



CALIFA Electronics & DAQ



Supported by BMBF 05P15WOFNA and 05P19WOFN1.

The results presented here are based on the experiment s444/s473, which was performed at the beam line/infrastructure Cave C at the GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt (Germany) in the frame of FAIR Phase-0.

GEFÖRDERT VOM

TUM Members:

Roman Gernhäuser, Philipp Klenze, Mrunmoy Jena, Gero Bollmann, Tobias Jenegger

Tobias Jenegger

R3BWeek Paris

12.11.2024

Inner Cabling

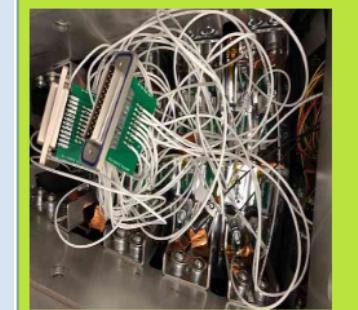
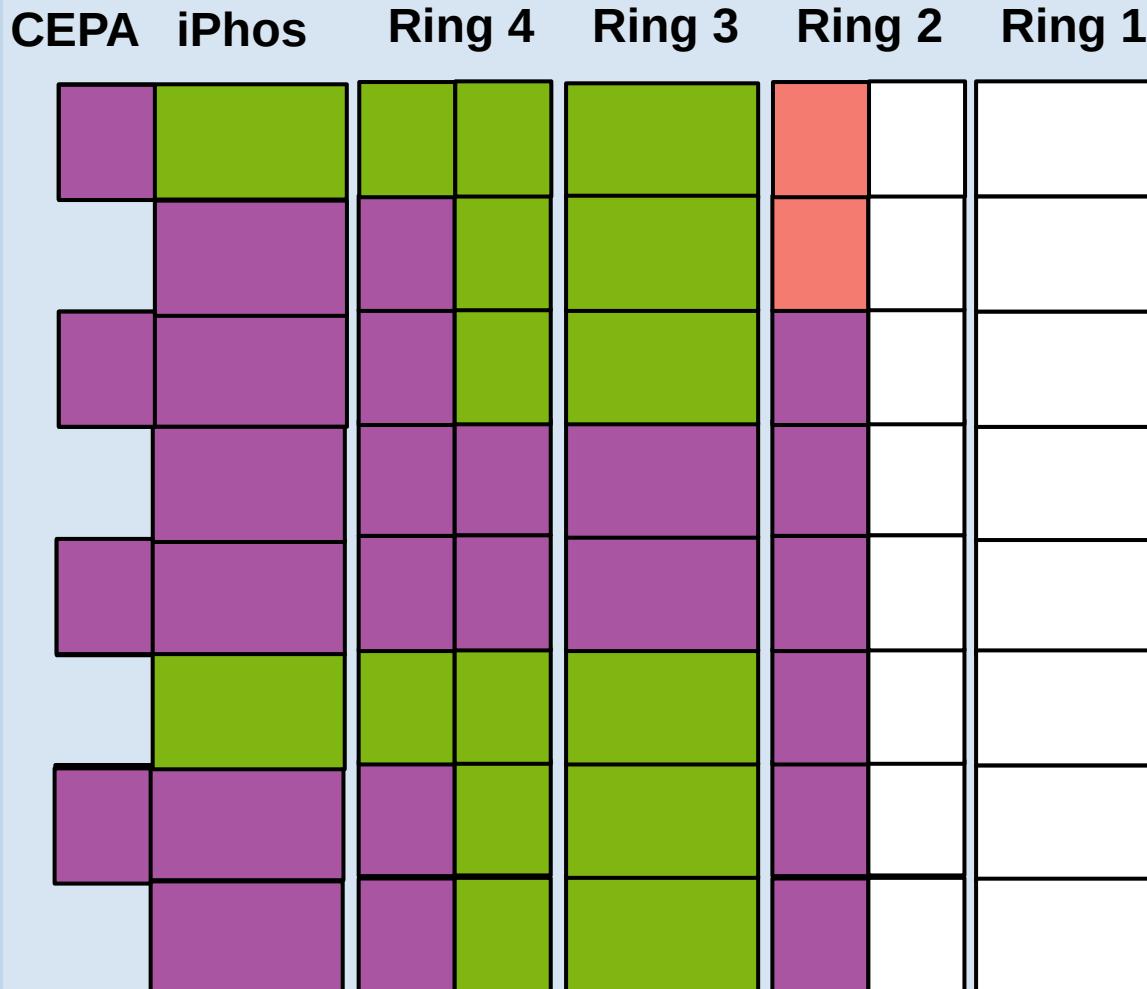
Preamplifier Status

DAQ status & Upgrade

LED System

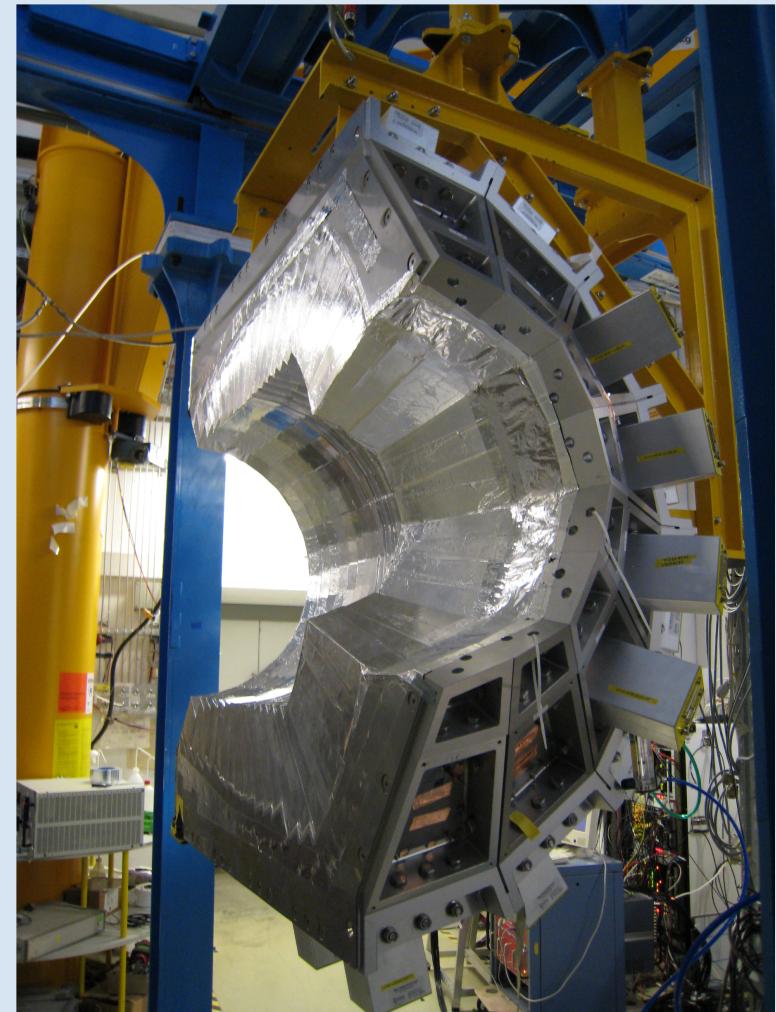
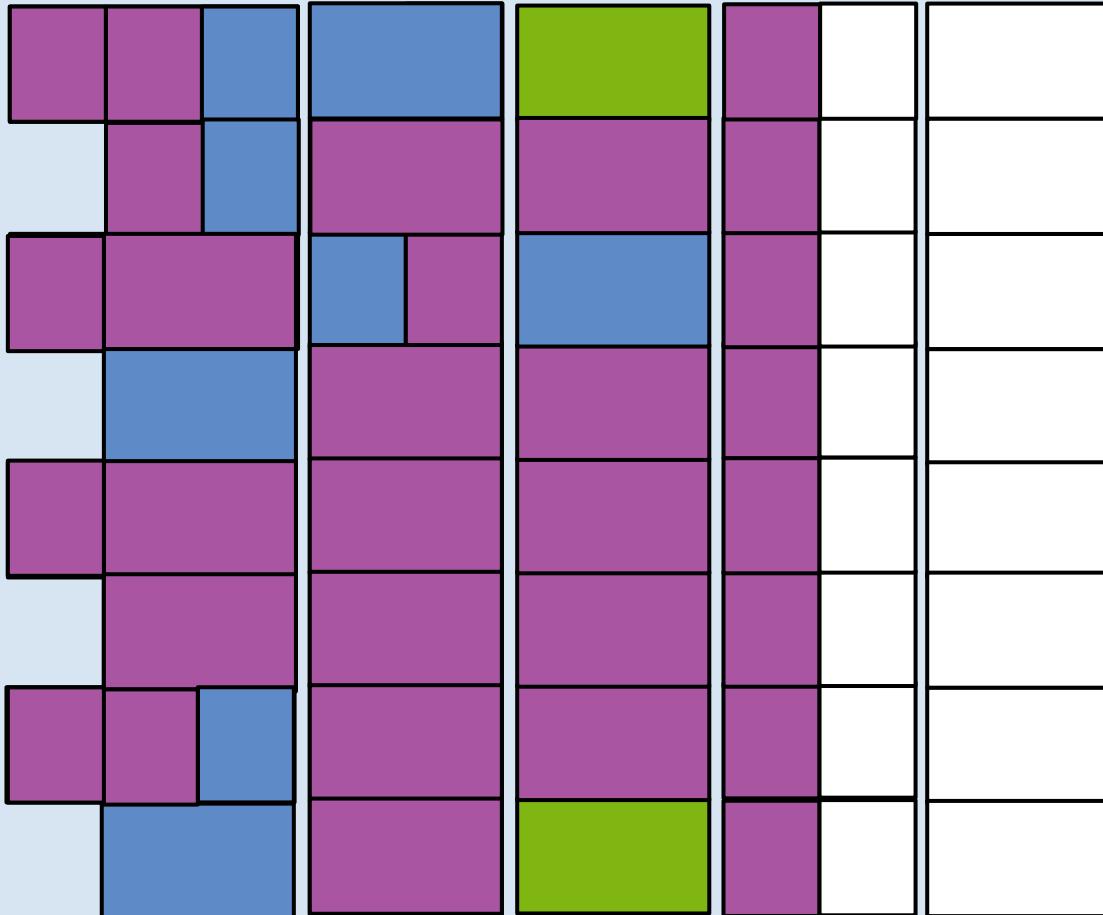
Documentation Status

Inner Cabling – Wixhausen Half

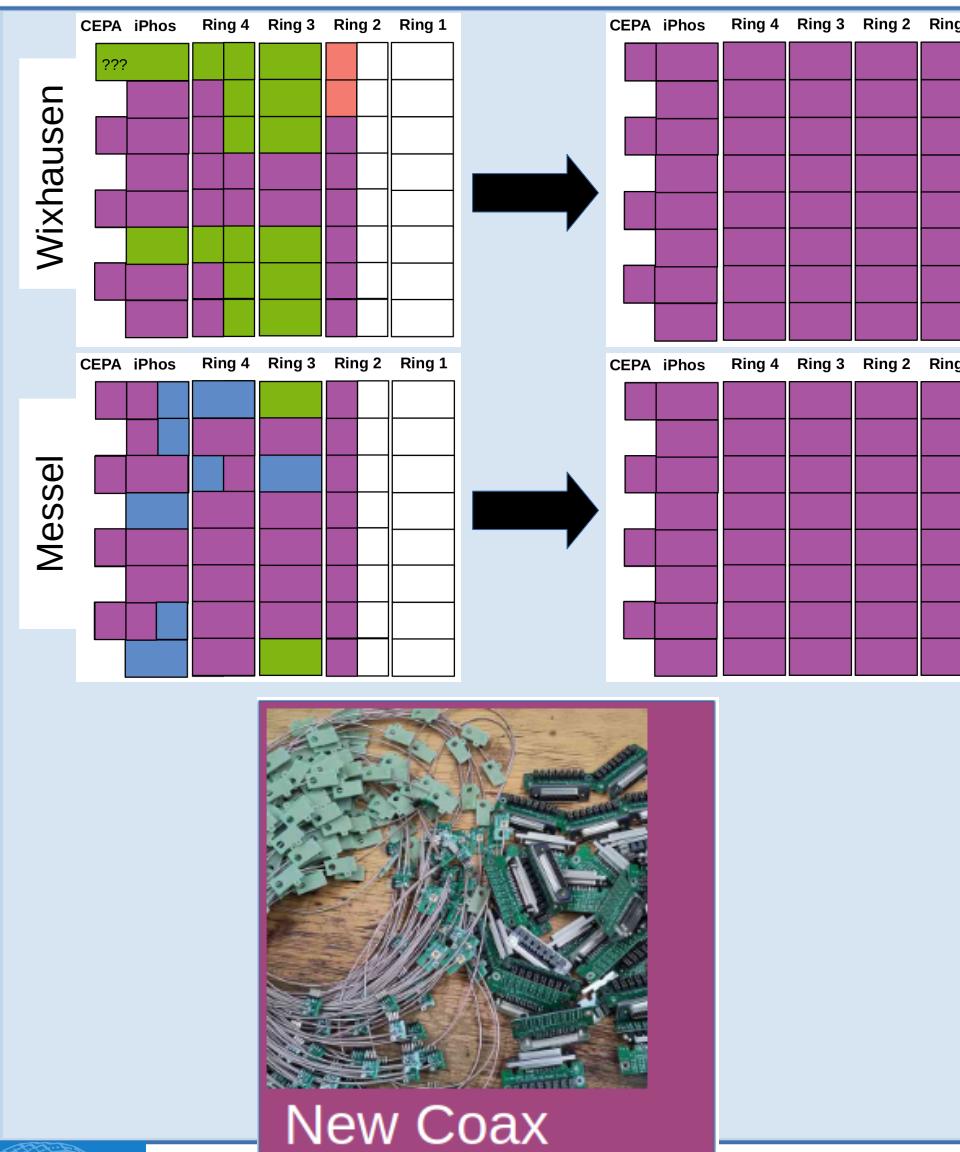


Inner Cabling – Messel Half

CEPA iPhos Ring 4 Ring 3 Ring 2 Ring 1



Inner Cabling – Upgrade Backward Barrel + Refurbishment



Shopping List:

Connectors
(SubD 25Pin, socket strip,...)

1.6 k€

Cables
(Coax cables, APD PCBs,
Fiber connector & additional PCBs)

9.3k€

11k€

Production:

Only producer at the moment: TuDa workshop ~ several weeks

Financial resources unclear

Installation time ~ 3 months

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		

- **CEPA:** 8 x 3/45pC DR Preamplifier
- **iPhos:** mixed configuration:
 - 8 x 3/45pC DR PA
 - 8 x 3/30pC DR PA
- **Barrel – Ring 4&3:** 32 x 3/30pC SR PA
- **Backward Barrel (BB) – Ring 2:**
Bricolage of 16 PA (SR/DR)

What is still needed?

32 x SR 3/30pC PA for BB
(the current BB are spares for different applications)

Modifications:

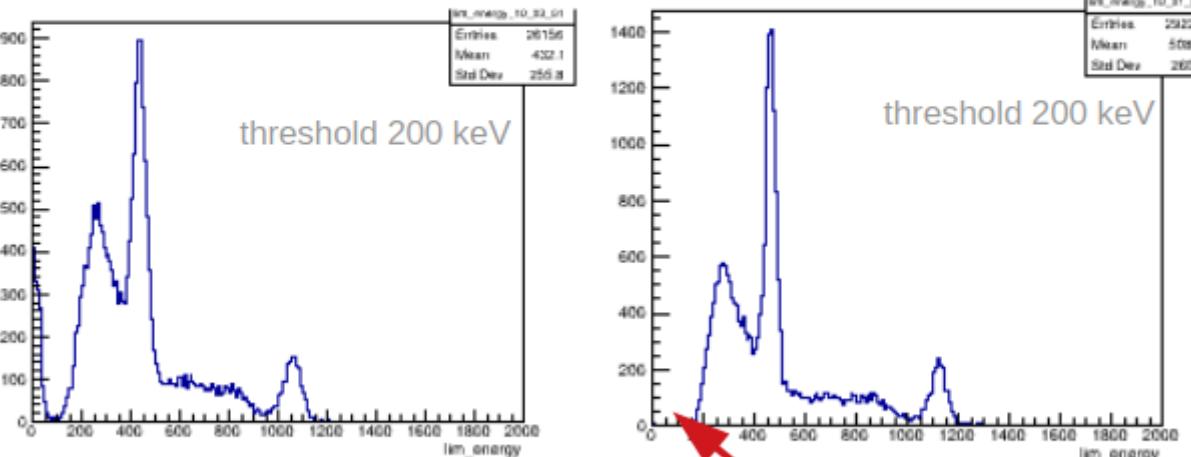
12x DR → to low noise input and 3/45pC range
32x SR → lower noise input stage

Optimization of S/N in Preamplifiers

Noise Optimization by Mesytec:

more current in input FET improve S/N ratio

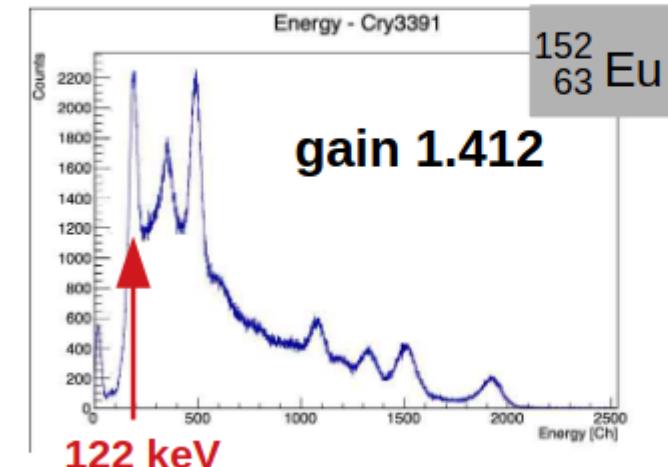
reference preamplifier low noise DR 3/45pC preamplifier



efficient noise reduction

Gain Optimization:

Stefan Eder's talk in R³B Week in Budapest



larger APD gain – constant electronic noise
gain ~ S/N with N= const

3/45pC DR Preamplifiers:

- allow to increase gain → lower thresholds
- 45pC covers full range up to 300 MeV

What we still need:

“Default Config.”

“4 π Config.”

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	DR 30/300	DR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300



CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300

* in both versions all preamps are upgraded to lower noise input stage



Workload & Costs

“Default Config.”

To Buy:

32 x 3/30pC SR PA for BB

224k€

To Modify:

12x DR → to low noise input and 3/45pC range

10k€

32x SR → low noise input stage

26k€

260k€

“ 4π Config.”

To Buy:

16 x 3/45pC DR PA for Ring4

128k€

16 x 3/30pC SR PA for Ring1

112k€

To Modify:

12x DR → to low noise input and 3/45pC range

10k€

32x SR → low noise input stage

26k€

Note:

+ 32 FEBEX cards are needed for this configuration

47k€

323k€

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300

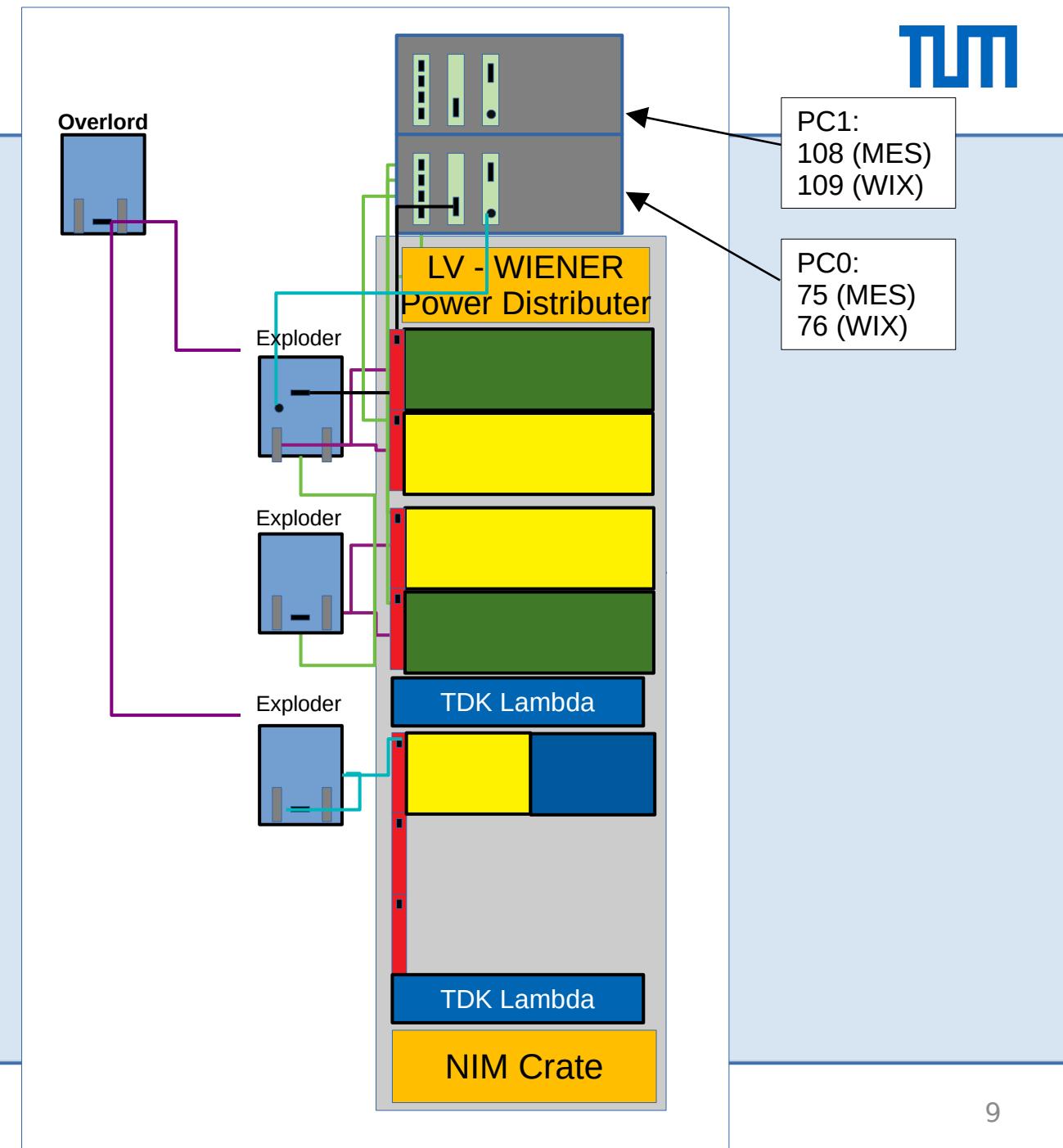
Tob

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300

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DAQ Status for Exp. S091/118 - 2024

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		
DR 48 30/450		SR 30/300	SR 30/300		
	DR 30/300	SR 30/300	SR 30/300		

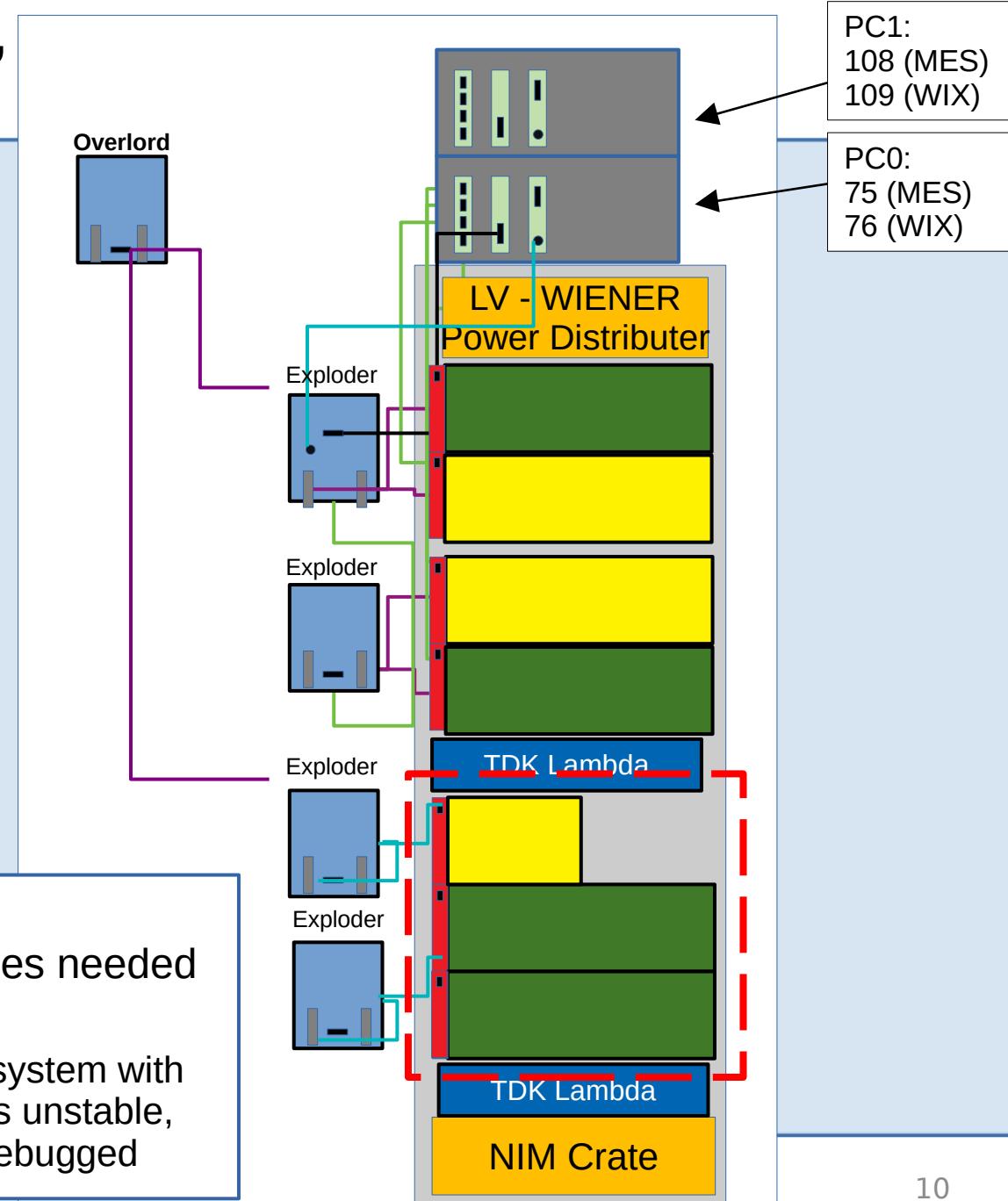


DAQ – Future Upgrades - “Default Config”

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
	DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
	DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
	DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
	DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300

More about CALIFA DAQ Status:
 Presentation Philipp Klenze,
 Wed, 11am

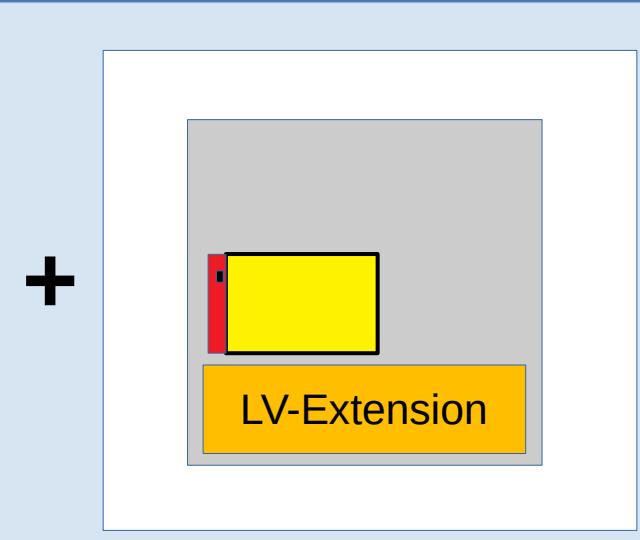
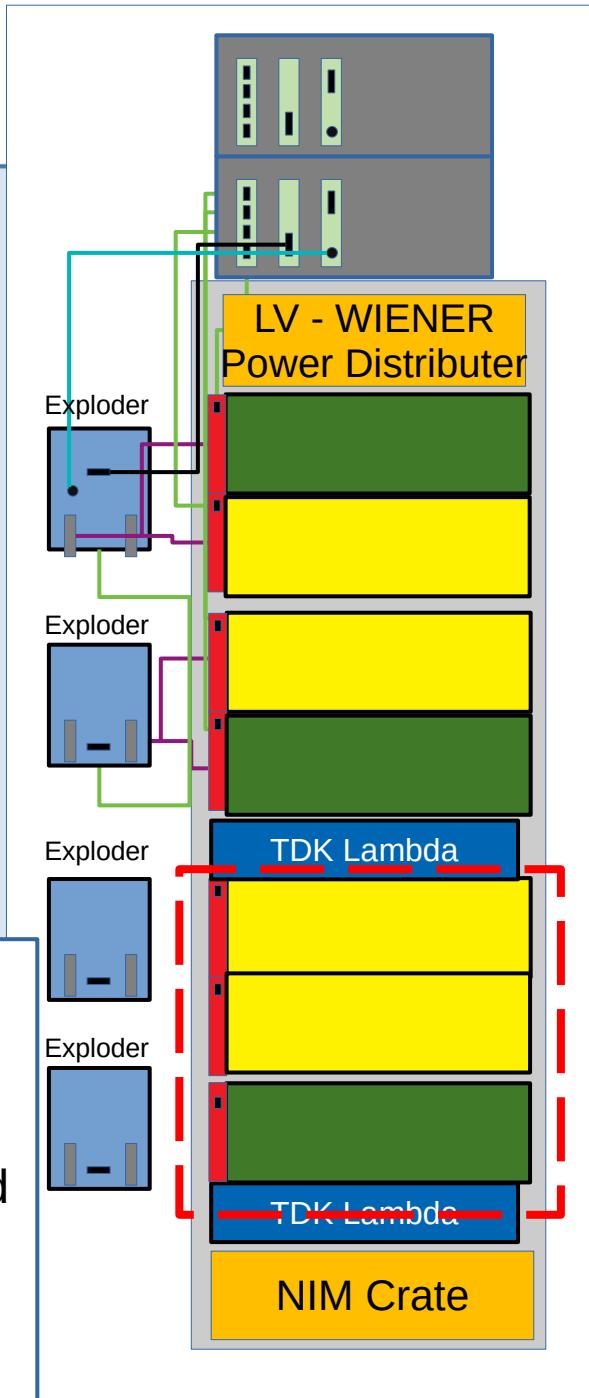
- ✖ 2+ LV modules needed
- ✖ Running sub-system with all three crates unstable, needs to be debugged



DAQ – Future Upgrades - 4π Config.

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450		DR 30/450	SR 30/300	SR 30/300	SR 30/300
	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450		DR 30/450	SR 30/300	SR 30/300	SR 30/300
	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450		DR 30/450	SR 30/300	SR 30/300	SR 30/300
	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450		DR 30/450	SR 30/300	SR 30/300	SR 30/300
	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300

- ✗ Load balancing
- ✗ 2+ LV modules needed
- ✗ Running sub-system with all three crates unstable, needs to be debugged



Rack extension
already available

Already available or ordered:

- 5 Exploders
- 16+ FEBEX cards
- NIM Power Crate

Still to buy:

- LV Power Distributer Board
- 2 x PEXOR cards
- 2 x PEXARIA cards
- 2 x TRIXOR cards
- 2 x DAQ PCs
- 2 x TDK Lambdas



Costs: ~ 30k€

Outer Cabling for Backward Barrel

For “Default Config.”:

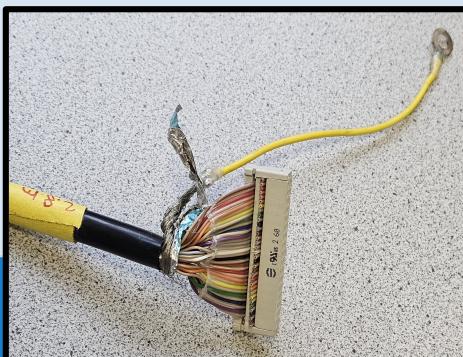
- 48+ SR cables need to be produced
- 16+ LV cables need to be produced

Components
on stock or
easily
available



Workload: ~ 1 month

Single Range (SR) cables



LV cables



For “4π Config.”:

- 16+ SR cables need to be produced
- 16+ LV cables need to be produced
- 32+ DR SCSI cables for Ring 4 and according Febex PCB adapters



Workload: 2 weeks

No ~3.5 m SCSI cables available on the market !

SCSI cables

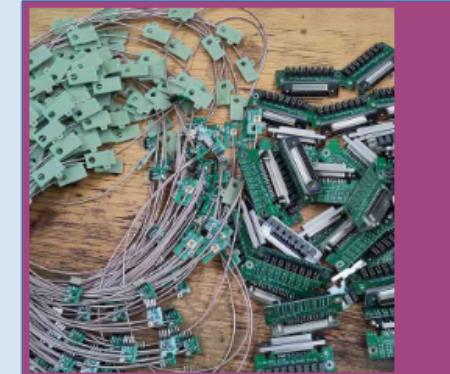


LED Gain Monitoring System

PCB-Boards with a mount for the fibre are installed/available

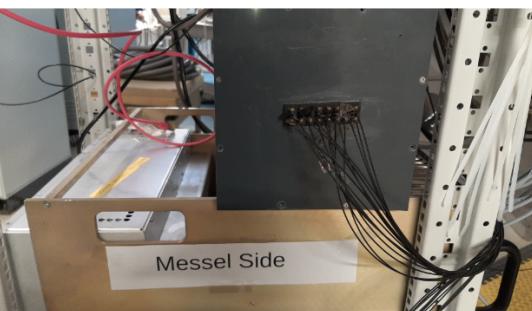


Revised
APD-PCB



New Coax

LED-system is mounted on Messel side,
16 fibres are connected



(a) The fibres connected to the adapter, which was glued to the box
(b) The gain monitoring system connected on the Messel beam-side of CALIFA

Next steps for the implementation in the HEC need to be defined!

Electronics Documentation Status

Google Sheets:

info about FAB,FEBEX,PAs, Exploders
commercial, lifetime, availability



Google Sheets

ELog:

info CALIFA cabling and slow-control
difficult to keep track and search for

R3BWiki:

overview page, more or less well structured
good as overview page, not suitable to store expert-documentation



Where to store documentation?

Cloud Storage for sharing and synchronising



EDMS - CERN's Engineering Data Management Service



How is documentation done by other WGs ? Synergy effects..

“Default Config.”

Decision has to be taken:

“4π Config.”

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300	SR 30/300

Costs:
260k€

Workload cable
production:
2-3 weeks

CEPA	iPhos	Ring 4	Ring 3	Ring 2	Ring 1
DR 48 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300
DR 48 30/450	DR 30/450	DR 30/450	SR 30/300	SR 30/300	SR 30/300

Costs:
323k€
+ 3k€ (SCSI cables)

Workload cable
production:
1-2 weeks

- Inner cables (11k€) - production ?
- Outer cabling for Backward Barrel (10k€)
- Provide electronics for extension (30k€)
- Implementation of LED System in HEC
- Documentation



Thank you!

CALIFA @ Technical University of Munich (TUM)

Roman Gernhäuser, Philipp Klenze, Mrunmoy Jena, Tobias Jenegger



BACKUP

Connectors

Parts needed for one connector:				
	Quantity	Number	Supplier	~Price
Sub-D-Connector		D-SUB ST 1 25 IPS W+P 153PF-008-	Reichelt	11.8
Buchsenleiste	82	AN- CALIFA_PIGTAIL2SU 1 1621452	Reichelt	1.56
T-Sensor(Sensor+Cab)	1			
Buchse T-Sensor	1			
				25.59

Necessary connectors:

	R6	R5	R4	R3	R2	R1	
W	4	16	16	16	16	16	
M	4	16	16	16	16	16	spares
	8	32	32	32	32	32	8
							Total
							176
							already in
							77
							ready to go
							12
							87

Parts needed :	missing	existing pa	order:	costs
Sub-D-Connector	87	53	34	401.2
Buchsenleiste	696	4	692	1079.52
CALIFA_PIGTAIL2SUBD	87	20	67	87.77
T-Sensor(Sensor+Cable)	87	118	-31	0
Buchse T-Sensor	87	0	87	0
				1568.49

Kind contribution by Anna-Lena Hartig

Cable

Cable				
Parts needed for one cable pair:				
	Quantity	Number	Supplier	~Price
CALIFA_Pigtail	1	AN-1621452	Multi-cb	0.21
Steckerleiste	1	MPE 087-2-008	Reichelt	0.21
Coax cable 40cm	2	AN-1621452	Iemo	2.42
Fiber connector	2	20388015800880	Mous	0.25
APD_Connector left	1	AN-16148	Multi-cb	0.5
APD_Connector right	1	AN-16148	Multi-cb	0.5
Leiterplattenbuchse	4	48579-0-15-15-11-27-10-0		6.76

Necessary cables:

	R6	R5	R4	R3	R2	R1	
W	56	256	256	256	256	208	
M	56	256	256	256	256	208	spares
	112	512	512	512	512	416	48
							Total
							2624
							already in
							1104
							ready to go
							in
							1520
							number of
							760
							3

Parts needed :

	missing	existing pa	order:	costs
CALIFA_Pigtail	1520	457	1063	223.23
Steckerleiste	1520	81	1439	302.19
Coax cable 40cm	3040	325	2715	6570.3
Fiber connector	3040	400	2640	660
APD_Connector left	760	0	760	380
APD_Connector right	760	0	760	380
Leiterplattenbuchse	6080		6080	730
				9245.72

Kind contribution by Anna-Lena Hartig