SVT BACKGROUNDS PRESENT KNOWLEDGE

E.P. For the Bkg. Simulation Team

pairs: 16980 Events
seen by L0 from 388300

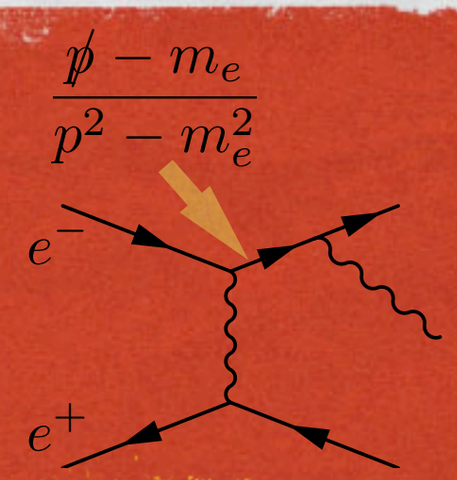
CKGROUND SOURCES
RCH 2009 PARAMETERS

	Cross section	Evt/bunch xing	Rate
Beam Strahlung	~340 mbarn ($E\gamma$/Ebeam > 1%)	~850	0.3THz
e^+e^- pair production	~7.3 mbarn	~18	7GHz
e^+e^- pair (seen by L0 @ 1.5 cm)	~0.3 mbarn	~0.8	0.3GHz
Elastic Bhabha	$O(10^{-4})$ mbarn (Det. acceptance)	~250/Million	100KHz
$\Upsilon(4S)$	$O(10^{-6})$ mbarn	~2.5/Million	1 KHz
	Loss rate	Loss/bunch pass	Rate
Touschek (LER)	4.1kHz / bunch (+/- 2 m from IP)	~3/100	~5 MHz

SVT BACKGROUNDS PREDICTIONS

BEAM STRAHLUNG

$$e^+e^- \to e^+e^-\gamma \quad (\gamma \sim\!\| \, e^-)$$



- The process "*per se*" is not dangerous:
  - outcoming particles are almost collinear with the beam lines
  - Interplay between machine optics/ material
    - PEP-II and Super*B* are very different
    - Super*B* will be by far more SVT friendly (no B1)

VERY VERY PRELIMINARY

- Based on the ~last IR design (Mike P3) assuming we will be able to build the magic QD0
- Simulating 1600 bunch crossing (~ one night CPU time on my desktop)
- Sample too small to capture the fine details of the distribution (i.e. no clear sign of hot spots)

Preliminary

```
Electron Rates
--------------
Mean hit rate on layer 0:        0.090992 MHz/cm^2
Mean hit rate on layer 1:        0.022707 MHz/cm^2
Mean hit rate on layer 2:        0.013902 MHz/cm^2
Mean hit rate on layer 3:        0.013939 MHz/cm^2
Mean hit rate on layer 4:        0.001678 MHz/cm^2
Mean hit rate on layer 5:        0.003832 MHz/cm^2
Positron Rates
--------------
Mean hit rate on layer 0:        0.069760 MHz/cm^2
Mean hit rate on layer 1:        0.012165 MHz/cm^2
Mean hit rate on layer 2:        0.019589 MHz/cm^2
Mean hit rate on layer 3:        0.001186 MHz/cm^2
Mean hit rate on layer 4:        0.000186 MHz/cm^2
Mean hit rate on layer 5:        0.000126 MHz/cm^2
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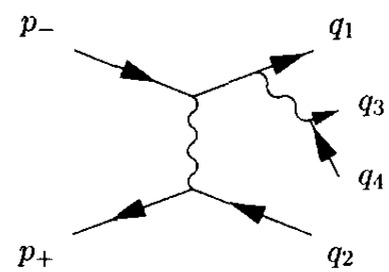
- 3cm thick Tungsten shielding assumed
- Small dedicated production needed to extract the details of the spatial distribution

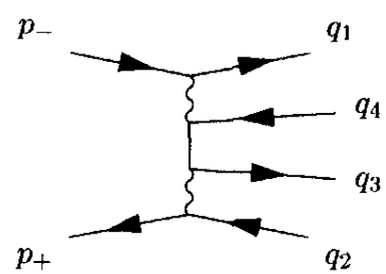
PAIR PRODUCTION

Diag36
(BaBar)



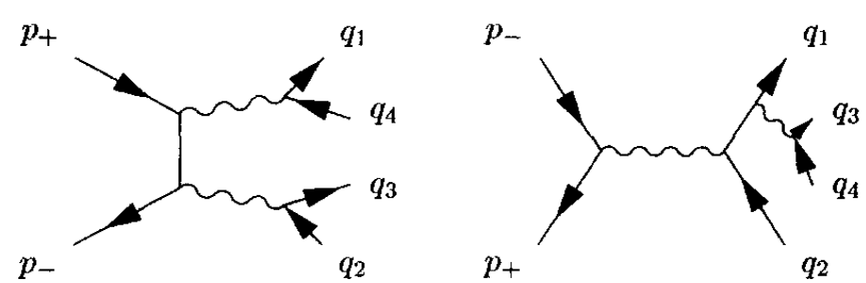
0.022 mbarn

Fig. 1. One of the sixteen bremsstrahlung graphs representing the leading t-channel dynamics.



7.27 mbarn

Fig. 2. One of the eight Feynman diagrams for multiperipheral dynamics.



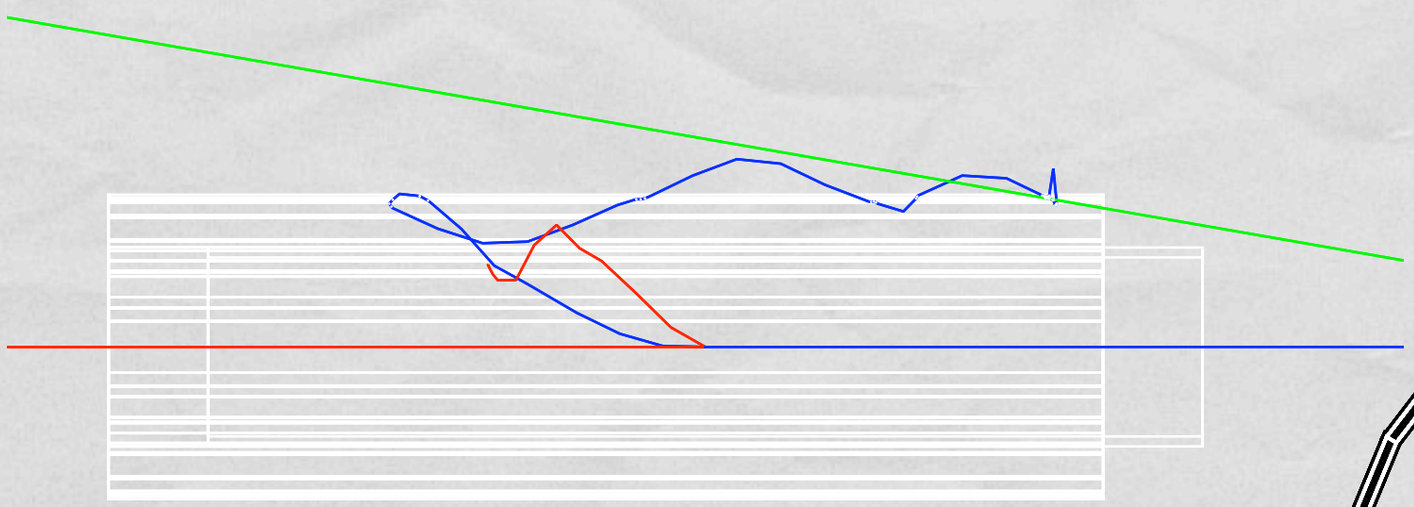
1.1 nbarn

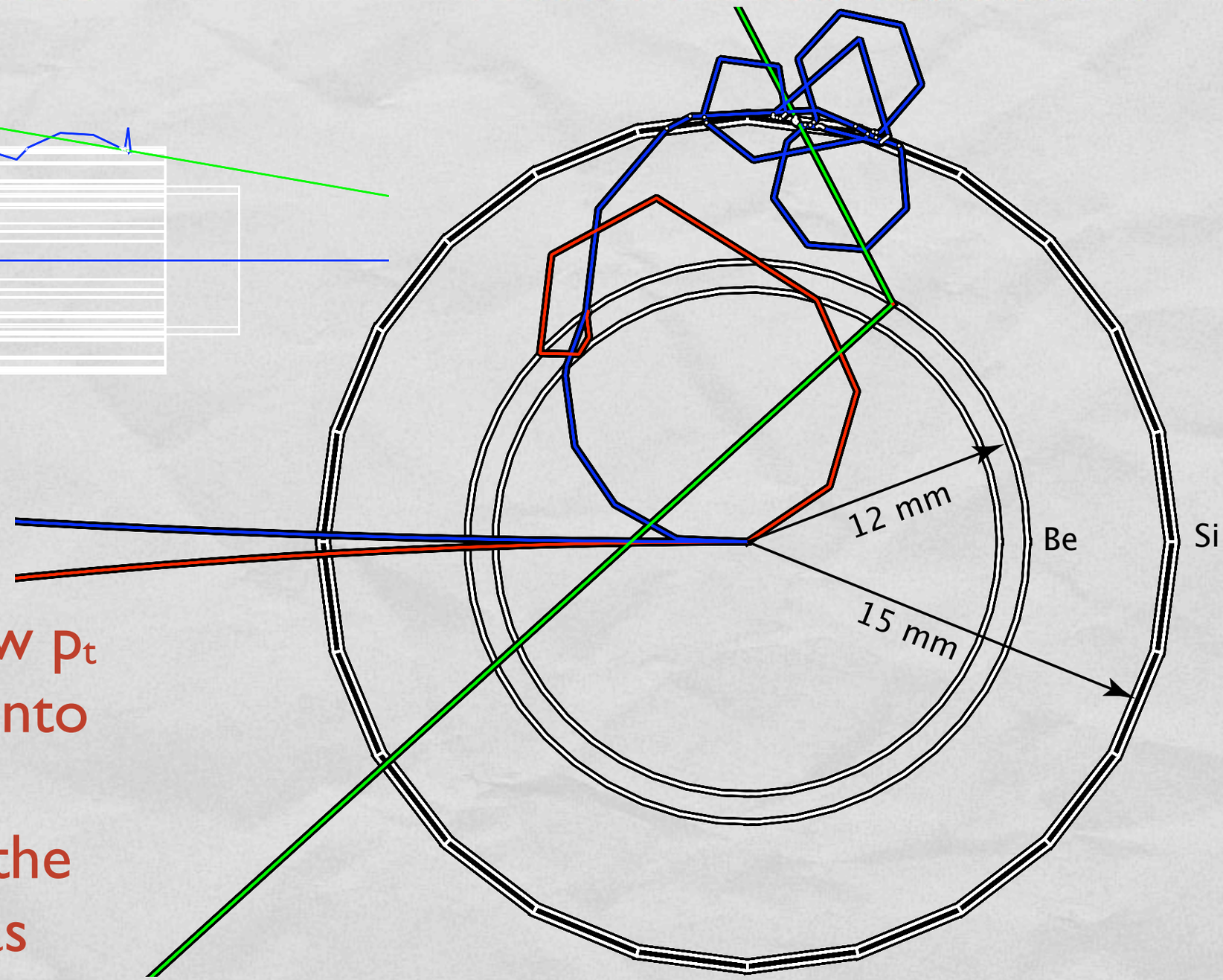
Fig. 3. Two of the twelve Feynman diagrams representing conversion and annihilation dynamics, respectively.

PAIR PRODUCTION PECULIARITY

- Particles produced by this process can have enough pt to enter directly into the detector acceptance
  - No interplay among particle production mechanism and machine optic
  - Magnetic field and L0 radius enough to make a rough “thumb-o-metric” estimate (cfr. Super*B* CDR).

BACKGROUND GENERATION

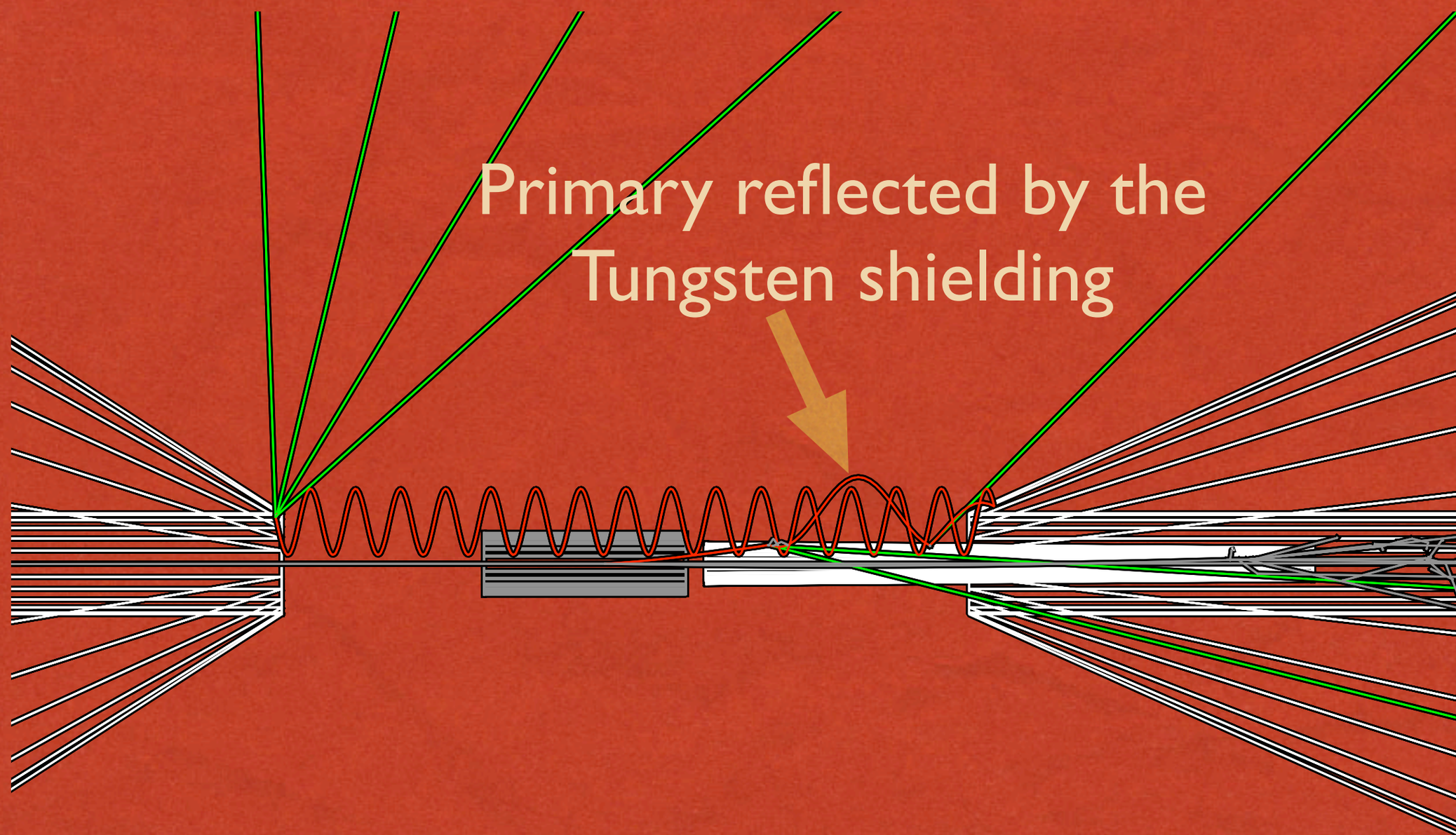




Beam pipe intercept low p_t particles and divert in into L0.

Lesson learned: place the Beam Pipe as close as possible to L0

SHIELDING UNDESIRED EFFECTS



Preliminary

```
Electron Rates
--------------
Mean hit rate on layer 0:        5.581095 MHz/cm^2
Mean hit rate on layer 1:        0.312809 MHz/cm^2
Mean hit rate on layer 2:        0.147186 MHz/cm^2
Mean hit rate on layer 3:        0.032746 MHz/cm^2
Mean hit rate on layer 4:        0.006877 MHz/cm^2
Mean hit rate on layer 5:        0.003729 MHz/cm^2
Positron Rates
--------------
Mean hit rate on layer 0:        3.881121 MHz/cm^2
Mean hit rate on layer 1:        0.217557 MHz/cm^2
Mean hit rate on layer 2:        0.102656 MHz/cm^2
Mean hit rate on layer 3:        0.024569 MHz/cm^2
Mean hit rate on layer 4:        0.001767 MHz/cm^2
Mean hit rate on layer 5:        0.000752 MHz/cm^2
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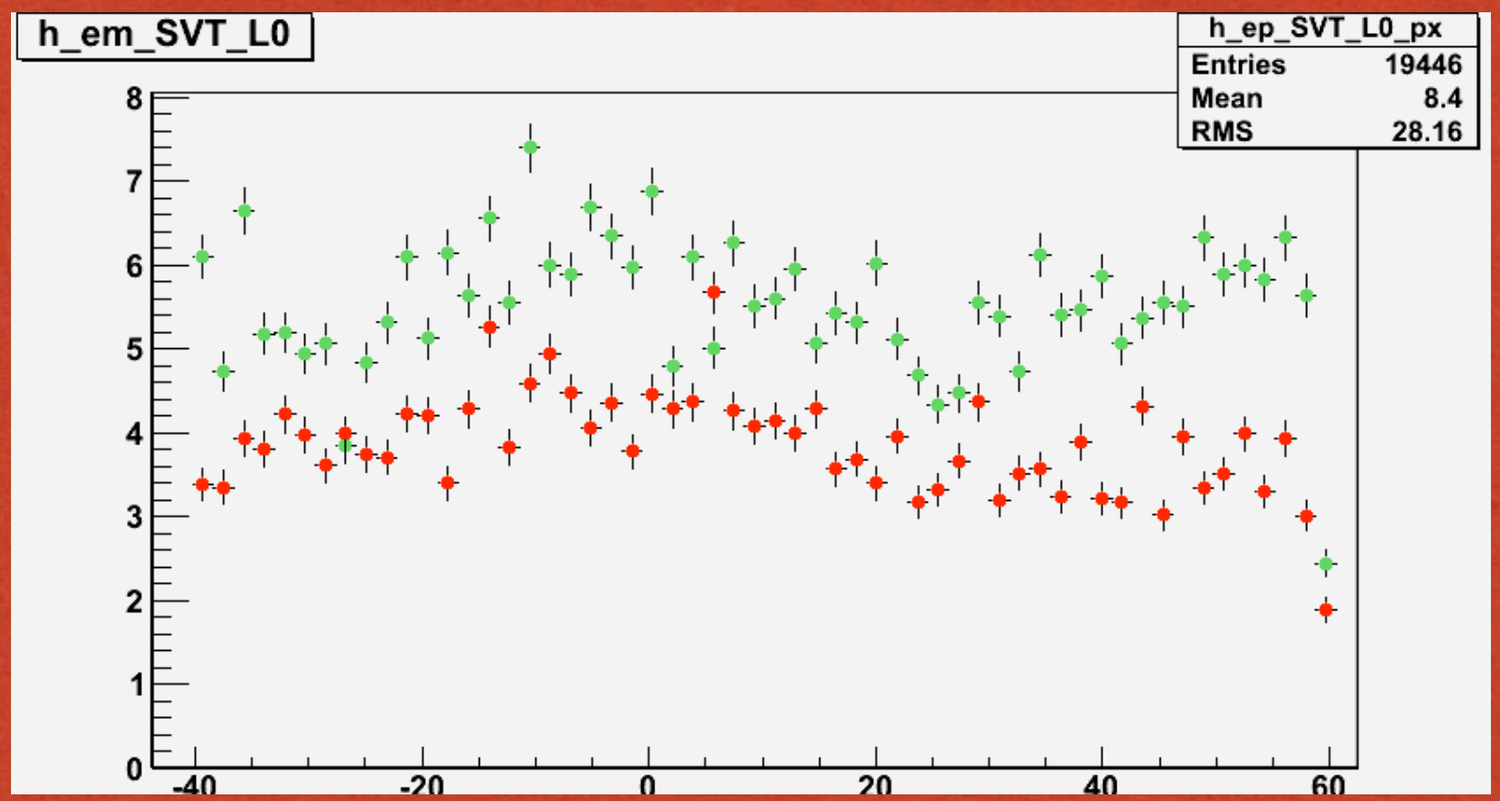
L0 inner radius: 1.5 cm

Hit multiplicity included (50 mum x 50 mum)

Beam Pipe outer radius 1.5 cm

1mum Gold foil + 1mm Be

Preliminary



SINGLE BEAM

- Touschek scattering
  - particles inside the same bunch collides: transverse momentum transferred onto the longitudinal direction
- Beam gas
  - particles inside a bunch interact with the residual gas in the vacuum chamber
    - Angular deflection and/or energy loss

TOUSCHEK

- Beam collimation & primaries generation by Manuela
- Analysis by Giovanni Marchiori @ Elba in 2008

preliminary

Layer	e- from LER	e+ from LER	e- from HER	e+ from HER
0	12.8±1.4 kHz/cm^2	1.3±0.1 kHz/cm^2	537±17 kHz/cm^2	170±10 kHz/cm^2
1	5±2 Hz/cm^2	2.9±1.5 Hz/cm^2	50±3 kHz/cm^2	20±2 kHz/cm^2
2	6±2 Hz/cm^2	2.9±1.3 Hz/cm^2	16±1 kHz/cm^2	7.2±0.9 kHz/cm^2
3	324±80 Hz/cm^2	8.4±1.5 Hz/cm^2	6.4±0.5 kHz/cm^2	0.8±0.1 kHz/cm^2
4	127±35 Hz/cm^2	0.05±0.01 Hz/cm^2	1.2±0.1 kHz/cm^2	0.12±0.03 kHz/cm^2
5	19±5 Hz/cm^2	5±1 Hz/cm^2	0.56±0.06 kHz/cm^2	~0 Hz/cm^2

BEAM GAS

- Preliminary studies made by Manuela
- Dedicated beam scrapers not yet in place
- Work in progress

HOW TO USE THESE FIGURES?

- With lot of care!
- What is missing?
  - Beam gas (work in progress)
  - Beam halo (challenging)

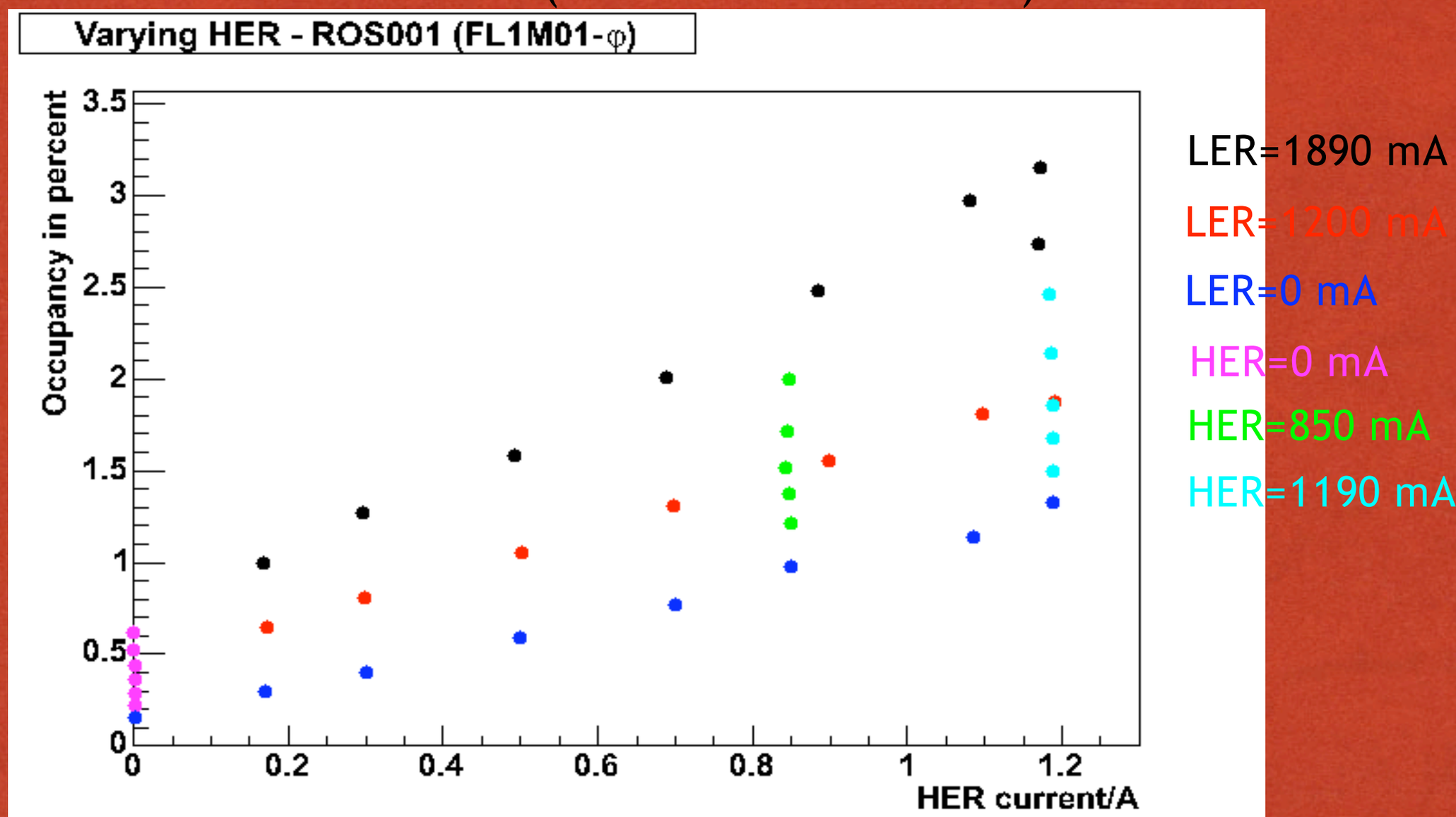
GENERAL CONSIDERATIONS

- Backgrounds does not depend solely on beam currents and luminosity
- Beam gas: vacuum condition can be far from ideal
- Touschek: machine imperfection and tuning
  - Safety factor have to accomodate for “real life” accidents

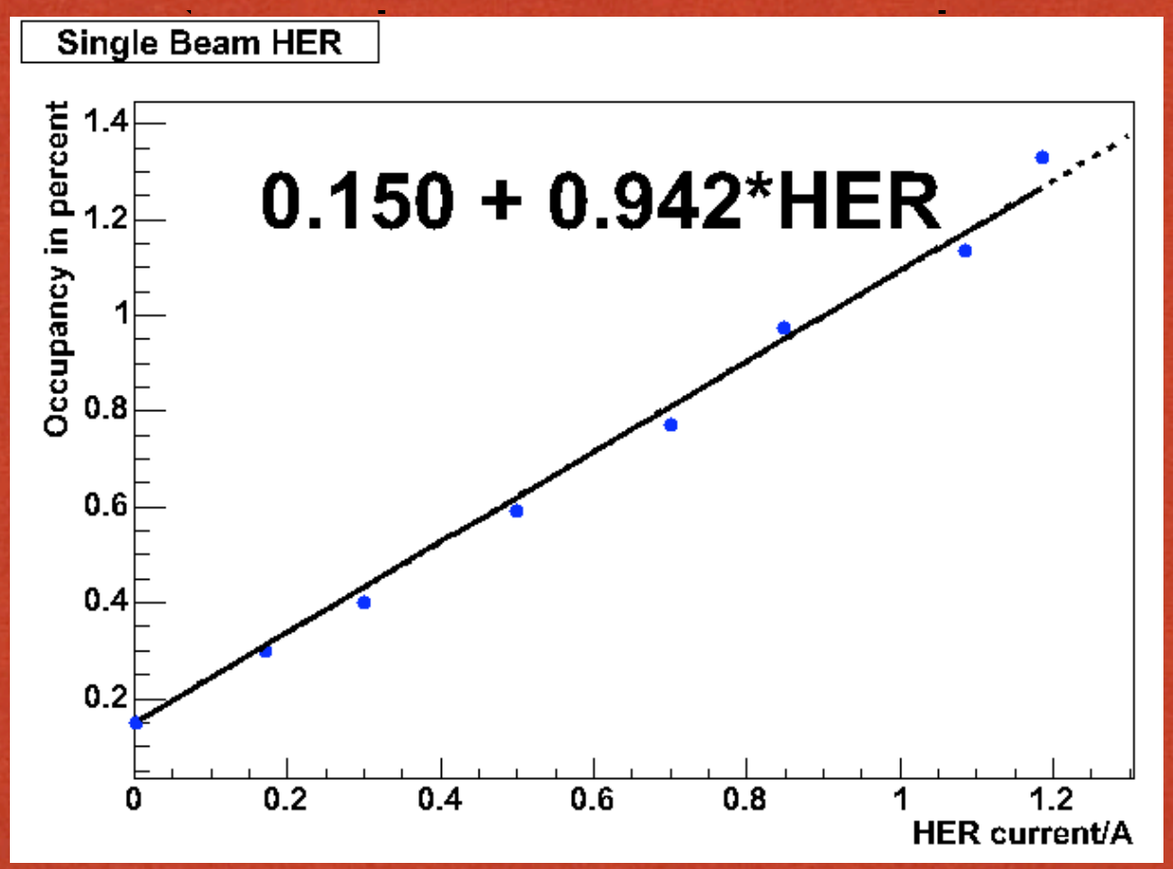
PEP-II EXPERIENCE (B.AAGAARD PETERSEN)

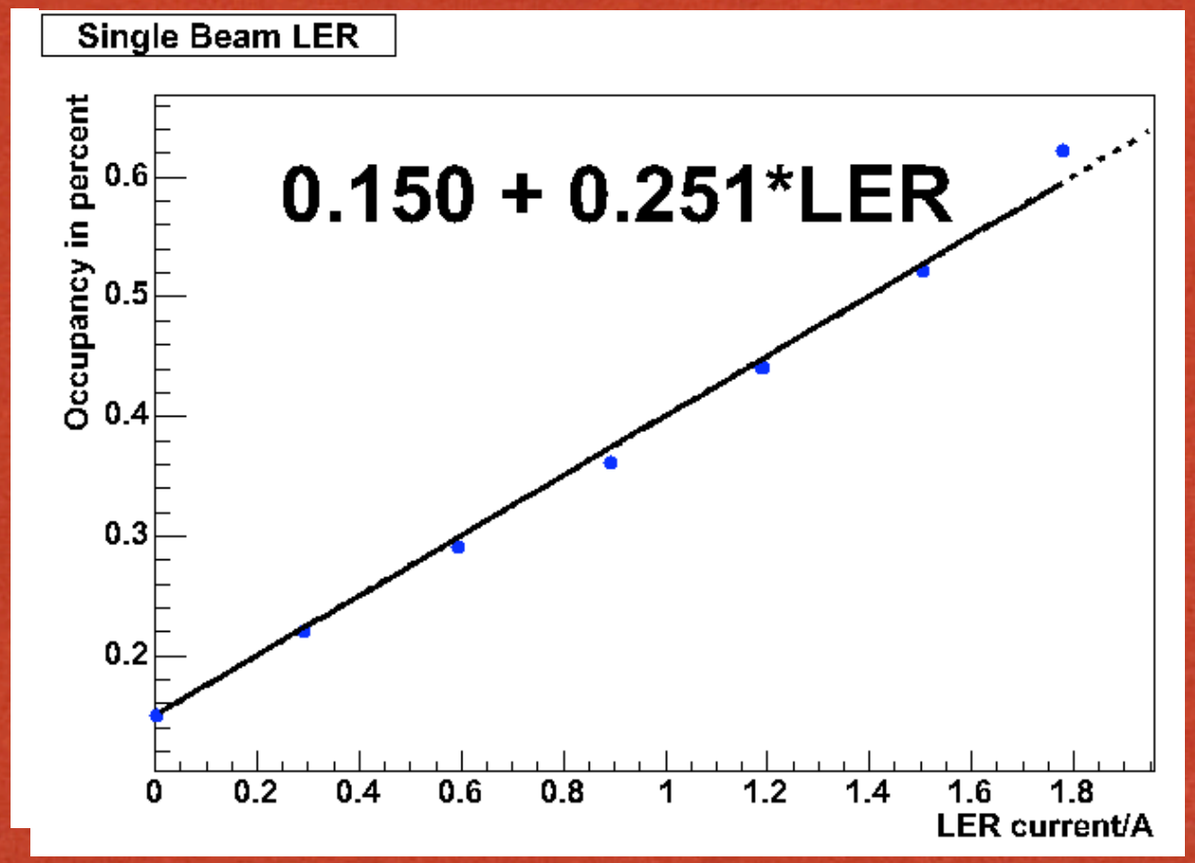
- Bkgd. rate measured on dedicated runs

All data for one ROS (ROS1=FL1M1=FE:MID):



SINGLE BEAM CONTRIBUTION

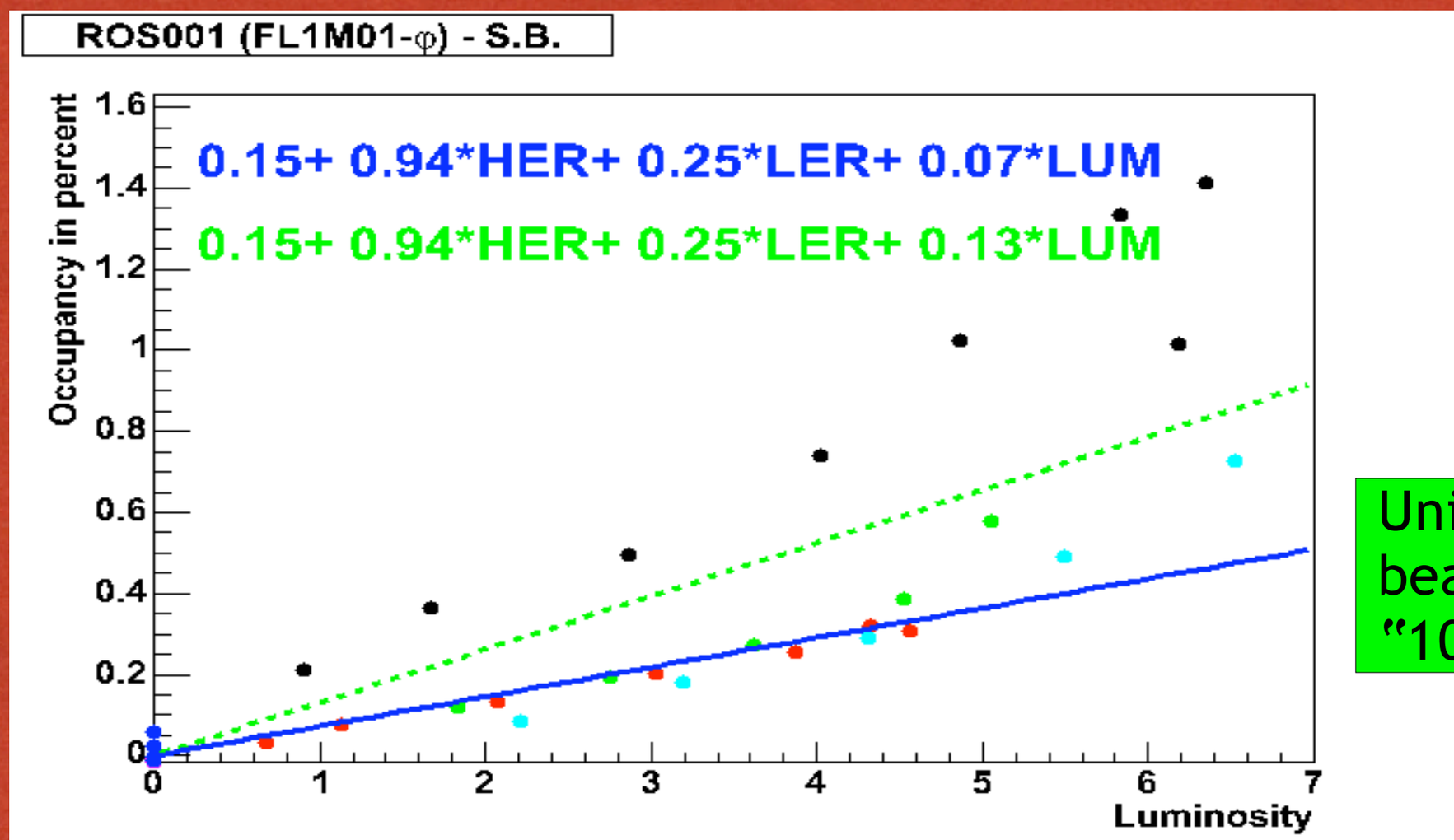




B.Aagaard Petersen courtesy

“LUMINOSITY” TERM

Subtracting single beam terms, we obtain 2-beam contributions (includes: luminosity, beam-beam and 'cross-term')



LER=1890 mA

LER=1200 mA

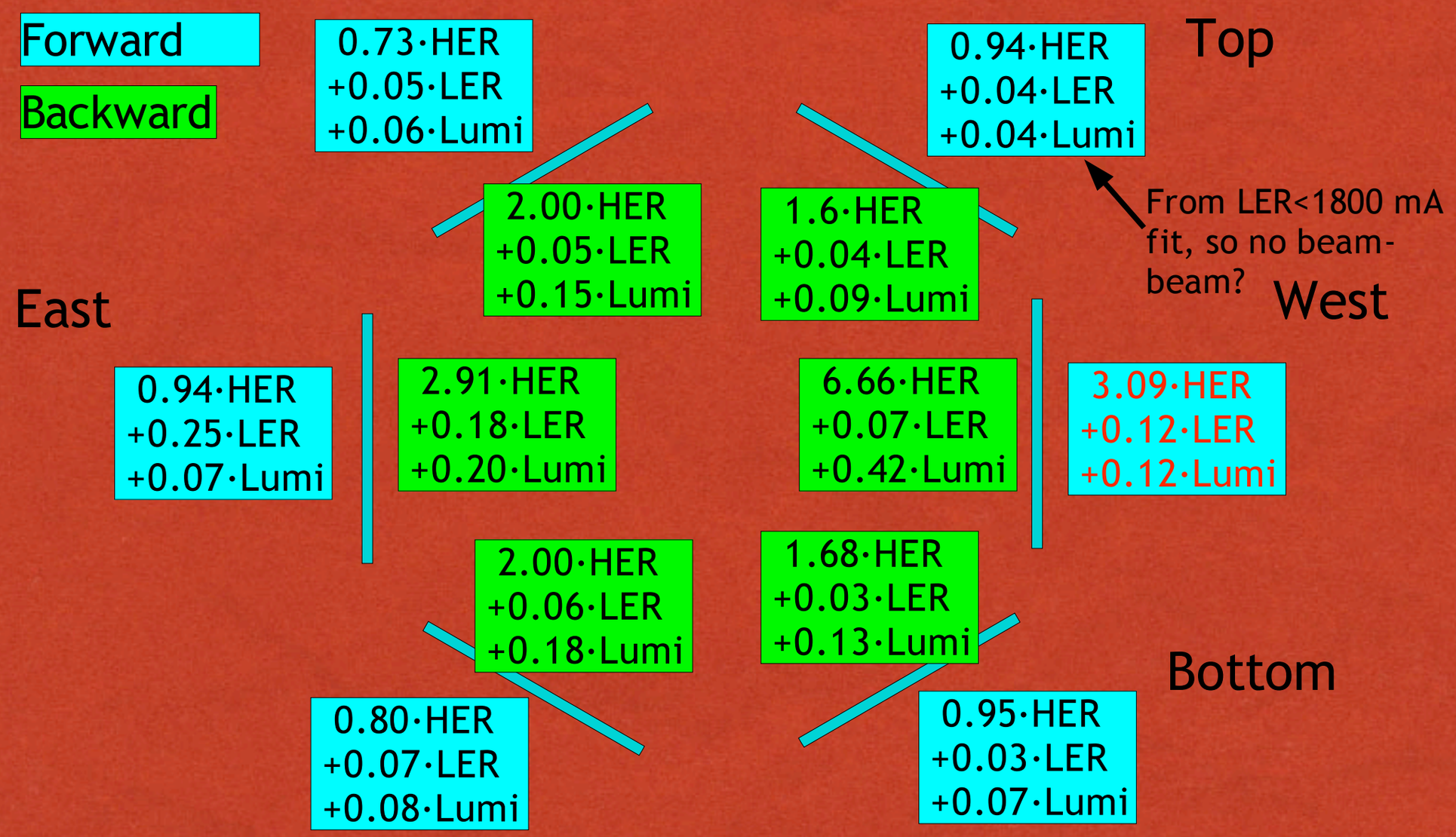
HER=850 mA

HER=1190 mA

Units in fits are “A” for beam currents and “10^{33} cm^{-2}/s” for Lumi

B.Aagaard Petersen courtesy

ANISTOPIC LUMINOSITY BACKGROUND



“LUMINOSITY” BACKGROUND IN PEP-II

- Non linear with “luminosity”
- peculizr azimuthal distribution
  - My 2 cents opinion
    - significant contribution from beam-beam effects on the beam halo (non linear dependence on luminosity) rather than beam-strahlung

CONSIDERATION

- Uncertainties on these numbers
  - Cross sections (primaries generation)
  - Model of the detector & machine (Geant 4)
  - Real life “accidents” (vacuum leaks, imperfections, errors in the above outlined 2 steps...)

HARD TO QUANTIFY UNCERTAINTIES AT THIS STAGE

Source	Worst occupancy	Cross section	Model	Accidents
Beam Strahlung	0.16 MHz/cm^2	Infrared divergences (50% ?)	significant	moderate
e^+e^- pair production	9.6 MHz/cm^2	Radiative corrections (20%)	moderate	none (almost)
Touschek (L0)	0.6 MHz/cm2	negligible	significant	hard to quantify
Touschek (L1-L5)	0.07 MHz/cm2	negligible	significant	hard to quantify
Beam gas	work in progress (expect ~Touschek)	negligible	significant	
Beam halo	???	negligible	significant	hard to quantify

CONCLUSIONS

- Detailed Geant4 simulation of pairs produced @ IP done
- More statistics needed to identify hot spots (if any) in beam strahlung background
- Beam gas simulation in progress