Selected properties of plastic scintillators for muon detection

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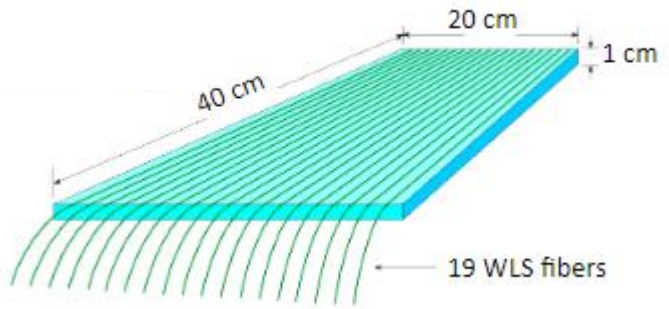
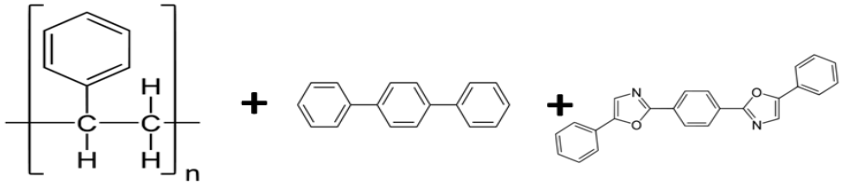
Detector description (Scintillator + SIPM)

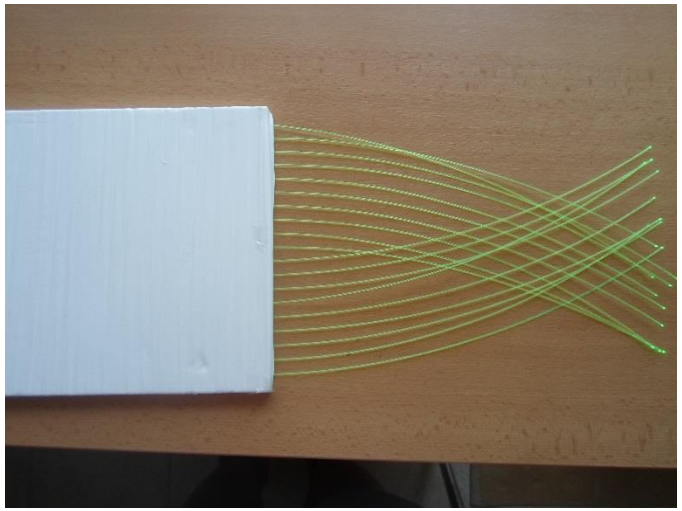


- NUVIA, a.s., Czech republic
- chemical composition: polystyrene matrix + 2%$_{wt}$ p-terfenyl + 0.025%$_{wt}$ POPOP

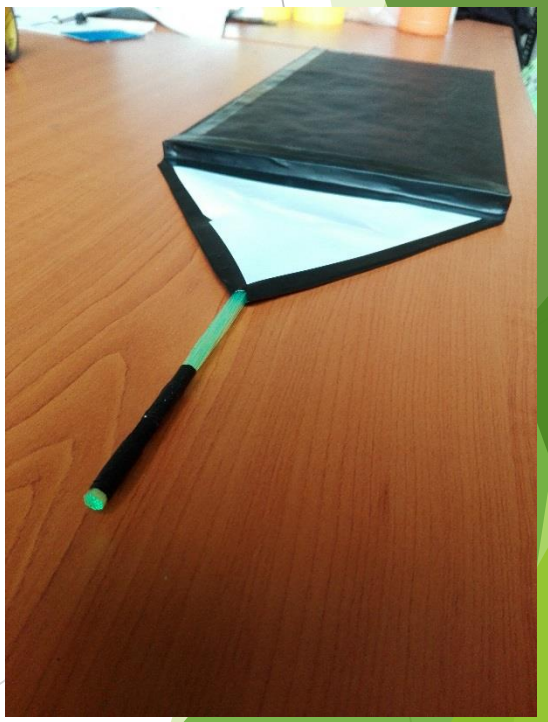


- 40 x 20 x 1 cm^3
- 19 KURARAY Y-11(200) wavelength-shifting fibers
- reflective material – Teflon (800 μm)
- ONSEMI C-series silicon photomultiplier (3 x 3 mm^2)
- photoelectron yield 75 p.e./MeV

Plastic scintillator with 19 grooves



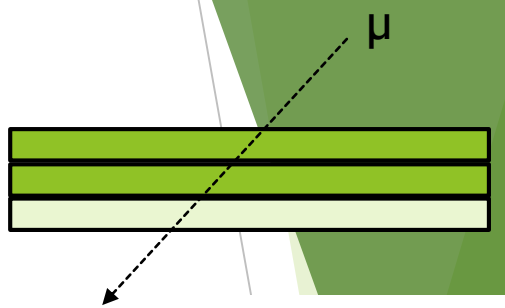
Scintillator with WLS fibers in Teflon layer

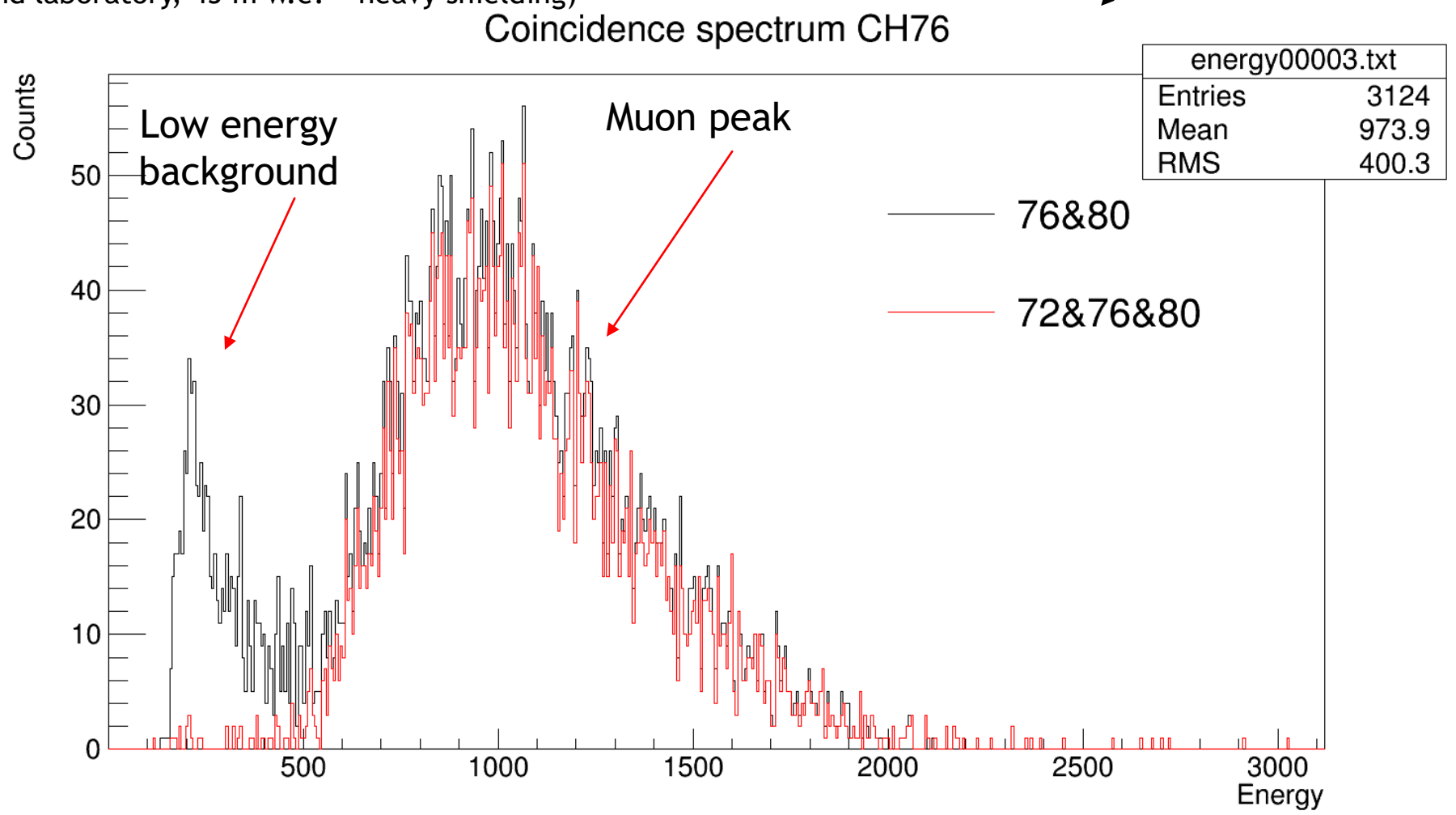


Scintillator prepared for photosensor application

Measurement

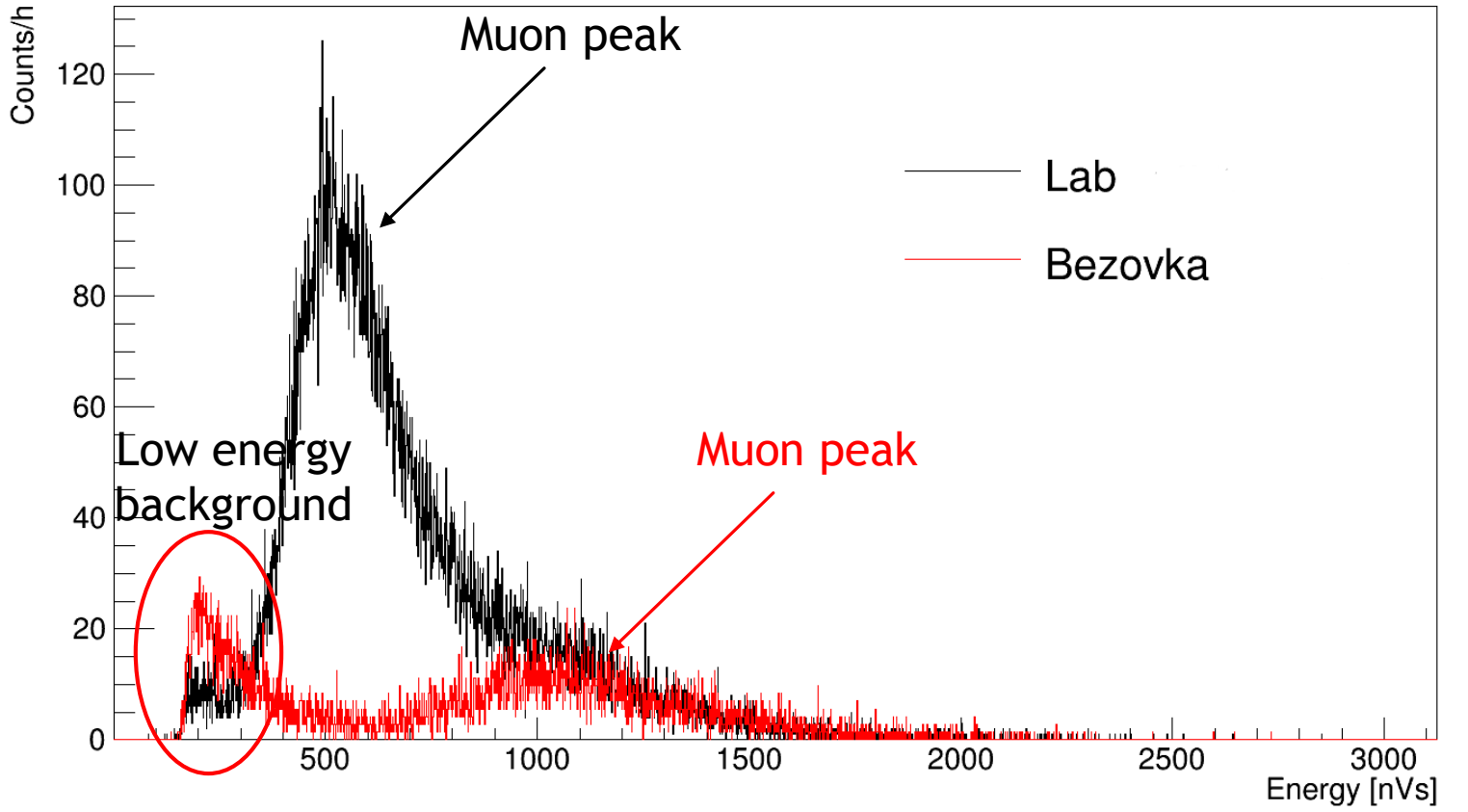
- **coincidence spectrum from two vs. three scintillators**
  - **Required synchronized digitizer**
- two scintillators – low energy background + muon peak
- three scintillators – muon peak without background
- energy deposition- 2 MeV/cm
- 2.4 muons/s (underground laboratory, 45 m w.e. + heavy shielding)





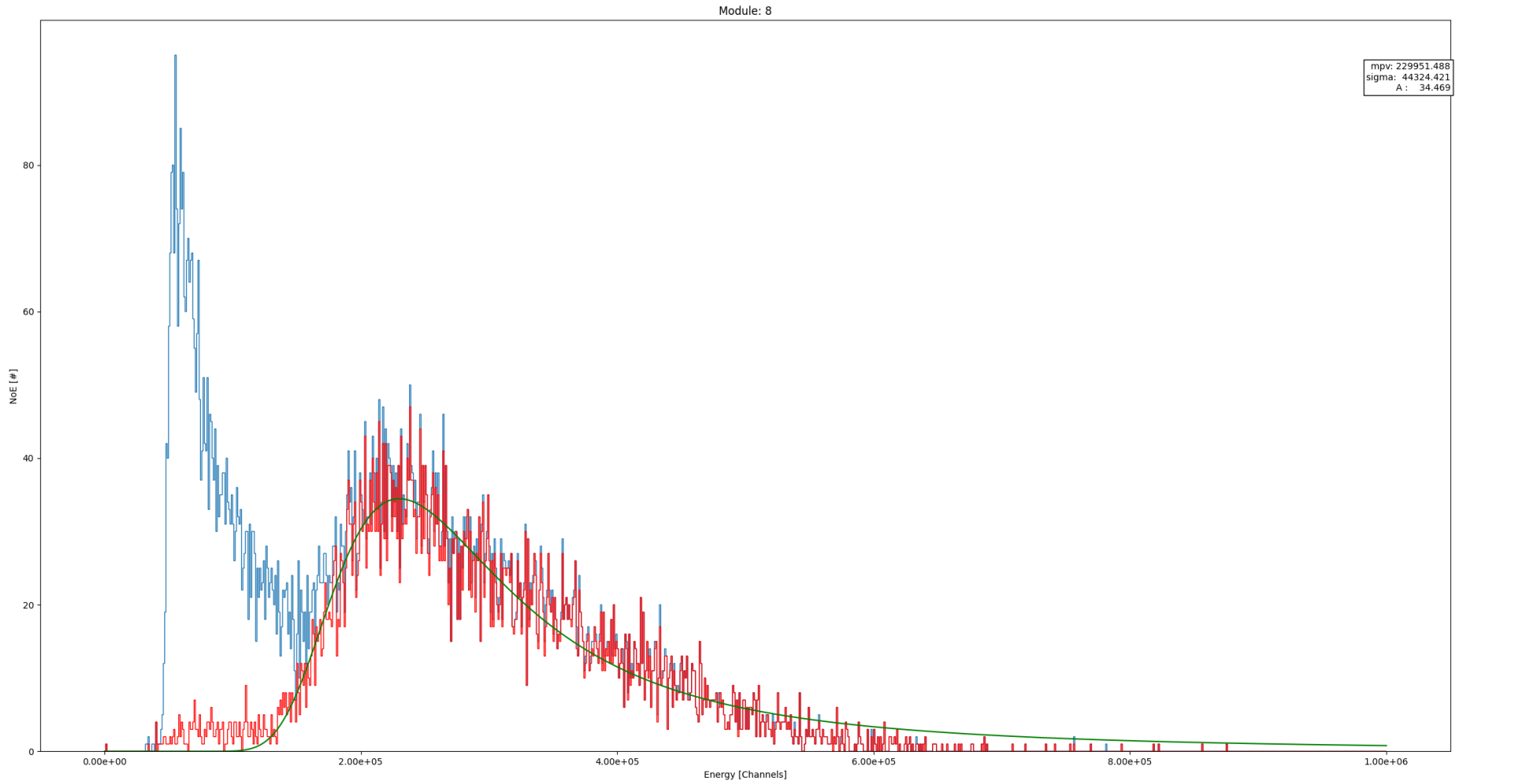
Applications

- measurement of muon flux at different locations
- comparison of muon flux at standard laboratory and bomb shelter (45 m w.e., 12 m of rock, soil, concrete wall) - 2 scintillators
- muon flux expected at the sea level- 1 muon/cm^2/min => 13.3 muons/scintillator (40 x 20 cm^2)
- experimentally measured- 12.5 muons/s
- underground measurement- 2.4 muons/s => 4.5 x suppression of muon flux in the bomb shelter (confirmed by measurement using HPGe detector)
- shift in the energy spectrum caused by the temperature dependence of silicon photomultipliers



Applications

- Fit of energy spectra



Conclusions

- Plastic scintillators have low energy resolution, but sufficient to distinguish muon peak from gamma background
- 1 muon/cm^2/min expected => 13.3 muons/scintillator
- energy deposition- 2 MeV/cm
- Coincidence among 3 scintillators (thickness of 1 cm)
- Update of electronics required