

Radiation Hardness of electronic components of the Luminosity Detector

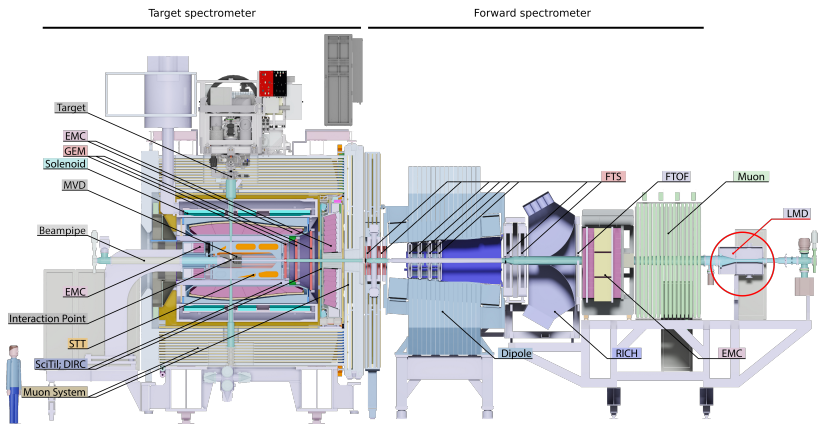
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PANDA Collaboration Meeting
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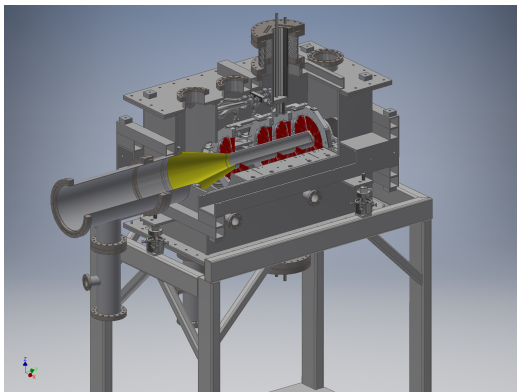
The Luminosity Detector at \bar{P} ANDA



tracking detector for elastically scattered antiprotons from 3 - 8 mrad

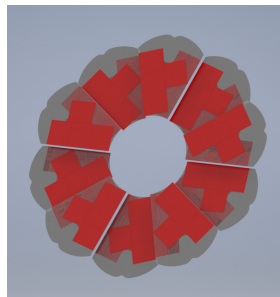
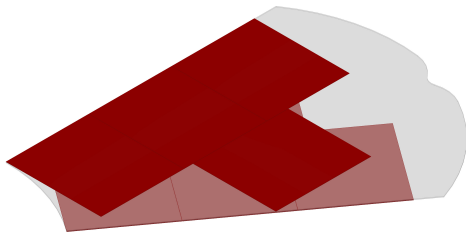
PANDA Luminosity Detector

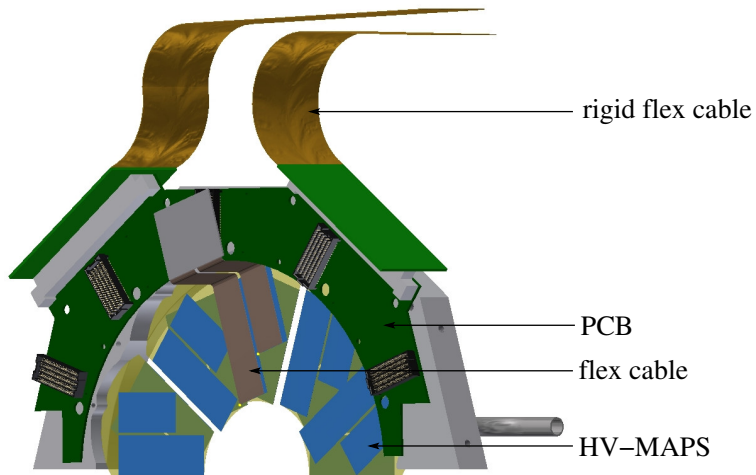
- 4 planes in line
- 10 modules on each plane
- 8 sensors on each module
- 320 pixel sensors in total



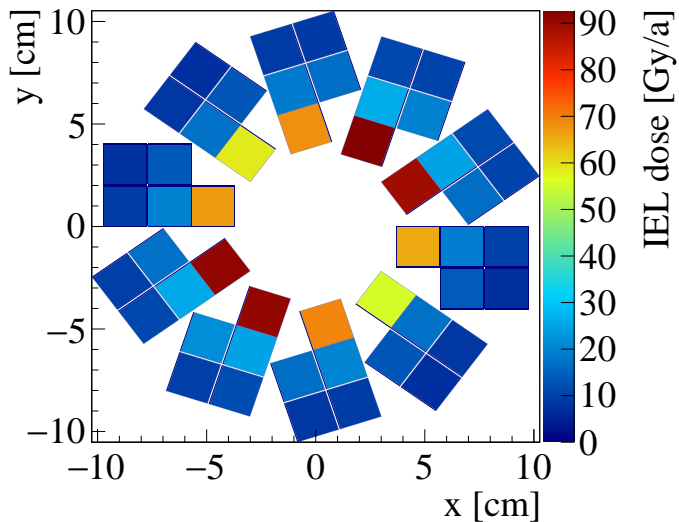
Single Plane, 10 Modules

- 10 modules, 36° angle between sensors
- High Voltage Monolithic Active Pixel Sensor
- sensor size: $2\text{ cm} \times 2.3\text{ cm}$
- pixel size: $80\ \mu\text{m} \times 80\ \mu\text{m}$
- total module thickness: $350\ \mu\text{m}$





Expected radiation dose

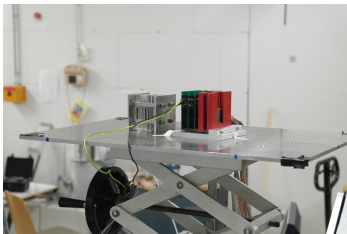


Radiation Hardness Tests

Two beam tests with protons at COSY

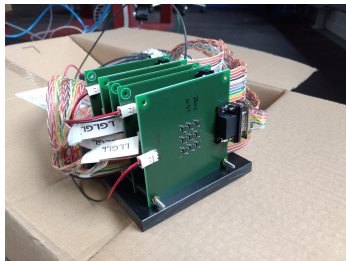
2014

- Jessica
- Energy: 2.8 GeV
- $\sim 10^8$ p/s
- Dose: ~ 1.5 kGy
- Online monitoring of all parts



2016

- Synchrotron
- Energy: 35 MeV
- $\sim 10^{10}$ p/s
- Dose: ~ 5 kGy
- Online monitoring of all parts



5 kGy, 30 MeV protons

type	part number	# irradiated	# broken
LDO regulator	MCP1727	9	0
	ADM7172	9	9
LVDS repeater clock driver	DS25BR100	8	0
	ADCLK846	8	0

1.5 kGy, 2.9 GeV protons

type	part number	# irradiated	# broken
LDO regulator	MCP1727	10	0
	ADP1740	15	8
LVDS repeater clock driver	DS25BR440	4	2
	MAX9153	6	0
microcontroller	AT90CAN128	3	0

- First tests with electronic components done in Jülich with protons
- LDO regulators and LVDS repeater available for the expected radiation dose in the LMD

To Do

- Test with a larger sample
- Test with neutrons