MDI Summary

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INFN – Sezione di Pisa

Pisa SuperB Collaboration Meeting

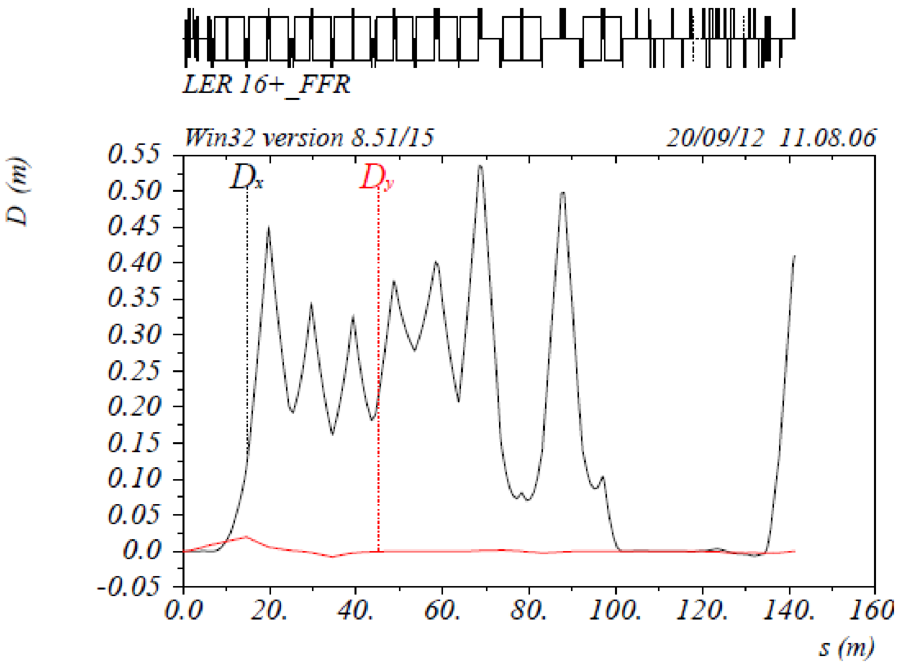
Outline

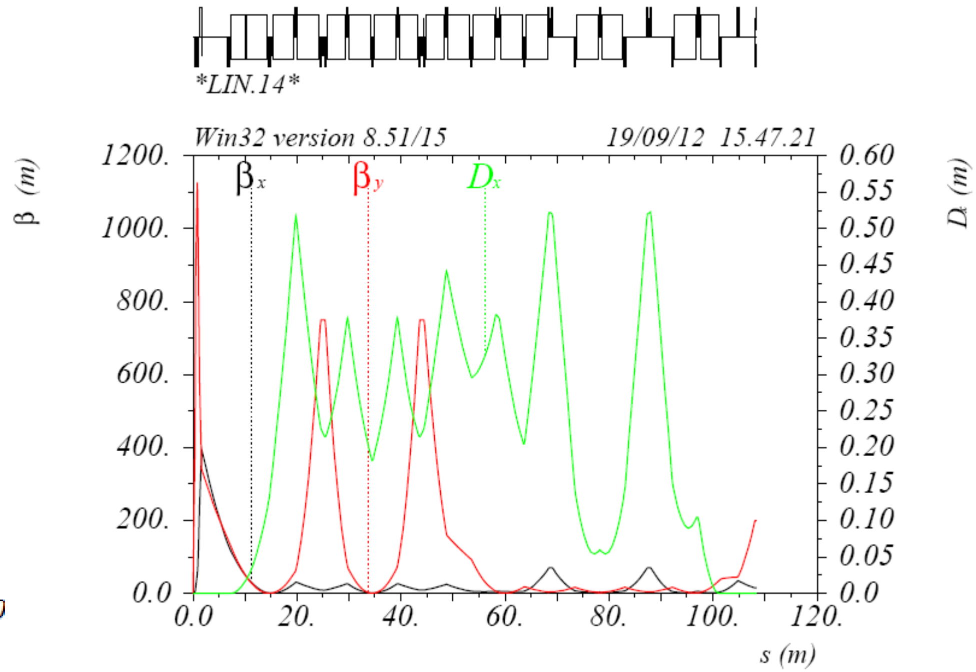
- **Interaction region progress**
  - Final focus final layout
  - Radiation monitor
- **Background Simulation**
  - Latest production
  - New background samples
  - Latest simulations
- **Pending issues and future activities**
- **Summary**

Work on the final focus design with detector solenoid ON

L. Malysheva
R. Bartolini
M. Boscolo

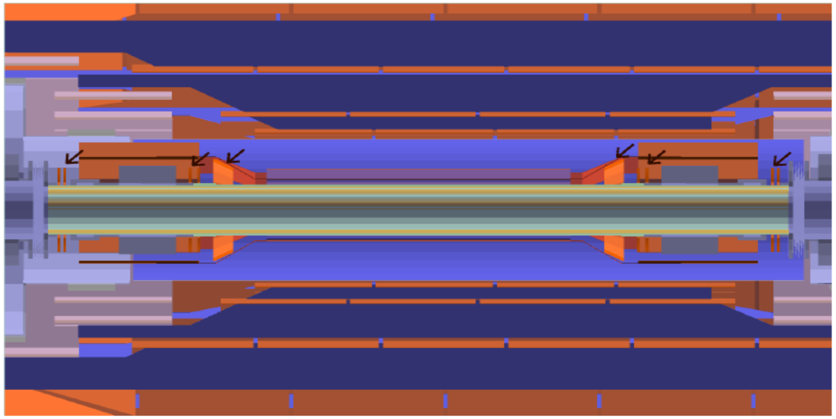
- **Work in progress to finalize the machine layout**
  - Ring lattice: M. Boscolo is looking at Touschek lifetime
  - Final focus: L. Malysheva and R. Bartolini are defining the overall layout
- **We are ready to simulate the backgrounds as soon as this layout will settle down**



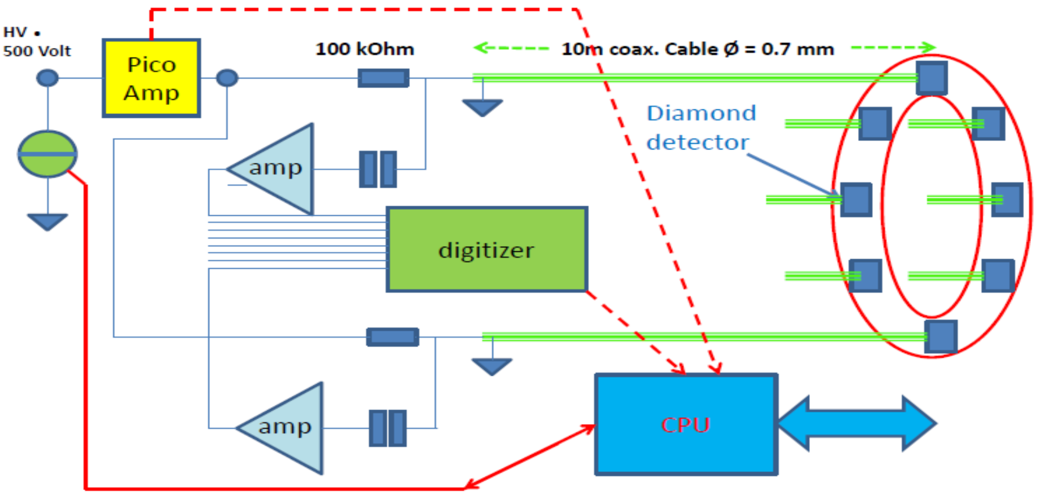


Diamond Radiation Monitors (I)

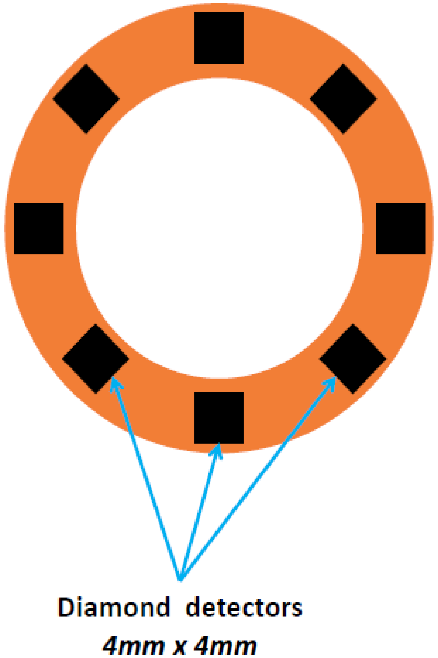
R. Cardarelli



Tentative electronics diagram



8 diamond detectors for each ring

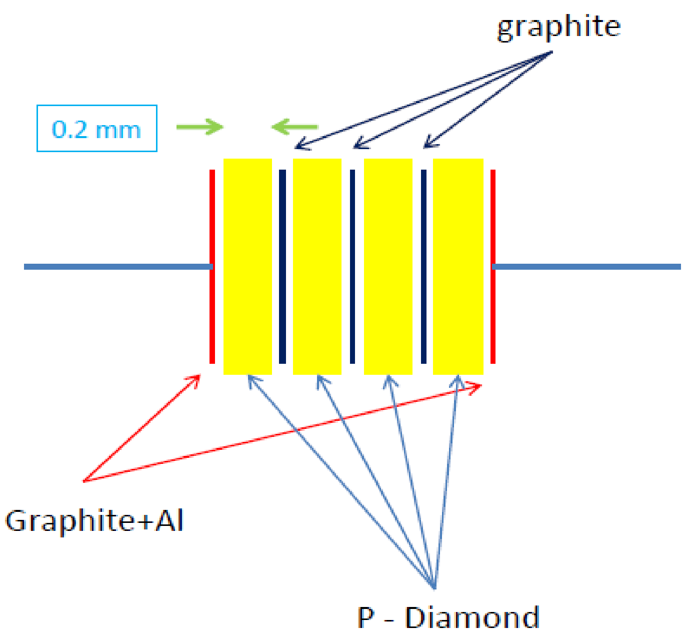


feature

detector size	8 X16 mm^2
leakage current	$80x10^{-10}$ A
Ionization current	$6.7x10^{-10}$ A
hits rate	130KHz
Transit time	20 ns
Integration time	30 ns
Electric resistance	10^{11} Ωcm
energy threshold	150KeV

Diamond Radiation Monitors (II) R. Cardarelli

New detector concept



- **Single crystal diamond collection time drift**
- **New concept under study using polycrystalline diamonds layered (Work in progress)**

Conclusions

- The background of the detector has been simulated.
- The developement of FE electronics is in progress.
- A new structure of diamond detector has been proposed to solve the main problems of the present ones.

Future plans for 2013

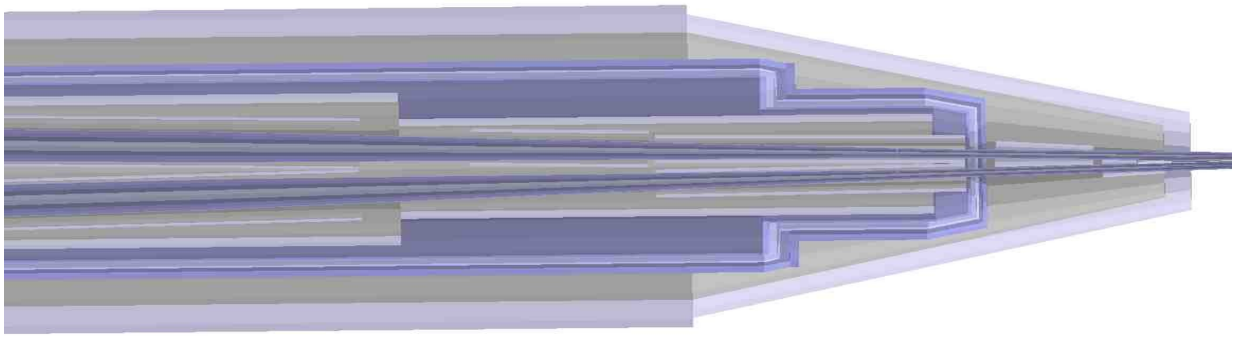
- Test at H8 (CERN) with muon beam.
- Test of the new detectors.
- Test of the final layout.
- Developement of a full custom FE electronics in SiGe technology.

A new default detector configuration for SuperB

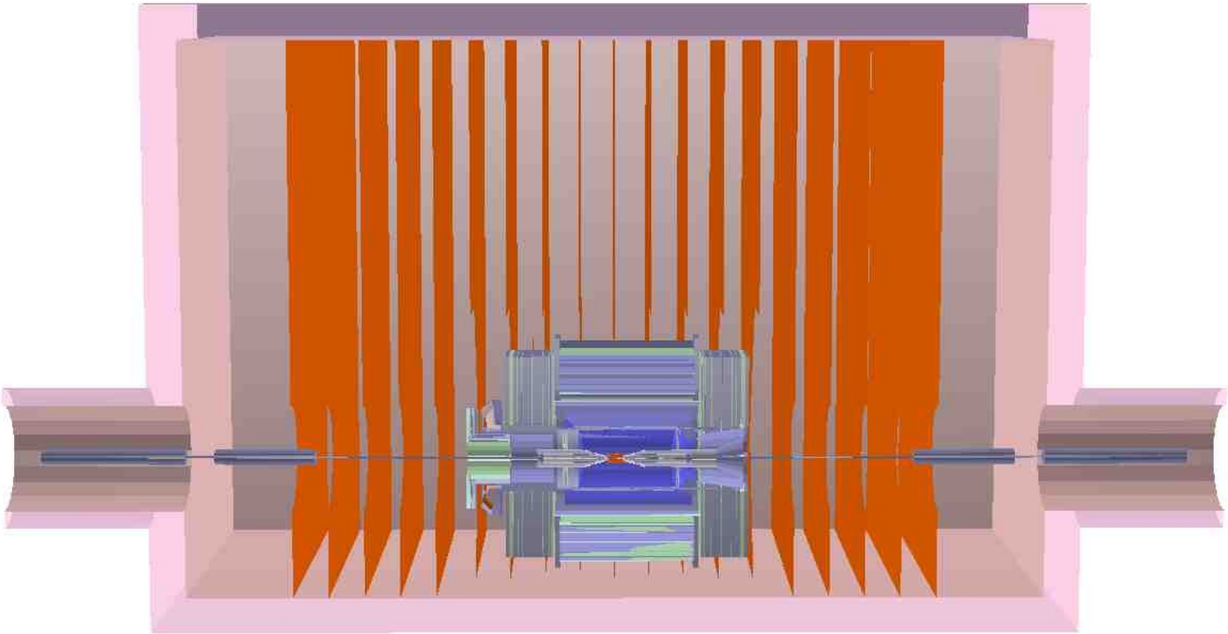
Several improvements to the detector model where implemented for Summer-2012 production (Geometry_CABIBBO-V03)

- **Final focus:** more realistic W-shield compatible with space available and integration constraints.
- **Detector Hall:** more realistic model using Fabrizio Raffaelli drawings
- **Solenoidal detector field:** field was extending beyond the Super-conducting magnet volume and was different from zero inside the FDIRC FBLOCK.
- **Several improvements on the subsystem geometries: SVT, DCH, EMC, IFR**

New model of detector Hall and W-sheild A. Pérez



- Conical section 3cm thick
- Cylindrical section 4.5cm thick



- More realistic model of the detector hall following Fabrizio Raffaelli
- Better estimation of the neutron cloud

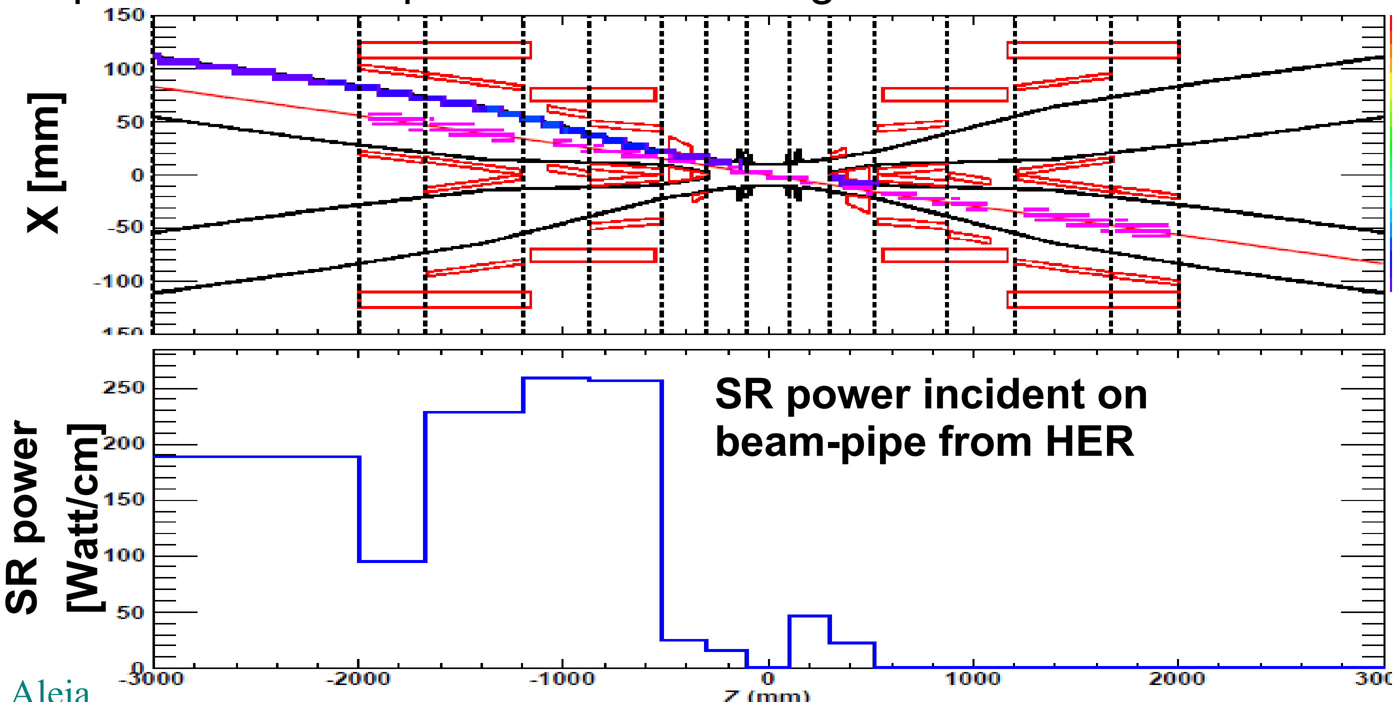
The machine background model

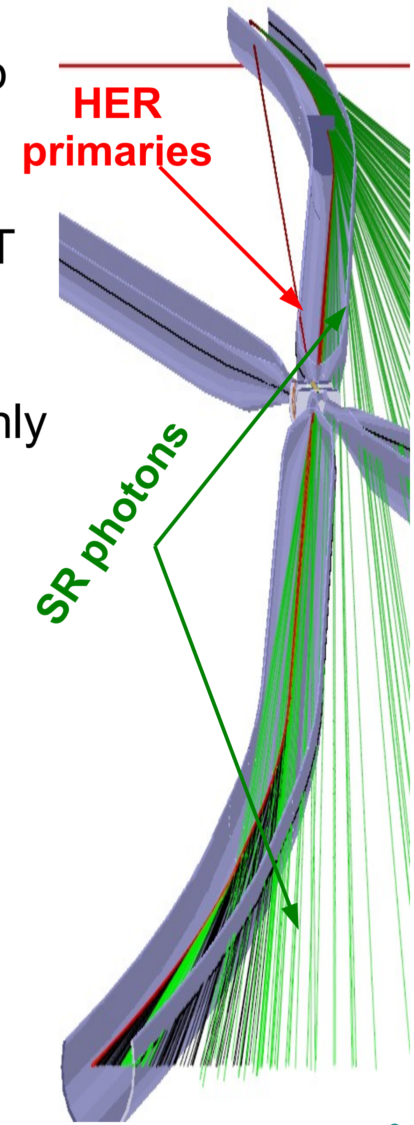
- **We are continuously improving our background model. The usual samples have been studied**
  - High-κ Rad-Bhabha ($\kappa = \Delta E/E >$ 30%). This is the main Rad-bhabha component giving backgrounds on the detector.
    - Geometry_CABIBBO-V03/Geometry_CABIBBO-V03_LYSO: 15k/12k bunch-crossings (BC)
  - Pairs (Geometry_CABIBBO-V03): 100k BC
  - Touschek HER/LER: 88k/198k primaries
  - Beam-Gas HER/LER: 185k/283k primaries
- **In this cycle we also produced for the first time two other background sources (Geometry_CABIBBO-V03)**
  - Low-κ Rad-Bhabha ($0.5 < \kappa < 30\%$): 20k BC
    - Models a significant fraction of the total Rad-bhabha losses for |Z| > 10m (first downstream dipoles)
    - These losses can contribute significantly to the neutron cloud build up process
  - Synchrotron Radiation (SR) HER/LER: 10k/10k BC
- **Note: the primaries used for Pairs, Touschek and Beam-Gas are the same as in previous productions**

Synchrotron Radiation

A. Pérez

- SR energy spectrum is the soft X-ray, but the rates are huge (hundreds of watts)
- The final focus W-shield should be more than adequate to absorb SR-photons passing through the thin beam-pipe
- The small fraction of the SR radiation that will be reflected and diffused by the inner surface of the pipe eventually hitting the SVT will be evaluated with Bruno
- Simulation tool allows to include non-gaussian tails of the beam-profile. Current production use the gaussian core of the beams only





SVT backgrounds

R. Cenci

- **New L0 geometry with somewhat higher radius (F. Bosi drawings)**
- **SR is giving no backgrounds on SVT. Additional test ongoing**

- Small contribution from new RadBhabha
- L0 lower rate due to different radius (Jun12, Sep12)

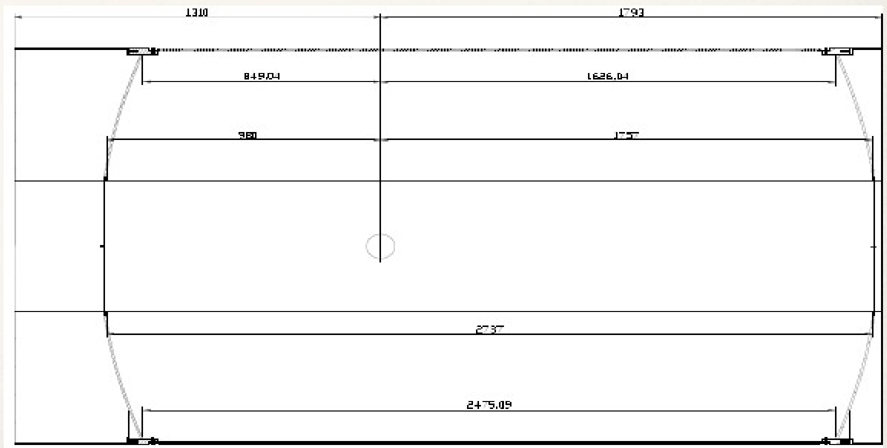
LAYERS	2photons				Bbbrem		Touschek HER		Touschek LER		BeamgasHER		Beamgas LER		Bbbrem LowΔE
MHz/ cm^2	Jan12	May12	Jun12	Sep12	May12	Sep12	May12	Sep12	May12	Sep12	May12	Sep12	May12	Sep12	May12
L0 phi	29.4	30.1	18.7	18.8	0.83	0.54	0.62	0.40	1.70	1.39	0.47	0.37	1.48	1.12	0.013
L0 z	37.2	38.1	20.2	20.3	1.58	0.80	1.94	1.23	4.73	3.7	1.37	1.04	4.27	3.03	0.021
L1 phi	1.56	1.60	1.71	1.66	0.13	0.13	0.19	0.21	0.67	0.93	0.16	0.2	0.58	0.77	0.027
L1 z	0.74	0.76	0.80	0.79	0.08	0.086	0.20	0.23	0.69	0.98	0.18	0.22	0.61	0.80	0.020
L2 phi	0.78	0.81	0.94	0.82	0.079	0.086	0.135	0.13	0.51	0.66	0.12	0.14	0.43	0.56	0.021
L2 z	0.40	0.41	0.49	0.41	0.056	0.056	0.15	0.14	0.55	0.69	0.13	0.14	0.47	0.58	0.018
L3 phi	0.14	0.15	0.26	0.14	0.049	0.023	0.035	0.03	0.165	0.16	0.029	0.028	0.14	0.14	0.009
L3 z	0.13	0.14	0.24	0.11	0.055	0.023	0.057	0.05	0.255	0.25	0.048	0.046	0.21	0.22	0.009
L4 phi	0.022	0.027	0.031	0.023	0.013	0.006	0.0042	0.004	0.014	0.018	0.0035	0.003	0.012	0.016	0.002
L4 z	0.014	0.019	0.019	0.016	0.0081	0.005	0.0031	0.003	0.010	0.014	0.0026	0.003	0.0087	0.012	0.0017
L5 phi	0.012	0.016	0.015	0.014	0.0062	0.005	0.0020	0.002	0.0070	0.011	0.0015	0.002	0.0056	0.009	0.0017
L5 z	0.0082	0.011	0.010	0.010	0.0039	0.003	0.0015	0.002	0.0054	0.008	0.0012	0.002	0.0044	0.007	0.0012

DCH backgrounds

R. Cenci

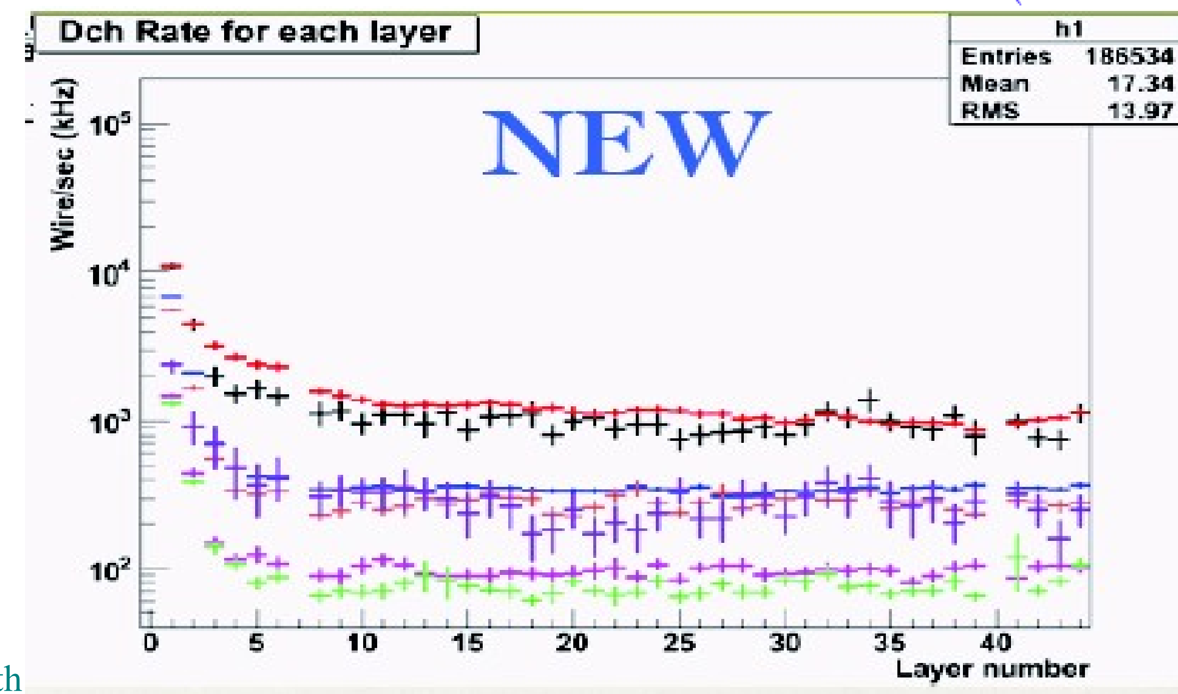
New DCH geometry

- Convex endplates
- Inner radius: 236 ->265 mm
- Thinner inner plate: 1 -> 0.5mm
- Correct thickness for all the walls plus coating



Contributions (Avg. rate)
Radiative Bhabha (662 kHz)
2photons (781 kHz)
Touschek HER (68 kHz)
Touschek LER (273 kHz)
Beamgas HER (56 kHz)
Beamgas LER (219 kHz)
Radiative Bhabha Low ΔE(6974 kHz)

- **Background rates are somewhat lower w.r.t previous production. Main reason is the higher internal radius of the chamber**



ETD radiation level

R. Cenci

<u>All background sources included</u>

DCH, FTOF, FDIRC, EMC

Syst.	Location	rMin(cm)	rMax(cm)	zMin(cm)	zMax(cm)	TID(Gy)	NIEL(cm-2)	SEE(cm-2)
DCH	FEEZone0	23.6	40	-112.8	-112.8	7.69108	2.63079e+11	6.41147e+10
DCH	FEEZone1	40	60	-112.8	-112.8	6.61284	1.8293e+11	4.91622e+10
DCH	FEEZone2	60	81	-112.8	-112.8	4.42703	1.27754e+11	3.42023e+10
TOF	FEE	55	92	200	200	1.68779	1.09059e+11	2.14255e+10
DRC	BarCenter	81.7	89.3	-10	10	3.00009	1.14594e+11	1.2256e+11
DRC	FEE	103	155	-377	-342	0.678448	2.18521e+10	2.77301e+08
EMC	FwdFEE	70	110	216	236	0.928144	1.05235e+11	4.74704e+08
EMC	BrlFEE	120	120	-155	216	0.106681	2.26647e+10	2.35279e+08
EMC	BrlCtrFEE	120	120	-10	10	0.0158816	1.48401e+10	3.0782e+08

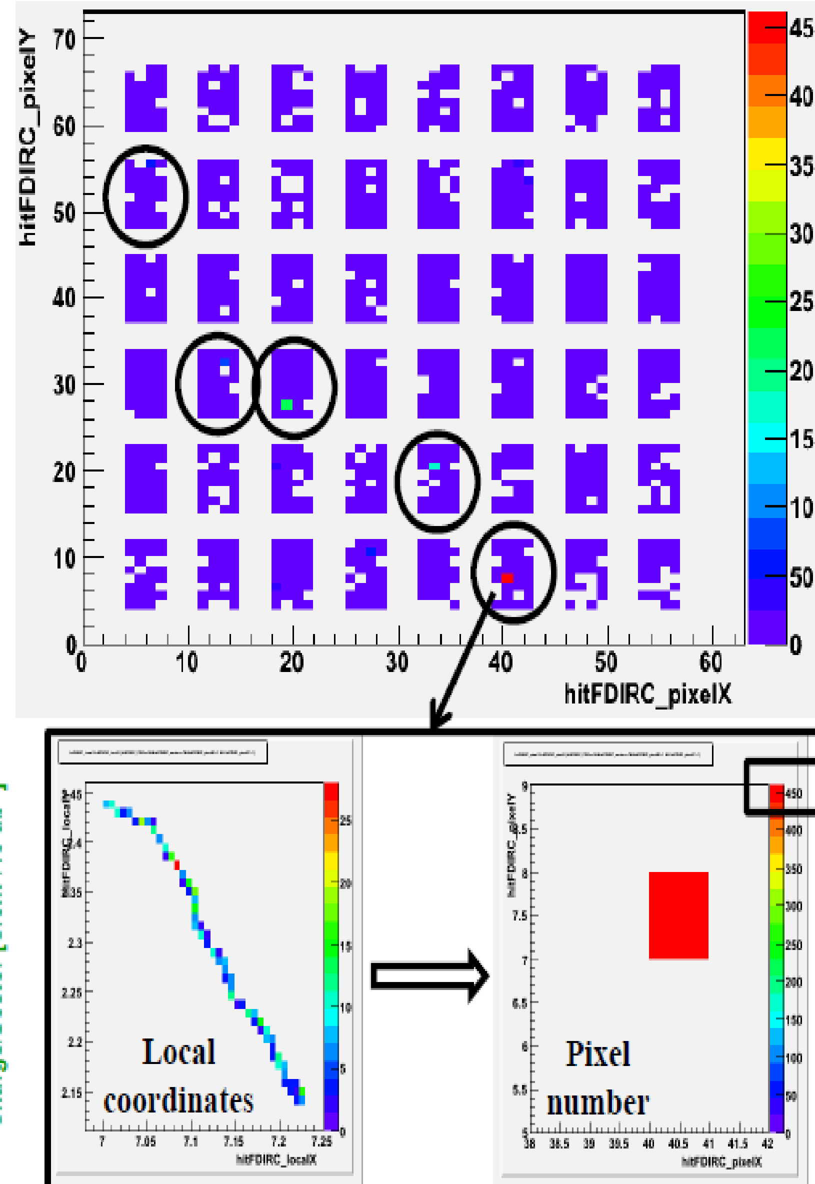
IFR and Detector Hall

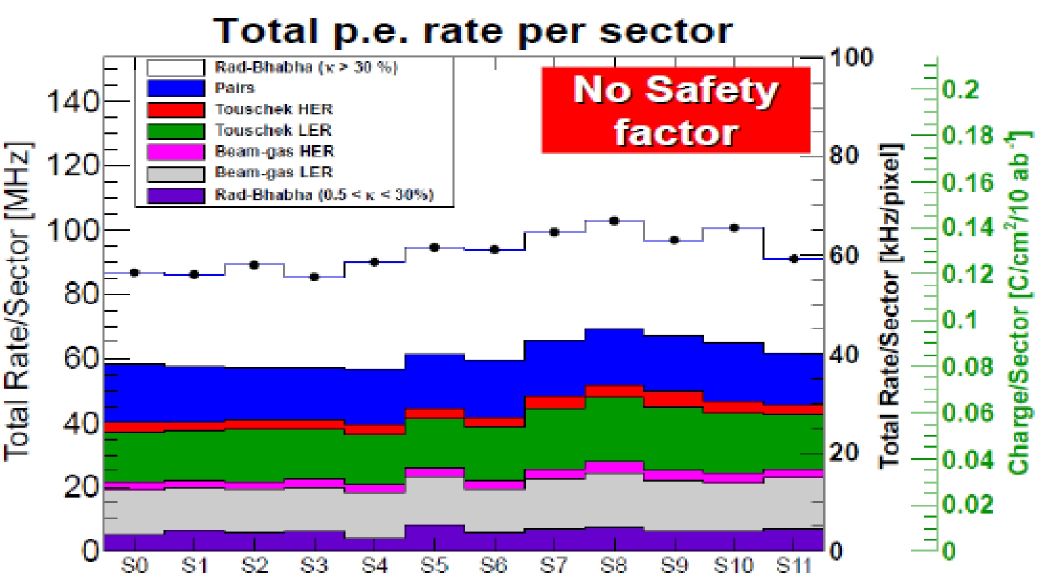
Syst.	Location	rMin(cm)	rMax(cm)	zMin(cm)	zMax(cm)	TID(Gy)	NIEL(cm-2)	SEE(cm-2)
IFR	FEEZone0Loc0	325.576	332.866	-281	-239	35.5415	3.14595e+10	5.24862e+08
IFR	FEEZone0Loc1	360.555	400.5	-281	-239	32.1066	2.75763e+10	3.96366e+08
IFR	FEEZone0Loc2	300	356.09	-281	-239	36.7237	2.73128e+10	5.24862e+08
IFR	FEEZone0Loc3	300.666	340.588	-281	-239	62.5895	3.92851e+10	1.02362e+09
IFR	FEEZone0Loc4	332.866	325.576	-281	-239	70.4446	4.26482e+10	8.60564e+08
IFR	FEEZone0Loc5	400.5	360.555	-281	-239	73.272	3.48311e+10	9.78856e+08
IFR	FEEZone0Loc6	356.09	300	-281	-239	64.7146	3.85524e+10	3.58052e+08
IFR	FEEZone1Loc0	325.576	332.866	-21	21	1.95322	2.66851e+09	2.86855e+08
IFR	FEEZone1Loc1	360.555	400.5	-21	21	0	0	0
IFR	FEEZone1Loc2	300	356.09	-21	21	3.03989	2.97994e+09	0
IFR	FEEZone1Loc3	300.666	340.588	-21	21	3.17473	7.62869e+08	0
IFR	FEEZone1Loc4	332.866	325.576	-21	21	3.74495	1.62685e+09	0
IFR	FEEZone1Loc5	400.5	360.555	-21	21	0	0	0
IFR	FEEZone1Loc6	356.09	300	-21	21	3.01123	1.74442e+09	0
IFR	FEEZone2Loc0	325.576	332.866	239	281	22.7479	2.68286e+10	4.78091e+08
IFR	FEEZone2Loc1	360.555	400.5	239	281	21.8372	1.72995e+10	7.16098e+08
IFR	FEEZone2Loc2	300	356.09	239	281	20.5691	2.21623e+10	4.29244e+08
IFR	FEEZone2Loc3	300.666	340.588	239	281	54.1005	3.9675e+10	1.28773e+09
IFR	FEEZone2Loc4	332.866	325.576	239	281	35.2387	2.89157e+10	6.44904e+08
IFR	FEEZone2Loc5	400.5	360.555	239	281	49.7229	3.39024e+10	9.21228e+08
IFR	FEEZone2Loc6	356.09	300	239	281	40.7733	3.41487e+10	8.01186e+08

FDIRC backgrounds

A. Pérez
N. Arnaud

- Closer look (N. Arnaud) to previous production samples revealed strange events with many hit in a single pixel
- Problem was a miss-modelling of the MaPMT photocatode (BK7 glass)
- Fix: Material changed to aluminium
- Fix not in time for Summer production but samples could be used applying a patch

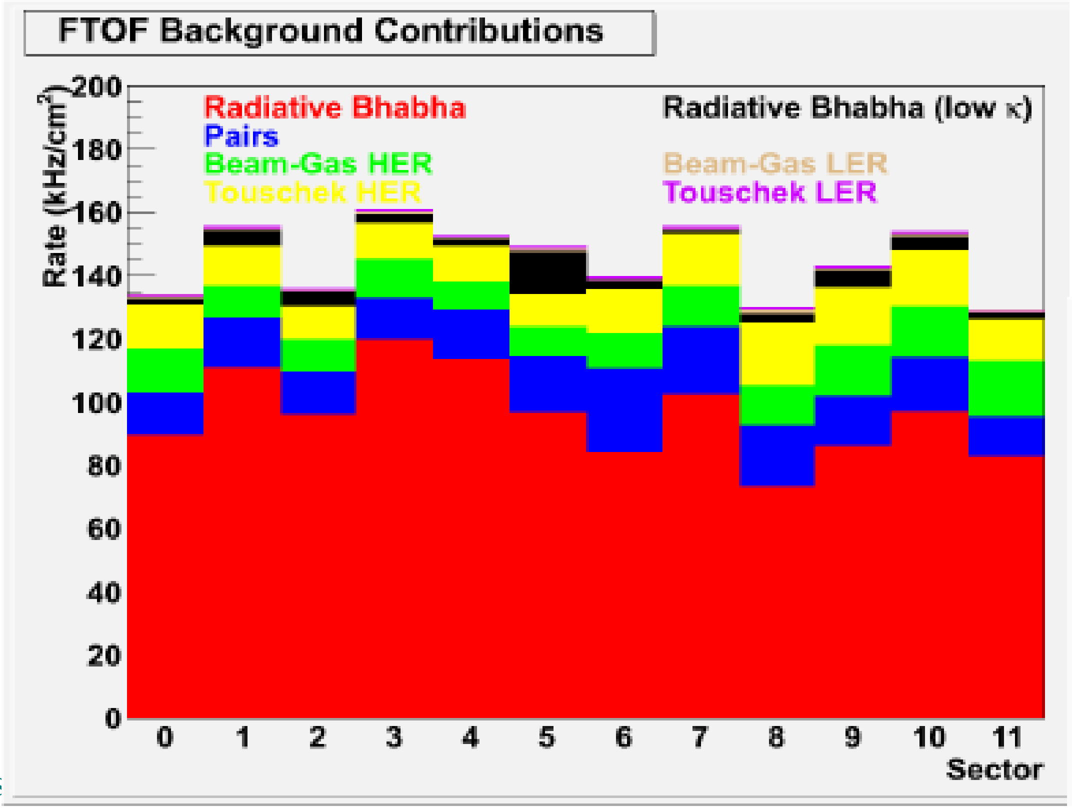




FTOF backgrounds

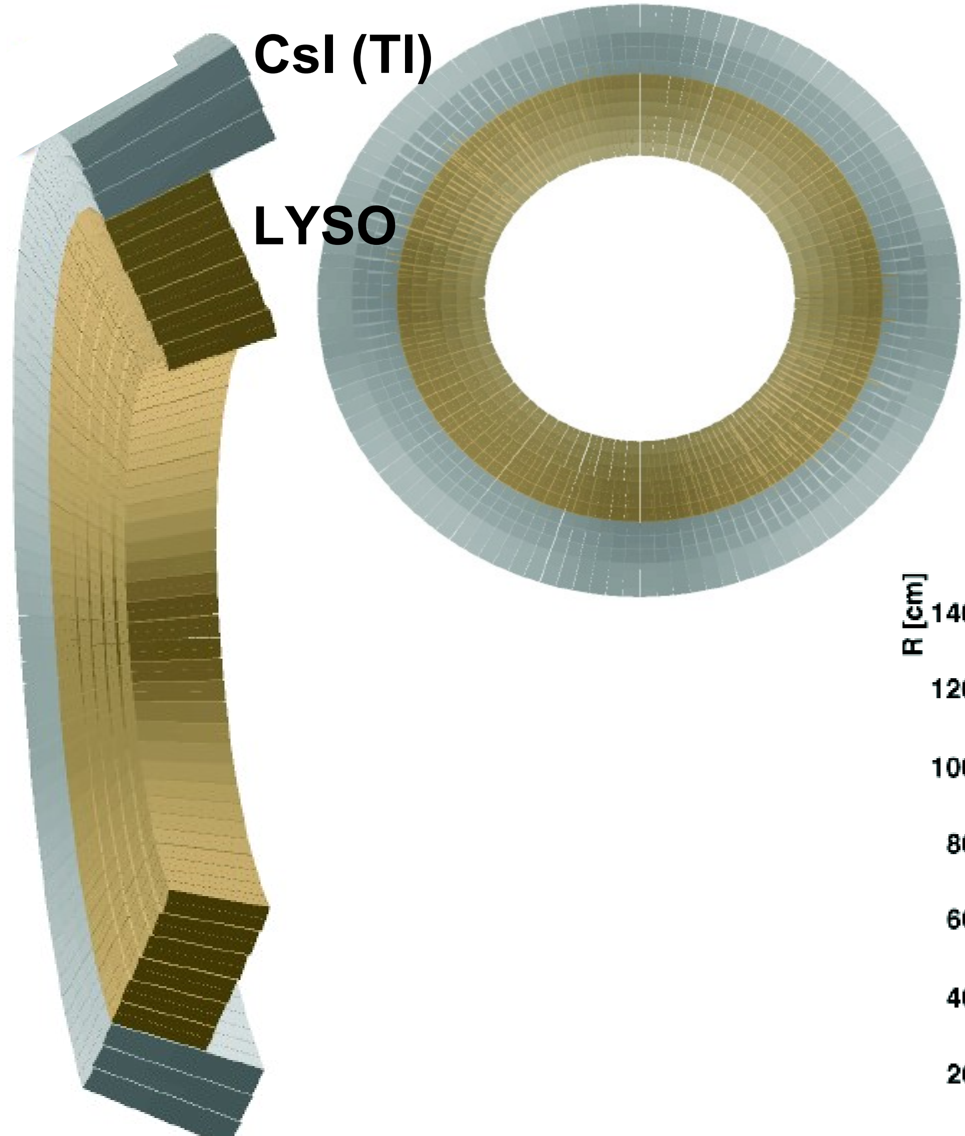
N. Arnaud

- Quick look to the samples for FTOF background studies
- Rad-bhabha is the dominant source
- Reasonable levels of background are obtained
- Space available for FTOF is better known => simulation will be modified in the near future
- Will give a closer look on the origin of the backgrounds soon

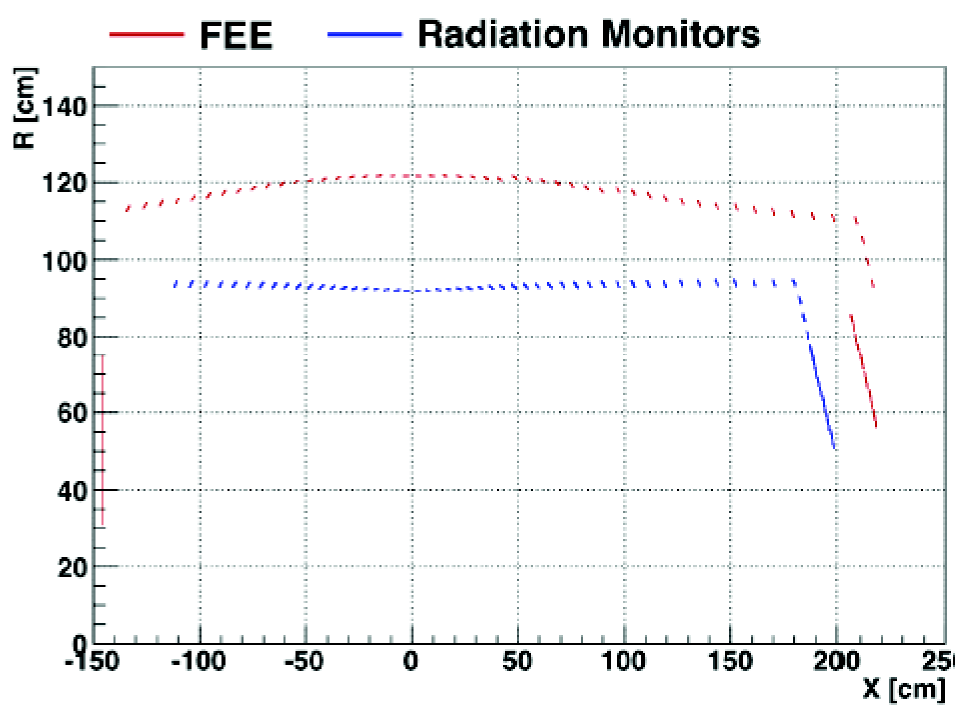


EMC backgrounds (I)

S. Germani



- New Fwd-end-cap geometry: Hybrid CsI(Tl)+LYSO
- Radiation monitors added in between the from part of the crystals



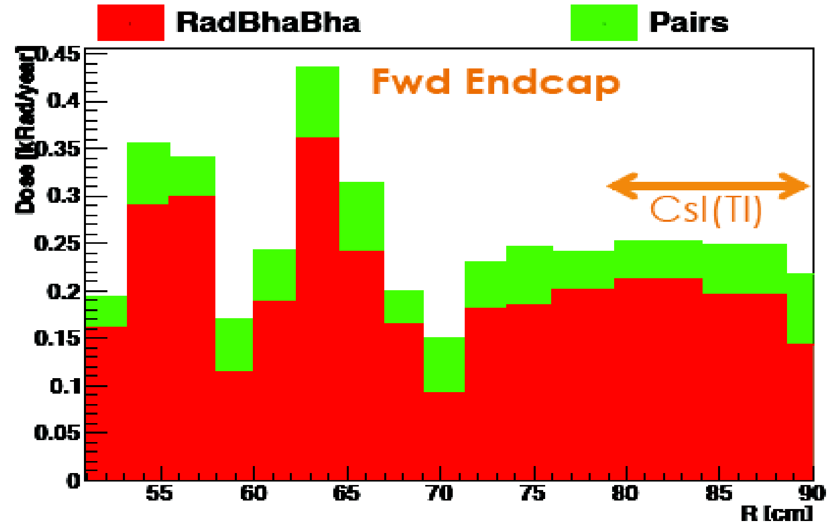
EMC backgrounds (II)

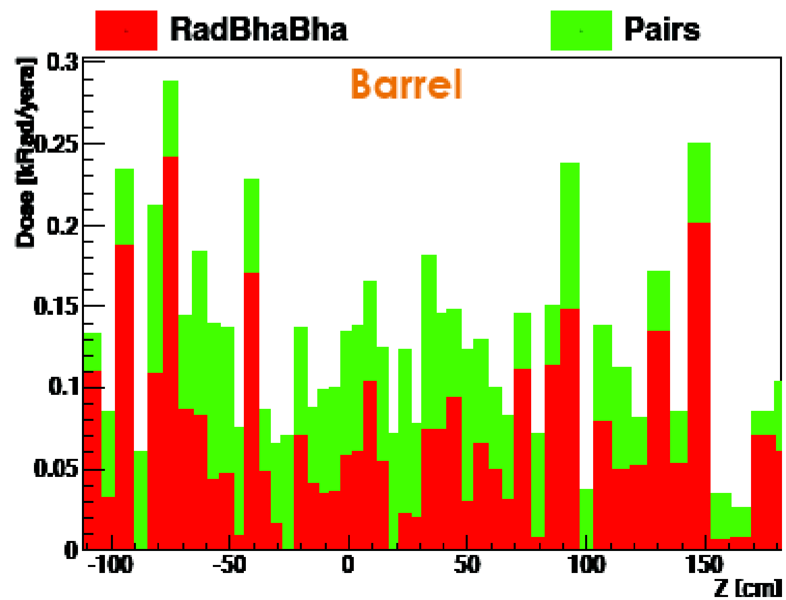
S. Germani

Rad. Monitors

- BaBar
  - 1 Rad/h @10^{36} → 2.78 kRad/year
  - Radiation test reached 10 kRad → 75 % LY
- SuperB (Pairs+RadBhaBha)
  - Backward Barrel ~ 0.135 kRad/year
  - Central Barrel ~ 0.123 kRad/year
  - Forward Barrel ~ 0.116 kRad/year
  - CsI Endcap Part ~ 0.239 kRad/year

  - Used in extrapolation 0.25 kRad/year
  - 10 year running dose < BaBar radiation test (10 kRad)





- SuperB seems to have 1/10 of Dose vs Int. Lumy w.r.t. BaBar

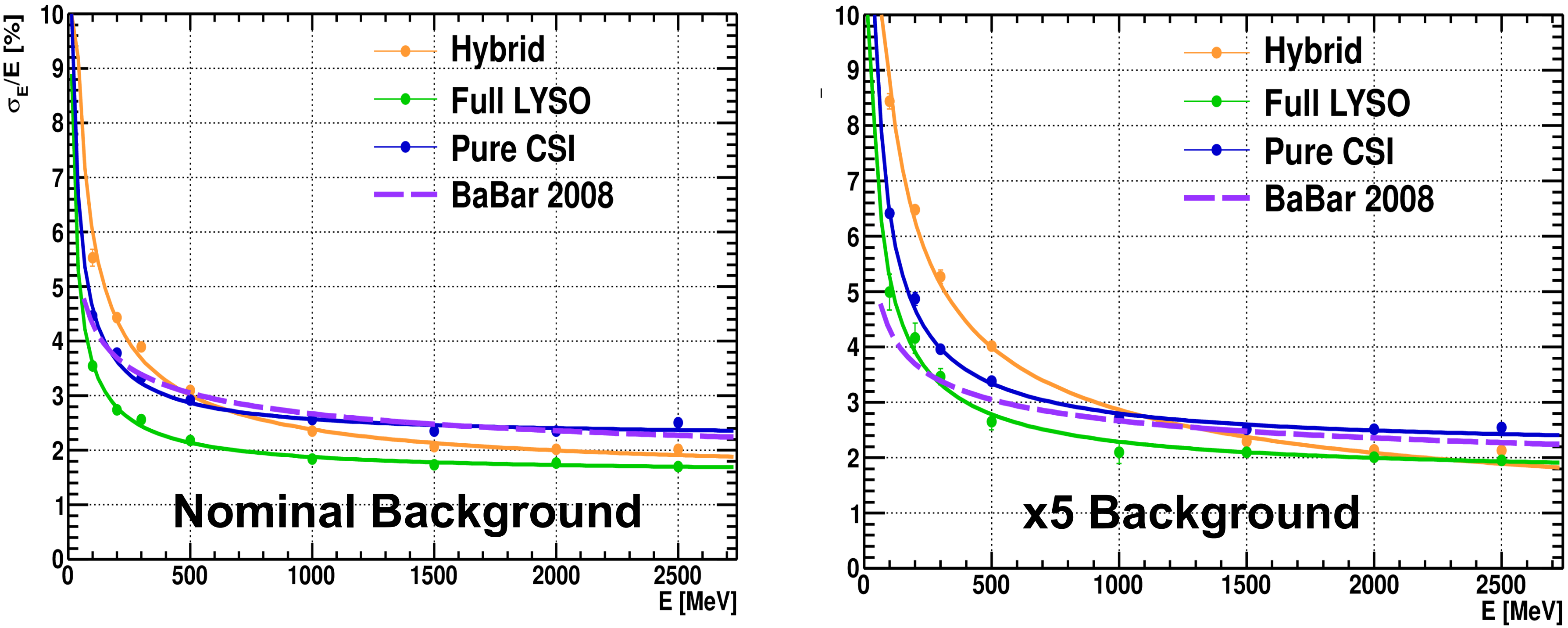
- Wants to run a short production without W-shield to understand the reason

EMC backgrounds (III)

S. Germani

- Hybrid solution is baseline of TDR => tolerable degradation of resolution with x5 backgrounds
- Other solutions are still considered as an option
- Still need to understand the noise level

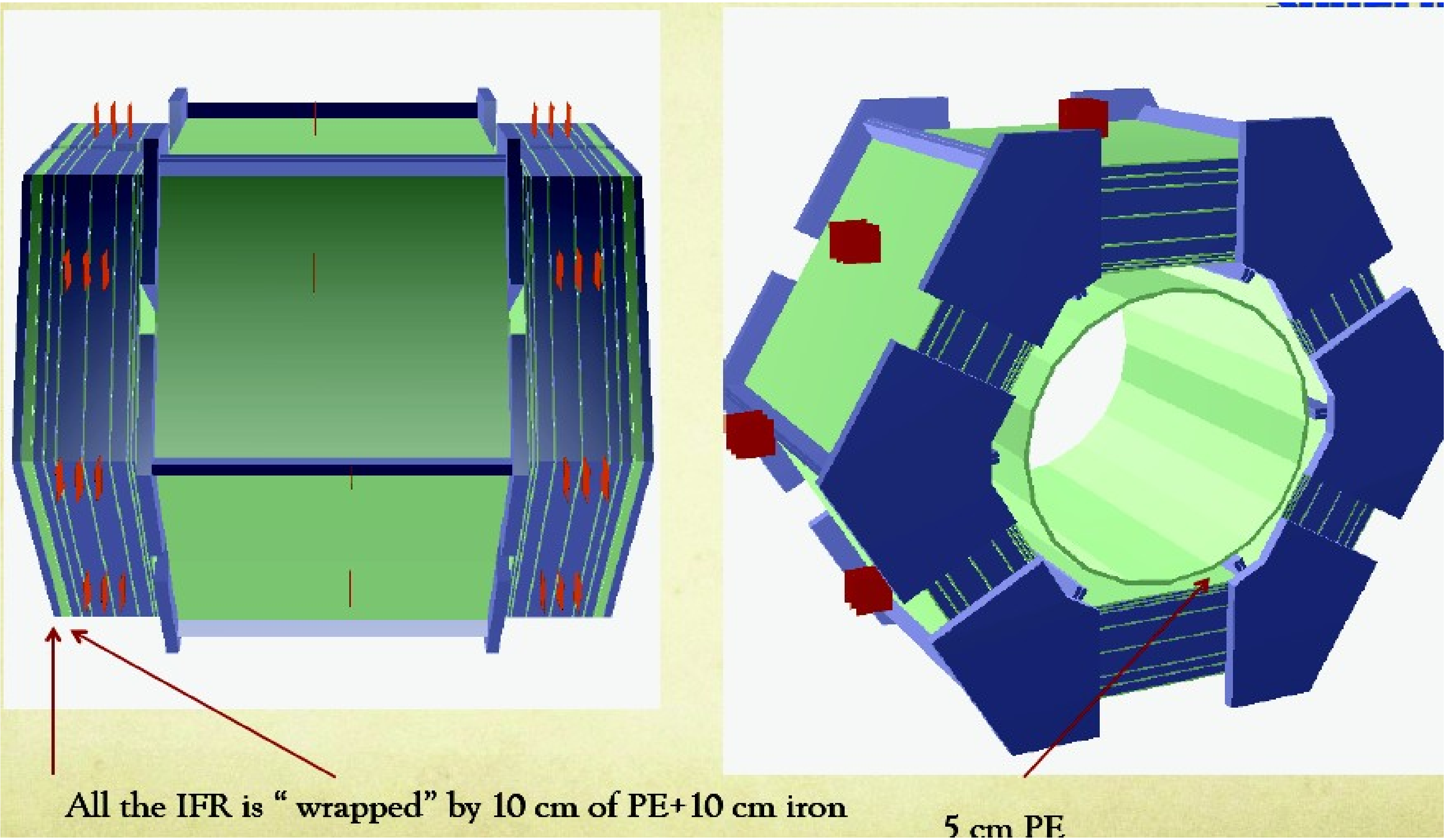
Rad-bhabha Only



IFR backgrounds (I)

V. Santoro

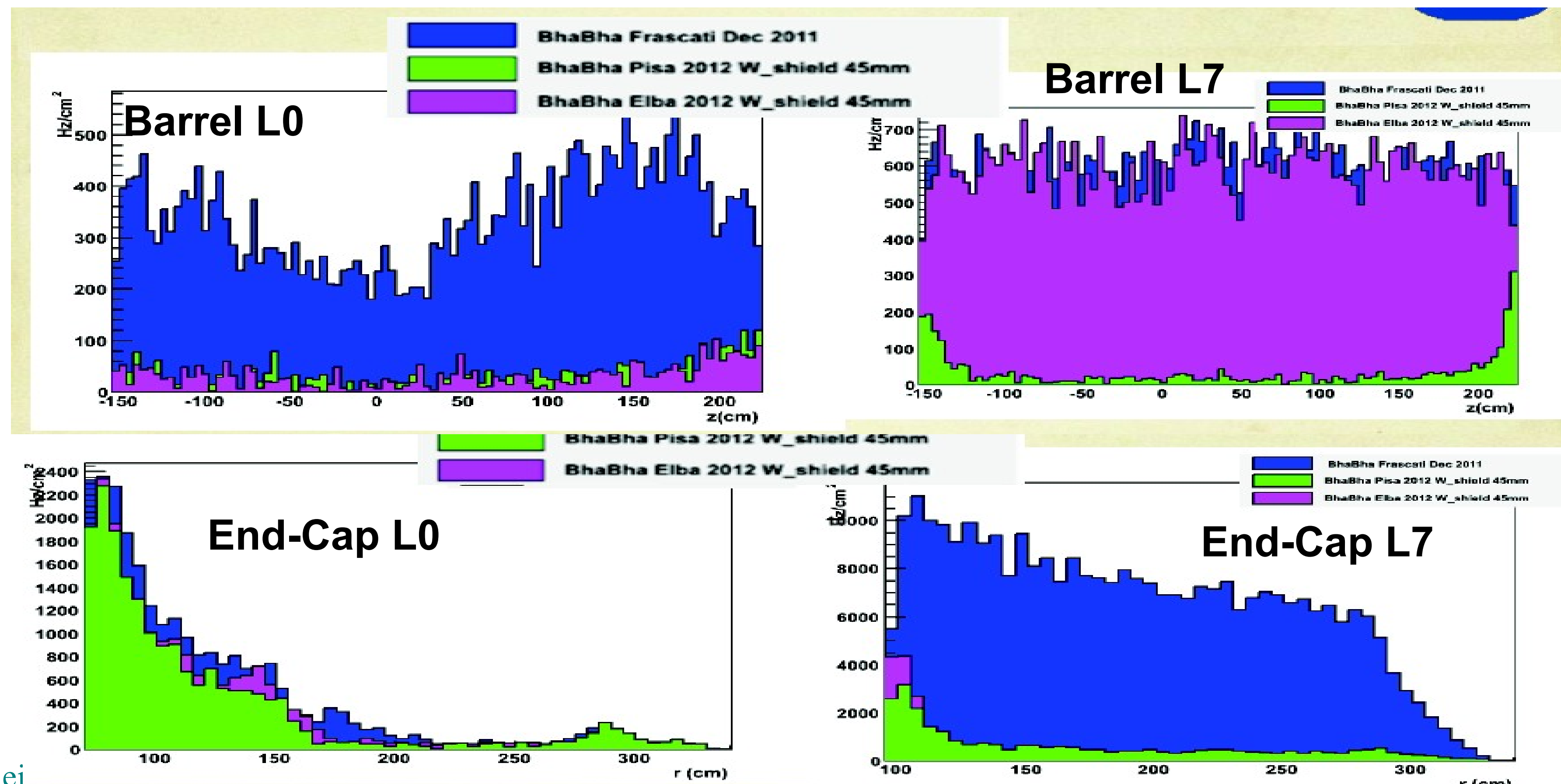
- **New Iron-polyethylene shield configuration on barrel and end-caps**



IFR backgrounds (II)

V. Santoro

- Significant reduction of neutron flux from Rad-bhabha with new shields
- Current levels background (x safety factor) seem tolerable
- These simulations suggest that this scheme provides enough reduction of the backgrounds but mechanical implementation of the shields could be tricky => Plan to do some more studies



Pending Issues and future activities

- **Pending issues:**
  - TDR writing!!!
  - Budged and scheduling
- **Future activities:**
  - Simulation of the SR from non-gaussian tails
  - Simulation of next final focus layout and lattice
  - Neutron shields around the detector hall

Summary

- **Ongoing work on final focus and ring lattice including the detector solenoid**
- **Rad-monitors design progresses reported**
- **A very complete set of background samples have been analysed**
  - Rad-bhabha (low and high κ)
  - Pairs
  - Touschek and BeamGas (HER/LER)
  - Synchrotron Radiation (HER/LER)
- **Many useful results with latest production**

Many thanks to the Computing team that made this fullsim production possible with the hard work during the during the holidays

- A. Fella

- C. De Santis

- M. Manzali

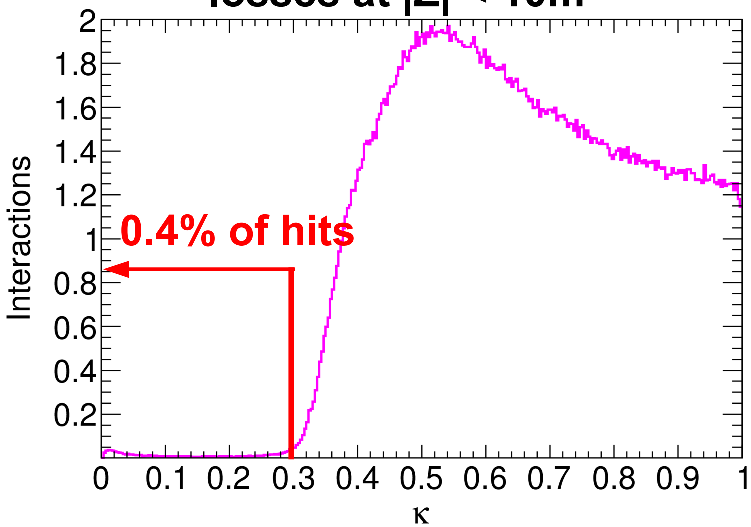
- R. Stroili

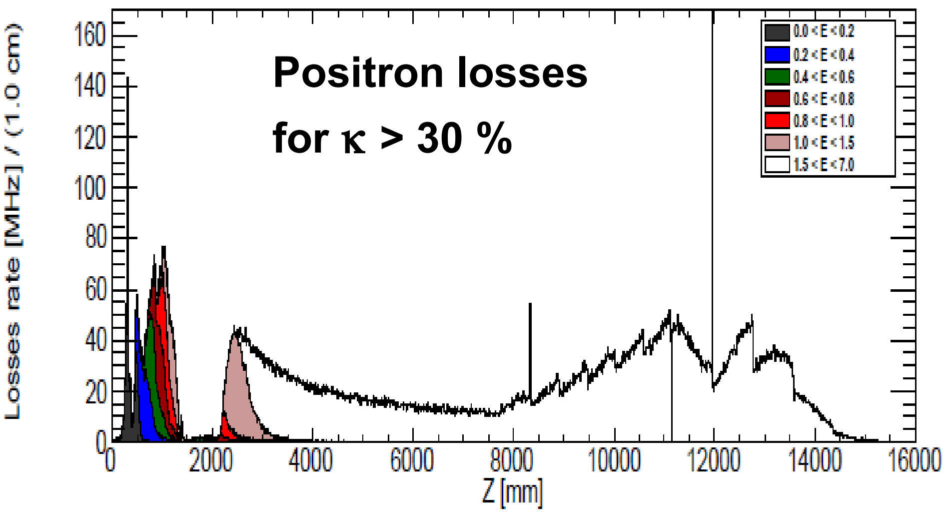
Backup

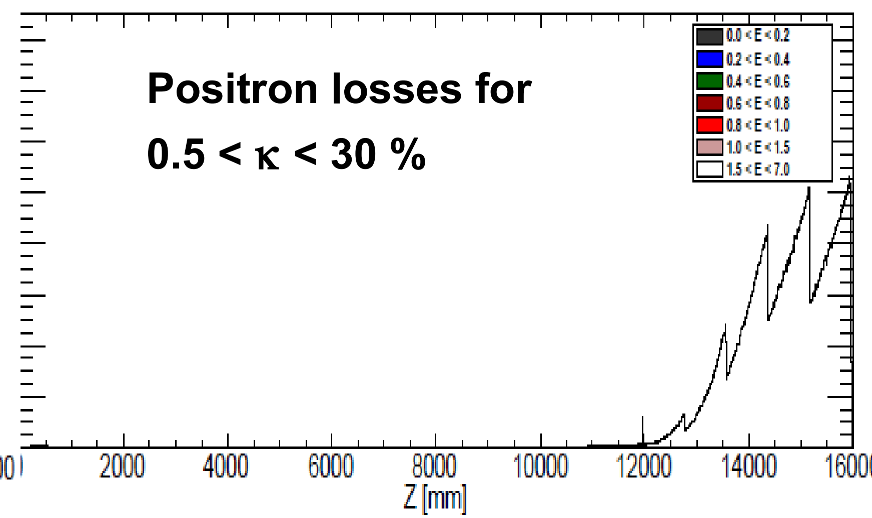
The machine background model: low κ Rad-Bhabha

- **κ > 30% gives the main component of Rad-bhabha losses for |Z| < 10m (hits with κ > 30% are ~0.4% of total).**
- Photons and leptons for from Rad-bhabha with 0.5 < κ < 30% can hit the beam pipe at the far dipoles (|Z| > 10m) and contribute to the neutron cloud
- Expect only non-negligible contributions on the IFR and on the Detector hall transmission lines

κ distribution for lepton losses at |Z| < 10m

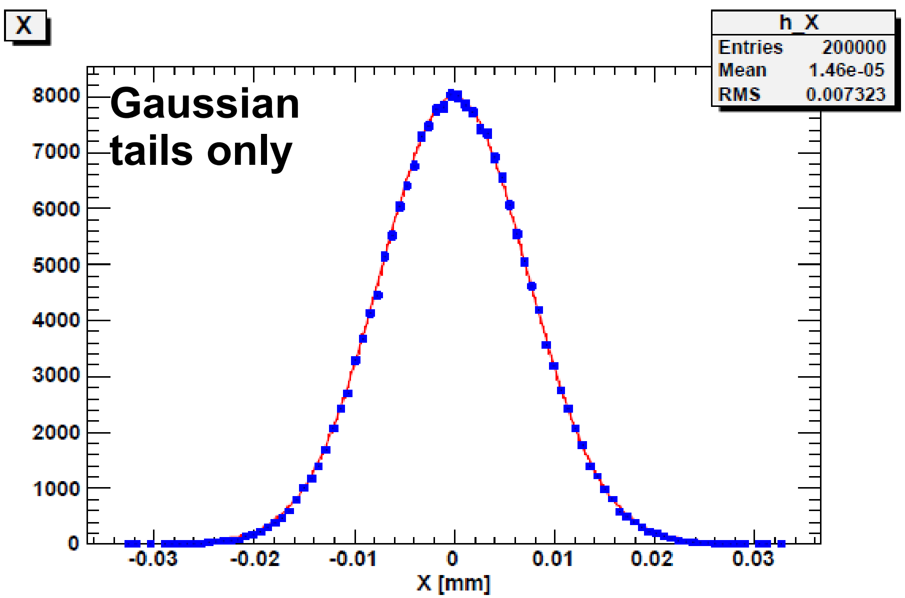


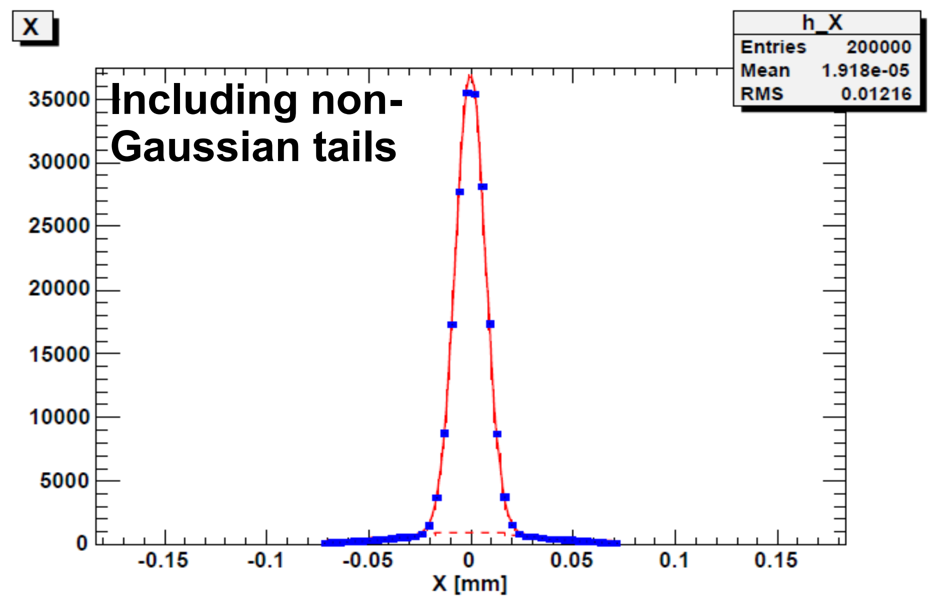




Synchrotron Radiation: strategy

- **3 stages code:**
  - Stage 1: use the IP parameters of the beams to generate primaries for HER/LER. Invert momentum and charge and backtrack particles up to the 2nd dipoles upstream the beam-line
  - Stage 2: at this point re-invert the momentum and charge and foward-track the particles turning-on the Synchrotron radiation
  - Stage 3: use as primaries for the simulation those photons that eventually hit the beam pipe
- **Can include non-gaussian tails from Touschek/Beam-Gas by adding 2 gaussian functions: core + tails. Can also move the location of the IP**
- **Summer 2012 production used gaussian tails only**





Drift of the monocrystal diamond