

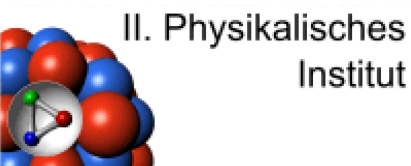
Report on EMC Barrel Slice Assembly



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2nd Physics Institute
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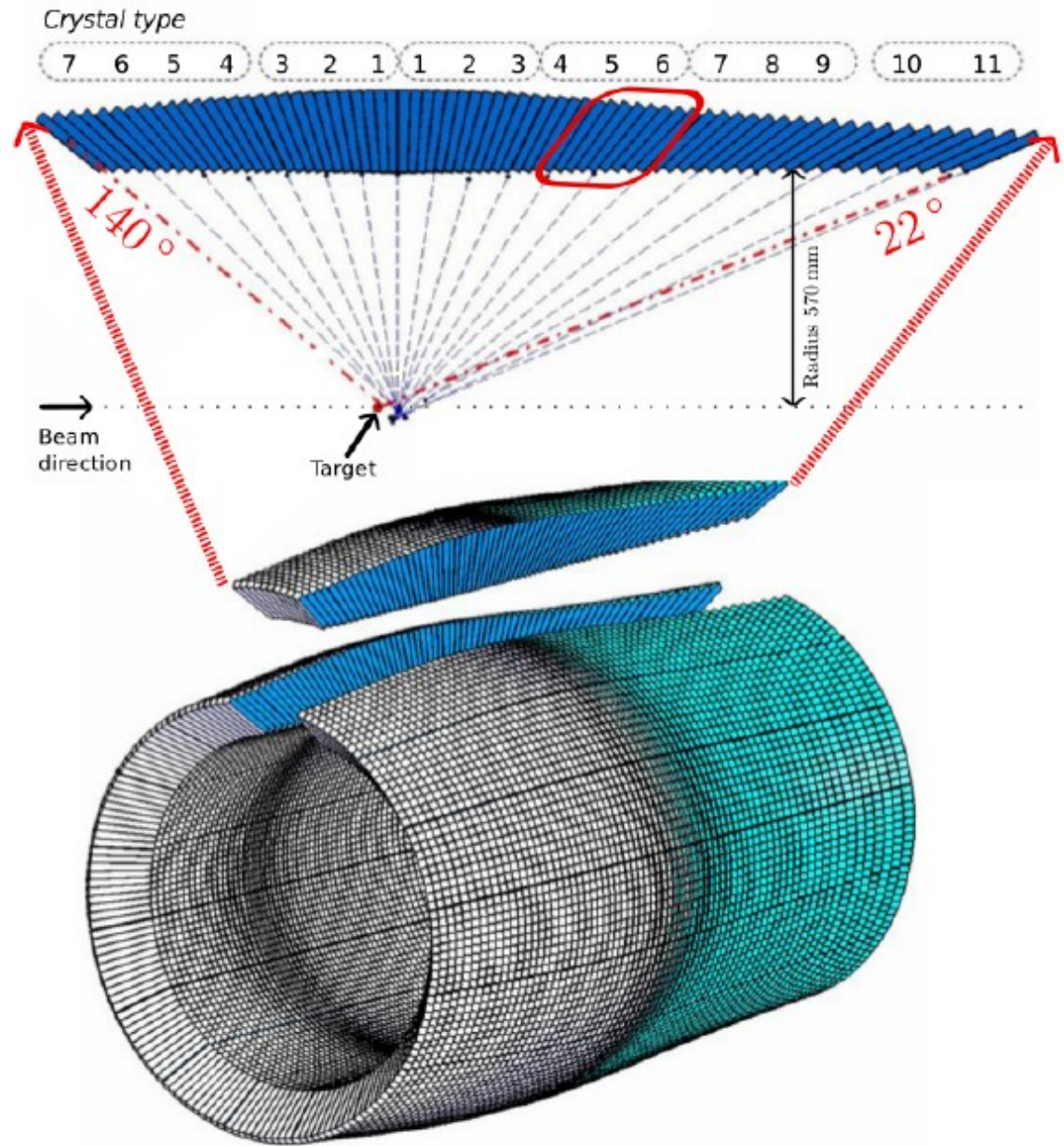
1st EMC Assembly Review Meeting,
Giessen
20-Sept-2016



Barrel Slice

Assembly of one full Barrel EMC Slice until Q2/2017

- 710 crystals in 11 different geometries
- 1420 APDs after 1st screening, irradiation, 2nd screening and matching
- 360 left and 360 right handed APFEL-ASIC flex PCBs
- 4500 m of signal cables



Barrel Slice – Mechanics

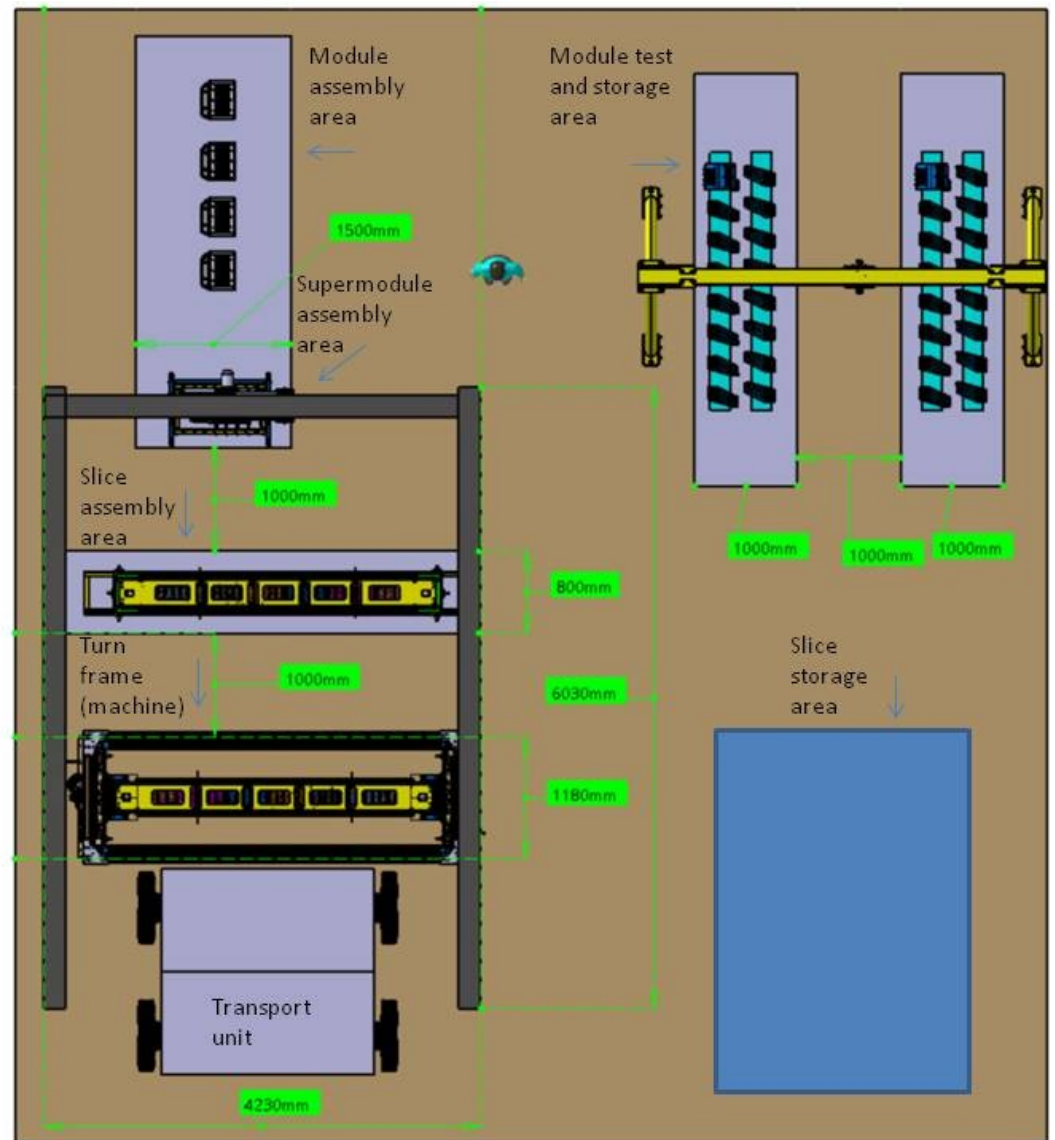
- After some custom issues, all parts for the first slice arrived at Giessen in the middle of August.
- No damages were found inside. All parts seem to be in good condition after visual inspection.



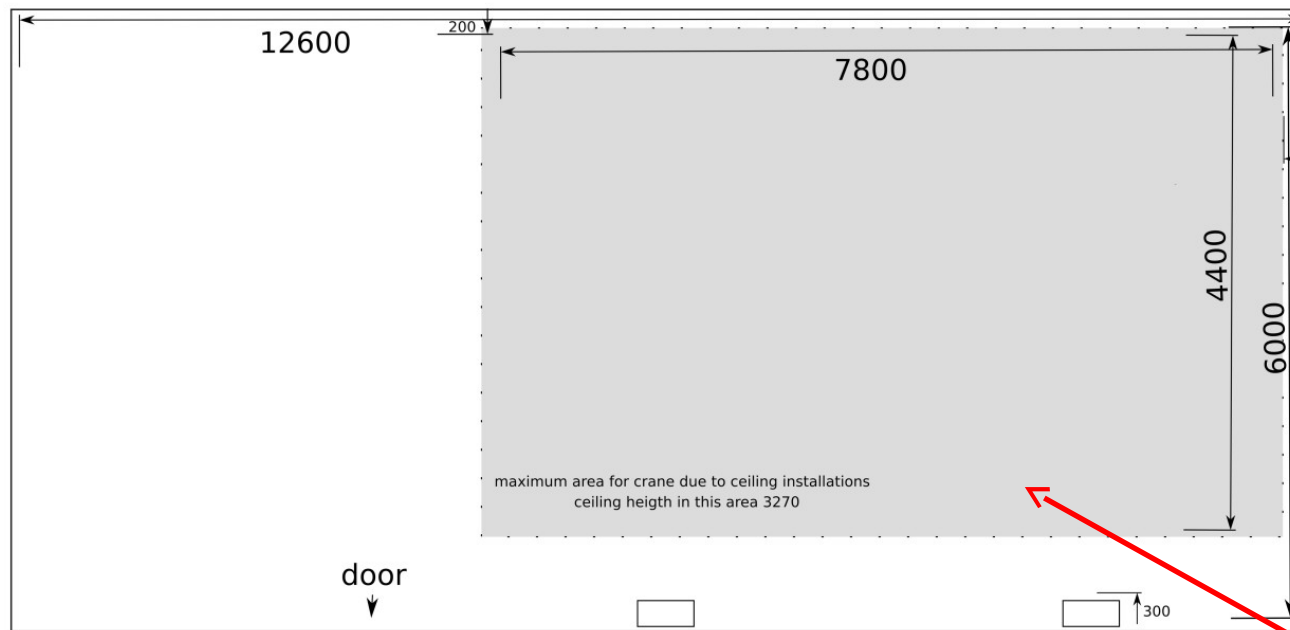
Barrel Slice Assembly

- IHEP Workspace draft

- Detailed process description:
EDMS- Document Number 1421085/1

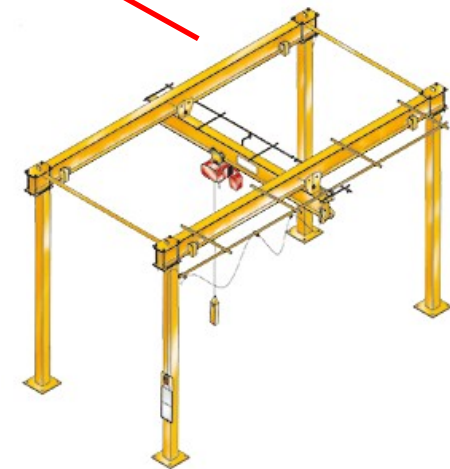


Barrel Slice Assembly - Tools

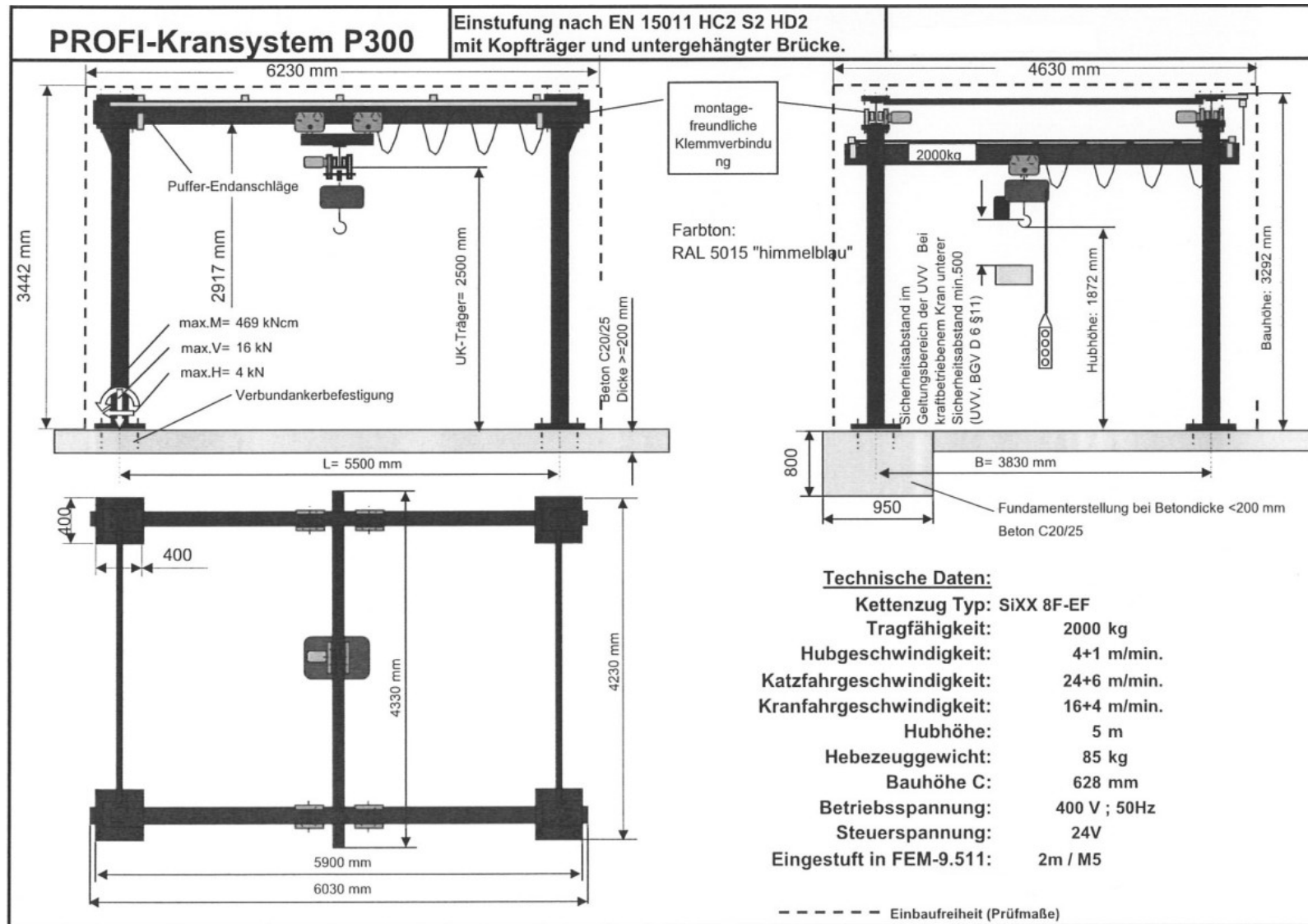


Assembly room

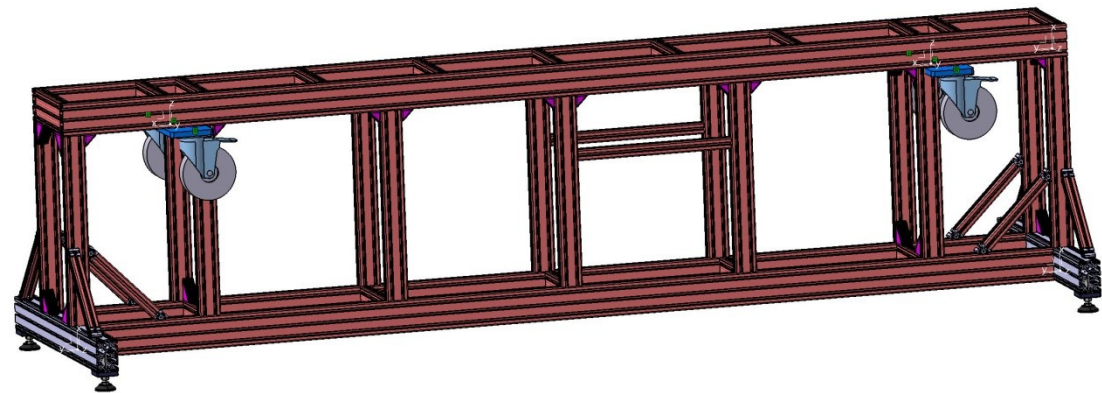
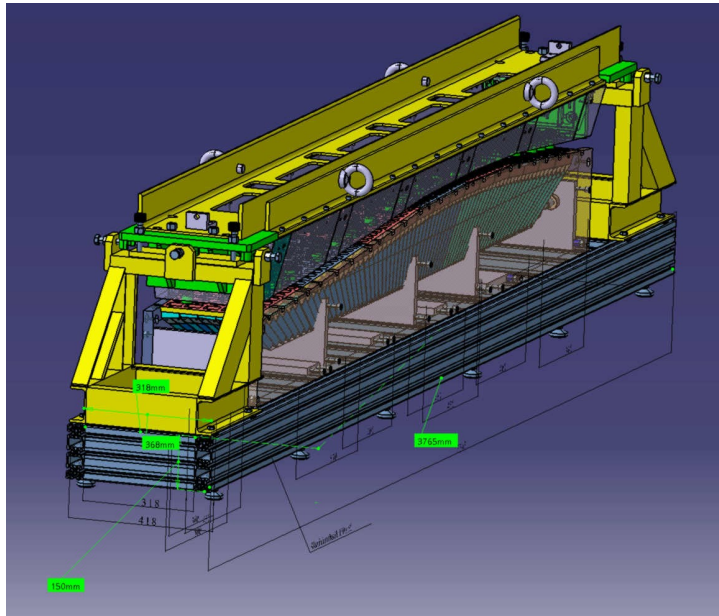
- Giessen provides workspace ~ 76 m²
- Crane construction needed (ordered this week)



Barrel Slice Assembly - Tools



Barrel Slice Assembly - Tools

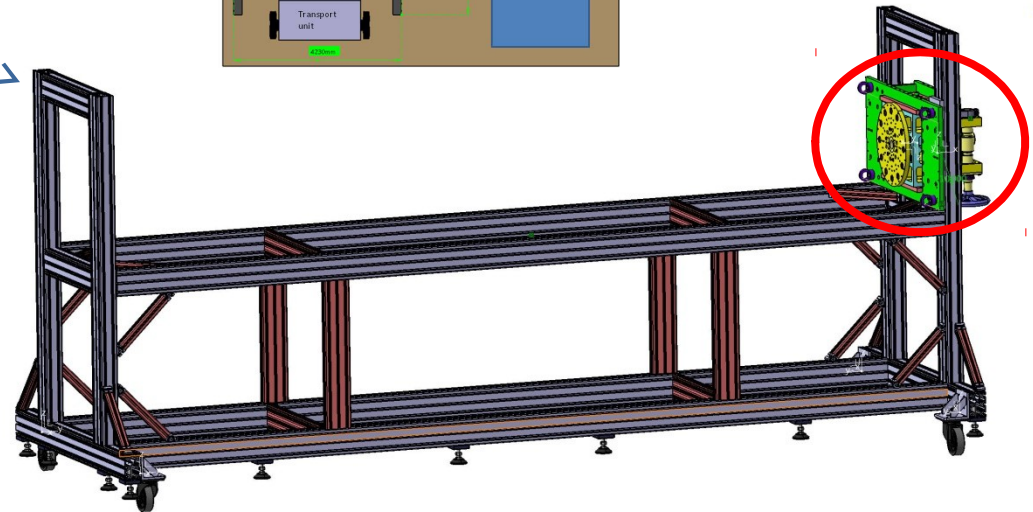
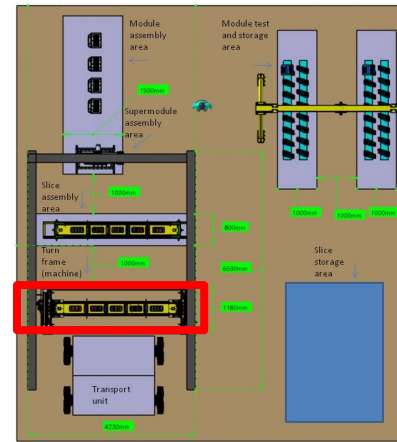
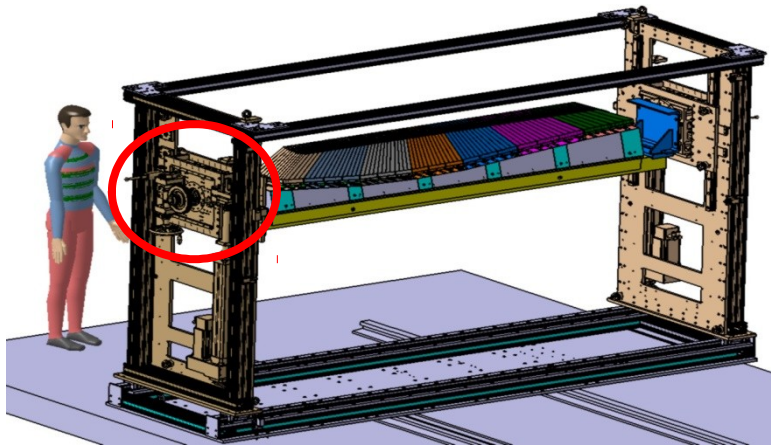


Slice assembly table

- provides perfect flat surface
- upper frame can be detached and used as transportation unit

Barrel Slice Assembly - Tools

- Turn frame

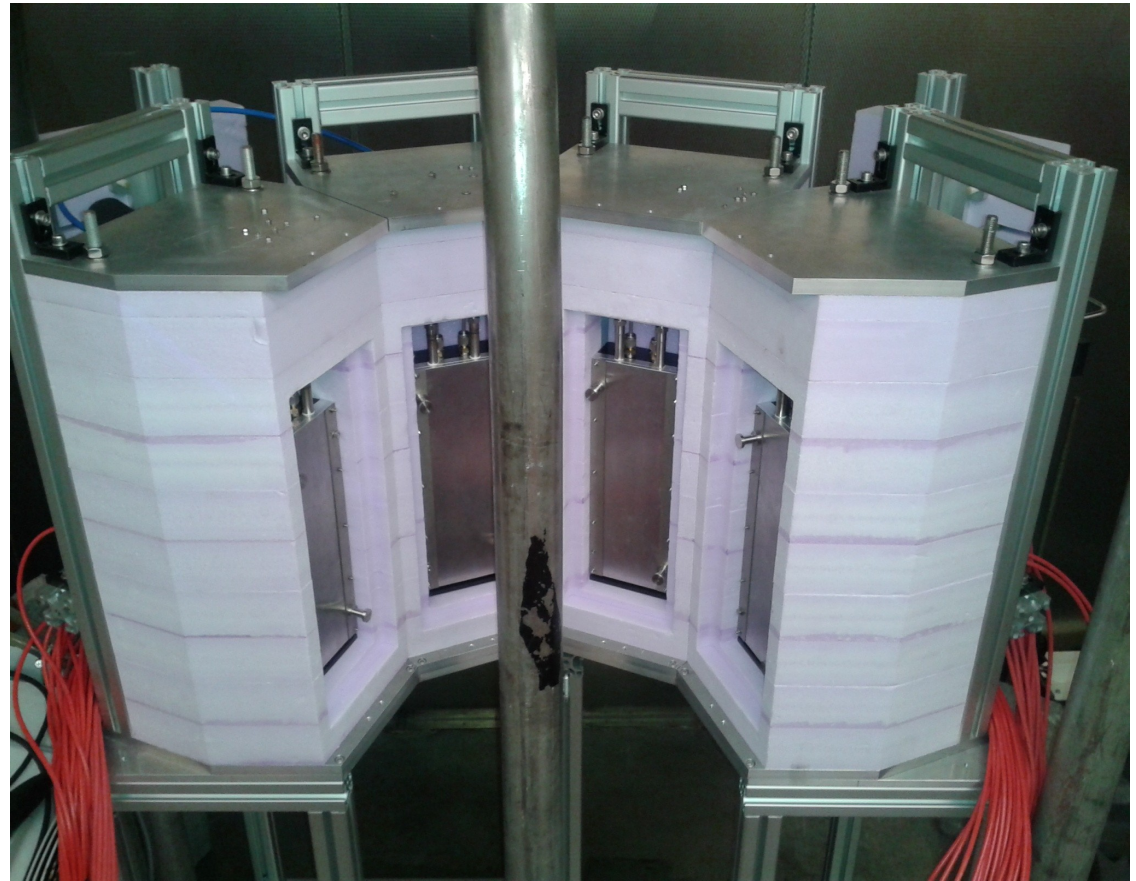


- The foreseen XY table at Mainz does not fit under the crane hook
- Therefore only the turning mechanics will be used for assembly.

APD irradiation

APD irradiation @Giessen

- ^{60}Co source: ~ 50 Gy/h, 80 APDs / day
- Activity distribution of source newly measured \rightarrow correction of integral dose to lower values
- Irradiation and Transport at RT, Annealing in oven with 80°C @ GSI

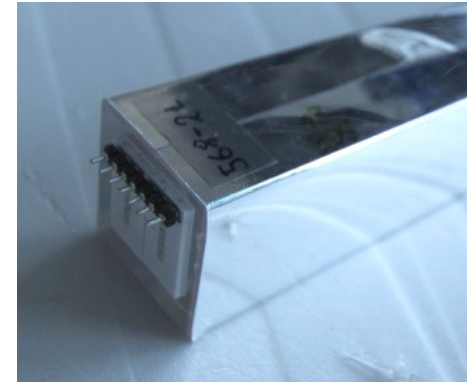


APD irradiation

- Bochum EPICS based HV control Software was installed last week by Tobias Triffterer.
- Previous Software causes several problems, for example:
 - USB-CAN converter produced a lot of error messages.
 - channels stopped randomly voltage ramp up
 - Several Software crashes
- With the new Software and Andrea it was figured out:
 - Some channels had (have) a short circuit
 - Some channels had (have) a loose contact
 - Some channels were (are) wrong wired.
- **The Problems will be fixed together with Andrea in the next few days.**

APD matching

- 2 APDs per crystal, 710 matched pairs required for slice
- Matching procedure:
 - dV for gain 150 @ $-25^{\circ}\text{C} < 0,1$
 - dM/dV around gain 150 @ $-25^{\circ}\text{C} < 0,1$
 - Minimum distance $\sqrt{dV^2 + (dM/dV)^2}$ between leftover will define a matched pair
 - Yield: approx. 81% out of 300 APDs can be matched
 - Characteristics of each APD → PSL
 - New matching parameter: change of dM/dV after irr.



APD database

RUHR-UNIVERSITÄT BOCHUM

A-Z | OVERVIEW | SEARCH | CONTACT

INSTITUT FÜR EXPERIMENTALPHYSIK I

PANDA FEMC PRODUCTION DATABASE



RUB

RUB » Physics » The Faculty » Chairs and Working Groups » EP1 » PANDA FEMC Production Database

PRODUCTION DB

► Main Page

► Alveoles

► Units

► Detectors

VPTT

Caps

► Subdetectors

Lot 06	07	08	09
12	13	14	15
16	17	18	19
20	21	22	23

► Temperature Sensors

WORKFLOW

► Combine APDs

► Assemble Unit

► Assign Unit

► Find Unit

► Upload VPTT magnet results

APD IRRADIATION

► Grid Overview

► Enter irradiation data

► Enter annealing data

► Shipment GSI ↔ Gießen/Bochum

PANDA HOME PAGE

SELECT APD GRID TO DISPLAY

Information: If the information about a grid is incomplete, it may show up several times.

GRIDS AWAITING IRRADIATION

[549](#)

GRIDS AWAITING ANNEALING

There are no APD grids in this category.

GRIDS READY FOR SHIPPING FOR ANALYSIS AFTER IRRADIATION/ANNEALING

There are no APD grids in this category.

GRIDS UNDER ANALYSIS AFTER IRRADIATION/ANNEALING

49	50	55	67	207	208	267	268	271	277
287	295	298	310	331	351	370	371	390	446
456	468	491	519	532	546	559	694		

GRIDS READY FOR ASSEMBLY

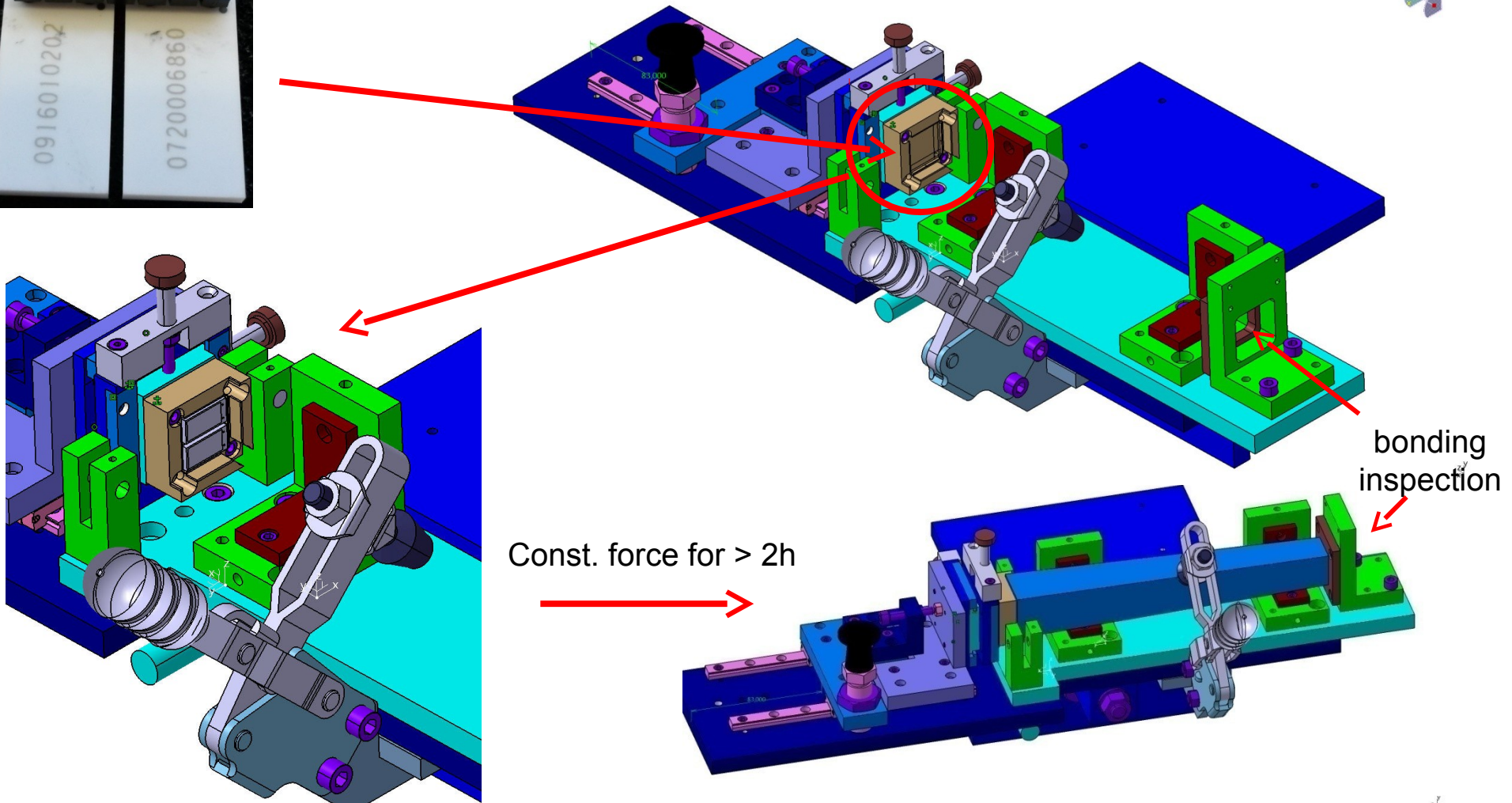
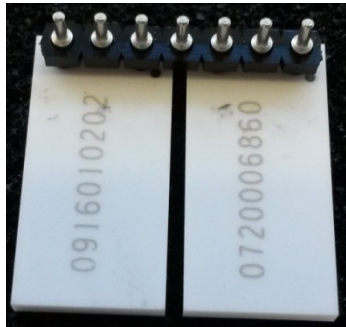
44	47	73	94	104	116	128	139	150	175
190	192	195	209	210	215	219	220	221	222
223	224	225	228	230					

GRIDS NOT YET DELIVERED FOR IRRADIATION

48	214	250	251	252	253	254	255	256	257
258	259	260	261	262	263	264	265	266	269
270	272	273	274	275	276	278	279	280	281
282	283	284	285	286	288	289	290	291	292
293	294	296	297	299	300	301	302	303	304
306	307	308	309	311	312	313	314	315	316
317	318	319	320	321	322	323	324	325	326
327	328	329	330	332	333	334	335	336	337
338	339	340	341	342	343	344	345	346	347
348	349	350	352	353	354	355	356	357	358
359	360	361	362	363	364	365	366	367	368
369	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	391
392	393	394	395	396	397	398	399	400	401
402	403	404	405	406	407	408	409	410	411
412	413	414	415	416	417	418	419	420	421
423	424	425	426	427	428	429	430	431	

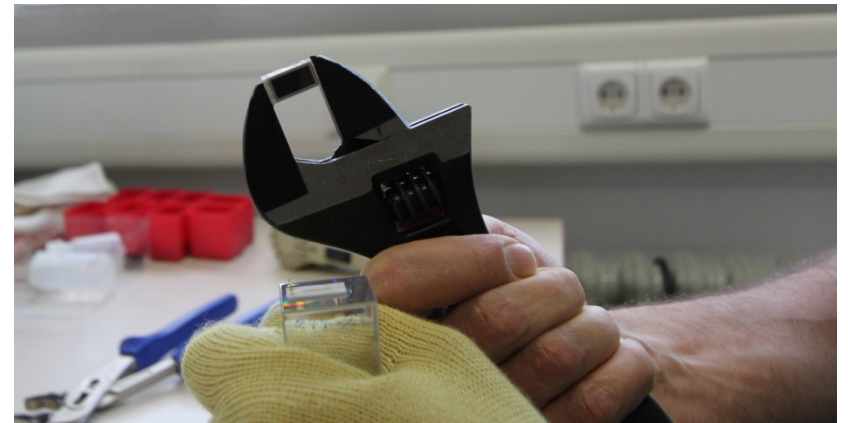
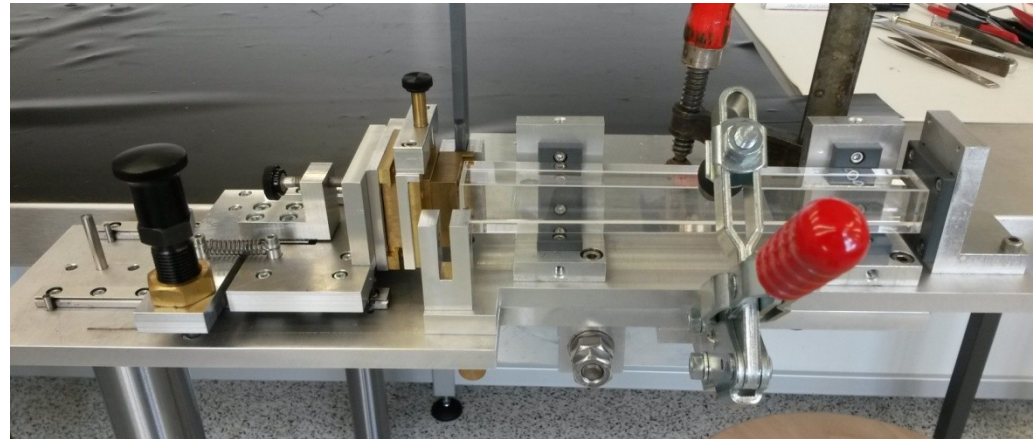
<http://www.ep1.ruhr-uni-bochum.de/endcapProductionDB/>

Detector Assembly - Glueing



Detector Assembly - Glueing

- No vacuum
- No primer
- Constant force for > 2 h
- Bubbles are very rarely seen
 - In case of bubbles: new attempt
- Aging test with **30** cycles of **2h@-30°C** & **2h@+30°C** showed no significant reduction in adhesive strength.
 - One APD was damaged due to the needed force after the aging test.



Detector Assembly - Capsules

- All capsules for the 1st slice were 3D printed via Laser Sintering.
- Samples made out of two different materials were radiated with 1kGy from ^{60}Co source.
- The plastic powder supplier was EOS.
 - PA 2241 FR (flame retardant)
 - Halogen based f.r.
 - PA 2210 FR (flame retardant)
 - Halogen free f.r.
- After radiation both samples showed no development of acids or alkalis
- But: PA 2241 FR smells very strong after irradiation.



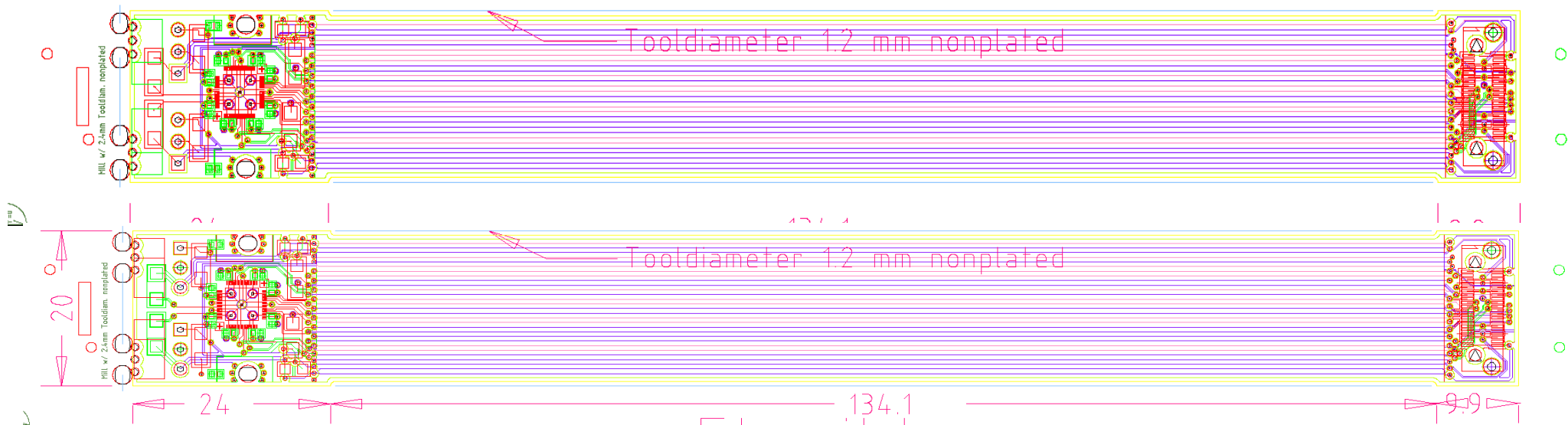
➡ PA 2210 was chosen for all capsules

Detector Assembly - Foils

- Crystals, capsules and front inserts will be equipped with reflector foils.
- First laser cut prototypes will be delivered in the next week

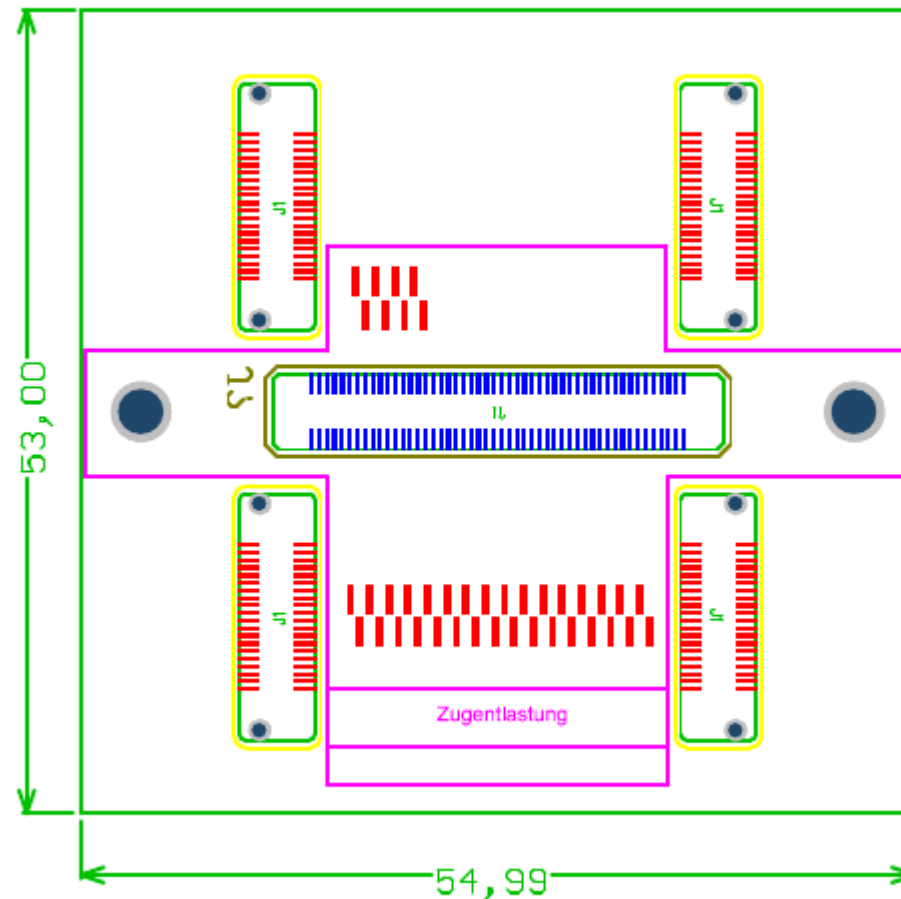


FE Flex PCBs



- Offers for 1000 pcs (PCB prod. + mounting + bonding + glob top) from 2 companies: Würth & Samtec
- Lead time ~ 10..11 weeks, start of production asap

Backplane sandwich PCB



- Lower PCB: FE connectors, LDOs,
- Upper PCB: HV distr and monitoring
- Intermediate PCB: cable adapter and connector to lower/upper PCB

Assembly Schedule

CW	Remarks
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	1 st session
42	
43	
44	
45	2 nd session
46	
47	
48	
49	3 rd session
50	
51	
52	

Super Mod.	Type of Mod	Assembly Date	All crystals available?
1	7 (-)	CW 41	yes
2	6 (-)	CW 41	yes
	5 (-)	CW 41	yes
	4 (-)	CW 41	yes
	3 (-)	CW 45	yes
3	2 (-)	CW 45	yes
	1 (-)	CW 45	yes
	1 (+)	CW 45	yes
4	2 (+)	CW 45	yes
	3 (+)	CW 45	yes
	4 (+)	CW 49	1X R missing
5	5 (+)	CW 49	1X L&R missing
	6 (+)	CW 49	with proto60 ok
	7(+)	CW 49	1X L&R missing
6	8(+)	CW 49	3 X R & 1 X L missing
	9 (+)	CW 49	yes
	10 (+)	CW 41	yes
7	11 (+)	CW 41	yes

Assembly Schedule

						Workplan (glueing APDS, wrapping with foil)										
						ammount of crystals										
pairing																
CW	Remarks	APDs ready	Expected APD pairs in total (dV<=0,1 & dM/dV<=0,1)	Needed APD pairs in total	Difference expected – needed (dV<= 0,1 & dM/dV<=0,1)	type1 (need:80)	type2 (need:80)	type3 (need:80)	type4 (need:80)	type5 (need:80)	Type6 (need:80)	type7 (need:80)	type8 (need:40)	type9 (need:40)	type10 (need:40)	type11 (need:30)
30		96	39	0	39											
31		299	122	0	122											
32		299	122	0	122											
33		299	122	0	122											
34		299	122	0	122											
35		299	122	20	102											20
36		299	120	60	60										30	10
37		399	160	140	20						30	40			10	
38		519	210	200	10				10	40	10					
39		639	260	230	30				30							
40		759	310	230	80	buffer										
41	1 st session	879	360	310	50	80										
42		999	410	390	20		80									
43		1119	460	450	10			60								
44		1239	510	470	40			20								
45	2 nd session	1359	550	550	0				40	40						
46		1479	600	600	0						40	10				
47		1599	650	650	0							30	20			
48		1719	700	700	0								20	30		
49	3 rd session	1839	750	710	40									10		
50																
51																
52						40	40	40								
sum						80	80	80	80	80	80	80	40	40	40	30

Assembly Schedule

	2016							2017					
	6	7	8	9	10	11	12	1	2	3	4	5	6
crystal tests													
APDs (2000 pcs)													
irradiation	400/week												
2 nd screening	150/week												
matching													
reflective foil production													
capsule production													
detector assembly		40/week											
ASIC PCBs (710 pcs)													
PCB production	1 month + order + vacation time												
mounting/bonding			8 weeks										
testing				90/week									
module assembly													
Backplane PCB (180 pcs)													
design													
testing	testing of prototypes + rad hardness of components												
production													
testing							20/week						
signal cables (890 pcs)													
ordering													
tayloring													
mounting on connector PCBs				38/week									
slice assembly													
module placement													
BPL mounting													
cable routing													
SC & DAQ													
cooling													
installation of Bo cooling													
test with slice													

Summary

- **Workspace will be ready for slice assembly at Giessen**
- **APD gluing parameters fixed**
- **Capsules ready; Foils design ready, order within the next weeks.**
- **IHEP delivery complete.**
- **Few crystals have to be produced until December. Crytur is already aware and working on it.**
- **Repairing PSL APD radiation setup in progress.**
- **APD throughput is on the limit of the assembly schedule.**
- **FEs to be produced soon. Verification of fully equipped r/o chain still pending. Build-up of test benches for Gi and Bo**