



Ciências
ULisboa

ELECTRONICS ADAPTATION FOR SCINTILLATION DOSIMETER

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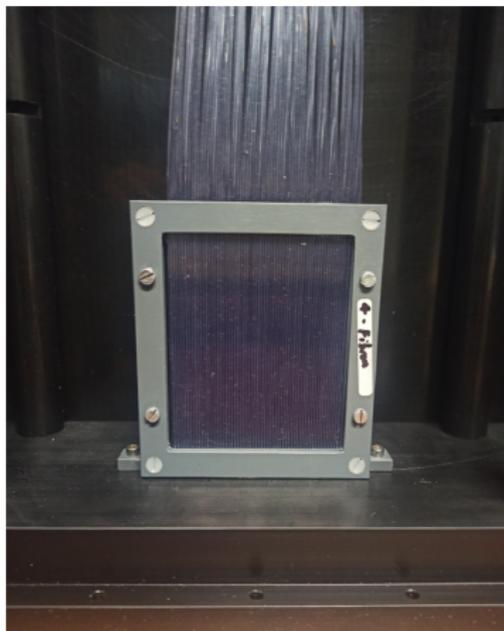
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The scintillation dosimeter is a radiation detector currently in development in LIP at FCUL. It consists of:

- ▶ A light tight case;
- ▶ An array of 64 scintillating plastic optical fibres with a 1mm diameter;
- ▶ 64-channel multi-anode PMT H8500C;
- ▶ SAMTEC-LEMO00 electronic interface for output.

SCINTILLATION DOSIMETER

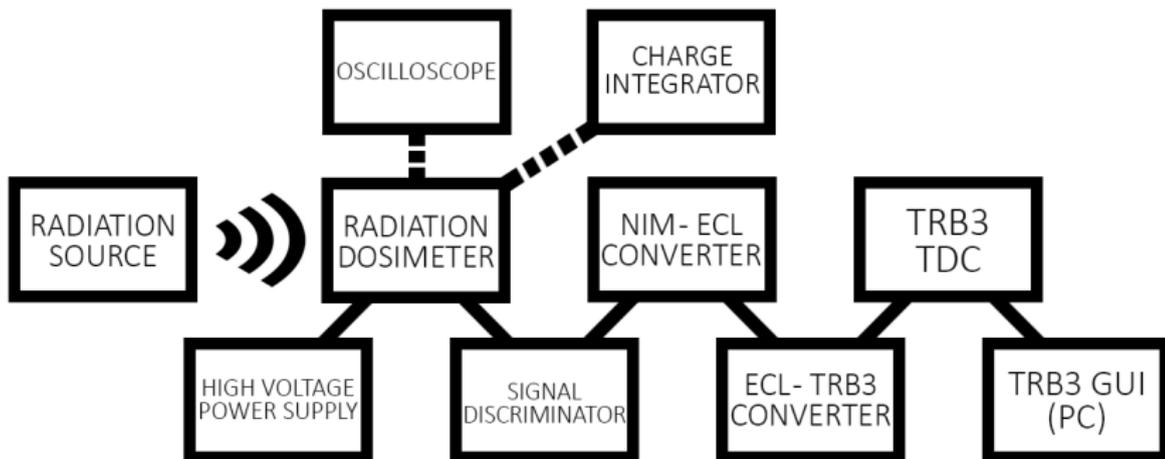


The detector and the fibre array within.



For measurements to be made, a circuit was setup in the lab at LIP:

- ▶ Individual channel LEMO00 output;
- ▶ Signal discriminator;
- ▶ NIM - ECL translator;
- ▶ TDC board (TRB3);
- ▶ Computer for TRB3 GUI.



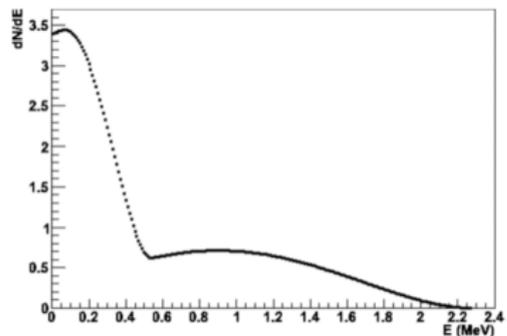
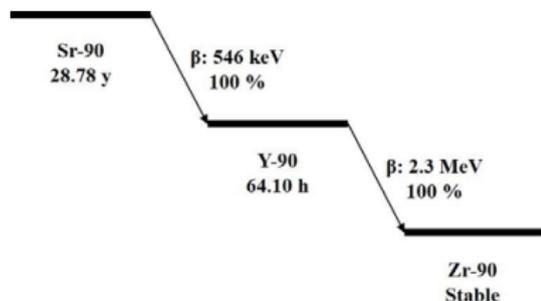
Two radiation sources have been used for testing:



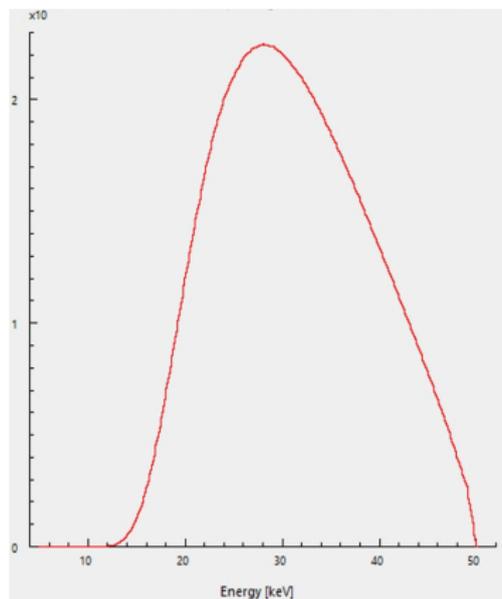
Strontium-90
 β^- radiation



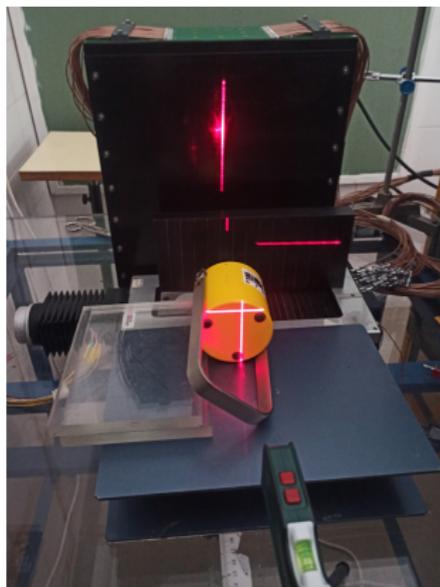
X-Ray Emitter
X-Ray radiation



Sr-90 Decay Scheme and Emission Spectrum
(Source: researchgate.net)



X-Ray Emitter Spectrum (Bremsstrahlung)
(Source: SpekCalc Software)



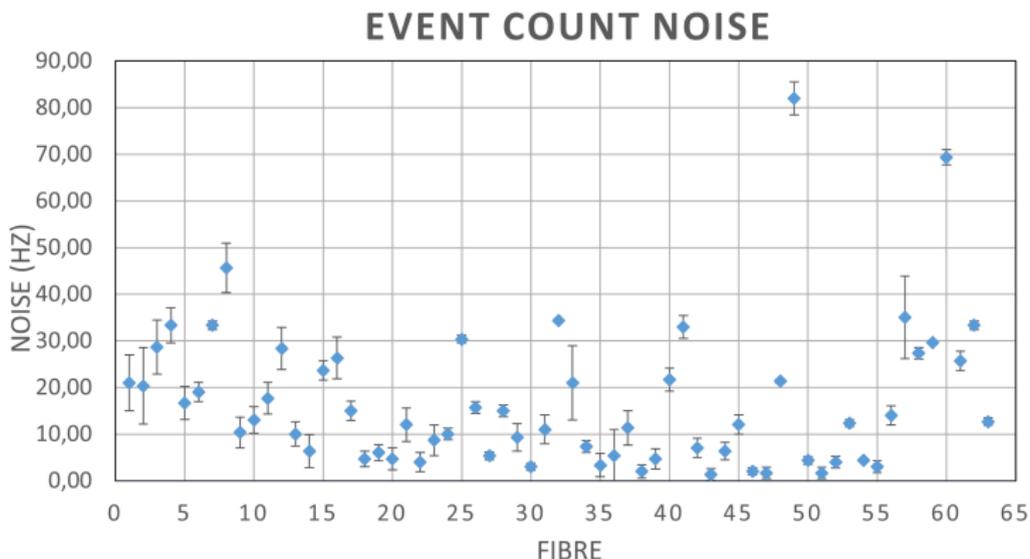
A PMMA absorber was also developed for trials with protons:

- ▶ Sr-90 tests yielded no results as electrons are absorbed;
- ▶ X-Ray tests were possible.

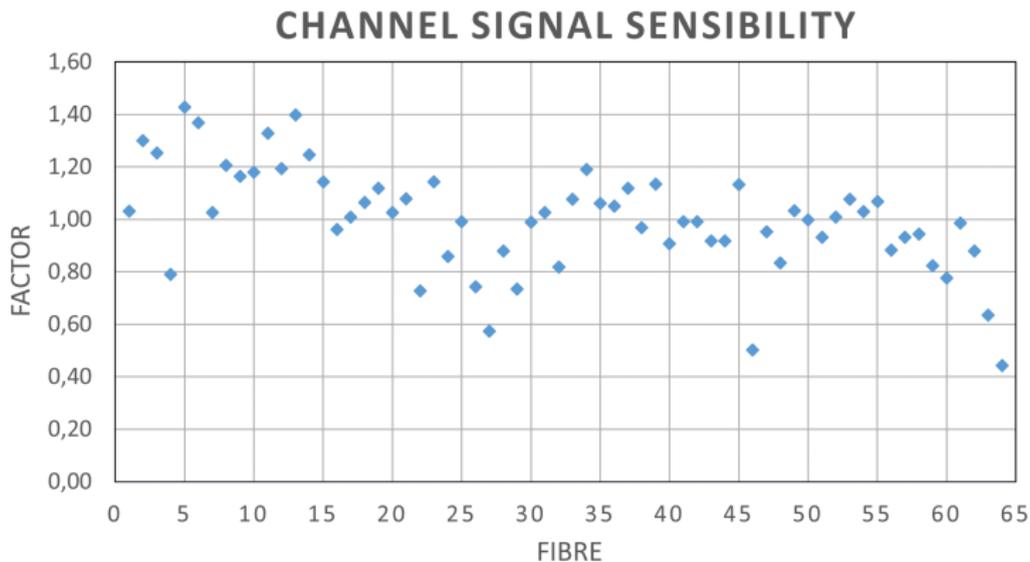


While analysing measurement data the following have to be considered:

- ▶ Dark current-induced noise;
- ▶ Channel signal sensibility;
- ▶ Signal reflection-induced noise;
- ▶ TRB3 reading errors.



Measured with PMT HV at 1000V when only exposed to background radiation.



$$\text{FACTOR} = \frac{\text{FIBRE CHARGE}}{\text{AVERAGE OF FIBRE CHARGES}}$$

Maximum = 1,43 Minimum = 0,44

TRB3 ERRORS AND SIGNAL REFLECTIONS



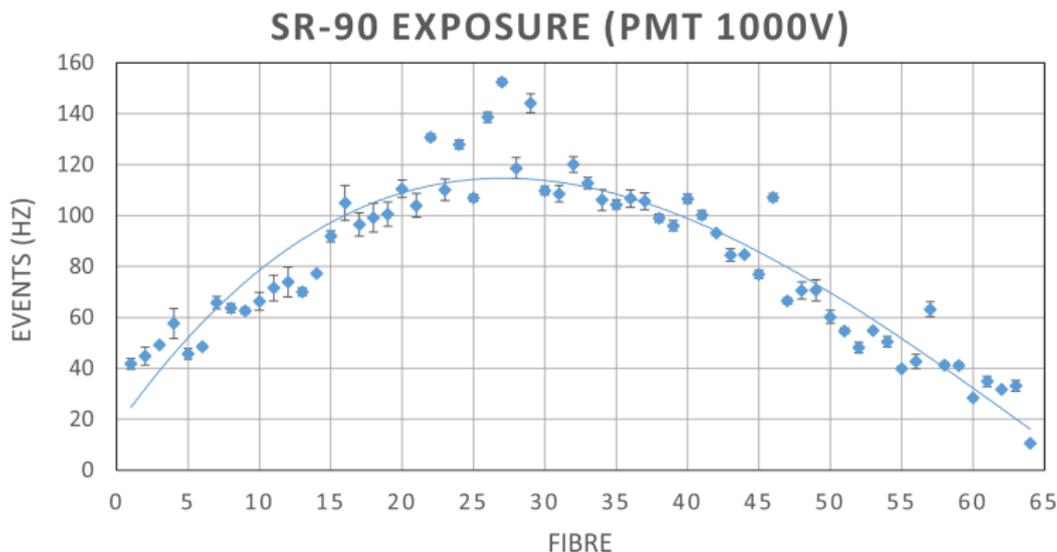
Signal Function Generator Frequency (Hz)	TRB3 Registered Value (Hz)	Relative Deviation
10	10,67	6,7%
100	106,33	6,3%
1000	1069,67	7,0%
100000	108112,33	8,1%
10000000	1072808,00	7,3%
10000000	10650216,67	6,5%
20000000	21640009,67	8,2%



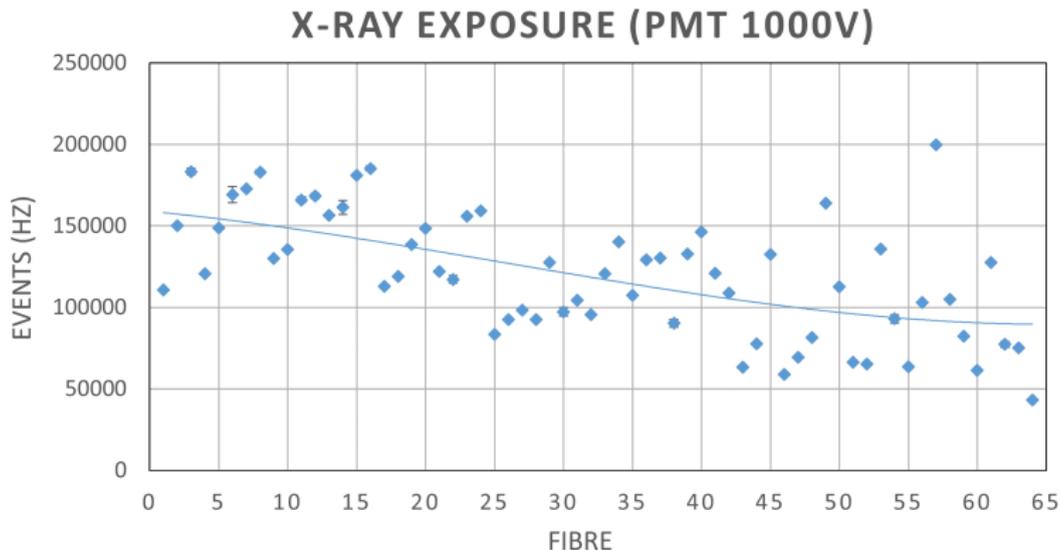
A TRB3-compatible external clock is currently being tested.

In the future, multiple improvements may be considered for implementation :

- ▶ Fibre array grid;
- ▶ Using thinner fibres;
- ▶ Using an alternative photodetector.



Average = 80,31Hz Avg. Dev. = 2,47Hz
 Maximum = 152,47Hz Minimum = 10,55Hz



Average = 119895Hz Avg. Dev. = 946Hz
 Maximum = 199852Hz Minimum = 43189Hz

- ▶ The dosimeter is currently working and well-along in its development.
- ▶ It requires more calibration and may require some more work as previously discussed.
- ▶ It already achieves its purpose of providing reliable radiation detection measurements along each vertical millimeter wide-strip of its detection area.

