns, corresponding to an energy difference of 11 MeV at 91 GeV. In addition to being different between calibration and physics, the effect is time dependent.

There is then a problem of possible double counting, since the orbit lengthening is equivalent to shifting the central RF frequency. Indeed, a reasonable correlation between the central frequency measurements from $x_{\rm arc}$ and inferred from the corrector orbit length model is seen.

For the Z data, this possible double counting was avoided. The $x_{\rm arc}$ data were used to give an average correction per fill, and the corrector data were used to make shifts during a fill if big changes of corrector settings were made.

To make energy files for the high energy running, the $x_{\rm arc}$ data are included, so it would risk double counting to also make an energy shift to account for different corrector settings. A global shift of 8 MeV will be applied to account for the measured difference between 60/60 and 90/60 optics. An appropriate uncertainty will be applied for now, and more simulation work carried out before making final energy files.

4 Preliminary energy files

Guy Wilkinson has made pre-release energy files for all the physics running in 1997. These have revealed some residual logging problems which are in the process of being fixed.

The absolute energy scale is fixed from 2 parameter fits to polarisation vs. NMR data. All the available fills with two or more points are used. The results have been cross checked against fits by Peter Renton.

A few fills show an initial energy which is more than 50 MeV lower than the typical fill. Most are bunched with a spread of 10 to 20 MeV.

The dipole rise is taken directly from the NMR data. The effect of bend modulation is seen as reduced rise per fill (usually less than 5 MeV even for a 6 hour fill).

The tide and $x_{\rm arc}$ corrections take into account optics differences. The effect of the routine shift in RF frequency to increase the luminosity results in an average reduction in beam energy of 150 MeV.

RF corrections for each IP have been supplied by Mike Hildreth, and no correction for opposite sign vertical dispersion is necessary (following checks shown by Alfons Weber in a previous meeting).

The global shift for optics dependence remains to be implemented.

The average centre-of-mass energies for the nominal 183 GeV turn out to be around 182.75 GeV. This is approximately 50 MeV higher than the recommendation of last summer of 182.7 ± 0.2 GeV, but well within the quoted uncertainty.

Action: Guy will implement the optics correction and release energy files this afternoon/evening. The experiments will be notified by an e-mail to the working group.

5 Flux loop, polarisation and NMR comparisons

Peter Renton has extended his analysis to use the flux loop data provided by Joerg Wenninger. The method used is similar to the method to compare polarisation and NMR data. The flux loop data are converted to MeV as follows: The flux loop measures the change in B field for between 300 A excitation current and higher excitation currents. An additional 80 G is added to account for the field at 300 A. The value at peak-2 is then used to convert from Gauss to MeV. This then defines E(flux-loop) for each excitation current.

Fits are made for each NMR so that E(flux-loop) = c + d*B(NMR), in the region corresponding to 40 to 55 GeV. A good correlation is seen between the fitted slopes and intercepts for these fits to flux-loop data, and the previous fits to polarisation data E(pol) = a + b*B(NMR).

The average residuals between flux-loop and NMR's over WORKING NMR'S show an "upside-down" banana compared with the figures shown previously comparing polarisation and NMR's. However, in the plots shown the points are not at exactly the right nominal energy values. For fills 4000 and 4206, they should be at peak-2, peak, 50 and 55. These fills have 11 NMR's working. For fill 4151, there are only 5 NMR's, and the same energy points. For the two flux loops in fill 4434, there are only 3 NMR's and the energy points are 41, 45, 50 and 55 GeV. The flux loop has been seen to have a bias when points are close together, so it was suggested that the peak point should be excluded if the peak-2 point is used.

The fits can also be used to predict the physics energy. The NMR's predict an energy of 91509 MeV from fitting to fluxloop 4000, with an rms of 36 MeV, 91531 MeV from fill 4121, 91522 from fill 4206, 91575 from 4434(a) and 91560 from 4434(b). If only the three NMR's working in fill 4434 are used in fill 4000, the prediction increases to 91527, which is still somewhat below the 91560—91570 predicted by fill 4434.

Using the fluxloop MEASURED increase in B field, the predicted physics energy is 91490 MeV, with an rms over flux loop measurements of only 4 MeV. This is a worrying discrepency, and larger than the bias found by Joerg in a similar study. However, around 50–60 MeV of the shift seems to be caused by the subset of 3 NMR's that survived Pete's quality cuts.

Action: Pete Renton will repeat the fits excluding the peak points, to attempt to mimic the results of Joerg. Joerg will also communicate to Pete the quality cuts he made.

6 Work in the ISR tunnel

Marcel Heemskerk has joined the effort to investigate flux loop effects in the ISR tunnel.

7 Next Meeting

The next meeting will be on Friday 27 February at 14:00 in the Pavillon.

Pippa Wells, 23 February 1997