Insitute for Nuclear Research of Russian Academy of Sciences

The first results obtained with array of 16 electron-neutron detectors in INR RAS

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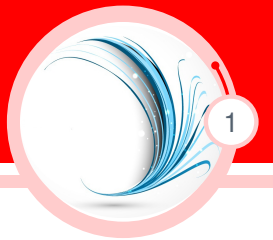
Layout



1. Scientific goals
2. Array layout and location
3. Detector and Electronics
4. Simultaneous recording of EAS and background variations
5. Pulse shape separation of signals
6. EAS size spectrum
7. Conclusion

Scientific goals

1. Test of our EAS and background recording technique
2. Detector and electronics stability test in outdoor conditions
3. Comparison of the results obtained with electron-neutron detectors at the sea level (Moscow) and mountain level (Tibet)

Array layout and location

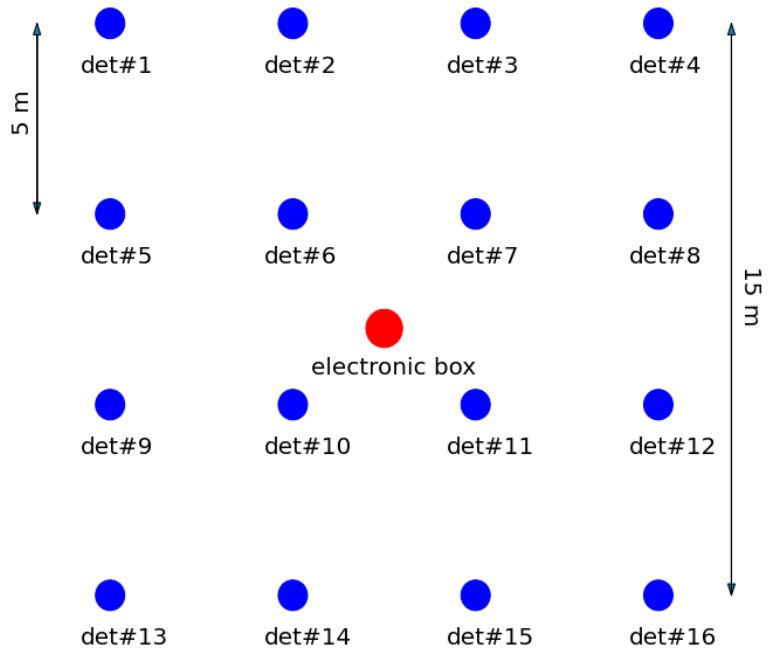


Figure 1: Array layout

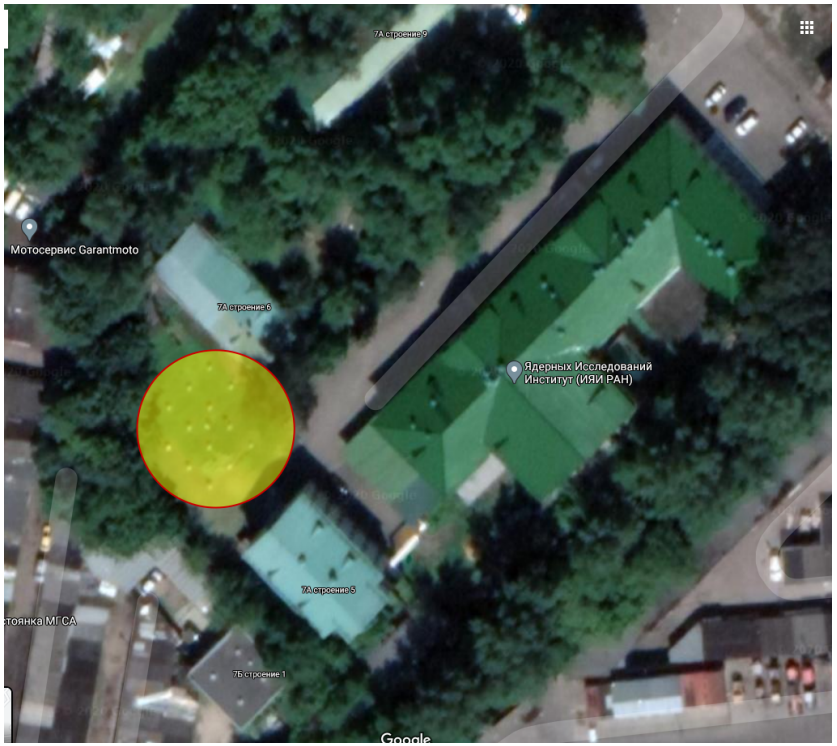


Figure 2: Array location

Detector and electronics

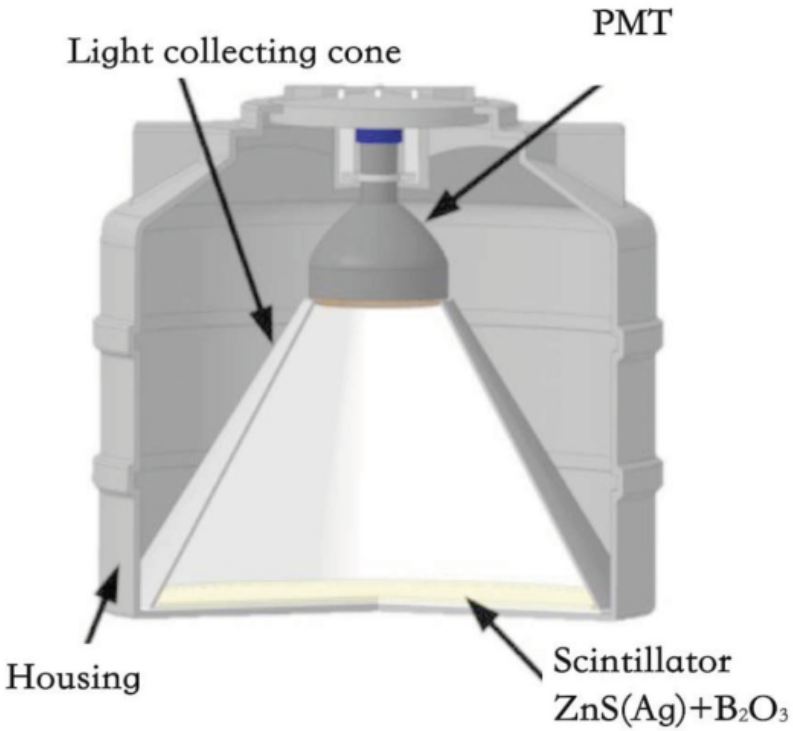


Figure 3: Detector design

Figure 4: FADC CAEN DT5740

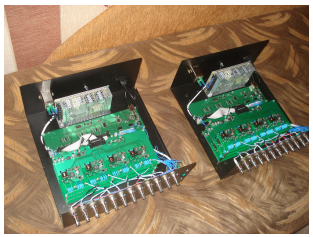


Figure 5: HV power supply

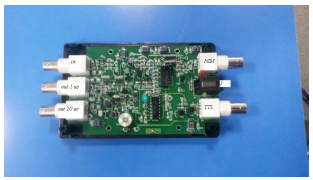


Figure 6: DIU

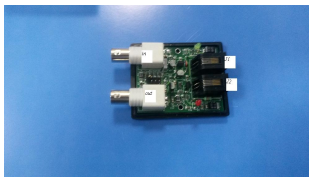


Figure 7: IU

Recording of EAS and background variations

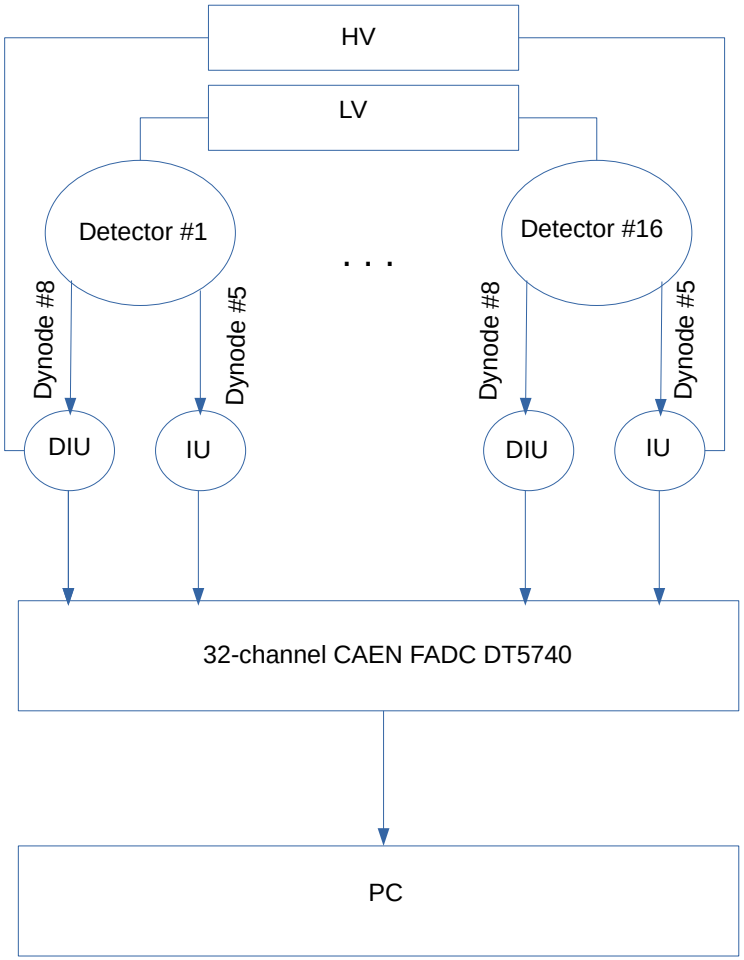


Figure 8: Electronics design

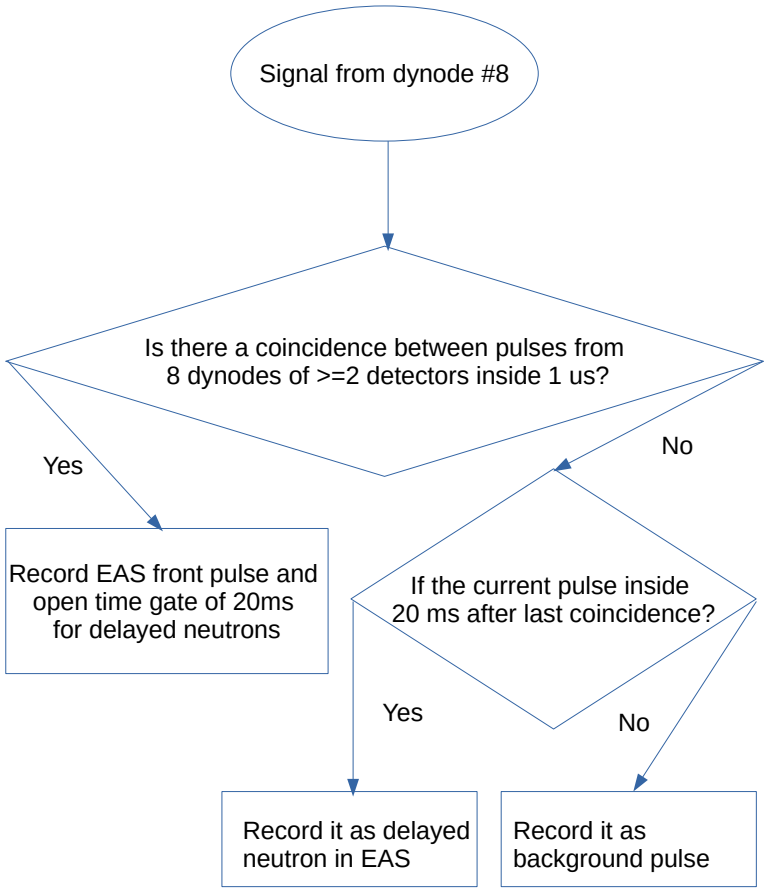


Figure 9: Recording algorithm

Pulse shape selection

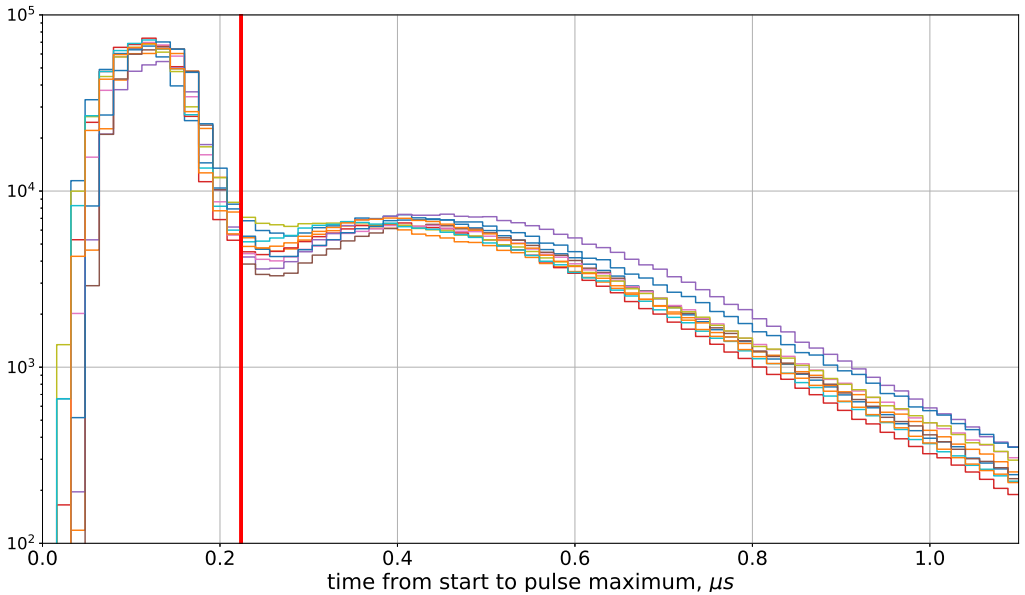


Figure 10: Rising front width distribution of pulses. Pulses to the right from red line are mostly neutrons, while pulses to the left are mostly produced by simultaneous transition of several relativistic light charged particles

$^{10}B + n \Rightarrow ^4 He + ^7 Li + 2.3(2.7) MeV$ - excite slow components of ZnS

Test of pulse shape separation technique using radioactive sources

Counting rate of neutrons (blue) and "short" (orange).

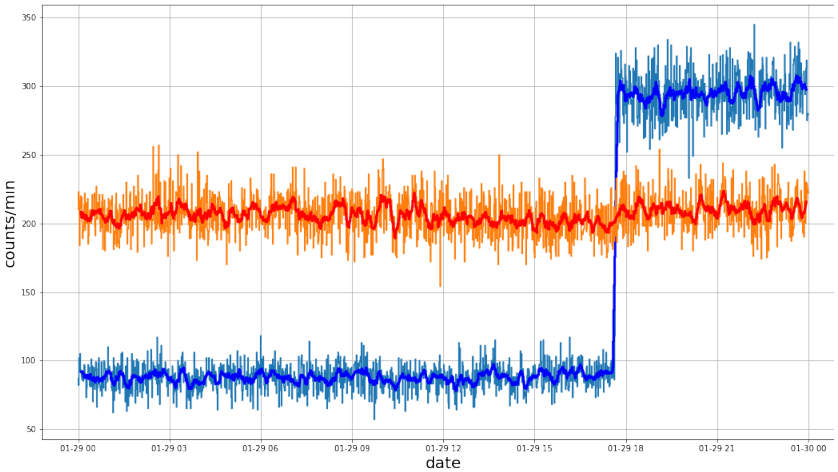


Figure 11: Effect of adding ^{252}Cf

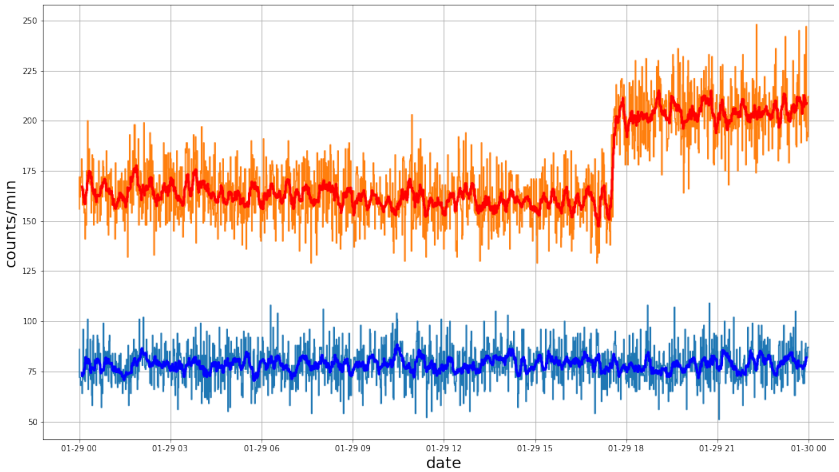


Figure 12: Effect of adding ^{232}Th

Test of pulse shape selection technique with ^{252}Cf

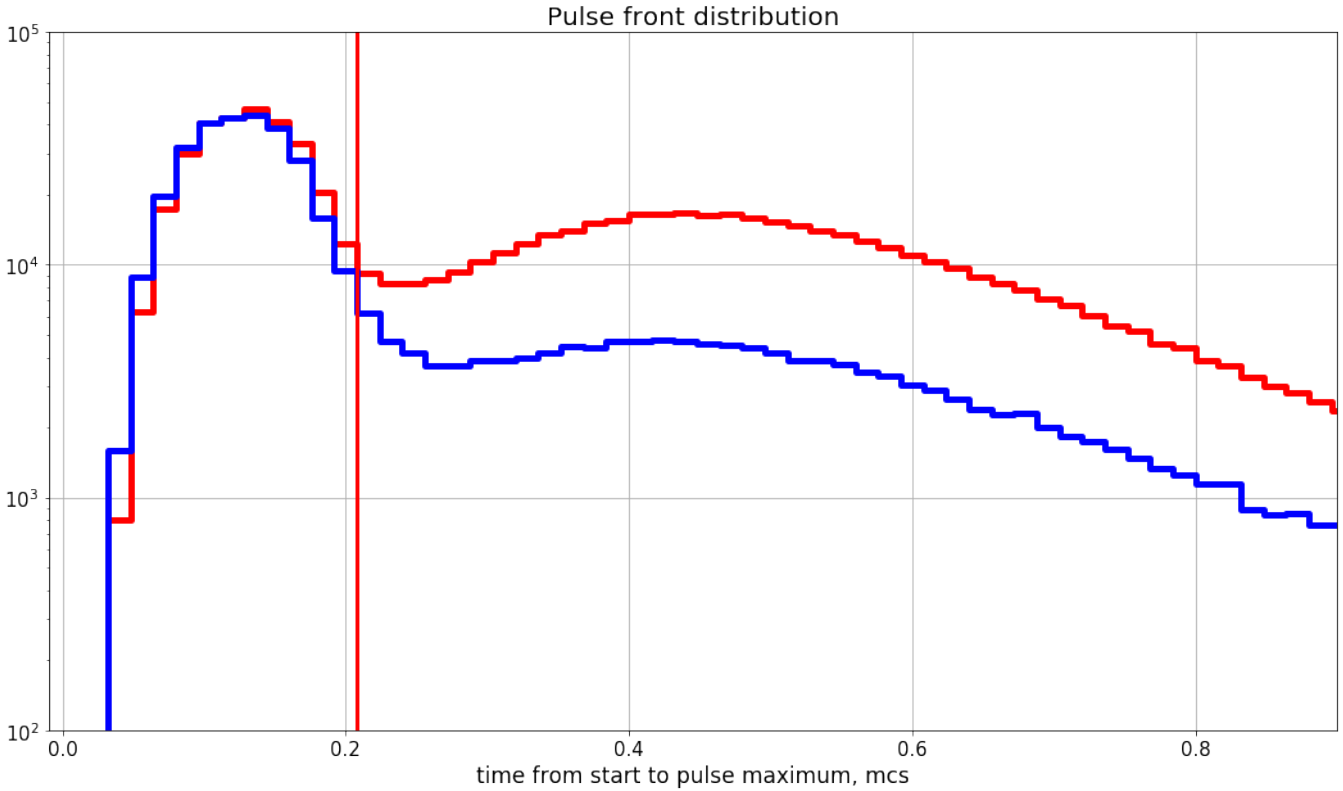


Figure 13: Time front distribution with and without neutron source ^{252}Cf

Example of background variations recorded

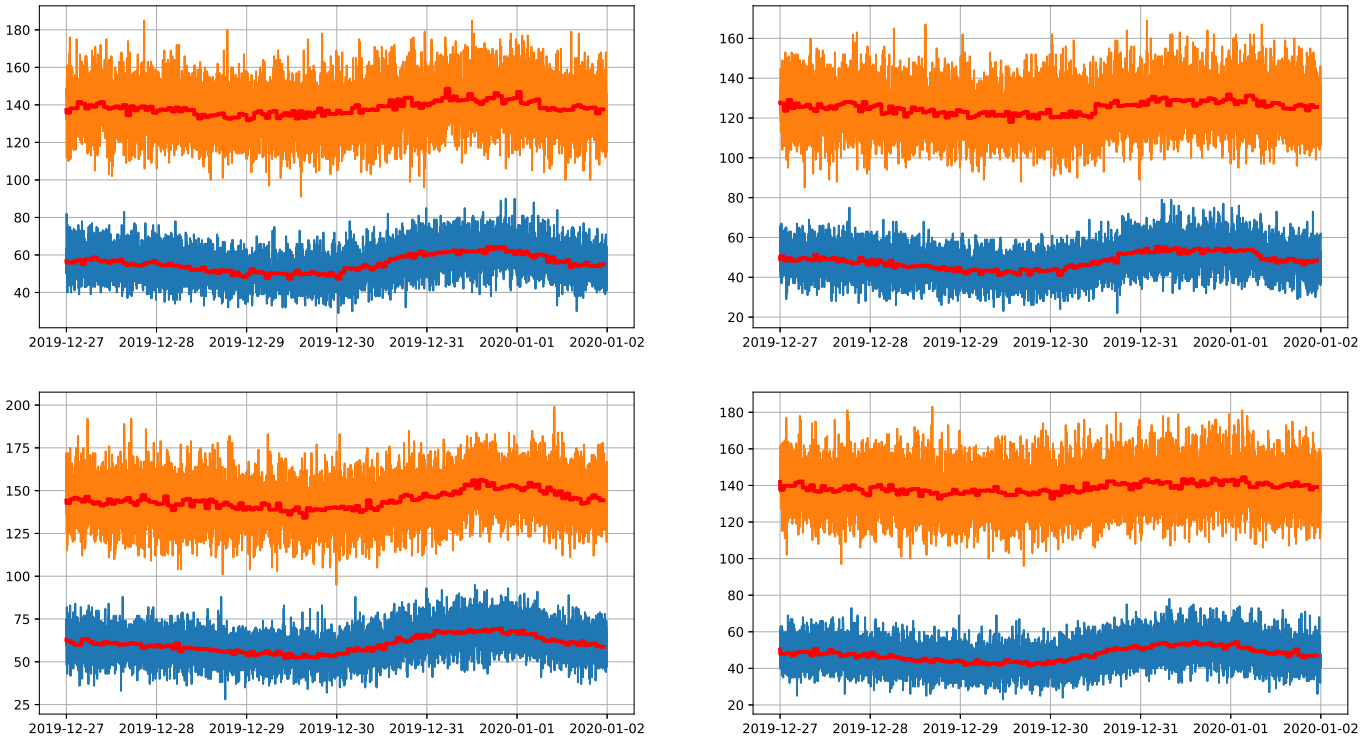


Figure 14: Example of background variations from first 4 detectors of the array. Blue - neutrons, orange - "short". Red lines - adjacent average

Example of recorded big event

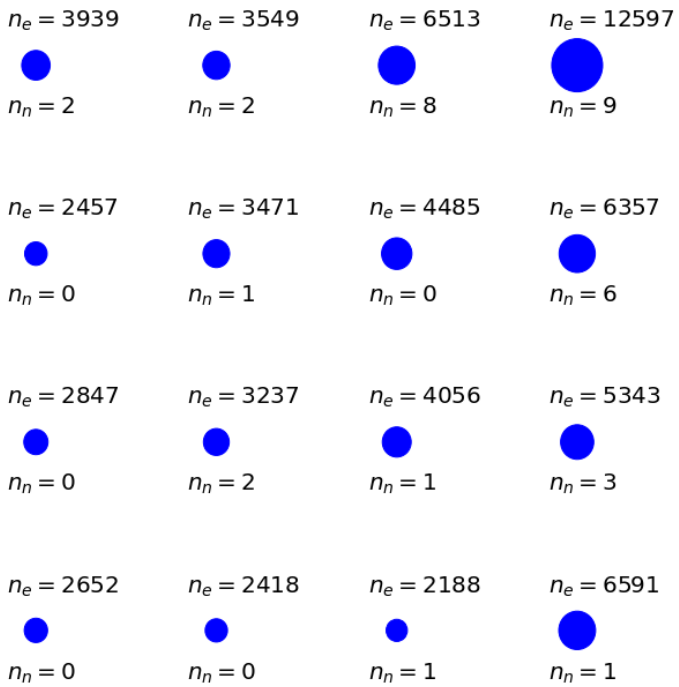


Figure 15: Recorded event with 36 neutrons, 05/07/2020

Temporal distribution of delayed pulses in EAS time window is 20 ms

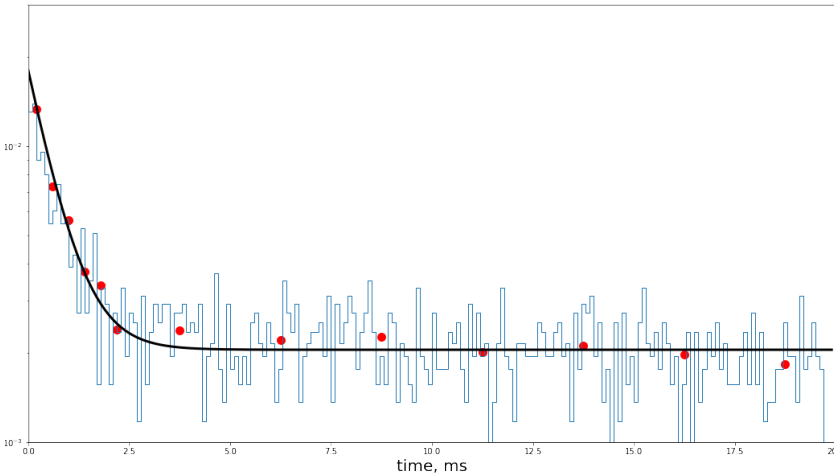


Figure 16: neutrons

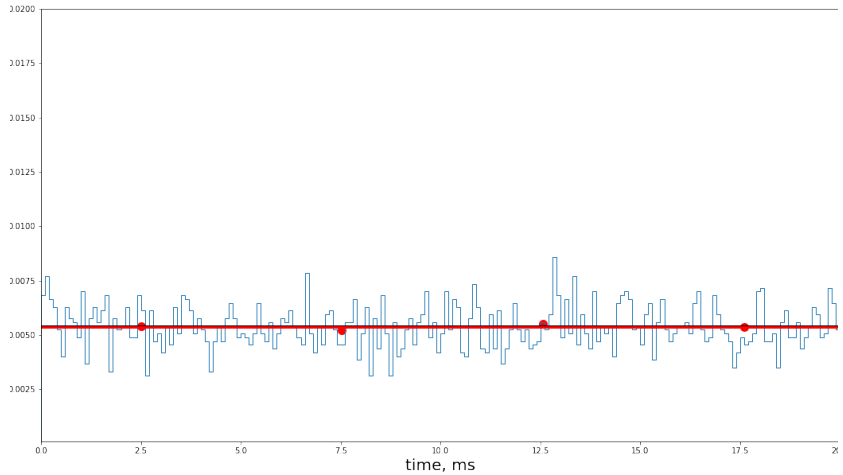


Figure 17: "short"

EAS energy deposit spectrum

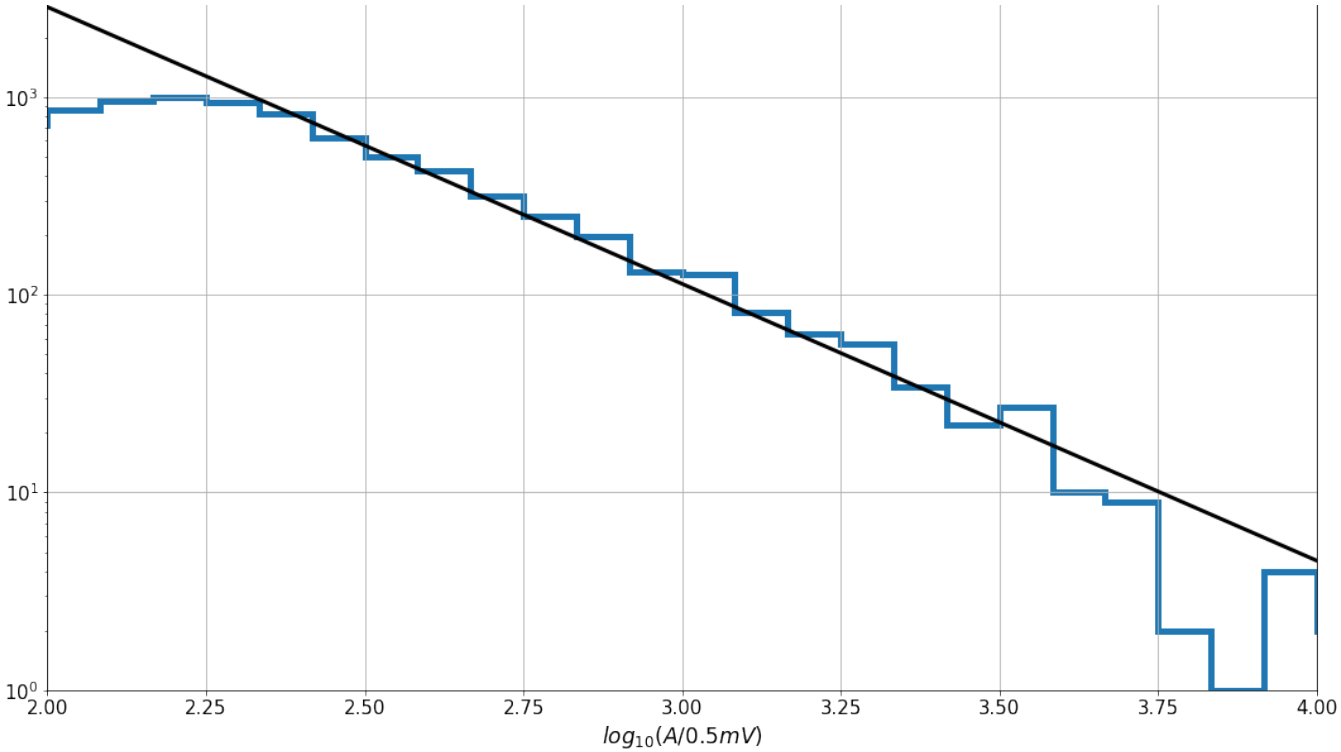


Figure 18: EAS distribution on sum of detectors amplitudes

Conclusions

1. Array of 16 en-detector was installed in INR RAS in Moscow
2. Technique of simultaneous recording of EAS and background variations was successfully realized
3. Technique of pulse shape selection was realized and tested
4. Temporal distribution of delayed neutrons in EAS was obtained

Thank you for attention!