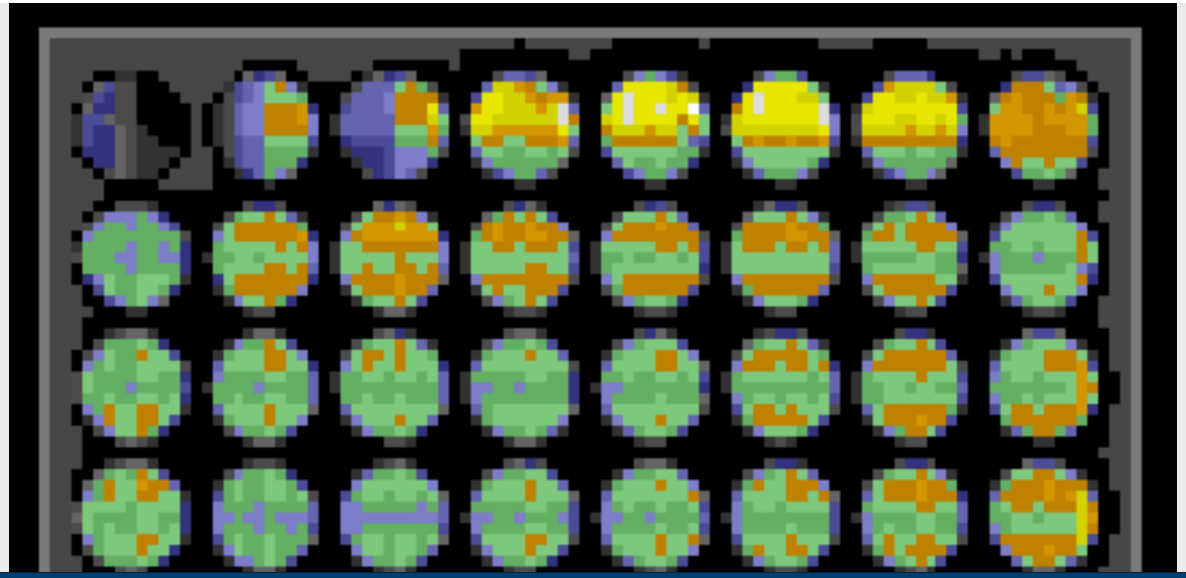
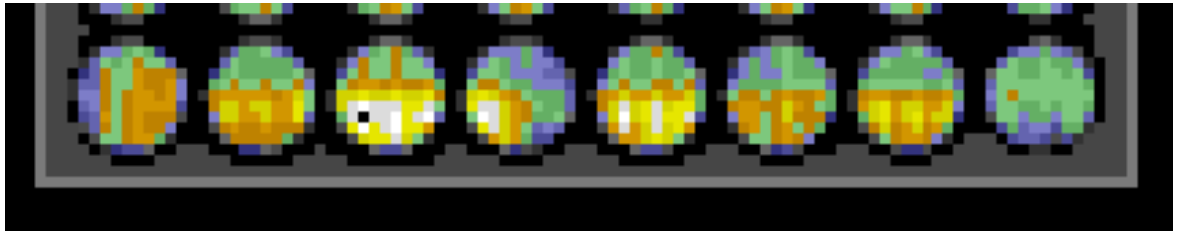


DETECTOR ACTIVITIES AT FZJ - JCNS

ICND Meeting @ FZJ

OCTOBER 27, 2019 I R. ENGELS, G. KEMMERLING



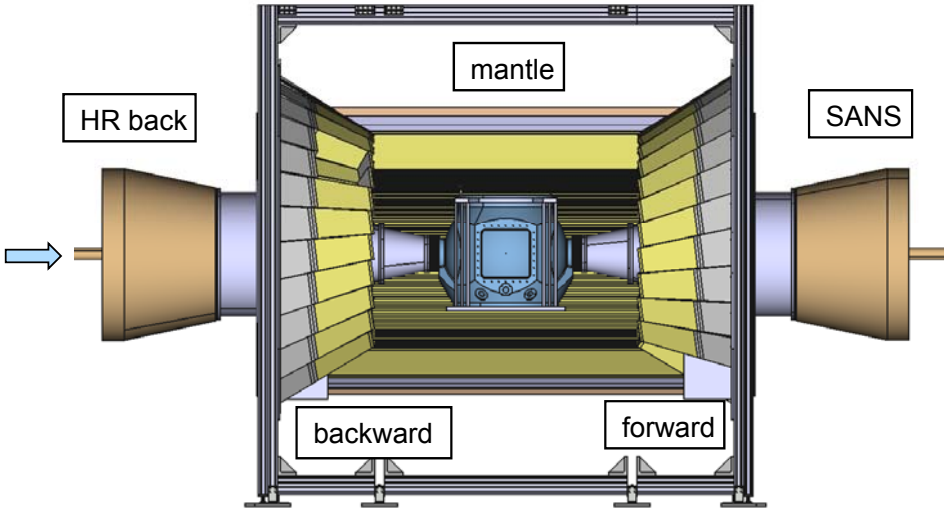
HEADLINE

- DREAM Detector
  - End-Cap Detector Test
  - Results of these Test‘s from beamline V20@HZB
- SoNDe Detector Updates
  - Tile and 3x3 Demonstrator
  - Detector Design and Heat Simulation
- Summary

TEST OF END-CAP DETECTOR

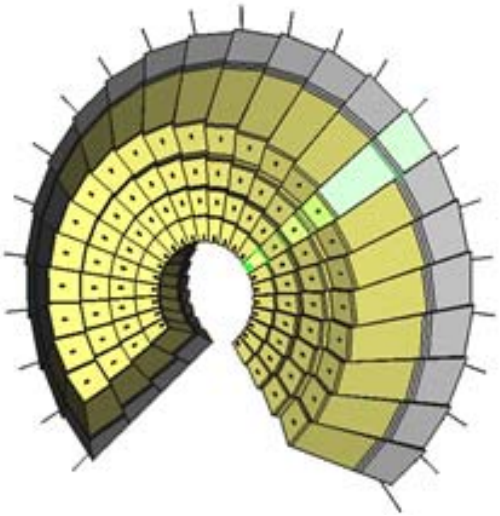
prototype for DREAM@ESS

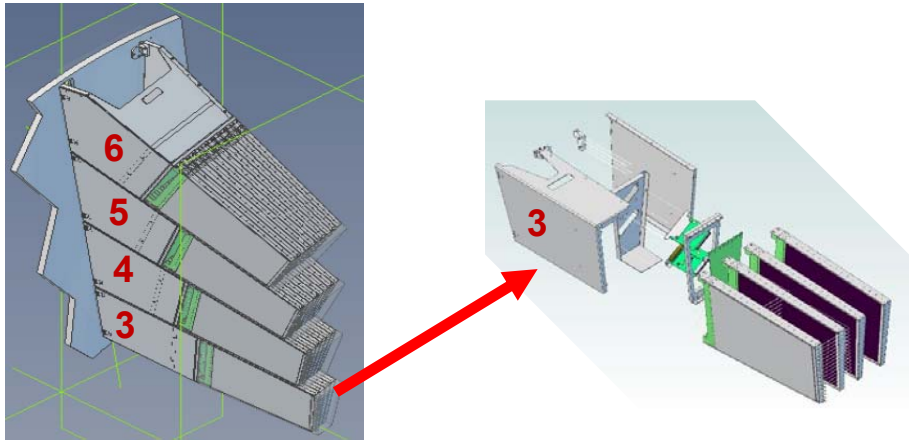
- **D**iffraction Resolved by **E**nergy & **A**ngle **M**easurements (DREAM)
  - versatile & flexible Powder diffractometer
  - FZJ, LLB, ESS
- Detectors overview
  - based on boron coated cathode layers of multi-wire chambers from CDT
  - several detection layers with inclined geometry of 10° relative to incoming neutrons
  - mantle detectors for cylindrical barrel, end-cap detectors for forward-/backward-sections
  - technologies already used similarly for future POWTEX instrument at FRM2



DREAM END-CAP DETECTORS

- **End-cap detectors for DREAM forward-/backward-directions**
  - build up in φ by 12°-segments sub-structured in 4 submodules
  - each module with several 2-layer MWPCs with boron coated segmented cathodes (inclined geometry of 10° relative to incoming neutrons)
  - 3D hit position (voxel) identified through anode/cathode signal coincidence
  - mechanics with a lot of individual designed parts mounted with several different rotation angles (complicated voxel map)





- **DREAM end-cap prototype detector**
  - 1 mounting unit (12°-segment with 4 submodules
  - measurements with up to 12 boron layers
  - production completed at CDT
  - tested at HZB beamtime (Jul. 2019)

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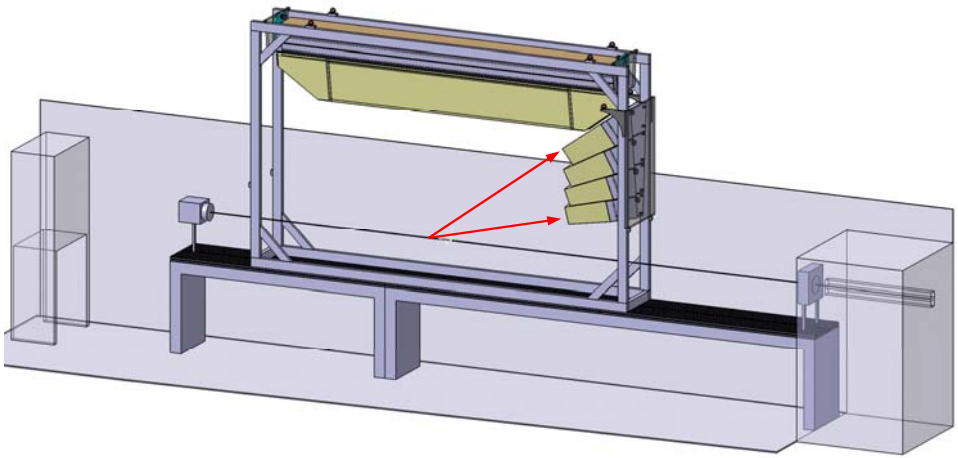
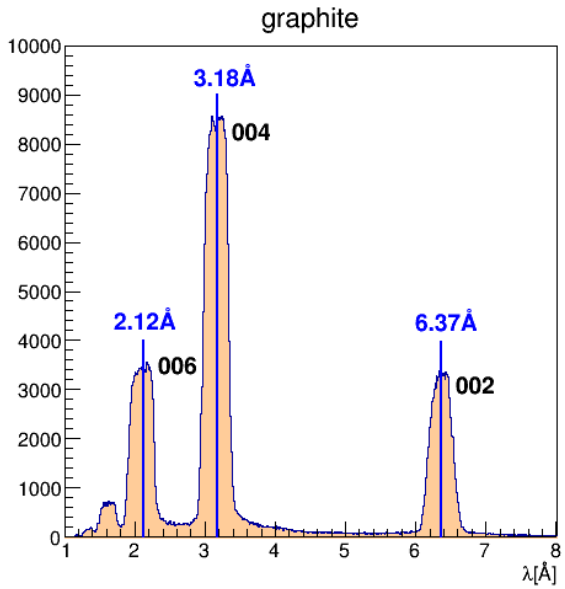
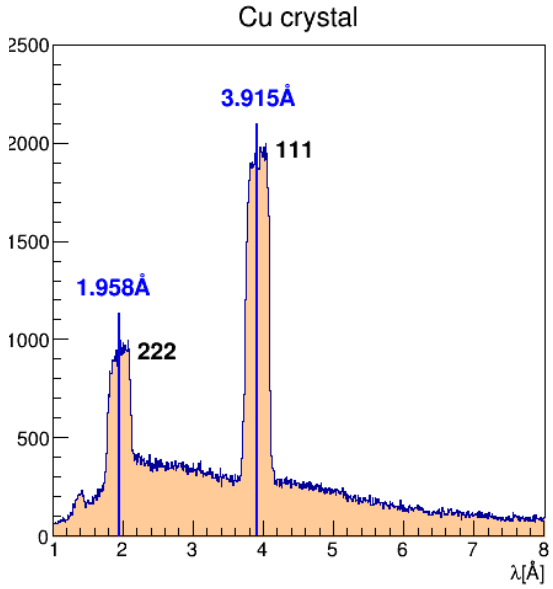
TEST SETUP AT ESS TEST BEAMLINE V20@HZB

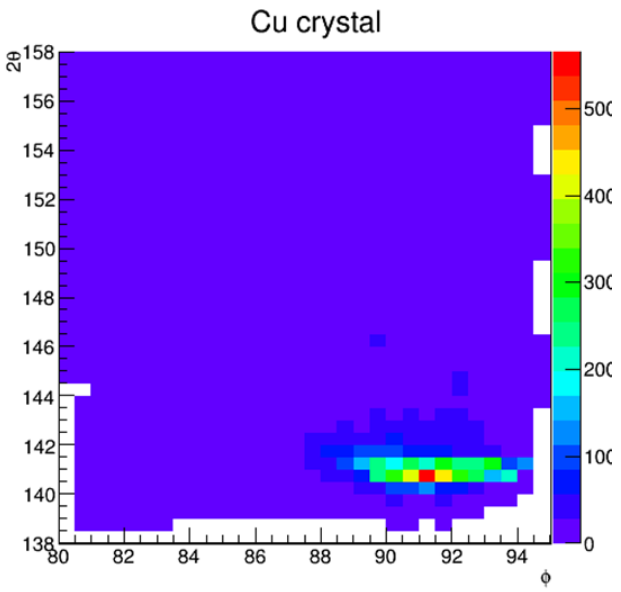
- Goals of measurements
  - functional test of end-cap segment under operation conditions
  - verification of complicated 3D-voxel structure with validity check of position reconstruction
  - demonstration of detector capability by sample measurements
- Experimental setup
  - mounting of 12° end-cap segment in backscattering geometry similar to later arrangement at DREAM
  - total angular 2θ-range ~138° - 166°
  - average of L_{ToF} about 30 m from source chopper
  - measurements with source -& WFM-chopper
  - usage of POWTEX readout electronics
  - side-shielding of detector with B_4C
  - frame also designed for later use with mantle detector



TEST RESULTS: CU & GRAPHITE W. SOURCE CHOPPER



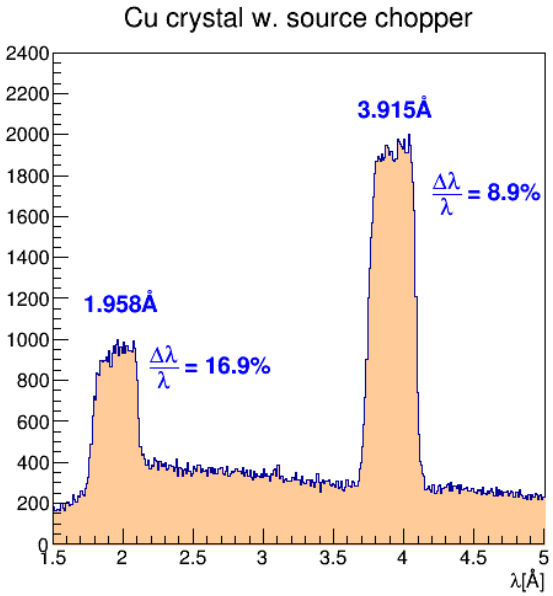




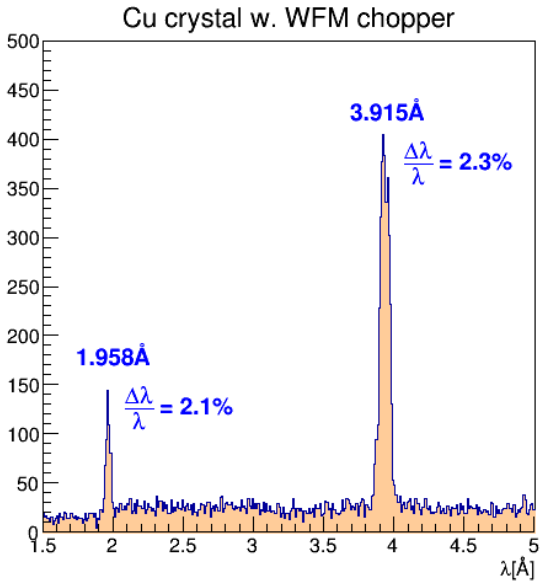
Parameters for L_{tof},chopper timing etc. together with hit times allow for wavelength calculations. Values match well with peak wavelengths of Cu and graphite.

Complicated 3D-voxel structure validated by correct Bragg peak positions reconstruction

TEST RESULTS: CU CRYSTAL SOURCE-/WFM-CHOPPER



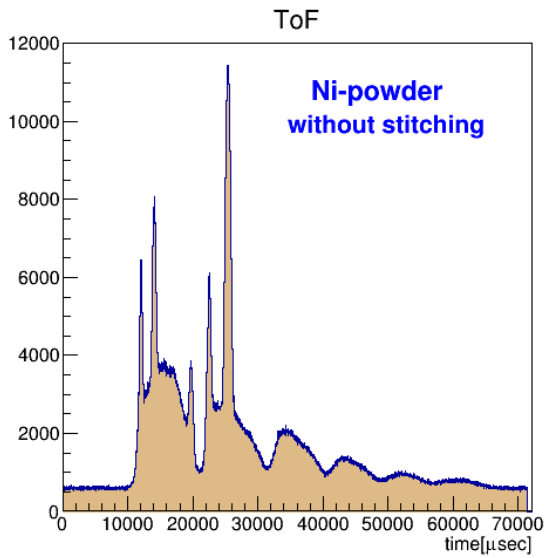
Cu crystal measurement
without WFM-chopper



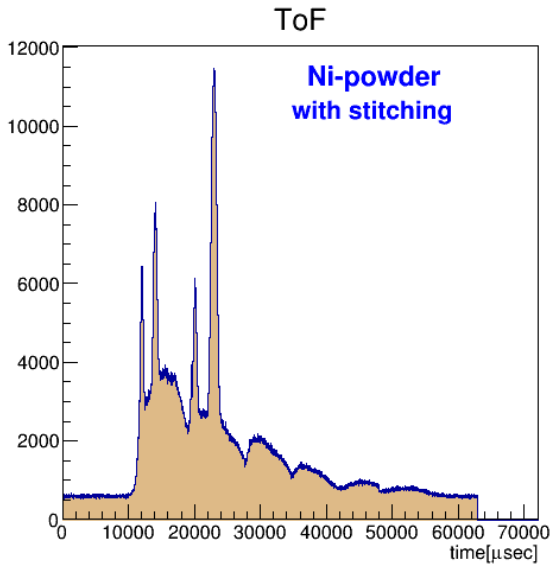
Cu crystal measurement
with WFM-chopper

- Peak positions match well with expected Cu peaks without & with WFM chopper
- Wavelength resolution compliant to expected wavelength resolution of choppers.

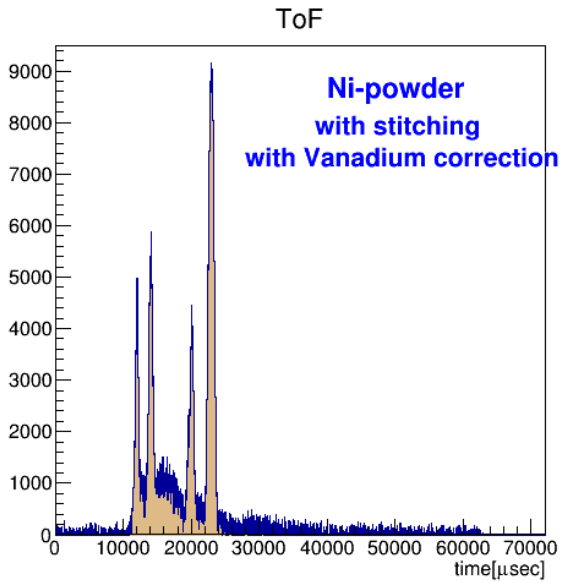
TEST RESULTS: NI-POWDER MEASUREMENTS W. WFM-CHOPPER



Raw ToF-spectrum
only with T_0 correction



ToF-spectrum with
stitching according to
chopper windows
time shift delays



ToF-spectrum with
empty Vanadium can
subtraction

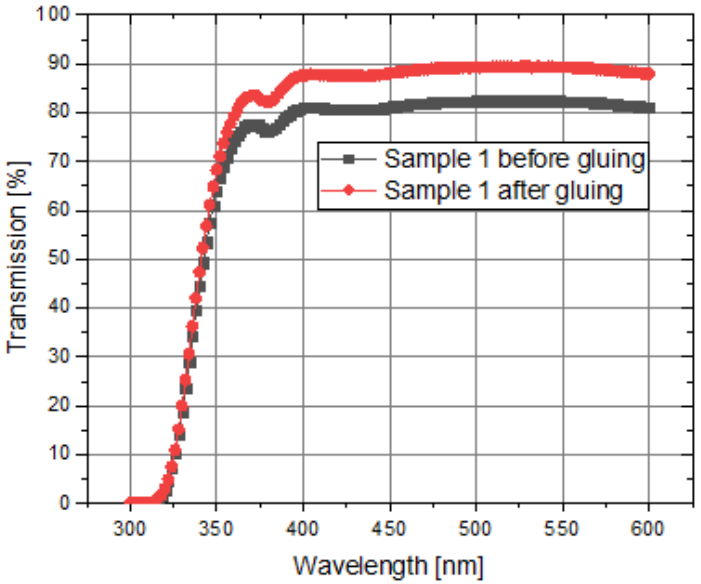
- Succeeded in process of stitching spectrum according to WFM chopper windows.
- Further refinements will be done.

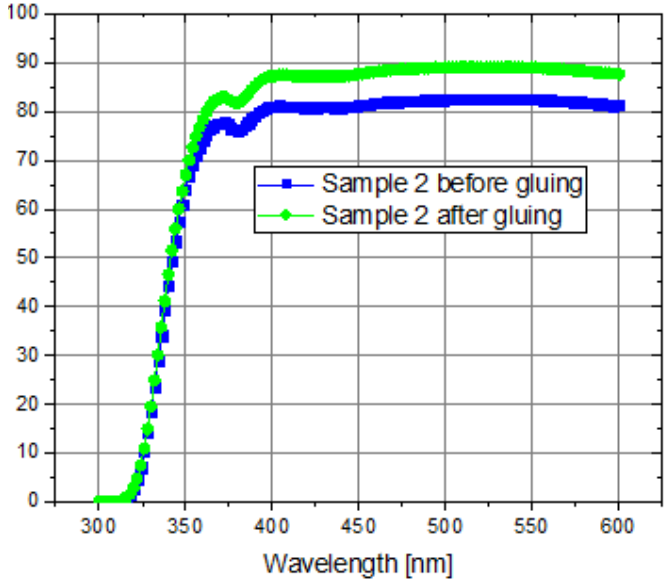
SoNDe Detector Updates

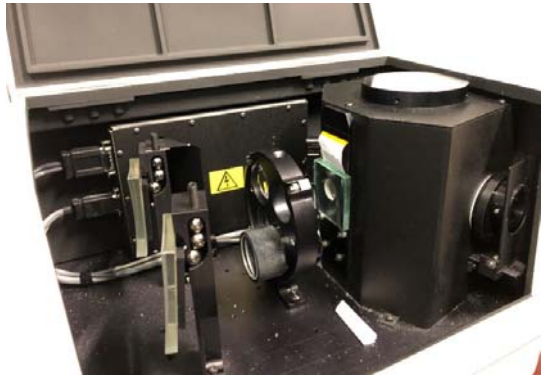
ADHESIVES TEST

Spectrophotometer

- Vitralit® VBB-N / UV 2725
  - Flexible
  - solvent-free UV-curing acrylate adhesive
  - transparent
- Viscosity [mPas] 50-150 (VBB_N) {Sample 1}
- Viscosity [mPas] 200-400 (UV2275) {Sample 2}
- approx. 6% different before and after
- Spectrometer
  - UV/Vis Resolution ≤ 0.05 nm
  - Wavelength Accuracy +/- 0.08 nm UV/Vis







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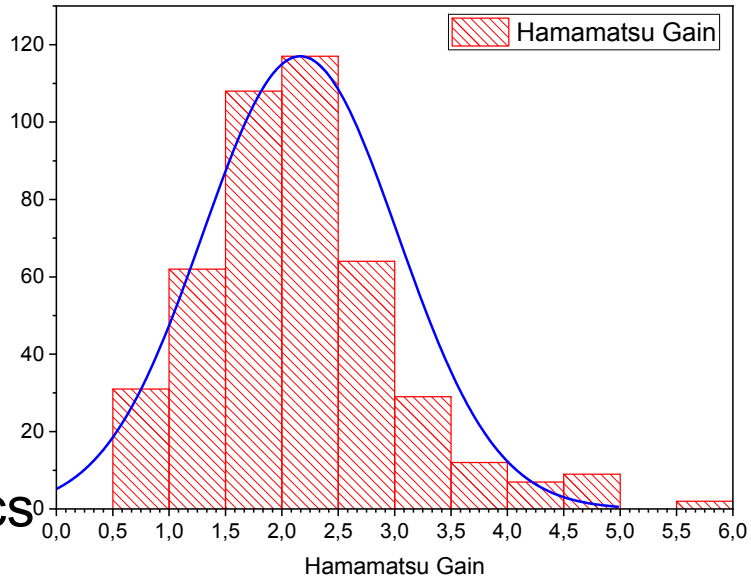
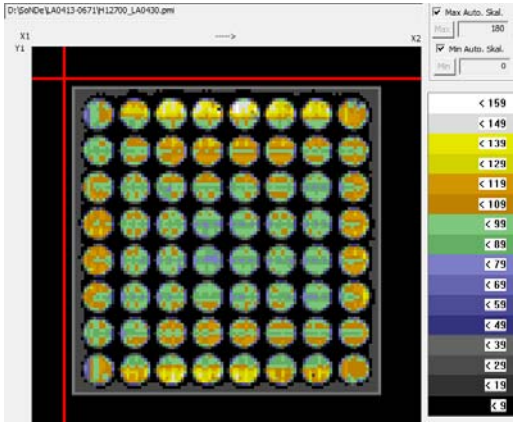
MAPMT

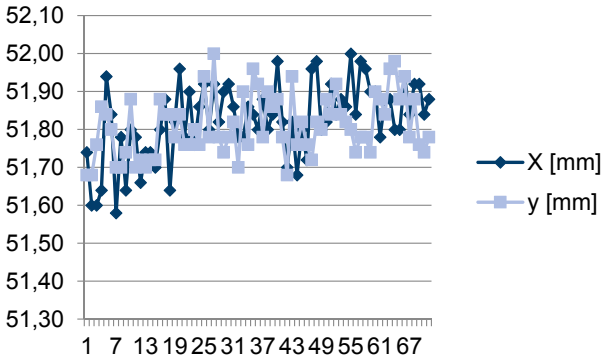
Outside dimensions

- 440 MaPMTs were scanned
- no broken one -> ALL OK
- all are fullfilling the outer dimensions in the given specs
- the calculation and comparison for the pixel gain variation is on going
- uncertainty :
  - Inhomogeneity within the pixel

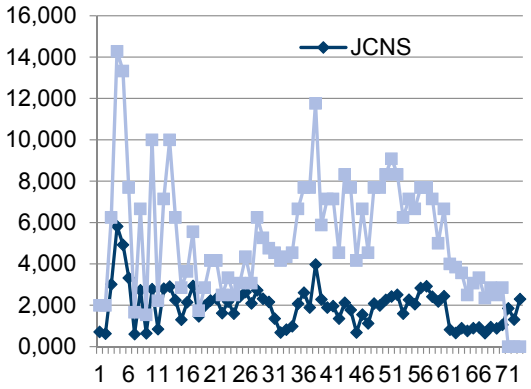




Status End of 2018



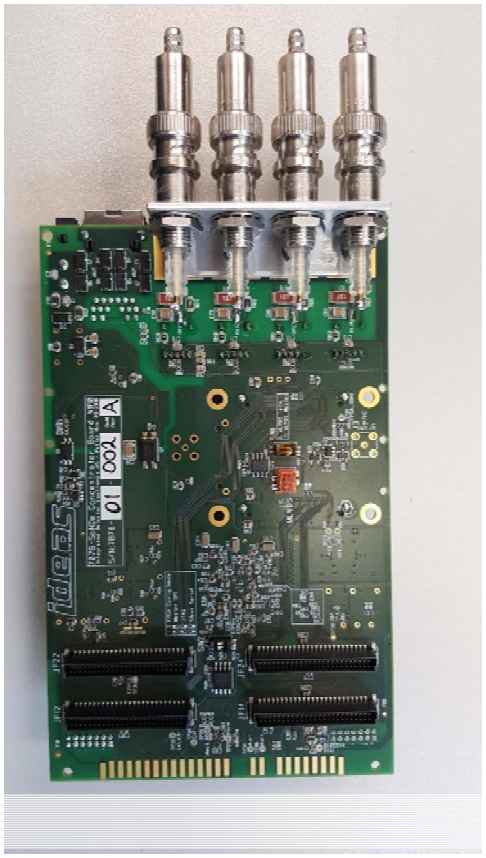
Dimensions in x and y
Hamamatsu state 52,0 $\pm 0{,}3$



Gain variation

CONCENTRATOR BOARD

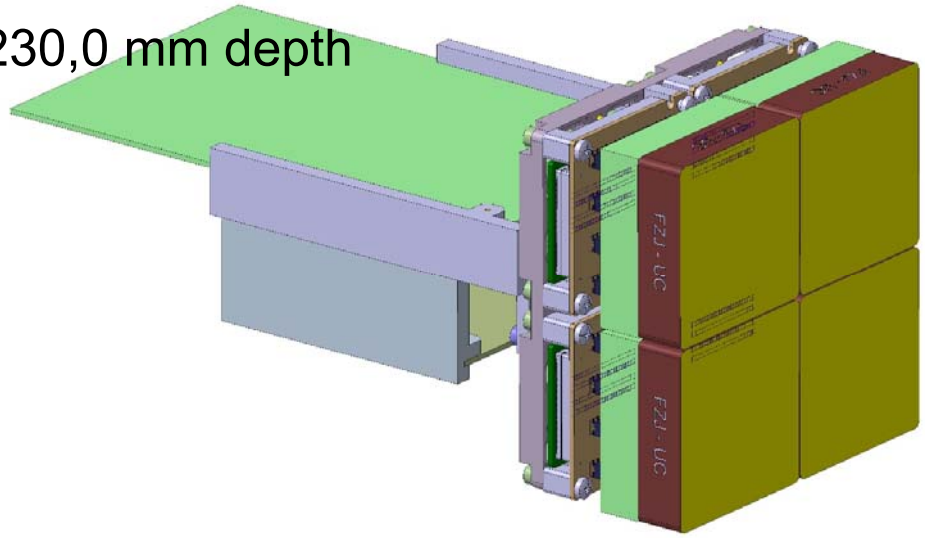
- all needed materials were sent to Oslo to finally assemble the concentrator board
- all FEBs are with the JCNS and ready to use
- connector boards are expected to deliver together with the concentrator boards soon in Juelich

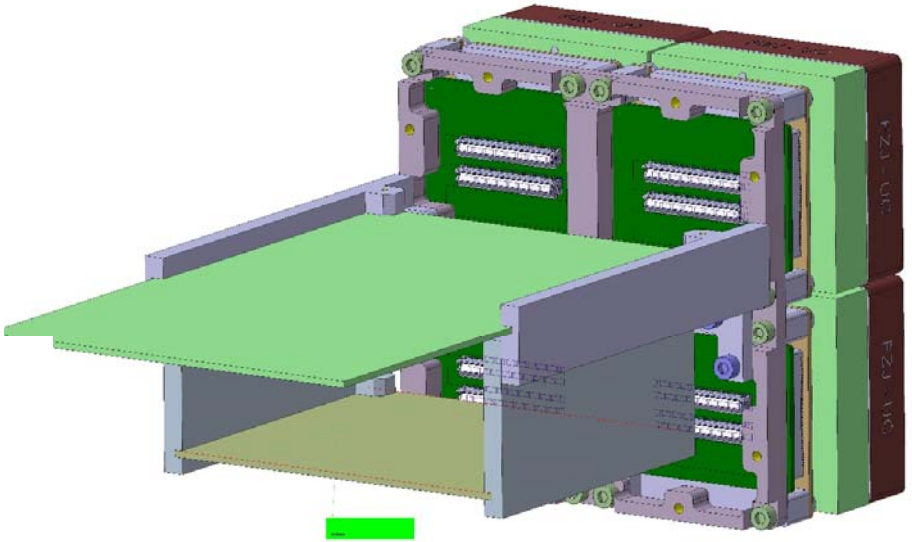


TILE

Drawings / Model

- MaPMT mid/mid 52,5mm
- outer dimensions of a tile
  - ~104,5 mm squared
  - ~230,0 mm depth

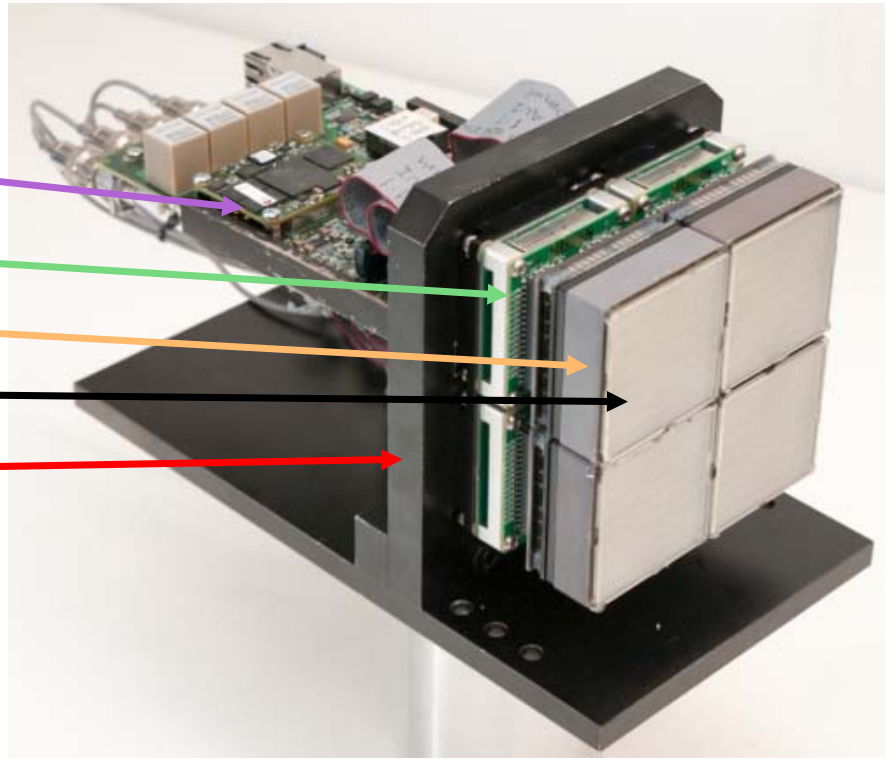


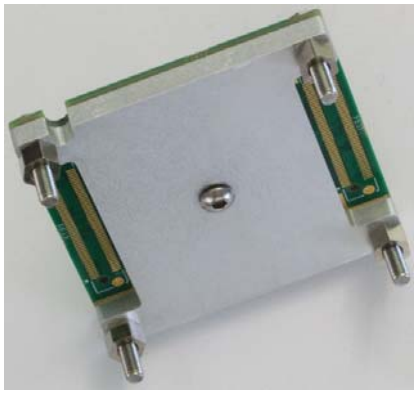


Source: ZEA-1

TILE

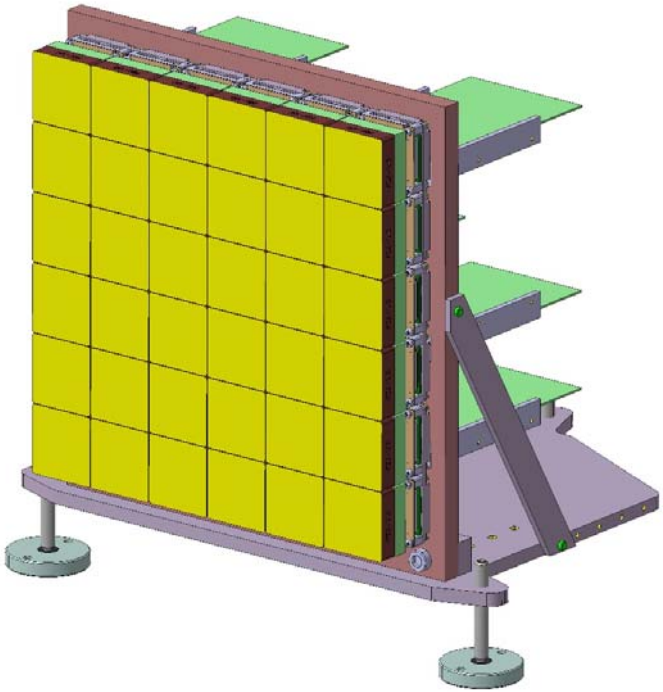
- CB (Connectors, HV,…)
- FEB
- MaPMTs
- ^{6}Li glass scintillator
- Frame holder

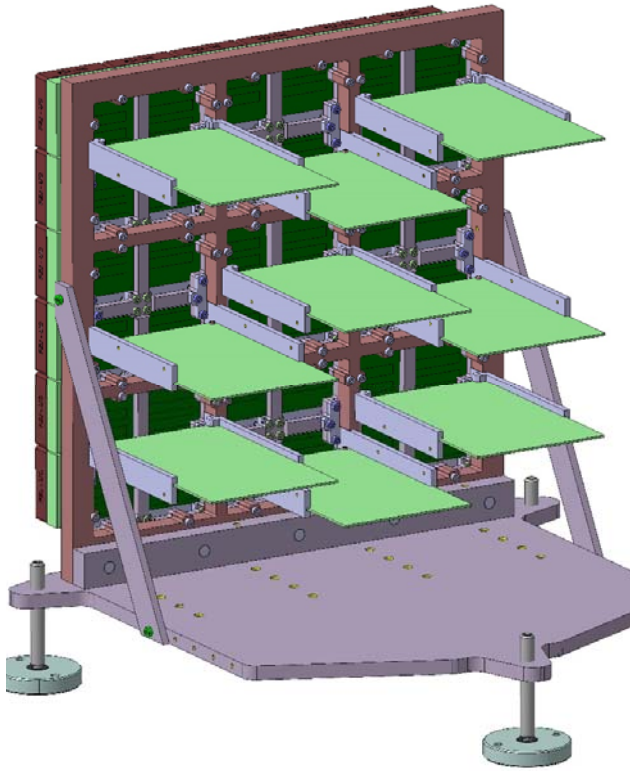


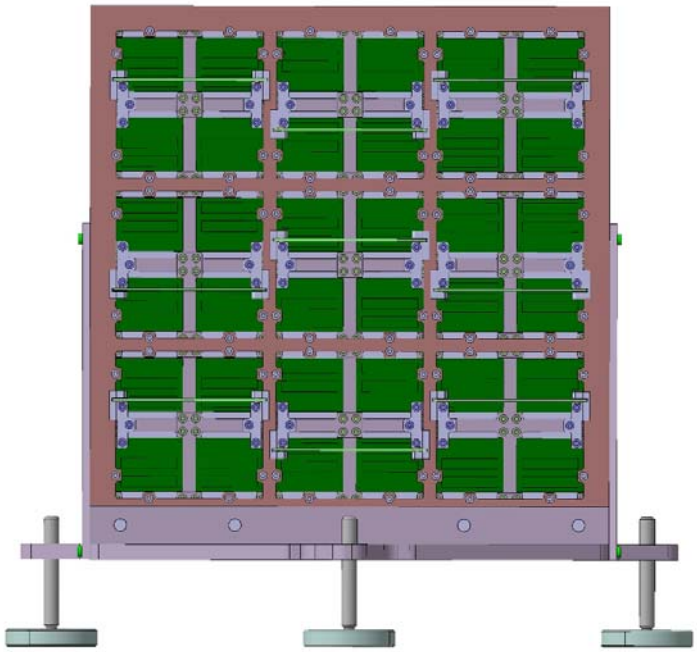


DETECTOR SUBSET DEMONSTRATOR

3x3 Tile Demonstrator – Drawing / Model







Source: ZEA-1

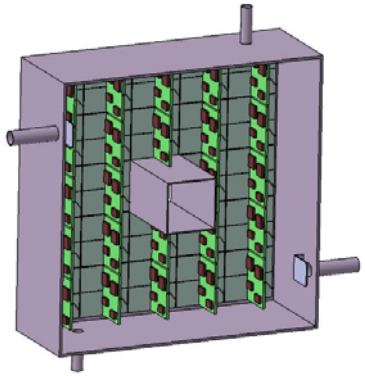
DETECTOR SUBSET DEMONSTRATOR

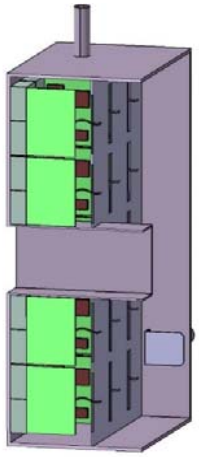
- outer dimensions of the demonstrator
  - width 340,0 mm
  - height 420,0 mm

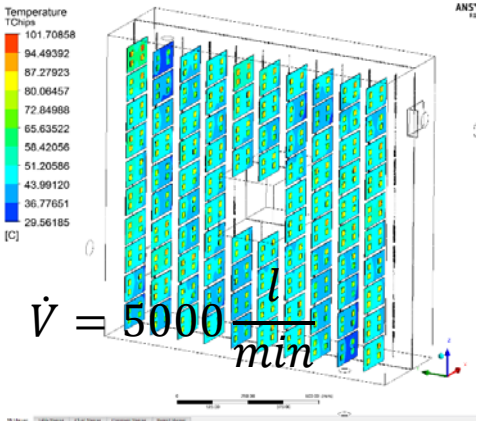
HEAT CALCULATION / SIMULATION

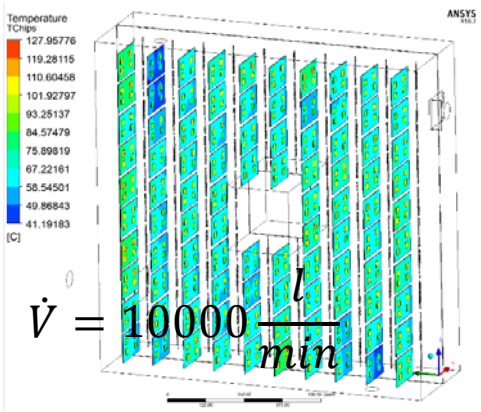
Tile of SoNDe

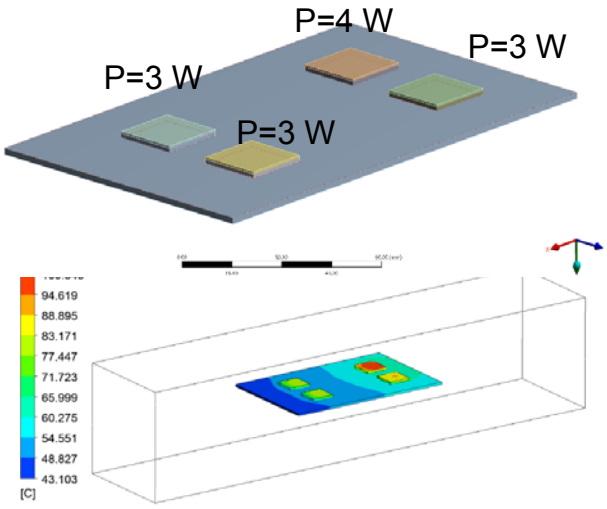
- simulations were made for different airflow
- uncertainty :
  - PCB stacking
  - heat transfer in chips





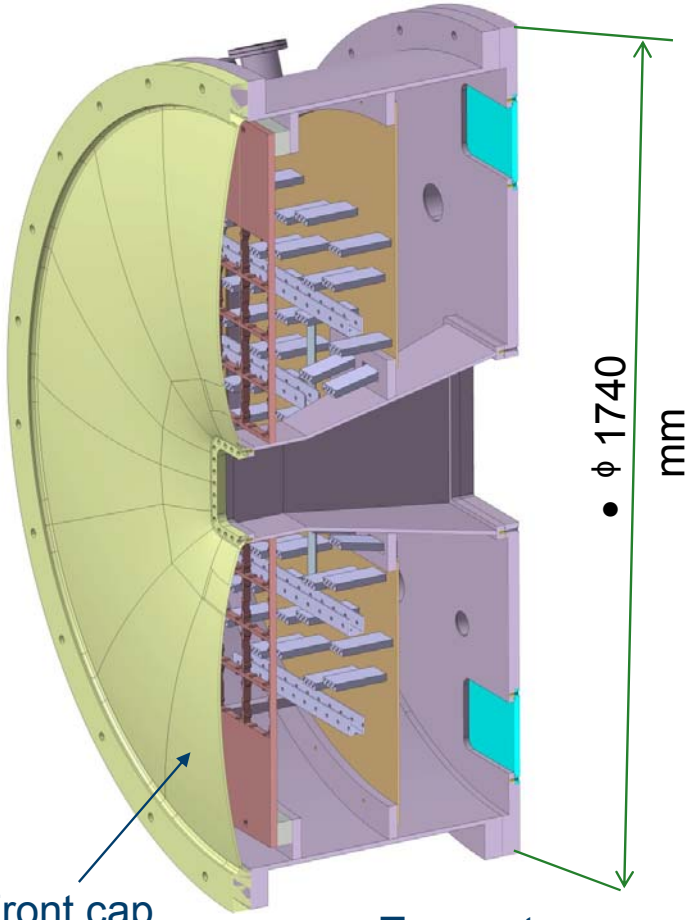


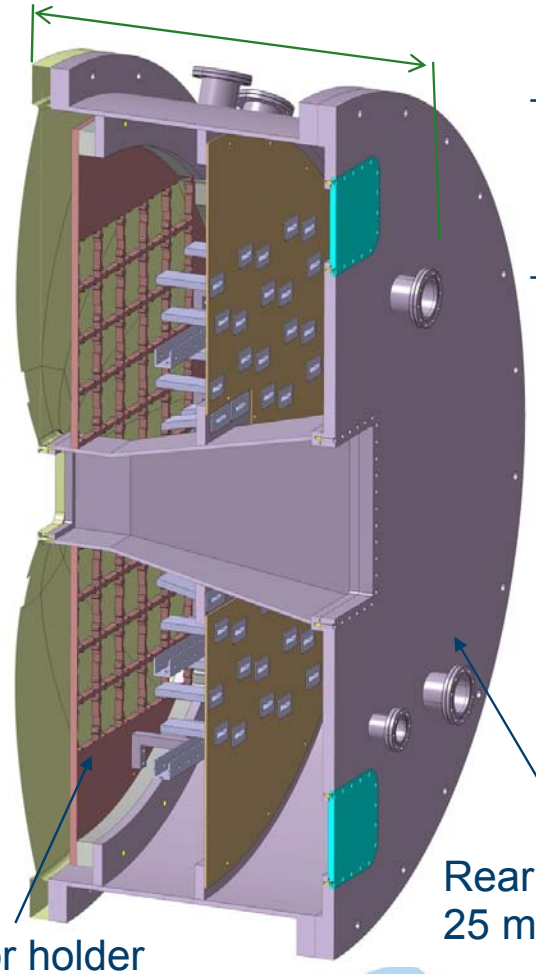




Temperature (PCB + Chips) in °C

DETECTOR HOUSING CUT

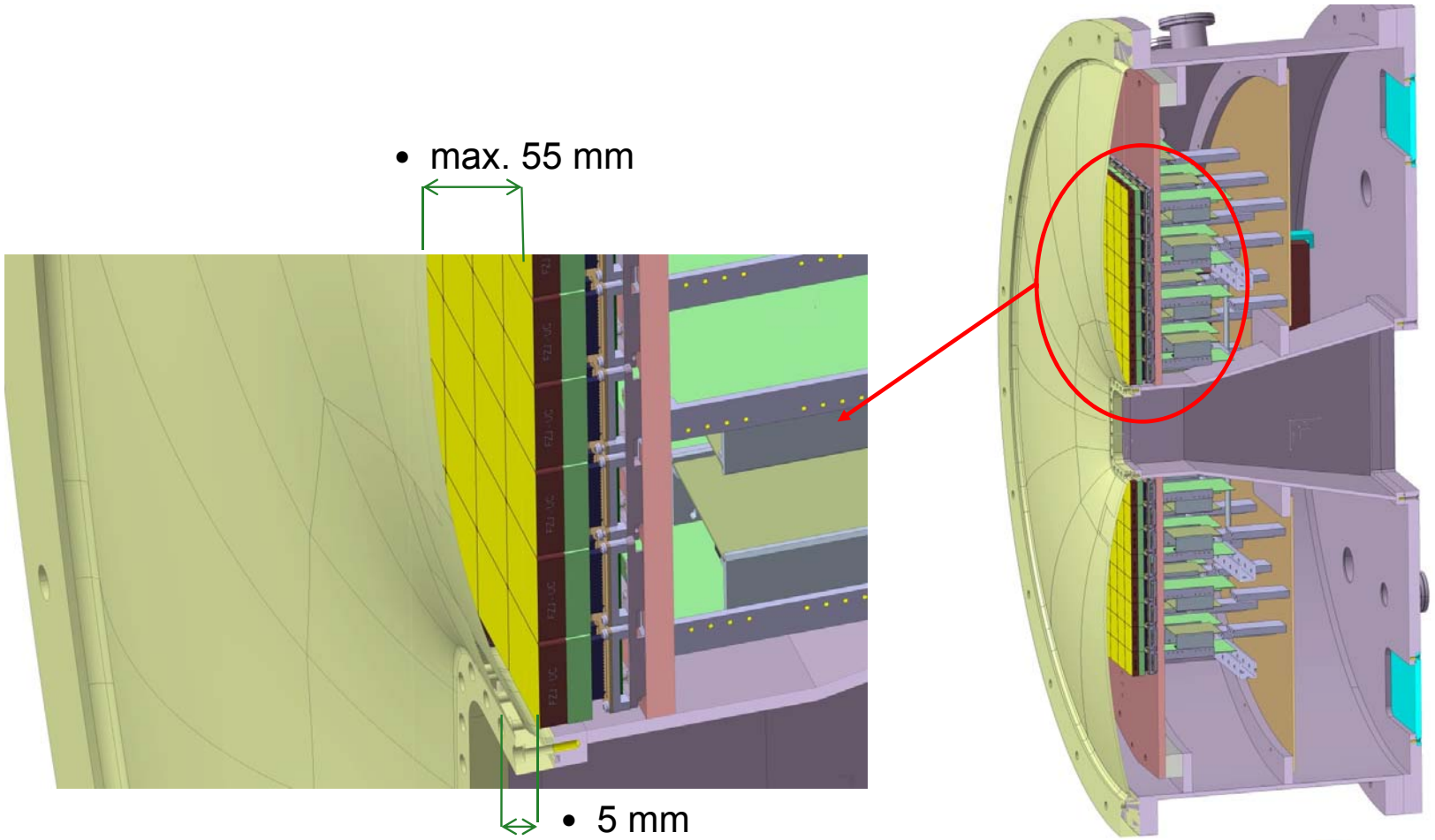




- Sensor holder from Ti,
- Another components from AlMg4,5Mn0,7
- Bolts from Ti

Source: ZEA-1

DETECTOR HOUSING



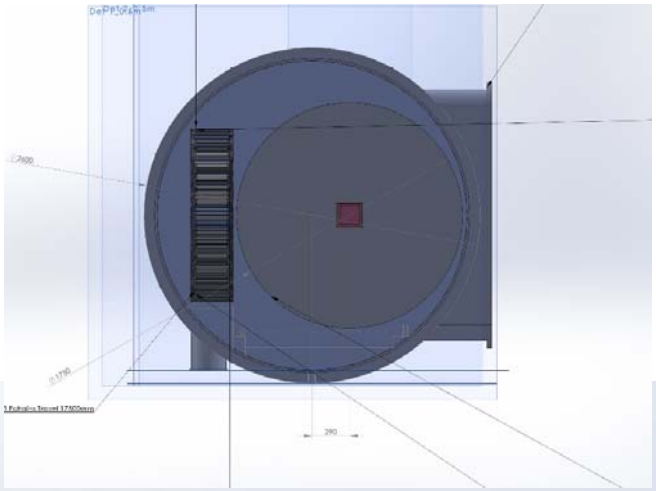
Detector housing
cut rear view

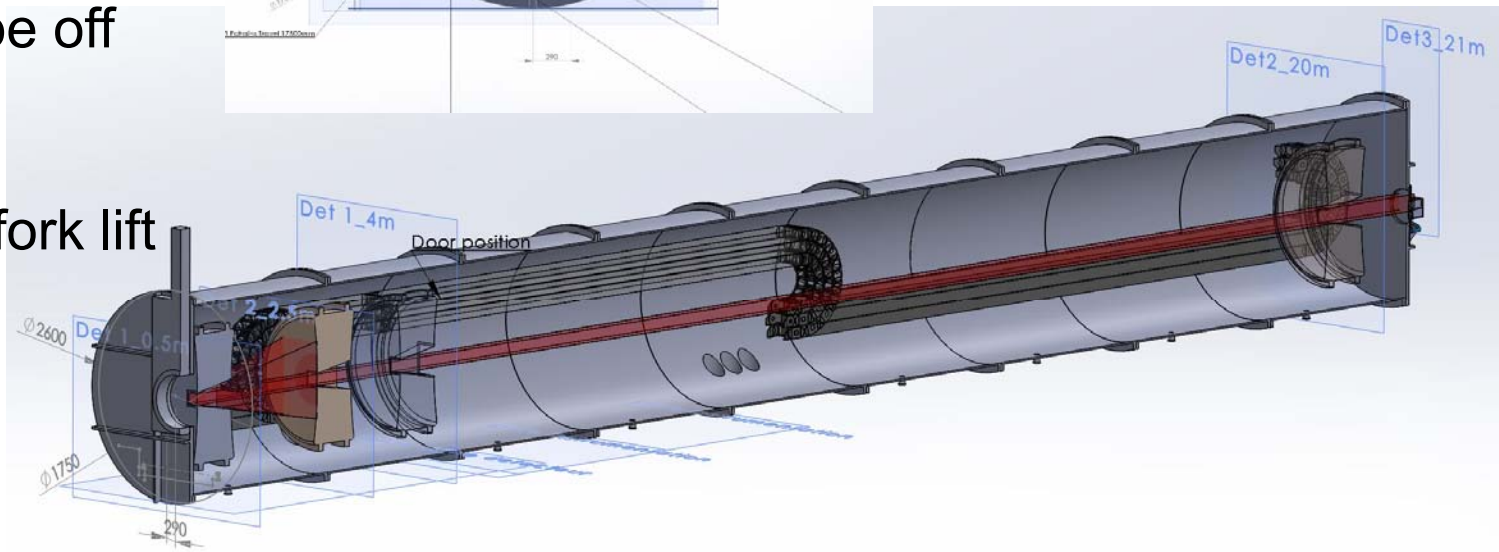
Source: ZEA-1

DETECTOR TANK

Not Finalized - Preliminary

- Detector Tank design is ongoing
- Detector is planned to be off center
- Detector in and out via fork lift for maintenance/repair

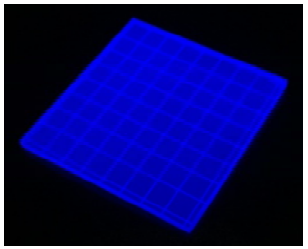


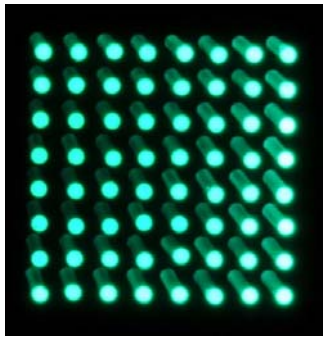


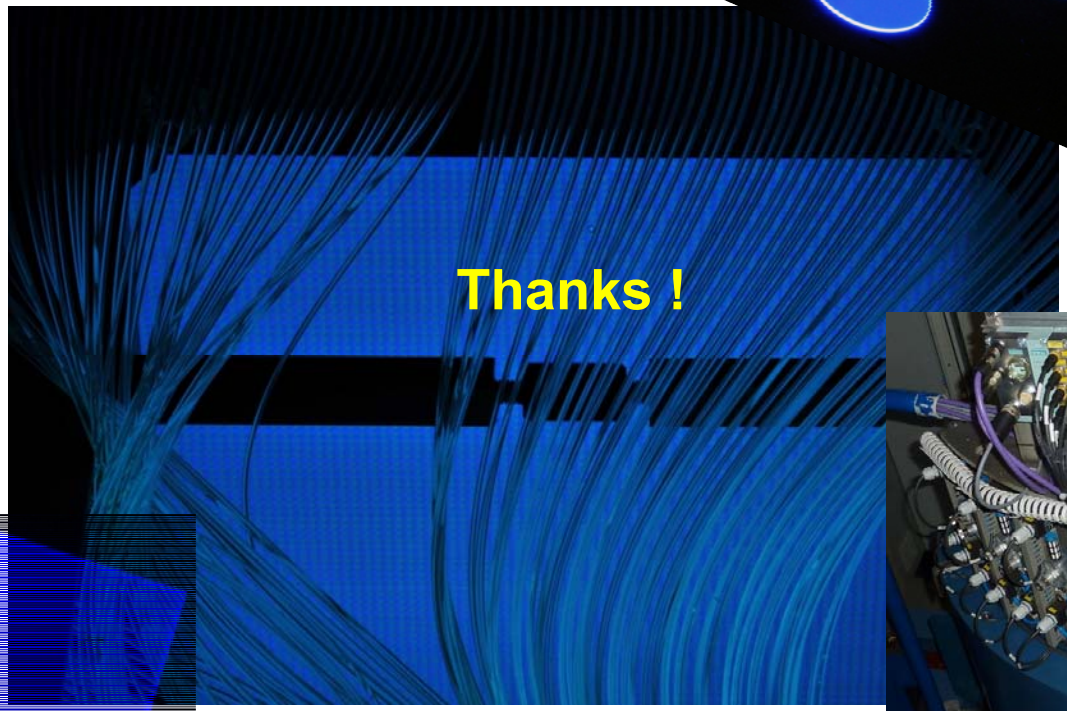
Source: CEA

SUMMARY

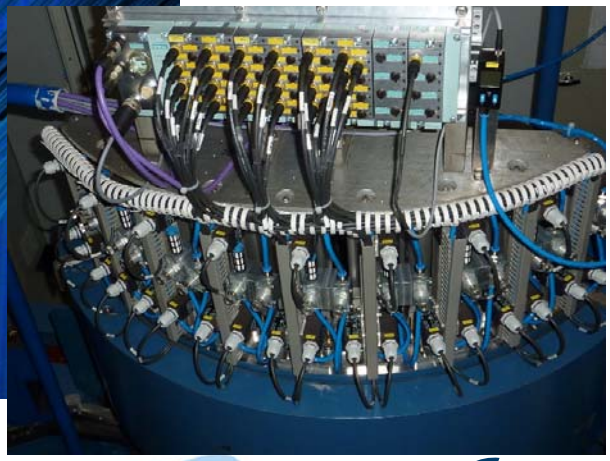
- DREAM Detector Tests were successful
- SoNDe
  - concentrator board is finished and tested
  - scintillators are ready to mount to the tested MaPMTs
  - tile is in the commission phase
  - part of the detector housing is in production
  - future neutron test’s are planed for the ROSMAP MP and the demonstrator

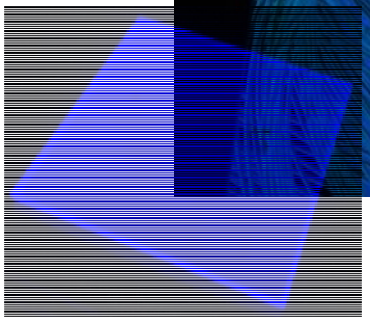






Thanks !





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