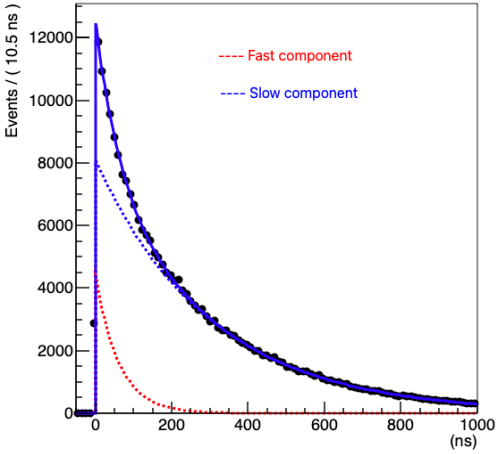
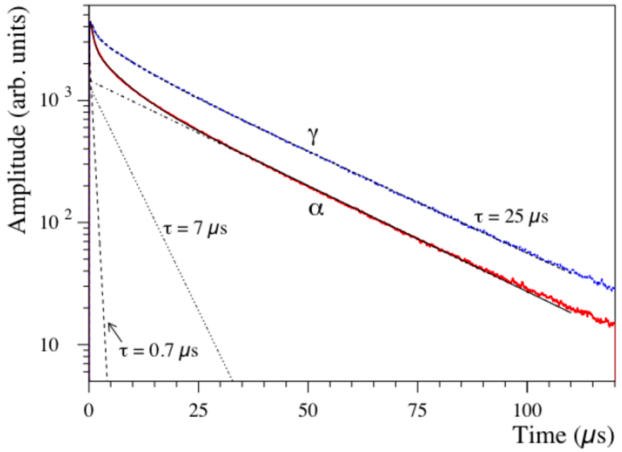
Considering more complicated cases

- Previous toy:
  - Only 2 two components, the fit to time and fast fraction can reach to a good precision.
  - What about more complicated case?
    - ZnWO4: 3 components for EM and hadron/ion
    - Pion: ~54% EM + ~46% Hadronic





Type of irradiation	Decay constants, μs		
	τ_1 (A_1)	τ_2 (A_2)	τ_3 (A_3)
γ ray	0.7 (2%)	7.5 (9%)	25.9 (89%)
α particles	0.7 (4%)	5.6 (16%)	24.8 (80%)

π^+ cascade initial information

Particle	e^-	e^+	γ	π^-	π^+	p
Mean, %	38.7	13.0	2.0	4.9	11.2	22.9
RMS, %	8.1	5.5	0.5	3.7	11.6	10.3

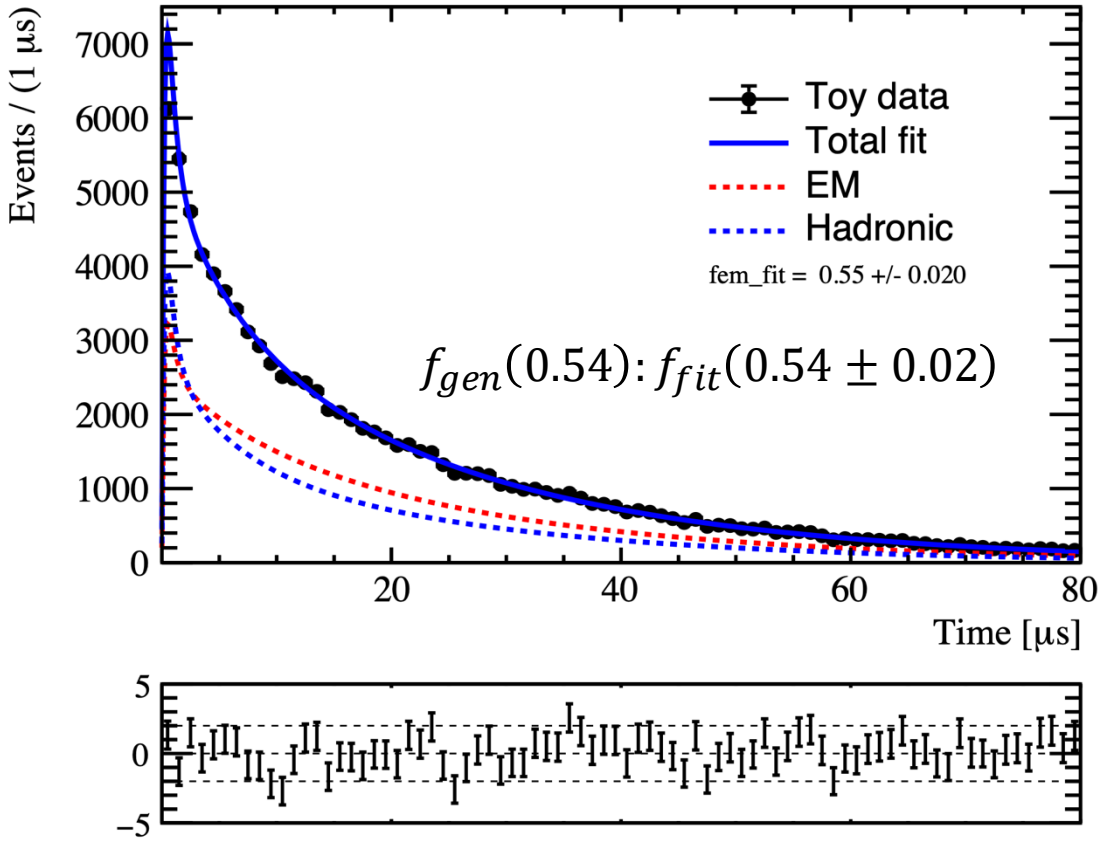
Particle	n	D	T	α	nuclei	Total
Mean, %	0.8	1.8	0.3	0.8	2.5	98.9
RMS, %	0.4	1.7	0.5	0.5	1.4	

Average energy deposit contribution fraction per particle

- Only particles experienced more than 500 steps are considered;
- The deposits can further be split into the 2 components:
  - Electromagnetic [e^-, e^+, γ] - on average 53.7% of the total energy;
  - Hadronic [all the rest] - on average 46.2% of the total energy;

Generate new toys based on the pion+

- Toy settings:
  - 10000 PE/GeV, 10 GeV pion+
  - Time constants and fraction:
    - 54% with parameters from gamma ray
    - 46% with parameters from alpha
  - Fitting:
    - The time shape parameters are fixed.
    - The fraction of EM part (54% in truth) is float



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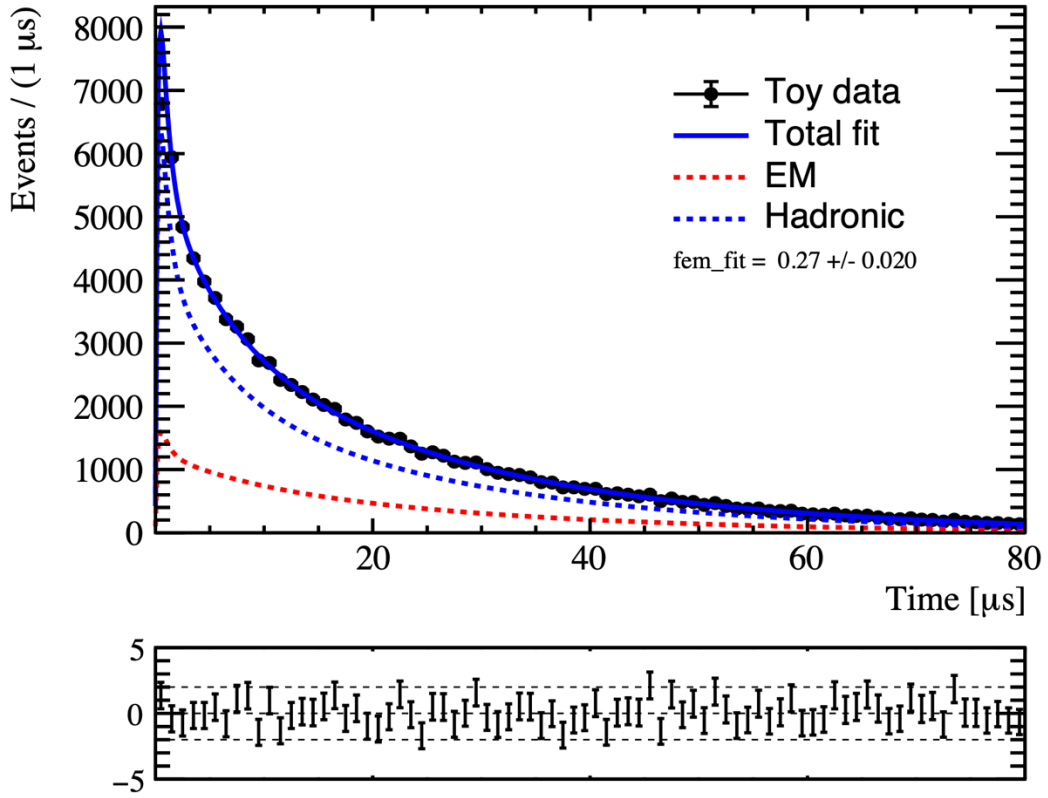
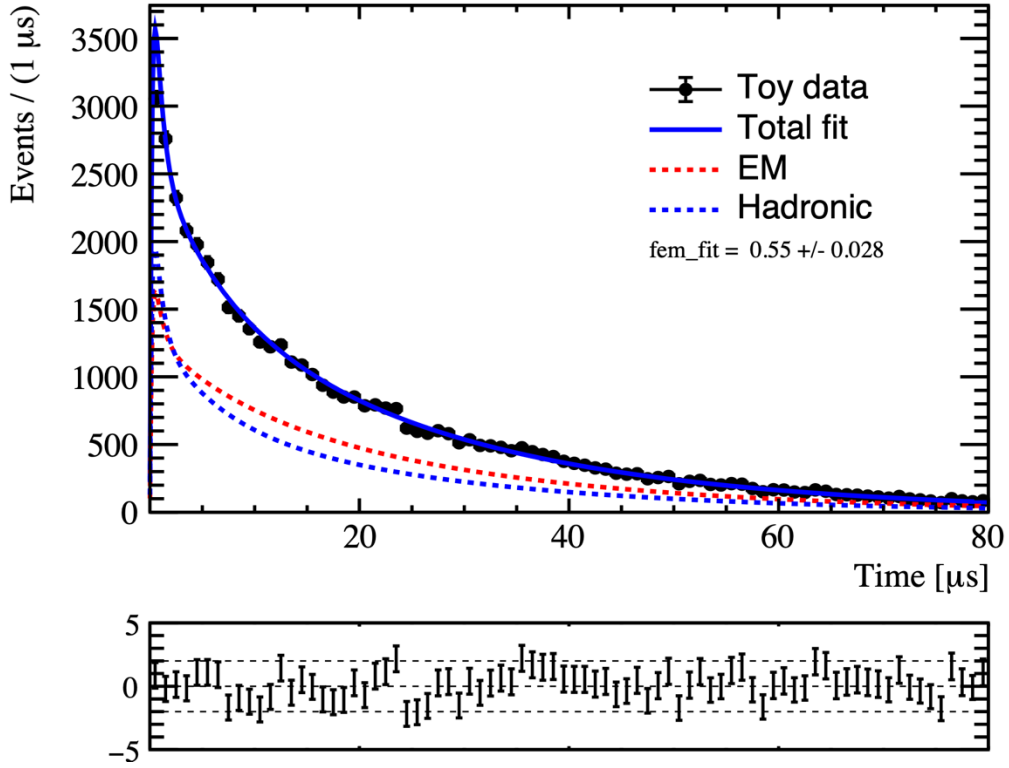
Other cases

- With lower EM fraction:
  - 25%, 10 GeV
  - f_EM from fit: 0.25 +/- 0.02



- With lower energy :
  - 54%, 5 GeV
  - f_EM from fit: 0.55 +/- 0.03

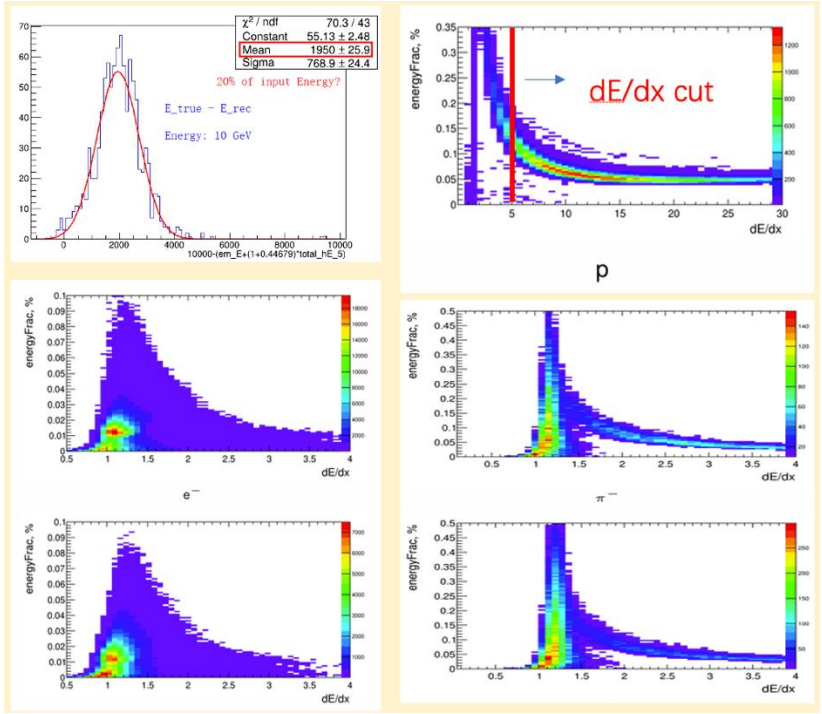


Simulation with Geant4

- Basic settings
  - Geometry: 0.04m * 0.04m * 0.08m
  - Material: ZnWO4
  - OpticalProperty: assuming proton and other ions have same parameters as alpha

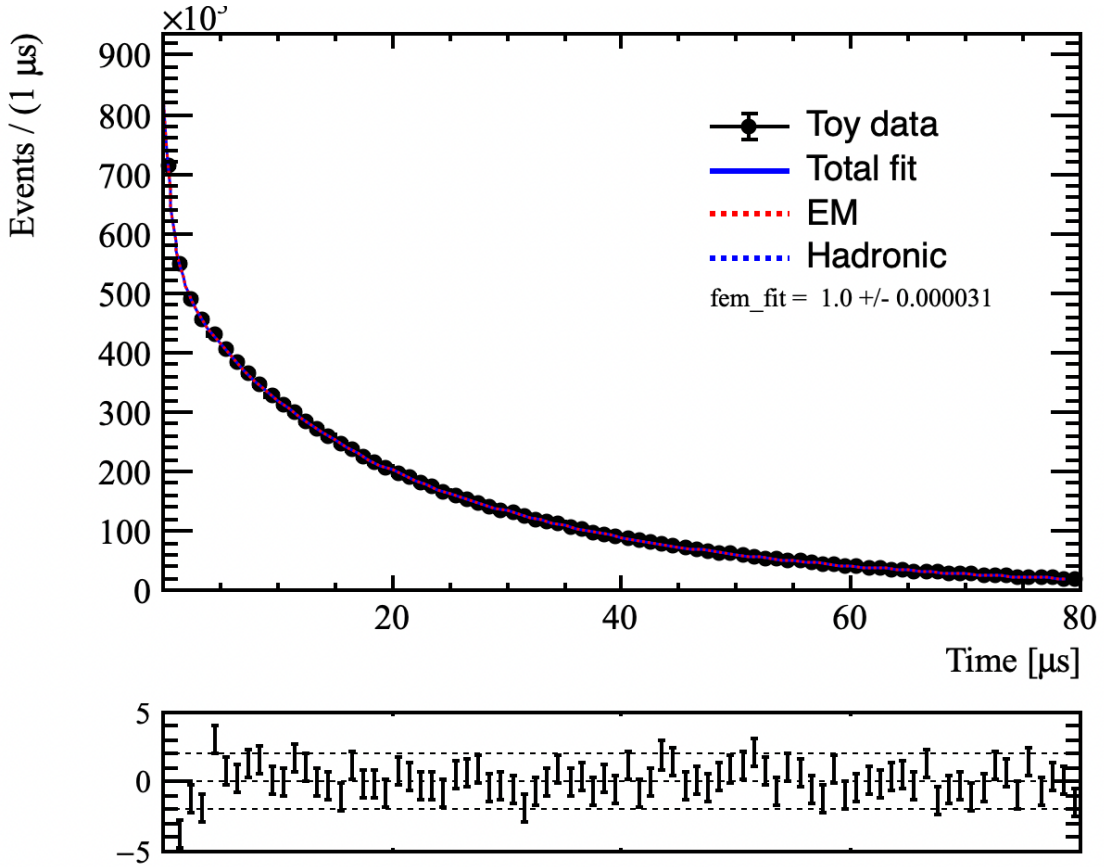
Type of irradiation	Decay constants, μs		
	τ_1 (A_1)	τ_2 (A_2)	τ_3 (A_3)
γ ray	0.7 (2%)	7.5 (9%)	25.9 (89%)
α particles	0.7 (4%)	5.6 (16%)	24.8 (80%)

  - When de/dx < 5 (EM)
    - All particles follows the same parameters as photon



The decay time

- The geometry might be too small for the 10 GeV pi+



Missing physics processes..
☹

Updating…

f_EM and its uncertainty from 500 toy