Update on E_b with the Spectrometer

(update of material shown in meeting of 29 April)

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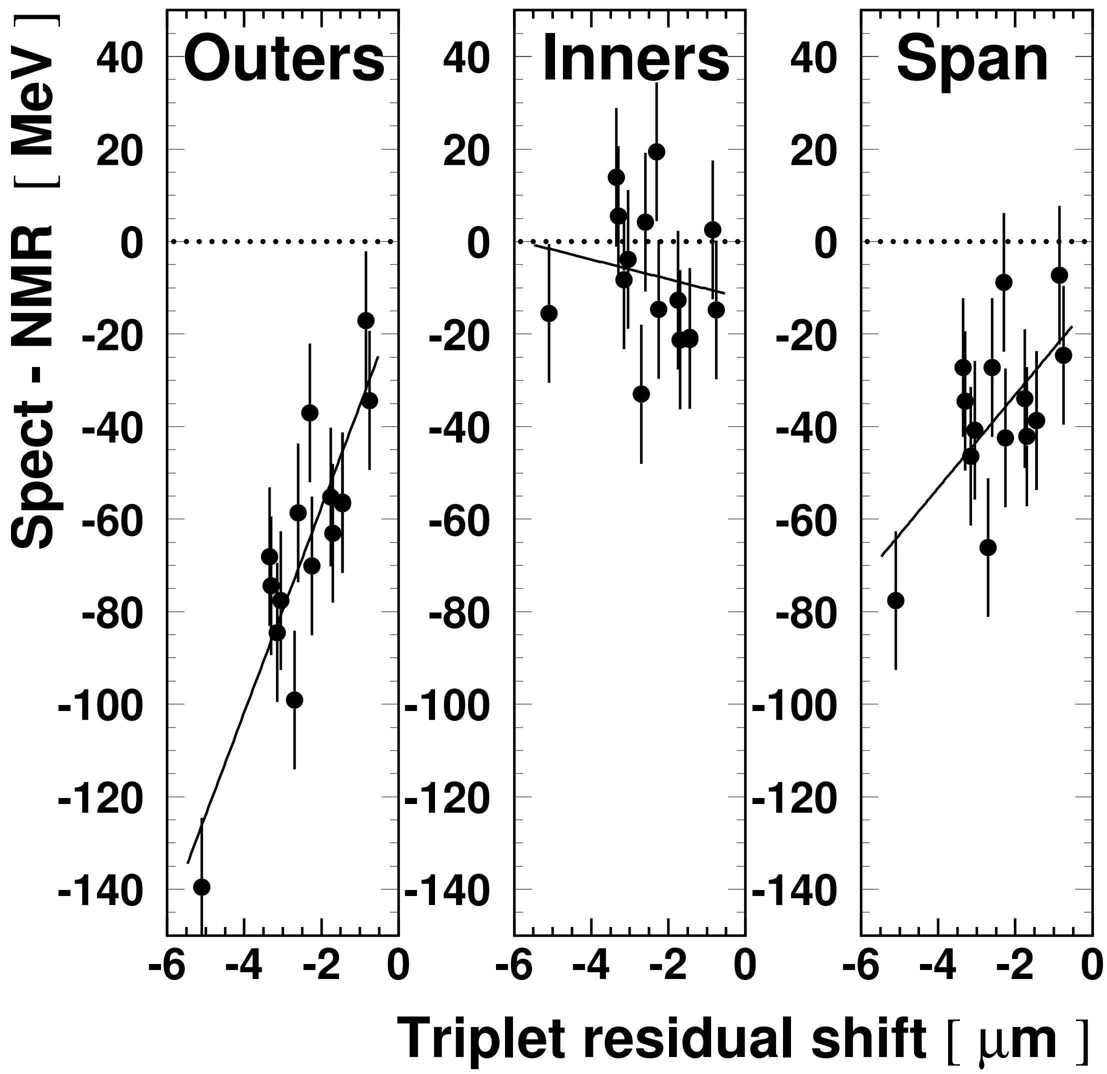
Dependence of high energy results on residual shift

Take energy estimate at high energy and triplet residual shift from 50 GeV for all fills. Fit residual e^-/e^+ sawtooth correction, slope and spectrometer-NMR offset

Results, at mean energy of 92.3 GeV, after sawtooth correction



(Error bars of ± 15.6 MeV chosen to give $\chi^2/\,\mathrm{p.d.f.} = 1.$)

	Sawtooth [MeV]	Offset [MeV/GeV]	Slope [(MeV/GeV) $\mu\mathrm{m}^{-1}$]
Outers	$14.3\pm$ 4.1	-14.3 ± 10.3	24.0 ± 4.0
Inners	$14.0\pm$ 4.1	-13.9 ± 10.3	-2.3 ± 4.0
Span	$14.2\pm$ 4.1	-14.1 ± 10.3	10.9 ± 4.0

Dependence of high energy results on residual shift

What do we learn from these fits?

- Outers are biased, whereas inners are much less so...
- This behaviour agrees with expectation if almost all shift in BPMs 6 & 3. Simulation then predicts slopes of 25.0, 0 & 12.5 MeV / μm in the outers, inners and span respectively.
- Nonetheless all combinations can be extrapolated to limit of 0 systematic to give estimate of true energy. These agree remarkably well.
- At mean spectrometer experiment energy of 92 GeV,

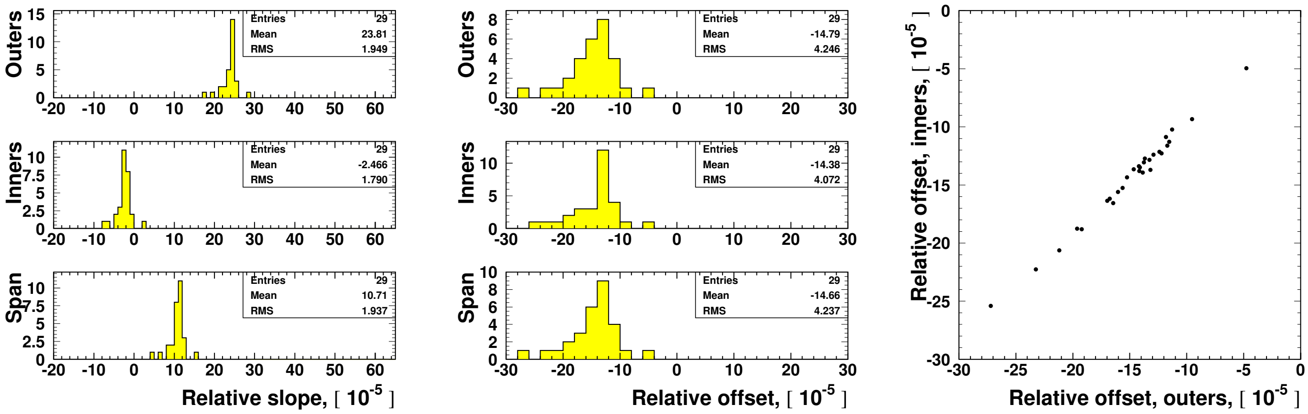
$$\mathrm{E_{spect} - E_{NMR} \; = \; -13 \pm 9 \, (`stat') \, MeV}$$

Is the data sample homogenous? Or are fits being pulled by particular experiments? Repeat for different scenarios:

- Drop each fill in turn
- Divide into physics and polarisation
- Divide into e^+ and e^- (with fixed sawtooth correction)
- Divide sample into first half & second half of year
- Divide into 2 samples according to whether LHS or RHS BPMs have biggest systematic
- Leave out fills used in low energy test (see later)
- Leave out 3 fills where BPM residuals are anomalous
- Add in 2 rogue fills with anomalous triplet shifts

Results of high energy fit stability tests

Plots of offset and slope with entry for each fitted scenario:



Results are very stable w.r.t. errors from central fit

Finally, look at more straightforward (but biased...) combination of spectrometer results:

- Average 'span' values from 3 best e^- fills, and 3 best e^+ fills. Take error bar from average of 'inners' and 'outers':

$$\mathrm{E_{spect}} - \mathrm{E_{NMR}} \;=\; -27 \pm 17\,\mathrm{MeV}$$

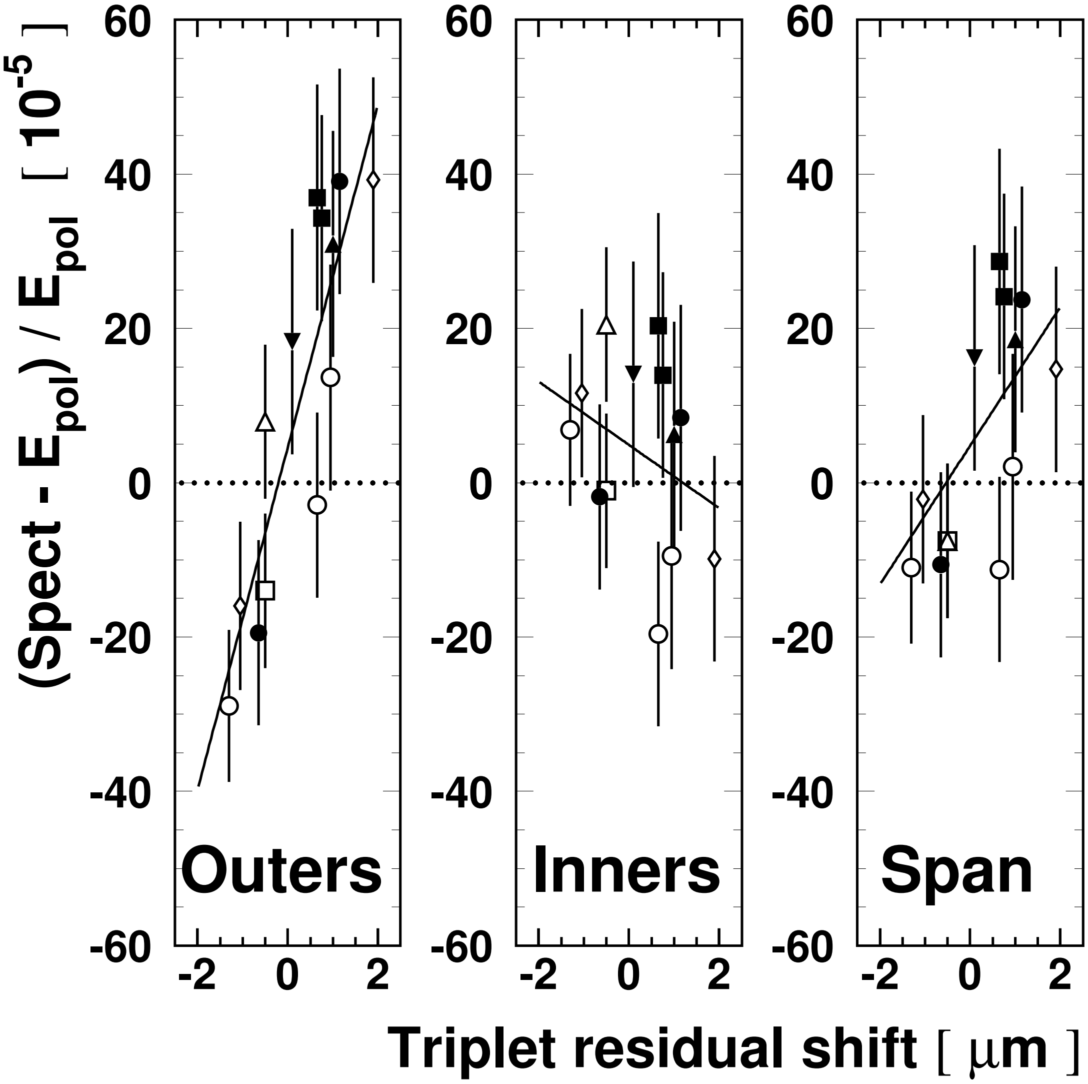
- Take average of 'inners' result from all fills. Take RMS scatter as error:

$$\mathrm{E_{spect}} - \mathrm{E_{NMR}} \;=\; -8 \pm 14\,\mathrm{MeV}$$

These are not too different from the results of our slope fit

Comparison with true energy 40–60 GeV and dependence on triplet residual shift

Same exercise for low energy data points. Now y axis represents spectrometer deviation w.r.t. known TRUE energy



(Error bars of 6 MeV chosen to give $\chi^2/\,\mathrm{p.d.f.} = 1.$)

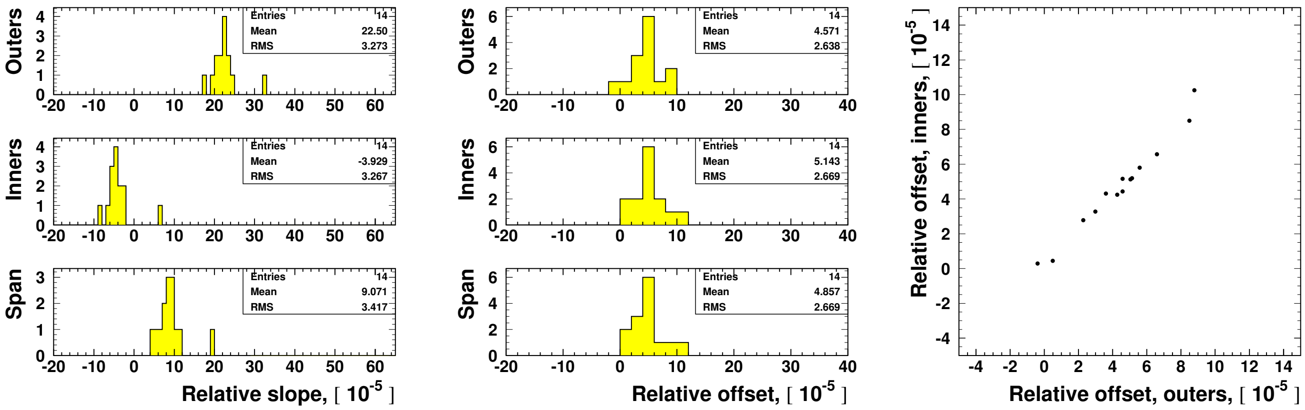
Results of linear fits:

	Offset [MeV/GeV]	Slope $[(\mathrm{MeV/GeV})\mu\mathrm{m}^{-1}]$
Outers	4.6 ± 3.4	22.2 ± 3.6
Inners	4.9 ± 3.4	-4.1 ± 3.6
Span	4.8 ± 3.4	9.0 ± 3.6

Comparison with true energy 40–60 GeV and dependence on triplet residual shift

What do we learn from these fits?

- Slopes are very consistent with those seen at high energy!
- Here if everything is working OK, offset should be 0.
  It is close to 0 but not quite...
- Carry out similar stability checks to those at high energy



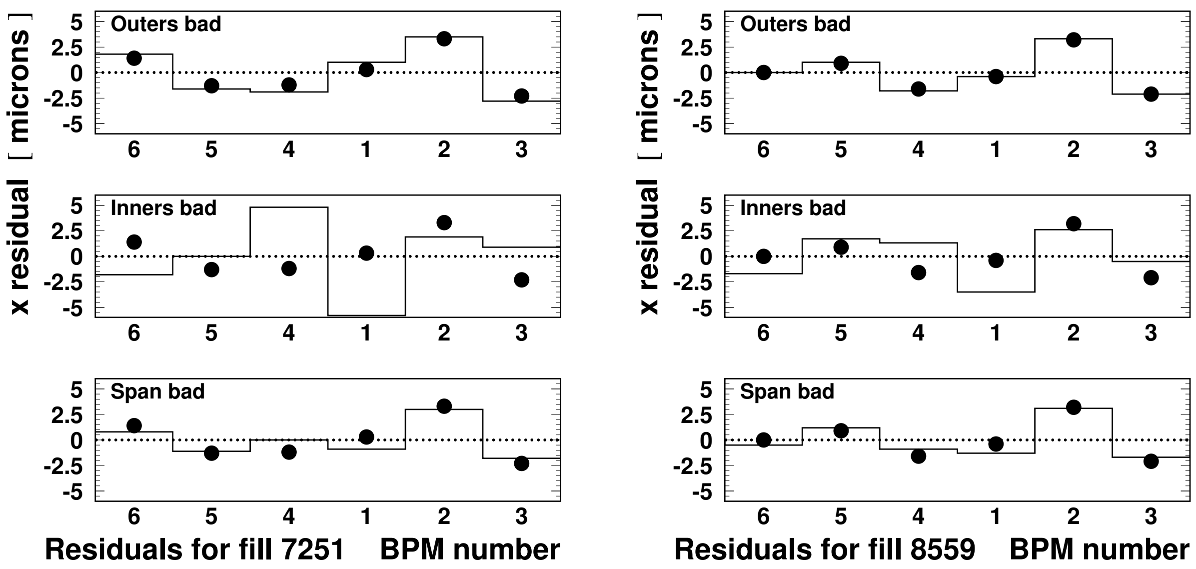
Again, behaviour is encouraging. Use these results to set an error of 10 MeV/GeV, or 9 MeV at 92.3 GeV. Why 10?

- Approximately the value of offset + 1 sigma
- Encompasses biggest variation seen in stability tests
- Approximately the raw RMS of the 'inners' distribution in plot on previous page
- ...

Aside: update on BPM residual studies

Above studies suggest that inners significantly more stable than outers. Verify this independently by looking at BPM residuals & comparing to MC. Prelim study shown last time.

Result is confirmed, esp. for fills with largest expected effect



But 3 fills give contrary conclusion. However:

- Analysis much more significant to 'inner' effects, than 'outer' effects...
  (also note that method cannot easily distinguish between 'outers' and 'span' bad)
- ...so these fills could have an admixture of 'inner' + 'outer' systematic to generate triplet residual shift
- ...and the slopes in presented fits for inners *are* non-0

Interestingly these 3 fills have largish residuals in *slope fit*. Removing them shifts energy estimate by 2 MeV and reduces χ^2 a little. This was all considered in stability studies.

Next Steps and Error Summary

Spectrometer to do list:

- BPM benchtests!
- Look at stretched wire data for analysis points
- Recheck Bdl's and E_{mod} values before cementing central value
- Evaluate missing items in below error table

Error assignment at 92 GeV:

Contribution	Value
Consistency of high energy measurements	9 MeV
Spectrometer performance at low energy	9 MeV
BPM gain issues	
Bdl	
Sawtooth	

Last 3 contributions *should* be smaller than first 2...

(Caveat: wires study *could* lead to further error contribution)