FPGA-gestützte Auslese für eine Teststation zur Charakterisierung von Siliziumstreifendetektoren*

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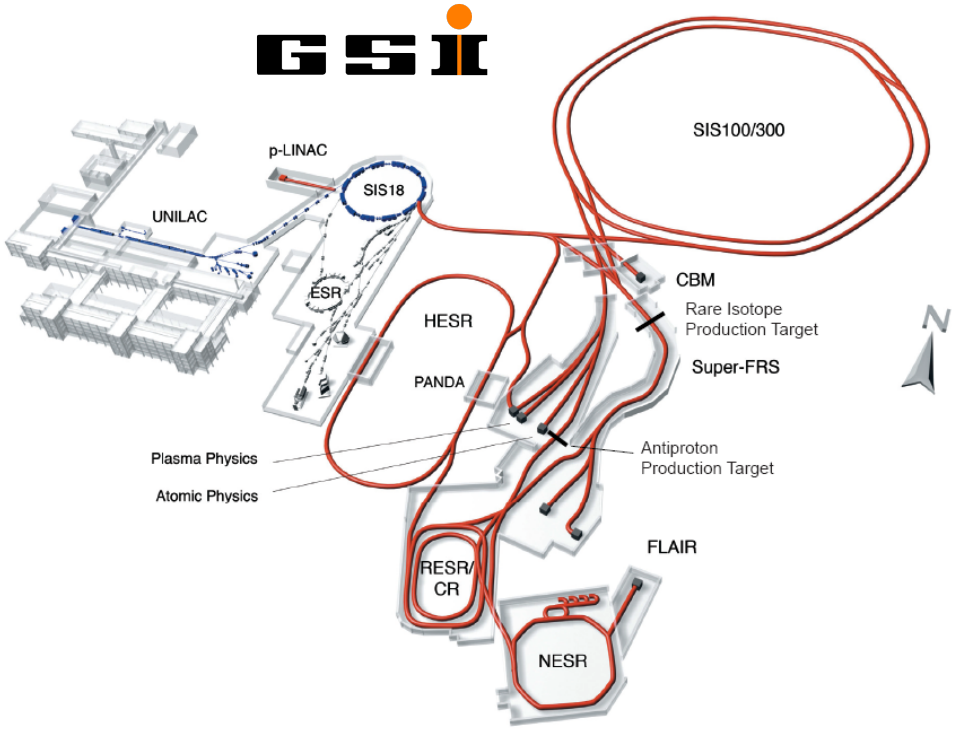
*Unterstützt vom BMBF und der EU

Motivation

$\overline{\text{P}}$ANDA as one experiment at FAIR, GSI



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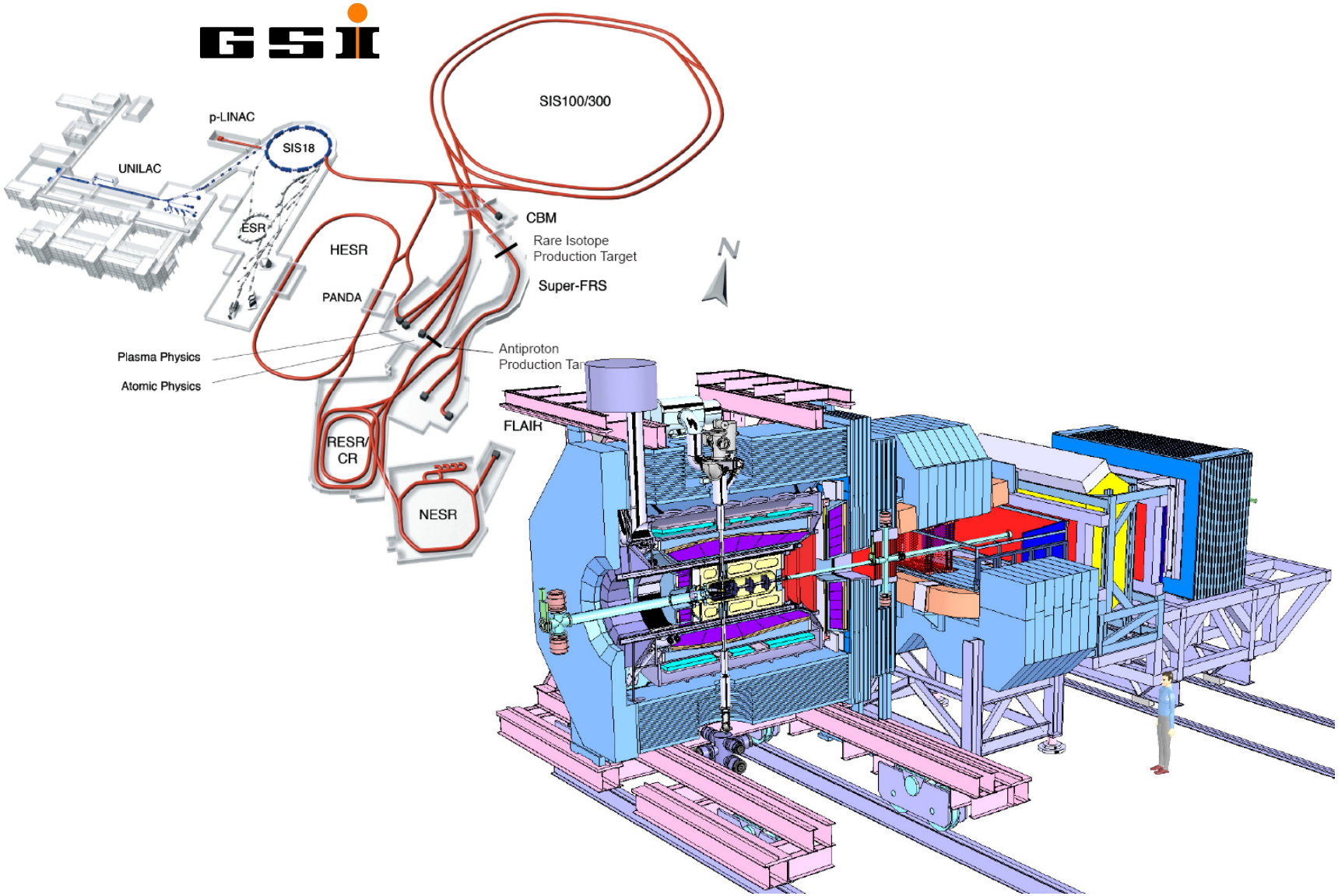

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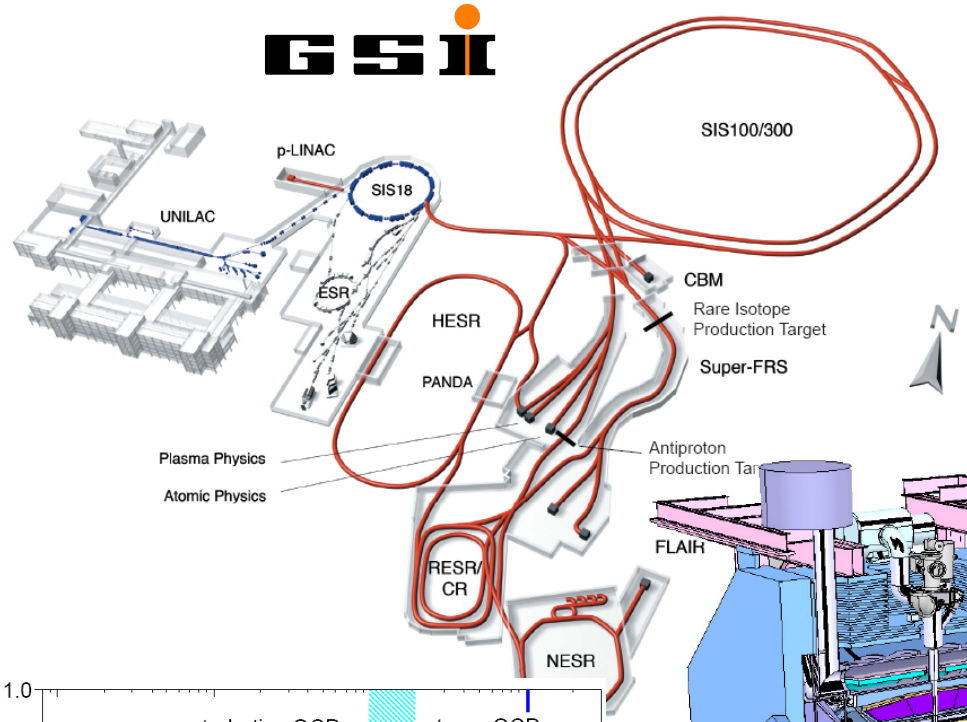

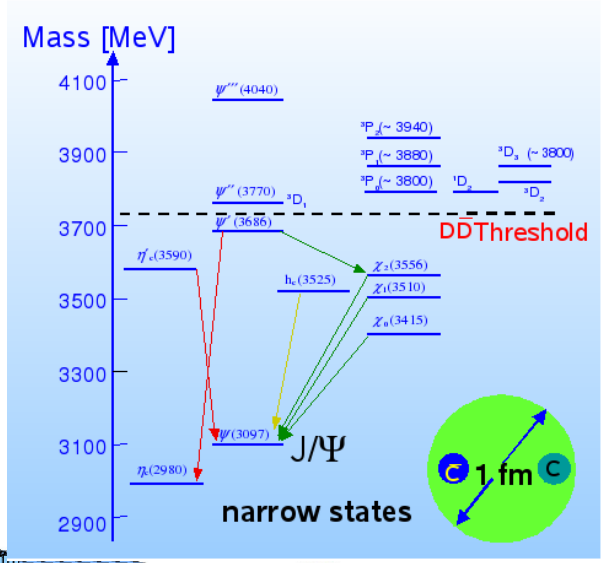

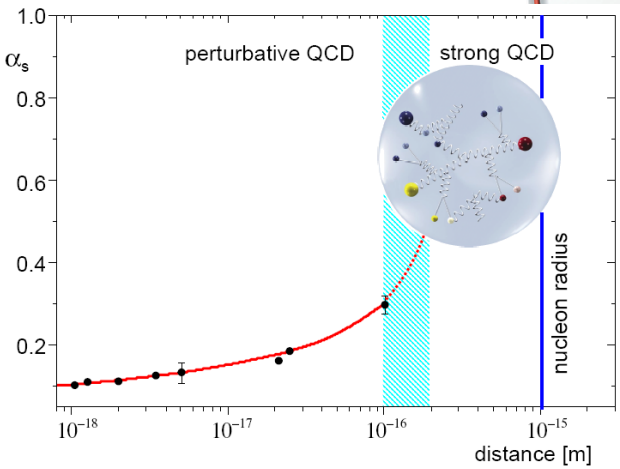

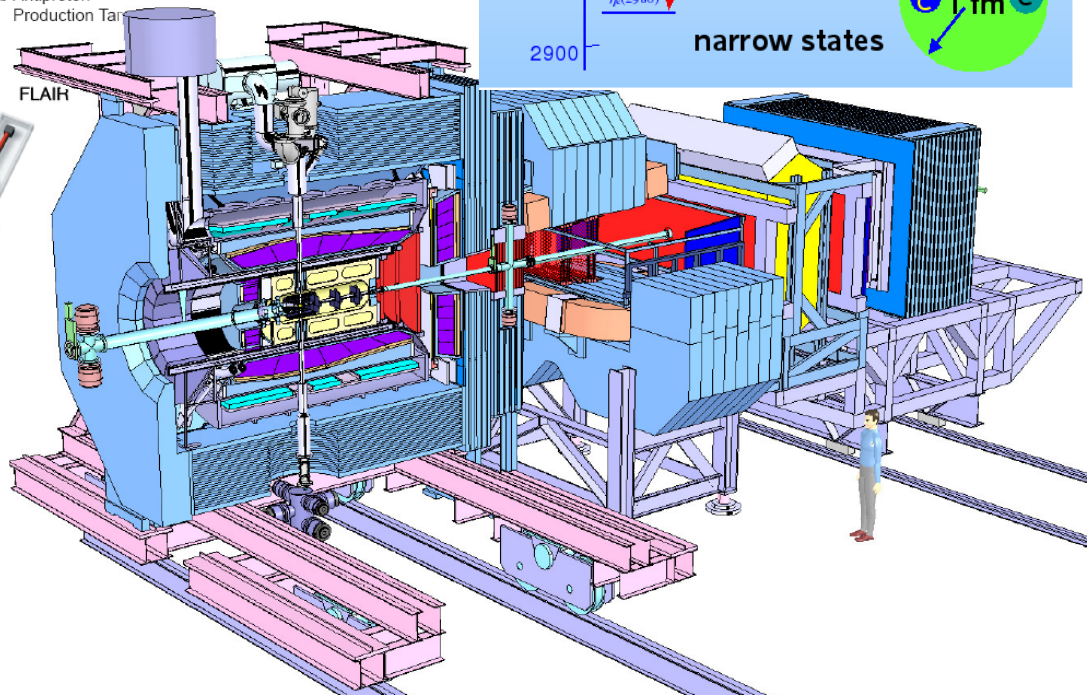

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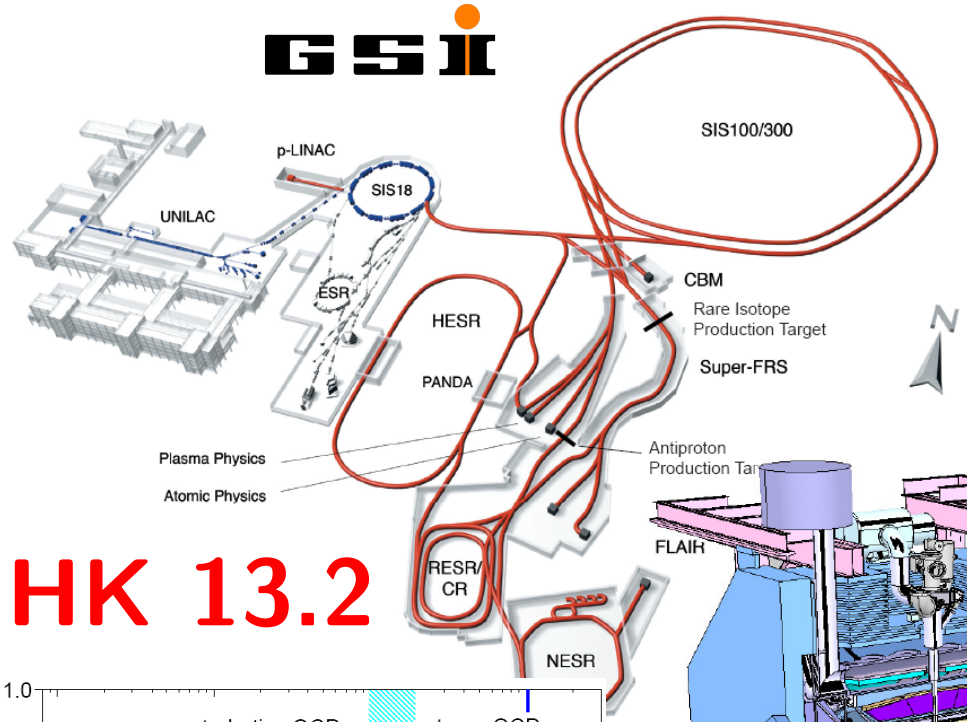

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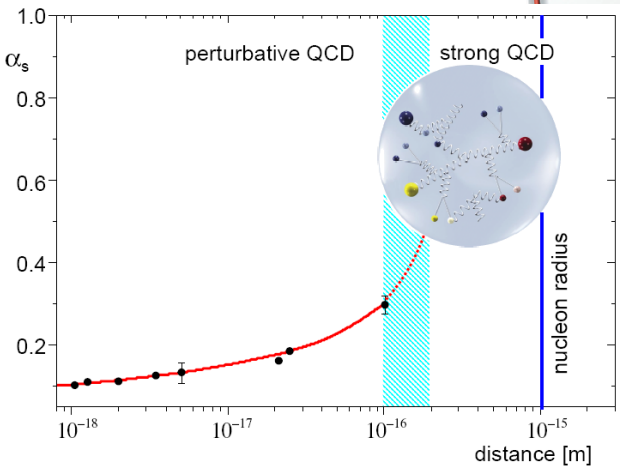
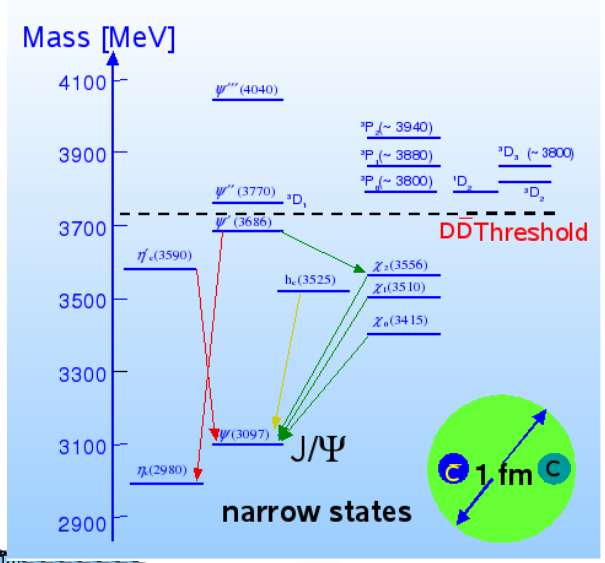
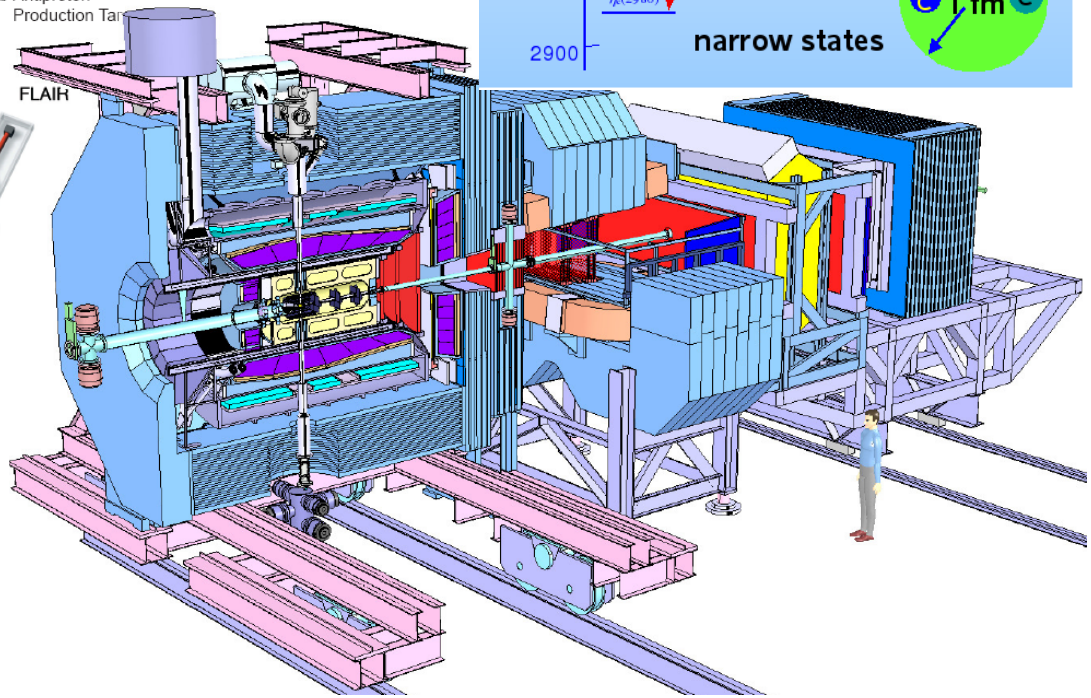


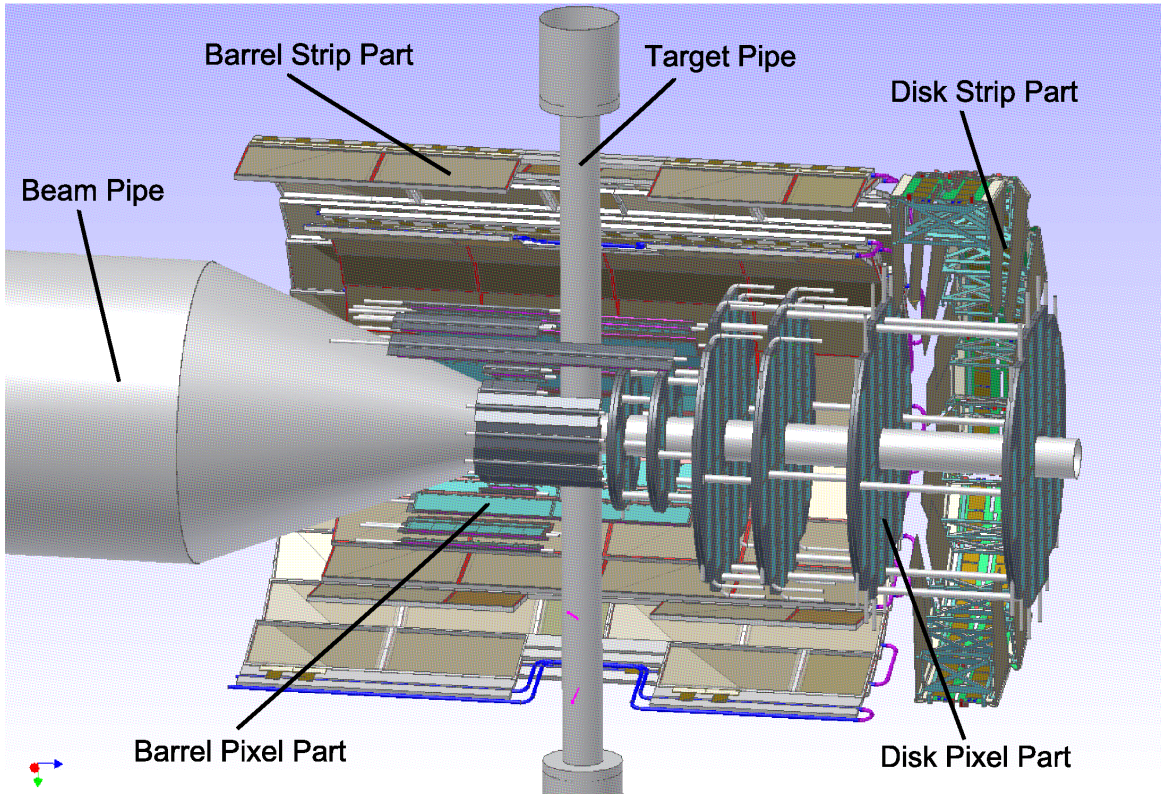
Charmonium - QCD





The Micro-Vertex-Detector

- pixel part
  - pixel size (100·100) μm^2
  - 12,000,000 channels
- strip part
  - strip pitch: barrel 130 μm, 90°; disk 70 μm, 15°
  - 200,000 channels



The Micro-Vertex-Detector

HK 21.1

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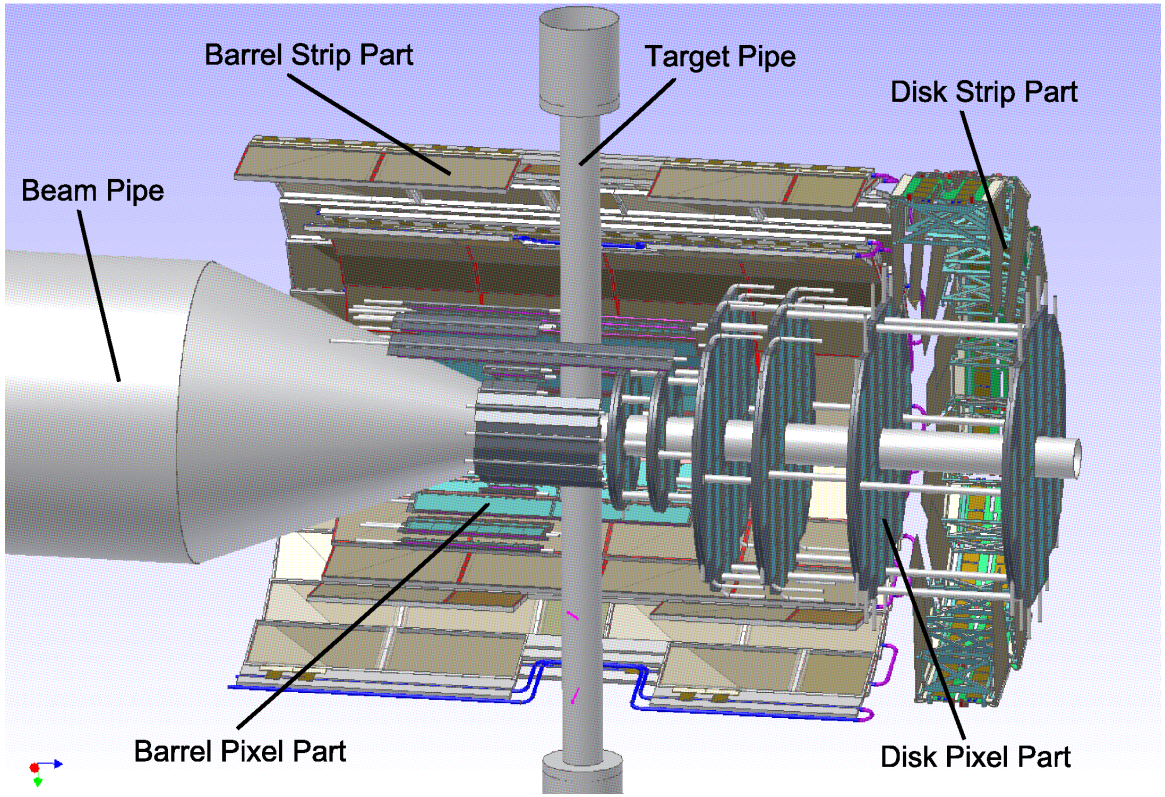
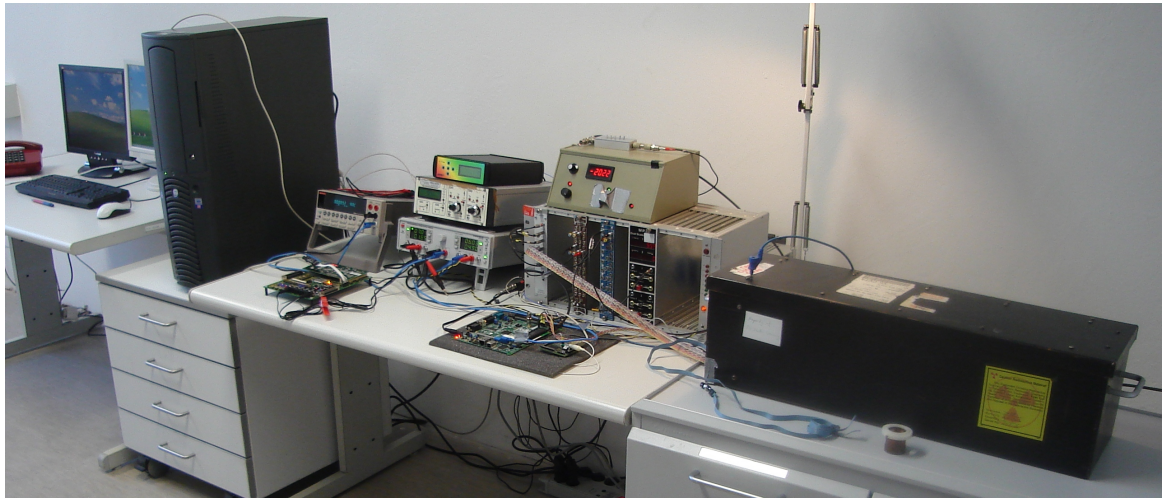
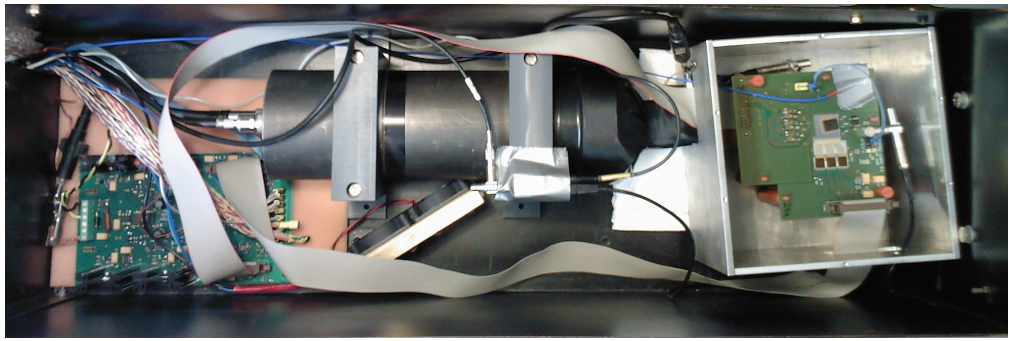


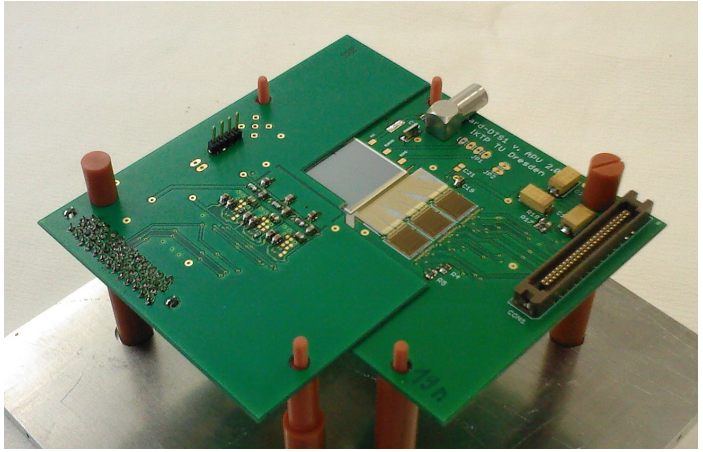
The Dresden Test Station

currently utilized components:

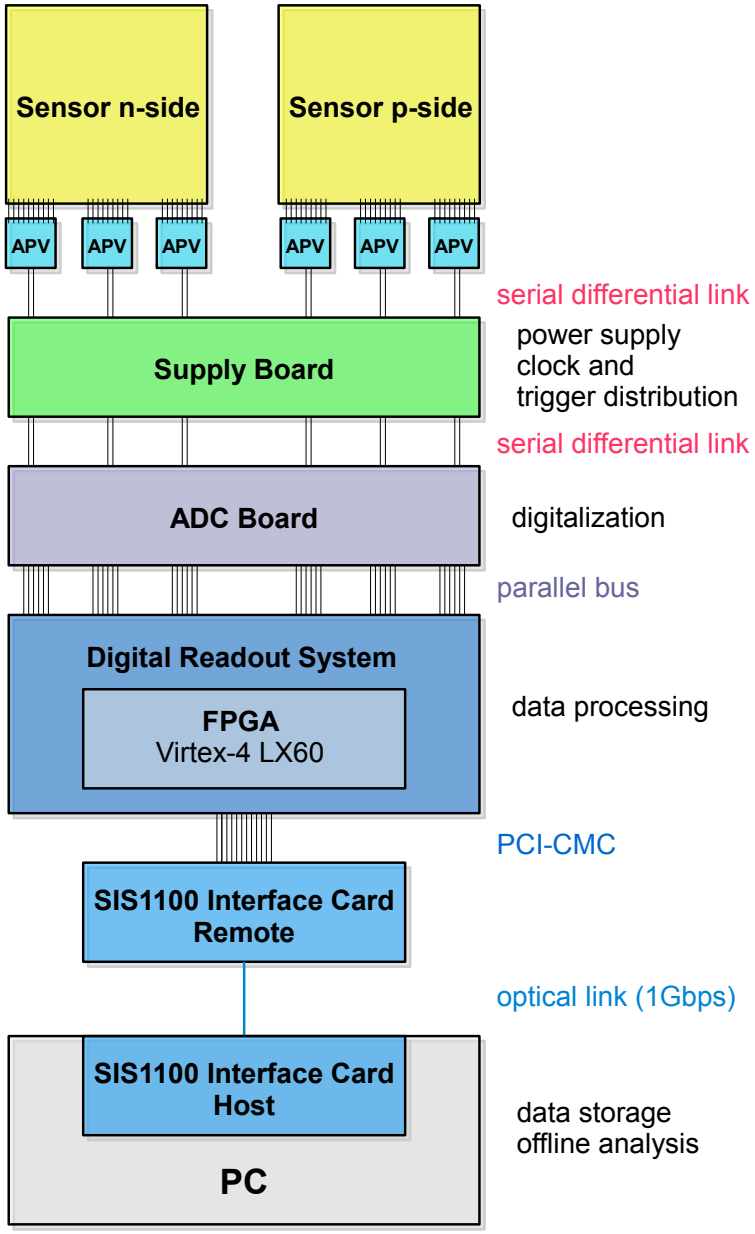
- Frontend APV25
- double-sided strip sensor, 50 µm pitch, 90° stereo angle







Readout structure

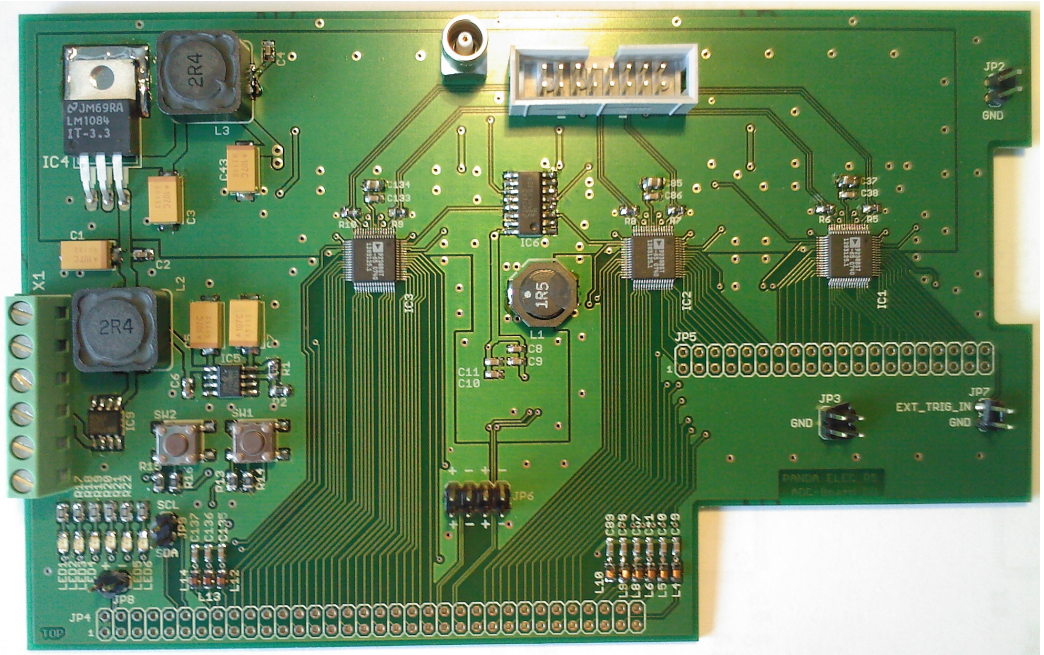


Readout hardware

New readout components 1

custom ADC card

- ADC AD9238
- 2 chn per ADC
- 6 chn in total
- 12 bit resolution
- differential inputs
- parallel outputs
- max. 65 MSPS
- running @ APV clock



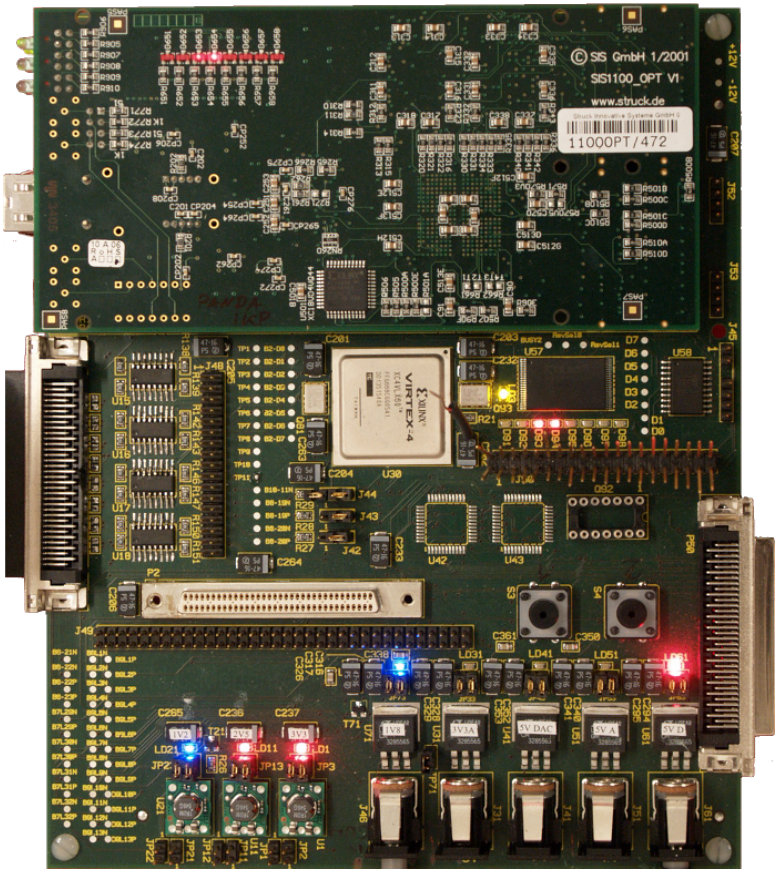
Readout hardware

New readout components 2

a versatile digital readout system for the PANDA MVD

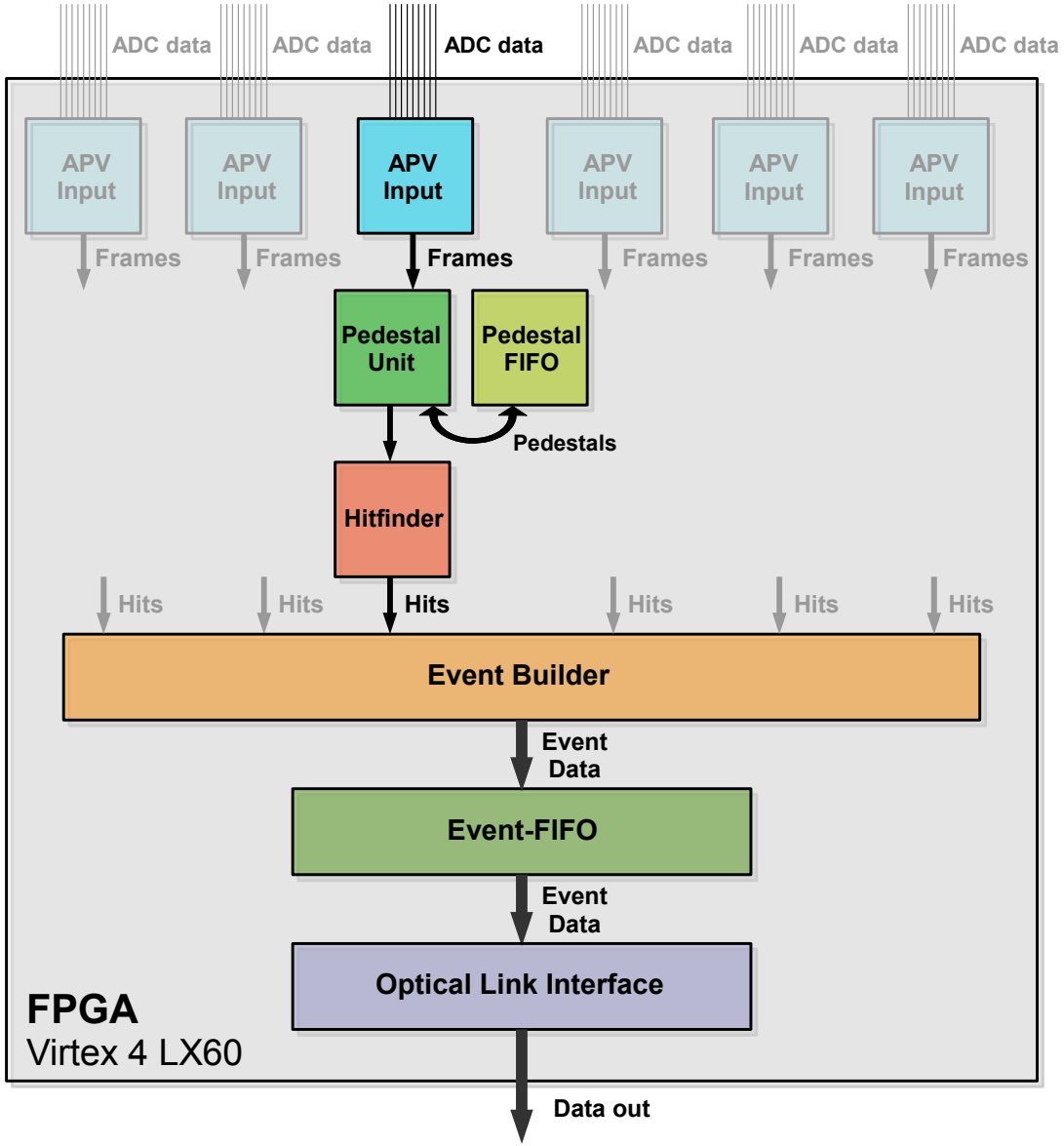
- developed at ZEL (FZ Jülich)
- FPGA: Xilinx Virtex-4 LX60
- 136 digital I/O´s
- optical interface to PC via SIS1100-OPT cards

- **MRF**-MVD Readout Framework



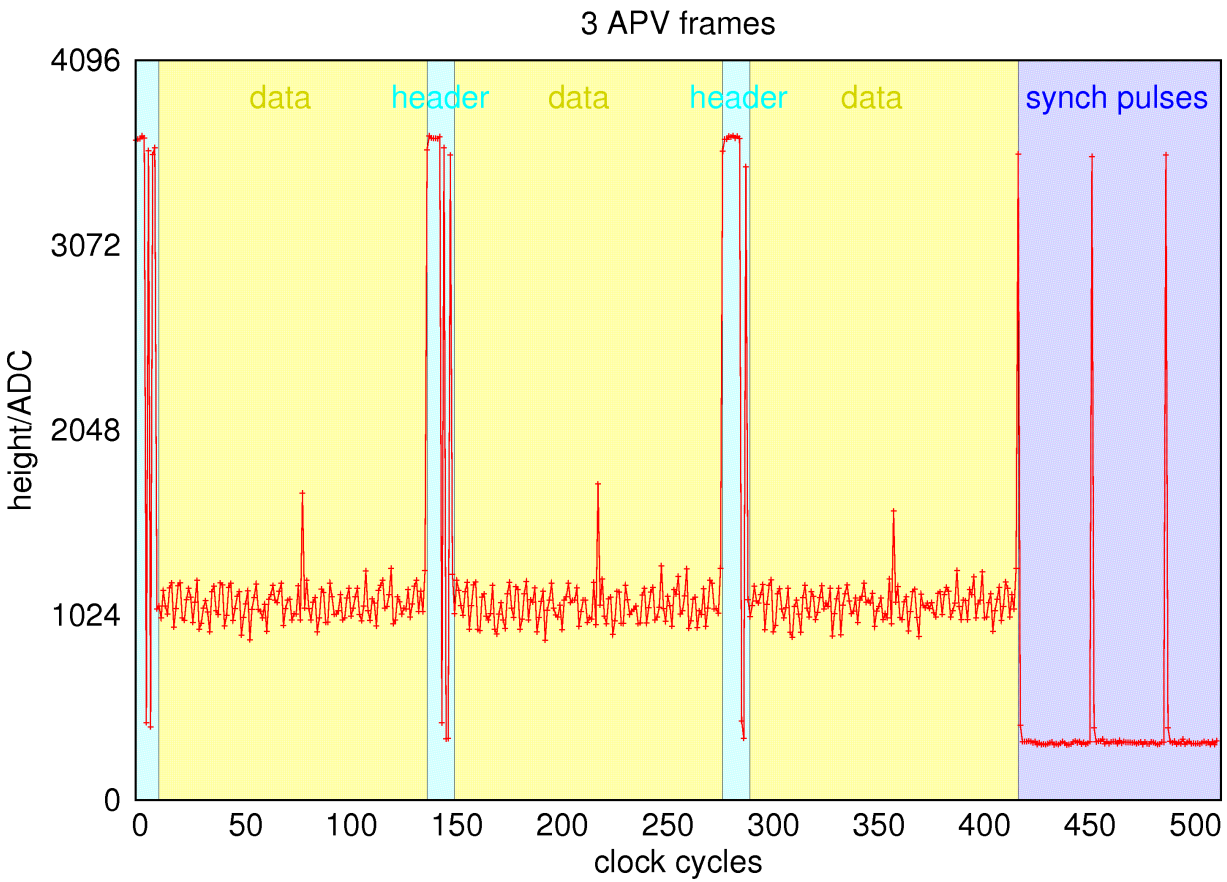
Readout hardware

FPGA processes



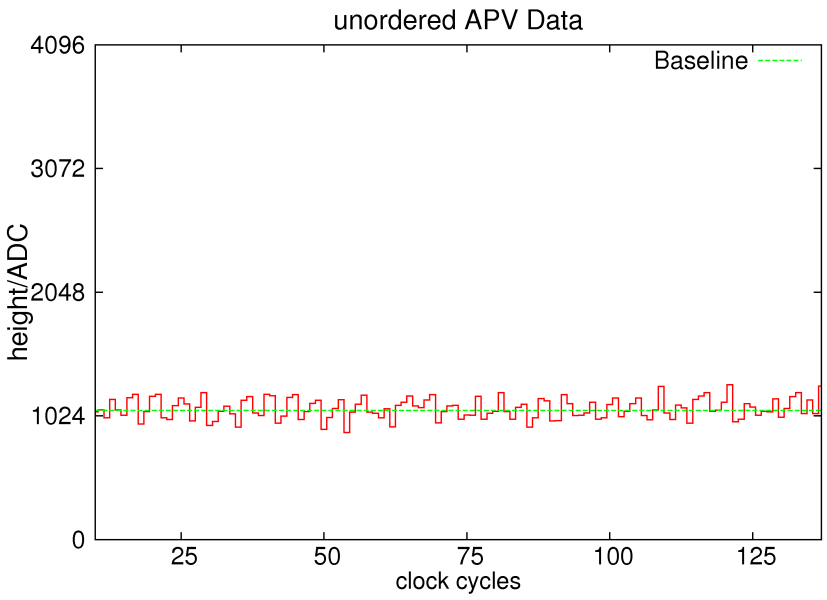
Results
Frontend data

- APV25 response on a single trigger
- APV in 3-Sample-Mode



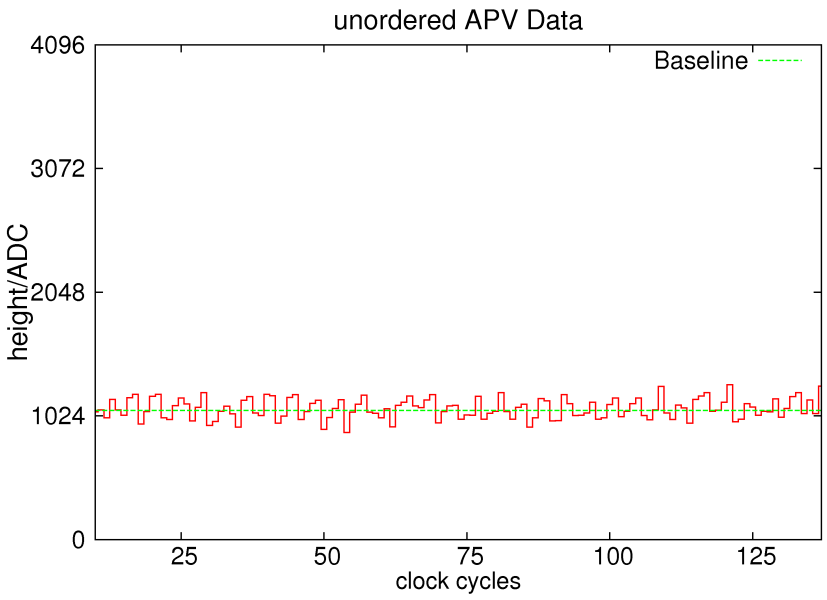
- FPGA-readout triggered on header start condition

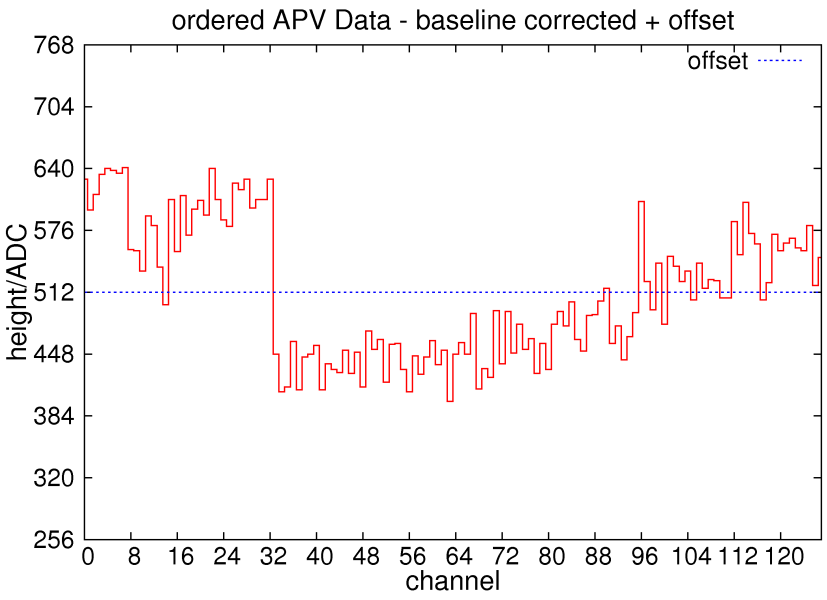
Results
Data processing



Step 1: separation of data and header

Results
Data processing

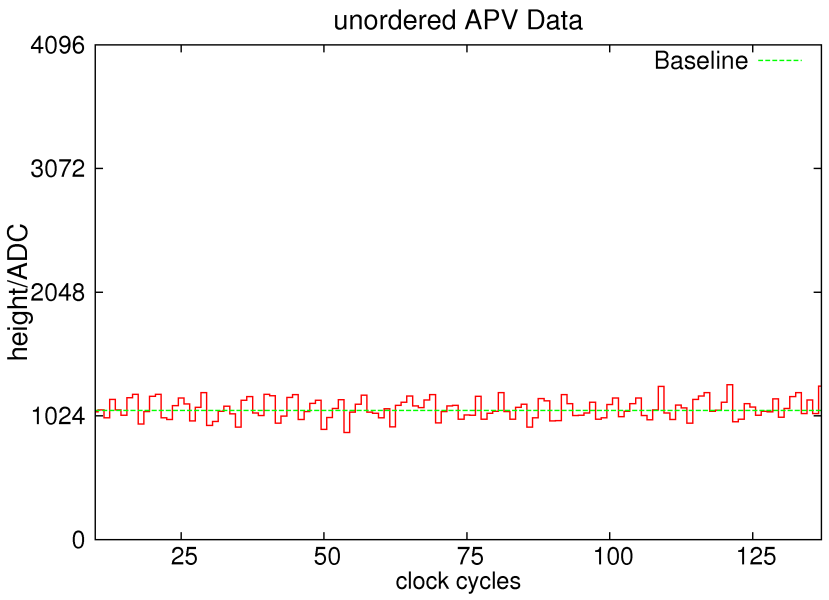


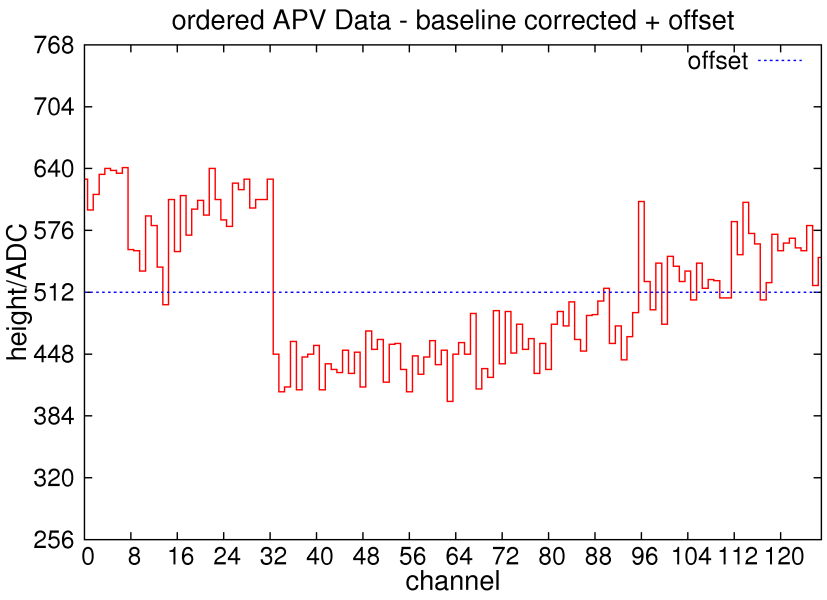


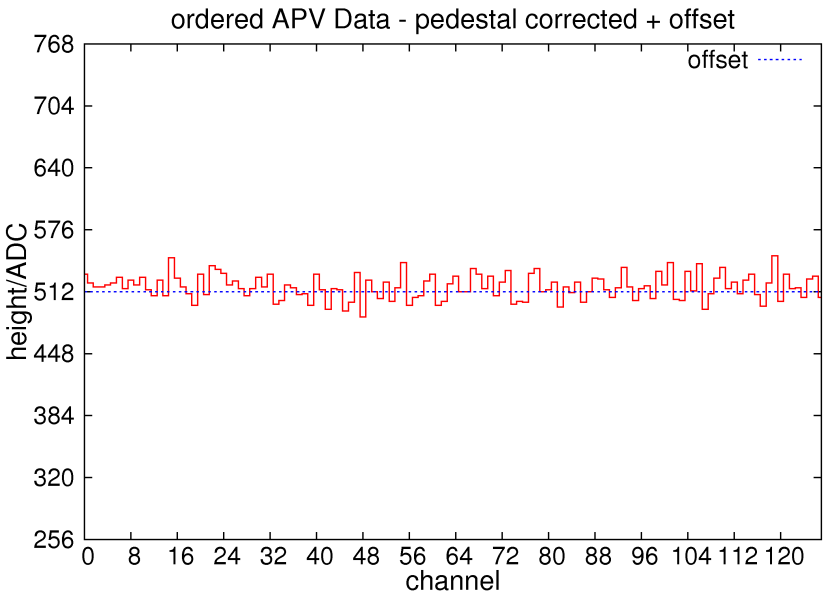
Step 1: separation of data and header

Step 2: baseline correction

Results
Data processing







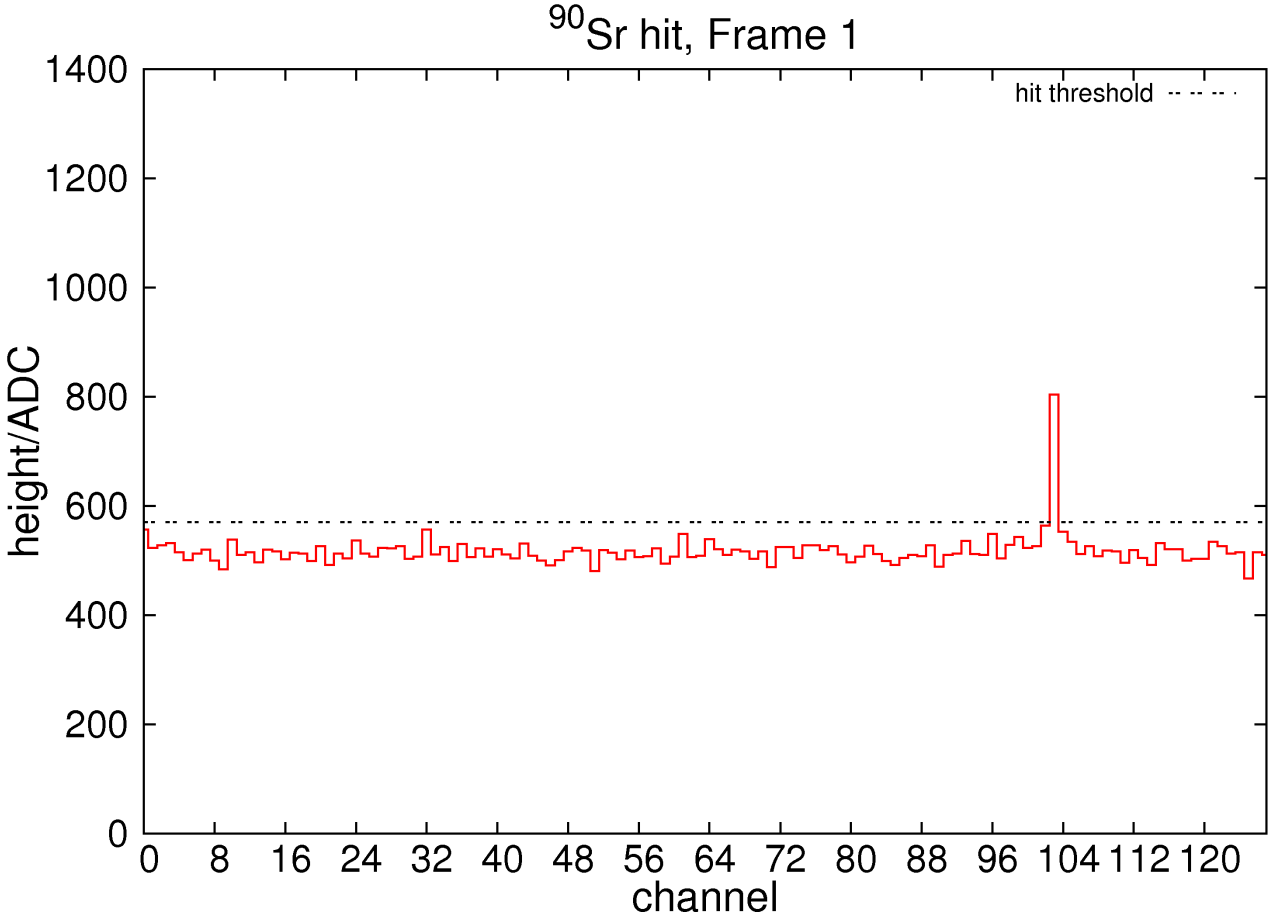
Step 1: separation of data and header

Step 2: baseline correction

Step 3: pedestal correction

Results
Hitfinder

- searches for hits
- hitfinder parameter: threshold, minimum length
- extraction of *maxHeight*, *Length* and *FrameID_begin*



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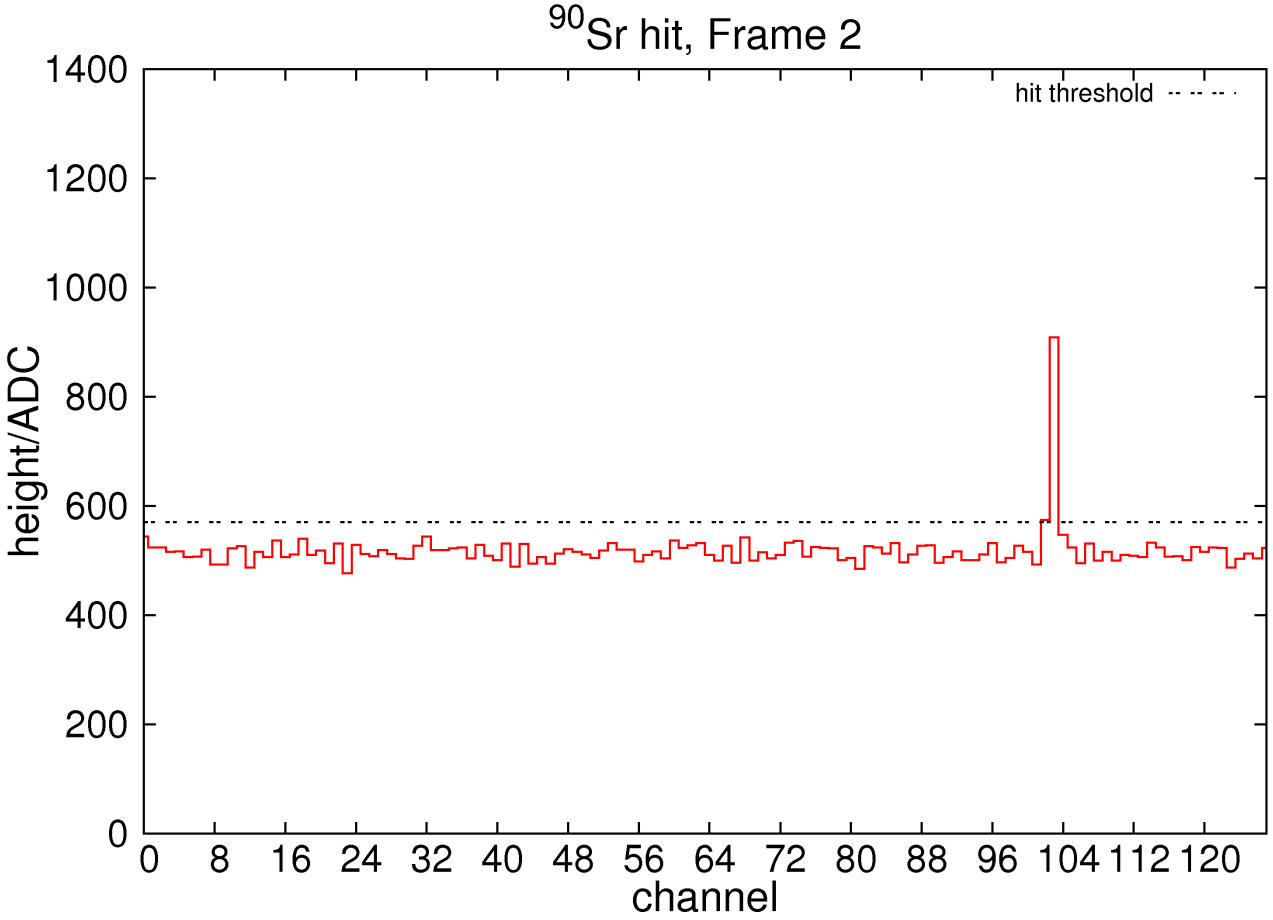

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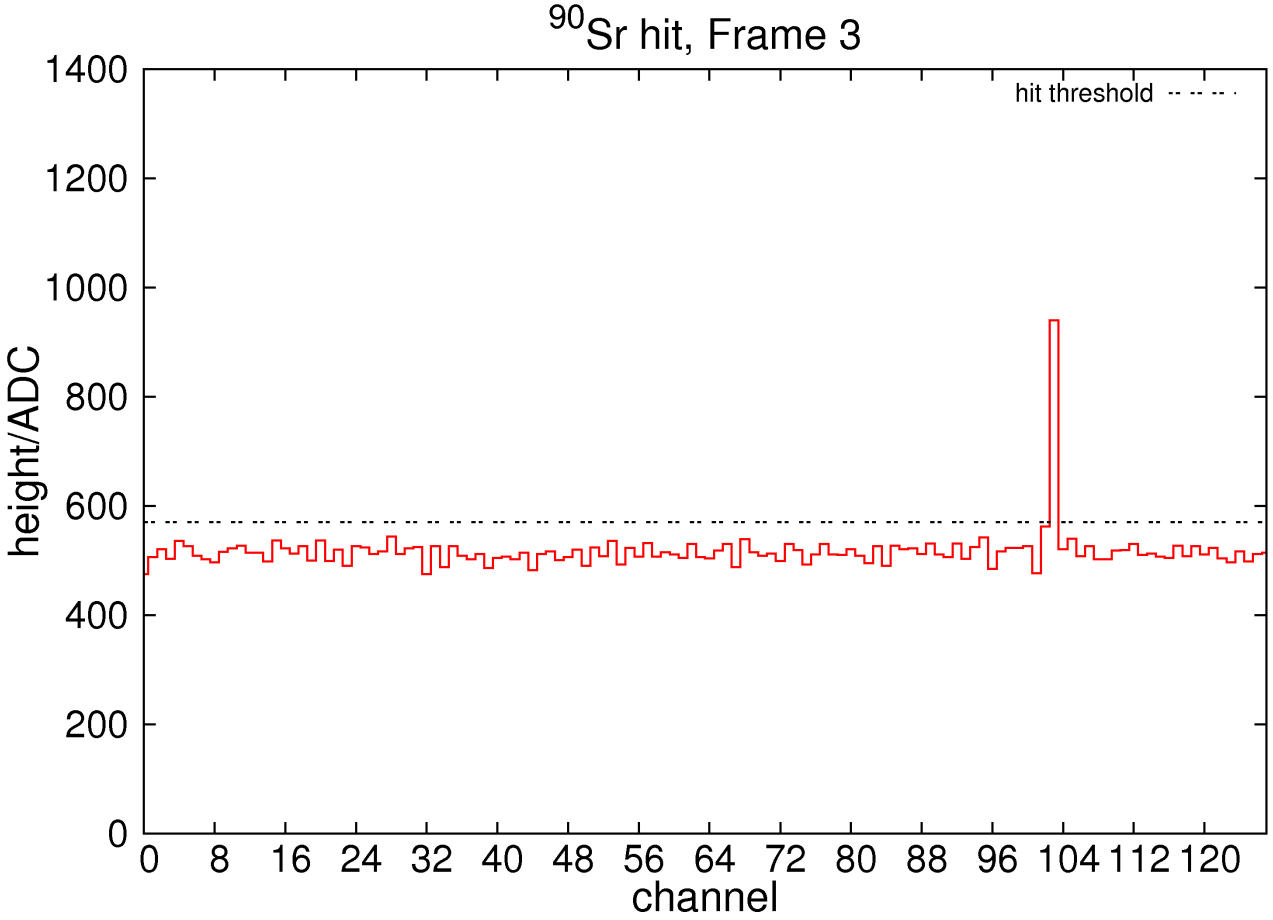

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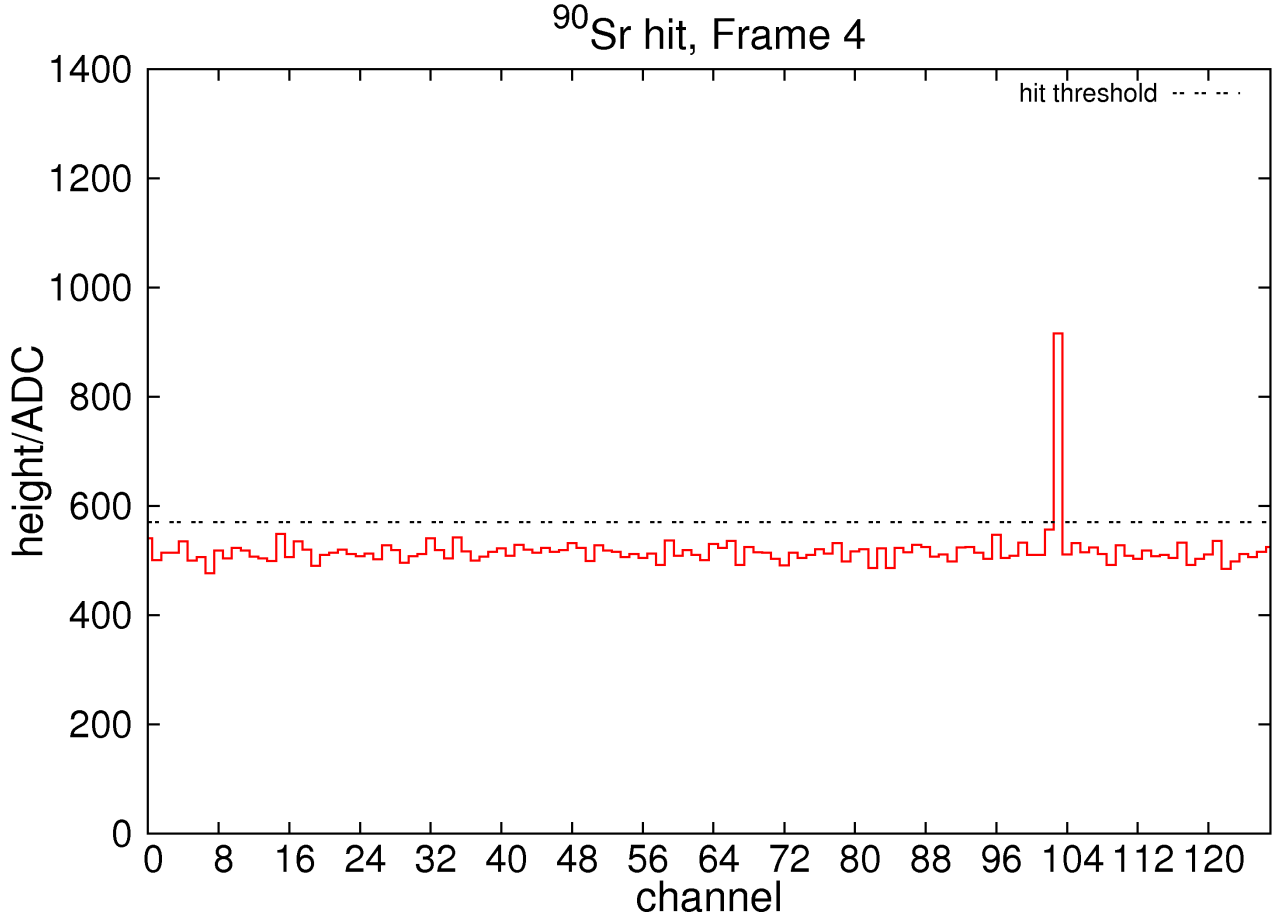


Results

Data format / dead time

- hit data format stored in Event-FIFO:

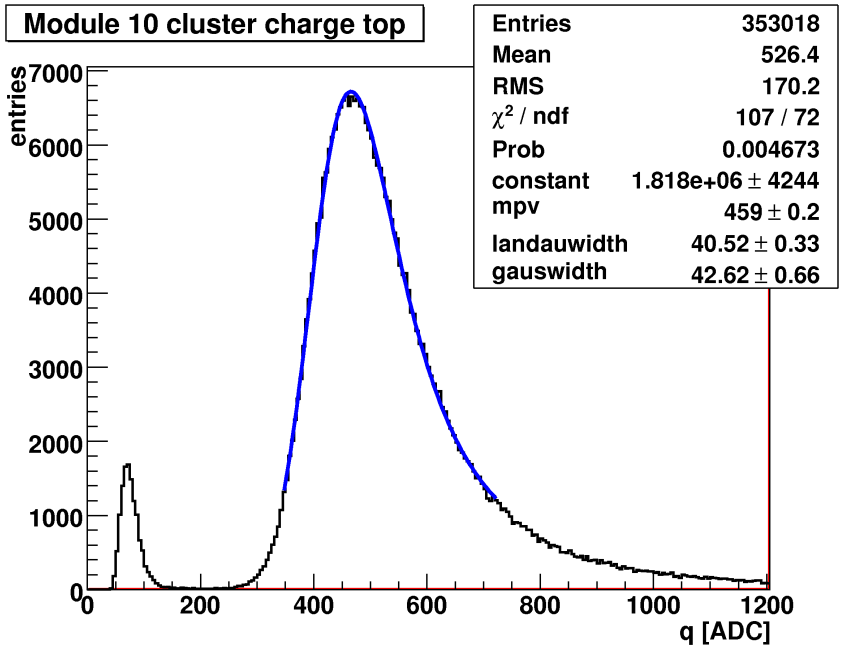
position	31	30. . . 27	26. . . 24	23. . . 17	16. . . 5	4. . . 0
value	EventID	FrameID_begin	FEID	Channel	maxHeight	Length
length	1 bit	4 bit	3 bit	7 bit	12 bit	5 bit

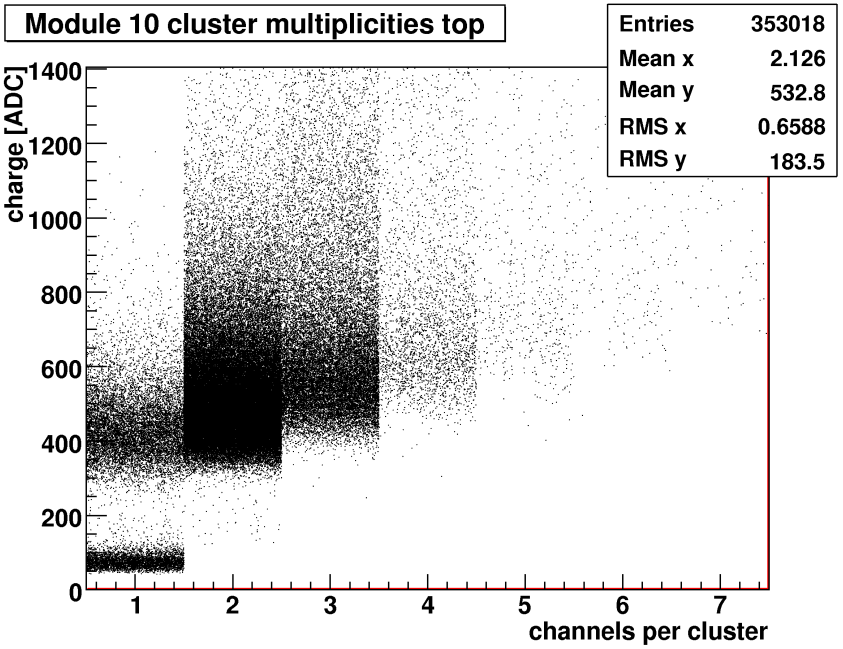
- dead time scales linear with number of requested frames:

# trigger	# frames	max. readout rate /kHz	dead time /clocks	dead time (@40 MHz) /µs
1	3	40,819	980	24,5
2	6	28,572	1400	35,0
3	9	21,978	1820	45,5
4	12	17,857	2240	56,0
5	15	15,038	2660	66,5

Results
Analyzed data

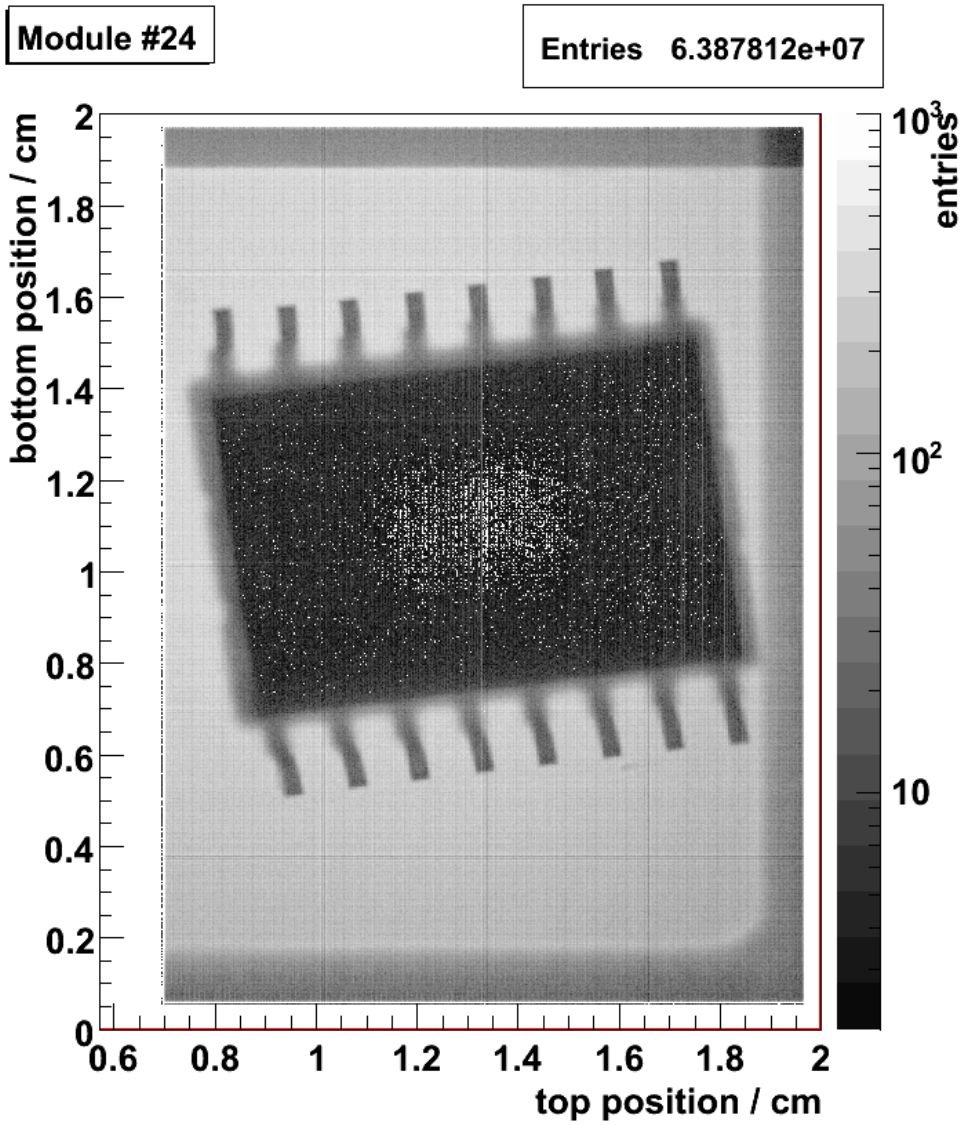
- electrons from a ^{90}Sr source
- energy loss distribution and hit multiplicity:





Results
2D imaging

- SMD device placed on the sensor
- acts as an absorber for electrons from a ^{90}Sr source



Summary

- Test Station for double-sided silicon strip sensors
- demonstrated a powerful FPGA based readout for APV25 frontends
- implemented online feature extraction

Thank you for your attention

HK 13.2 HK 21.1