General Introduction on Background Simulation

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What we did, how we did it, what we have to do and how we will do it

Machine Background: a primer

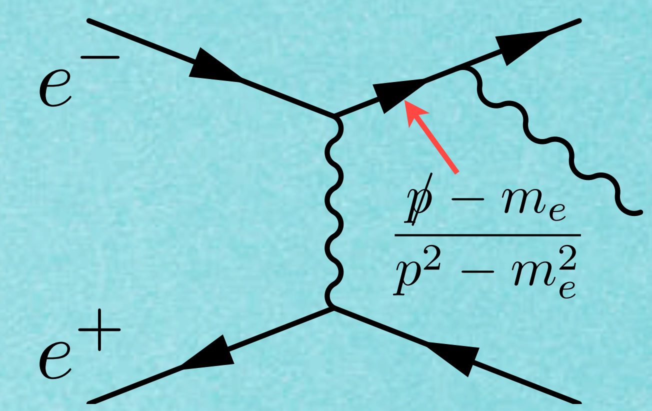
- Machine Background sources classified by scaling laws:
  - Luminosity: Radiative/Elastic Bhabhas, Pair Production
  - “Hardness of collision”: beam-sstrahlung, Touschek, non gaussian beam tails
  - Current: beam - gas interaction, synchrotron radiation from near bending

Luminosity Scaling

	Cross section	Evt/bunch xing	Rate
Radiative Bhabha	~340 mbarn ($E\gamma$/Ebeam > 1%)	~680	0.3THz
e^+e^- pair production	~7.3 mbarn	~15	7GHz
Elastic Bhabha	$O(10^{-5})$ mbarn (Det. acceptance)	~20/Million	10KHz
$\Upsilon(4S)$	$O(10^{-6})$ mbarn	~2/million	1 KHz

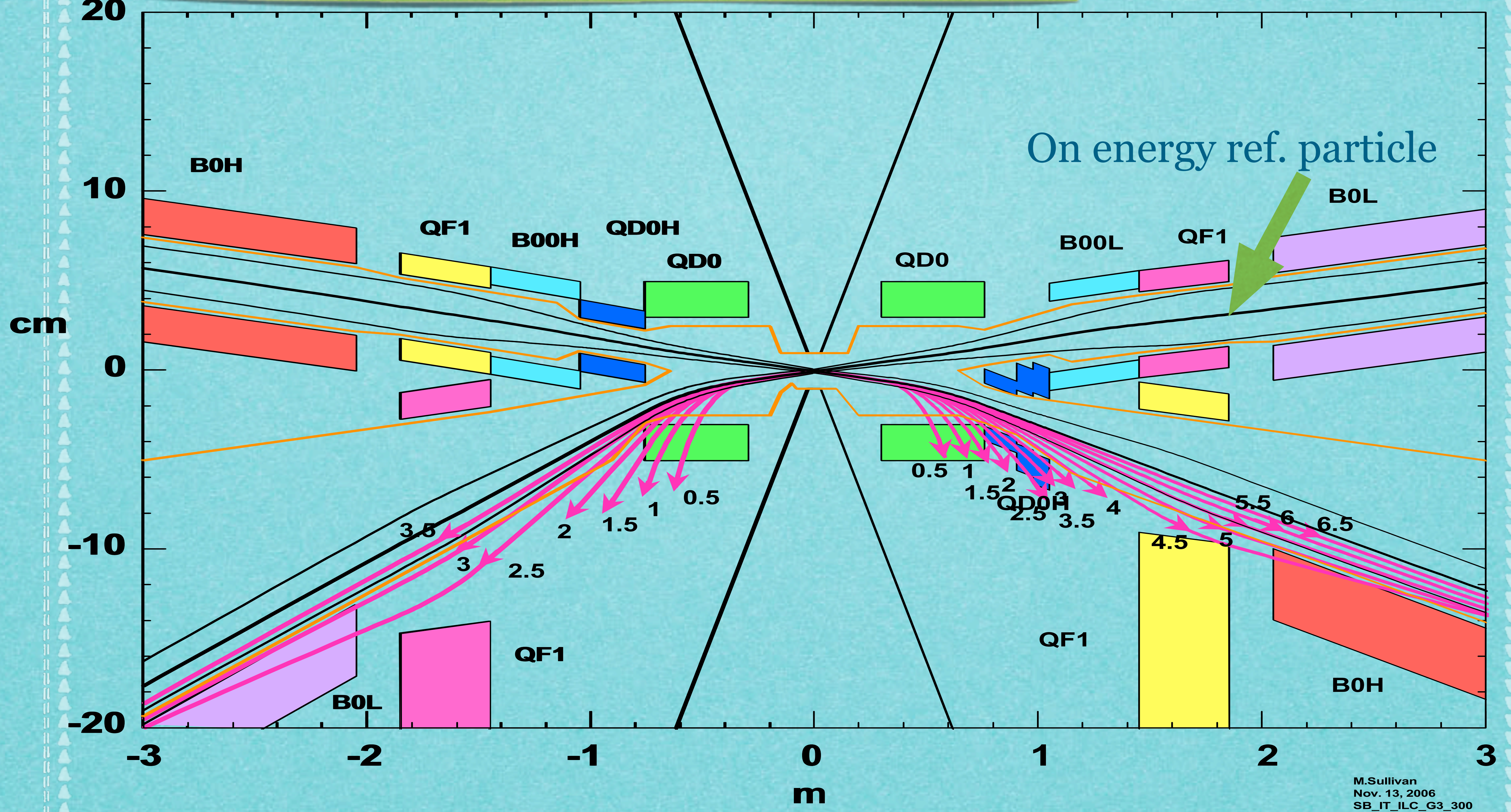
Radiative (Inelastic) Bhabha

$$e^+e^- \to e^+e^-\gamma \quad (\gamma \sim\parallel e^-)$$

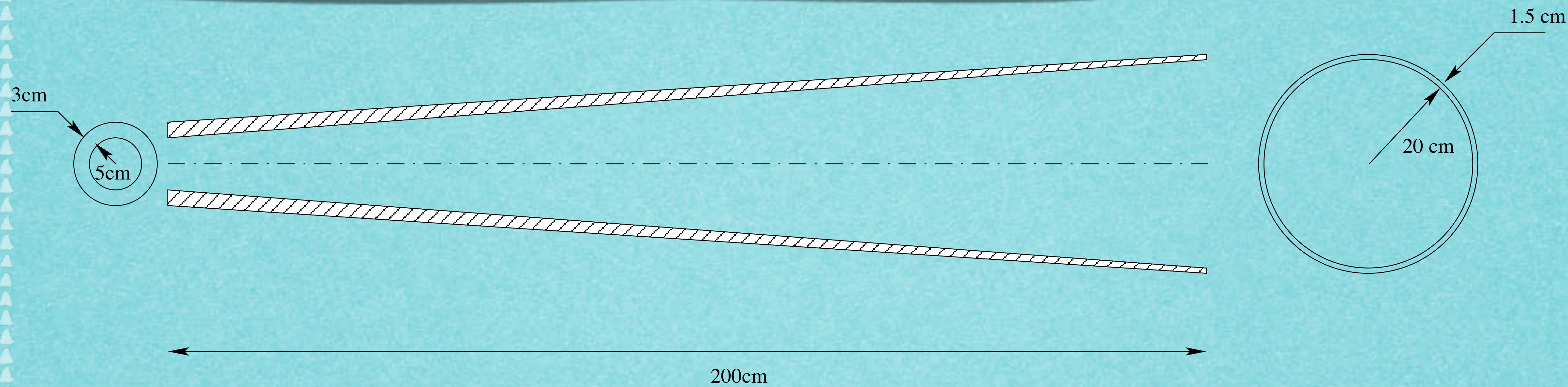


- Quasi elastic Bhabha of the electron on the positron followed by the emission of a photon
- The virtual photon and the virtual electron are almost on mass shell:
  - the amplitude pinches the electron and photon propagators pole. Huge cross section.

Background production



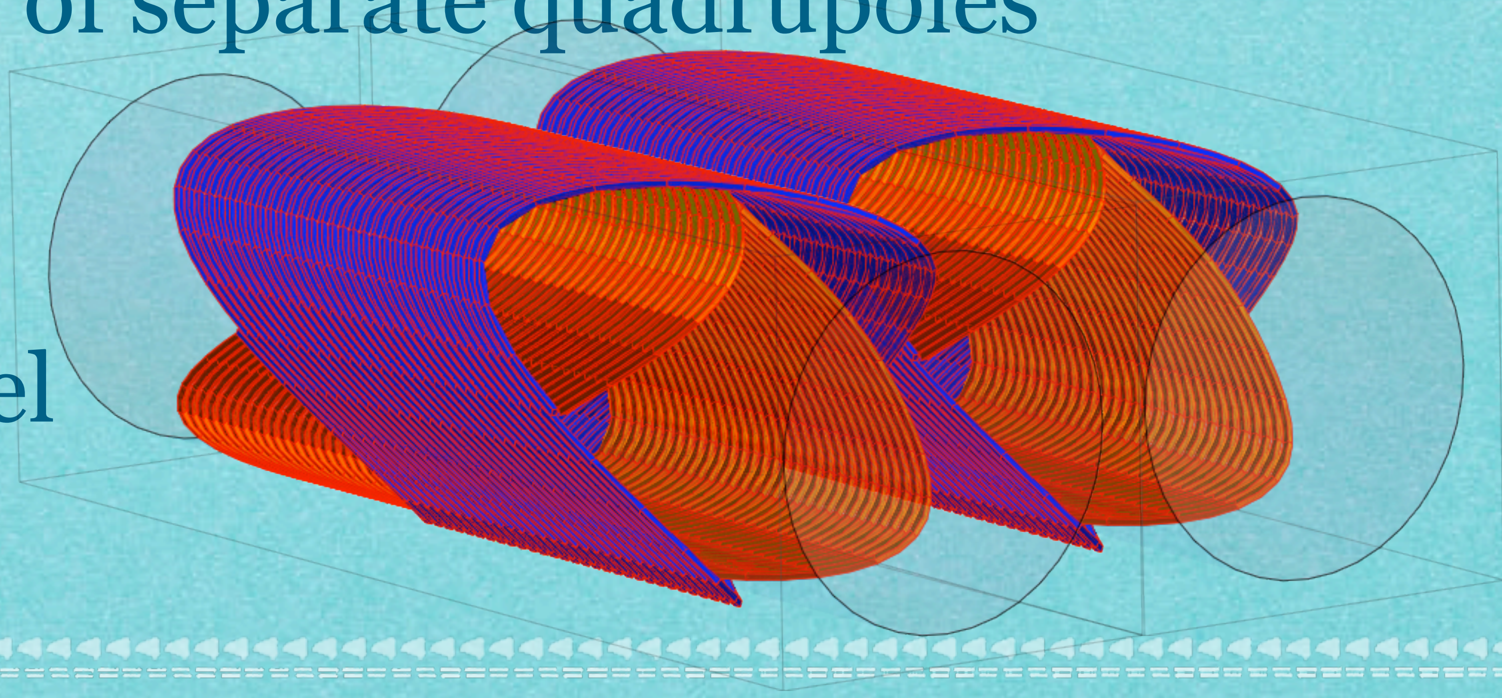
Background remediation I



- Brute force: massive (2.7 Ton) tungsten shielding
  - Pro: reliable
  - Con: cost ~ 2 x 330.000€ (Plansee offer)

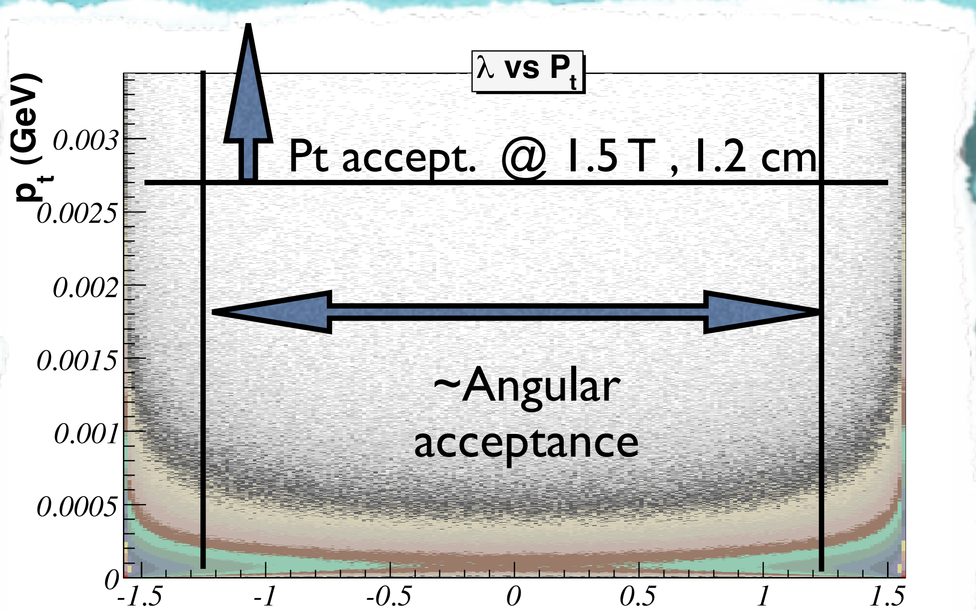
Background remediation II

- Drastic reduction of the linear and quadratic dispersion near the interaction point
  - Replacement of the shared quadrupoles QD0 with two pairs of separate quadrupoles
  - Pro: clever
  - Con: very novel

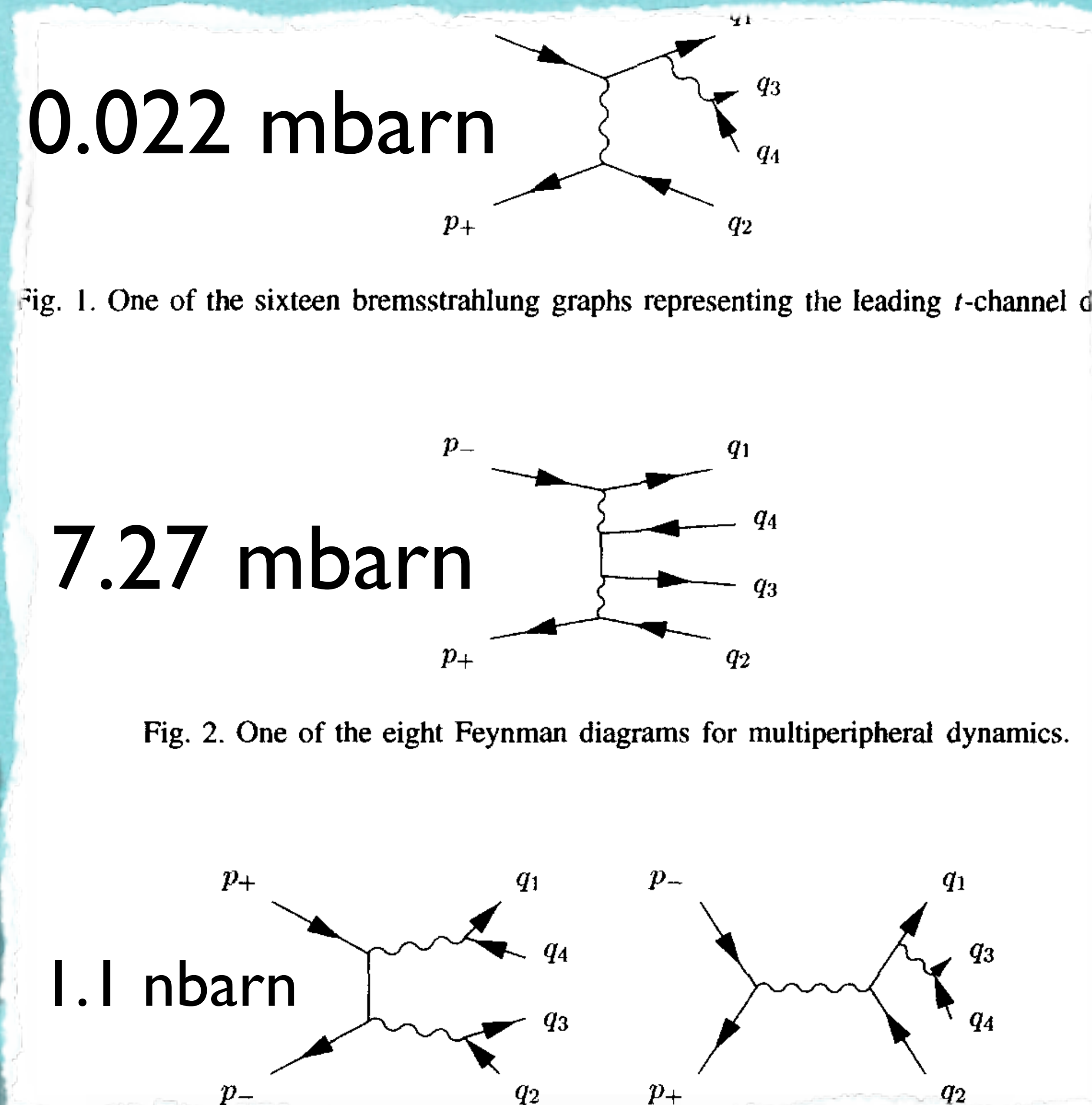


Pair Production

- Generator: Diag36
- Affect SVT Layer 0

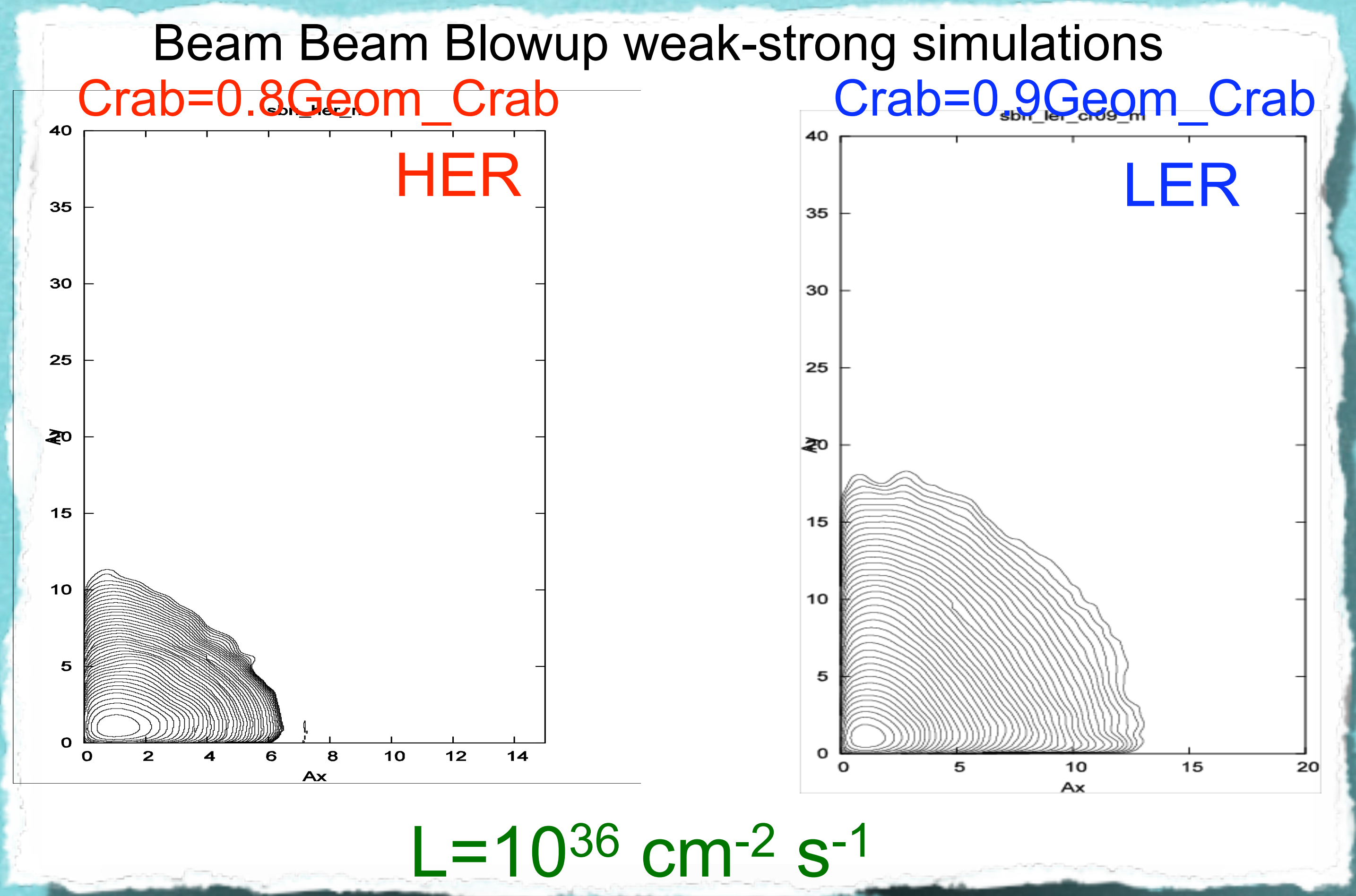


Most of the particles are outside det. accept.



“Hardness of collision”

- Non gaussian beam tails (Not simulated so far), should we? How?

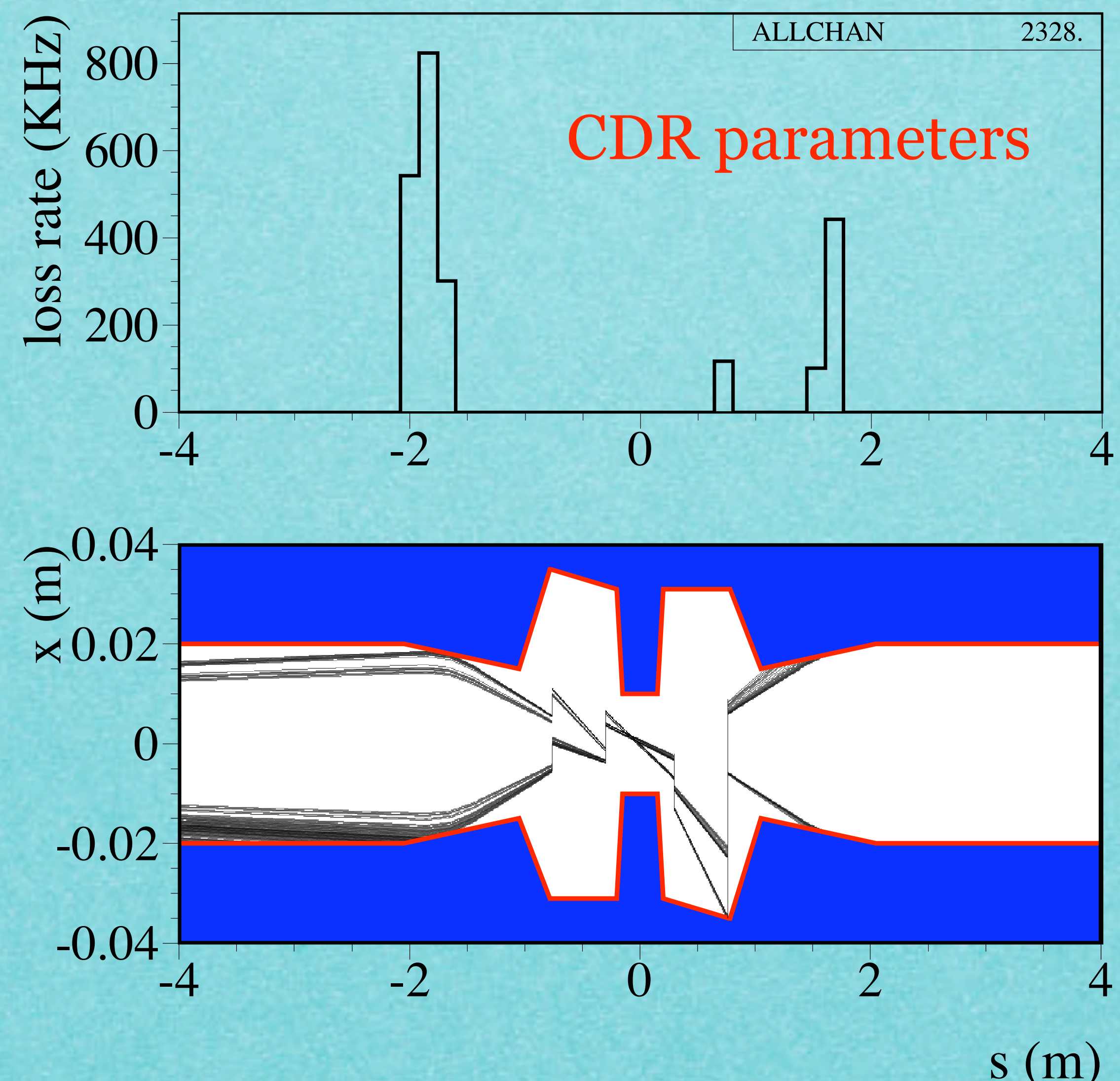


Touscheck Background

- Particles in the same bunch can undergo Touscheck scattering and escape the ring energy acceptance window
- Off energy particles hit the storange ring material producing backgrounds
- Manuela Boscolo (LNF) developed a tool to simulate Touscheck scattering around the ring

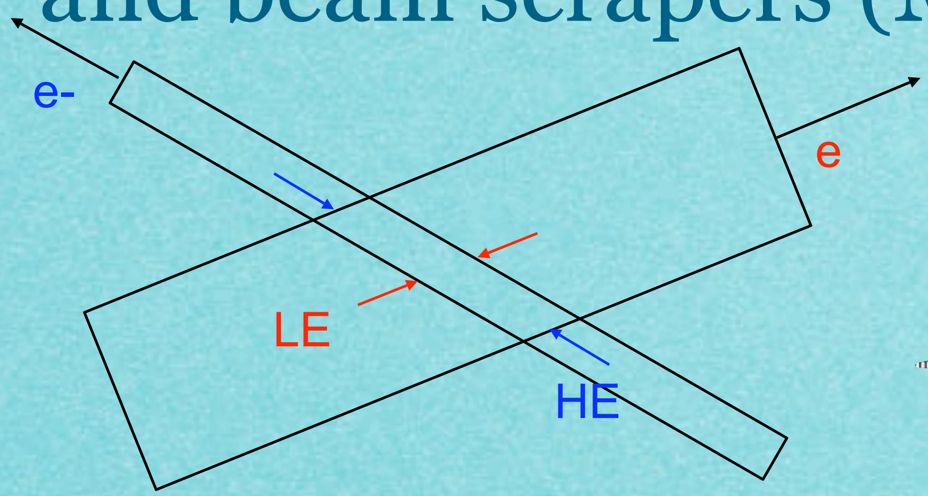
Touscheck rate

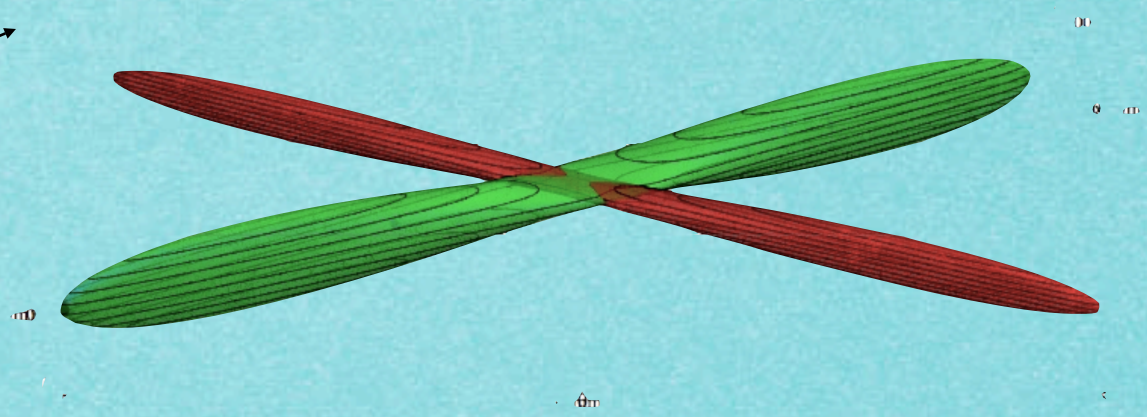
- Major source of concern during CDR finalization



Background remediation

- Brand new set of machine parameters (Panta) and beam scrapers (M.Boscolo)





	CDR		New	
	LER	HER	LER	HER
Vert. emitt. (pmr)	4		7	4
Hor. emitt. (nmr)	2		2.8	1.6
particles/bunch 10^{10}	6.16	3.52	5.52	
Touschek lifet. (min)	5.5	38	13.8	20.6

Geant 4 Simulation

- Giovanni Marchiori implemented the relevant part of the new final focus (the incoming and outcoming double QD0).

Layer	Old (kHz/cm2)	New (kHz/cm2)
0	23160	3.7
1	35800	7.0
2	29500	2.6
3	8000	4.9
4	885	0.0
5	510	0.0

Beam Current scaling

- Compton & Coulomb scattering among beam particles and residual gas in the vacuum chambers.
- For the CDR we just scaled by a factor close to 1 the BaBar backgrounds.

Software Framework

- Geant4 based program “SimSimpleApp” developed by Giovanni Marchiori, Giovanni Calderini
- QED generators (BBBREM + DIAG36), Touscheck generator(M.Boscolo) interface developed by E.P.
- Geant hits written on root files.

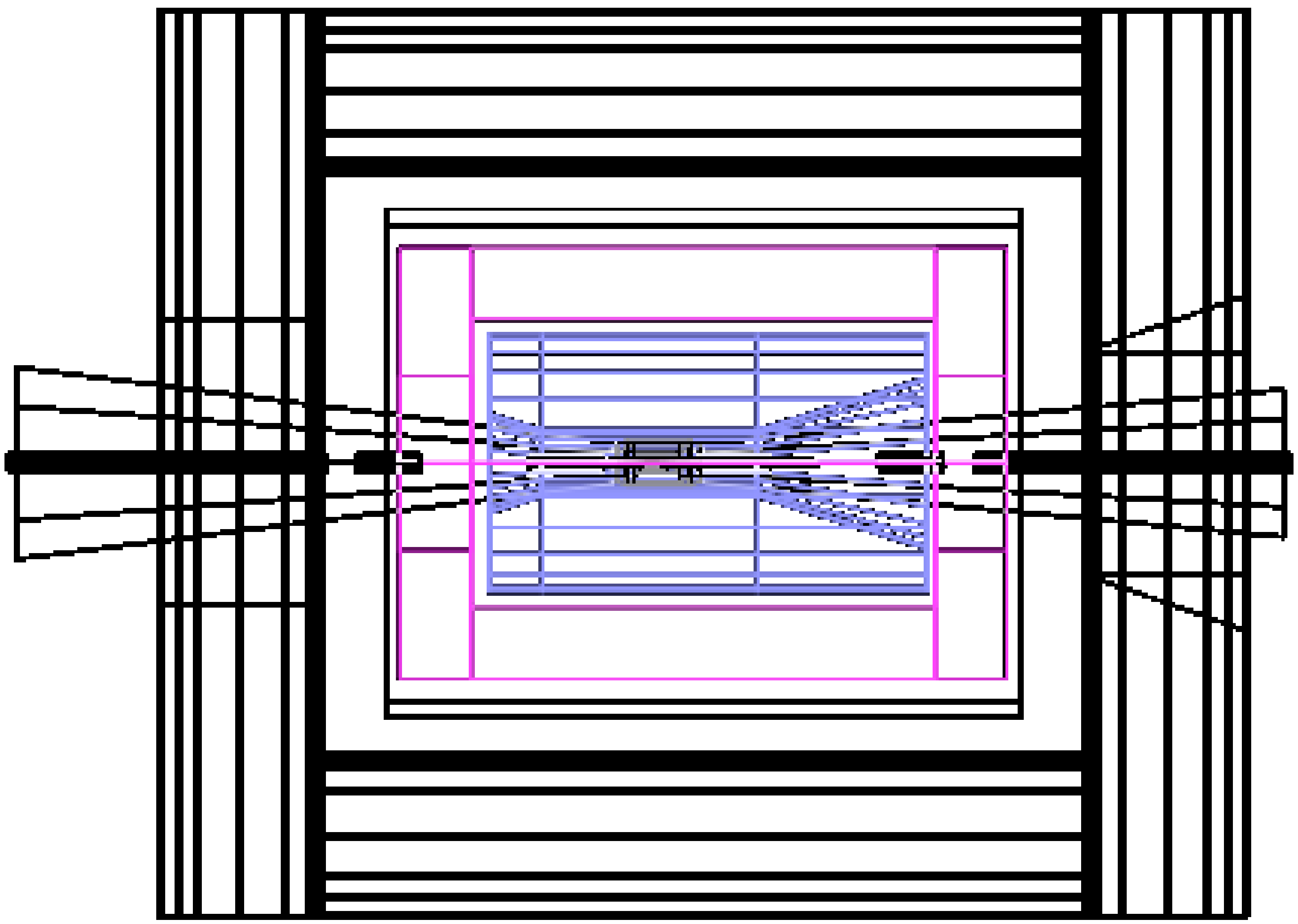
Software Framework II

- Geant hits digitization (i.e. conversion of the energy deposit information to “Electronic hit”)
  - at runtime for SVT
  - off line on top of the Root-tuples for other sub detectors.
  - In both case very rough, sufficient for occupancy studies, not for digi mixing for the full simulation

Detector geometry

- Buried in the C++ code:
  - hard to modify
  - hard to simulate a variety of detector configuration
- In the wish list: GDML/XML geometry description in an extern configuration file

CDR Detector Geometry



Questions for Det.Exprt.

- Does the present root tree contains all the information you need?
  - What information is missing?
- Does you intend to implement a digitization algorithm?

Job organization

- At present is not trivial to compile and run the SimSimpleApp
  - CVS is "private" to SuperB afs slac group
  - Software environment: Geant libraries, root version, gcc flavour, linux distribution
  - Documentation
- We need:
  - A common software environment
  - An agile shared documentation (wiki?)

Job Organization II

- A dedicated task force to implement GDML/XML detector construction
- Another dedicated task force should be devoted to the MAD to GDML conversion
- Detector contact persons should start learning GDML/XML to implement their subdetector

Job organization III

- Single beam background simulation still missing
  - We need a Turtle - SimSimpleApp interface
- Space for 3 task forces (3 single man band?)

SVT

- We need to evaluate the radiation dose on the detectors and on the readout electronic
- Describe the geometry in a more flexible way: GDML/XML