Ar mixture Garfield simulation

Alexey Boldyrev (Moscow SU)
Konstantin Vorobev (MEPhI)

TRT Days @ ATLAS ID Week

Motivation & Used software

Motivation.

(1) Our task belongs to detailed studies of Ar gas mixture for TRT usage. That involve electron transport properties for given gas mixture (drift velocity, diffusion, attachement coefficient, etc.) and signal simulation (thresholds, timings).

(2) e/π separation in Ar. Is it possible under TRT conditions?

Both (1) & (2) required comparison with well-known Xe mixtures.
Therefore we made simulations also with $Xe/CO_2/O_2$ mixtures.

Used software:

- **Garfield++** (rev. 330 → 337) for simulation of fields, signals and timing for TRT straw*;
- **Magboltz** (v. 9.0.1) for computing electron transport and avalanches in gas mixtures.

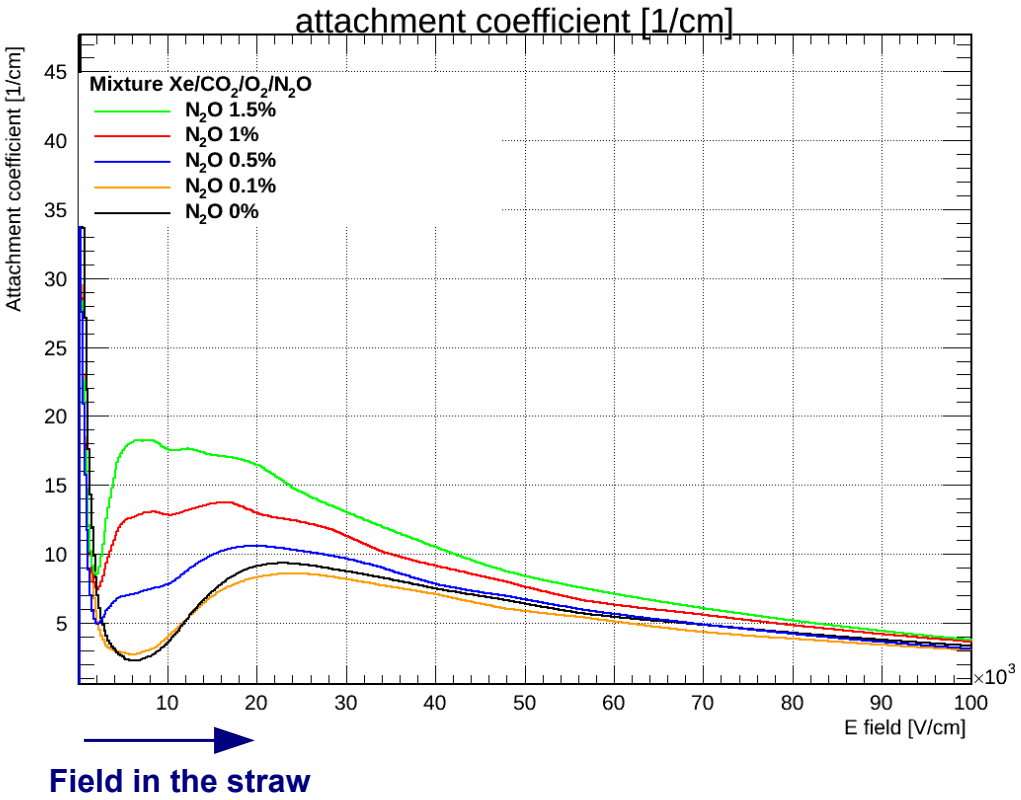
Previous talks on Garfield simulation: [1], [2], [3], [4], [5].

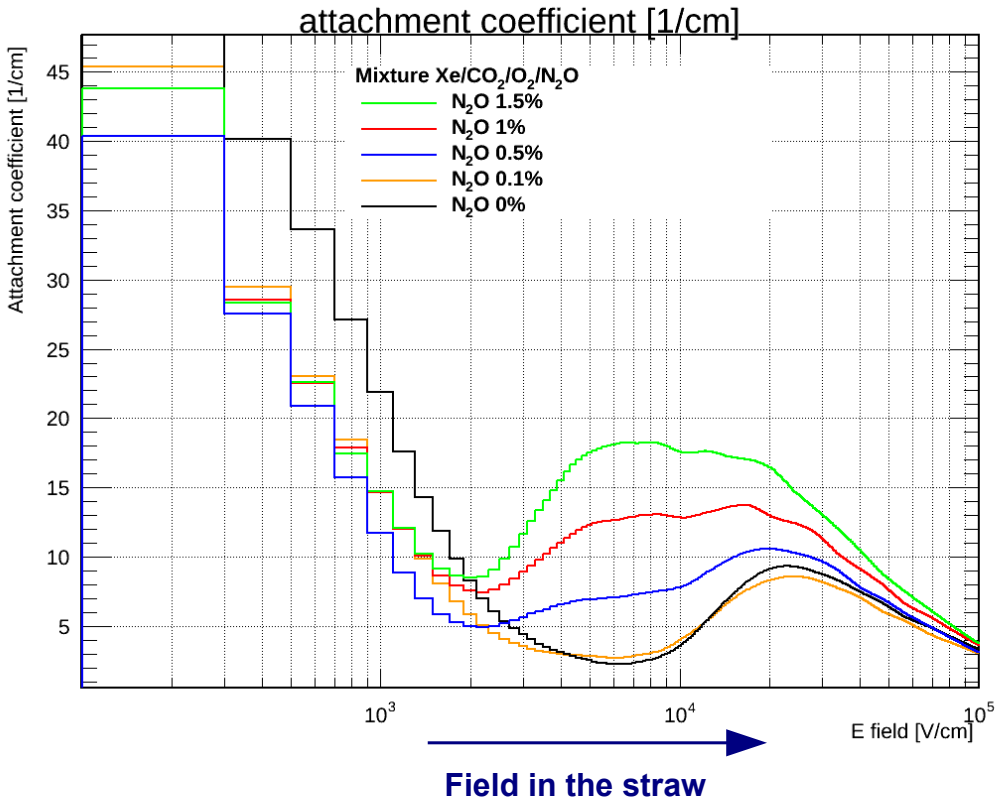
* Special thanks to Rob Veenhof & Heinrich Schindler for Garfield++ support and development.

Attachment coefficient vs E in Xe-based mixtures with N_2O

Electron transport properties of Ar mixtures are well-known.
Calculated V_{dr} and diffusion coefficients show good agreement with measurements.

Electron attachement are important for TRT gas system operation.
There are results of studies on attachement coefficient with regard to photoabsorption (one of the key features of Garfield++, that was not available in Garfield v.9).

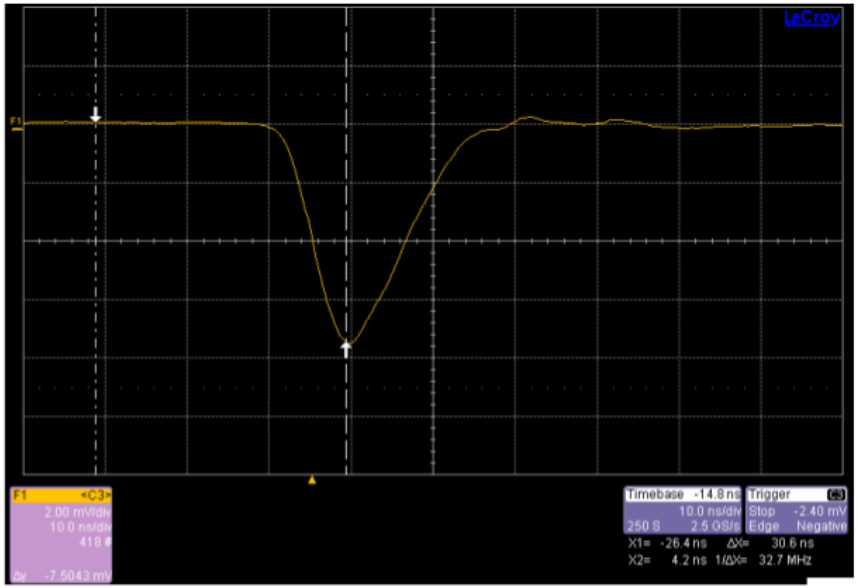




(Later N_2O-admixture was declined due to O_3 increasing).

Response for signal convolution (from Konstantin's studies)

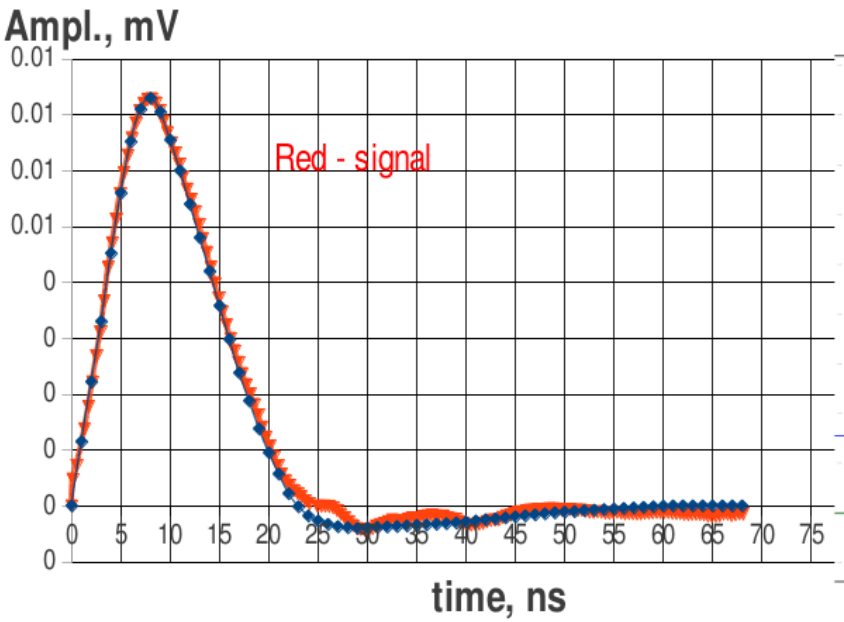
ASDBLR response from real prototype straw

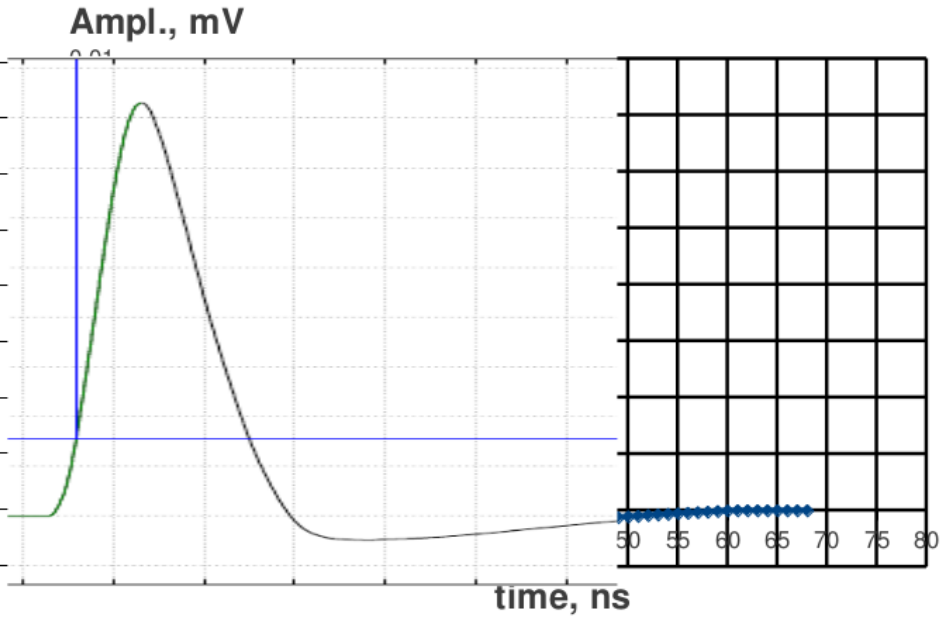


This is signal for Ar-Shaping
from ASDBLR
(line is average of signal)

Original source is Fe^55
for a signal of ~1keV in amplitude
with a 50 ohm resistor

Thank for help Ximo





Konstantin Vorobev, TRT Operations meeting: 18 March 2013

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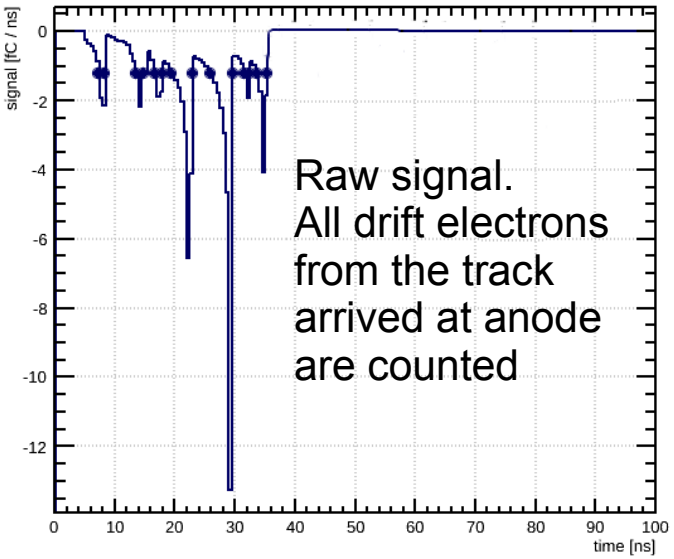
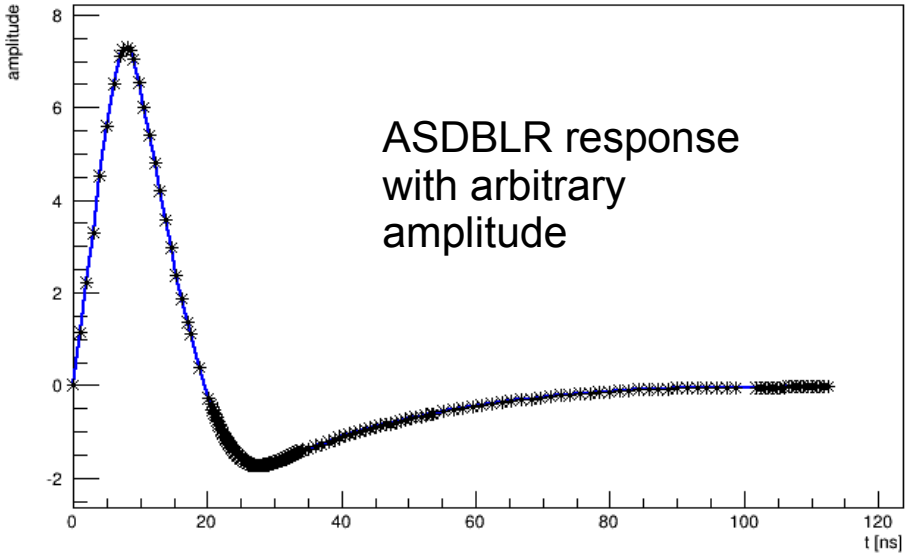
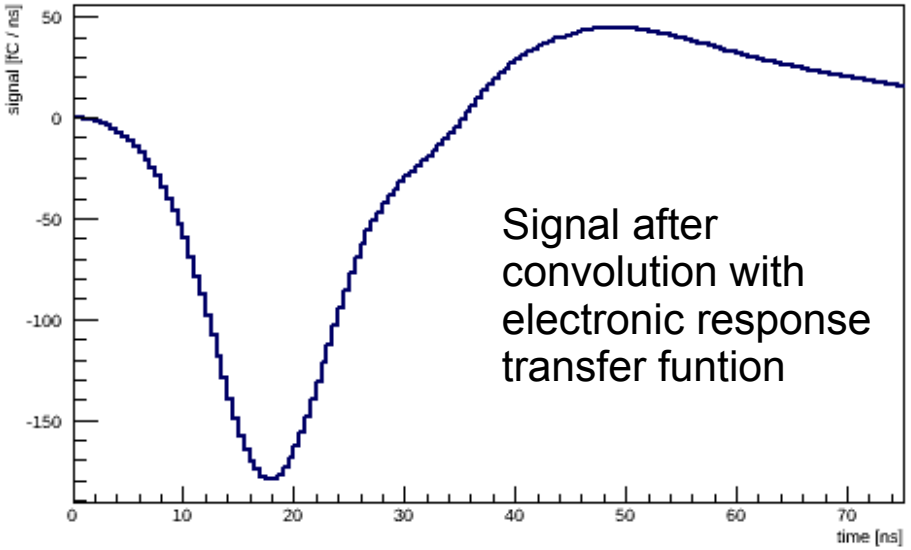
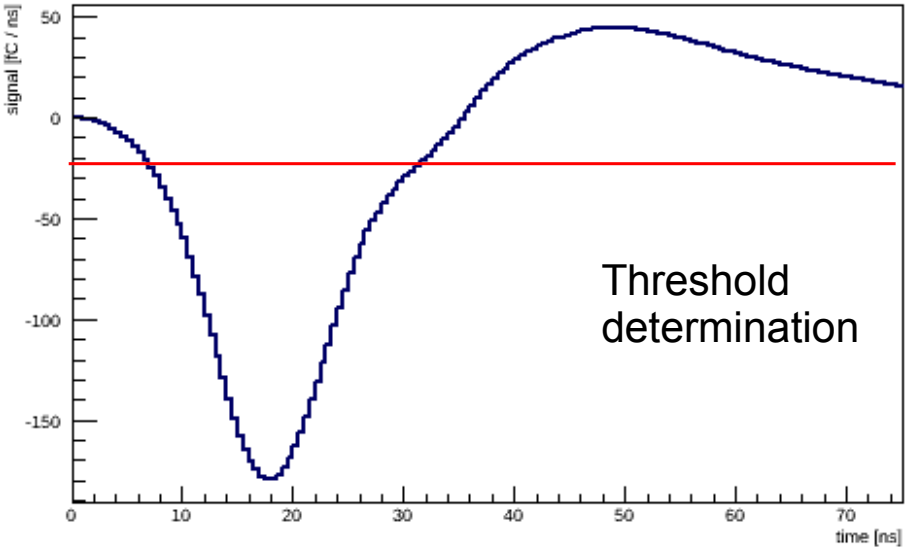
Signal simulation (step-by-step)









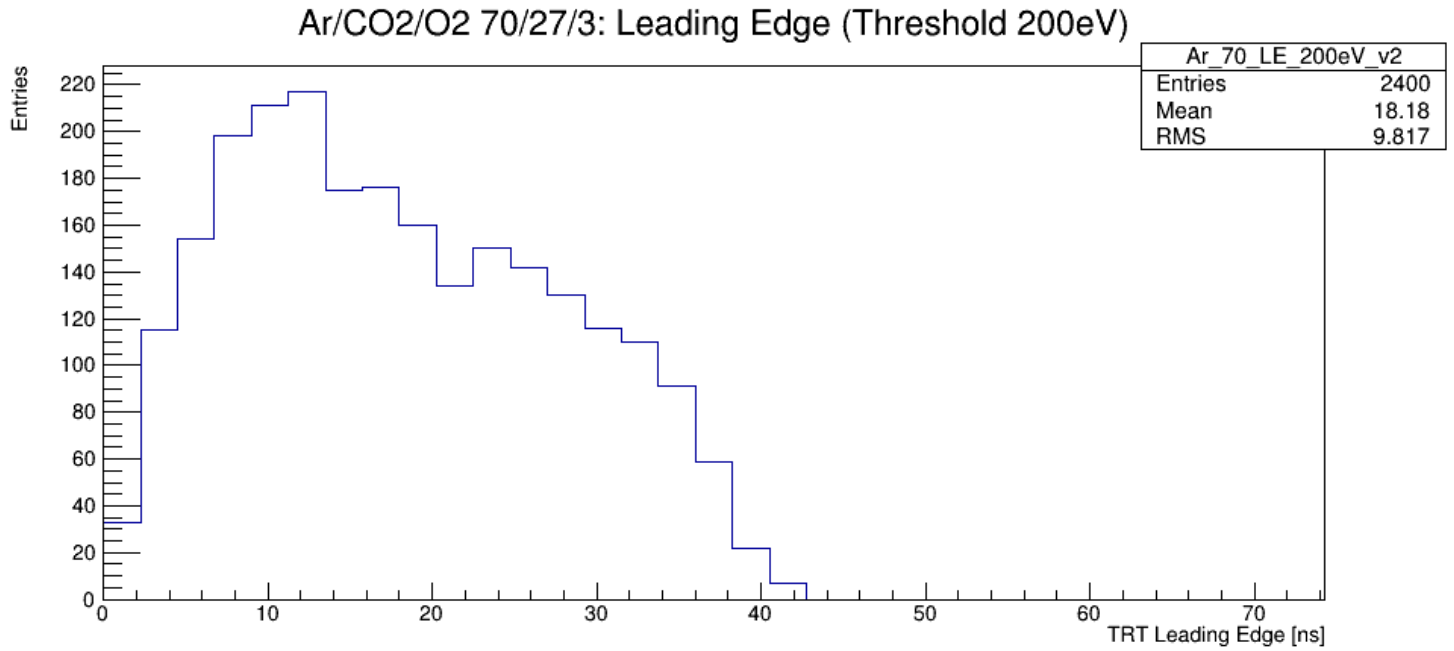
Threshold determination

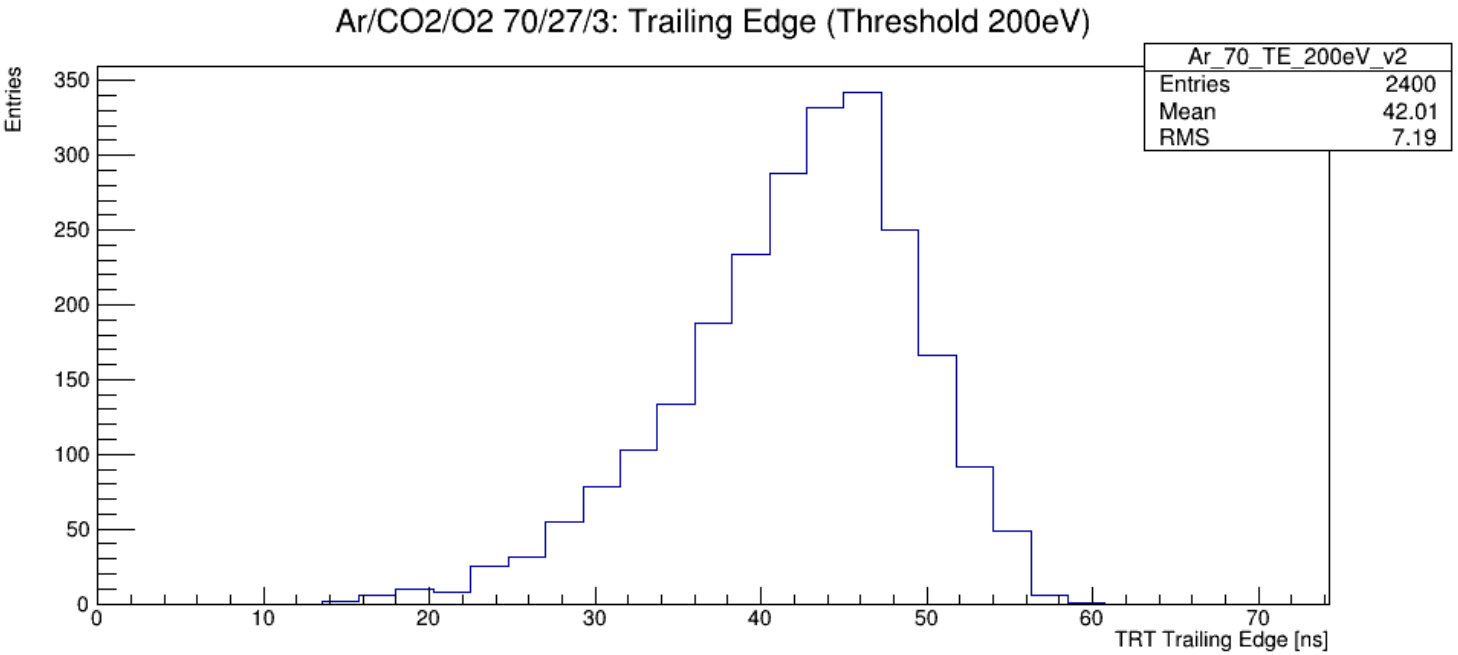
It turned out, that threshold determination in Garfield++ is nontrivial issue. Probably previous studies in Garfield v.9 with simulation signal of probe 1 keV electron were inaccurate.

We tried two methods for threshold determination:

- Energy loss calculations;
- Signal simulation with Xe-mixtures and its comparison with data (work in progress).

Leading edge and Trailing edge time distributions

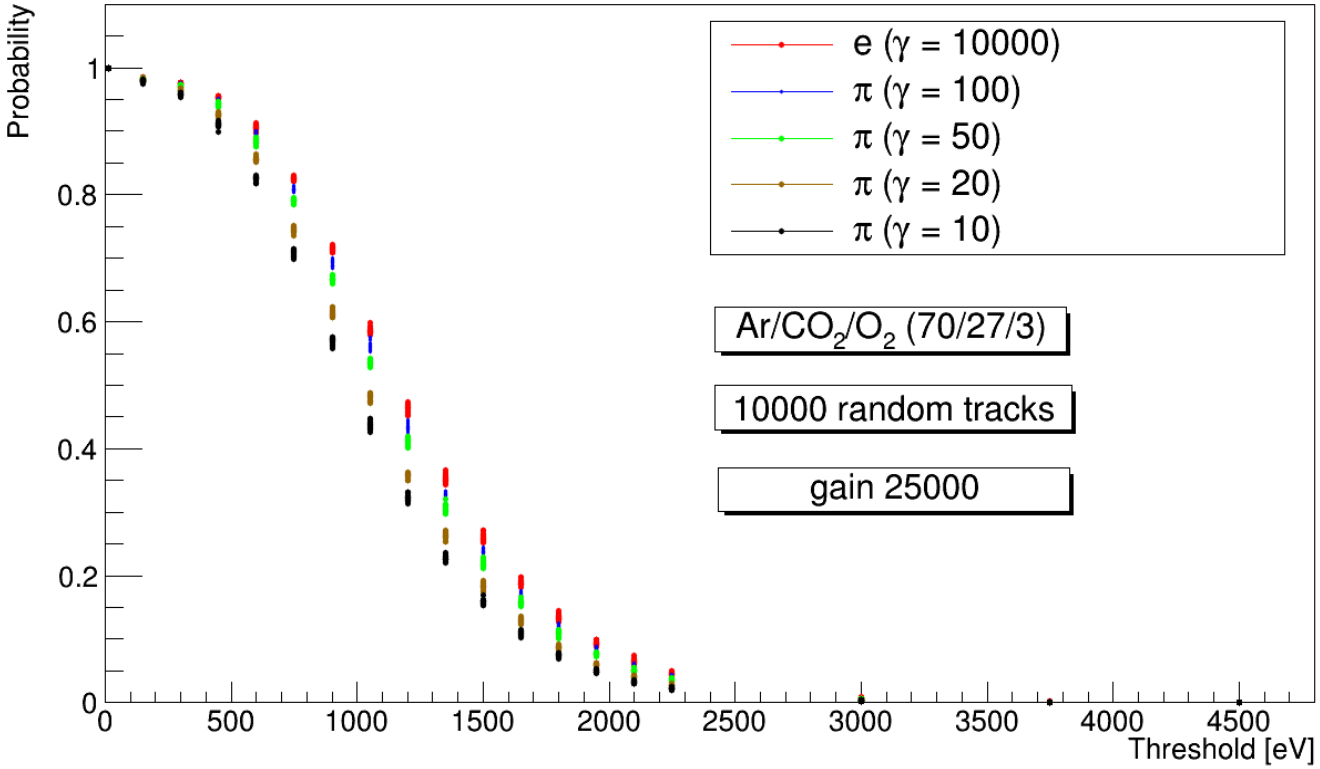


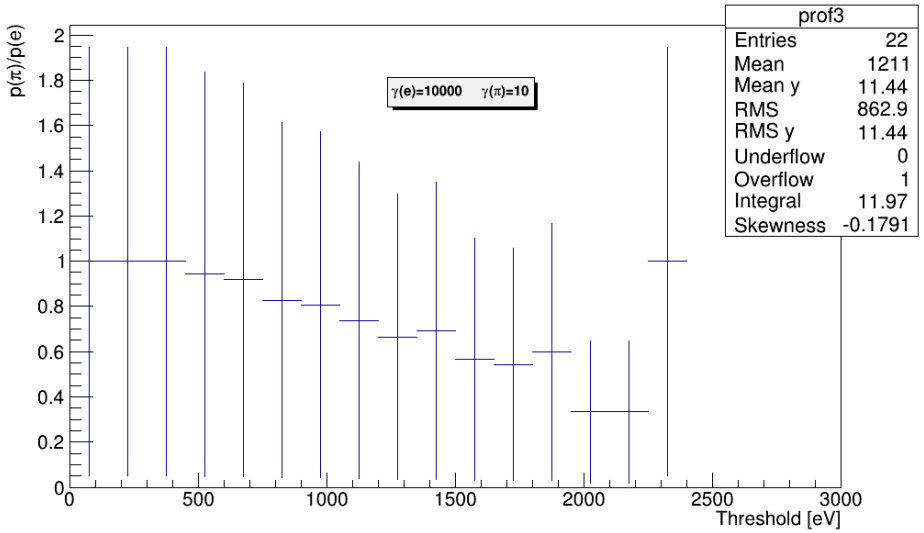


2400 tracks
π (γ = 100)

Threshold
200 eV

Possibilities to e/π separation in Ar





p(π)/p(e)

for π (γ = 10)

e (γ = 10000)

Conclusions

Migration to Garfield++ / Magboltz 9 & 10 software.

Generating the electron transport tables (required about 10 hours LXPLUS CPU time) for various gas mixtures: Ar/CO_2/O_2, Xe/CO_2/O_2(N_2O). Altogether 14 mixtures.

Calculating effects of N_2O admixture presence.

Tuning TRT Straw simulation parameters (e.g. operation voltages for given gain) and performing cross-check for timing information with data (for Xe simulations) and with previous Garfield v.9 calculations.

Signal simulations. Thresholds determination.

Collecting timing information: Leading & Trailing edge distributions.

Future plans:

Possibilities to e/π separation in Ar. Comparison with Xe simulation.

Backup slides

Drift velocity for $Xe/CO_2/O_2/(N_2O)$.