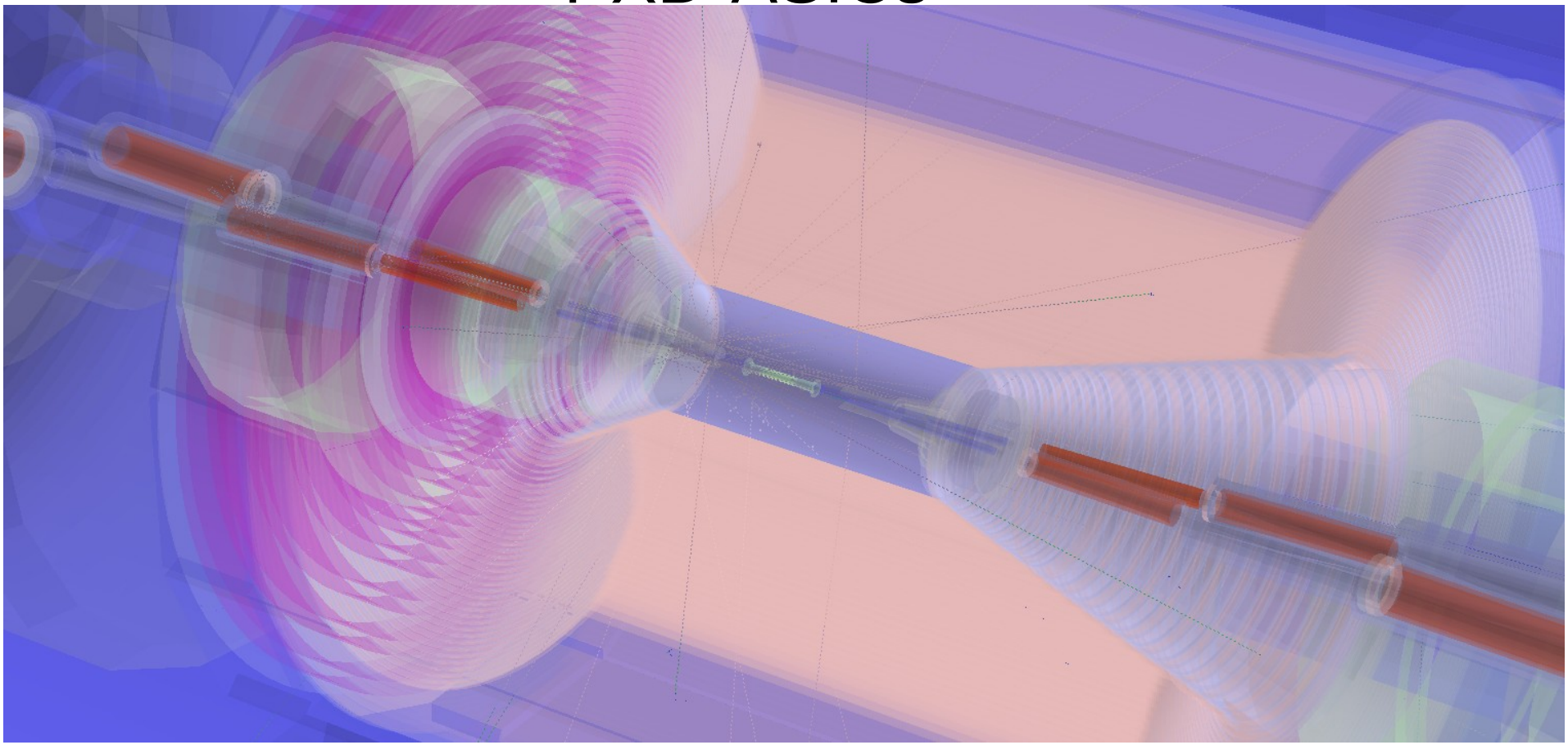
19th International Workshop on DEPFET Detectors and Applications
May 10-13 2015, Seeon, Germany

Background studies for Diamond sensors and PXD-ASICs



Gianluca Inguglia- DESY

11/05/2015

Outline

Diamonds:

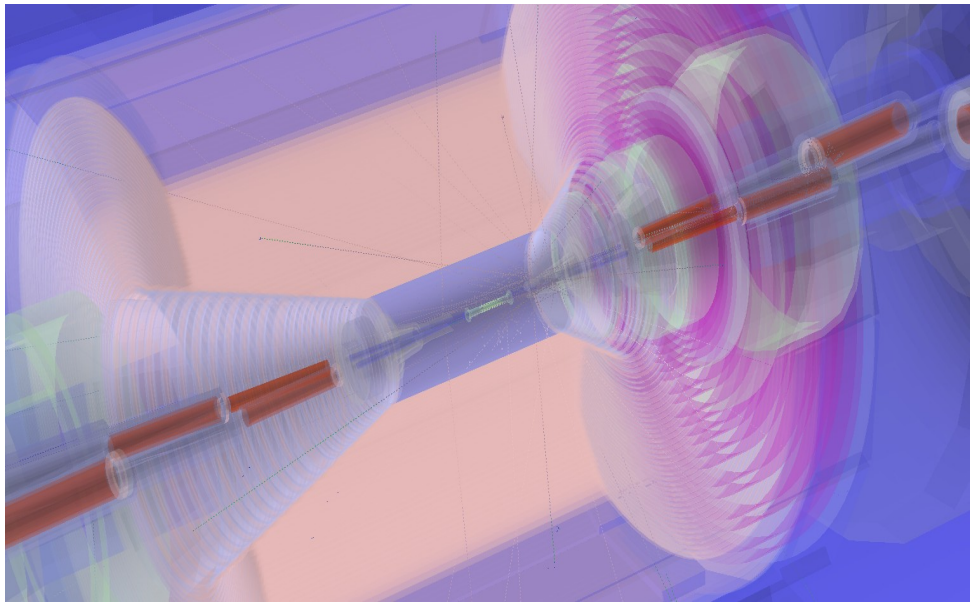
- Where to put them (horizontal or vertical)?
- Expected rates (from the different types of backgrounds)?
- Dose rates?

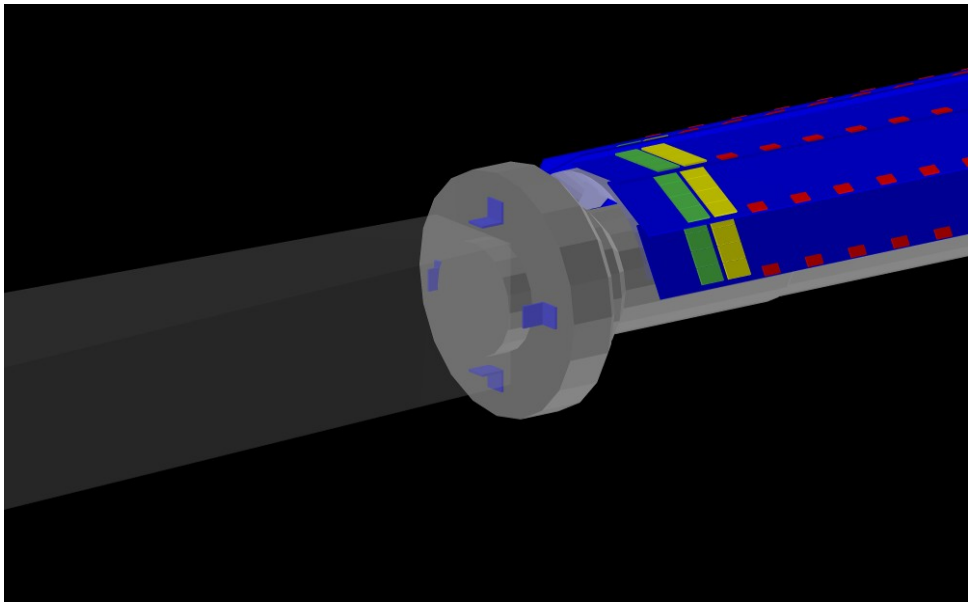
Neutrons on the ASICs:

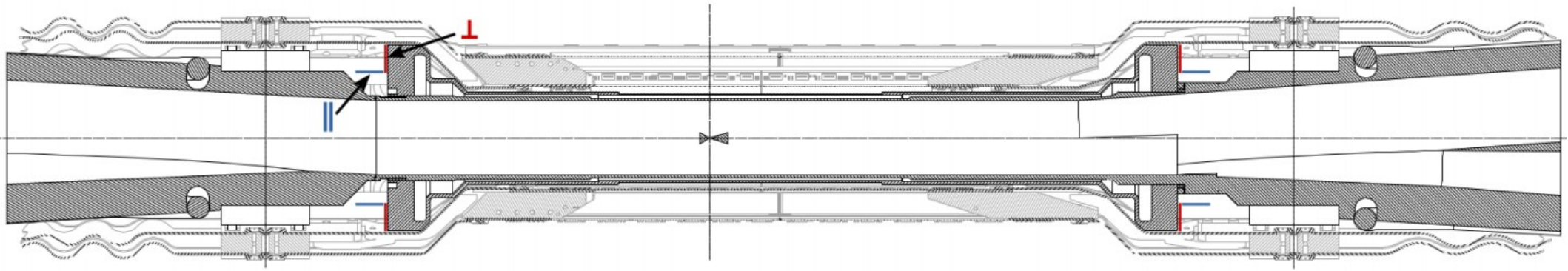
Are ASICs safe during phase 2/3?

Important Note: nominal luminosity has been considered for these studies!

Diamond sensors



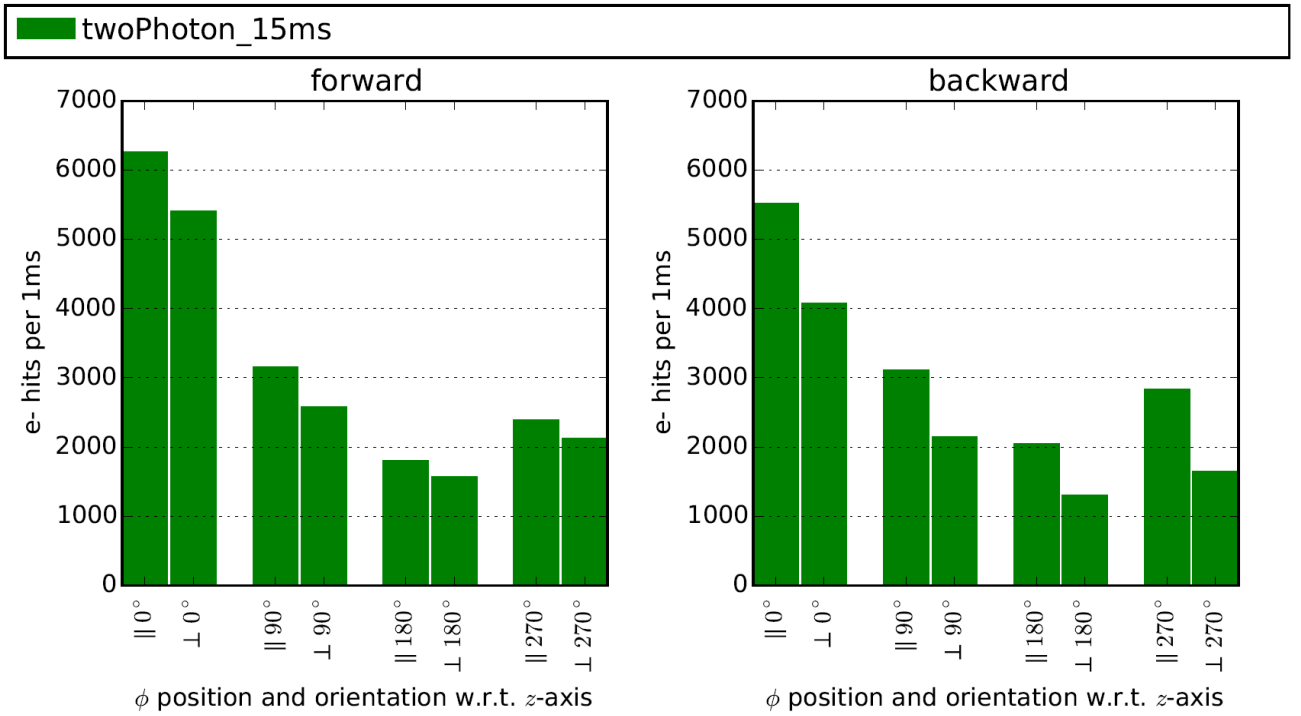




4 sensors in each direction positioned at φ=0, 90, 180, 270 [deg] with 2 possible configurations, one parallel and one orthogonal to the z-axis.

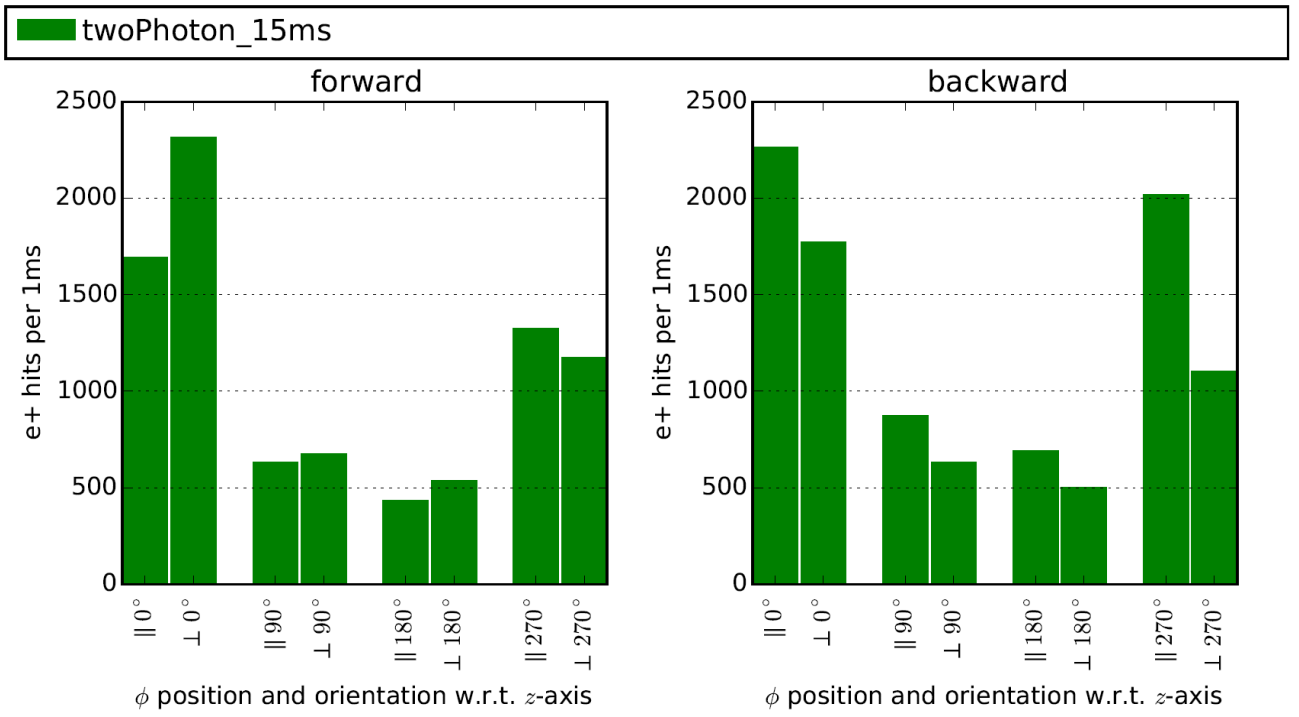
2-photon Background

Particle fluence (e^-) as a function of sensor position and orientation wrt to z-axis



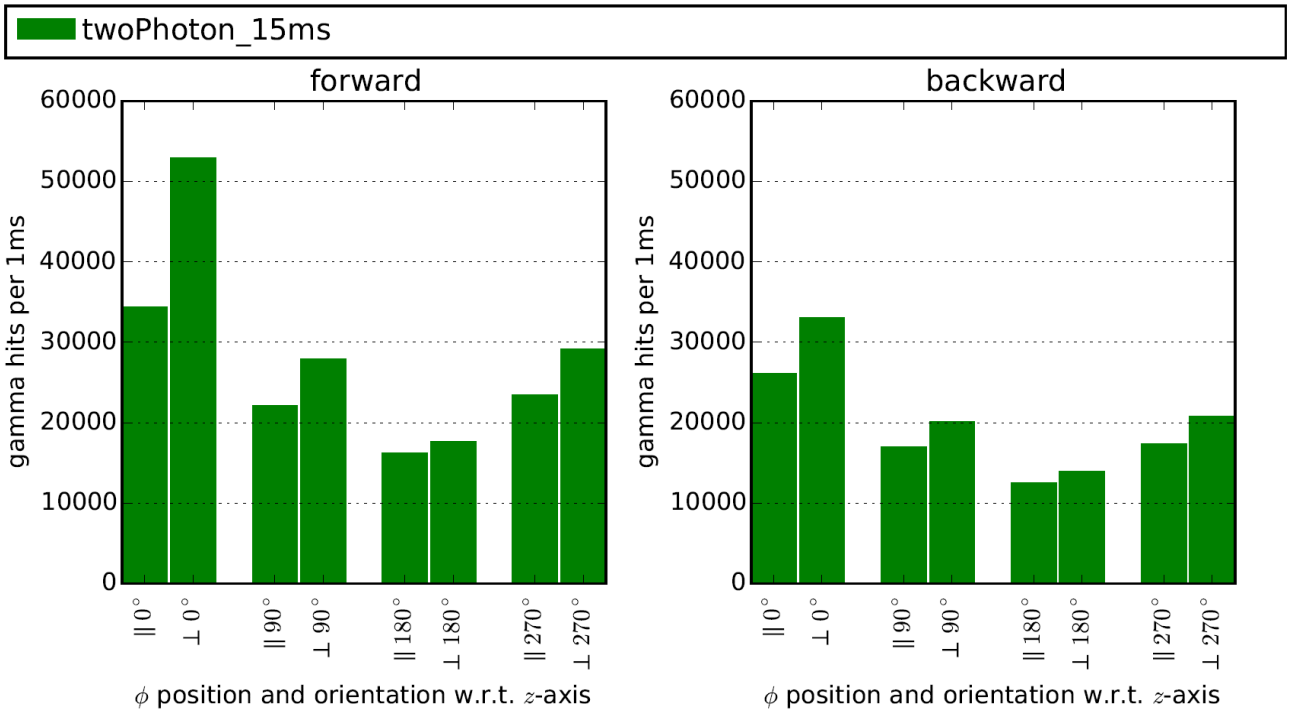
2-photon Background

Particle fluence (e^+) as a function of sensor position and orientation wrt to z-axis



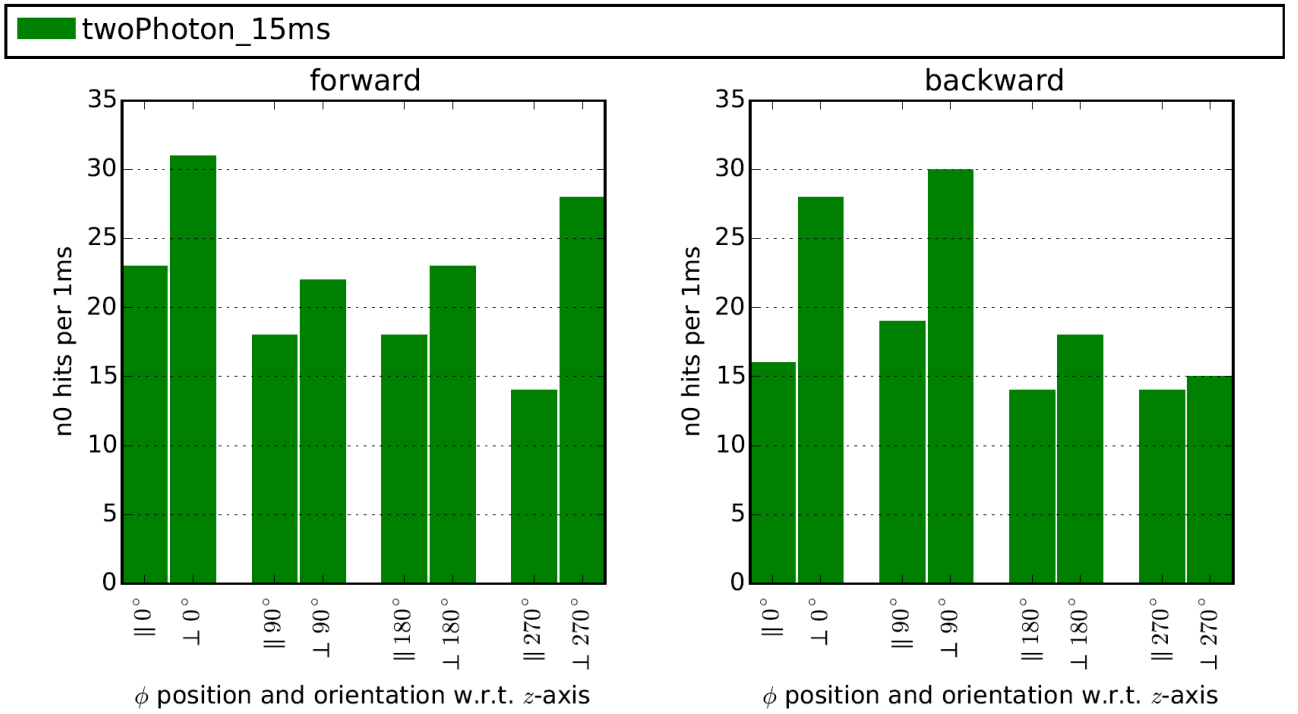
2-photon Background

Particle fluence (γ) as a function of sensor position and orientation wrt to z-axis



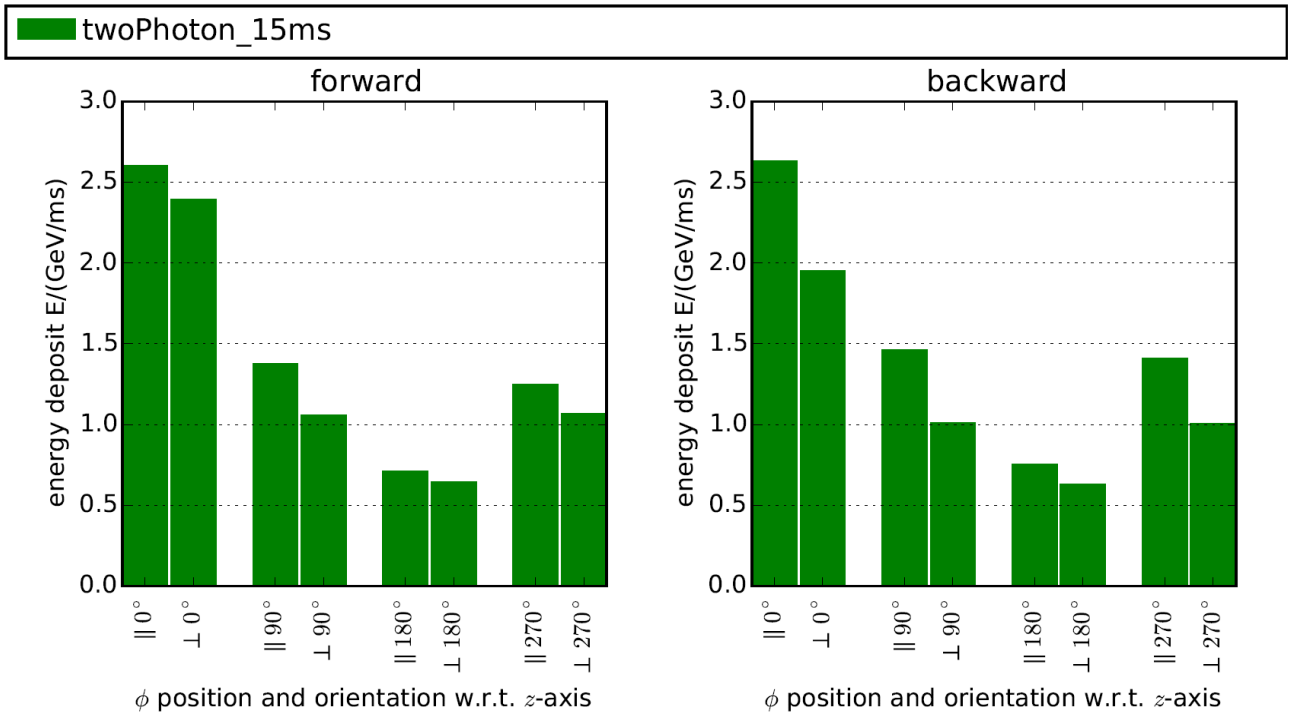
2-photon Background

Particle fluence (n) as a function of sensor position and orientation wrt to z-axis



2-photon Background

Energy deposit as a function of sensor position and orientation wrt to z-axis



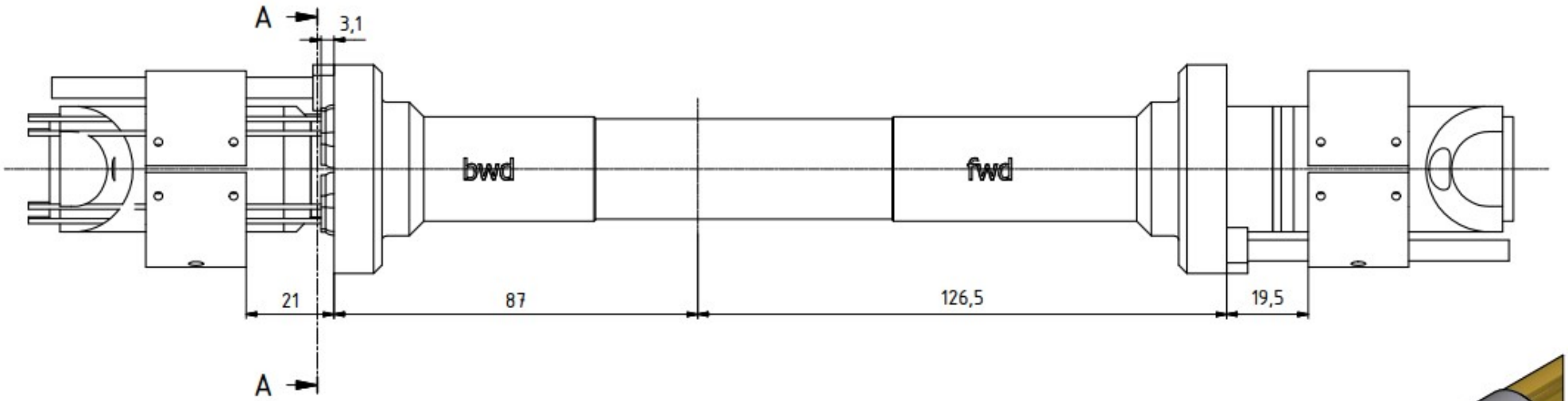
Total expected energy deposit for phi=0, orientation parallel to the beams is
~640 (330 ⊥) GeV/s for the forward direction and ~315 (227 ⊥) GeV/s in the backward direction

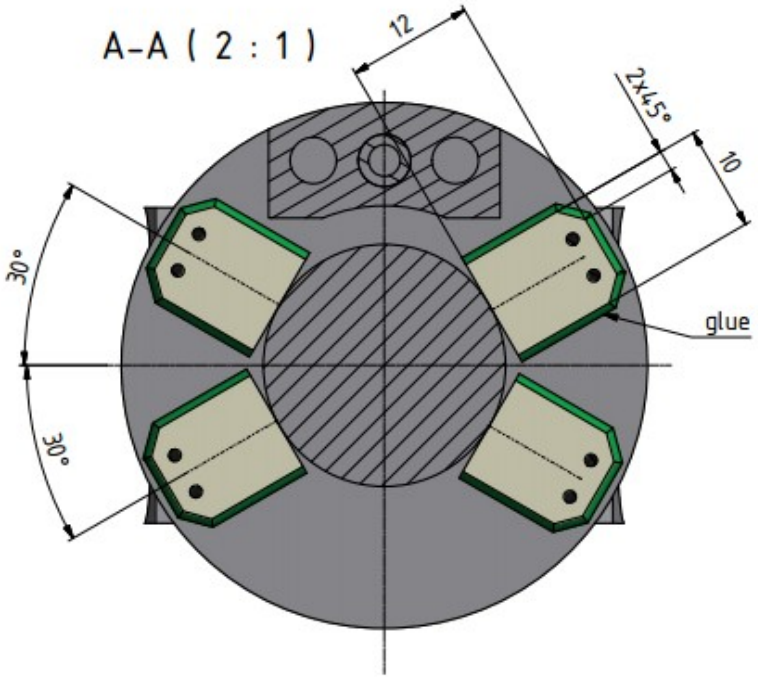
Forward direction:

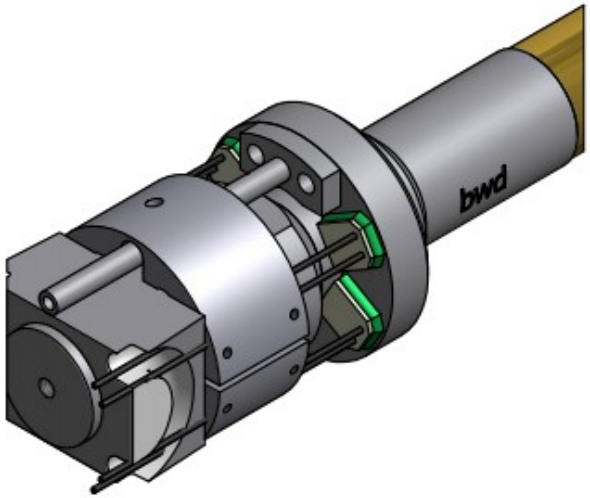
173 (160 ⊥) GeV from 2-photon
450 (150 ⊥) GeV from RBB (HER)
20 (18 ⊥) GeV from Touschek (LER)

Backward direction:

173 (127 ⊥) GeV from 2-photon
100 (70 ⊥) GeV from RBB (LER)
30 (30 ⊥) GeV from Touschek (LER)







-0,1 +0,1

Hauptprojektion

Max-Planck-Institut für Physik
(Werner-Heisenberg-Institut)
München

Gewicht.....: -
Dimensionen : mm
Maße ohne Toleranzangabe nach
DIN ISO 2768 m K

	Tag	Name
gezeichnet	03.10.2014	K. Ackermann
geprueft		
geplottet		

Projekt

Werkstoff

Maßstab

very small Diamond (12x10x3.1)

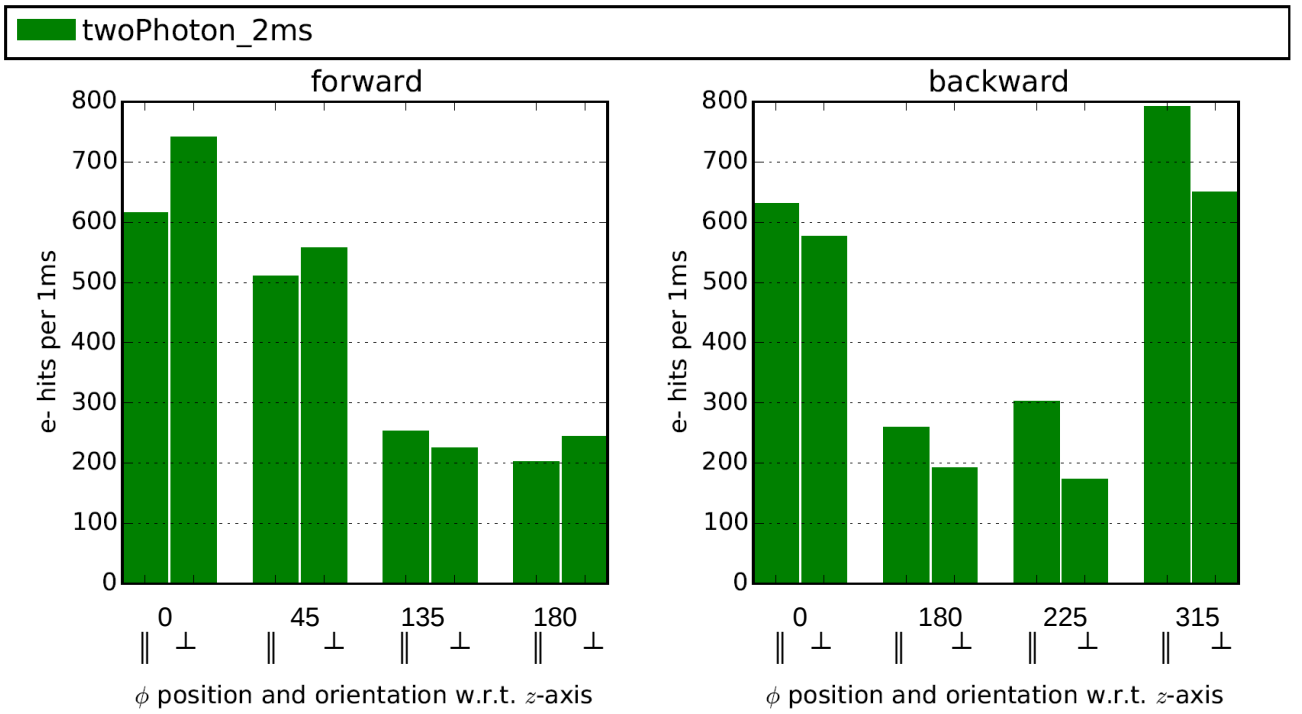
Teil:

Zeichnungsnummer / EDV Nr.:
106-013300-006.idw

Software.....: Inventor 2011
Blatt: 1 Gesamtzahl: 1 V12.b
DIN EN 20 216 - A3 (297 x 420)

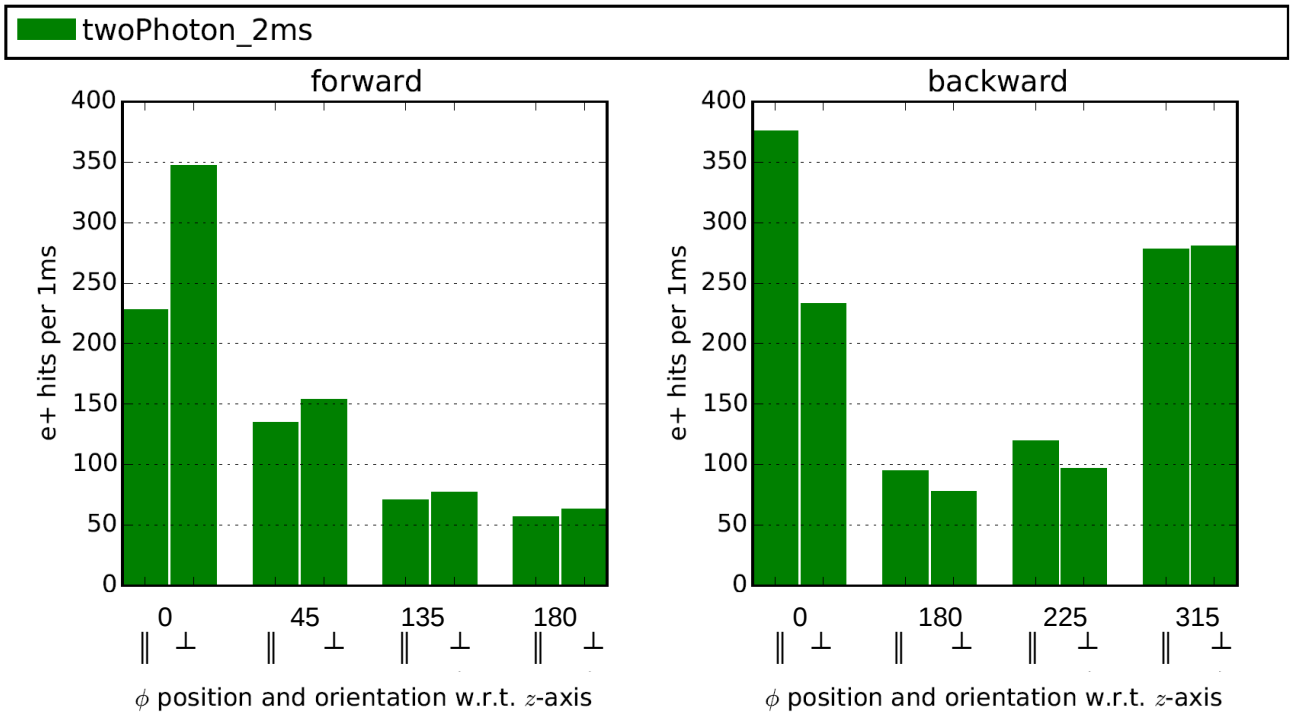
2-photon Background

Particle fluence (e^-) as a function of sensor position and orientation wrt to z-axis



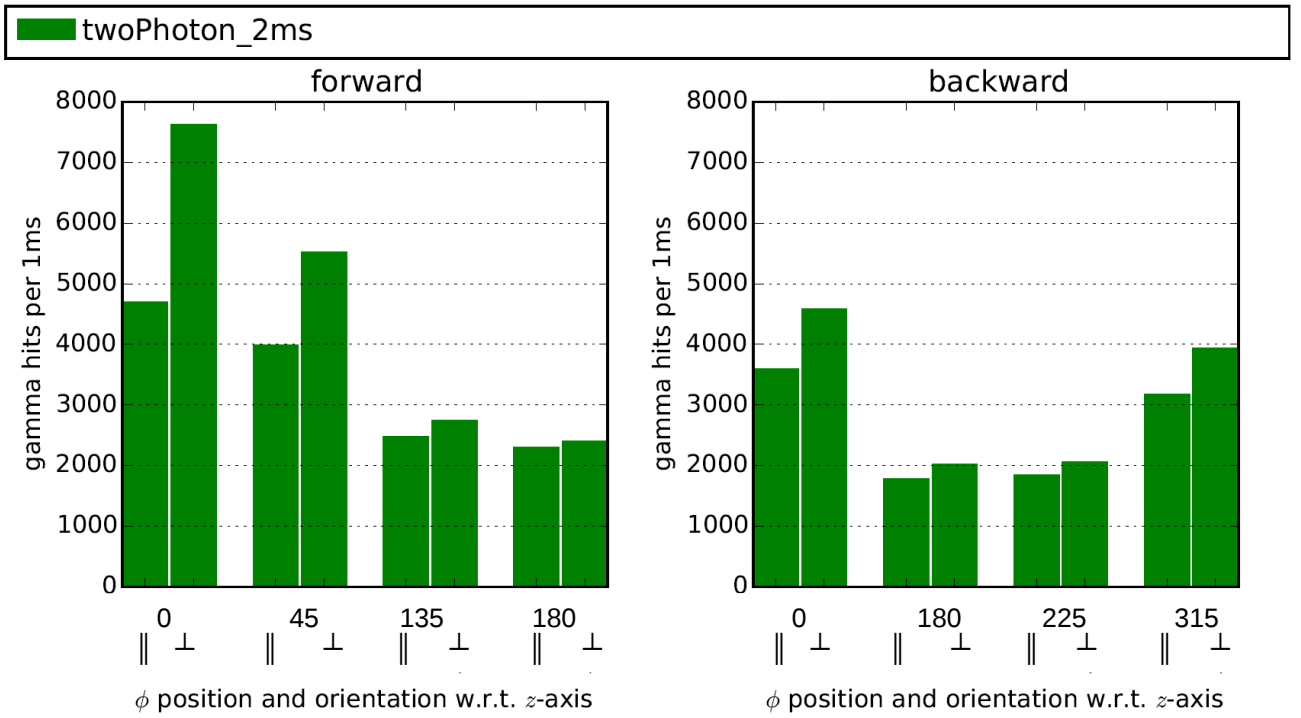
2-photon Background

Particle fluence (e^+) as a function of sensor position and orientation wrt to z-axis



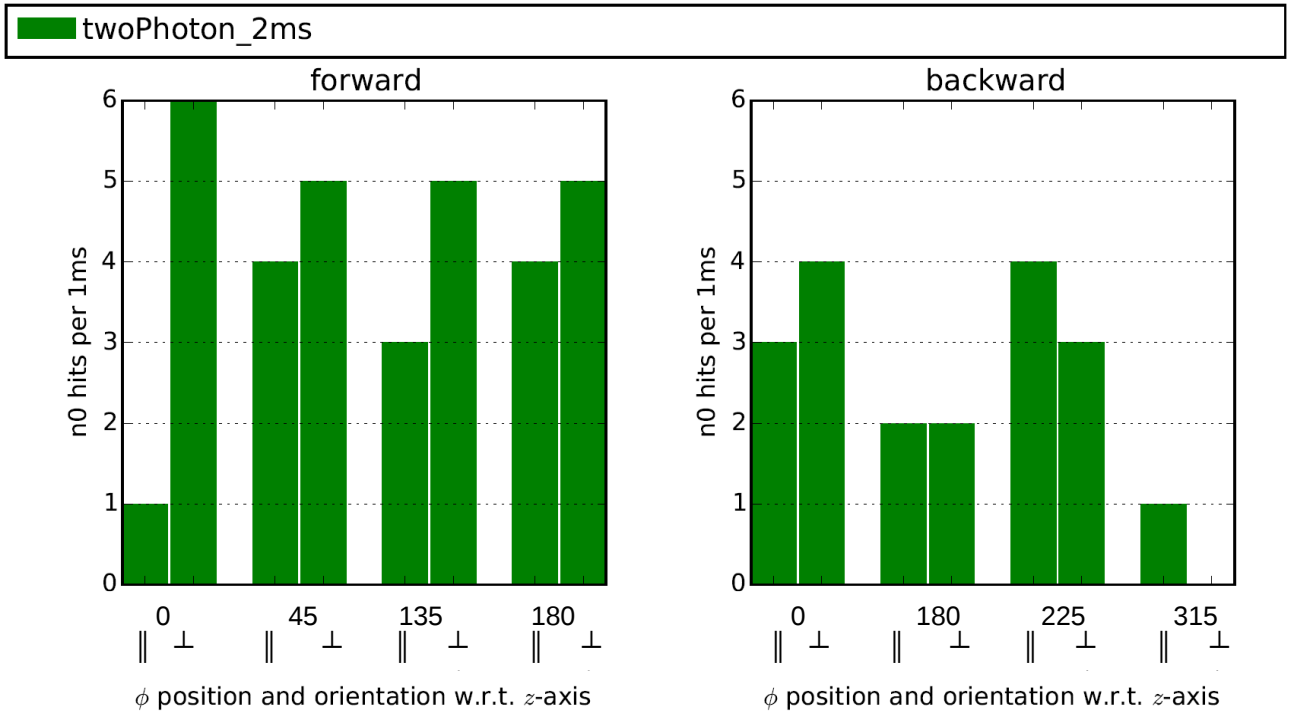
2-photon Background

Particle fluence (γ) as a function of sensor position and orientation wrt to z-axis



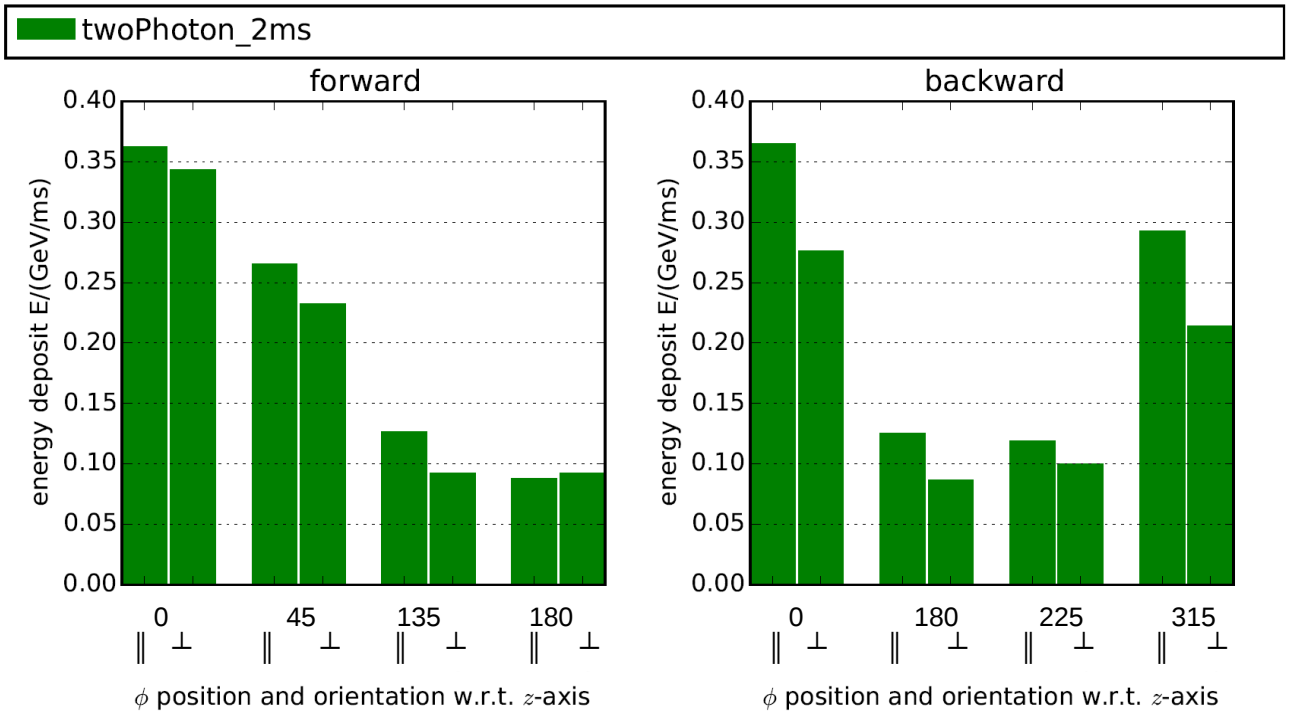
2-photon Background

Particle fluence (n) as a function of sensor position and orientation wrt to z-axis



2-photon Background

Energy deposit as a function of sensor position and orientation wrt to z-axis



Total expected energy deposit for phi=0, orientation parallel to the beams is
~645 (350 ⊥) GeV/s for the forward direction and ~322(250 ⊥) GeV/s in the backward direction

Forward direction:

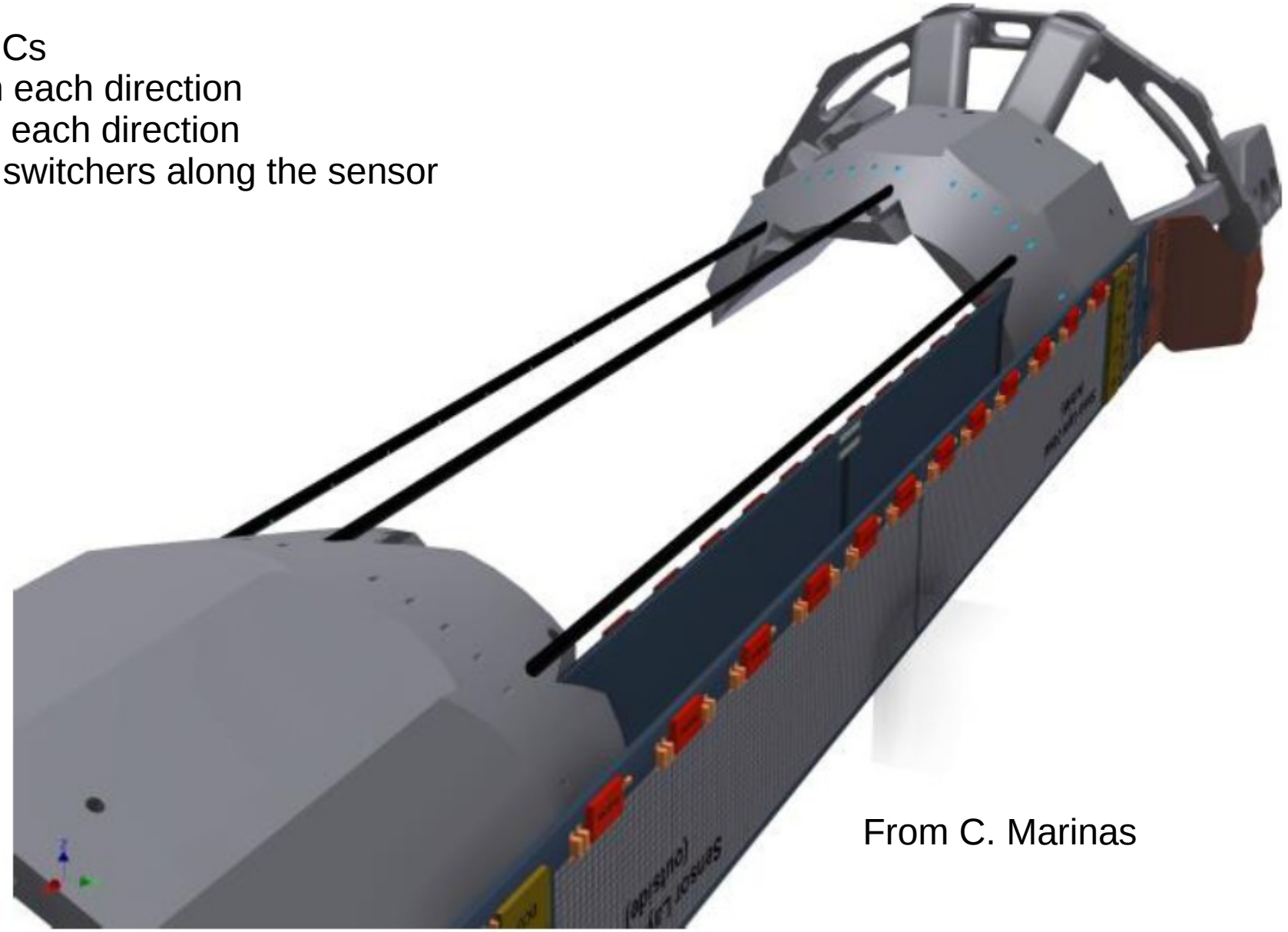
180 (170 ⊥) GeV from 2-photon
446 (160 ⊥) GeV from RBB (HER)
19 (20 ⊥) GeV from Touschek (LER)

Backward direction:

180 (135 ⊥)GeV from 2-photon
103 (75 ⊥)GeV from RBB (LER)
39 (39 ⊥)GeV from Touschek (LER)

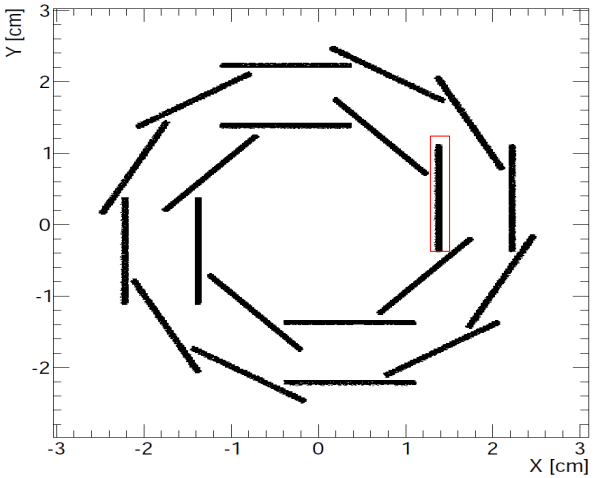
Neutrons on PXD-ASICs

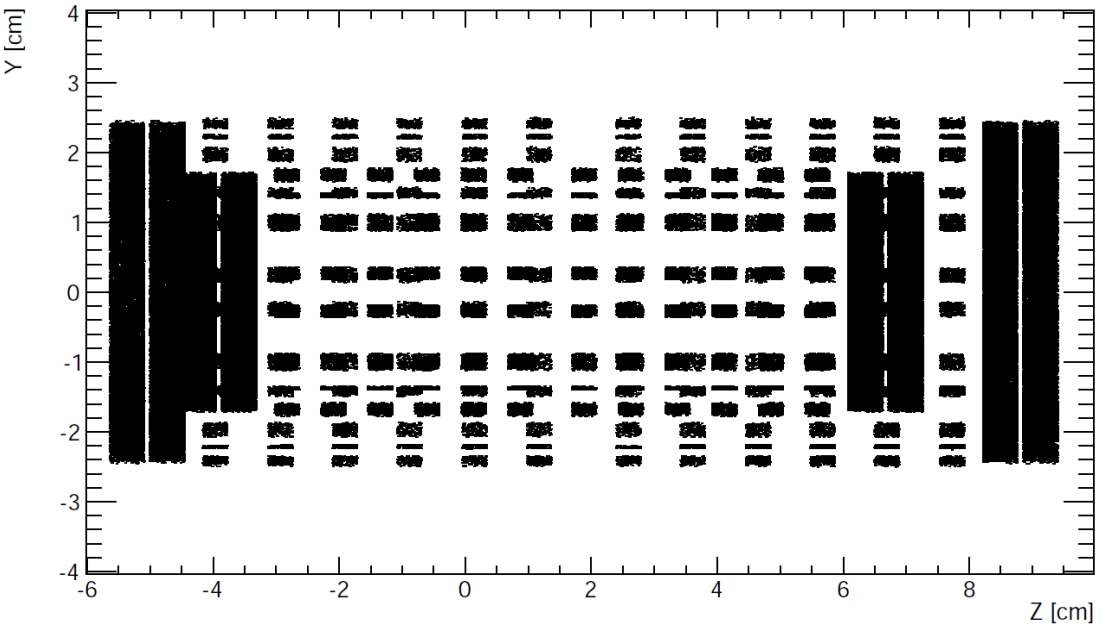
PXD-ASICs
4 DCD in each direction
4 DHP in each direction
12 (6+6) switchers along the sensor

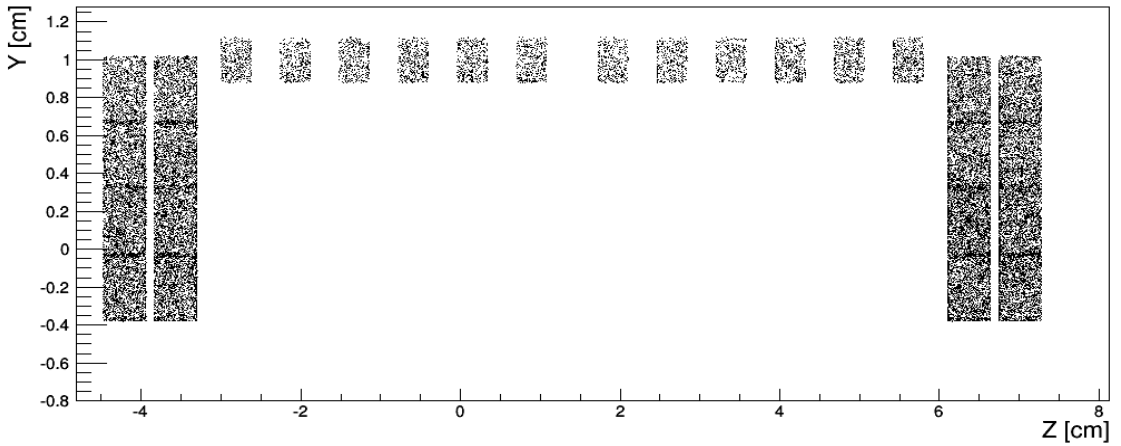


From C. Marinas

Fluence (any particle) on PXD-ASICs





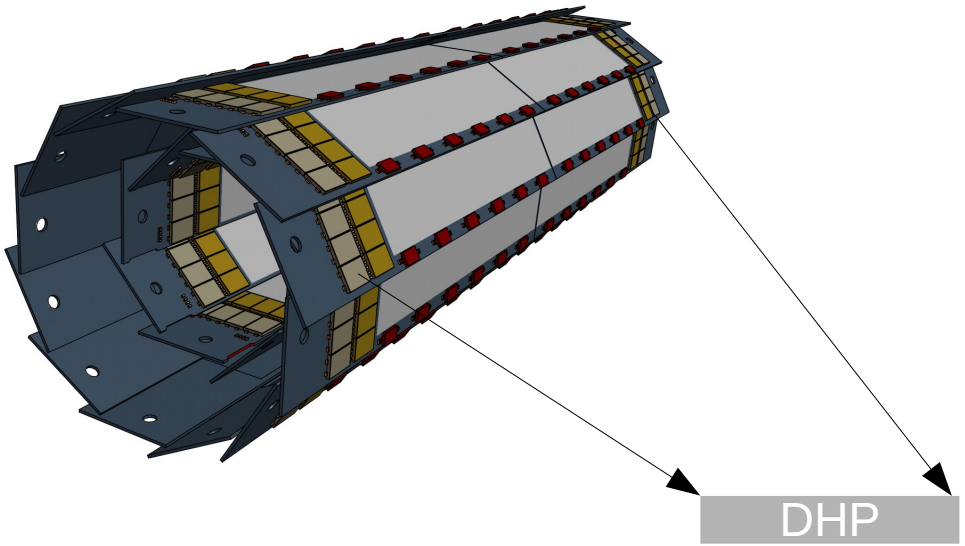


Neutron fluence (n per cm2s)in DHP_B for Layer 1 and Ladder 1= 2002
Neutron fluence (n per cm2s)in DHP_B for Layer 1 and Ladder 2= 3718
Neutron fluence (n per cm2s)in DHP_B for Layer 1 and Ladder 3= 4004
Neutron fluence (n per cm2s)in DHP_B for Layer 1 and Ladder 4= 2860
Neutron fluence (n per cm2s)in DHP_B for Layer 1 and Ladder 5= 2860
Neutron fluence (n per cm2s)in DHP_B for Layer 1 and Ladder 6= 2860
Neutron fluence (n per cm2s)in DHP_B for Layer 1 and Ladder 7= 3432
Neutron fluence (n per cm2s)in DHP_B for Layer 1 and Ladder 8= 4862

Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 1= 2860
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 2= 1716
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 3= 2002
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 4= 4004
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 5= 2574
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 6= 1430
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 7= 2002
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 8= 4004
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 9= 3432
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 10= 1430
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 11= 286
Neutron fluence (n per cm2s)in DHP_B for Layer 2 and Ladder 12= 3718

Neutron fluence (n per cm2s)in DHP_F for Layer 1 and Ladder 1= 2860
Neutron fluence (n per cm2s)in DHP_F for Layer 1 and Ladder 2= 4576
Neutron fluence (n per cm2s)in DHP_F for Layer 1 and Ladder 3= 3146
Neutron fluence (n per cm2s)in DHP_F for Layer 1 and Ladder 4= 2288
Neutron fluence (n per cm2s)in DHP_F for Layer 1 and Ladder 5= 2288
Neutron fluence (n per cm2s)in DHP_F for Layer 1 and Ladder 6= 4576
Neutron fluence (n per cm2s)in DHP_F for Layer 1 and Ladder 7= 5148
Neutron fluence (n per cm2s)in DHP_F for Layer 1 and Ladder 8= 4576

Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 1= 3432
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 2= 6864
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 3= 4004
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 4= 4290
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 5= 4004
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 6= 2860
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 7= 2002
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 8= 4290
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 9= 3718
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 10= 4004
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 11= 286
Neutron fluence (n per cm2s)in DHP_F for Layer 2 and Ladder 12= 5148



Max number of neutrons ($cm^{-2}s^{-1}$)

Layer1 DHP_B: 4862

Layer2 DHP_B: 4004

Layer1 DHP_F: 5148

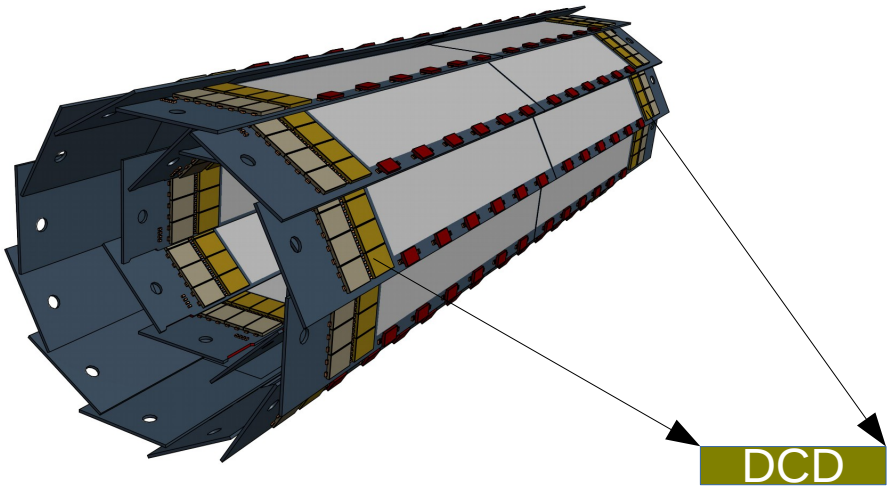
Layer2 DHP_F: 5148

Neutron fluence (n per cm2s)in DCD_B for Layer 1 and Ladder 1= 2484
Neutron fluence (n per cm2s)in DCD_B for Layer 1 and Ladder 2= 2760
Neutron fluence (n per cm2s)in DCD_B for Layer 1 and Ladder 3= 2208
Neutron fluence (n per cm2s)in DCD_B for Layer 1 and Ladder 4= 2484
Neutron fluence (n per cm2s)in DCD_B for Layer 1 and Ladder 5= 828
Neutron fluence (n per cm2s)in DCD_B for Layer 1 and Ladder 6= 1932
Neutron fluence (n per cm2s)in DCD_B for Layer 1 and Ladder 7= 1104
Neutron fluence (n per cm2s)in DCD_B for Layer 1 and Ladder 8= 2760

Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 1= 1932
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 2= 3036
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 3= 2208
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 4= 3036
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 5= 3036
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 6= 2208
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 7= 3312
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 8= 3588
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 9= 3588
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 10= 3588
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 11= 0
Neutron fluence (n per cm2s)in DCD_B for Layer 2 and Ladder 12= 2484

Neutron fluence (n per cm2s)in DCD_F for Layer 1 and Ladder 1= 1656
Neutron fluence (n per cm2s)in DCD_F for Layer 1 and Ladder 2= 4416
Neutron fluence (n per cm2s)in DCD_F for Layer 1 and Ladder 3= 2484
Neutron fluence (n per cm2s)in DCD_F for Layer 1 and Ladder 4= 2760
Neutron fluence (n per cm2s)in DCD_F for Layer 1 and Ladder 5= 2484
Neutron fluence (n per cm2s)in DCD_F for Layer 1 and Ladder 6= 828
Neutron fluence (n per cm2s)in DCD_F for Layer 1 and Ladder 7= 4692
Neutron fluence (n per cm2s)in DCD_F for Layer 1 and Ladder 8= 1932

Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 1= 4692
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 2= 3588
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 3= 5796
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 4= 2760
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 5= 3312
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 6= 4968
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 7= 2484
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 8= 2208
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 9= 2760
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 10= 4140
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 11= 276
Neutron fluence (n per cm2s)in DCD_F for Layer 2 and Ladder 12= 6348



Max number of neutrons ($cm^{-2}s^{-1}$)

Layer1 DCD_B: 2760

Layer2 DCD_B: 3588

Layer1 DCD_F: 4692

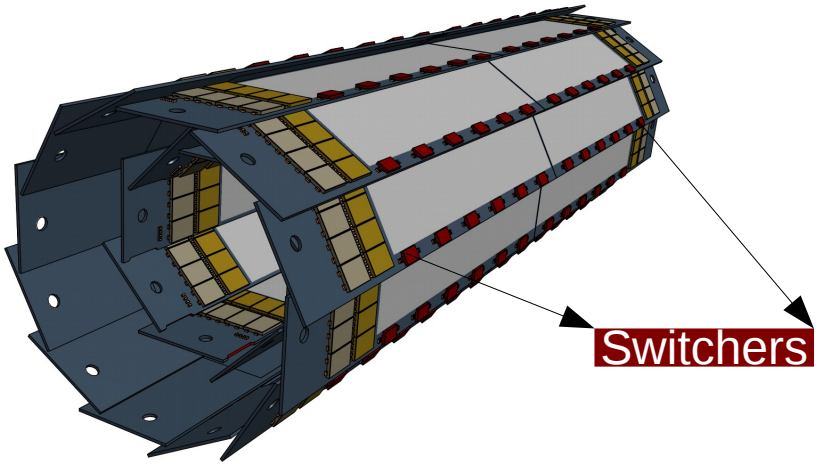
Layer2 DCD_F: 6348

Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 1 and Ladder 1= 2736
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 1 and Ladder 2= 3192
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 1 and Ladder 3= 4560
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 1 and Ladder 4= 3192
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 1 and Ladder 5= 912
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 1 and Ladder 6= 4560
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 1 and Ladder 7= 2736
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 1 and Ladder 8= 2736

Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 1= 1824
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 2= 3192
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 3= 2280
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 4= 3192
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 5= 3192
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 6= 2736
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 7= 2280
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 8= 2280
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 9= 4104
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 10= 4104
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 11= 5472
Neutron fluence (n per cm2s)in SWITCHERS_B for Layer 2 and Ladder 12= 4104

Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 1 and Ladder 1= 3192
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 1 and Ladder 2= 2736
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 1 and Ladder 3= 1824
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 1 and Ladder 4= 3648
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 1 and Ladder 5= 2736
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 1 and Ladder 6= 3648
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 1 and Ladder 7= 2280
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 1 and Ladder 8= 3648

Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 1= 3648
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 2= 2736
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 3= 1368
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 4= 2280
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 5= 1368
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 6= 1824
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 7= 2280
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 8= 4560
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 9= 2736
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 10= 2280
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 11= 2280
Neutron fluence (n per cm2s)in SWITCHERS_F for Layer 2 and Ladder 12= 3192



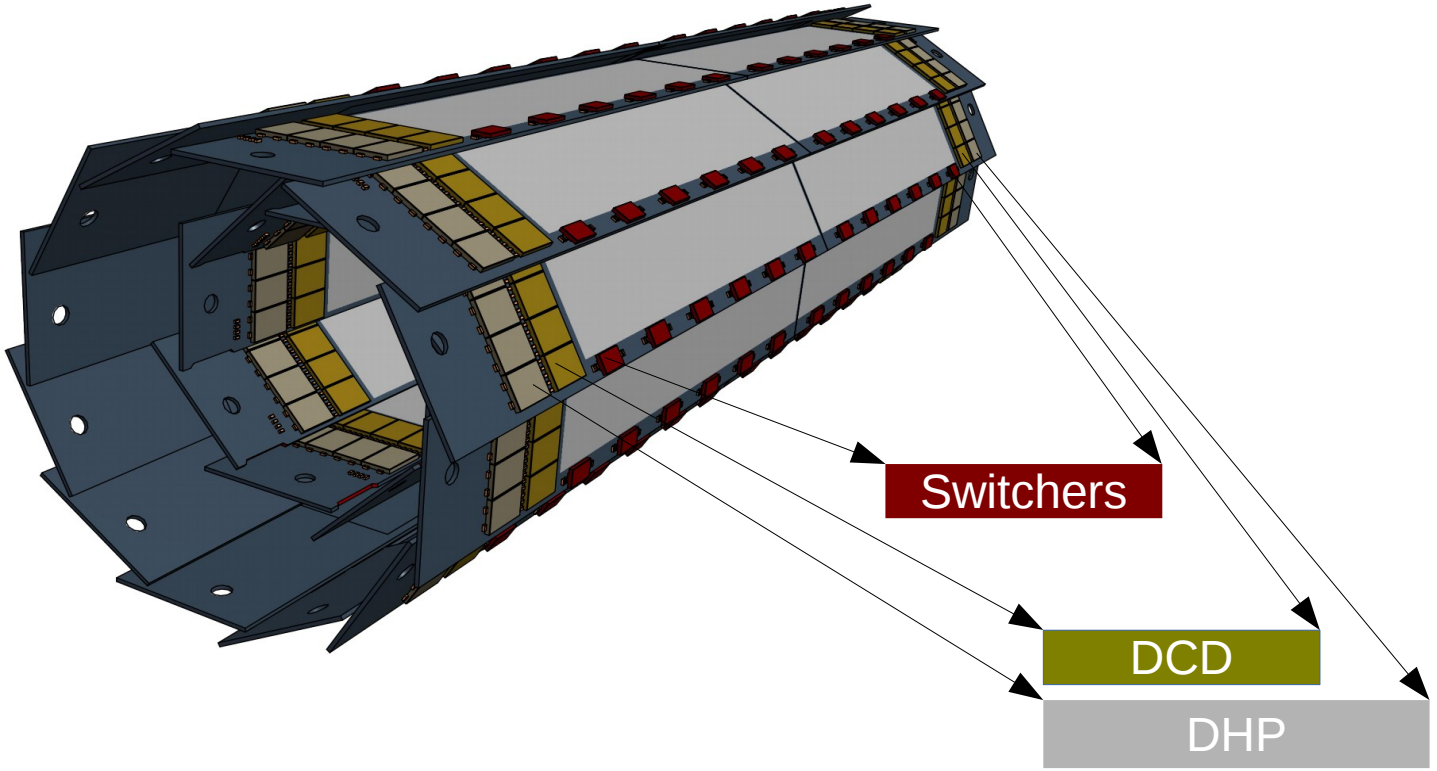
Max number of neutrons ($cm^{-2}s^{-1}$)

Layer1 SWITCHER_B: 4560

Layer2 SWITCHER_B: 5472

Layer1 SWITCHER_F: 3648

Layer2 SWITCHER_F: 4560



Entries for all ladders

Combination of 2-photon + RBB + Touschek still gives a fluence expressed as the number of neutrons per cm^2 per s smaller than 20000: ASICS are safe!

A file with detailed information about all these contribution has been forwarded to Carlos Marinas, just let me know if you need a copy of it

Comments

Background rates have been studied for diamond sensors at different phi position and orientation.

Due previous discussion on potential lack of statistics I have considered a larger integration time (15 ms vs 1 ms).
15 ms results confirms previous results and add more details to the study.
For both it is found that similar rates are expected at a given phi-position of the sensor for parallel and orthogonal orientation, however results show a slightly larger energy deposit in the parallel orientation and there seems to be a trend. A strong effect is more visible at phi=0 where the energy deposit in the parallel configuration is ~twice that in the orthogonal. One might consider this.

Neutrons rates on the PXD-ASICs have been studied and results show them to be well within tolerance rate design by a factor of ~100 indicating ASICs to be safe during phase 3.

Thank you for your attention and enjoy the rest of the workshop!