JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Barrel slice assembly

-Present status and ongoing preparations-

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PANDA CM, September 2017

HIC for FAIR
Helmholtz International Center

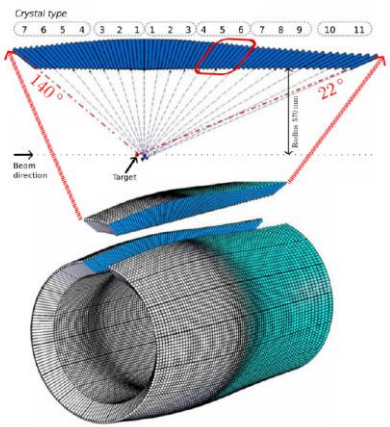
Reminder

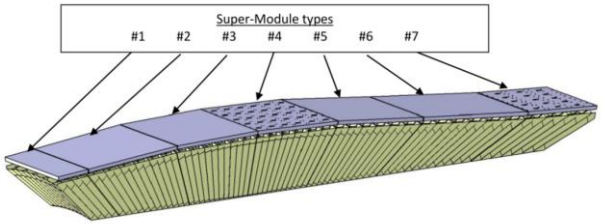
•Envisaged milestones:

Assembly of 1st full Barrel EMC slice

- Infrastructure ✓
- Mechanics (not approved yet) ✓
- 710 detectors ✓
  - 710 crystals in 11 different geometries ✓
  - 1420 APDS
    - Screening including irradiation ✓
    - Matching ✓
    - Glueing ✓
  - Capsules ✓
  - Wrapping ✓
  - •Assembly of 18 modules ✓

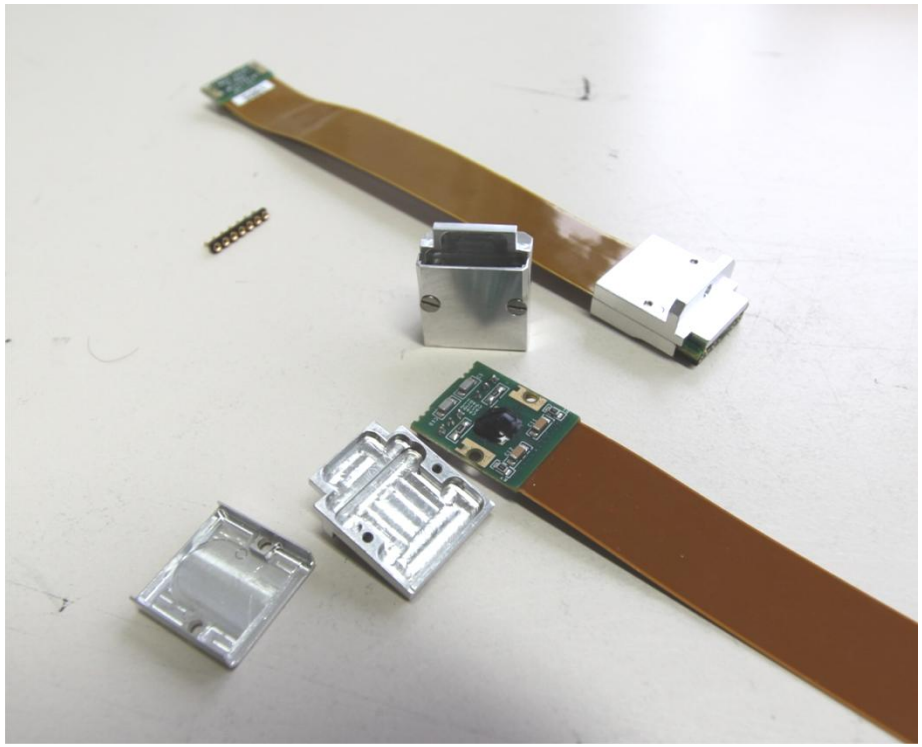
  - •Assembly of Supermodules
    - •360 left and 360 right handed APFEL-ASIC with flex PCBs
    - •ASIC housing or fixtures
  - •Assembly of slice
    - •Cooling
    - •Isolation
    - •Backplanes
    - •Cables
    - •Light pulser fiber coupling

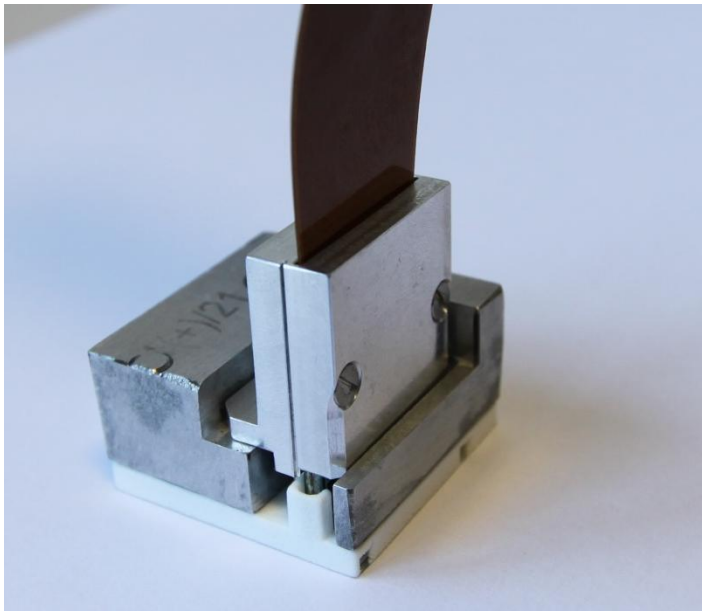




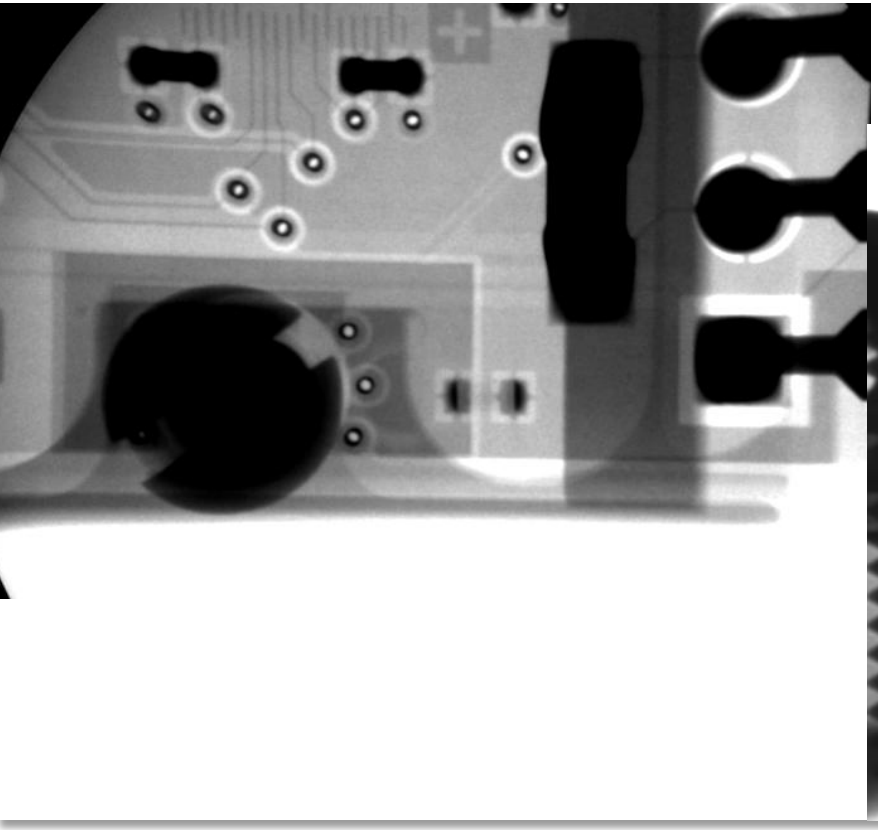
Inserts / ASIC fixture -first prototype review-

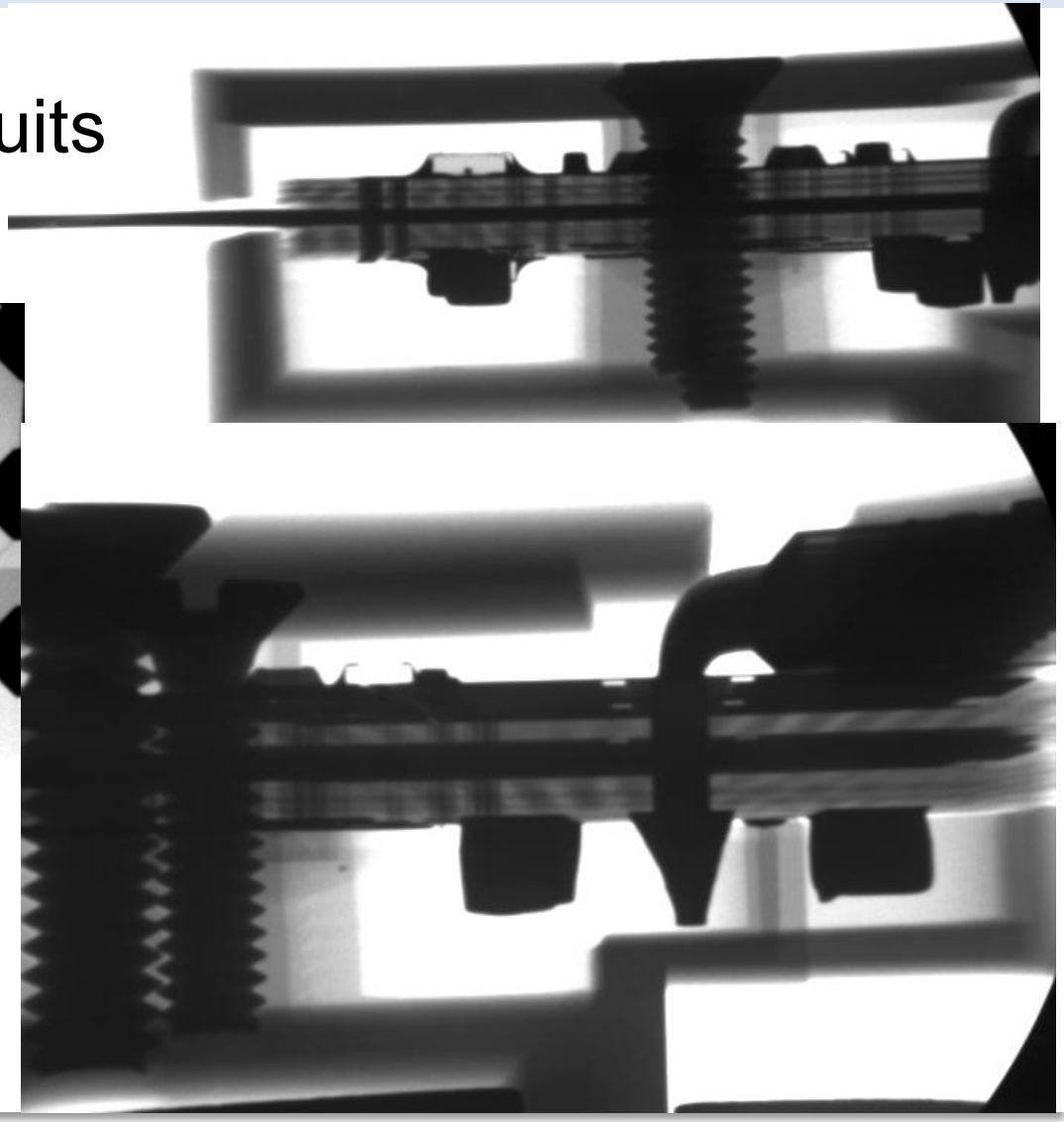
- Special ASIC fixture (housing) is needed for:
  - Reliable contact with APDs
  - Heat dissipation
  - Shielding





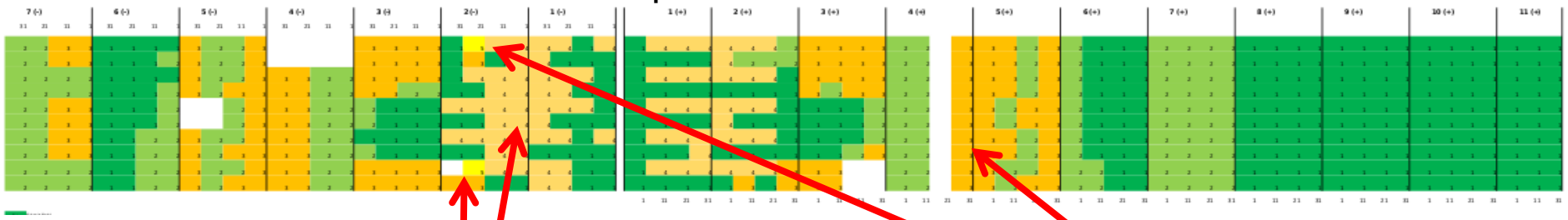
No danger of short circuits



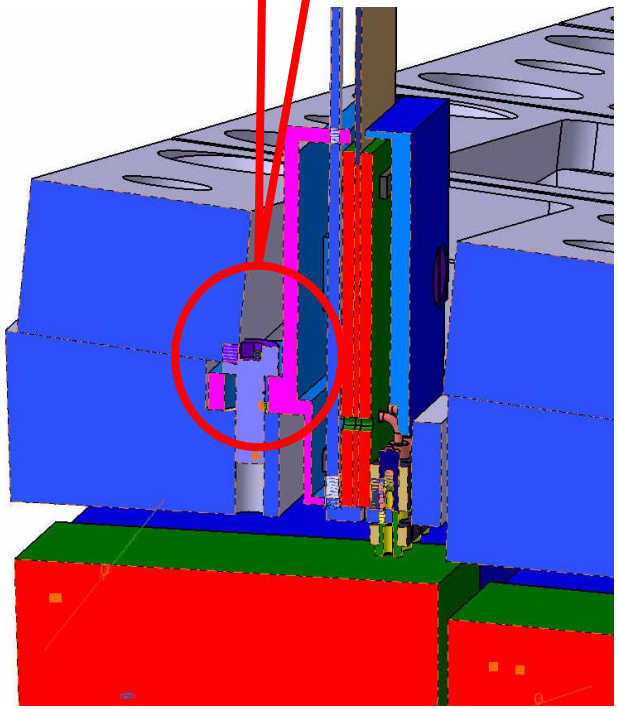


Inserts / ASIC fixture

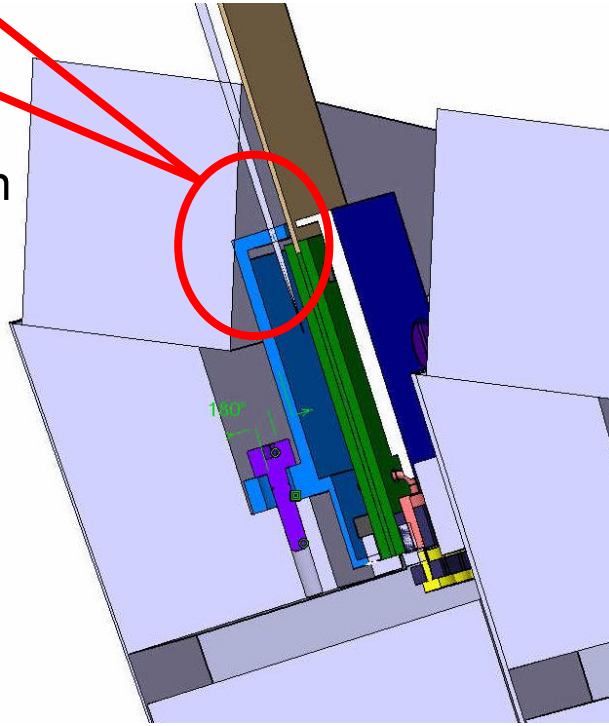
Slice overview
– two issues found in produced models and CAD model-



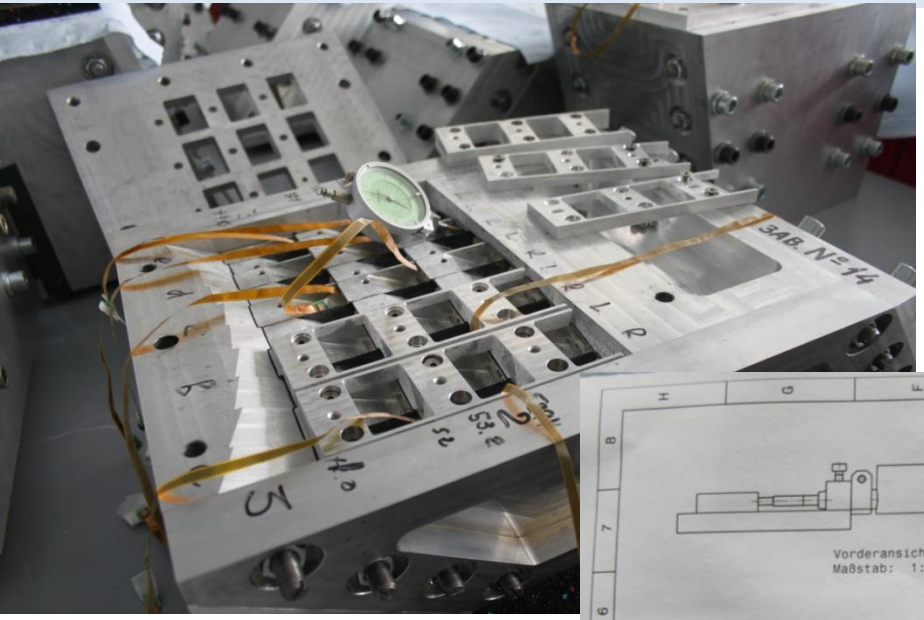
Not enough space for screw head



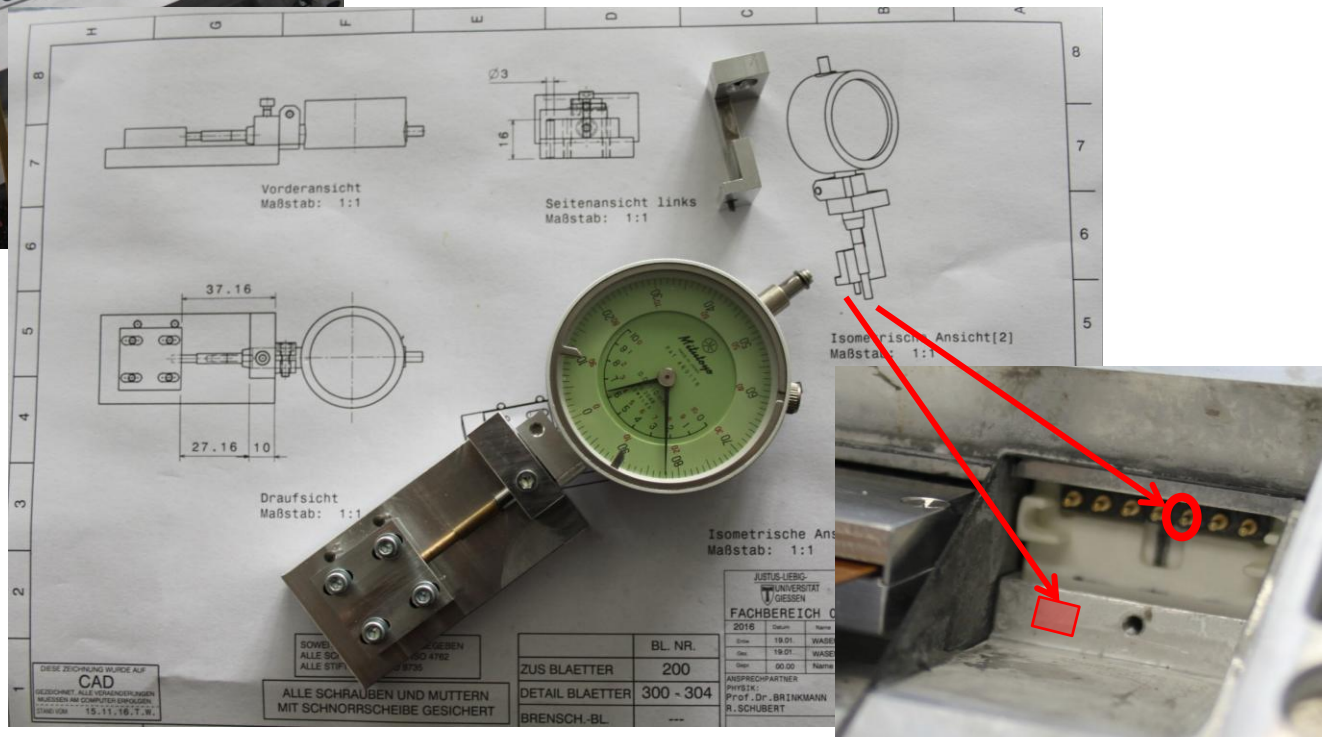
Not enough space for housing



Inserts / ASIC fixture



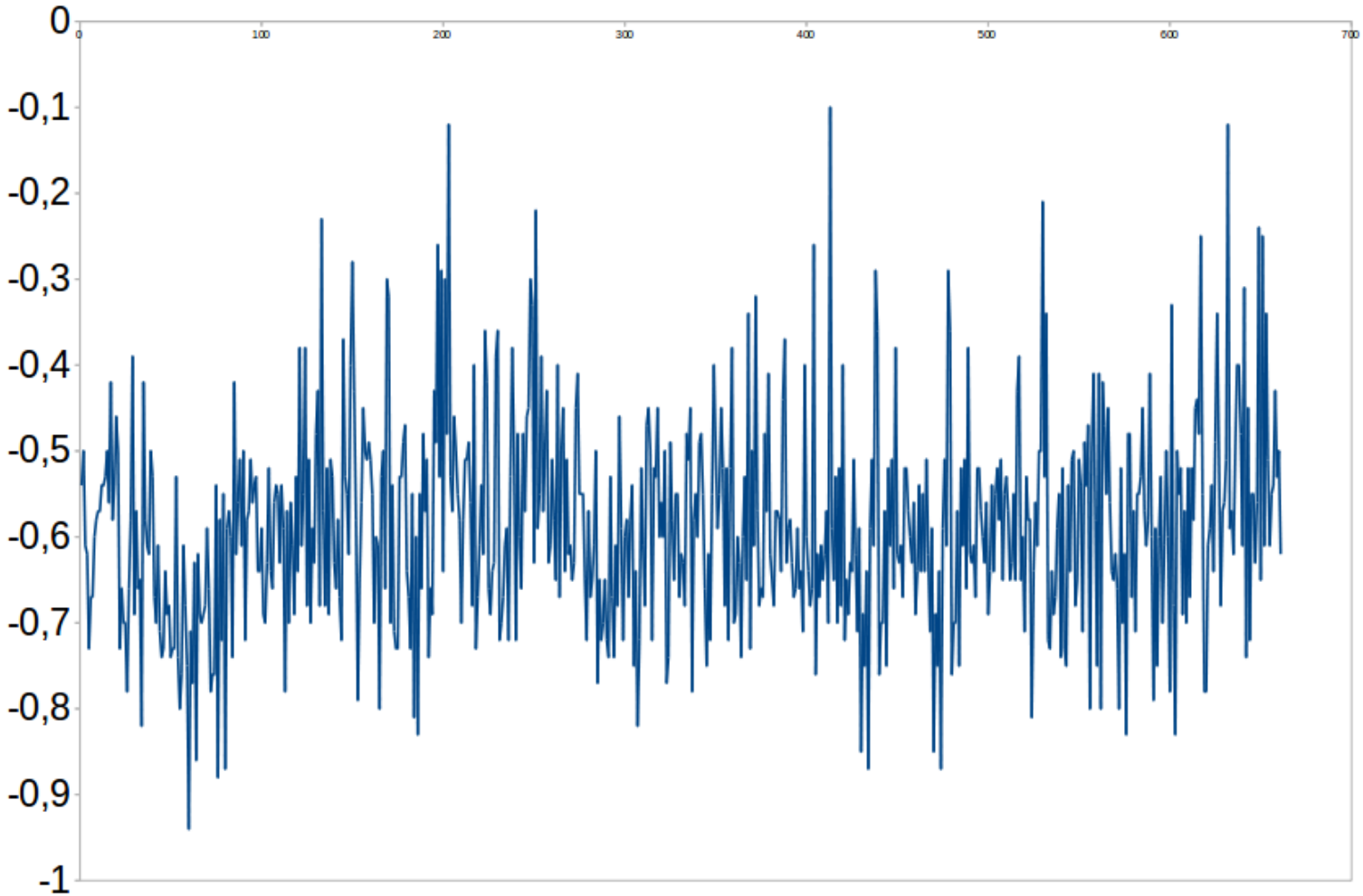
Precise distance is needed for reliable contact between ASCI and APDs



Inserts / ASIC fixture

mean: -0.59 mm
range: 0.84 mm

has to be considered in the fixture design



Support beam –Tests with dummy cables & backplanes-

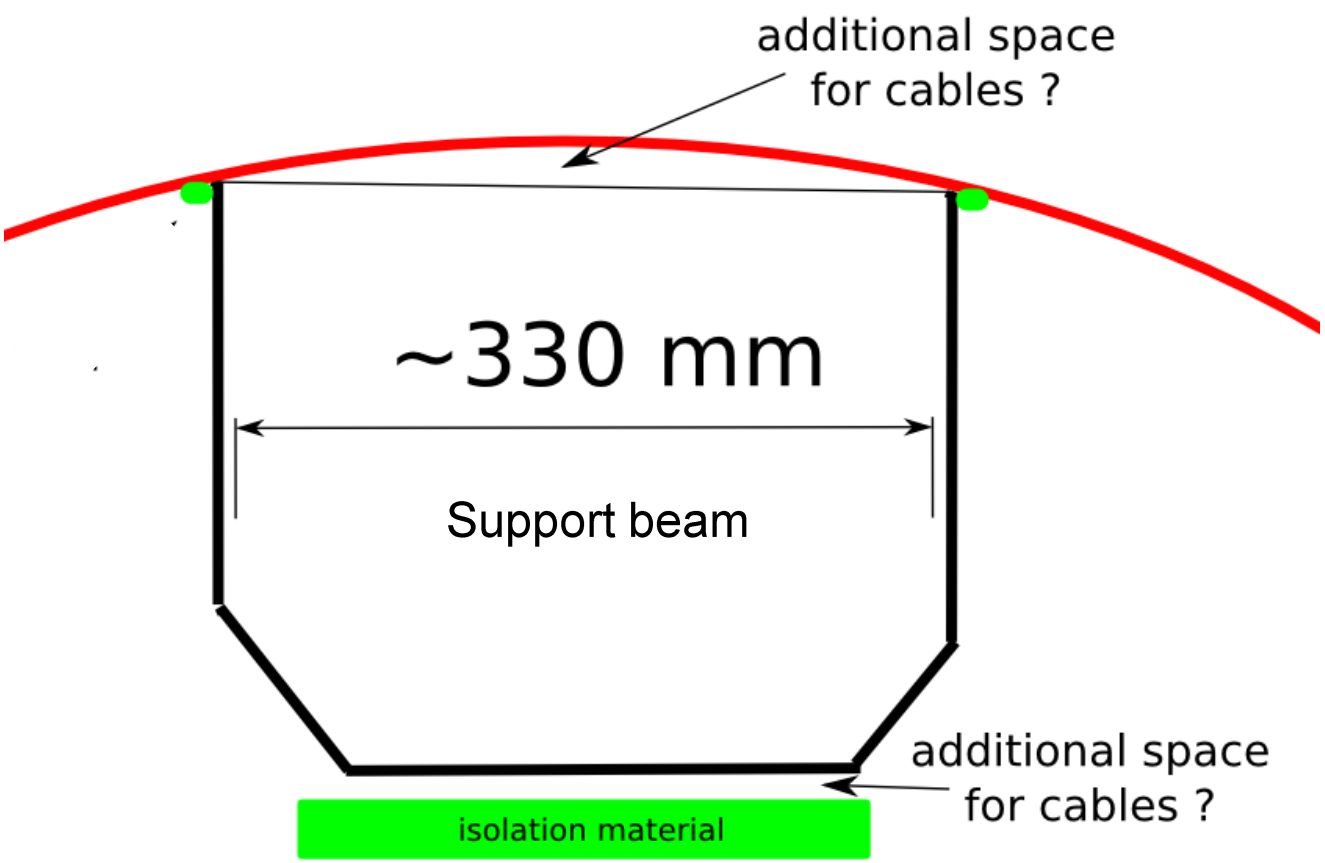
Good news:
All necessary cables will fit trough the window

Leftover space for backplanes will be very tight

Design of backplanes already on the limit

Very proper cable routing might help

Can we find more space elsewhere?



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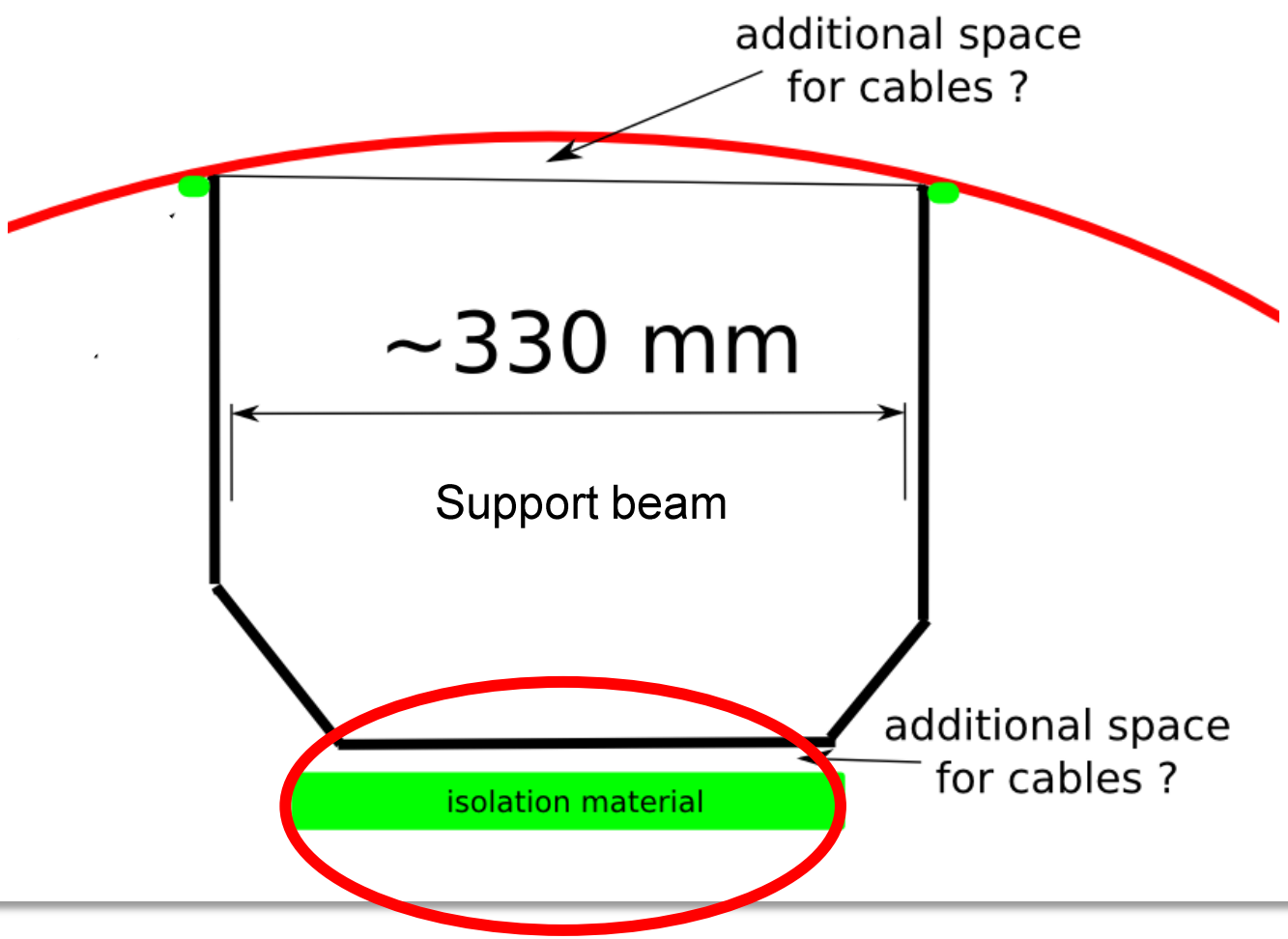

Proposal: Isolation Super-modules / Support-beam

- Since now: Rockwool under discussion
  - Advantages:
    - Price
    - Radiation hardness
    - All the FlexPCBs can go trough
  - Disadvantages:
    - Every Slice has to be isolated very carefully
    - No well defined process
    - Lose thermal isolation property in case of wetness (start of vicious circle)

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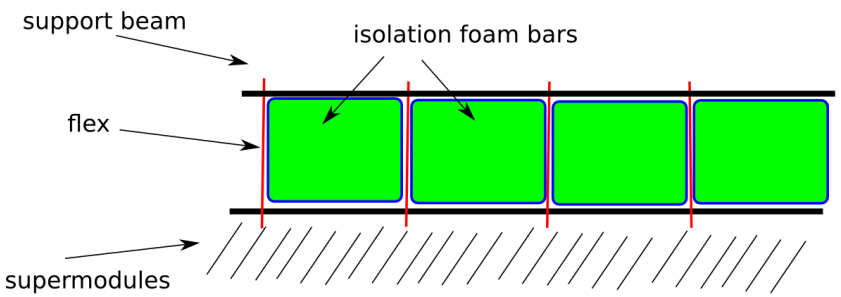
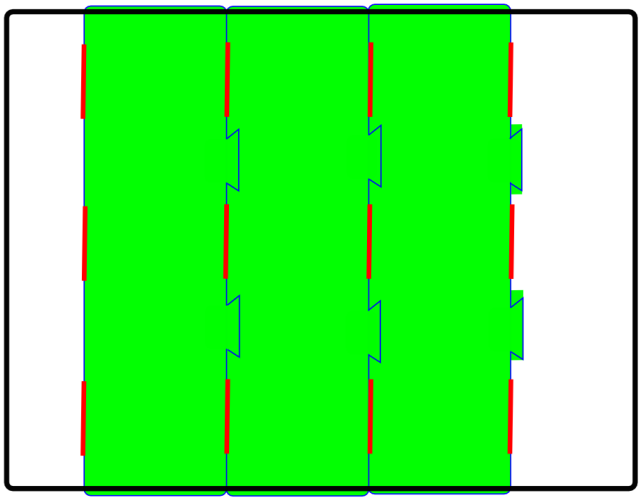
- **Proposal: puzzle shaped foam bars**
  - **Get rid of all disadvantages of Rockwool**
  - **Needs manpower for design**

side view:

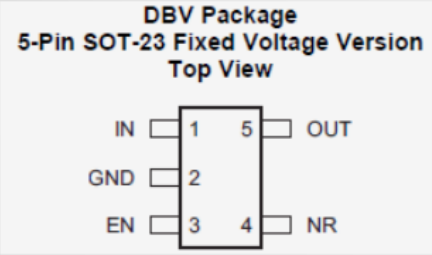


top view:

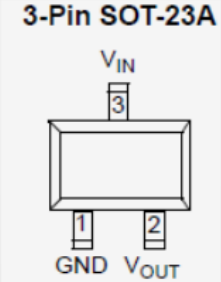


FEE: irradiation of voltage regulators for ASICs

- TPS79333
- Texas Instruments
- 200mA Low Drop Linear Regulator
- Fixed Output 3,3V
- Max Input 6V
- 5 Pins

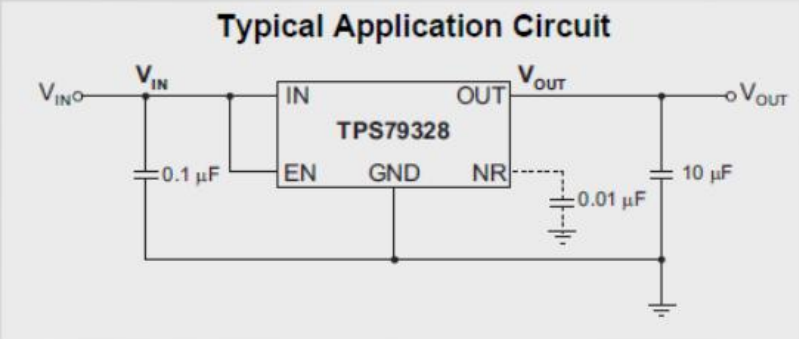


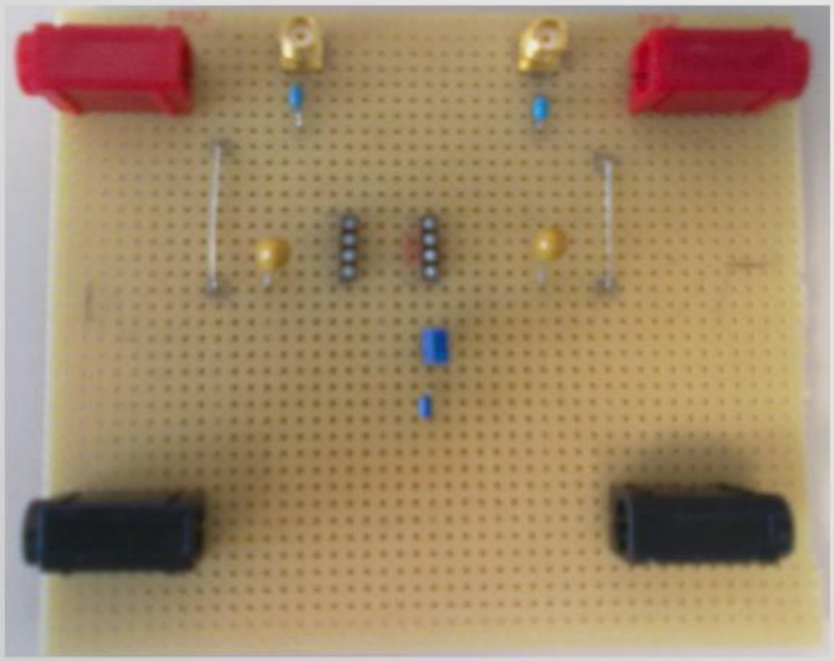
- MCP1703
- Microchip
- 250mA LDO Regulator
- Fixed Output 5 V
- Max Input 16 V
- 3 Pins

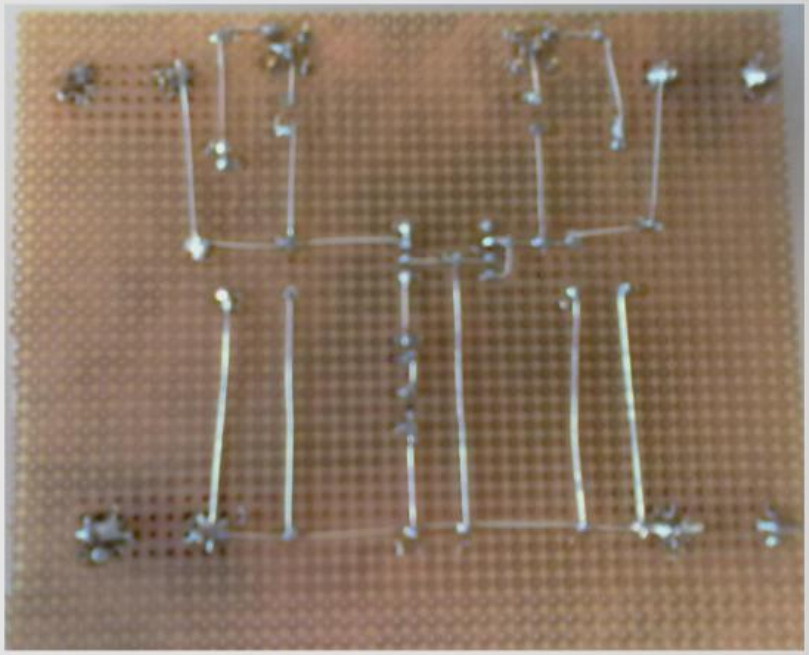


Bachelor-thesis Matthias Sachs

FEE: irradiation of voltage regulators for ASICs







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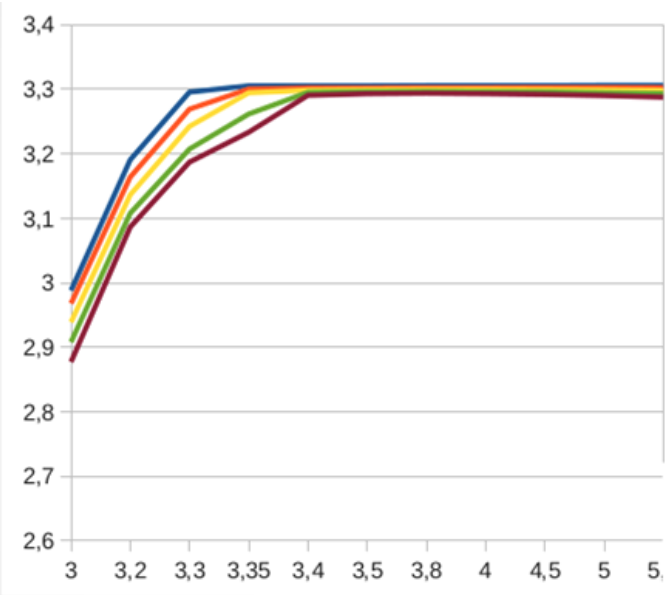
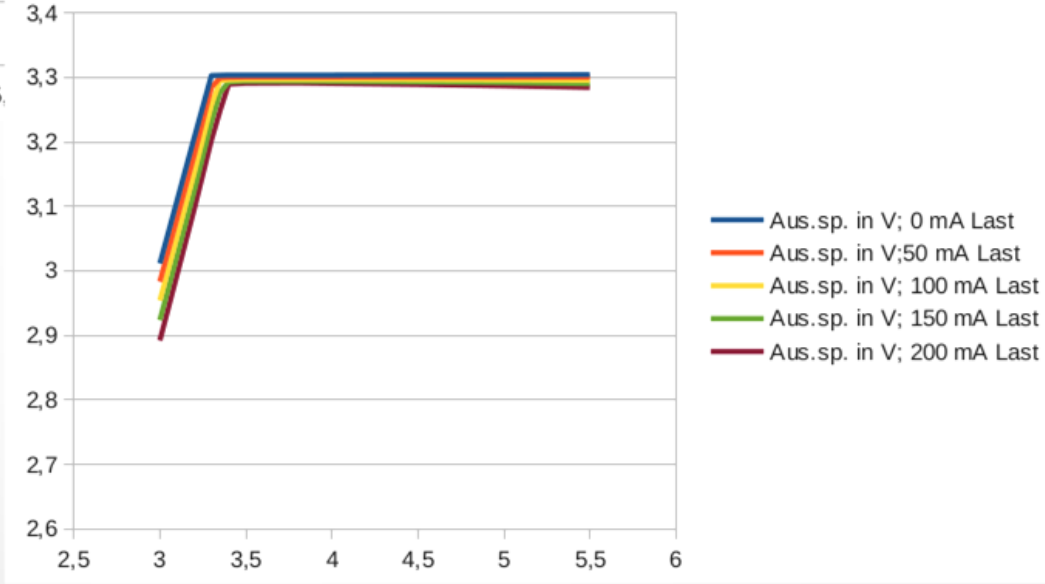
FEE: gamma irradiation of TPS 79333



0 Gray

50 Gray



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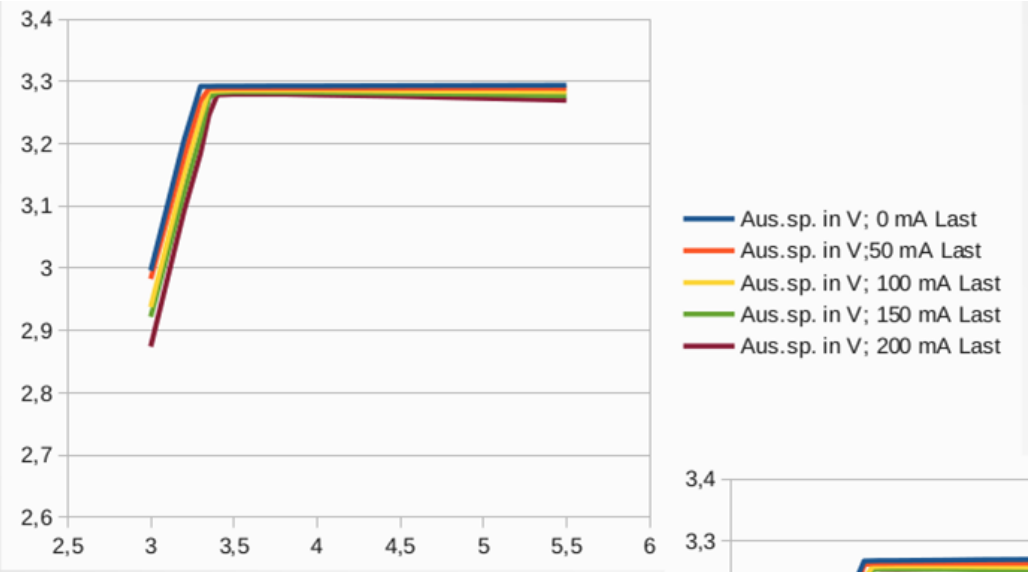
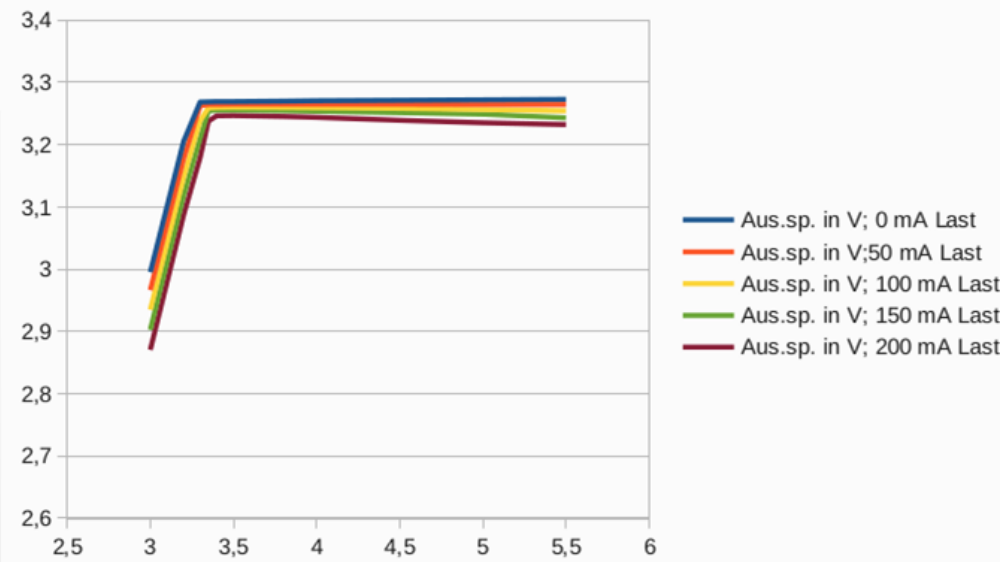


100 Gray

200 Gray



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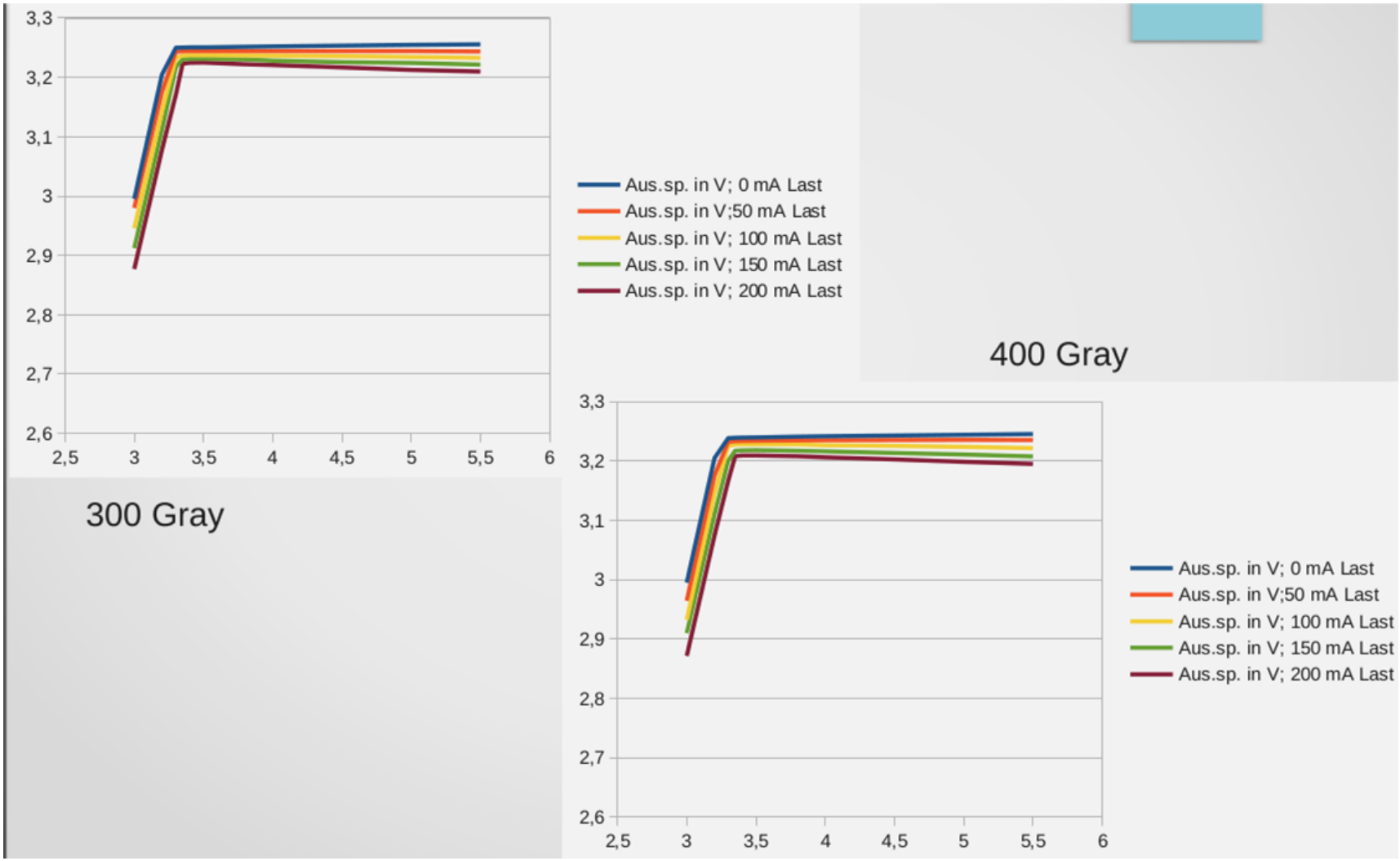
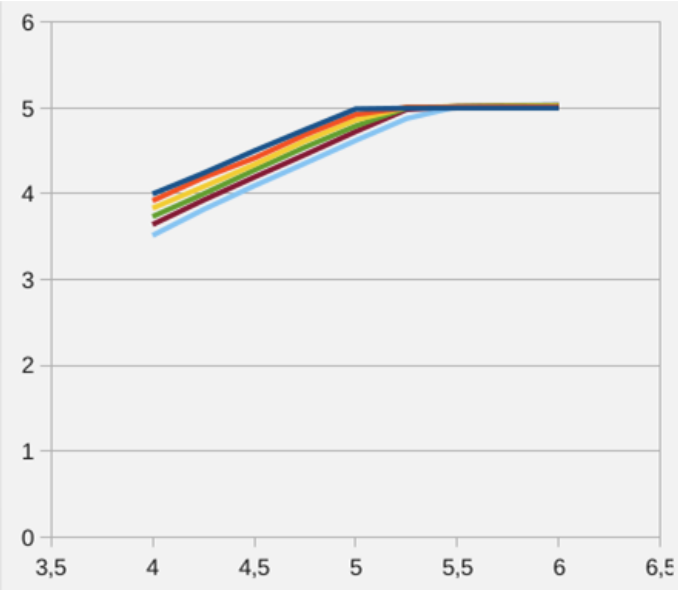


FEE: gamma irradiation of MCP1703



0 Gray

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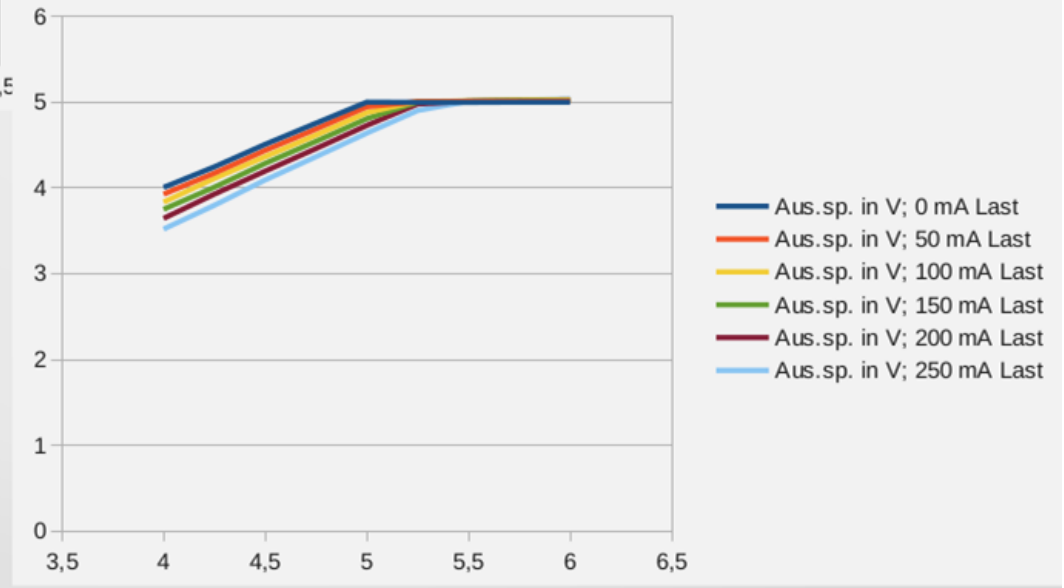
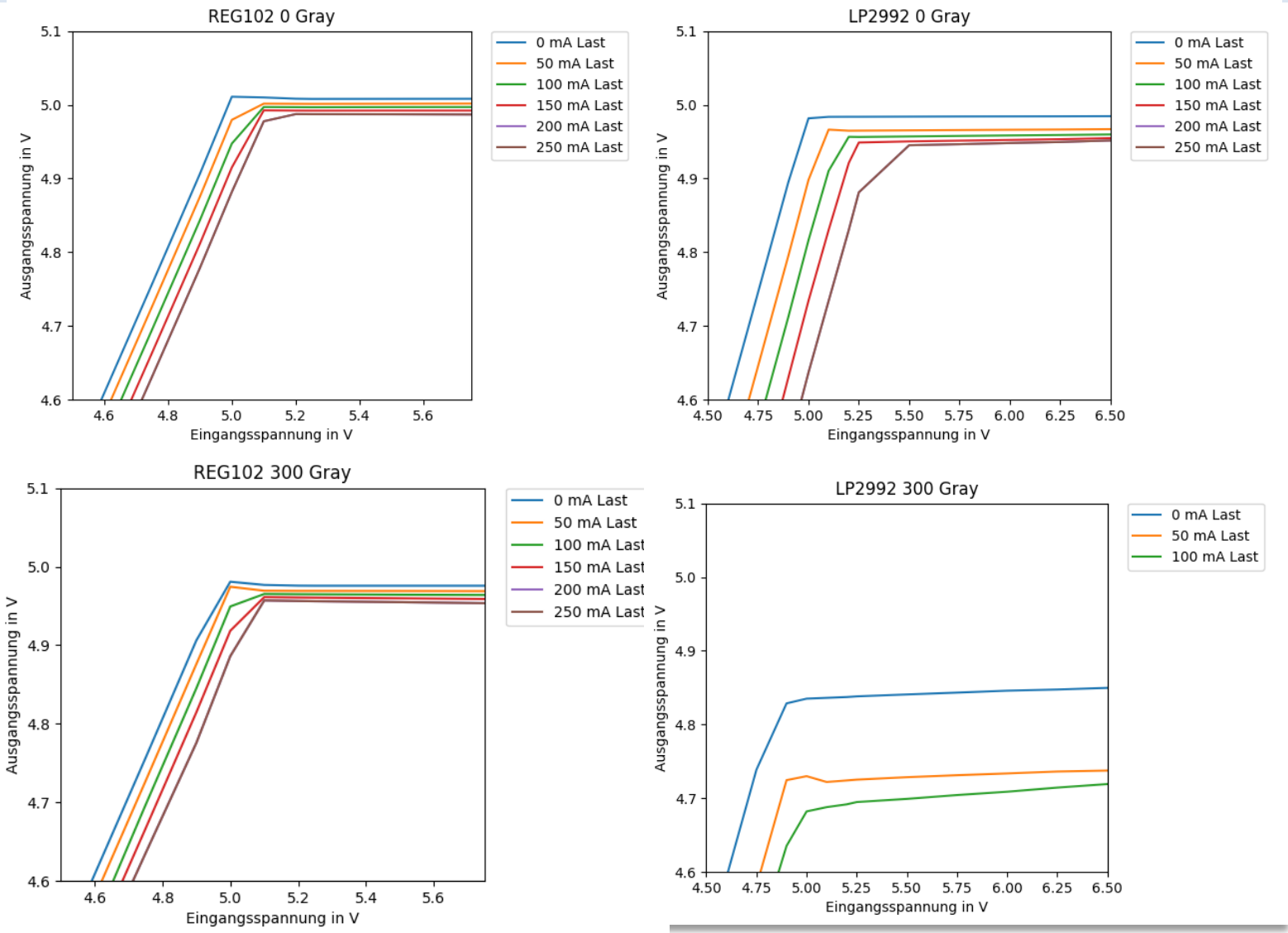


FEE: gamma irradiation of voltage regulatos

Promising candidates for 5 V

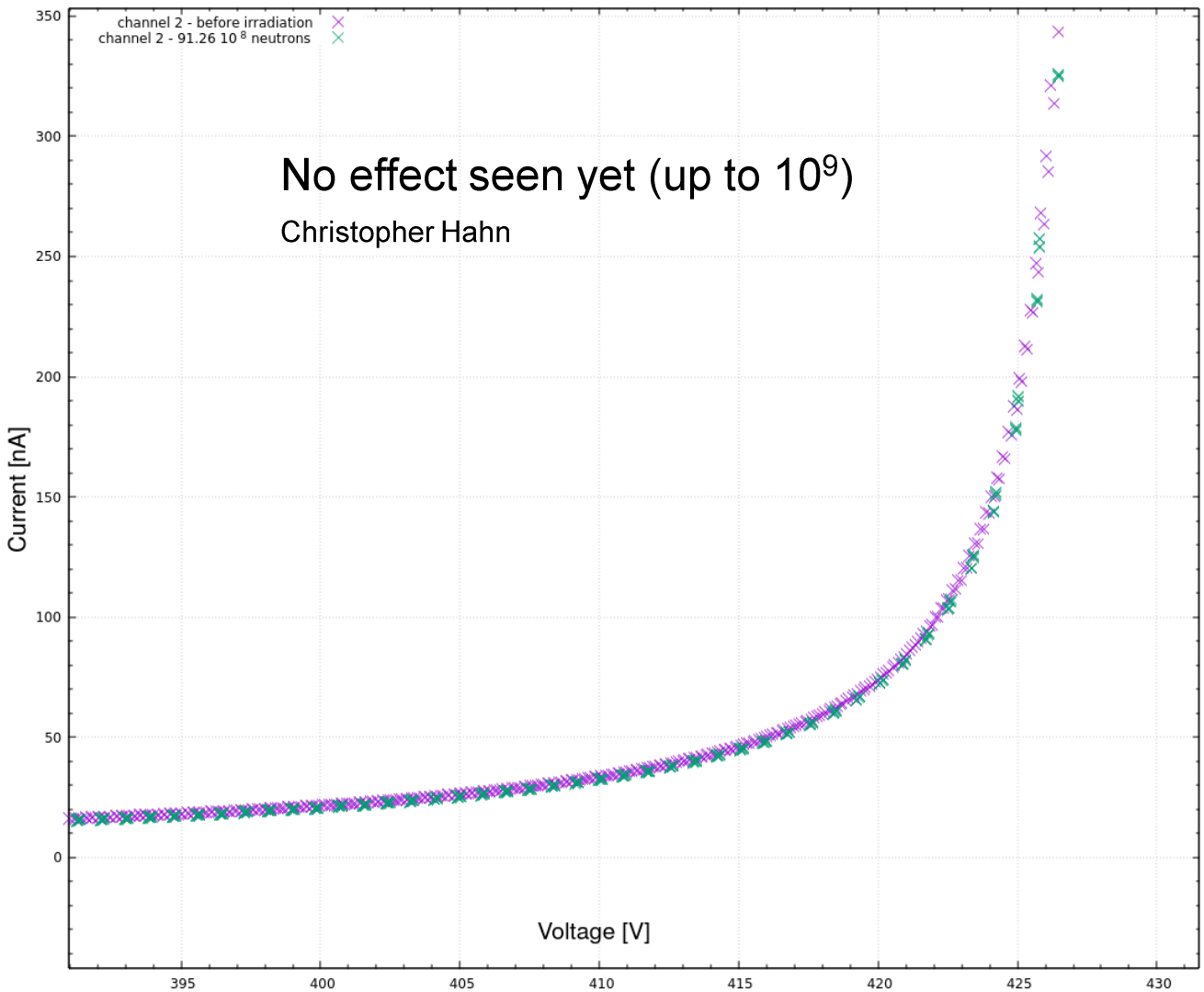


Neutron irradiation of Backplanes for APD-Voltage regulation

Dose estimation :

(M. Preston)

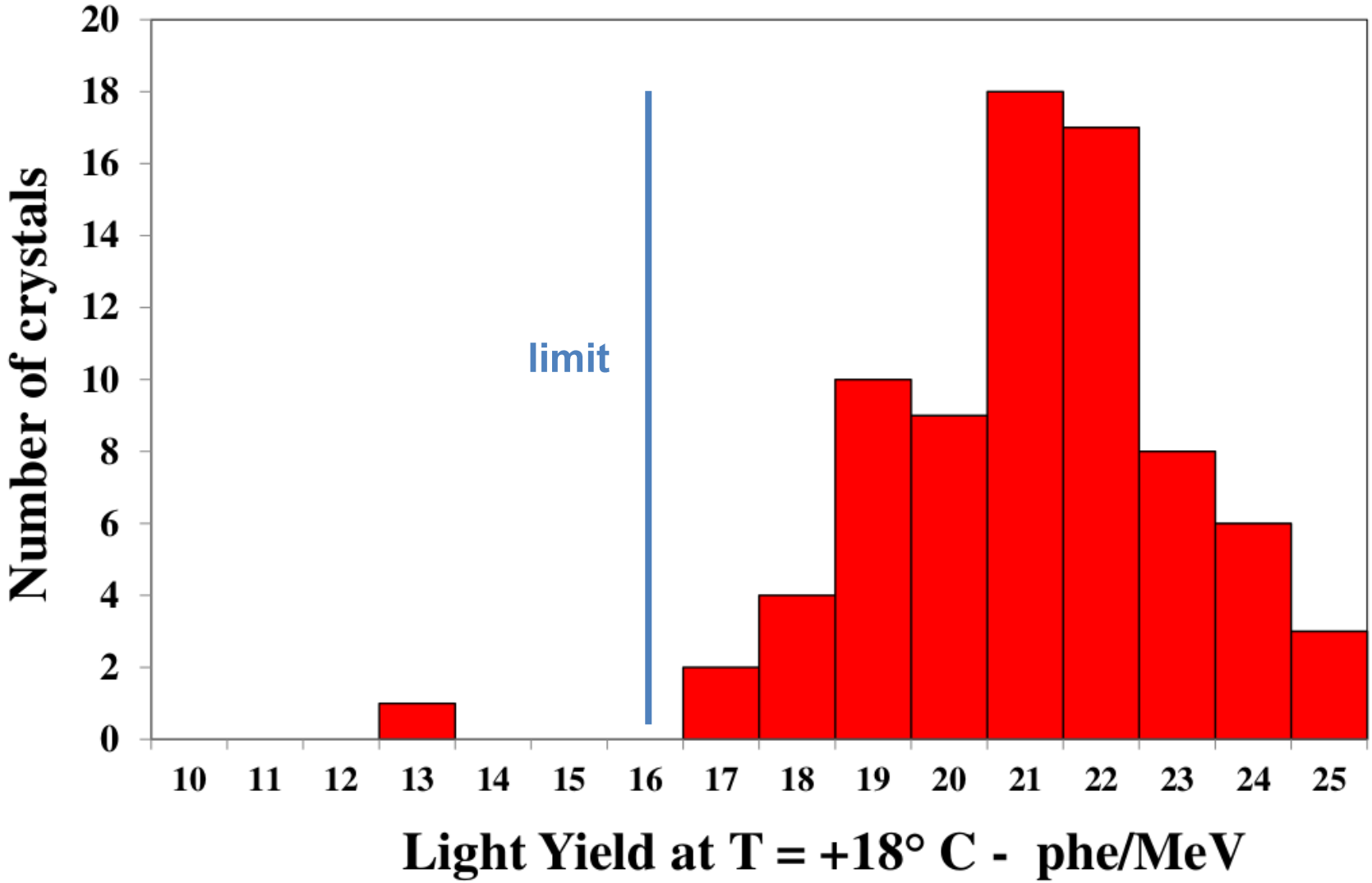
- PANDAroot simulation
- 2.5×10^6 p-pbar interactions
- 1.5 GeV/c
- -> At Backplanes up to 10^{11} neutrons per cm^2 within 10 years.



Status Crystal Production

					Left						Right						Missing		already financed		To be ordered	
type	total	total+spare	L	R	BTCP	PreProd	Proto60	SICCAS	CRYTUR	Tot	BTCP	PreProd	Proto60	SICCAS	CRYTUR	Tot	Left	Right	Left	Right	Left	Right
1	1280	1310	655	655	629	36				665	668	35				703	-10	-48			0	0
2	1280	1310	655	655	402	34				436	668	38				706	219	-51			219	0
3	1280	1310	655	655		40				40	628	37				665	615	-10			615	0
4	1280	1310	655	655		40				40		39				39	615	616			615	616
5	1280	1310	655	655		39			1	40		39			1	40	615	615			615	615
6	1280	1310	655	655		29	30			59		28	30			58	596	597			596	597
7	1280	1310	655	655		39			1	40		39			1	40	615	615			615	615
8	640	660	330	330		19			1	20		17			1	18	310	312			310	312
9	640	660	330	330	325	20				345	328	19				347	-15	-17			0	0
10	640	660	330	330	95	19		62	62	238	285	17				302	92	28	46		64	28
11	480	490	245	245		15					88	15				103	245	142	99		146	142
total	11360	11640			1451			62			2665				3		3897	2898			3795	2925
																					6720	

Status Crystal Production



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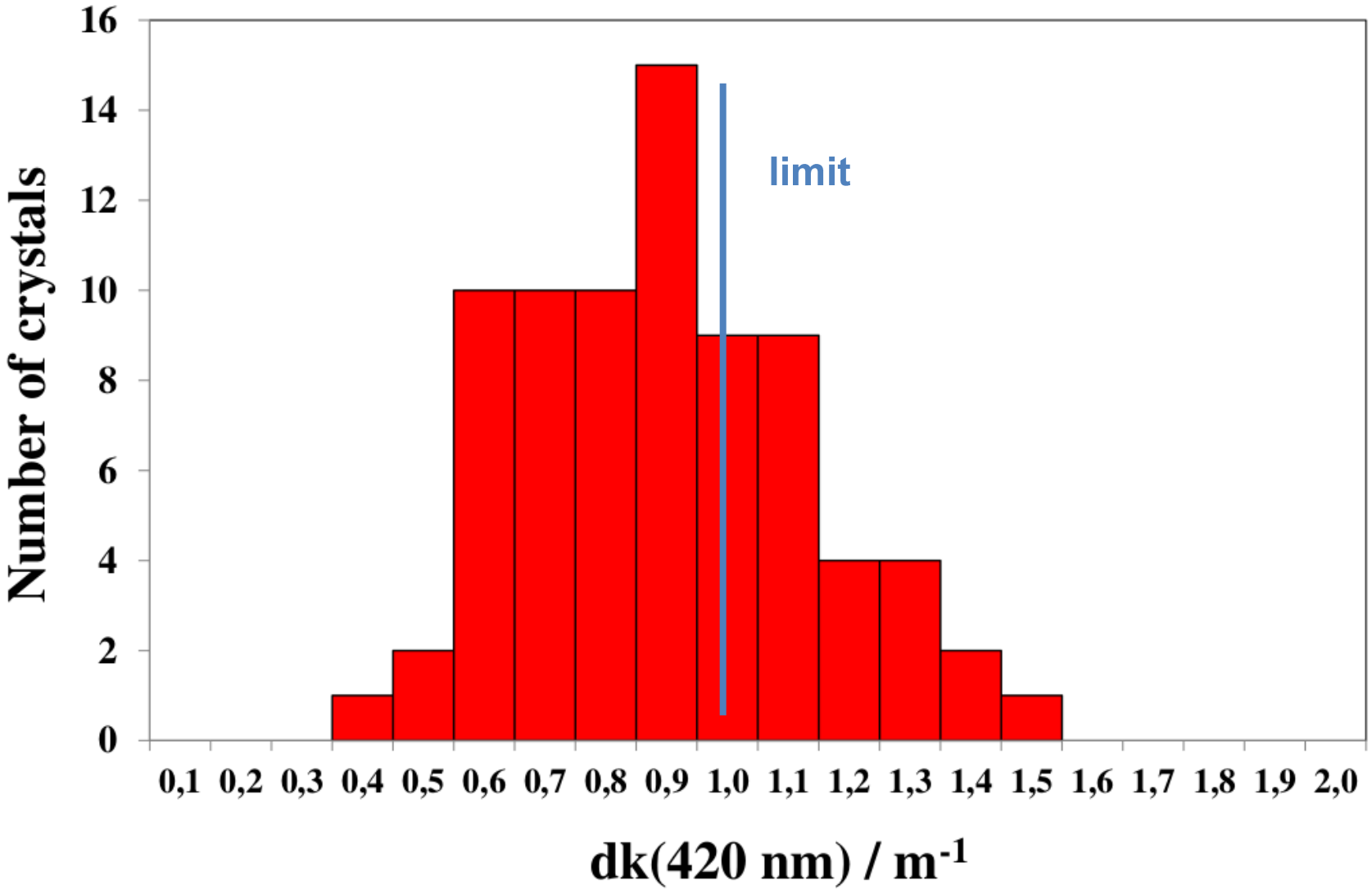

Barrel Status

Sub-PSP code	Work Package	Achievements	Current Activity	Critical Items	Schedule Status
1.4.1.10.1	WP1 Mechanics	Contract, mechanical design, parts for 1st slice delivered	Alveole production, preproduction slice, FEE dummy mounting tests	Verification of mechanical design (see WP8)	risk of delay
1.4.1.10.1	WP2 Detectors	3000 crystals, one complete slice; purchase of PWO raw material	Test crystals from CRYTUR/SICCAS	Crystal production funding	risk of delay
1.4.1.10.1	WP3 Photosensors	APD contracts, 25% APD delivered, ~1500 ready and glued to crystals	screening, APD irradiation	APD funding, APD screening	risk of delay
1.4.1.10.1	WP4 Electronics	ASIC validated and produced	ADC prototype testing, HV distribution boards and backplane electronics design, serial adapter chip prototype tests, radiation hardness tests	Cable assembly, preseries FE flex boards	delayed
1.4.1.10.1	WP5 Cooling system	Setup cooling system for one slice at Orsay	Design of cooling lines at backplane	Lack of manpower	risk of delay
1.4.1.10.1	WP6 Monitoring and Control	THMP,Sensors, LP prototype	Tests of fibre coupling	Integration of stimulated recovery, coupling light fibres to crystal, routing	on time
1.4.1.10.1	WP7 Software	Basic feature extraction, PANDAroot code	implementation of full geometry in PANDAroot	lack of person power	risk of delay
1.4.1.10.1	WP8 System	Proto120 beam tests	assembly of first slice	beam test analysis	risk of delay

Risks

Risk item	Probability	Damage	Description	Impact	Mitigation measures	Remarks
Verification of mechanical design	Very likely	moderate	Freeze for the slice design can be indicated only after the successful verification of the design of all components within the slice.	Delay for commissioning of first slice. Violation of contract deadlines with russian partner.	Intensify work on finalizing electronics and cooling design. Implies to increase manpower and funding	
Crystal production	Very likely	business critical	production of 8500 crystals not assured by funding yet. Decision of mass production required.	Delay of production or bailout of production company (Crytur) when R&D funding is interrupted. Potential price increase of >50% when decision of mass production delayed beyond mid 2017.	identify funding source. Expression of willingness for mass production of crystals.	
APD funding	Very likely	severe	17000 APDs are to be funded. BMBF funding on hold/not yet granted, Austrian funding for 5400 APDs not yet available.	Severe delay and/or abruption of the production of multiple slices, APD production line at Hamamatsu needs startup time (~3 month) after begin of funding, delay of screening	Funding request to Austrian Academy of science and BMBF in the pipeline	No Austrian funding up to 2017
APD screening	Likely	moderate	APD sensors can not be fully characterized within the foreseen time plan. Delay of screening from APD lab	probable delay of commissioning of series slices (not first slice). Minor impact on calibration procedures between APDs during operation	Improve speed of analysis of screened APDs. Concentrate on APDs from same lots, which can be matched more easy. Help with validation procedure (Bochum/Giessen)	1 PostDoc to join PSL in fall
Resp. cooling system	Very likely	moderate	Lack of manpower (Bochum) on the development of the barrel cooling system	delay of the design freeze for the slice mechanics, assembly and integration	Assign manpower to this task	
electronics production	Likely	moderate	Production of preseries slice FE electronics (ASIC FE flex PCBs) delayed due to administrative procurement problems	delay of the design freeze for the slice mechanics, assembly and integration	unknown	