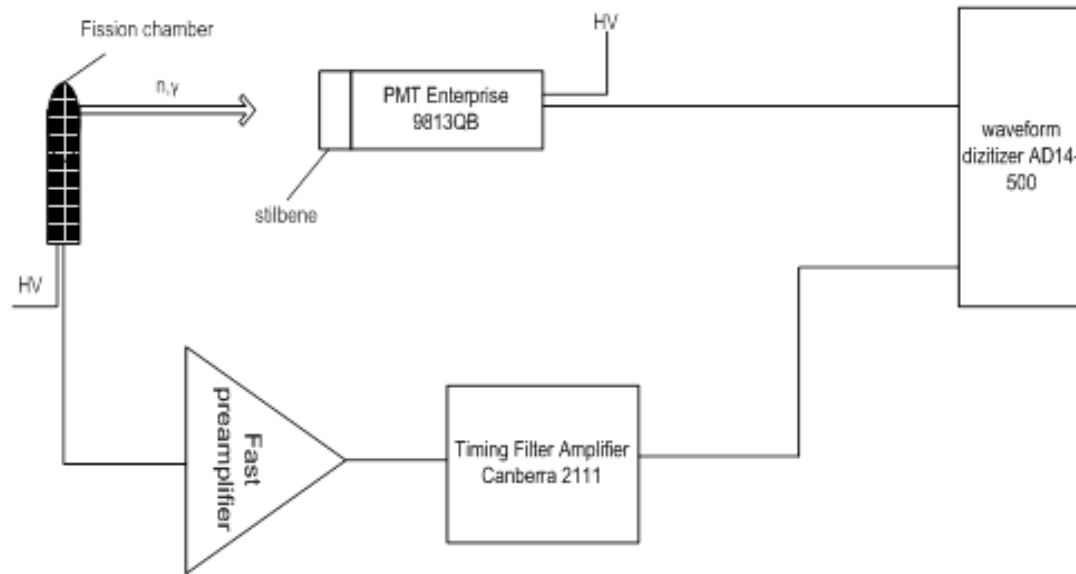


Digital spectrometer for prompt fission neutrons spectra measurement

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Experimental Setup



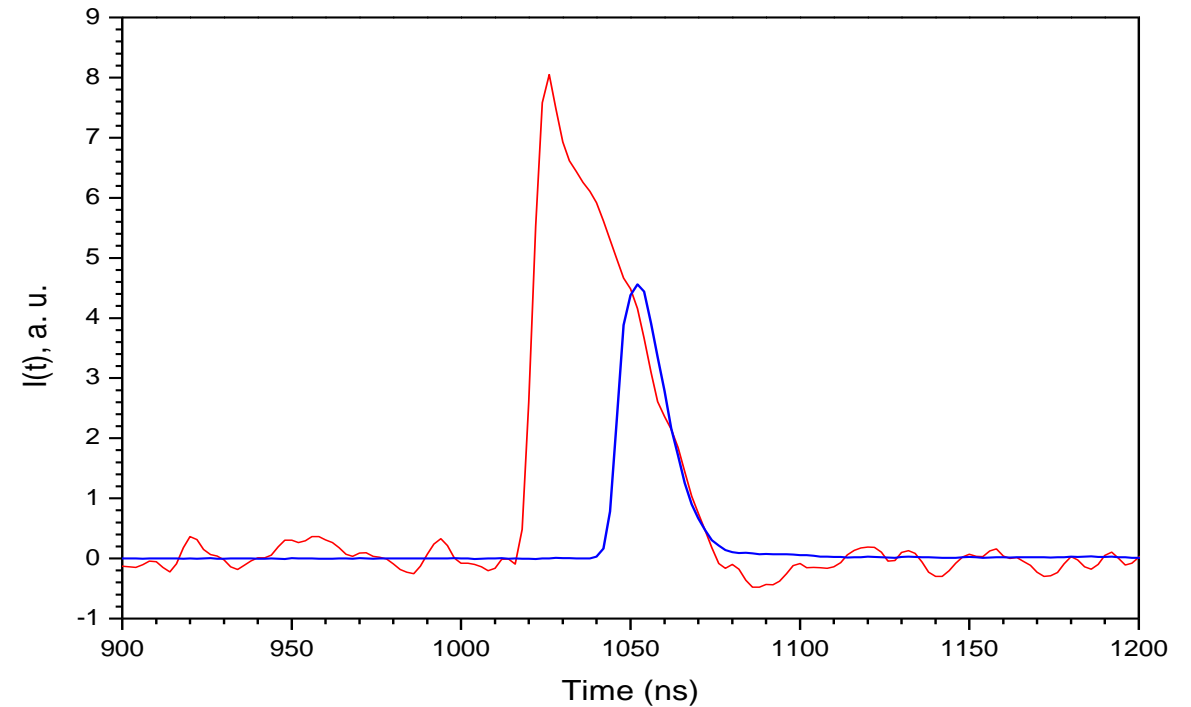
Electronic scheme of experimental setup.

Neutron detector - stilbene crystal with \varnothing 3 cm and 0.5 cm thick.

Method of measurement – time-of-flight.

Flight path is 2 m.

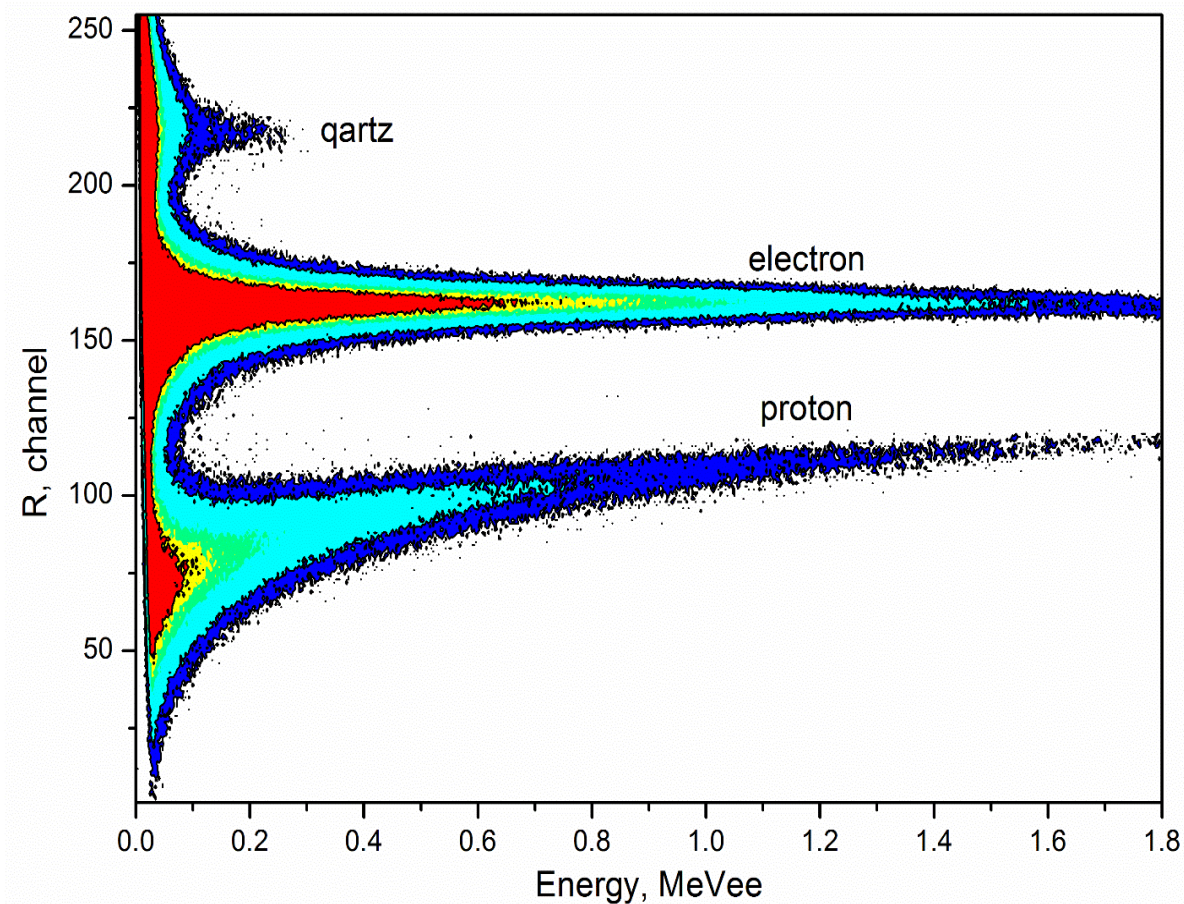
Dual-channel waveform digitizer Ultraview AD14-500 with sample rate of 500 Ms/s was used.



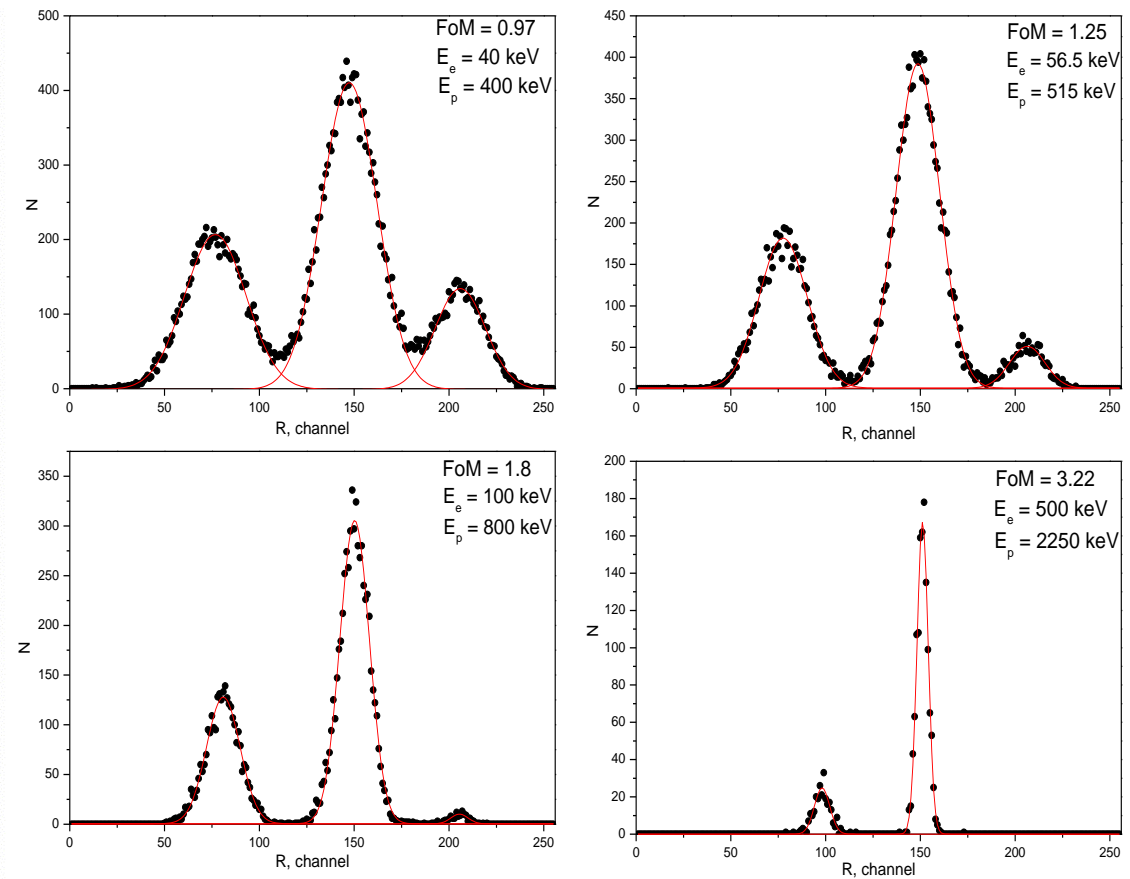
An example of a single event, which contains oscillograms from fission chamber (red line) and neutron detector (blue line).

Digitization was carried out on data from two synchronized channels.

Figure of Merit

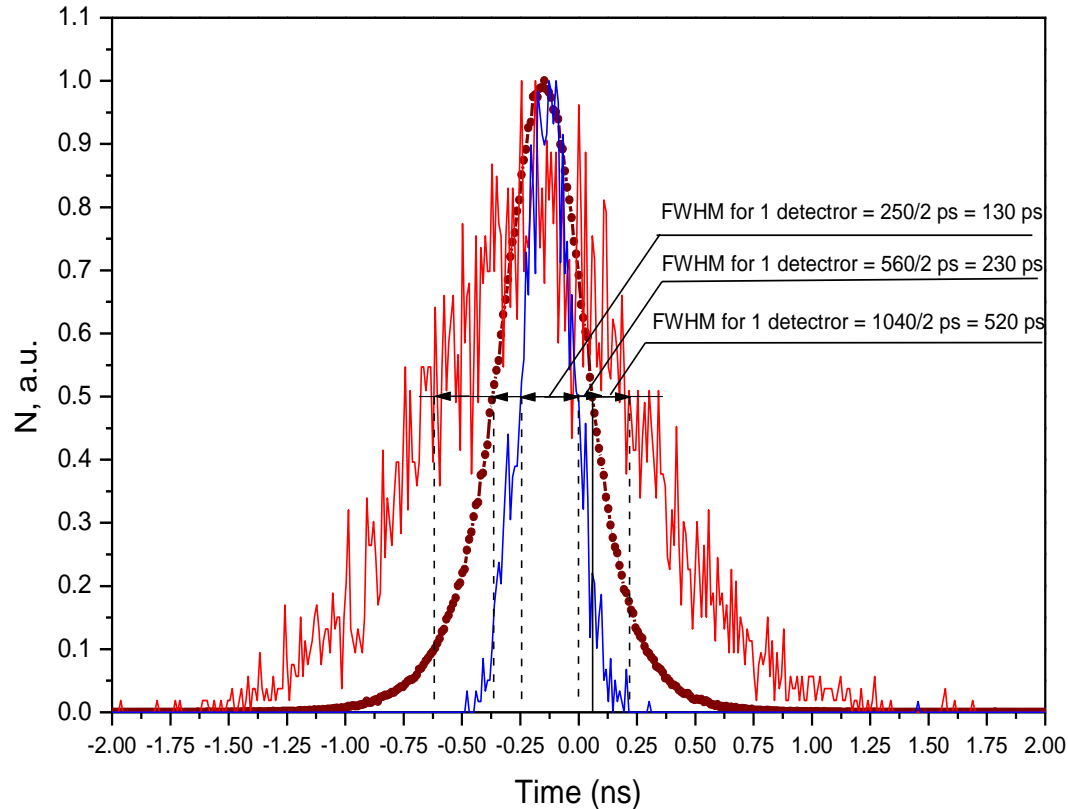


The two-dimensional spectrum. Axes: parameter of separation R - energy in MeVee.

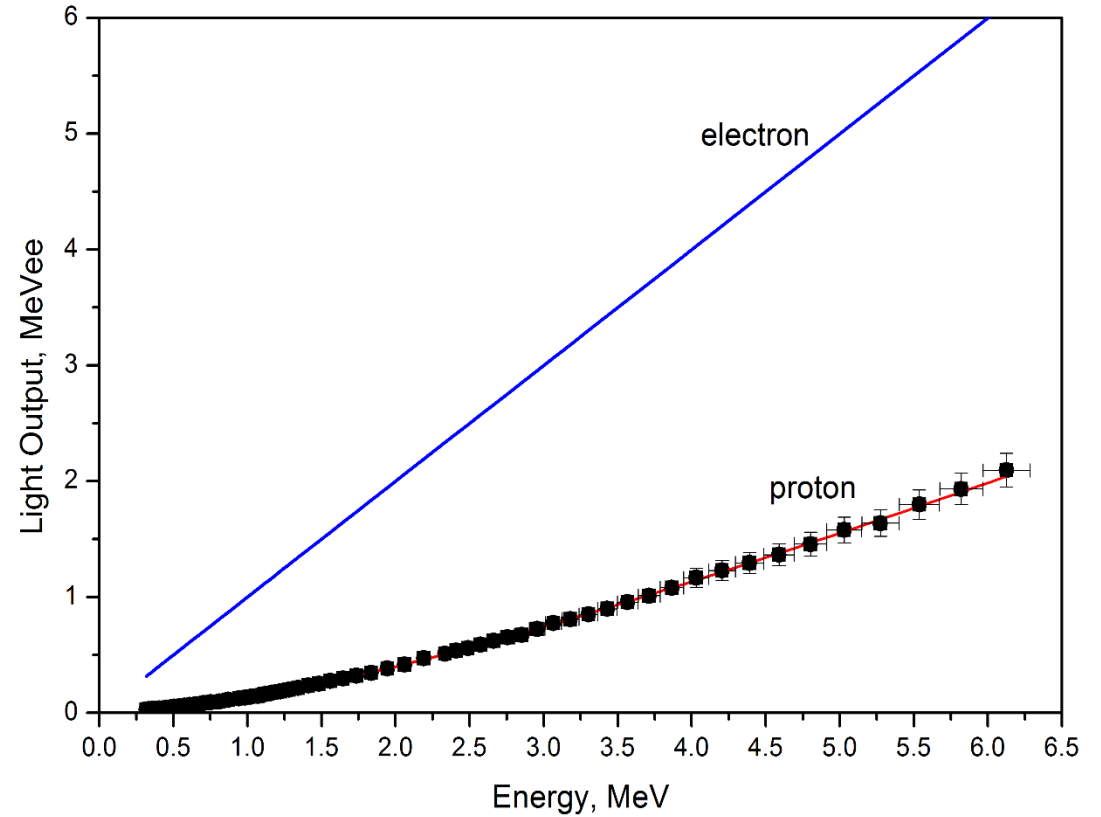


Slices of the two-dimensional spectrum at different energies.

Time resolution and light output



Total time resolution for two neutron detectors obtained by coincidence on ^{60}Co . Red line corresponds energy range 35-75 keV, blue line – 969 keV, wine point – integral.



Light output of recoil protons measurements that were carried out by time-of-flight method with ^{252}Cf source. Points - experiment, the line - an empirical approximation.

Conclusions

- Fully digital neutron spectrometer based on stilbene crystal, parallel plate ionization chamber and waveform digitizer was developed.
- The intrinsic time resolution of the scintillation detector is 130 ps.
- Simultaneous digitization of neutron detector signals and fission chamber signals got 1.5 ns time resolution.
- The influence of luminescence of the quartz input window of the PMT was observed and taken into account.
- Good quality of the n/γ separation was demonstrated down to energy of 40 keV, which corresponds to 400 keV neutrons. Possibility of n/γ separation down to neutron energies of 250 keV was also shown.
- The energy dependence of light output for the recoil protons for the stilbene crystal was obtained.