



**Update on Radiation Level using
Bruno simulation**

Riccardo Cenci
University of Maryland

SuperB Collaboration Meeting, Elba, ITALY - Etd Parallel Session

Jun 3rd, 2012

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

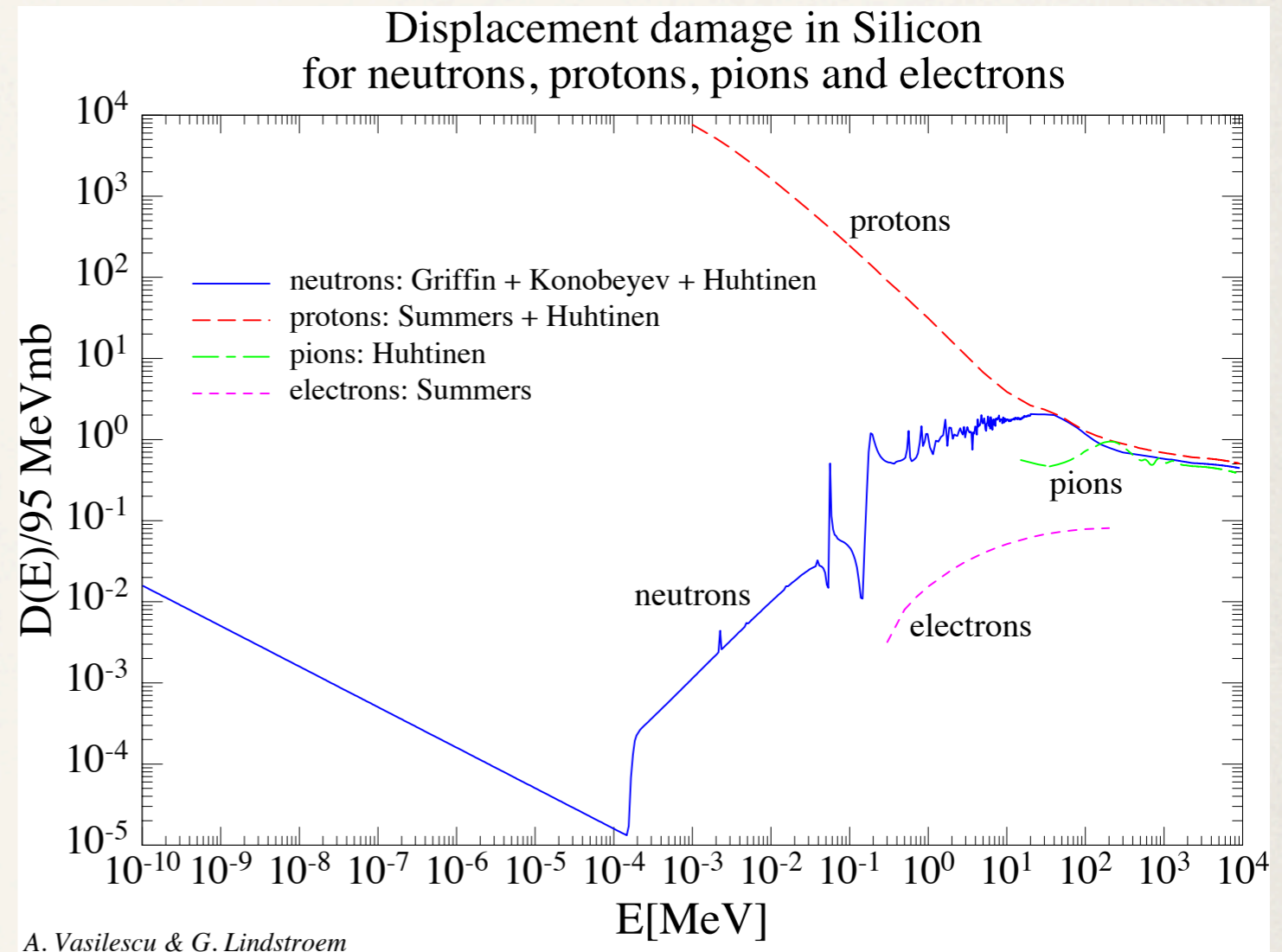
Simulated Radiation Level	Type of Radiation Constraint	SRL Unit
SRL_{tid}	Particles producing <i>TID</i> (Total Ionising Dose). Example: photons.	Total Dose in 10 years: <i>Gray</i>
SRL_{niel}	Particles producing <i>NIEL</i> (Non-Ionising Energy Loss). Example: neutrons.	Total Fluence in 10 years: <i>1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

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)

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
- 

Conventions

- 1 year = 10^7 sec = 10 ab⁻¹ collected
- To get the lifespan dose you need
 - x 7.5 (75 ab⁻¹ collected)
 - x 5 (Safety factor)

Simulated radiation level

EmcBrl

DrcFEE

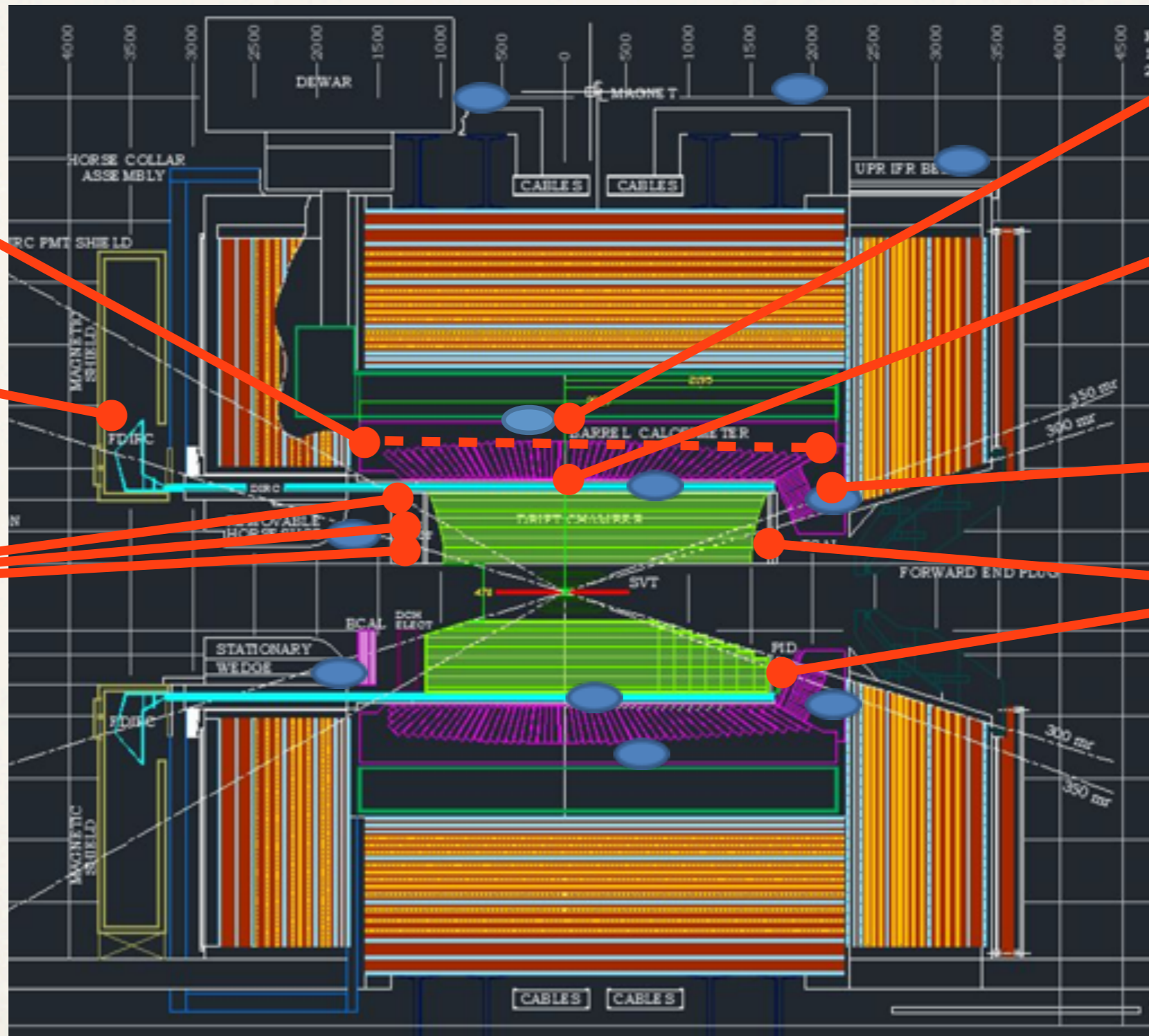
**DchFEE
(3 zones)**

**EmcBrl
Ctr**

**DrcCtr
Bars**

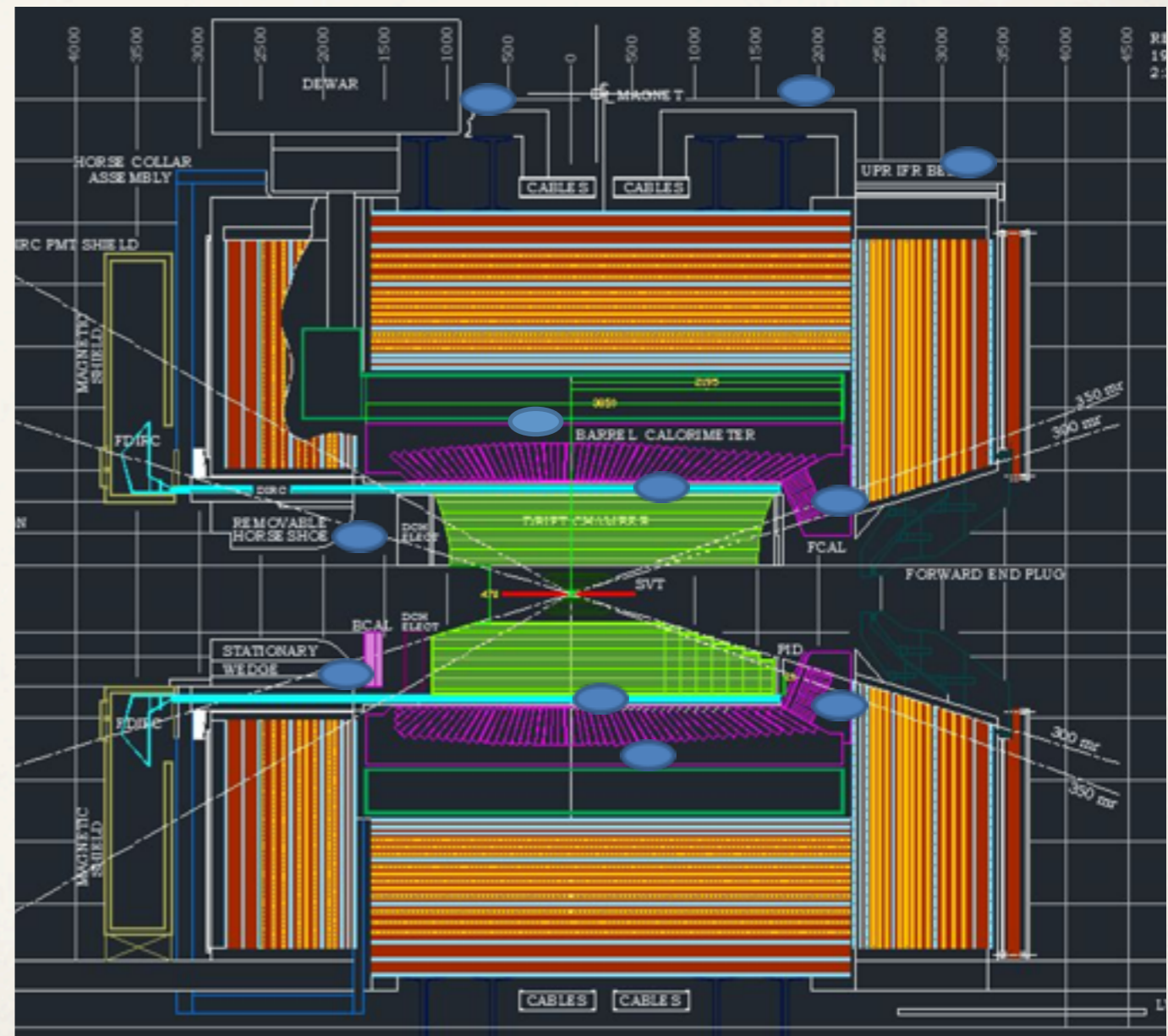
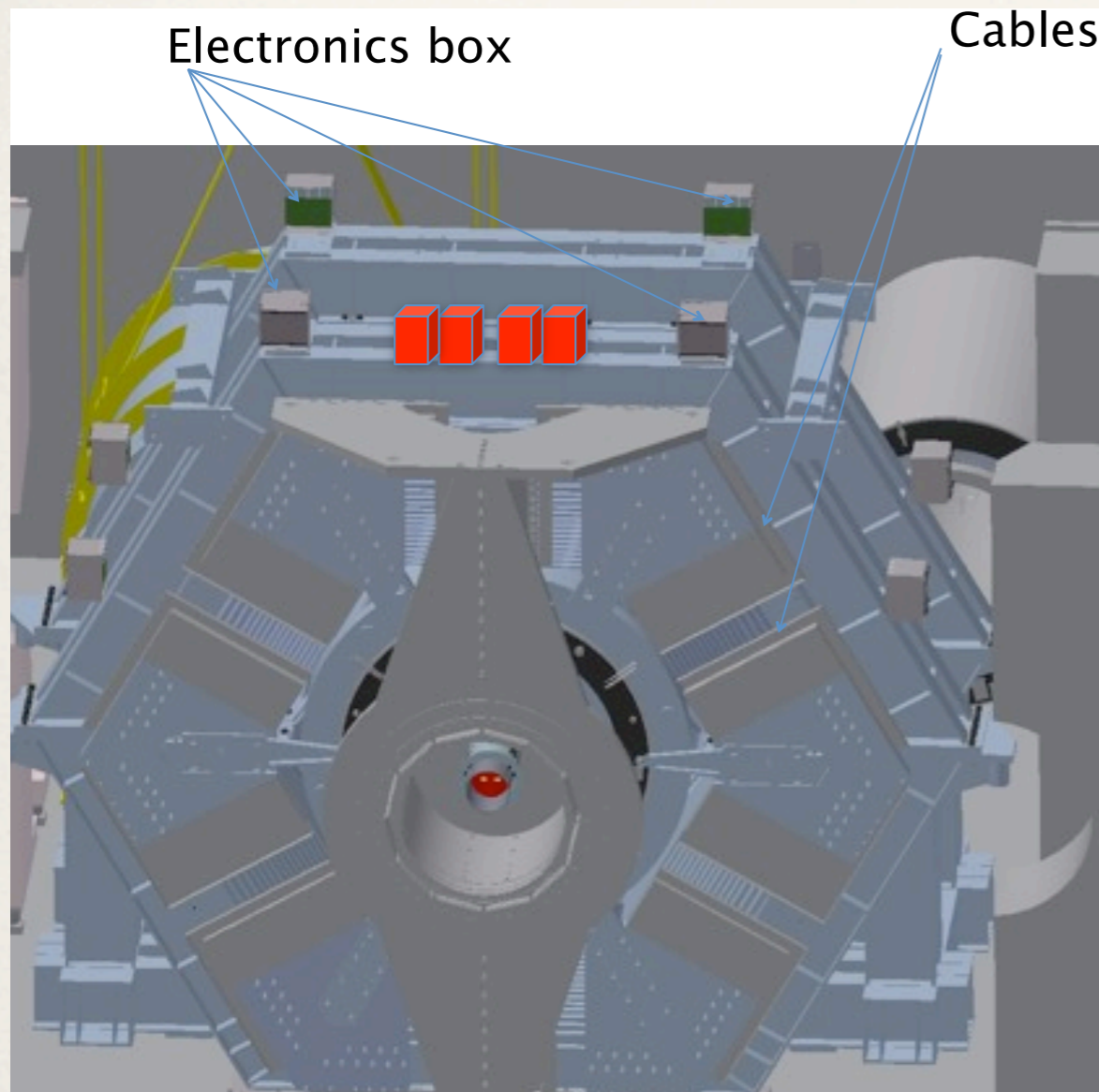
**EmcFwd
FEE**

TofFEE

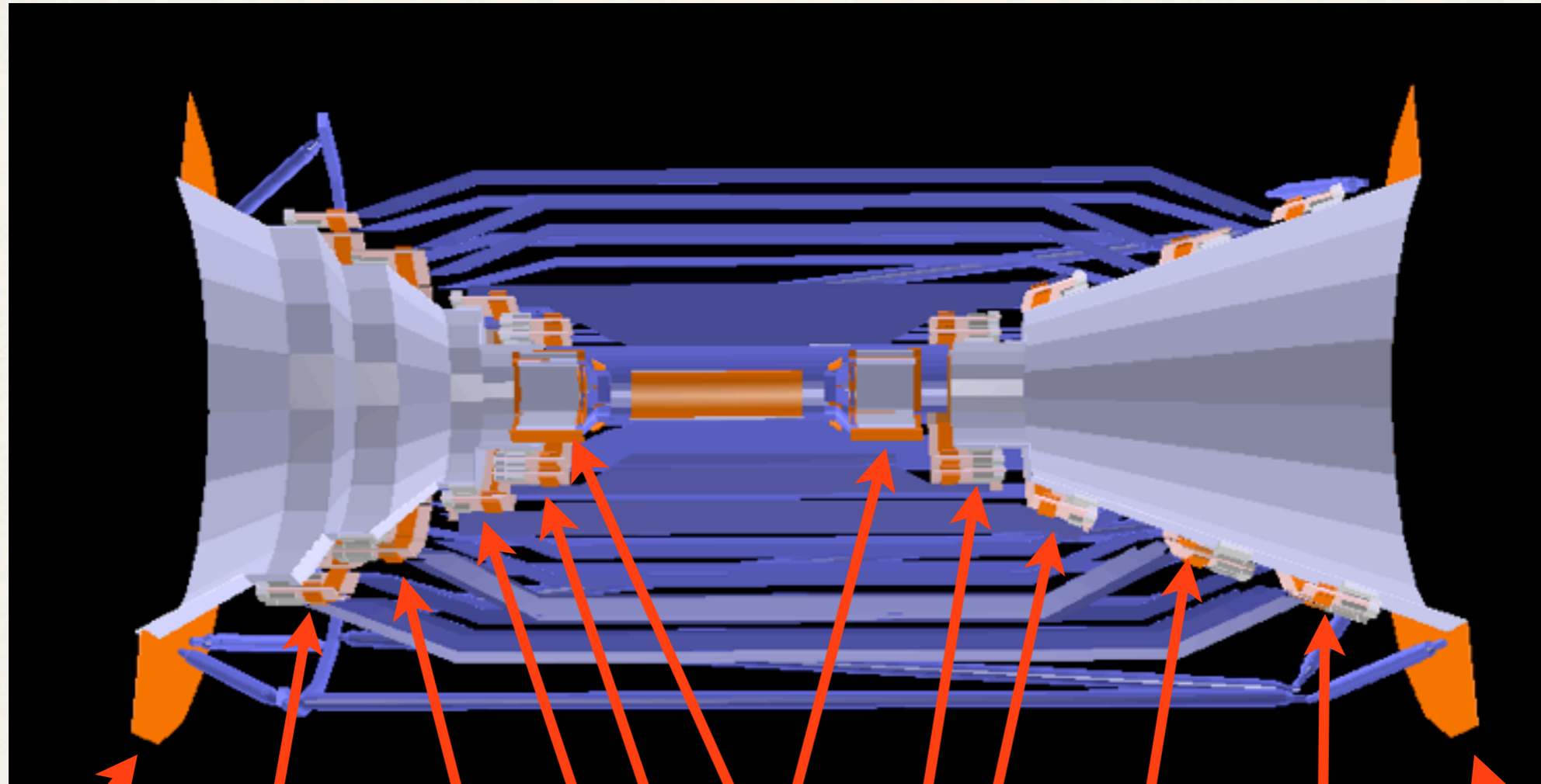


Simulated radiation level

- Locations requested by ETD people



Simulated radiation level



**Matching
Card**

Layer 5

Layer 4

Layer 0

Layer 1

Layer 2

Layer 3

Layer 4

Layer 5

**Matching
Card**

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

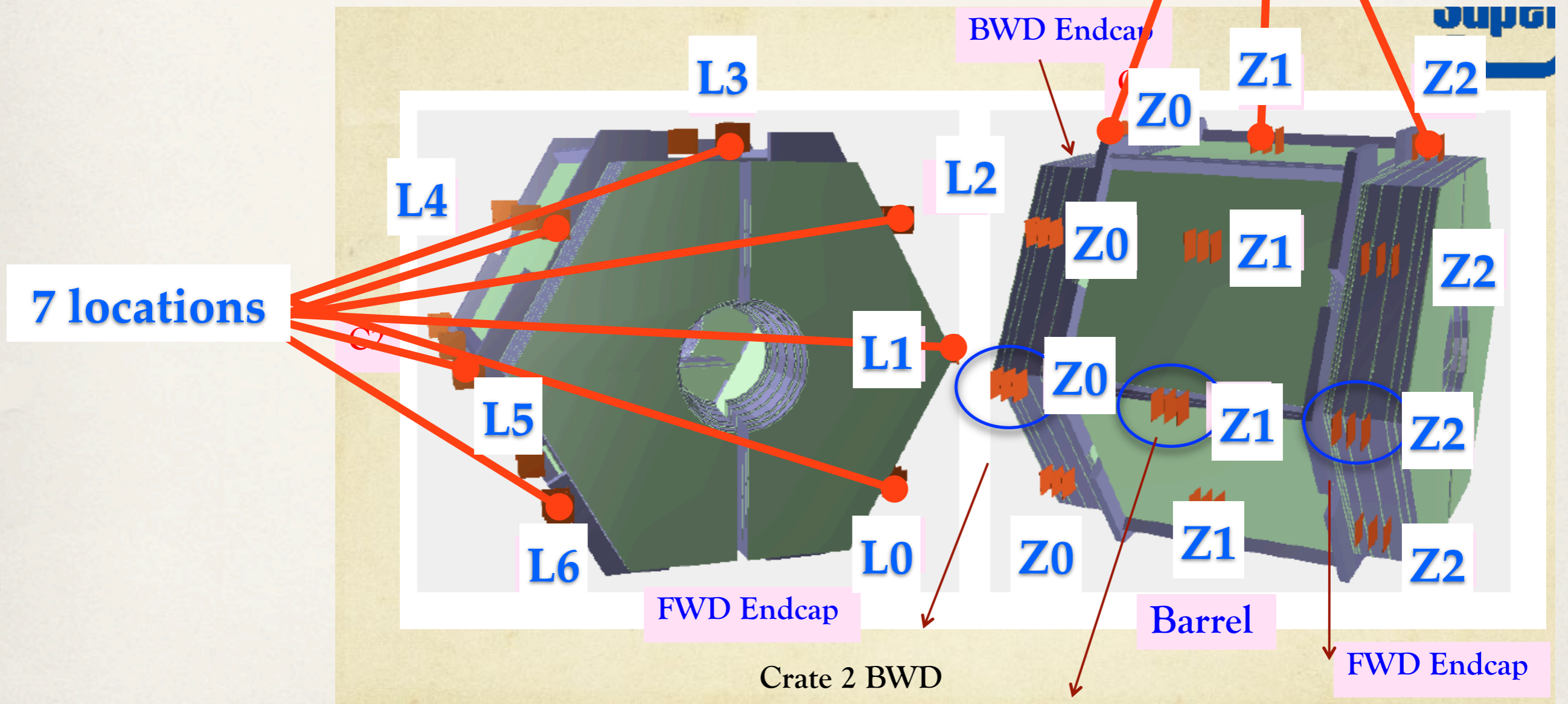
Dch Electronics

- 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

- 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:

- Thicker shielding has a significant effect on the total dose, but additional contribution from Beamgas from LER brings up the value

- DCH:

- Radiation dose on electronics is confirmed to be low, >1 krad

- ETD:

- New detailed map of radiation level for a large number of locations around the detector (macro is ready, need to add other contributions)
- New locations can be added easily (if hits information is available, map can be produced w/o run again productions)

Alejandro Perez

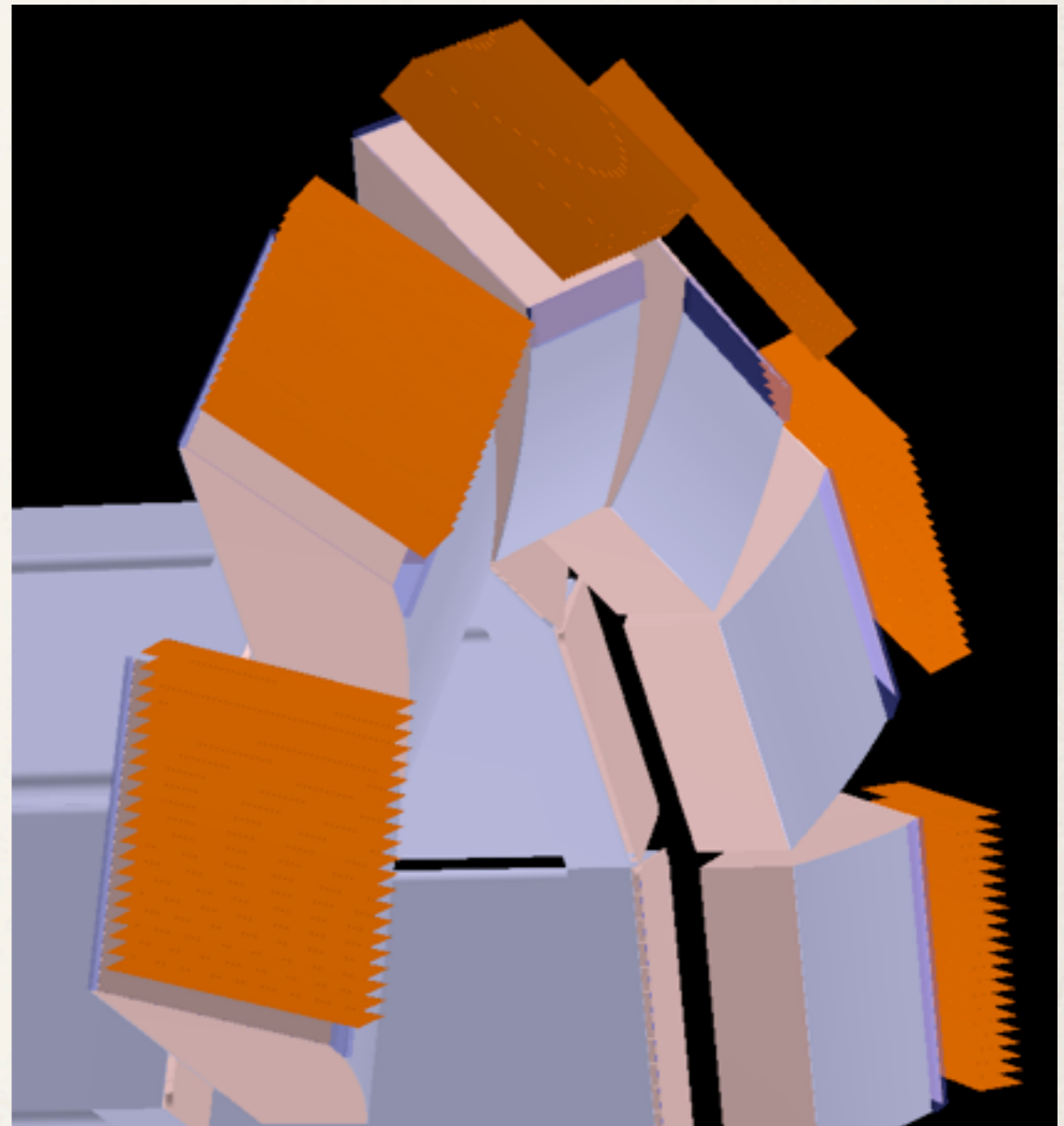
Studies

On DIRC

F. E. S.

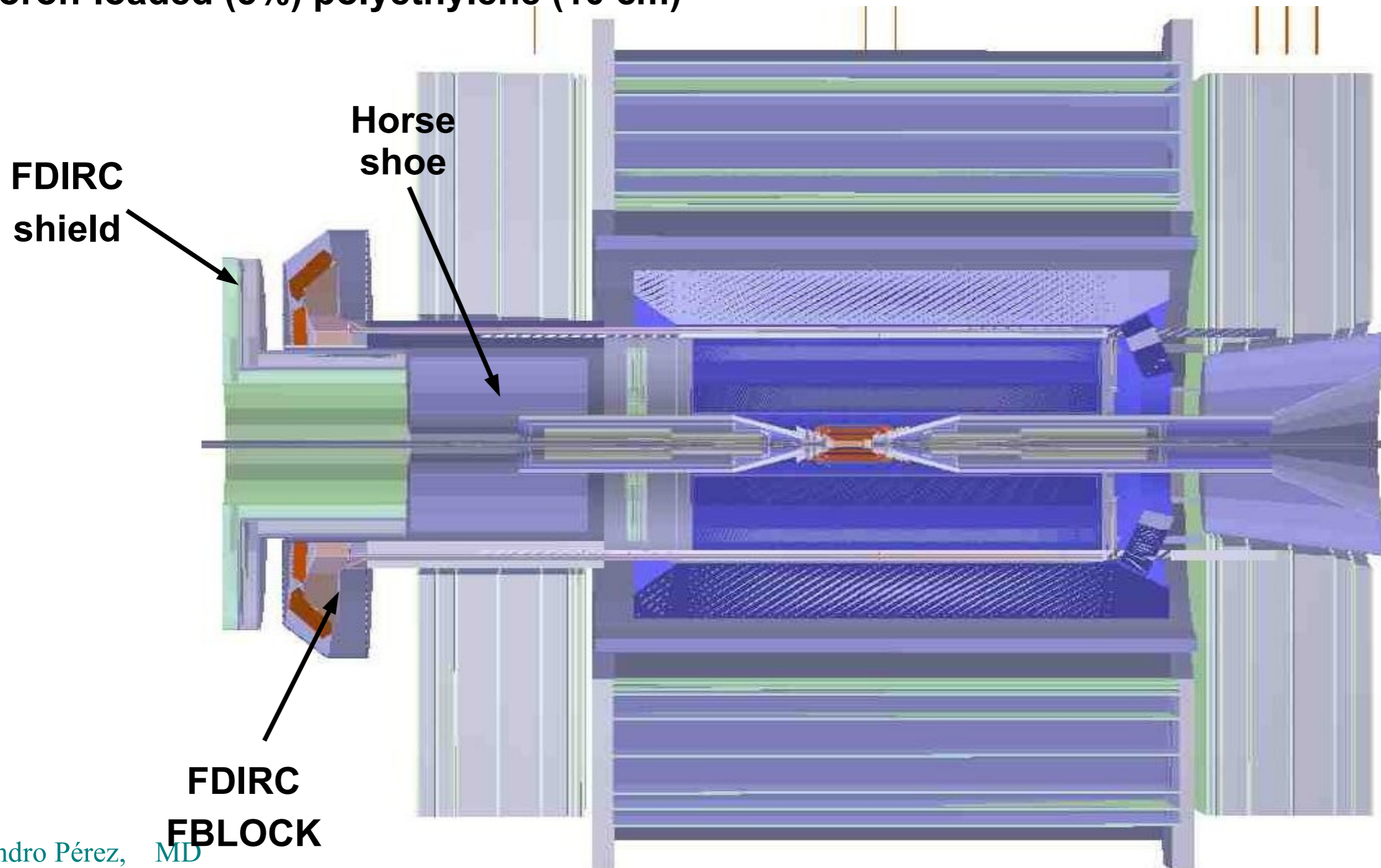
New development

- 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**



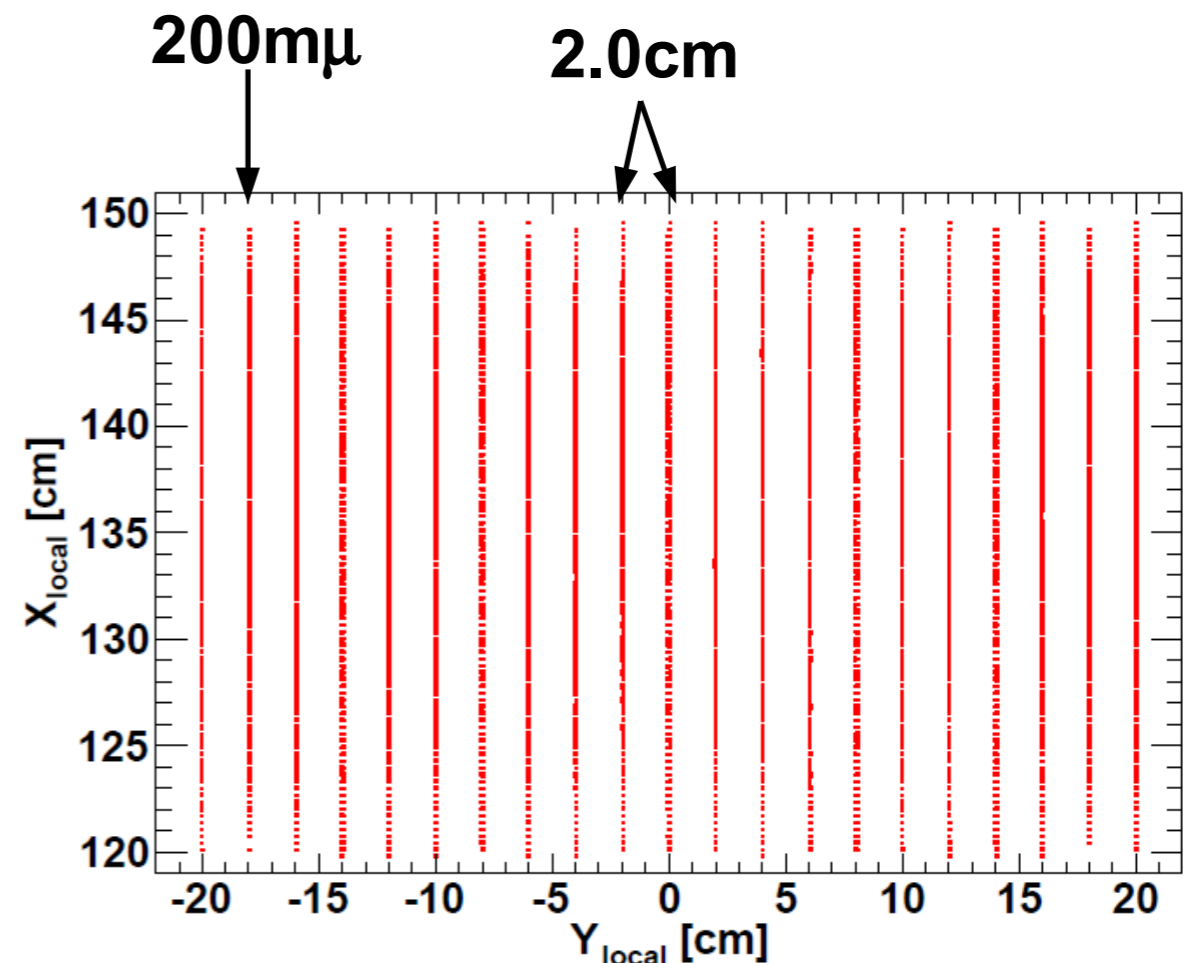
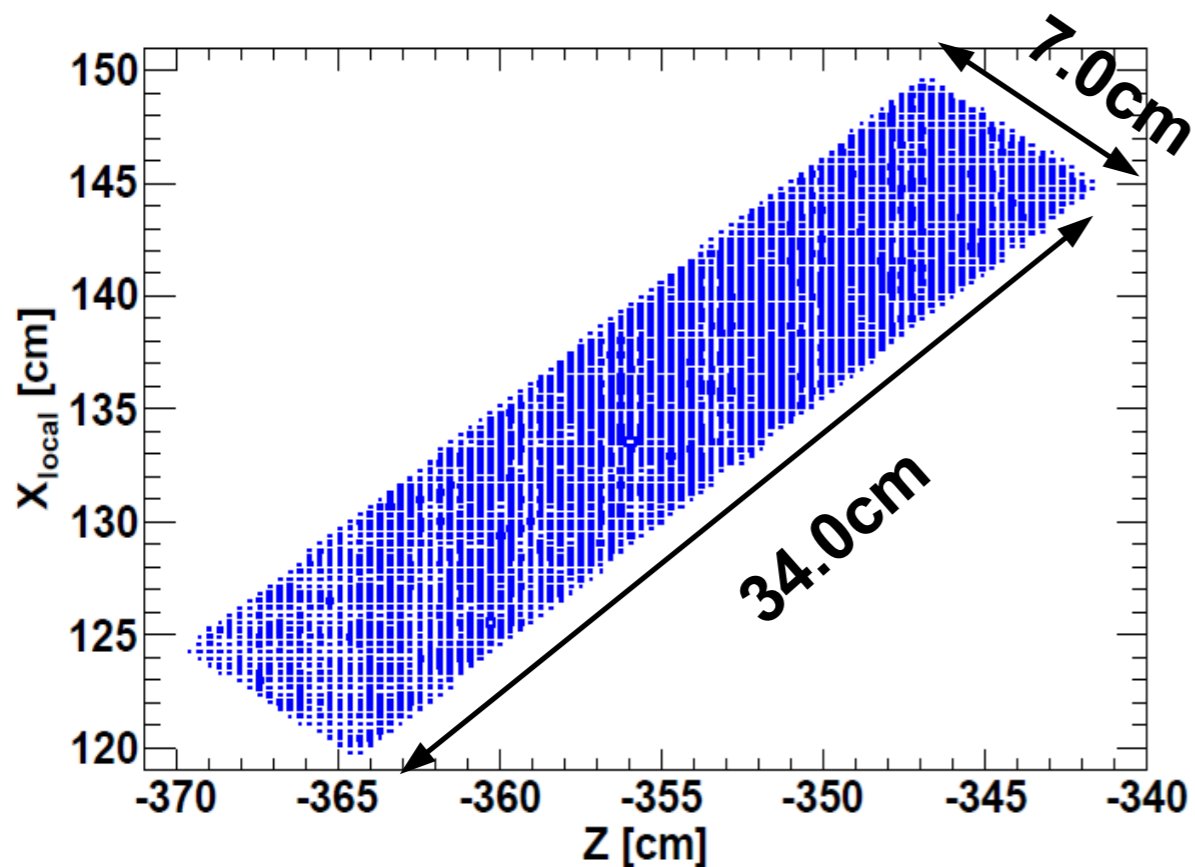
FDIRC shield: BRN implementation

- Steel-lead-steel sandwich (2.5-10-2.5 cm)
- Boron-loaded (5%) polyethylene (10 cm)



FEE Dose and fluency: geometric model and strategy

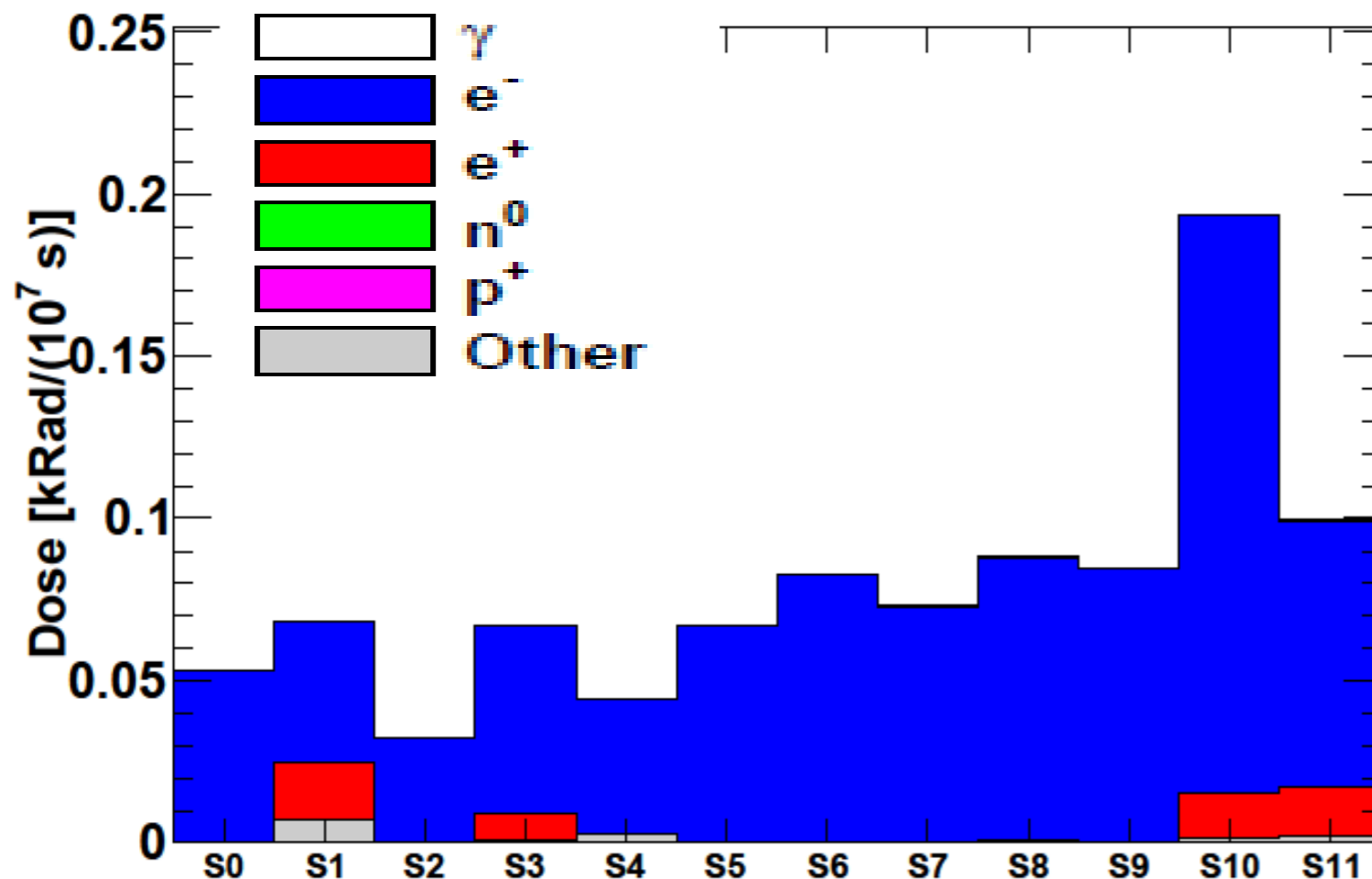
- **BRN implementation of FDIRC FEE**
 - FEE boards are silicon boxes of 7.0cm x 34.0cm x 200 μ
 - 21 boards per sector separated 2cm
- **The FEE boards are instrumented**
 - Incident particle information (4-p, position, time, particle type): fluency
 - Deposited energy: doses
- **As a first approach will consider all the board in a sector as a single element and will estimate doses and fluences**



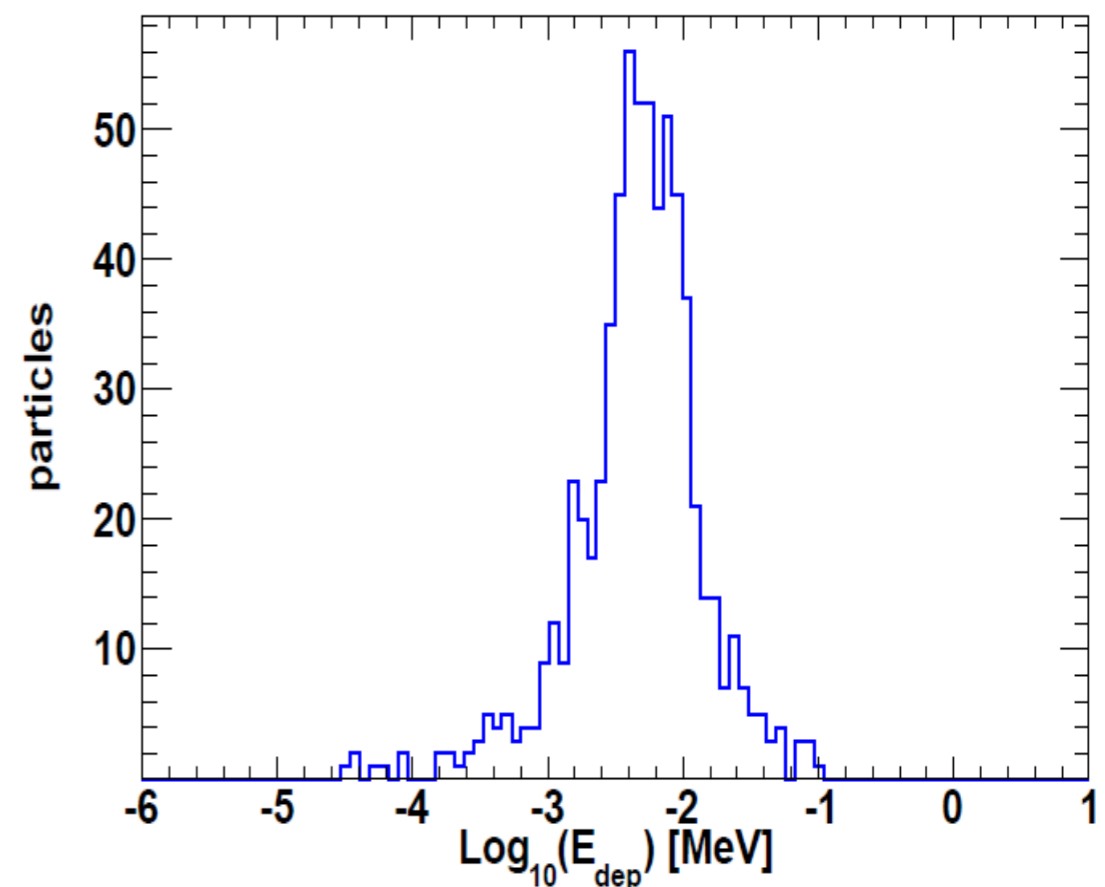
FEE Dose and fluency: The Dose

- **Doses:** (total deposited energy on FEE per sector)/(total mass per sector)
Quoted doses are for 10^7 s \Rightarrow 10ab^{-1} integrated luminosity
- **Main doses on FEE are due to electrons/positrons (ionization) and some heavy ions (very minor component)**
- **Main source of doses are Rad-bhabha, other sources are negligible (a factor of 100 smaller, see backup slides)**

Rad-bhabha: Total dose per sector on FEE

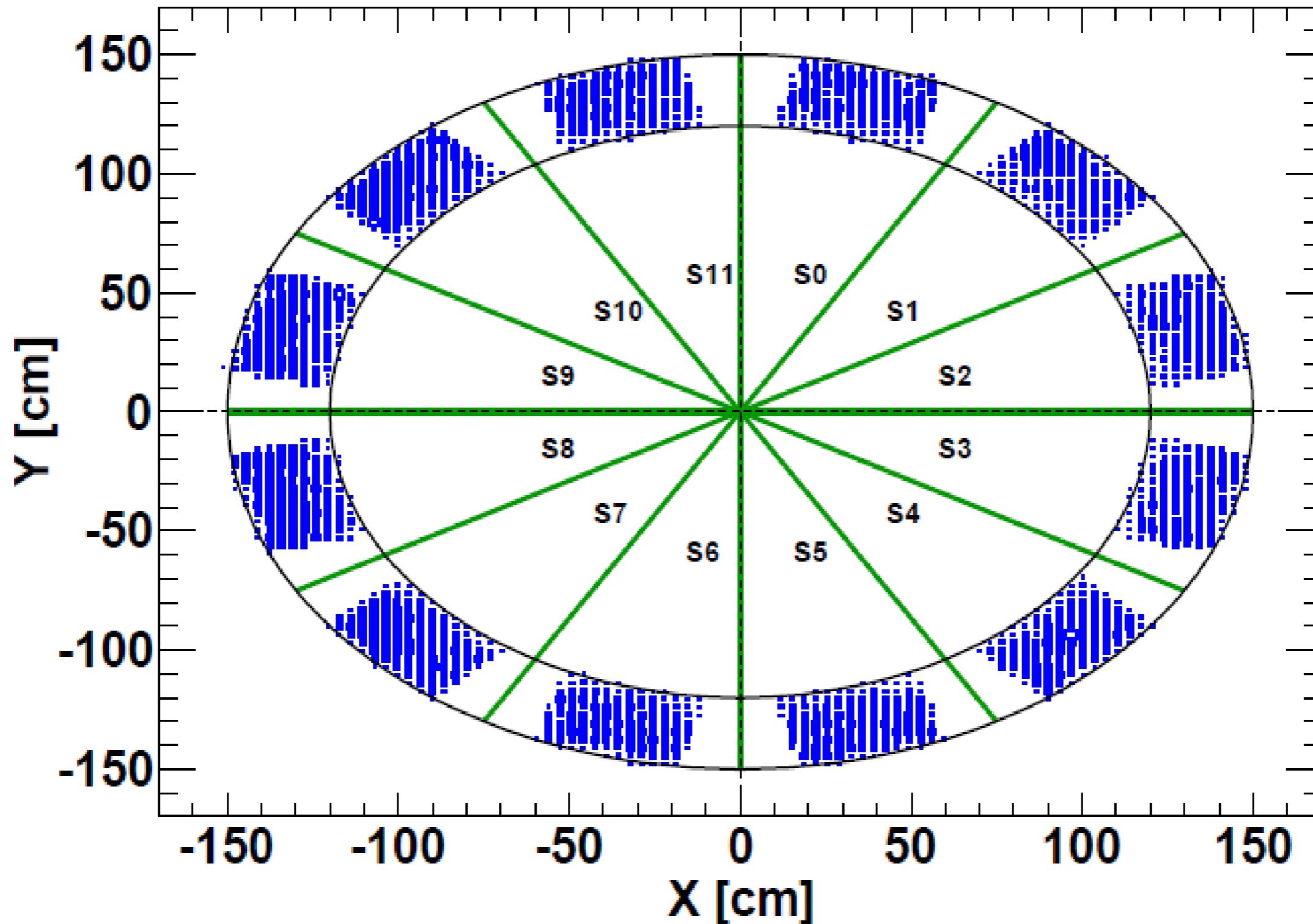


Rad-Bhabha: deposited energy on FEE-sector6 from all particle types

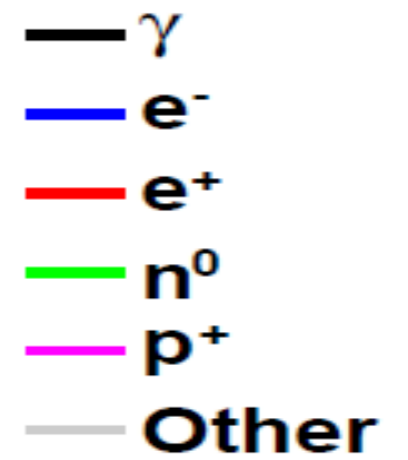


FEE Dose and fluency: FEE hits

FEE hit from Rad-bhabha sample

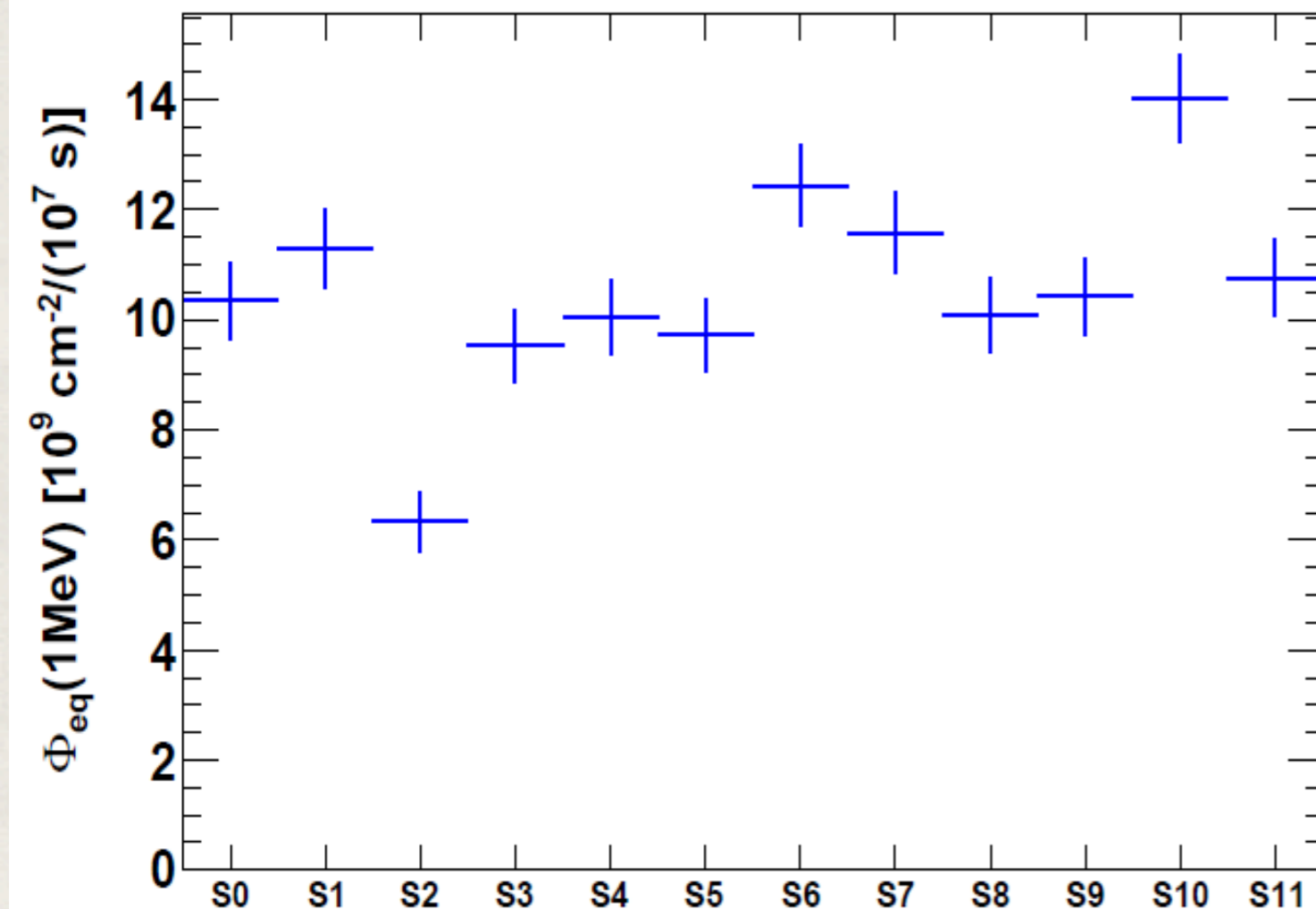


FEE Dose and fluency: The Fluency

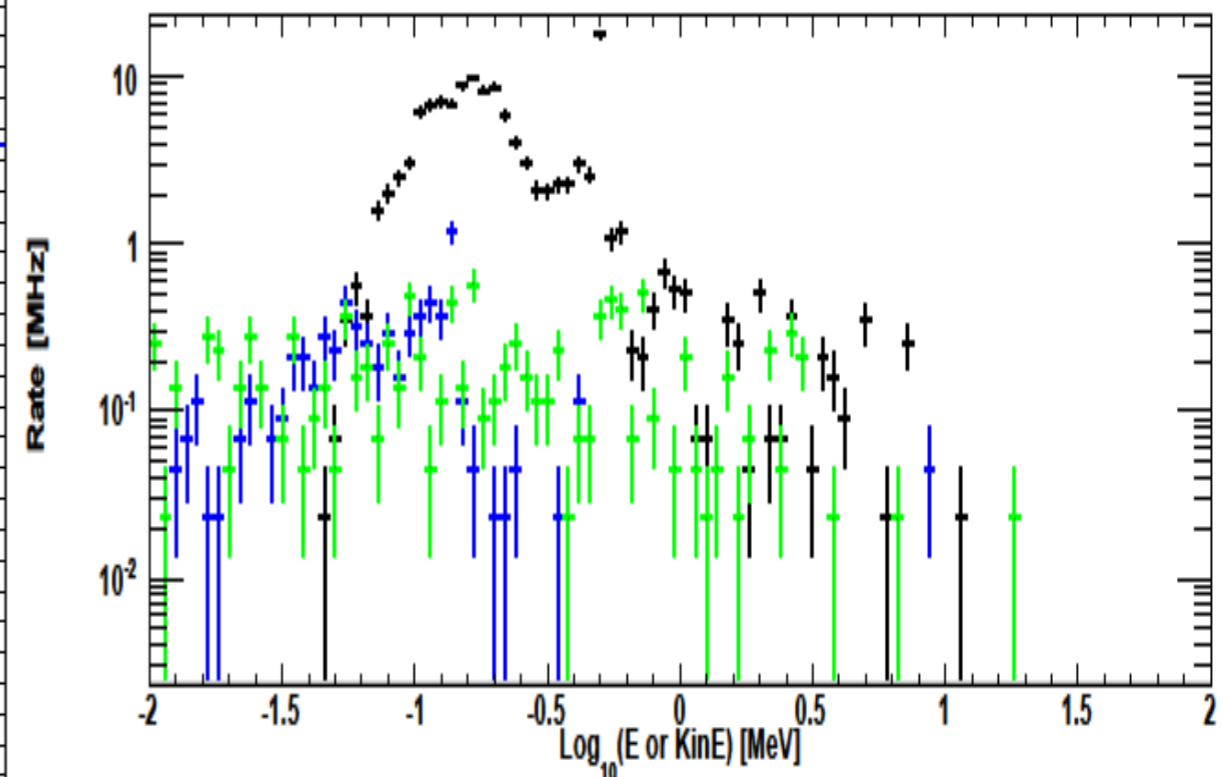


- Main 1MeV neutron eq. Fluency is from Rad-bhabha, other sources give negligible contributions (see backup slides)

Rad-bhabha: 1MeV neutron eq. fluency per sector on FEE



Rad-Bhabha: FEE-sector6 particles fluxes vs E_{kin}



Thank you for your

*patience
and attention*