Update on Background Rates using Bruno simulation

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SuperB Collaboration Meeting, Elba, ITALY - Bkg Parallel Session

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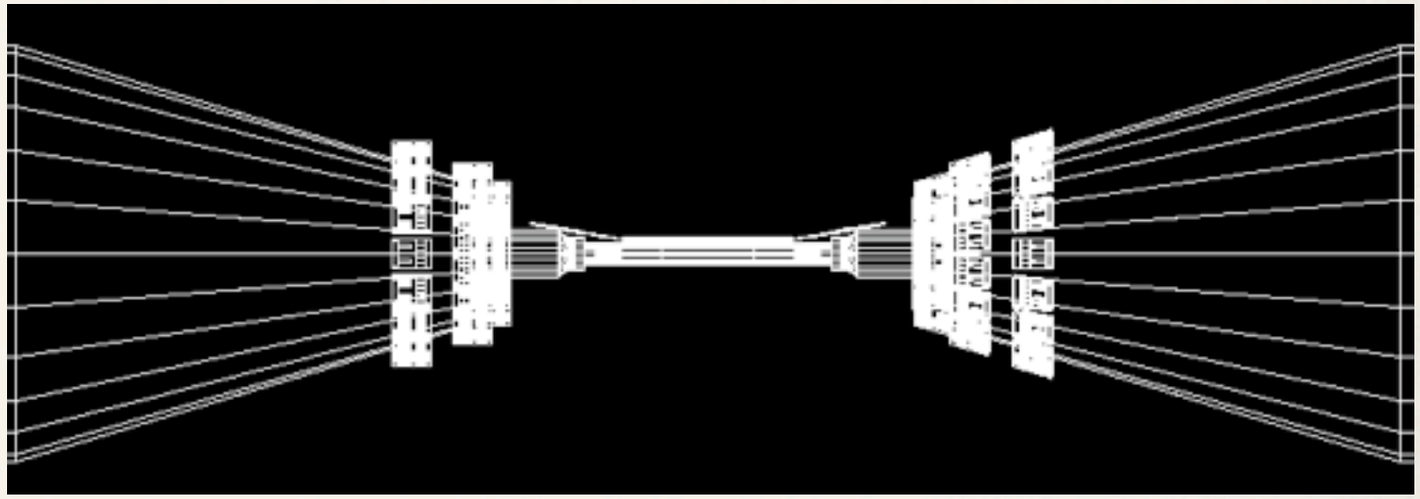
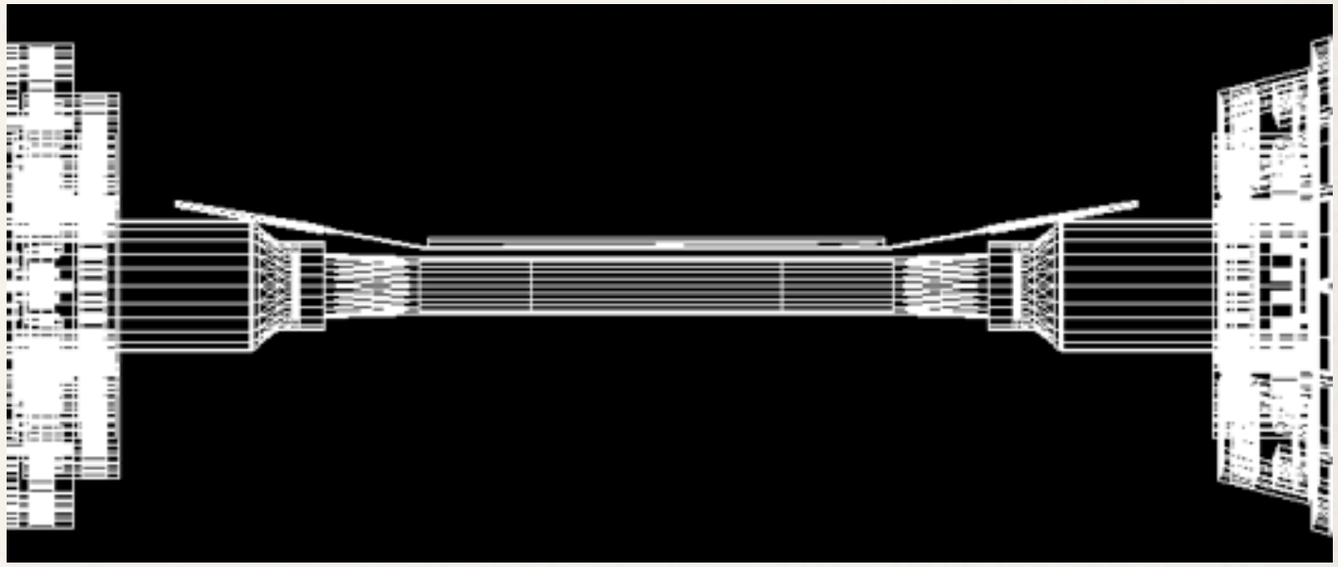
SVT striplets geometry

- **Not to be used for the next production**
- GDML version is **ready** and tested for overlaps
- Based on Geometry_CIPE_V00-00-02 revision 359, tag for V00-00-05
- Beampipe and final focus modifications were easy
- Tungsten shielding is completely symmetric wrt IP

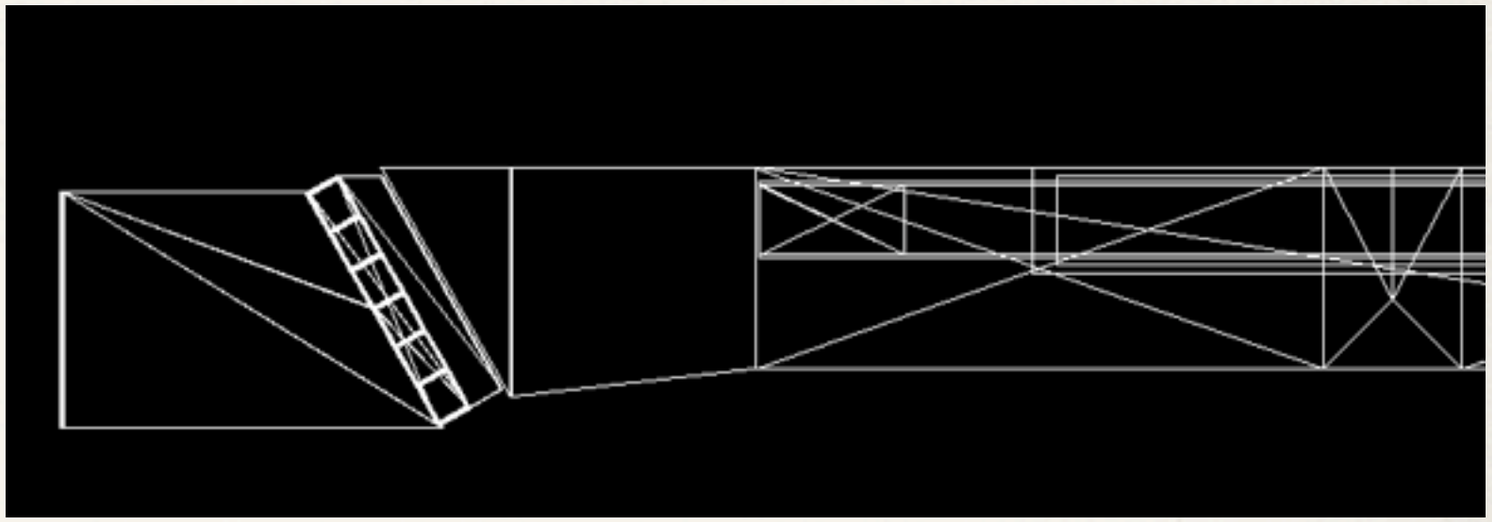


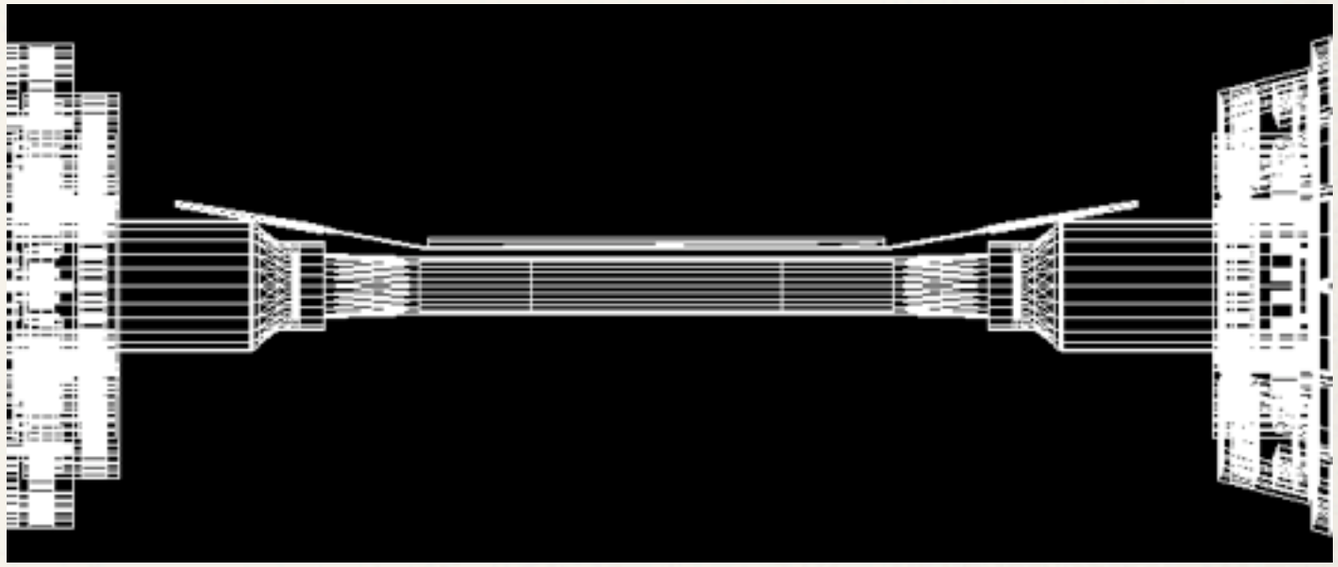


- Relevant changes on how container volumes are implemented but no changes to the internal volumes of the final focus (apart for the beampipe and shortened split pipes)
- **IMPORTANT**: RadMon need to be re-inserted

SVT striplets geometry

- **Not used for the May production**
- Svt L0 striplets plus electronics by F. Bosi
  - Si[200um] (0.2 X0)
  - FanOut x 2, Si[40um]-Kapton [50um]-Si[40um] (0.21 X0)
- Materials can be easily changed, but total X0 is correct
- Carbon fiber support (only ribs over the active silicon), fanout tails, hydrids, FEE chips





- Missing parts for L0: carbon fiber supports over the hybrids, buttons
- Outer layers: some support parts have been removed due to overlaps, FEE moved out closer to the updated position but silicon is still like in Babar
- Matching cards: monitor volume moved to the correct position (according last drawings)

New Productions

- 2012 official productions (**thicker tungsten shielding**):
  - **2photons** (~100k evts, 372us) solenoidal field limited in z, **±40 cm**
  - **RadBhabha** (~10k evts, 37us)
  - **Touschek**: (~87k evts HER, ~198k LER, weighted evts)
  - **Beamgas** (~284k evts HER, ~282k evts LER, weighted evts)
- 2012, additional productions:
  - **RadBhabha** (~10k evts, 37us) old tungsten shielding
  - **RadBhabha** (~10k evts, 37us) CSI, only for EMC studies

Rate comparison, updated

SVT

- No major changes
- Beamgas LER not ready yet but expected as Touschek LER
- Beamgas HER -30%, Touschek LER -20%

LAYERS	2photons		Bbbrem		Touschek HER		Touschek LER		BeamgasHER		Beamgas LER
MHz/cm^2	01/2012	05/2012	12/2011	05/2012	12/2011	05/2012	12/2011	05/2012	03/2012	05/2012	05/2012
L0 phi	29.4	30.1	0.87	0.83	0.57	0.62	1.91	1.70	0.635	0.47	
L0 z	37.2	38.1	1.42	1.58	1.71	1.94	5.06	4.73	1.72	1.37	
L1 phi	1.56	1.60	0.12	0.13	0.20	0.19	0.81	0.67	0.24	0.16	
L1 z	0.74	0.76	0.077	0.08	0.22	0.20	0.869	0.69	0.26	0.18	
L2 phi	0.78	0.81	0.078	0.079	0.135	0.135	0.61	0.51	0.16	0.12	
L2 z	0.40	0.41	0.059	0.056	0.158	0.15	0.68	0.55	0.19	0.13	
L3 phi	0.14	0.15	0.047	0.049	0.031	0.035	0.20	0.165	0.045	0.029	
L3 z	0.13	0.14	0.051	0.055	0.061	0.057	0.32	0.255	0.072	0.048	
L4 phi	0.022	0.027	0.0135	0.013	0.005	0.0042	0.021	0.014	0.027	0.0035	
L4 z	0.014	0.019	0.0078	0.0081	0.004	0.0031	0.014	0.010	0.018	0.0026	
L5 phi	0.012	0.016	0.0057	0.0062	0.0024	0.0020	0.0094	0.0070	0.0027	0.0015	
L5 z	0.0082	0.011	0.0038	0.0039	0.0018	0.0015	0.007	0.0054	0.0020	0.0012	

Radiation dose on Electronics

SVT

- Max dose accumulated after integrating 10 ab^{-1}

Max. Dose (krad)	0	1	2	3	4	5	Card
Pairs	**336**	**55**	**55**	**23.7**	**7.0**	**3.2**	**0.8**
RadBhabha	**47.7**	**10.2**	**12.4**	**15.3**	**6.5**	**1.15**	**0.5**
Touschek HER	**46.4**	**11.6**	**13.1**	**6.3**	**1.76**	**0.62**	**0.18**
Touschek LER	**142**	**38.0**	**49.3**	**23.6**	**3.9**	**1.8**	**0.7**
Beam-gas HER (old)	59.3	15.3	17.2	7.74	2.41	0.8	0.26
Beam-gas LER	**123**	**33**	**41**	**19**	**3.5**	**1.56**	**0.65**
TOTAL	**754**	**163**	**188**	**96**	**25**	**8**	**3.1**

TOTAL (old)	838	154	182	145	64.6	15

No BeamgasLER

Dch Rate

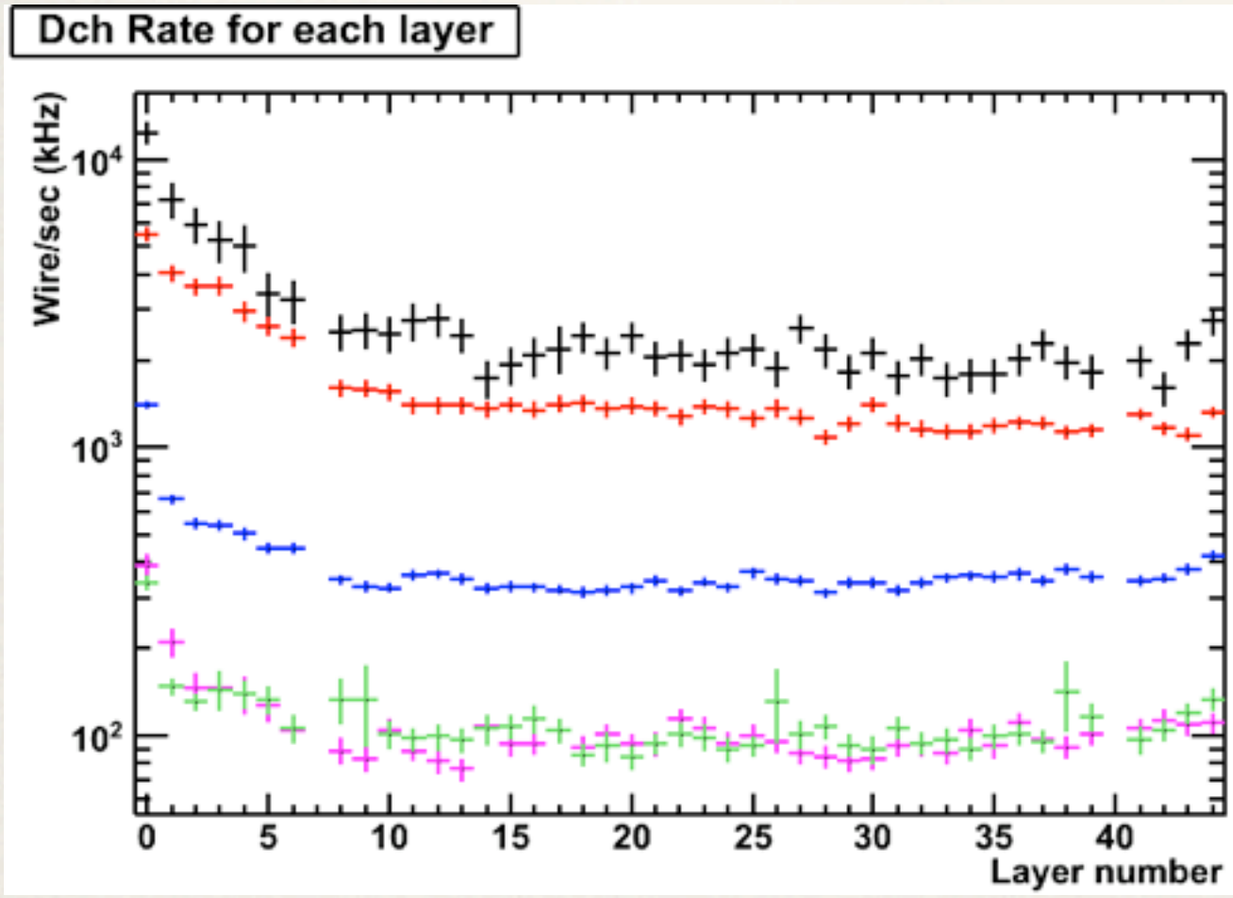
DCH

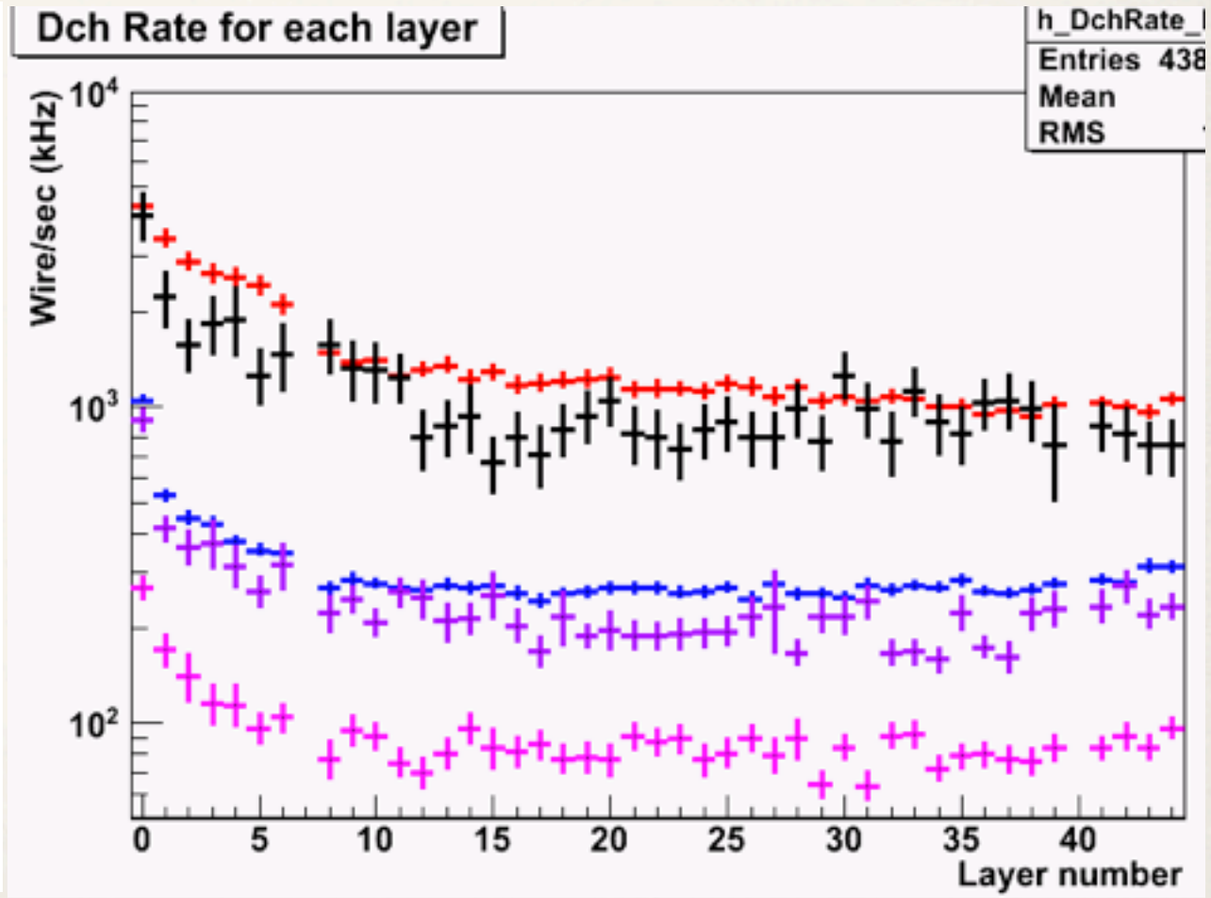
Contributions (Avg. rate)
Radiative Bhabha (2784 kHz)
2photons (1672 kHz)
Touschek LER (393 kHz)
Touschek HER (109 kHz)
Beamgas HER (114 kHz)

OLD

Contributions (Avg. rate)
Radiative Bhabha (1111 kHz)
2photons (1431 kHz)
Touschek LER (306 kHz)
Touschek HER (92 kHz)
Beamgas HER (xxx kHz)
Beamgas LER (244 kHz)

NEW





Dch Rate, stereo

- Updated table, including normalization correction

Avg. Rate [kHz](Occ.)	Axial01	SuperB01	SuperB02
Pairs	**1431**	**1613**	**1792**
RadBhabha	**1111**	**1410**	**1645**
Touschek HER	**92**	**117**	**140**
Touschek LER	**306**	**374**	**440**
Beamgas HER (old)	114	144	177
Beamgas LER	**244**	**291**	**342**
TOTAL	**3298**	**3949**	**4536**
TOTAL (old)	**4403**	**5721**	**6810**

No BeamgasLER

Dch Electronics

- 3 silicon plates behind the backward endplate to simulate the electronics
- Increased tungsten shielding cut half of the dose, mostly from reducing contribution from Radiative Bhabha

Dose [krad] (1y)	Plate 1	Plate 2	Plate 3
Pairs	**0.11**	**0.098**	**0.097**
RadBhabha	**0.16**	**0.18**	**0.22**
Touschek HER	**0.0035**	**0.0027**	**0.0024**
Touschek LER	**0.12**	**0.128**	**0.148**
Beamgas HER (old)	0.005	0.004	0.002
Beamgas LER	**0.09**	**0.10**	**0.11**
TOTAL	**0.49**	**0.51**	**0.58**
TOTAL (old)	**1.01**	**1.13**	**1.37**

Simulated radiation level

- Request from ETD to have coherent map of radiation level for various locations of the detector
- Modeled after Atlas radiation tolerance criteria

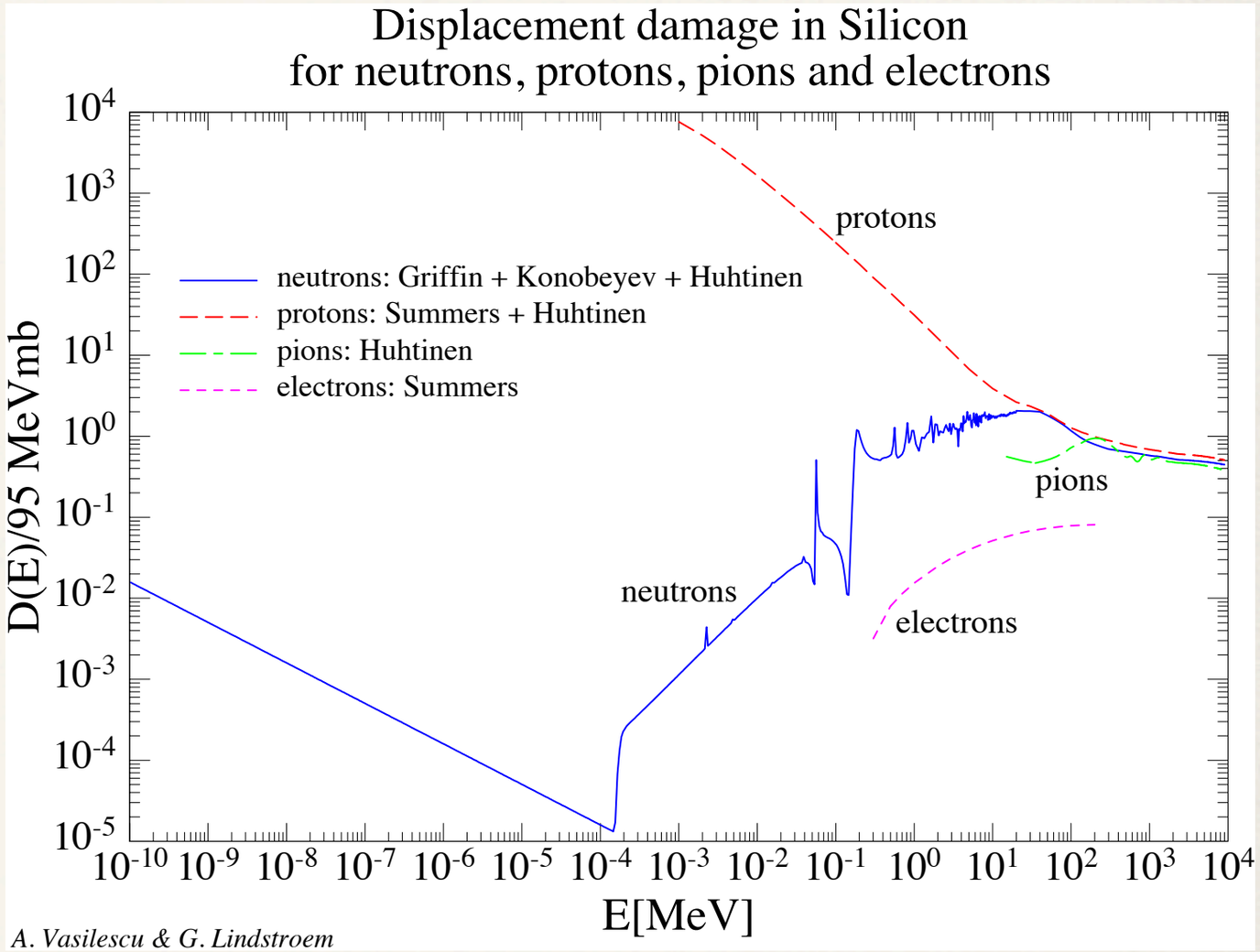
Simulated Radiation Level	**Type of Radiation Constraint**	**SRL Unit**
SRL_{tid}	Particles producing ***TID*** (Total Ionising Dose). Example: photons.	Total Dose in 10 years: ***Gray***
SRL_{niel}	Particles producing ***NIEL*** (Non-Ionising Energy Loss). Example: neutrons.	Total Fluence in 10 years: ***1 MeV eq. neutron.cm^{-2}***
SRL_{see}	Particles producing ***SEE*** (Single Event Effects). Example: heavy fragments.	Total Fluence in 10 years: ***> 20 MeV hadron.cm^{-2}***

From Atlas document

Table 1: Definition of the three types of simulated radiation levels

Simulated radiation level

- How quantities are computed:
  - **Dose (TID):**
    - total released energy in the sensitive volume divided by the weight
  - **Equivalent 1 MeV neutron flux (NIEL)**
    - each particle that cross the sensitive volume is weighted according the incident angle and using a conversion table (particle type and kinetic energy)
- **Hadron Flux (SEE)**
  - flux of hadrons (proton, neutron, ions) with kinetic energy greater than 20 MeV

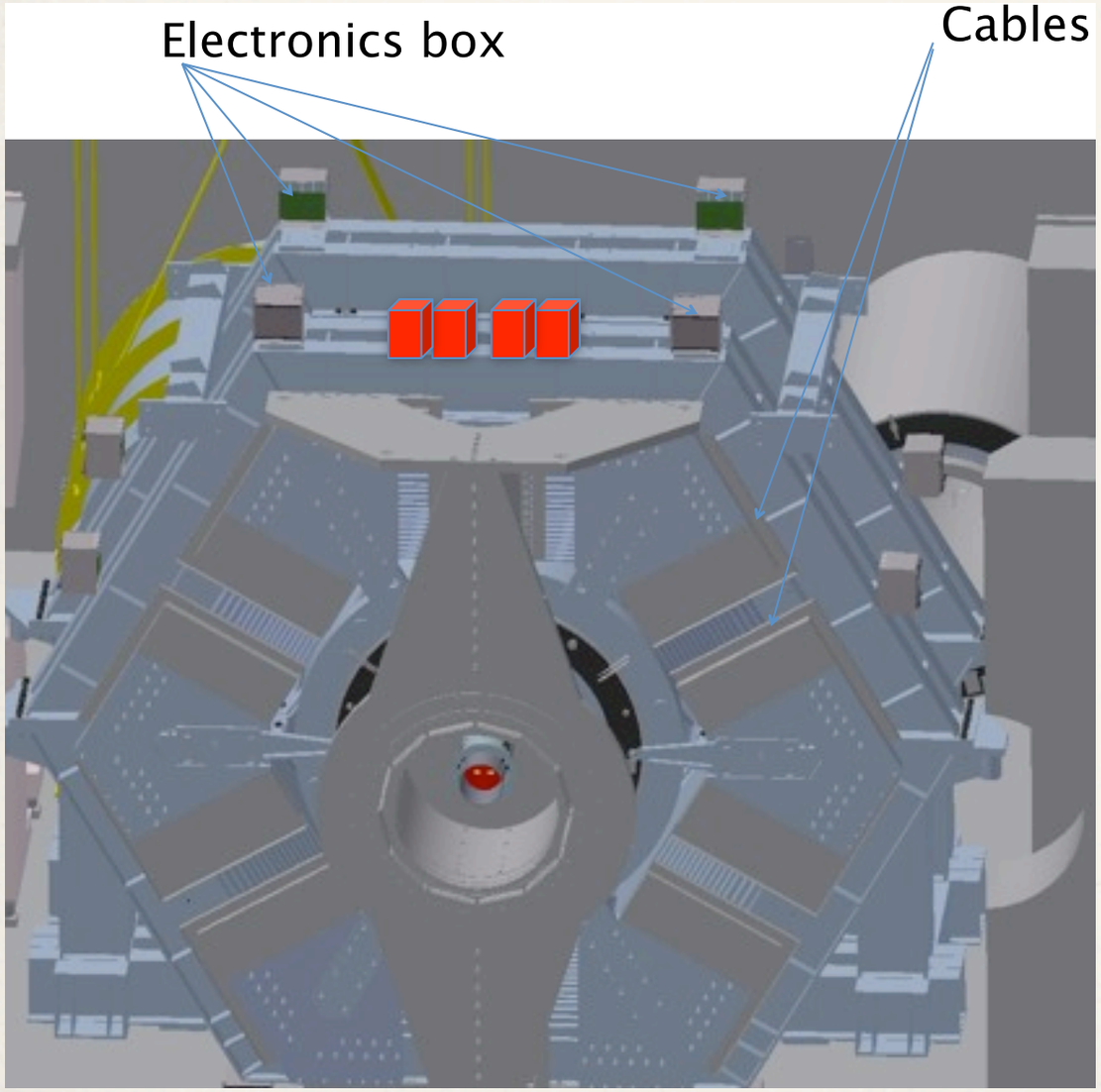


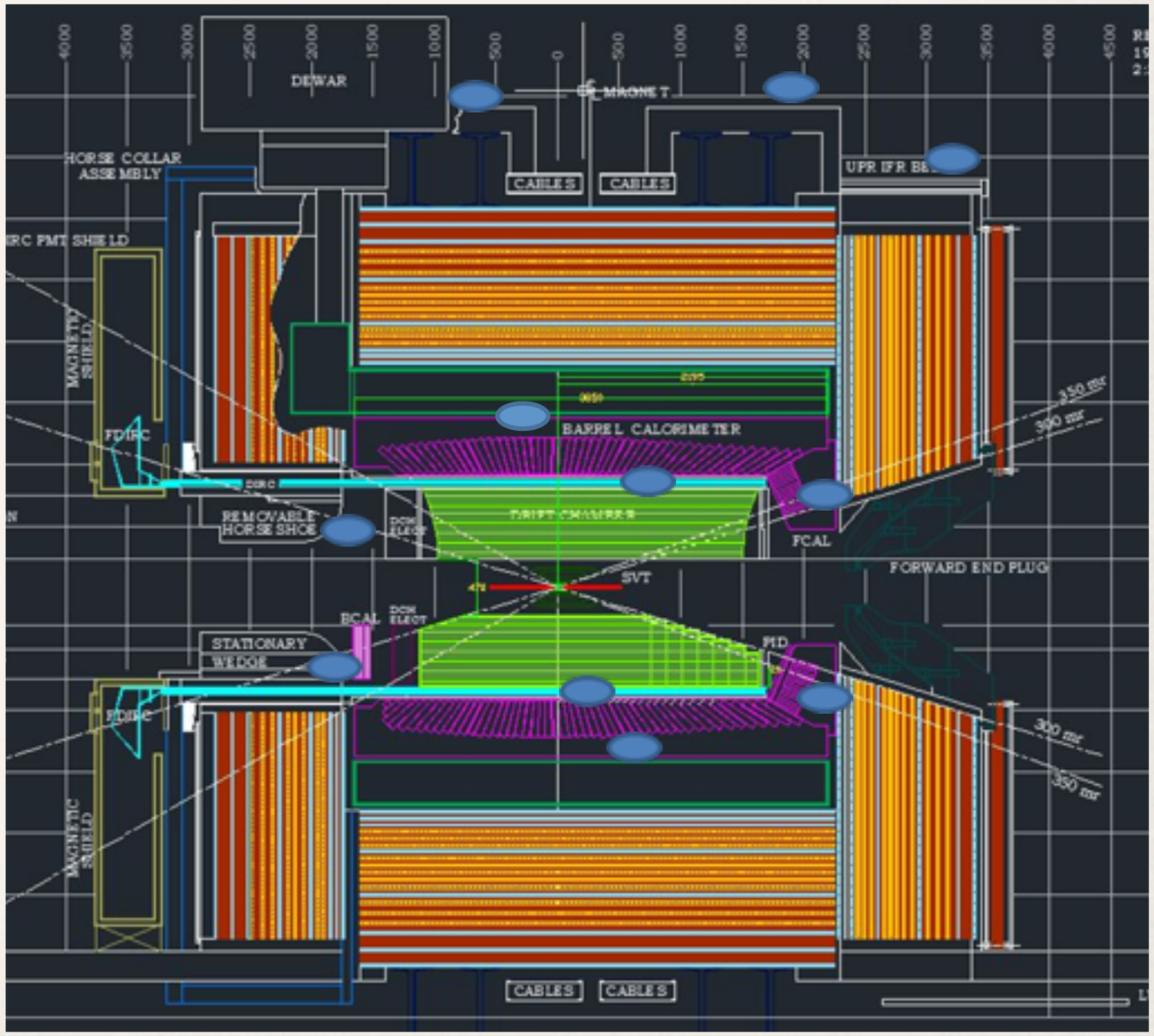
Http://sesam.desy.de/members/gunnar/Si-dfuncs.html

- For most of the locations the value is integrated over phi (measured over rings)

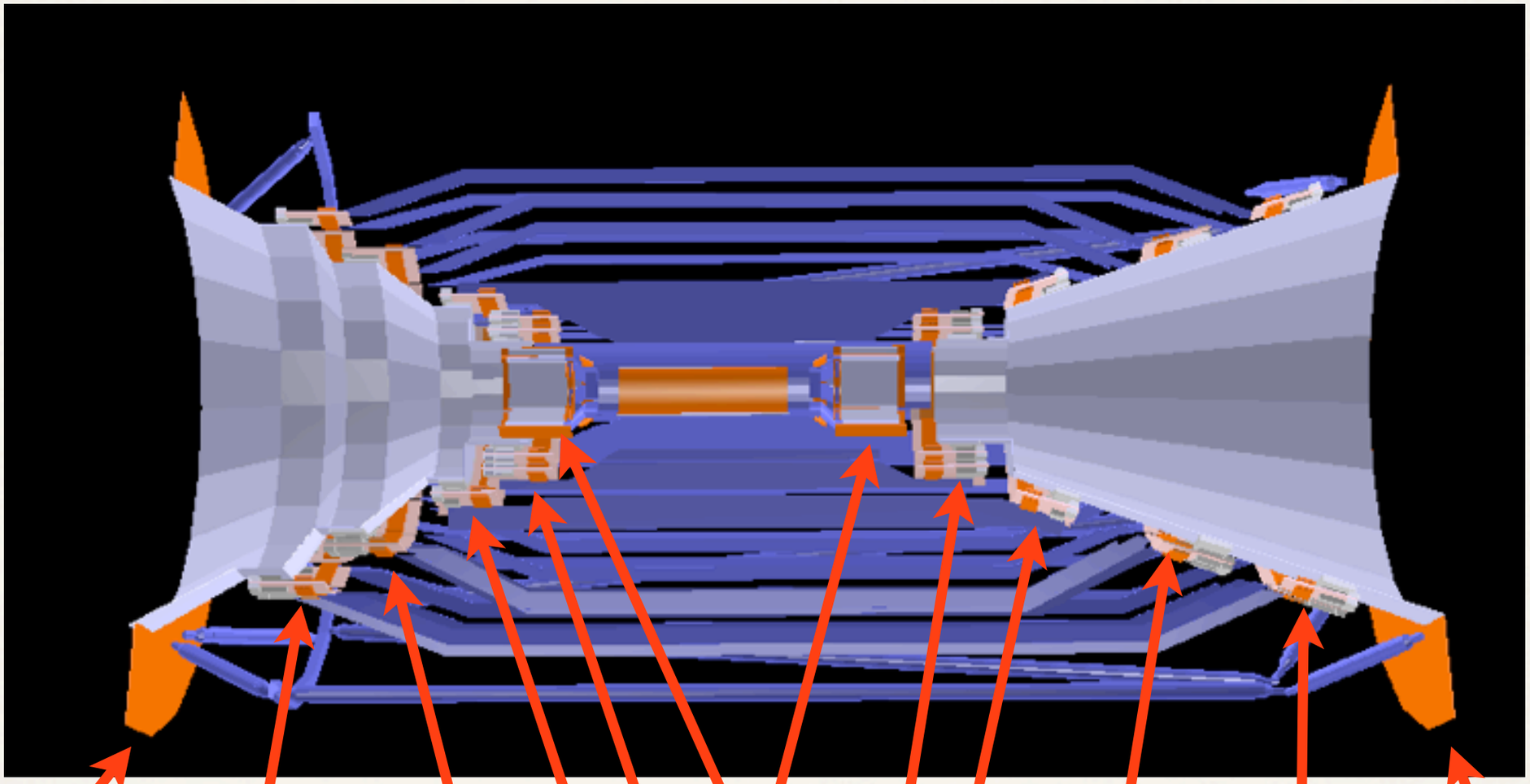
Simulated radiation level

- Locations requested by ETD people

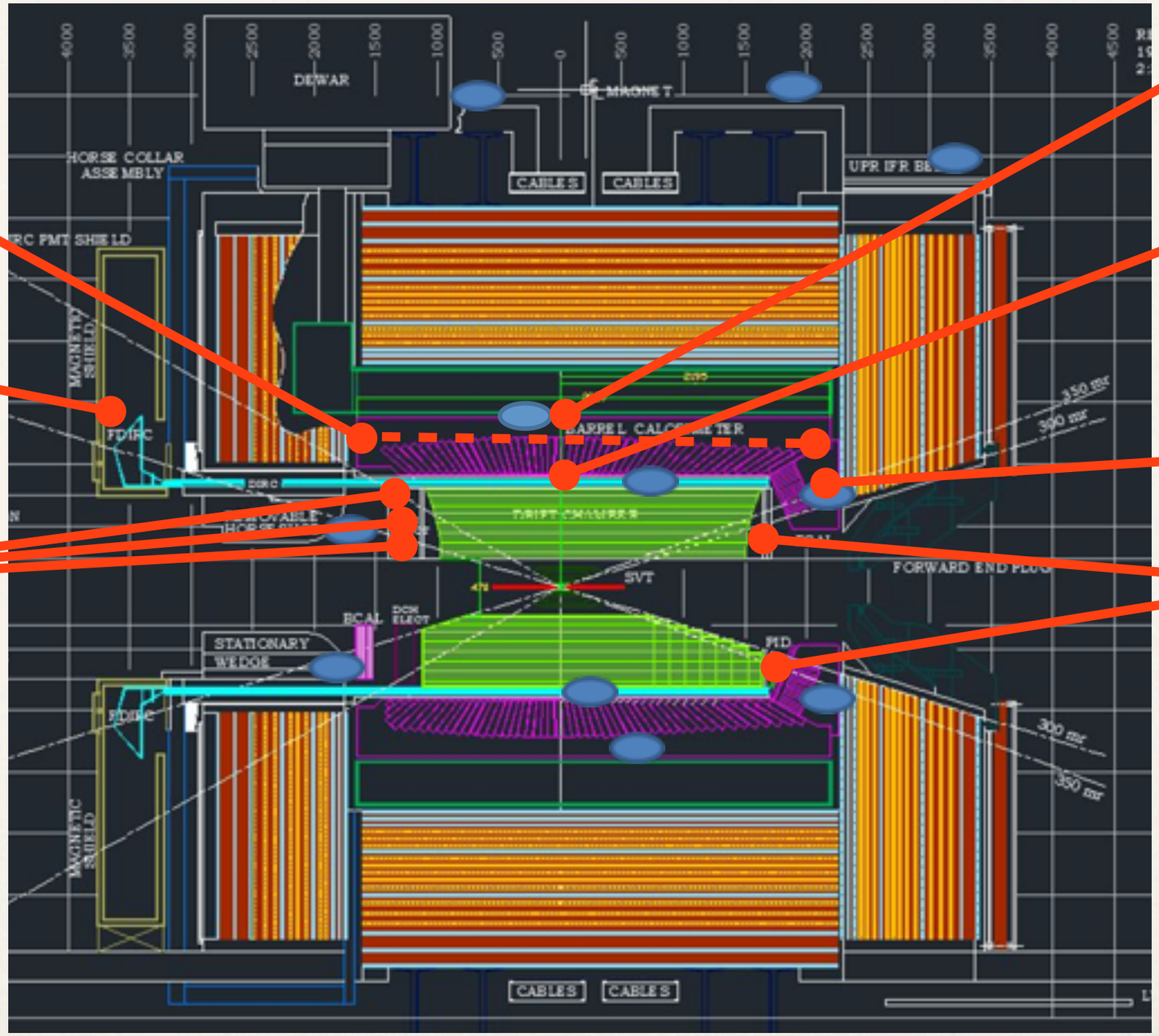




Simulated radiation level



Simulated radiation level



EmcBrl

DrcFEE

DchFEE (3 zones)

EmcBrl Ctr

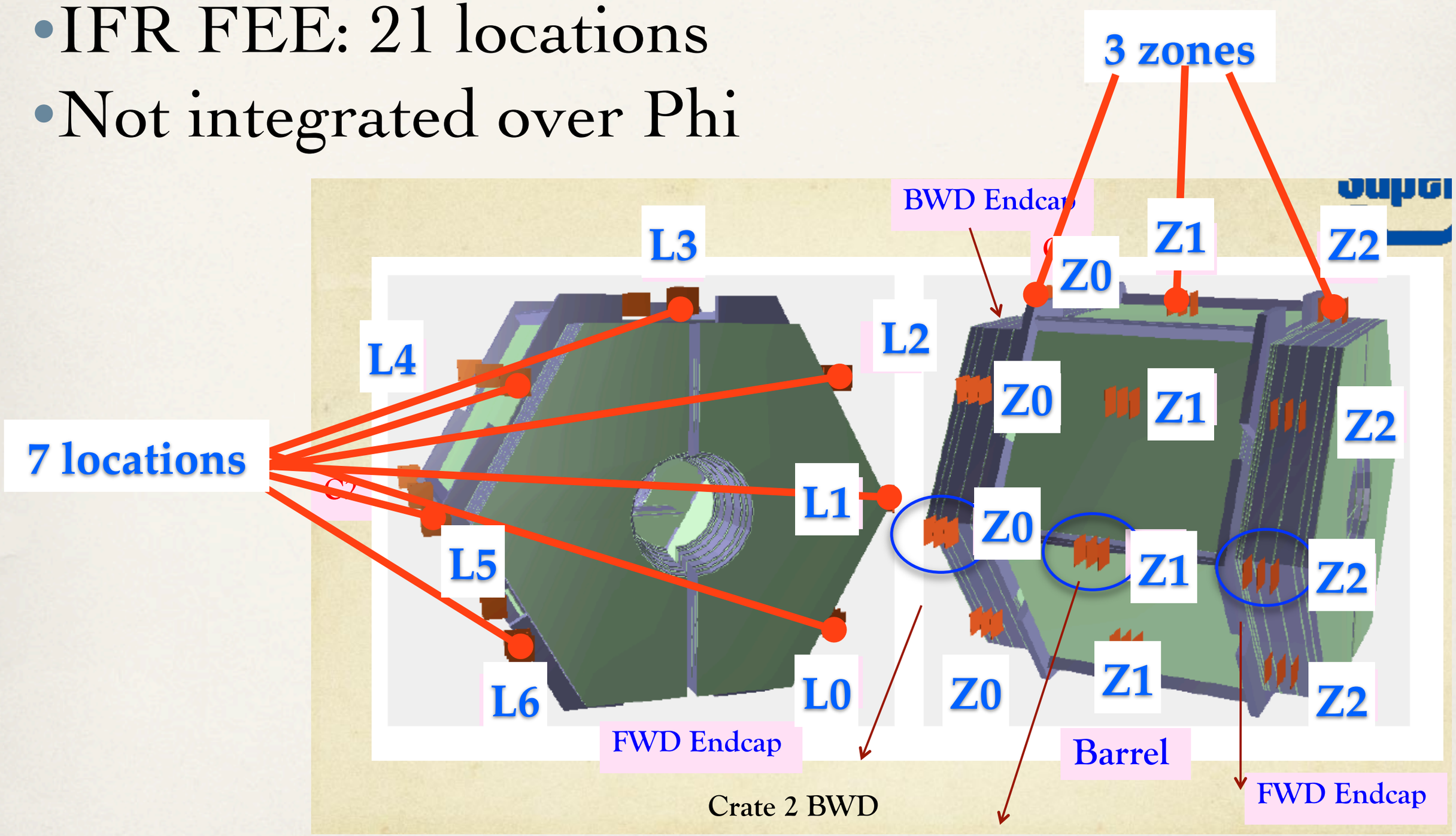
DrcCtr Bars

EmcFwd FEE

TofFEE

Simulated radiation level

- IFR FEE: 21 locations
- Not integrated over Phi



Simulated radiation level

- Nice big table (only for 2photons bkg)

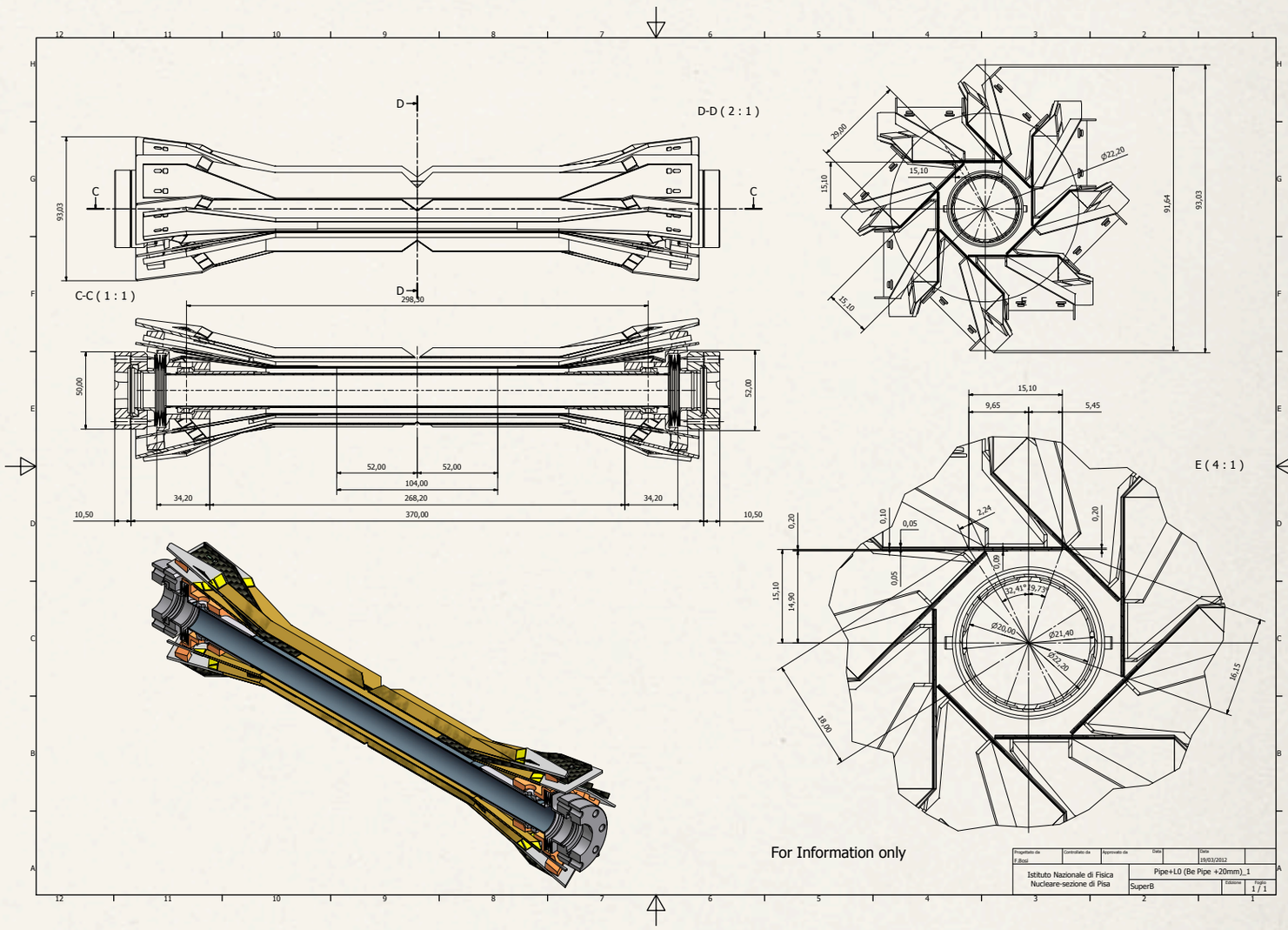
SubSystem	Location	rMin(cm)	rMax(cm)	zMin(cm)	zMax(cm)	TID(Gy)	NIEL(cm-2)	SEE(cm-2)
SVT	Layer0	1.292	1.292	-6	6	36059.5	1.20772e+13	0.0257399
SVT	Layer1	3.3	3.3	-10	10	1191.75	4.27953e+11	0.0189185
SVT	Layer2	4	4	-15	15	603.577	2.32608e+11	0.0388765
SVT	Layer3	5.9	5.9	-20	20	209.308	1.00633e+11	0.0454258
SVT	Layer4	12.2	12.2	-30	30	42.4517	5.1101e+10	0.0471571
SVT	Layer5	14.2	14.2	-30	35	25.257	4.36508e+10	0.0492751
SVT	FEELayer0	1.4	1.4	4.2	4.2	3359.8	1.14919e+12	0.157514
SVT	FEELayer1	3.3	3.3	1	1	548.919	2.0831e+11	0.29034
SVT	FEELayer2	4	4	1	1	546.259	2.18287e+11	0.539203
SVT	FEELayer3	5.9	5.9	1	1	236.526	1.20343e+11	0.609714
SVT	FEELayer4	12.2	12.2	1	1	70.0809	8.06467e+10	0.63149
SVT	FEELayer5	14.2	14.2	1	1	31.946	8.02268e+10	1.00651
SVT	MCard	30	30	0.2	0.2	8.2523	6.604e+10	0.471702
DCH	FEEZone0	23.6	40	-111.9	-111.9	0.847235	3.14484e+10	0.698707
DCH	FEEZone1	40	60	-111.9	-111.9	1.07063	2.45461e+10	0.506254
DCH	FEEZone2	60	81	-111.9	-111.9	0.946379	1.90069e+10	0.404555
TOF	FEE	55	92	200	200	0.423339	1.60694e+10	2.69903
DRC	BarCenter	81.7	89.3	-10	10	0.858083	2.19122e+10	3.12543
DRC	FEE	103	155	-377	-342	0.00749921	5.00567e+08	0.0553376
EMC	FwdFEE	70	110	216	236	0.0761059	1.22912e+10	1.40298
EMC	BrlFEE	120	120	-155	216	0.0223998	3.65836e+09	0.427492
EMC	BrlCtrFEE	120	120	-10	10	0	2.96564e+09	0.367001
IFR	FEEZone0Loc0	325.576	332.866	-281	-239	0.173197	2.35243e+08	0.0263963
IFR	FEEZone0Loc1	360.555	400.5	-281	-239	0.106209	3.88004e+08	0.0444569
IFR	FEEZone0Loc2	300	356.09	-281	-239	0.120344	2.58914e+08	0.0319534
IFR	FEEZone0Loc3	300.666	340.588	-281	-239	0.195358	2.8236e+08	0.0388998
IFR	FEEZone0Loc4	332.866	325.576	-281	-239	0.173152	4.05831e+08	0.0444569
IFR	FEEZone0Loc5	400.5	360.555	-281	-239	0.214878	3.12852e+08	0.0319534
IFR	FEEZone0Loc6	356.09	300	-281	-239	0.235287	2.66329e+08	0.0347319
IFR	FEEZone1Loc0	325.576	332.866	-21	21	0.0250389	1.82103e+08	0.0222284
IFR	FEEZone1Loc1	360.555	400.5	-21	21	0.0411469	1.70724e+08	0.0138928
IFR	FEEZone1Loc2	300	356.09	-21	21	0.0434939	1.71252e+08	0.0194499
IFR	FEEZone1Loc3	300.666	340.588	-21	21	0.10929	2.83561e+08	0.0305641
IFR	FEEZone1Loc4	332.866	325.576	-21	21	0.054466	2.33949e+08	0.0291748
IFR	FEEZone1Loc5	400.5	360.555	-21	21	0.0702368	2.79871e+08	0.0208392
IFR	FEEZone1Loc6	356.09	300	-21	21	0.0891178	2.51388e+08	0.0222284
IFR	FEEZone2Loc0	325.576	332.866	239	281	0.0743074	3.02512e+08	0.040289
IFR	FEEZone2Loc1	360.555	400.5	239	281	0.0854958	2.8198e+08	0.025007
IFR	FEEZone2Loc2	300	356.09	239	281	0.12929	2.41521e+08	0.0208392
IFR	FEEZone2Loc3	300.666	340.588	239	281	0.277088	4.19076e+08	0.0430676
IFR	FEEZone2Loc4	332.866	325.576	239	281	0.145233	2.38019e+08	0.0333426
IFR	FEEZone2Loc5	400.5	360.555	239	281	0.154433	2.47619e+08	0.0305641
IFR	FEEZone2Loc6	356.09	300	239	281	0.168629	2.67683e+08	0.0319534

Conclusions

- SVT:
  - New geometry with striplets and updated configuration is ready for a test production
  - Thicker shielding has a small effect on total rate, 20-30% decrease for BeamgasHER and TouschekLER contributions
  - Smaller radiation dose but additional contribution from BeamgasLER. Small variation
- DCH:
  - Rate increase due to stereo layers is similar for different contributions, larger when contribution has tracks coming through the endplates
  - Radiation dose on electronics is low, >1 krad
- ETD:
  - New detailed map of radiation level for requested locations around the detector (macro is ready, need to add other contributions)

Future plans

- **Not to be used for the next production**
- Svt L0 geometry: a new design is ready for L0 with striplets.
  - Longer beampipe, split pipes are going to be shortened. No modification after that point
  - FEE boards for layers 1-2 to be relocated to make room for L0 boards



- Svt geometry for outer layers: outer layers are the same as in Babar, but SuperB acceptance is wider. Need symmetric fwd/bwd modules

Rate comparison, updated

- Rates from previous production

OLD

LAYERS	May2011 2photons	Dec 2011 2photons	Dec 2011 2photons Extend B	Dec 2011 2photons ExtB-Alum	Dec 2011 Bhabha	Dec 2011 Touschek HER	Dec 2011 Touschek LER	Mar 2012 BeamGas HER
L0 phi	23.3	27.4	29.4	31.9	0.87	0.57	1.91	0.635
L0 z	29.9	34.5	37.2	39.0	1.42	1.71	5.06	1.72
L1 phi	1.5	1.45	1.56	1.54	0.12	0.20	0.81	0.24
L1 z	0.7	0.72	0.74	0.73	0.077	0.22	0.869	0.26
L2 phi	0.72	0.75	0.78	0.79	0.078	0.135	0.61	0.16
L2 z	0.35	0.38	0.40	0.39	0.059	0.158	0.68	0.19
L3 phi	0.194	0.37	0.14	0.15	0.047	0.031	0.20	0.045
L3 z	0.097	0.23	0.13	0.13	0.051	0.061	0.32	0.072
L4 phi	0.012	0.042	0.022	0.02	0.0135	0.005	0.021	0.027
L4 z	0.0076	0.026	0.014	0.014	0.0078	0.004	0.014	0.018
L5 phi	0.006	0.016	0.012	0.011	0.0057	0.0024	0.0094	0.0027
L5 z	0.0041	0.012	0.0082	0.0082	0.0038	0.0018	0.007	0.0020

Radiation dose on Electronics

SVT

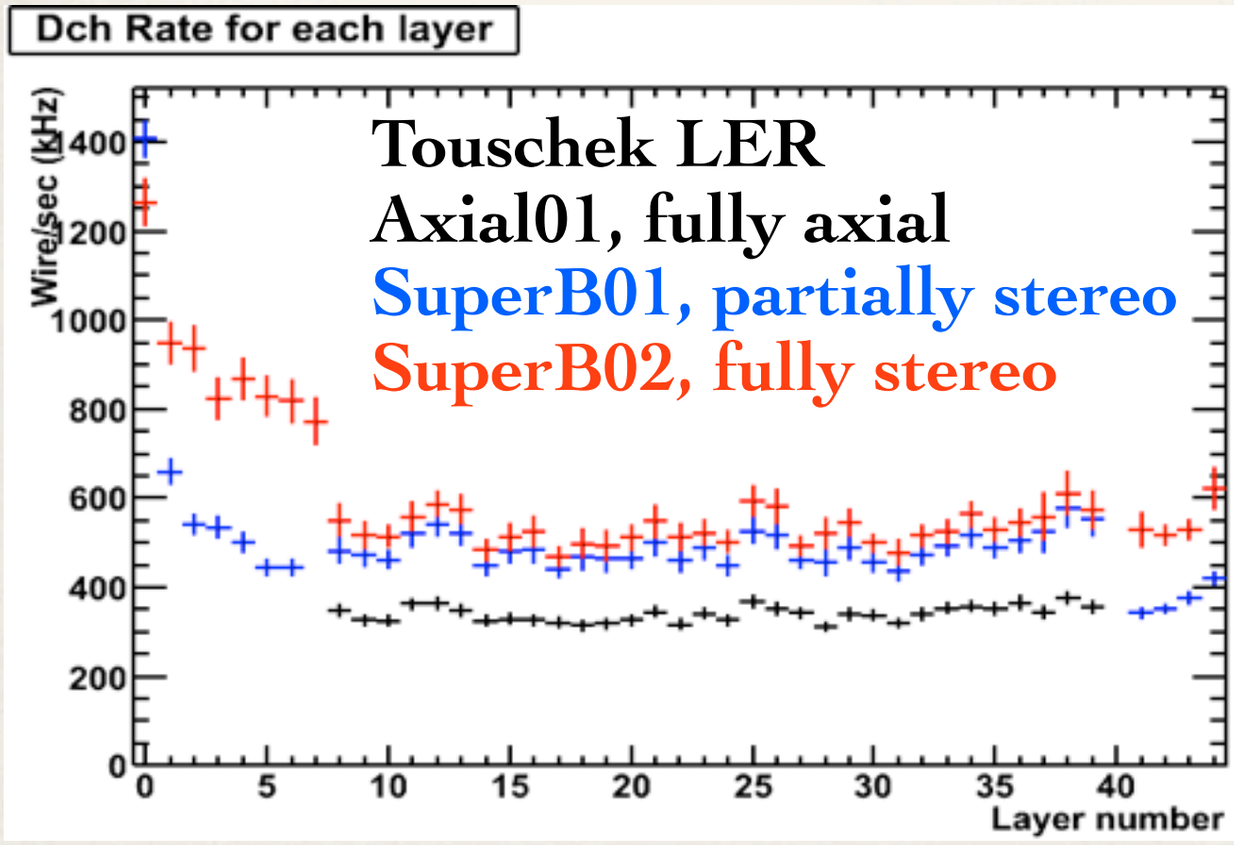
- Max dose accumulated after integrating 10 ab^{-1}

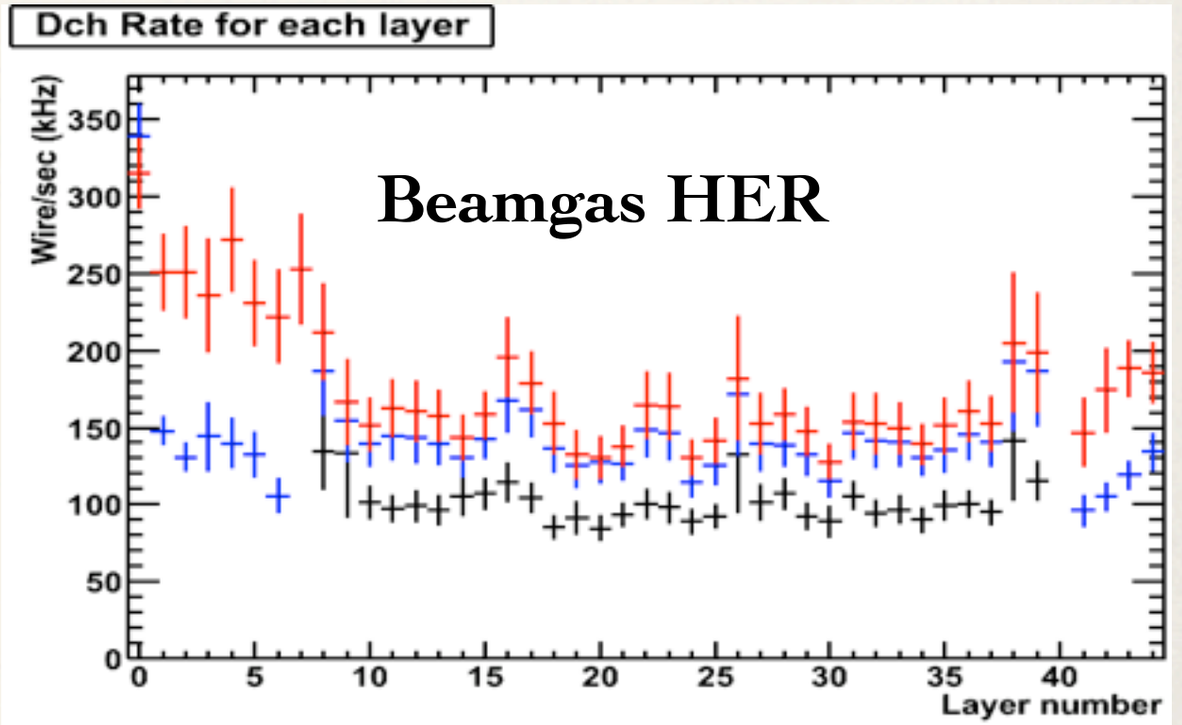
OLD

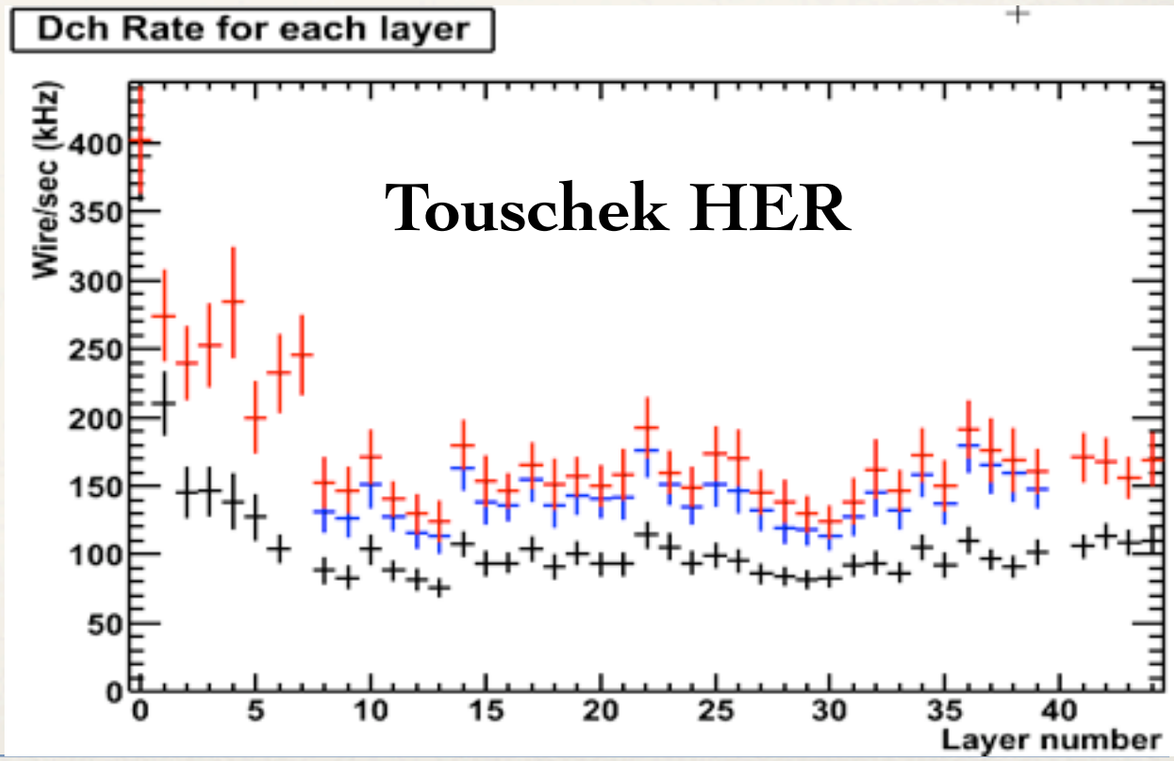
Max. Dose (krad)	0	1	2	3	4	5
Pairs	442	60	72	81	41	6.8
RadBhabha	81	13	12	19	9	1.7
Touschek HER	57	12	14	7.5	3	1.2
Touschek LER	180	52	64	29	8.2	3.9
Beam-gas HER	78	17	20	8.4	3.4	1.3
TOTAL	838	154	182	145	64.6	15

Dch Occupancy, stereo

- Significant increase in rate for stereo layers configuration, but same order or smaller than RadBhabha
- First layer has lower occupancy for SuperB02 due to larger radius compared to Axial01/SuperB01 (+0.6cm)







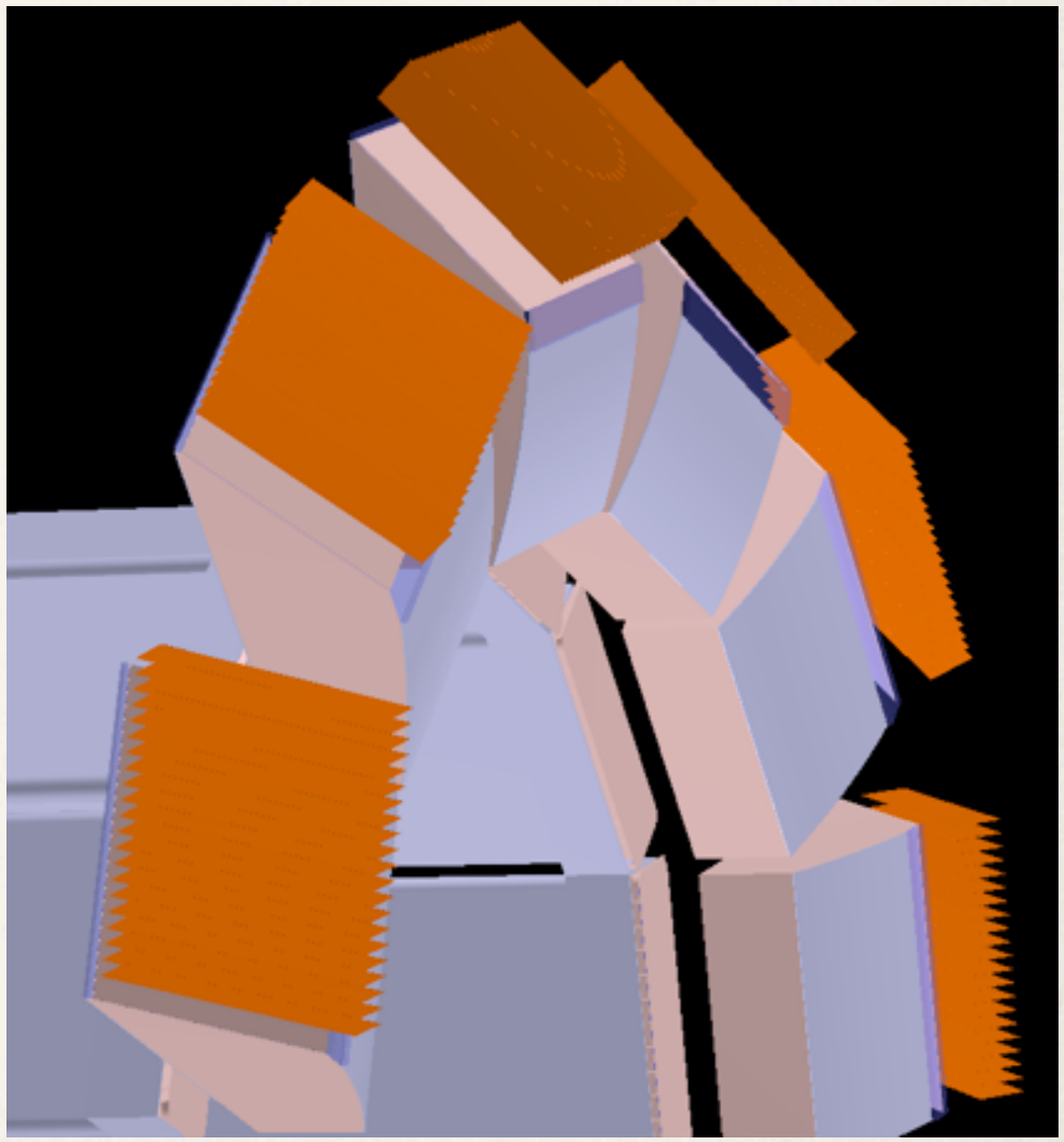
Bug Fixes

- Hits in DRCHits and SOBHits are missing some additional information, like the vector momentum of the tracks, due to using **BrnSensitiveDetector**. Replaced with the updated **BrnSensDet** and **BrnSensitiveDetector** is now obsolete. If you need please use **BrnSensDet** to fill additional hit collections
  - This information on DRC hits is needed to extract the incident angle of a track on the bars and obtain the plot of # optical photons vs track angle. Macro to produce those plot are ready, need to wait for the new production
- Minor fix in BrnRootHit to remove a warning when compiling Bruno shared library to be used with ROOT

New development

- Request from Drc people for instrumenting FDRC electronics. **Silicon plate,** behind the FDRC pixels, similar to engineer's design. Volumes have been sensitized, new hit collection **DRCFEEHits**. Dose and fluxes will be provided

- Tested with geantino's and for overlaps: PASSED



SVT issues

- Ingredients for estimation of offline occupancy:
  - strip rates on forward region, with 5x safety factor
  - electronics specifications
  - Occupancy should be less than 5%, but it is not easy to fix a threshold because SuperB reconstruction algorithm is not yet finalized
- All the rate should be reduced by 50%
- Beamgas from HER (first 100k evts) similar to Touschek HER
- Beamgas from LER is still missing, hopefully same or less than Touschek from LER
- Outer layers rates (pairs+Touschek): improved geometry (missing magnets, new shields), magnetic fields and collimators should reduce them
- Layer0: still 20% more than May 2011 estimation. No handle to reduce 2photon particles coming directly from IP. Need to check if it could still work when combined with outer layers at low occupancy