α, β, γ RADIATION MONITORING IN THE WORKING AREA OF THE MPD SLOW CONTROL ELECTRONIC EQUIPMENT

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PRESENTATION OUTLINE

Project introduction  Hardware  Software  Collected data  Data analysis  Conclusions
AIMS

- $\alpha$, $\beta$, $\gamma$ radiation monitoring
- Compatibility test between three detectors
- Determining average radiation dose in three separate locations
- Developing software for self-built Geiger-Müller counter
- Possible use on the NICA-MPD-PLATFORM
Ionizing radiation is radiation that carries sufficient energy to detach electrons from atoms or molecules.

Types of ionizing radiation: $\alpha$, $\beta$, neutron particles, $\gamma$ and $\text{X}$-rays,

GAMMA-SCOUT ONLINE DETECTOR

- Three working modes
- Measurement uncertainty 5%
- Readout of data in the real time
- Data saving

Picture from: https://www.radonshop.com/gamma-scout-online-geiger-counter-radiation-meter
GEIGER-MÜLLER TUBE
INSIDE GAMMA-SCOUT DETECTOR

712 End Window-Alpha-Beta-Gamma Detector


<table>
<thead>
<tr>
<th>General specification</th>
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</thead>
<tbody>
<tr>
<td>Gas filling</td>
</tr>
<tr>
<td>Cathode material</td>
</tr>
<tr>
<td>Maximum length (inch/mm)</td>
</tr>
<tr>
<td>Effective length (inch/mm)</td>
</tr>
<tr>
<td>Maximum diameter (inch/mm)</td>
</tr>
<tr>
<td>Effective diameter (inch/mm)</td>
</tr>
<tr>
<td>Connector</td>
</tr>
<tr>
<td>Operating temperature range °C</td>
</tr>
</tbody>
</table>
MANUFACTURER’S SOFTWARE

Real time readout

Saved data
GAMMA –SCOUT LABVIEW SOFTWARE

RUN PANEL
GAMMA –SCOUT LABVIEW SOFTWARE

SERVICE PANEL
GAMMA –SCOUT LABVIEW SOFTWARE

ENGINEERING PANEL
Compatibility test between three detectors
CALIBRATION – DETECTORS PLACED NEXT TO EACH OTHER

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HISTOGRAMS – DETECTORS PLACED NEXT TO EACH OTHER

Results of calibration - detectors next to each other

Detector GS 071537

Detector GS 071529

Detector GS 071533
CALIBRATION – DETECTORS PLACED ONE ON TOP OF THE OTHER
HISTOGRAMS – DETECTORS PLACED ONE ON TOP OF THE OTHER

Results of calibration - detectors one on top of the other

Detector GS 071533

Detector GS 071529

Detector GS 071537
COMPATIBILITY IN THREE SEPERATE LOCATIONS

- Inside the RACK
- On the RACK’s case
- Outside the RACK
RESULTS

$\alpha + \beta + \gamma$

$\beta + \gamma$

$\gamma$
HISTOGRAMS - $\alpha+\beta+\gamma$

- **Frequency**
- **Number of impulses**

- **GS 071529 (inside the rack)**
- **GS 071533 (on the rack's case)**
- **GS 071537 (outside the rack)**
HISTOGRAMS - $\beta+\gamma$

![HISTOGRAMS - $\beta+\gamma$](image)
SELF-BUILT GEIGER-MÜLLER COUNTER

Data acquired using NI myDAQ

Developer – BSc Nikita Dunin

Self-built Geiger-Müller counter
GEIGER-MÜLLER TUBE IN THE SELF-BUILT DETECTOR

ST-5 (CTC-5) Geiger tube
Picture from [https://www.pocketmagic.net/tube-sts-5-%D1%81tc-5-geiger-tube/](https://www.pocketmagic.net/tube-sts-5-%D1%81tc-5-geiger-tube/)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Gamma radiation sensitivity (Cs137)</td>
</tr>
<tr>
<td>MED – 0.28mkR·s⁻¹</td>
</tr>
<tr>
<td>Operating Voltage Range</td>
</tr>
<tr>
<td>360 – 440V</td>
</tr>
<tr>
<td>Starting voltage</td>
</tr>
<tr>
<td>280 – 330V</td>
</tr>
<tr>
<td>Geiger plateau length</td>
</tr>
<tr>
<td>not less than 80 V</td>
</tr>
<tr>
<td>Plateau slope</td>
</tr>
<tr>
<td>no more than 0.125%/V</td>
</tr>
</tbody>
</table>
NI myDAQ DETAILS

Analog Input:
- 2 channels, 200kS/s, 16-bit

Analog Output:
- 2 channels, 200kS/s, 16-bit
- 3.5mm stereo audio jacks

Digital I/O: 8 LV TTL lines

Counter: 1 counter/timer

Integrated DMM: V, A, Ohm

Power Supply: +5V

- 8 DIO lines,
- 1 counter
- 2 AI lines
- 2 AO lines

Power Supply: +/- 15 V

Audio IN/OUT

USB controlled, bus powered

Picture and specification from:
https://slideplayer.com/slide/5931164/?fbclid=IwAR0SHzZj2LjuTALg splice0f2UeTc0kMypBGr5yDAOrvxXDgglyATTotIm3Wvg
GEIGER-MÜLLER COUNTER SIGNAL

Signal measured with Picoscope USB oscilloscope
GEIGER-MÜLLER COUNTER LABVIEW SOFTWARE

RUN PANEL
GEIGER-MÜLLER COUNTER LABVIEW SOFTWARE

SERVICE PANEL
GEIGER-MÜLLER COUNTER
LABVIEW SOFTWARE

ENGINEERING PANEL
Gamma-Scout detectors and Geiger-Müller counter are best used as real time safety monitoring.

Gamma-Scout detectors and Geiger-Müller counter are appropriate devices for monitoring radiation safety on NICA-MPD-PALTFORM.

Calibration test of Gamma-Scout detectors was successful.

Lower number of impulses detected inside the RACK for each working mode.

No significant difference between results on the RACK’s case and outside the RACK.
THANK YOU FOR YOUR ATTENTION