LEP Energy Meeting 221

- News & planning
- Energy Files
- BPM beam-size systematics

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18/10/02

News & planning

News since last time:

- Comments from Mike H & Didier
- Progress on flux loop error assignment (Pete)
- Progress on finalising energy files (these transparencies)
- Progress on last spectrometer systematic (these trans)
- Discussions with Anke re Q_s

Outstanding analysis items:

- Completion of energy file studies & final flux loop analysis (Guy & Pete)
- Spectrometer:
  1. Analyses of '99 data + 2000 70 & 80 GeV points (Guy)
  2. BPM benchtests! (Bernd & Guy)
- Preliminary combination of results (Pete, Pippa, Guy)

Expected contributions for next draft:

- Re-jigged mag extrap & FL sections (Pete, Pippa, Guy)
- First draft of 'spectrometer apparatus' section (Eric)
- First draft of model error assignment section (Guy)
- First draft of global combination section (Pete, Pippa)
- Some progress in Q_s section (Guy, Anke)

Timescale? 1 months time, with meeting late November. Further minor iteration before Xmas. Aim for final number in New Year, and all text to be finished by March.

Final Energy Files

Time spent rechecking & updating prelim LEP2 energy files

- Improvements
  For instance Jorg's 'new' central frequency files
- Corrections
  Mistakes found. eg. wrong value of momentum compaction factor for physics optics in '99. When corrected results in ~ 8 MeV correction to $\mathrm{E_b}$

New files so far for '97, '98, '99. Outstanding tasks:

- 2000
  Hopefully no change needed. But double check for mistakes and re-study BFS.
- 1996
  Of little weight in m_W. Still interesting to recalculate energies, perhaps using NMR coefficients from other years. Also will make for more coherent analysis $+$ reduced error.

By-products are detailed lists of (pseudo-) lumi weighted values for each correction, year by year. eg. 1999, 192 GeV:

Correction to E_b	Value (MeV)
Dipole rise	1.2
Tide	0.6
fRFc ('xarc')	3.5
f_{RF}	-217.0
$\mathrm{H_{cor}}$	-0.8
QFQD	-0.8
RF (pt 8)	-7.9

Will make final error assignments straightforward task

BPM beam size / non-linearity systematics

Effects of finite beamsize + BPM geometry were investigated in detail by John Matheson. eg. Circular BPM of radius a:

$$\Delta x = \sqrt{2}\frac{x}{a}\left[1 - \left(3\frac{\sigma_x^2 - \sigma_y^2}{a^2} + \frac{x^2 - 3y^2}{a^2}\right)\right]$$

(Reliable simulation available for elliptical BPM calculations)

Ergo bias in each BPM, which can change with energy:

- Non-linearity term
  Relevant if beam not recentred well after ramp. But thanks to spectrometer crew, this was done well: change in position (RMS) in x = -57 (145) $\mu\mathrm{m}$, in y = -43 (184) $\mu\mathrm{m}$. Negligible effect.

- Beam spot term
  Relevant even if beam does not change position, since $\sigma_x \sim 1-2$ mm & approx doubles over ramp (pol optics)

  Depending on offset from BPM centre, effects of $\leq 10\mu\mathrm{m}$ possible. Also, these can be different BPM to BPM!

  1. Orbit at spectrometer may be offset or angled
  2. BPMs may be misaligned w.r.t. nominal (and each other)
  3. Beamsize grows through spectrometer due to β fn

  Dangerous, as not tested by low energy checks vs RDP!

Try to estimate possible bias for 2000 spect measurements

Estimating BPM beam-size systematics

Systematic evaluation a 4 step process:

1. John has calculated (change in) bias in going from $50 \rightarrow 93$ GeV at nominal offset from BPM centres of (1 mm, 0). Values in microns:

	BPM number					
Optics	6	5	4	1	2	3
Pol	-1.1	-1.5	-2.0	-3.5	-4.1	-5.2
Phy	-0.7	-0.8	-1.1	-1.9	-2.1	-2.7

   But now need to know average offset in each BPM

2. Establish where nominal LEP x=0 is in BPM frame

   Take several logged orbits and compare with BPMs $\rightarrow$

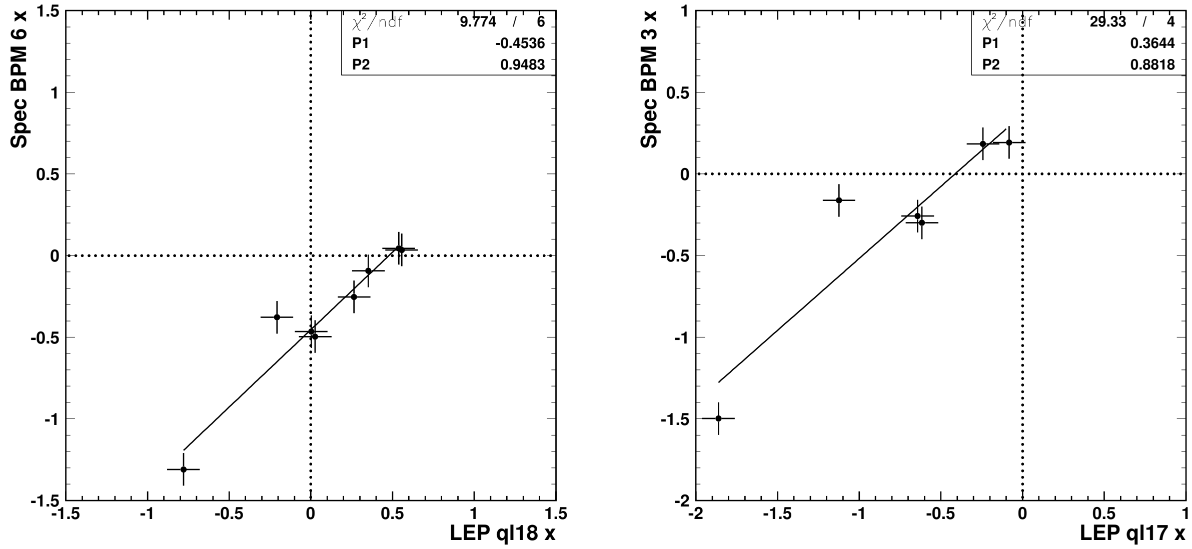
3. Examine survey information to see how well BPMs aligned to nominal (Bernd): Study in progress – looks to be better than 200 μm.

4. Convolute information in spectrometer simulation (or back of envelope) to estimate bias on measurements (results in minutes!)

Also can use same data to examine this as possible mechanism for triplet residual shifts. Unlikely: shifts are too large at low energy & do not appear to have correlation with orbit.

Estimating LEP x=0 in BPM system

Jorg has dug up various orbits close in time to spectrometer measurements – in some cases 2 orbits from same fill. Look at values of PU.QL18.L3 (2.08 m from BPM 6) and PU.QL17.L3 (4.46 m from BPM 3) and correlate with BPMs 6 & 3. From cases where 2 orbits exist we are encouraged to apply a time offset (1.8 mins – large?) between BPM and orbit timestamps.



Nice correlation and slopes close-ish to 1, as hoped (not the case if no time offset applied). Conclude that LEP x=0 is at '-454 μm' for BPM 6 and '364 μm' for BPM 3.

Now look at BPM readings at times of energy measurements and deduce mean offset from LEP x=0 for our data set:

BPM 6: $\Delta x = +316\,\mu\mathrm{m}$, BPM 3: $\Delta x = -170\,\mu\mathrm{m}$

(Absolute values turn out smaller if time offset not applied)
These are compatible with a priori tolerances estimated by Jorg