A new TASCA focal plane detector and data acquisition system

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for
TASCA Focal Plane Detector
Working group

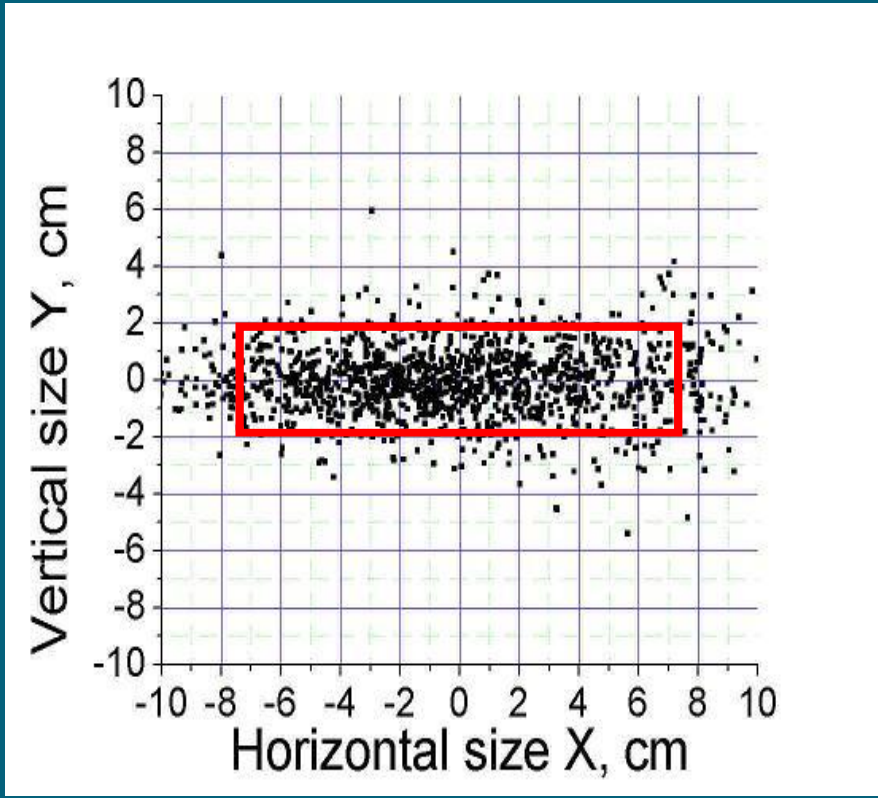
Monte-Carlo simulations

$^{48}Ca + ^{238}U \rightarrow ^{283}112$

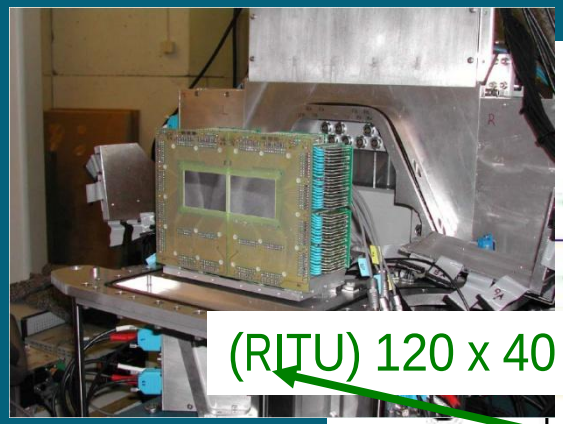
$\underline{DQ_hQ_v}$

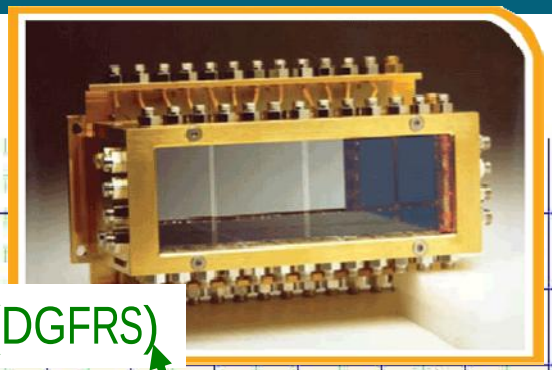
Detector/RTC window size:
14 * 4 = 56 cm^2

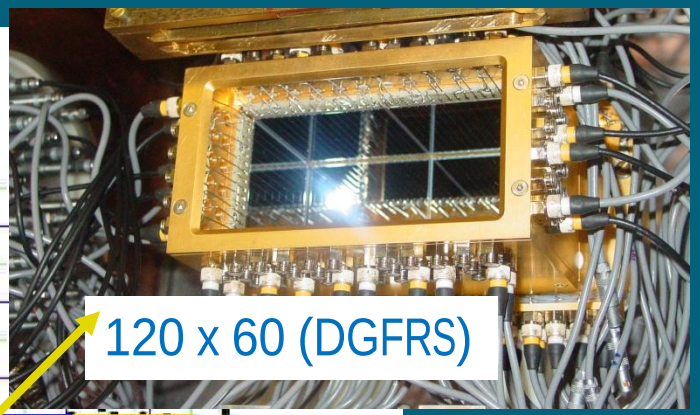
Angular Acceptances:	
Horizontal	± 80 mrad
Vertical	± 46 mrad
Solid angle	≈ 12 msr
Transmission	≈ 59 %
Horiz. image size	≈ 16 cm
Vert. image size	≈ 3 cm
Image area	≈ 48 cm^2



EVR distribution and detector size

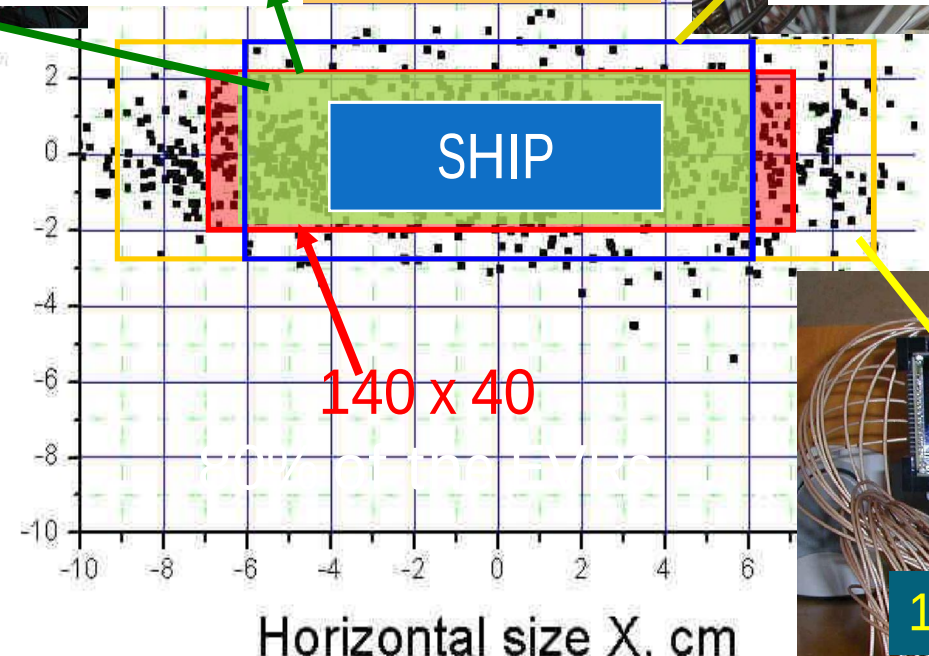


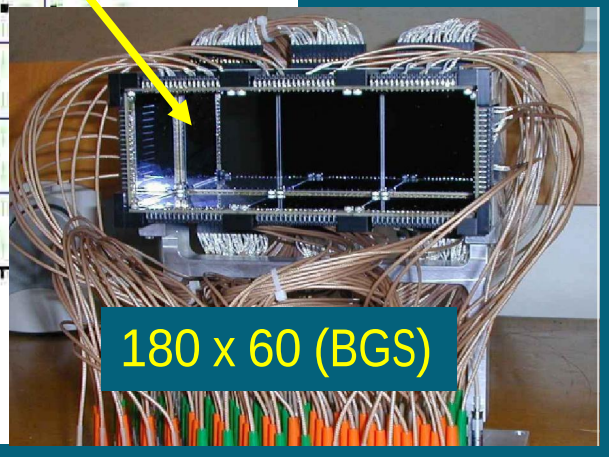




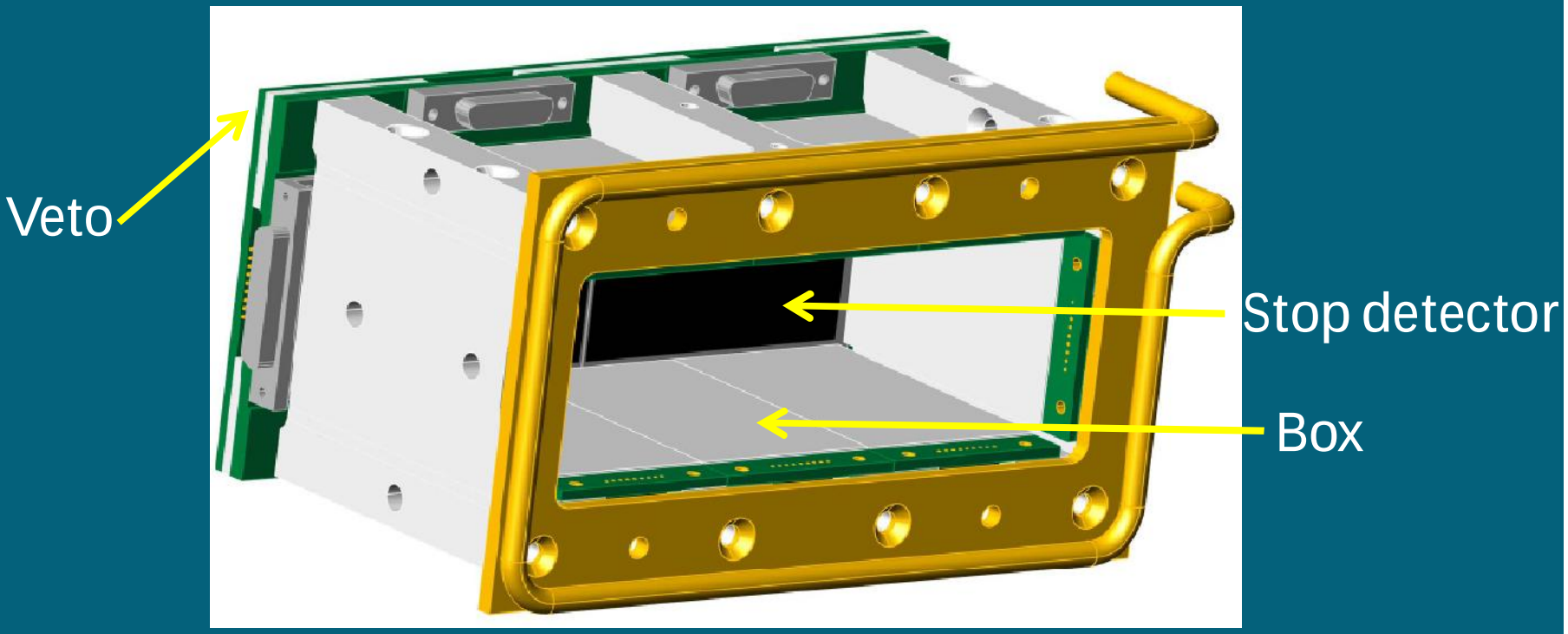
(RITU) 120 x 40 (DGFRS)

120 x 60 (DGFRS)





A principal design of a new TASCA FPD

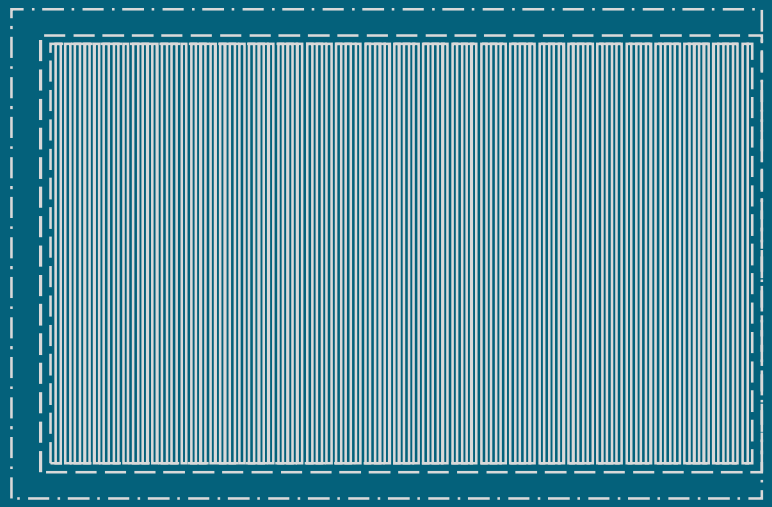


Stop detector: 2 x DSSSD 72 x 48 mm^2 (1 mm pitch)
Box: 8 x SSSD 72 x 48 mm^2 (8 strips)
Veto: 2 x SSSD 72 x 48 mm^2 (8 strips)
Efficiency of single alpha particle detecton 72%

DSSSD and SSSD structures

DSSSD structure (p^+ - ν - n^+)

Structure size “mechanical”	77 x 56 mm
Structure size “electronic”	74 x 50 mm
Active area	72 x 48 mm
Number of “X” strips	72 (front)
Number of “Y” strips	48 (back)
“X” Strip (p^+ - anode) pitch	1 mm
“Y” Strip (n^+ - cathode) pitch	1 mm
Total thickness of the structure	310 $\pm$ 10 μm
Thickness of the ν active layer	305 $\pm$ 10 μm



SSSD structure (p^+ - ν - n^+)

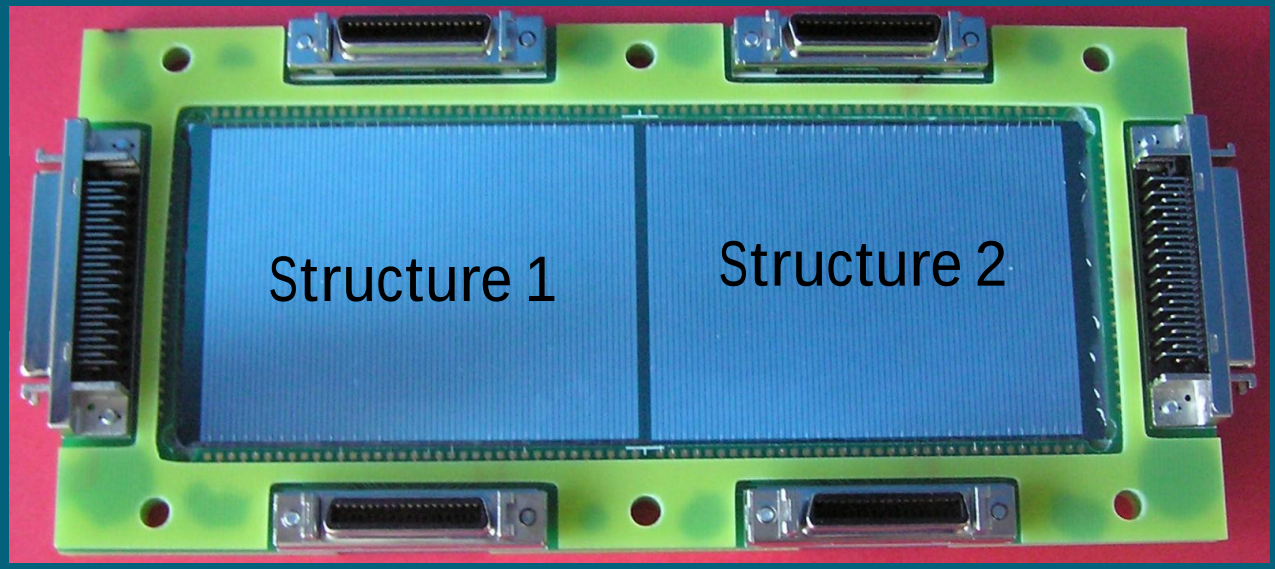
Structure size	74 x 48 mm
Active area	72 x 46 mm
Number of strip	8
Pitch	5,75 mm
Total thickness of the structure	500 $\pm$ 20 μm
Thickness of the ν active layer	495 $\pm$ 20 μm

Stop detector

36 even strips

36 even strips

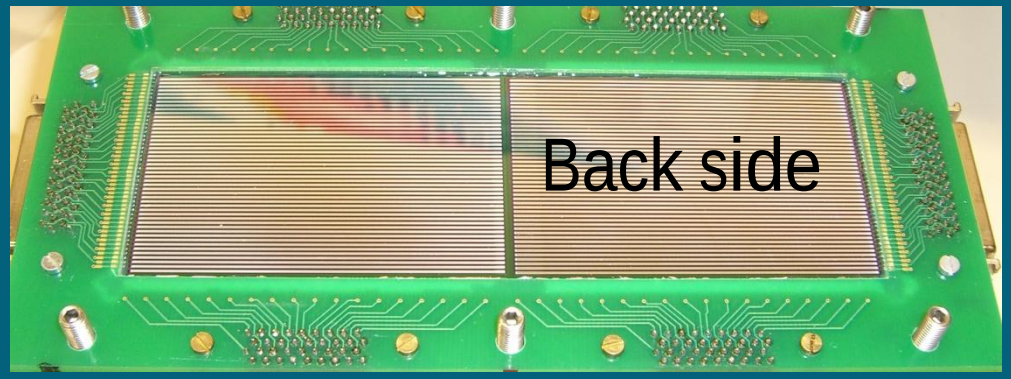
48 back strips



48 back strips

36 odd strips

36 odd strips



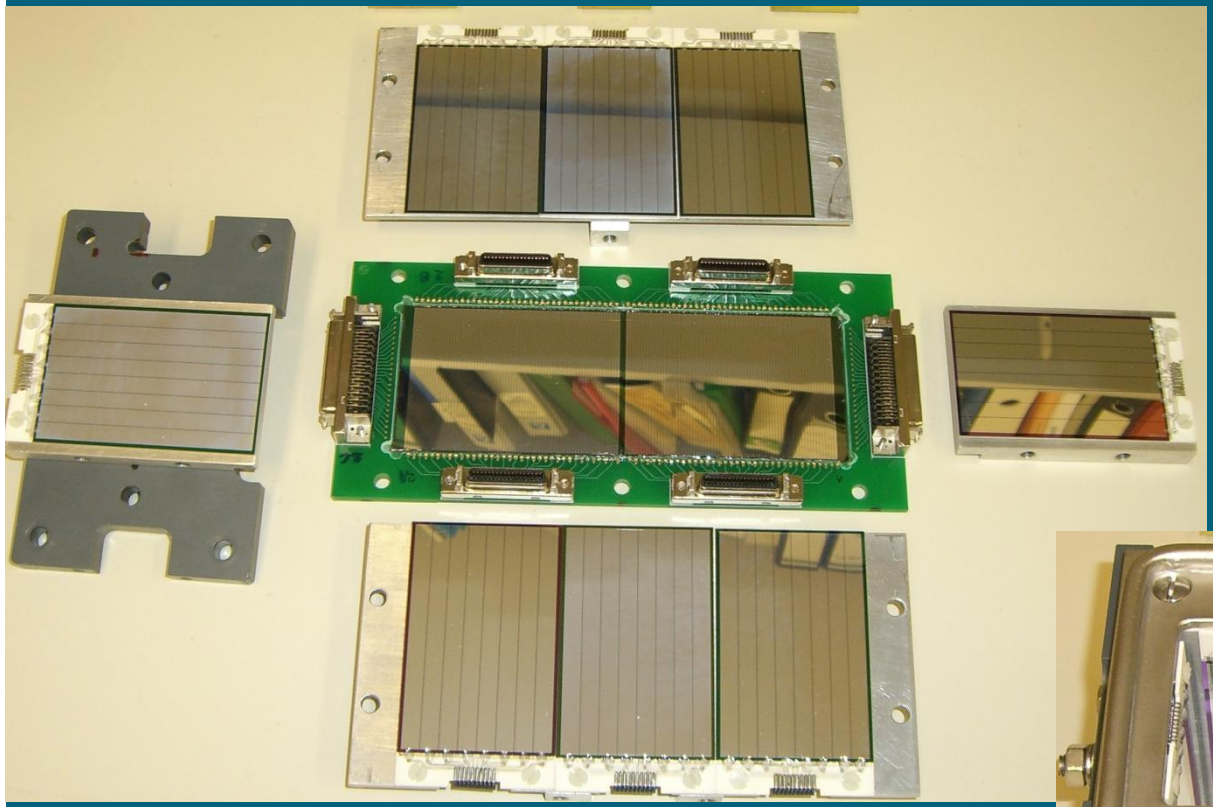
In total: 240 strips

Alpha energy resolution:

25 keV (external source)

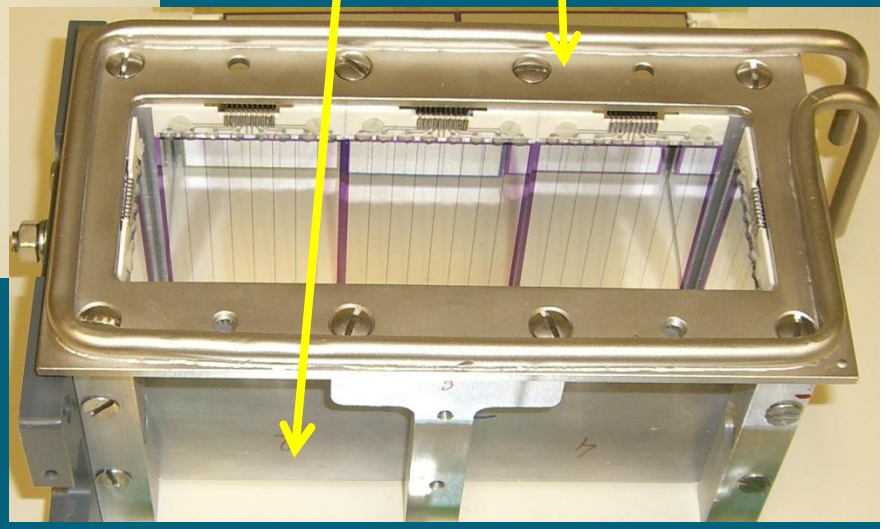
18 keV (implanted ions)

Box – backward array detector



Cooled Cu frame

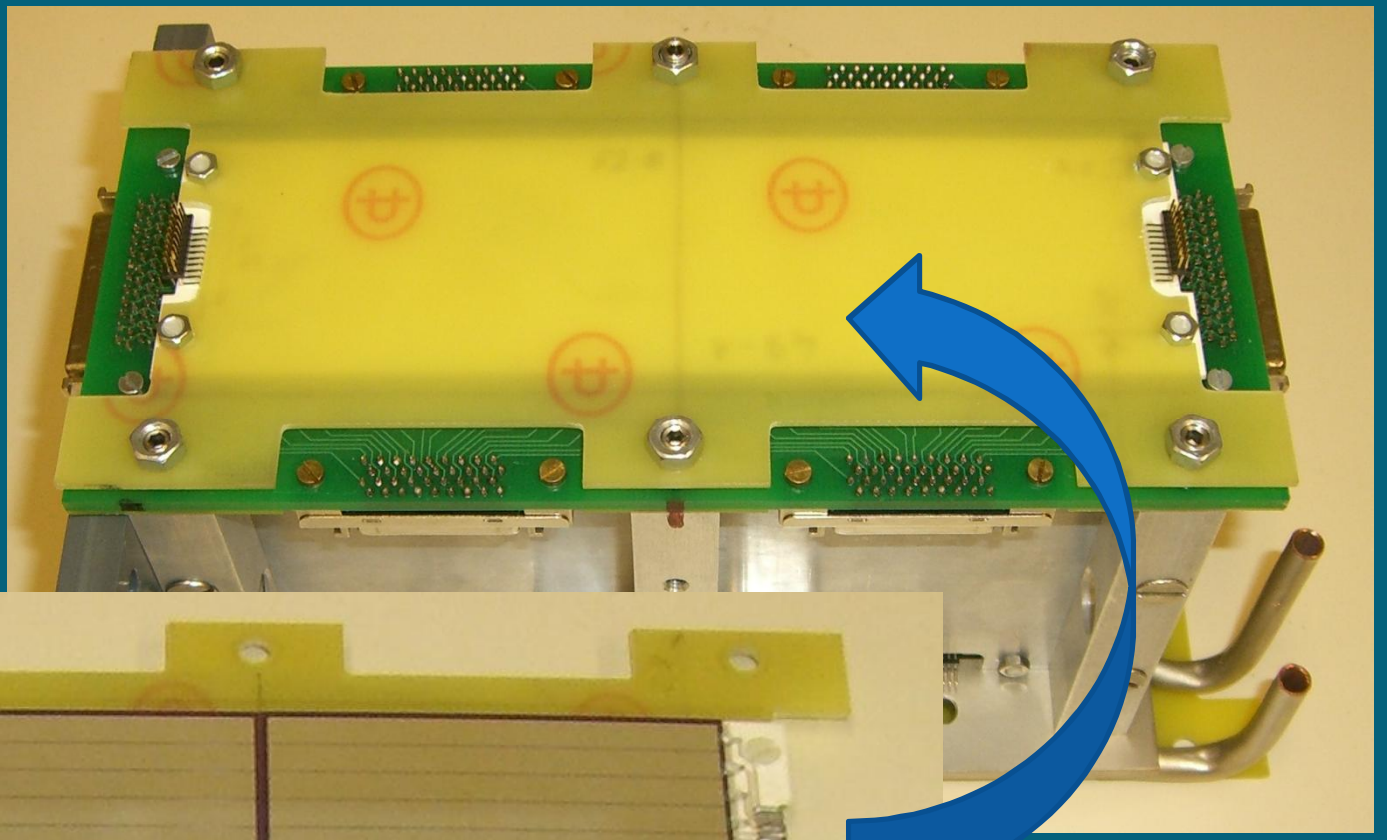
Al box

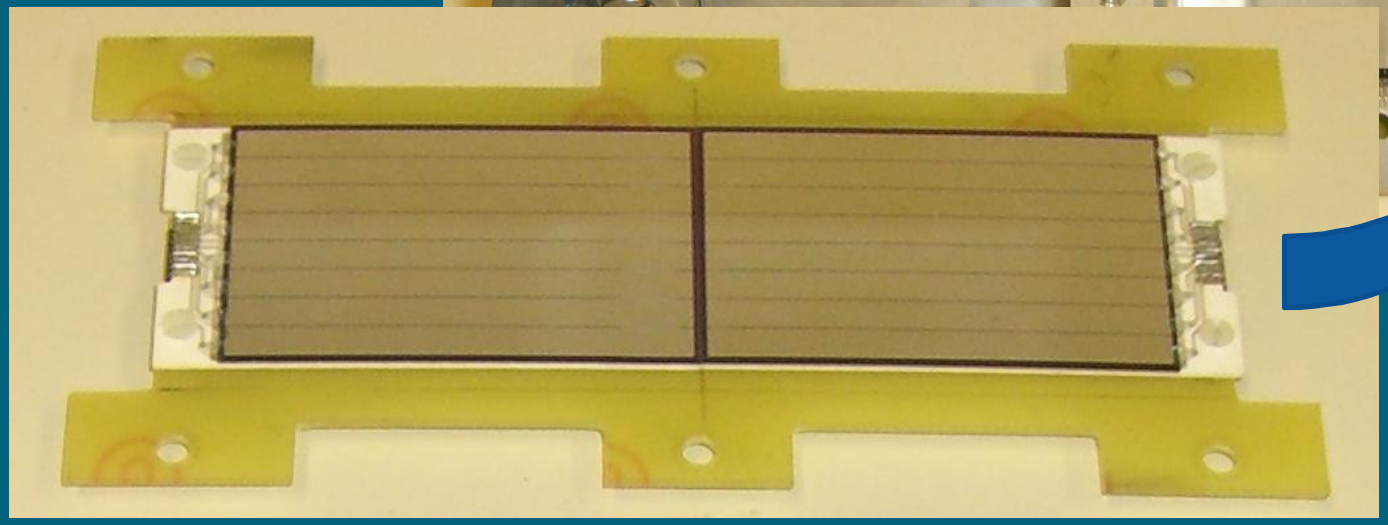


8 SSSD structures on Al_2O_3 ceramic
Si 500 μm; 8 x 8 strips
Beta resolution 8 kev (322 keV)

Veto (punch-through) detector

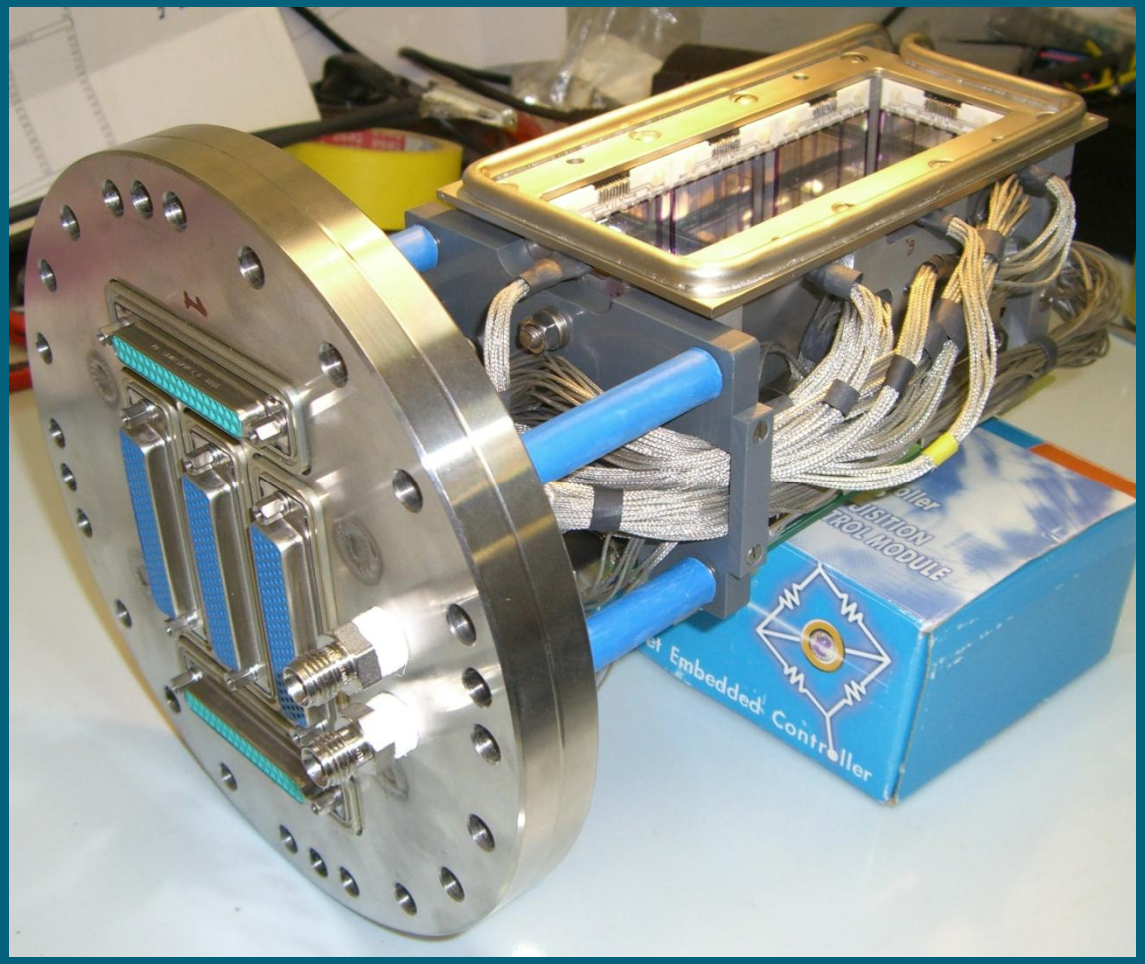
2 SSSD structures
on Al_2O_3 ceramic
Si 500 μm;
2 x 8 strips





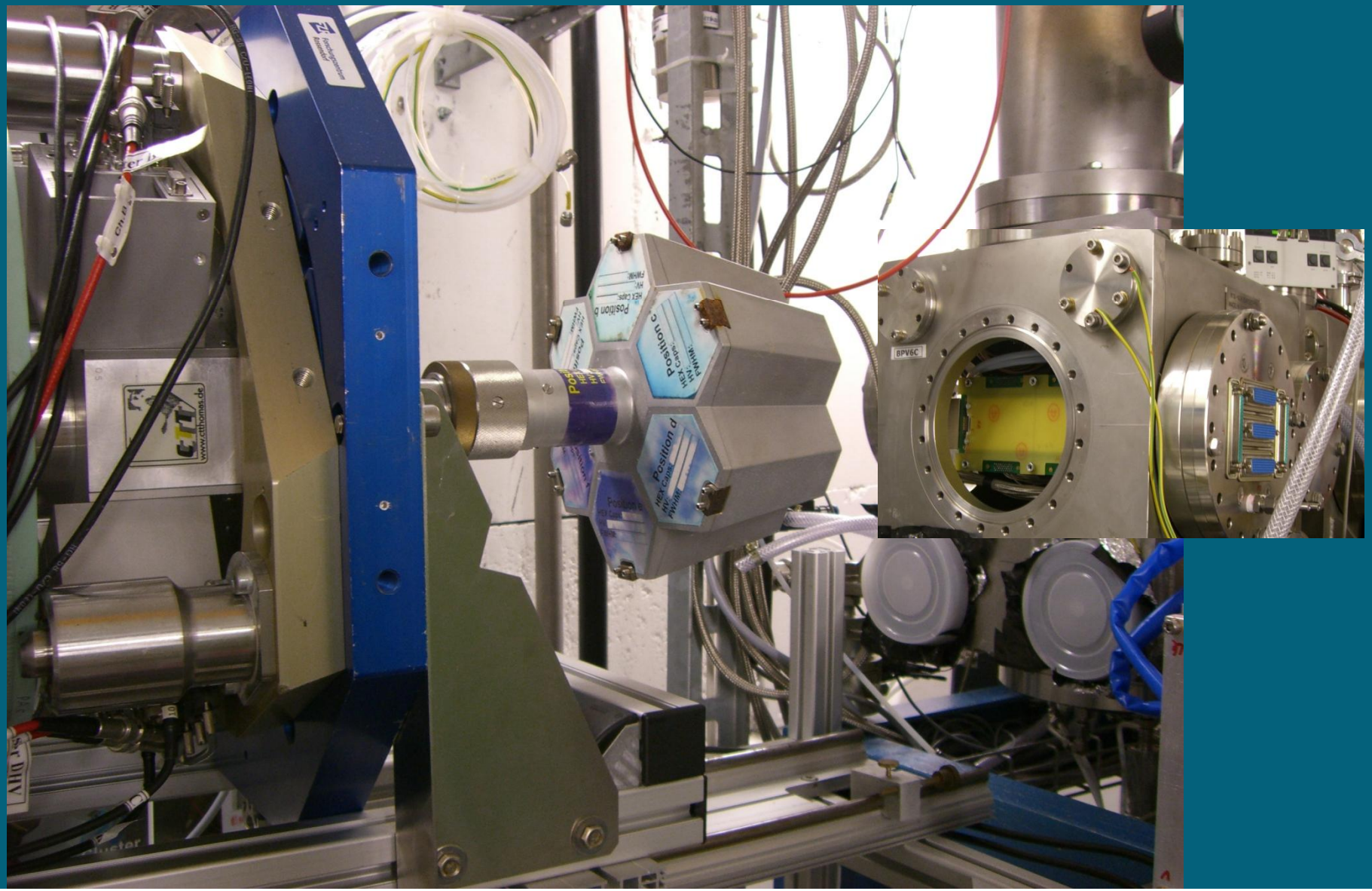
Final mounting and cabling

TASCA focal plane detector setup

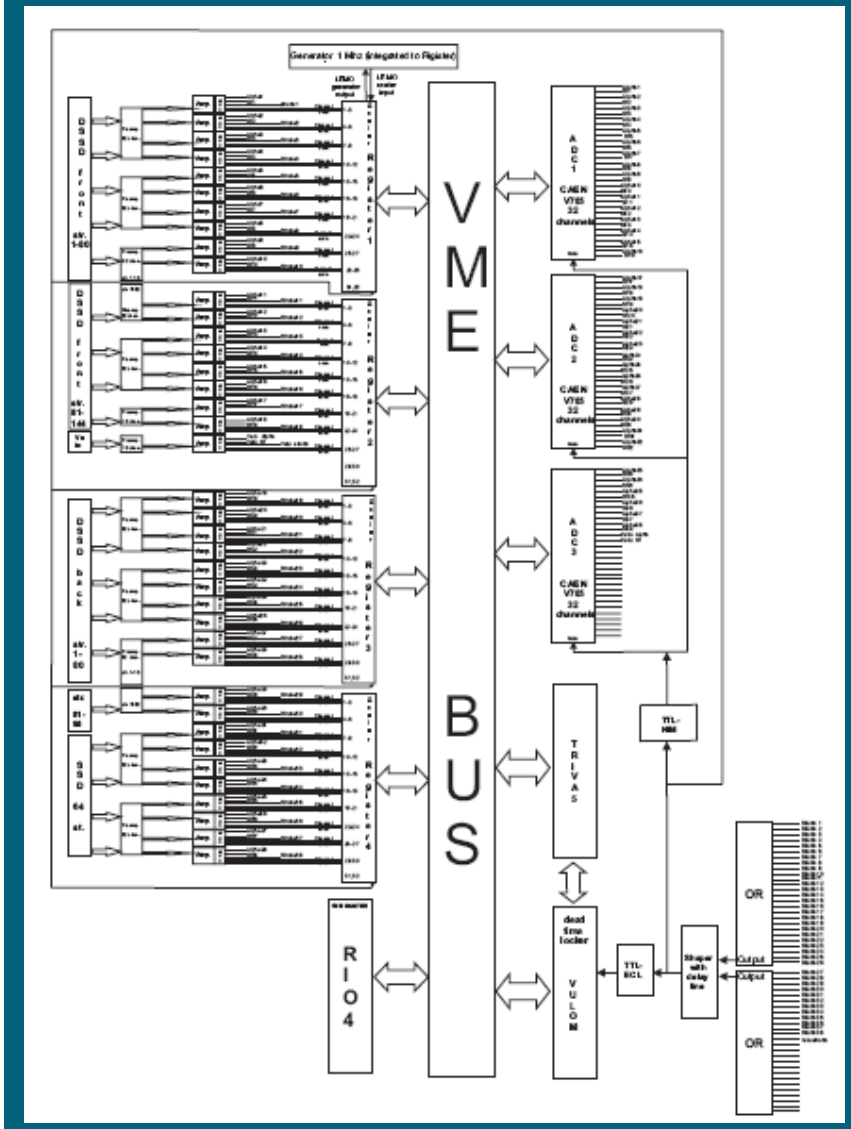


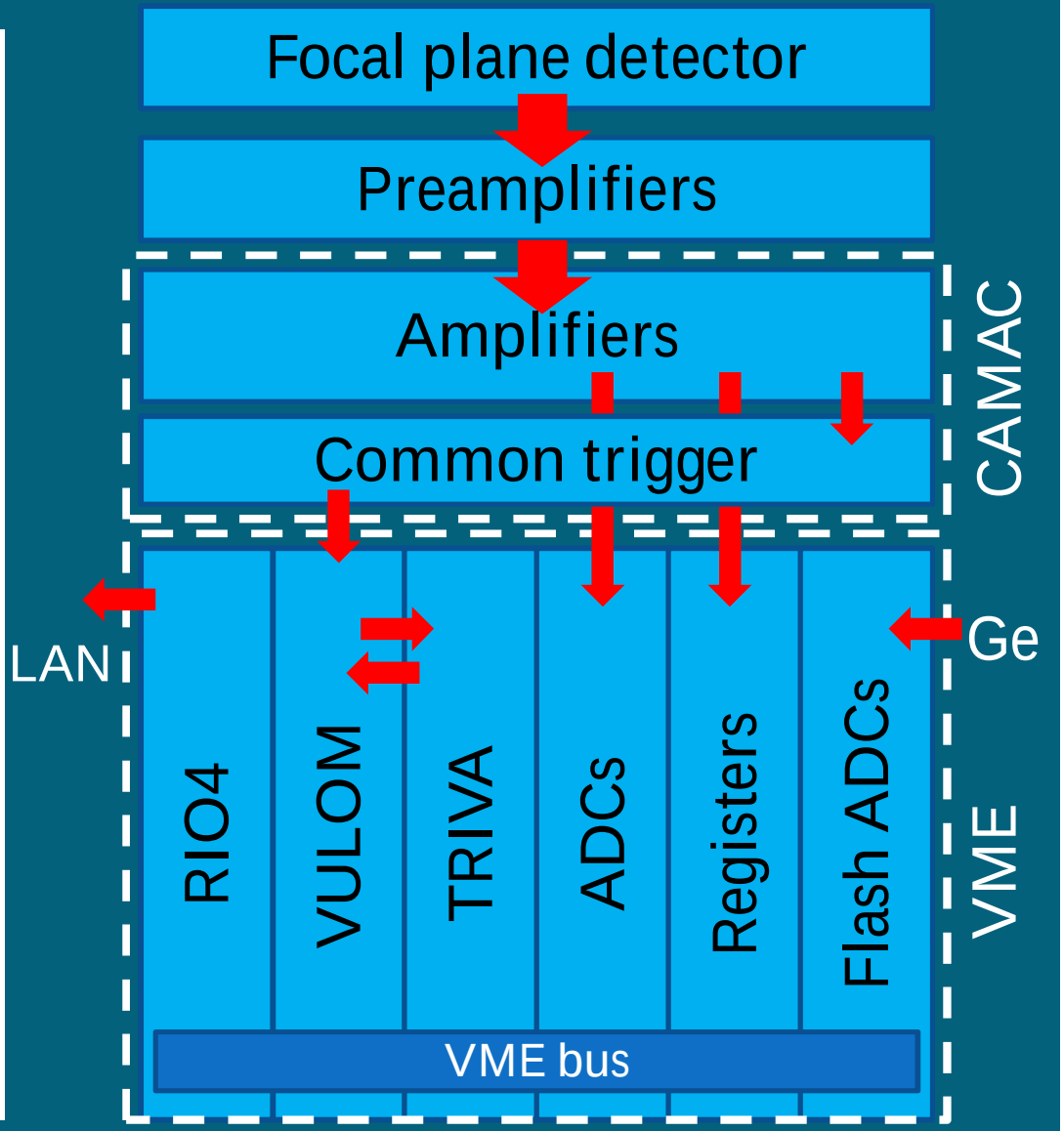
In total:320 strips; stop detector: 6912 pixels 1 x 1 mm^2

TASCA detector chamber & Ge cluster detector



A new data acquisition system

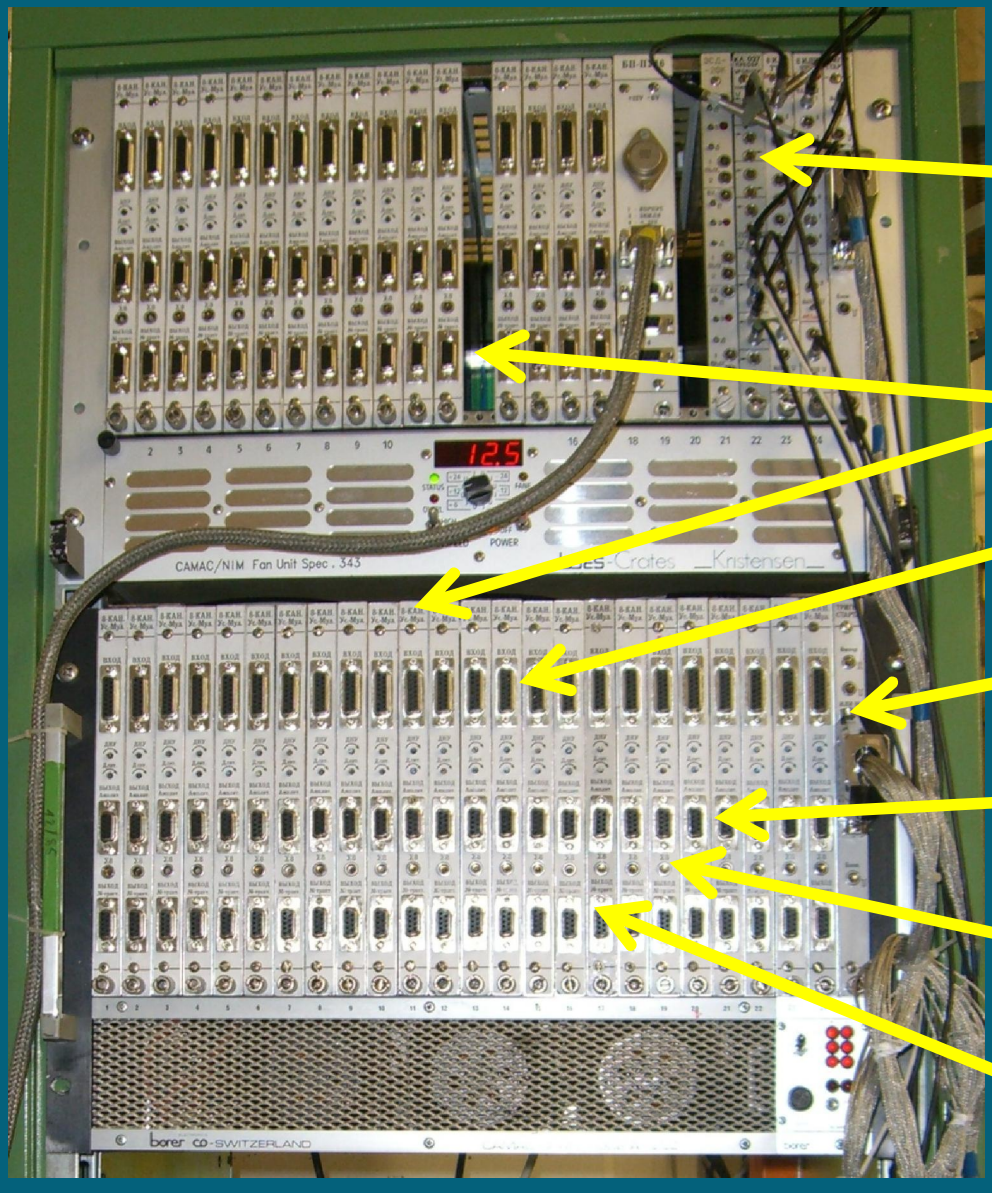




Hardware- preamplifiers

Signals from 320 detectors were amplified in 10 32-channel charge sensitive preamplifiers

Hardware - amplifiers



Logic signal adapters

and gate generator

40 8-channel amplifiers

Amplifier inputs

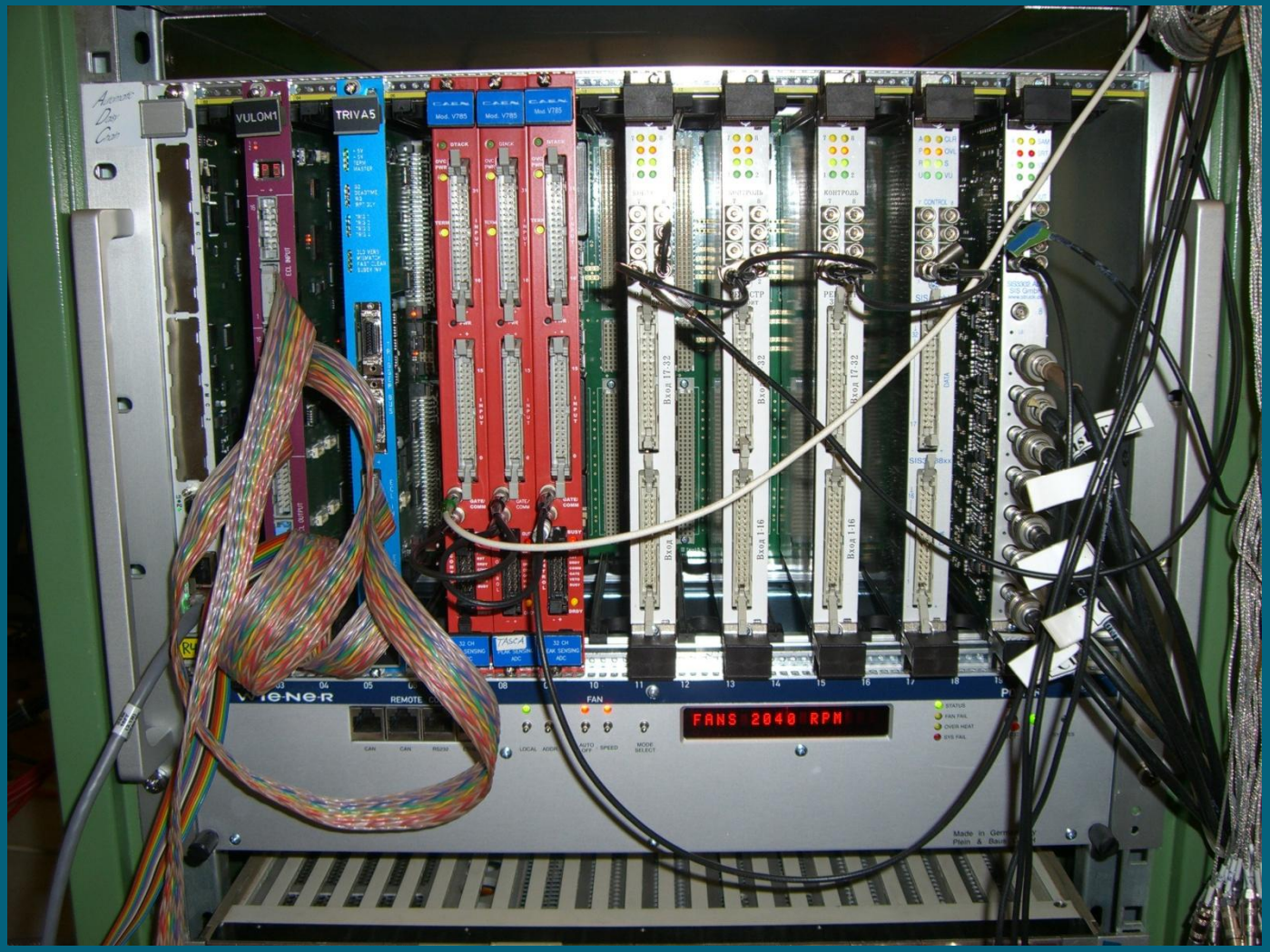
Common trigger modules

Alpha and SF analog output

Trigger output

3-bit address code output

Hardware – digital electronics



RIO4 – LinuxOS

VULOM

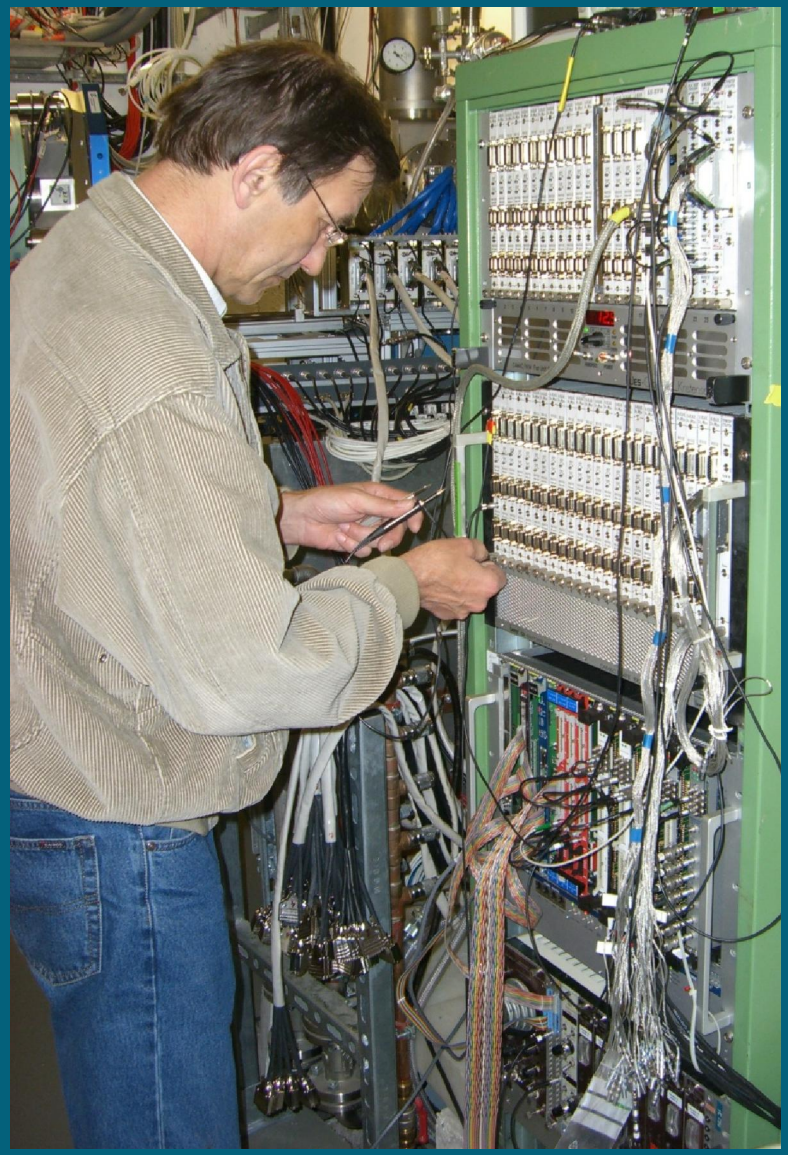
TRIVA5

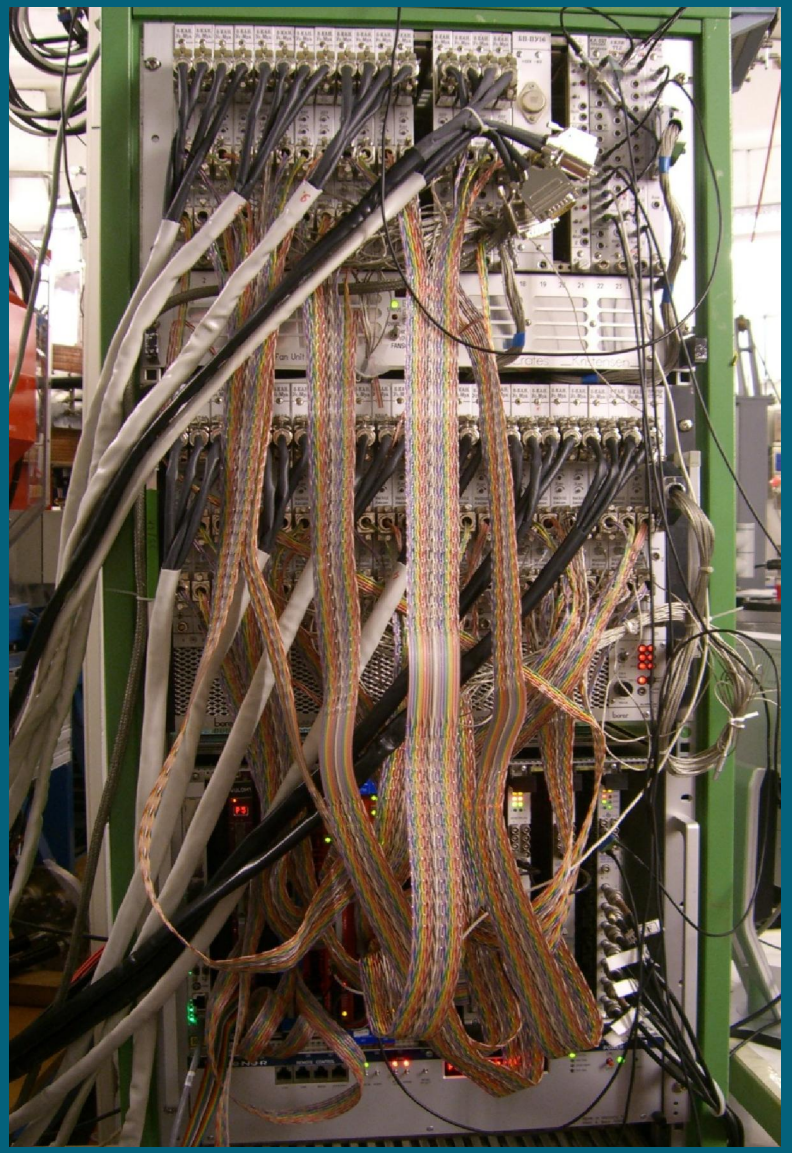
3x 32-channel ADCs (CAEN)

4x 32-bit input registers (SIS)

8-channel flash ADC (SIS)

Complete system – final adjustment



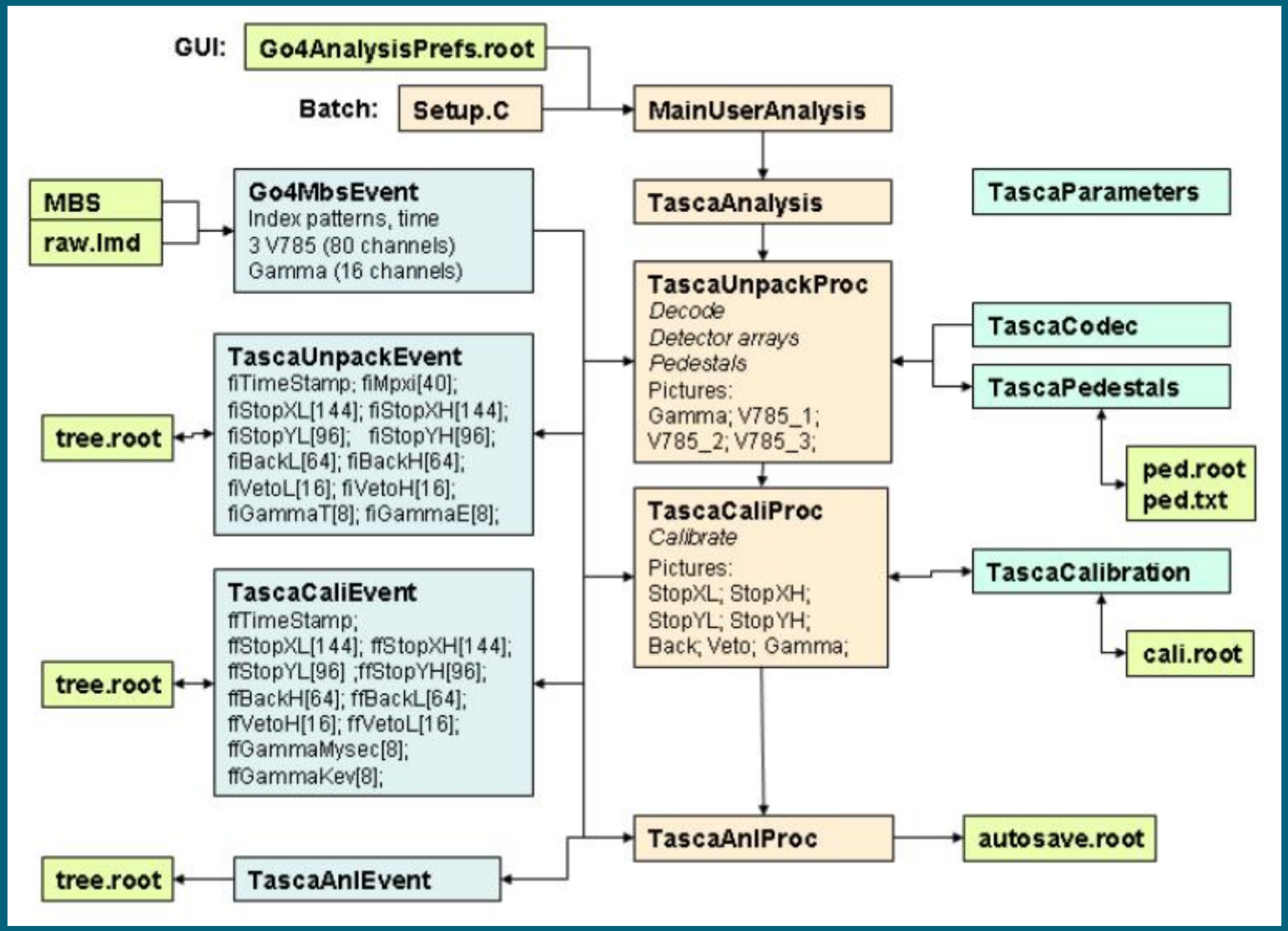


Data acquisition software – MBS

MBS - a triggering system:

- Every input signal from the focal plane detector into an amplifier above low level discriminator generates a trigger signal
- All trigger signal are collected by “OR” ➔ common trigger
- The trigger is accepted if the system is not “BUSY”
- The accepted trigger signal is a “LATCH” signal for all ADCs and registers and starts reading through the VME bus
- If the analog input signals into the ADCs are above a threshold they are digitized and read out
- The status of the registers and time from 1 MHz clock are read out
- The amplitudes from 8-channel flash ADC are read out

Analysis software – GO4



Online analysis and search for events

- Raw spectra from all ADC channels
- Decode ADC channel number and amplitude
- 640 unpacked single spectra
- 640 calibrated single spectra
- Sum spectra
- Spectra with conditions
- 2-dimensional spectra
- Checking and storing selected events
- Analysis and search for correlated events

Conclusions

- The new focal plane detector for TASCA in HTM

  and the new data acquisition electronics are build and used in the experiment on the synthesis of element 114
- Use of the DSSSD detectors ensured the search for correlated events
- Reliable operation of detectors and electronics during a long beam time
- Combination with Ge detectors allowed search for α-γ correlations
- Further developments of the MWPC detector are necessary