Error sources other than the extrapolation

We need to deliver to experiments a covariance matrix covering the 10 energy points of LEP 2.

Extrap term will dominate. Here review others.

Assume full correlation betwen IPs.

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Error sources considered

Propose a *slightly* different list than used in past

Model uncertainties:

- Energy variation in fill (tide & dipole rise)
- Horizontal correctors ('96-'99) & BFS ('00)
- QFQD

Parameter uncertainties:

- Consider 1% uncertainty in α_C

Interaction point corrections:

- RF sawooth
- Dispersion
- Electron-positron energy difference

RDP related:

- Polarisation systematic
- RDP vs physics optics difference

(Have discarded 'initial dipole energy' error & have lumped dipole rise and tide into same term.)

In cases where no clear recipe exits, but error is small, set 0.5 MeV. Otherwise track to 0.1 MeV.

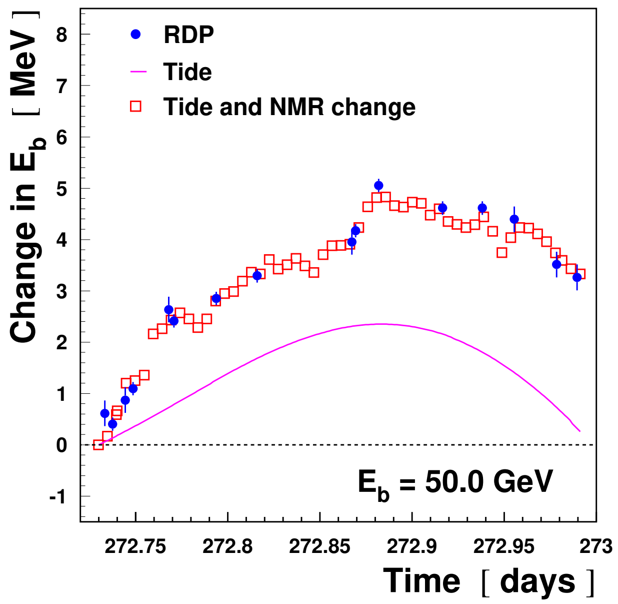
Luminosity weighted corrections

In assigning model errors year to year, and determining correlations, it is helpful to know the luminosity weighted corrections to the start of fill dipole energy from each component

Year	'96		'97	'98	'99				'00	
E_{cm} [GeV]	161	172	183	189	192	196	200	202	205	207
Dipole rise	3.6	7.0	1.7	0.8	0.7	-0.1	-0.7	-0.7	1.5	2.2
Tide	1.1	0.8	1.2	1.7	1.9	2.2	1.4	1.8	2.0	1.8
fRFc ('xarc')	-13.8	-14.2	-20.2	-27.5	1.2	-27.8	-40.0	-24.4	-32.3	-40.2
f_{RF}	0.0	-3.0	-152.4	-187.0	-222.2	-229.7	-194.9	-129.8	-85.9	-29.6
Hcor (BFS)	-2.8	-3.0	-5.6	-7.8	-1.1	-1.6	-0.4	1.1	357.6	430.0
QFQD	-2.6	-2.4	-2.8	-1.3	-1.3	-1.4	-1.4	-1.4	-1.4	-1.4
RF point 2	9.9	9.7	4.1	3.0	4.4	4.1	4.0	4.0	1.7	1.5
RF point 4	-2.8	-2.9	-5.4	-4.6	-6.3	-7.0	-6.9	-6.5	-5.5	-4.9
RF point 6	10.3	9.9	2.8	-1.3	-2.9	-2.6	-2.7	-2.2	-0.3	0.0
RF point 8	-4.7	-4.2	-6.6	-5.2	-8.6	-8.0	-7.5	-7.0	-5.7	-4.9

Model uncertainties

- Energy change in fill



Experience of LEP 1 and long RDP experiment of '99 suggest this understood very well. Propose 0.5 MeV (or 0 ??)fully correlated between years.

- Horizontal Correctors

Assign a 30 % error (difference between models), with 50% correlation between years. Errors from 0.1 MeV at 200 GeV to 2.3 MeV at 189 GeV.

- QFQD error

According to LEP 1 measurements we know relationship between quad current differences and energy to precision of 25 %. Gives error of 0.3 MeV (192 GeV) to 0.7 MeV (161 GeV)

Momentum Compaction Factor

Horizontal correctors, fRFc ('xarc'), f_{RF} and tide corrections all inversely proportional to α_C. (Of these f_{RF} is the largest correction.)

Assume a 1% uncertainty in the knowledge of α_C, and conservatively assume this to be fully correlated between all optics. Gives error of:

~ 2 MeV in '97–'99; less in '96 & '00

Do we need to assign any further error for fRFc ?

Interaction Point Corrections

- RF Sawtooth

  Mike says no change from prelim assignments:

	161	172	183	189	192	196	200	202	205	207
Error	?	?	4	4	4	4	5	5	5	5

  with 100 % correlation between years and IPs.

- Dispersion

  Take 1 MeV with 50% correlation between years.

- Electron-positron energy difference

  Take 2 MeV fully correlated between years – confirmed by Jorg, although we need some words of wisdom to explain why.

RDP Related Errors

- Polarisation systematic
  Each RDP has an uncertainty of ~ 0.5 MeV, of which 200 keV is theoretical and common to all measurements. Take 0.5 MeV at high energy.
- Optics dependence

  Study difference in NMR-RDP residuals between physics and polarisation optics. Scale this value (or error, if larger) to high energy.

  '96: no pol optics $\longrightarrow$ no error

  '97: 90/60 phys optics, 60/60 pol optics
  pol-phys $= -1.6 \pm .5 \rightarrow$ 3.2 MeV

  '98 & '99: 102/90 phys optics, 60/60 pol optics
  pol-phys $= -0.9 \pm .8 \rightarrow$ 1.8 MeV
  (100 % correlated between years)

  '00: 102/90 phys optics, 101/45 pol optics
  No cross-calib exists, so use earlier years
  pol-phys $= -0.8 \pm 1.5 \rightarrow$ 3.0 MeV

  Uncorrelated between years, apart from '98 & '99

Outstanding Items

- BFS

  Have restarted analysis of 3 spectrometer experiments:

  1. One experiment good (7931); one so-so (8566); one unusable (8715).
  2. Preliminary indications show an energy change close to expectation, but not 'on the nail'

- Clock synchronisation issues

  Most relevant for miniramps in 2000. Hopefully no need to assign an error, but it requires a sentence or two of text, and should be looked at.