# Status Report v.1.2

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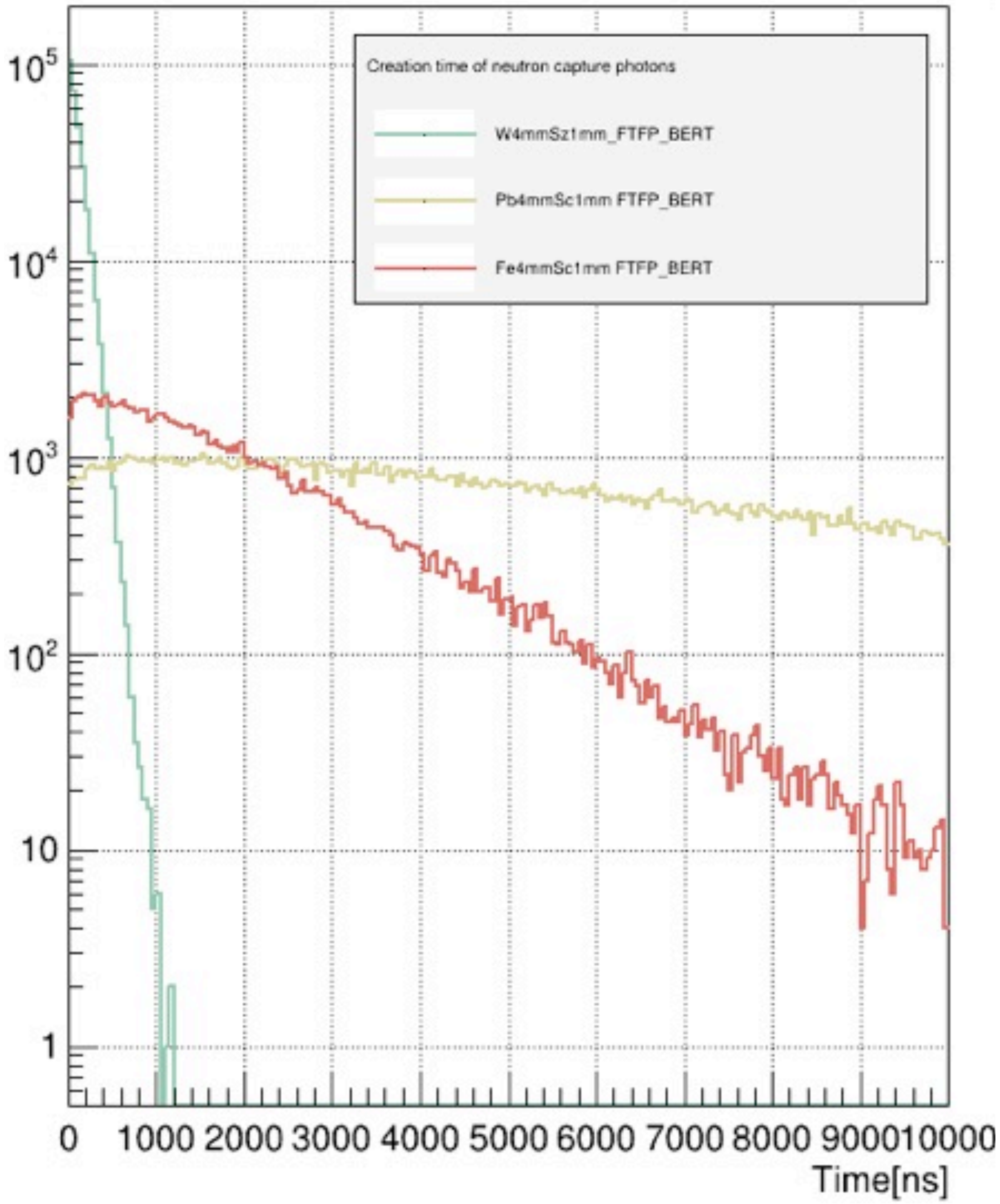
# Creation time of neutron capture photons in absorber



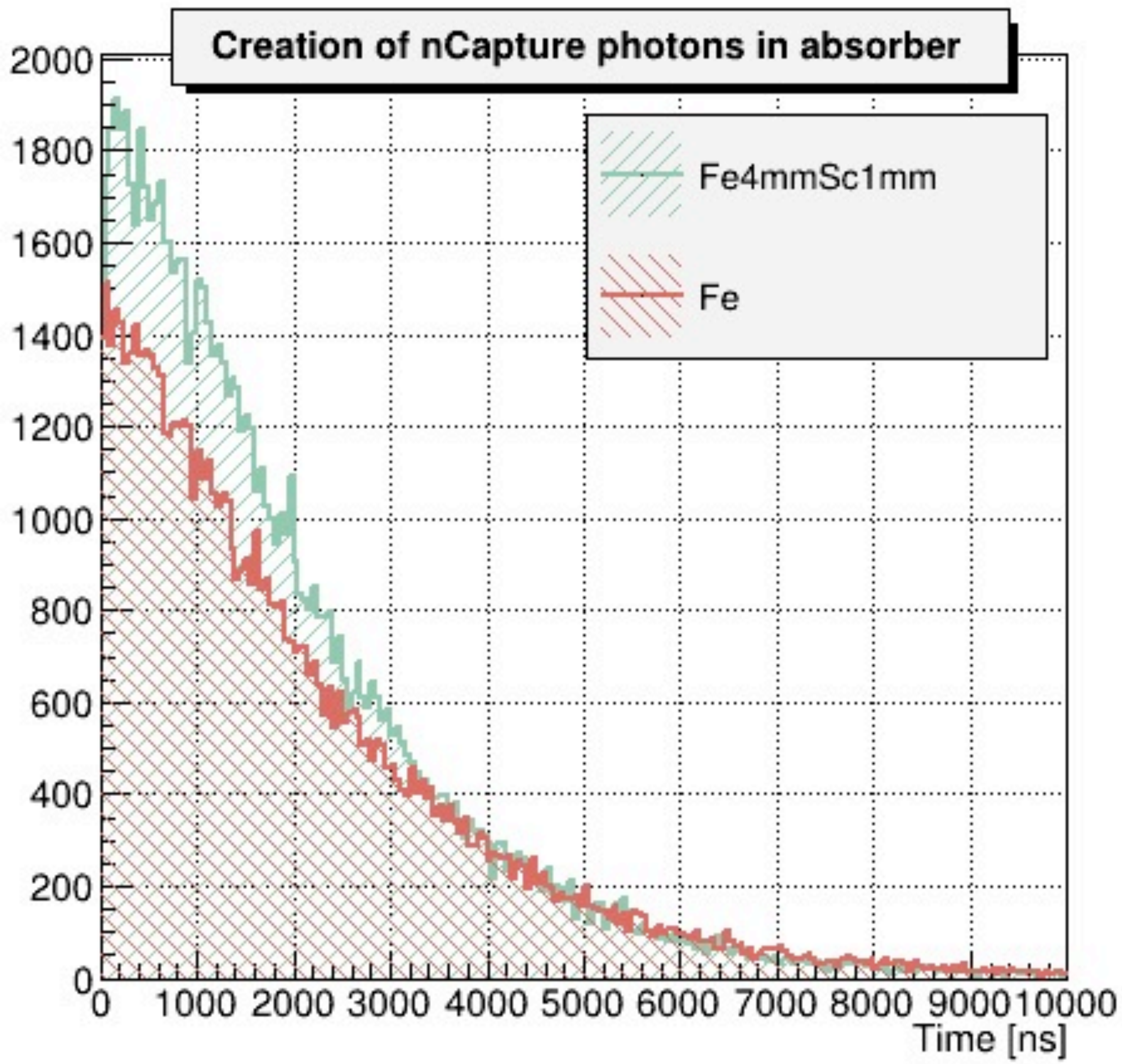

| For neutrons 2200 m/s | Neutron cross section (barn) | Density (g/cm3) |
|---|---|---|
| W | 18.4 | 19.25 |
| Pb | 0.171 | 11.34 |
| Fe | 2.56 | 7.874 |
| F | 0.0096 | 1.696 g/l |

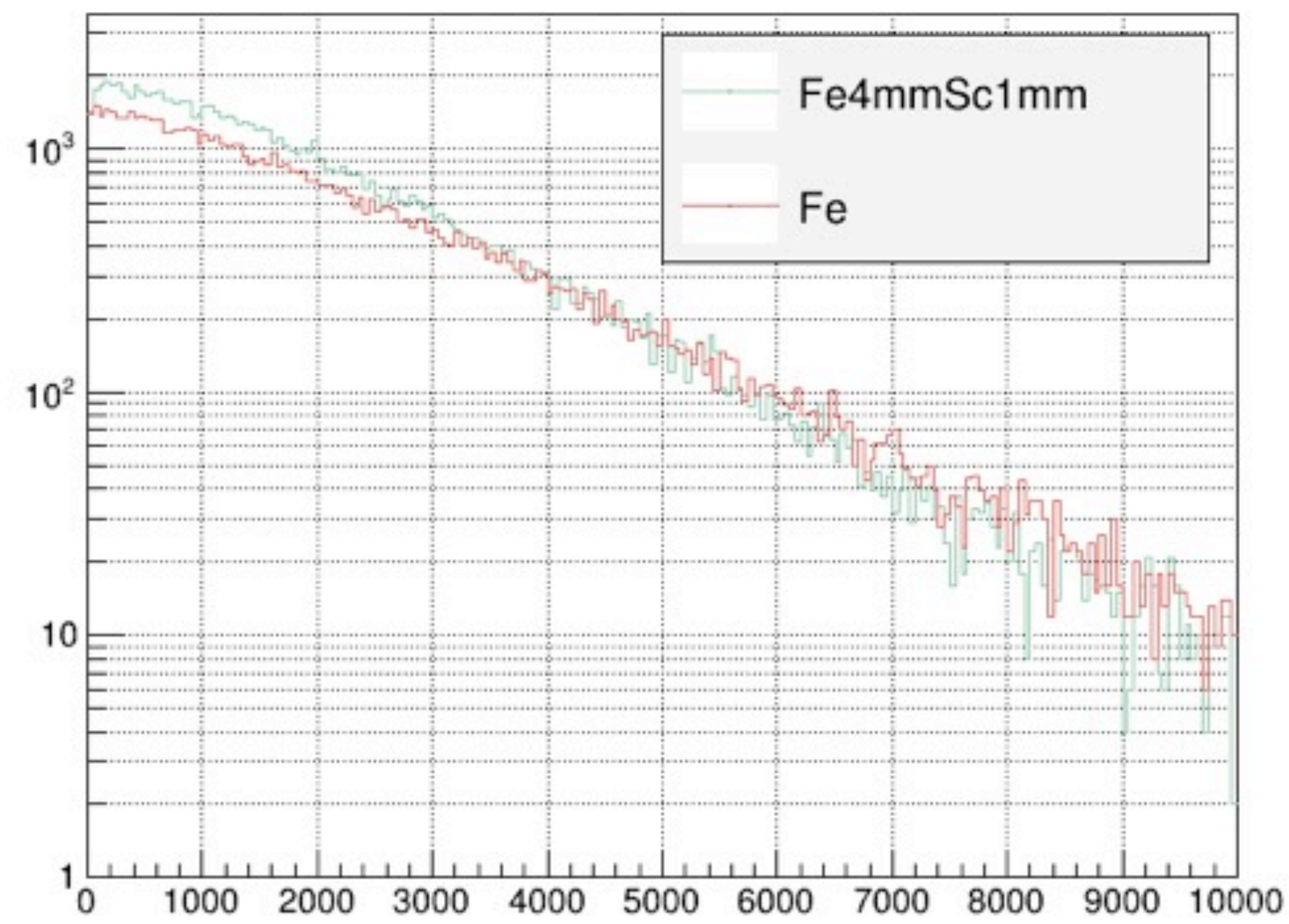
| | # entries (photons) |
|---|---|
| W4mmSc1mm | 297,712 |
| Pb4mmSc1mm | 56,572 |
| Fe4mmSc1mm | 88,971 |

It takes longer for neutrons to thermalize in Pb as compared to Fe, and W (where this process is prompt).

- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

# Creation time of neutron capture photons in absorber



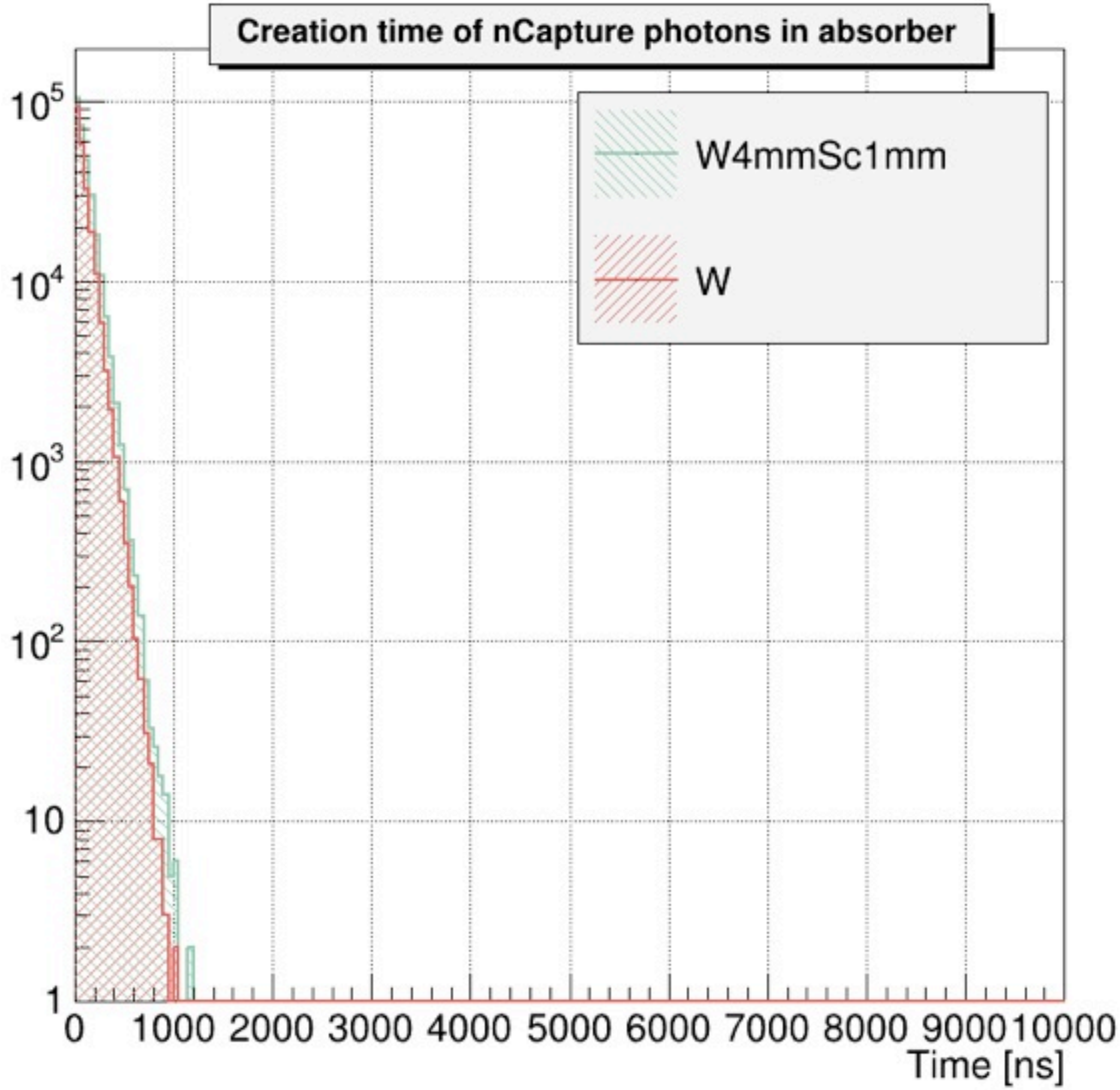




We see a 16.86% enhancement in the production of photons from neutron capture when adding plastic as active material.

| | # entries |
|---|---|
| Fe + Sc | 88,971 |
| Fe | 73,973 |

- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

# Creation time of neutron capture photons in absorber

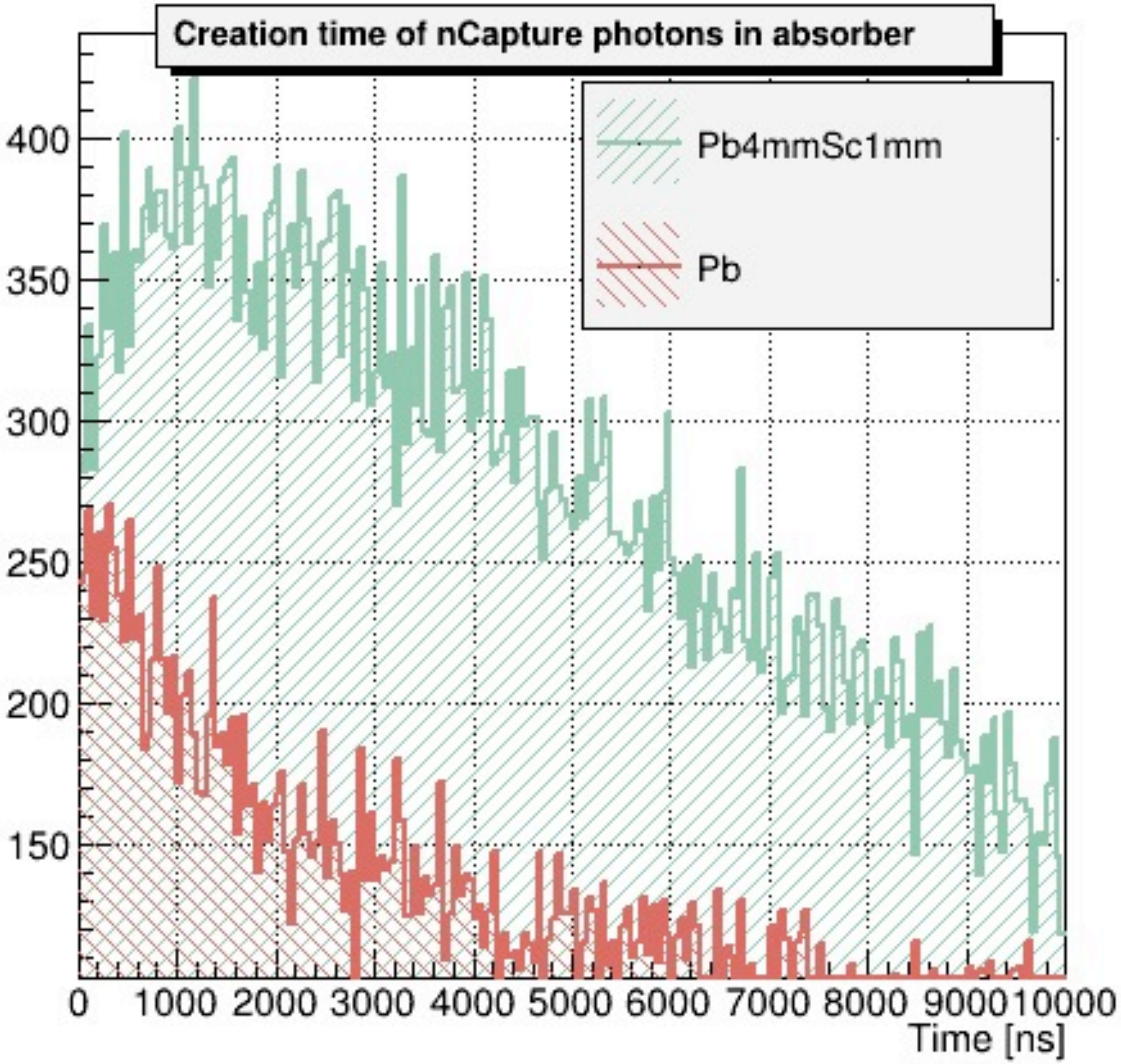



| | # entries |
|---|---|
| W + Sc | 297,712 |
| W | 227, 207 |

We see a 23.68% enhancement in the production of photons from neutron capture when adding plastic as active material.

- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

# Creation time of neutron capture photons in absorber

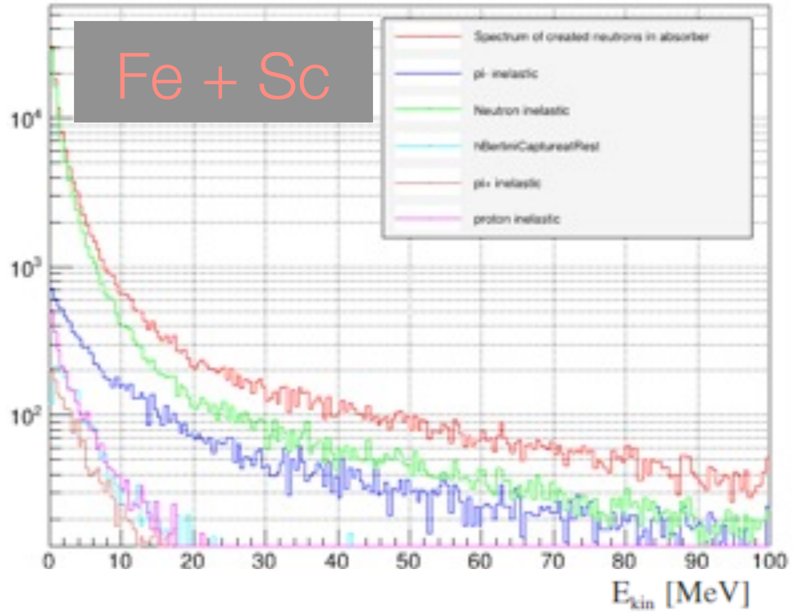


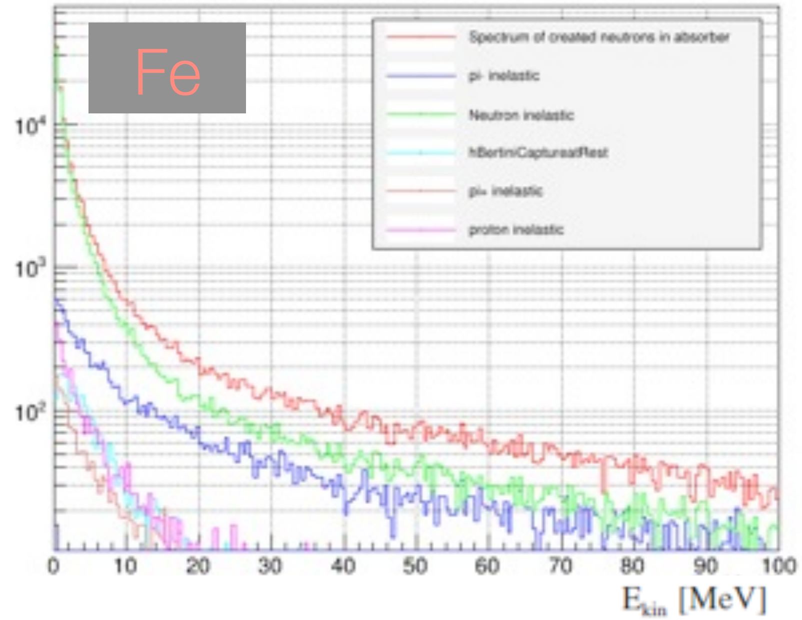

| | # entries |
|---|---|
| Pb | 26,523 |
| Pb4mmSc1mm | 56,572 |

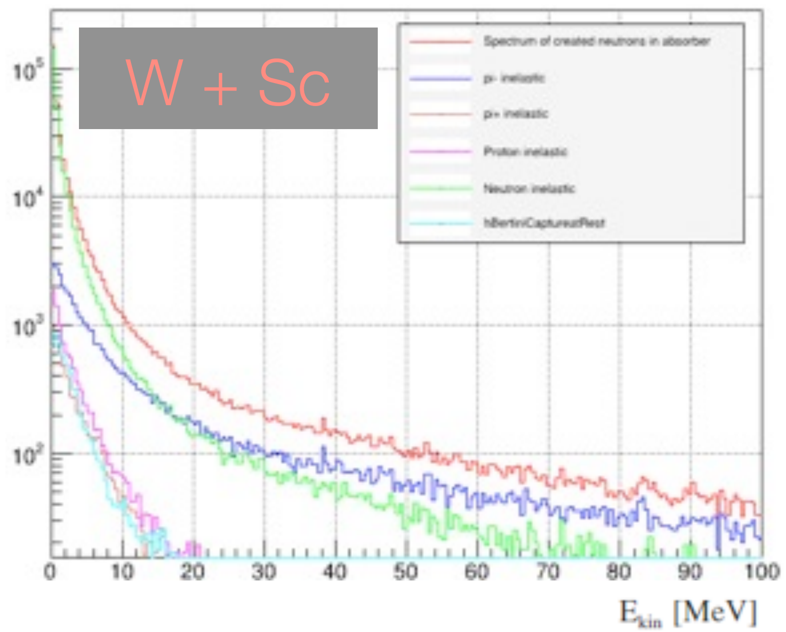
We see a 53.11% enhancement in the production of photons from neutron capture when adding plastic as active material.

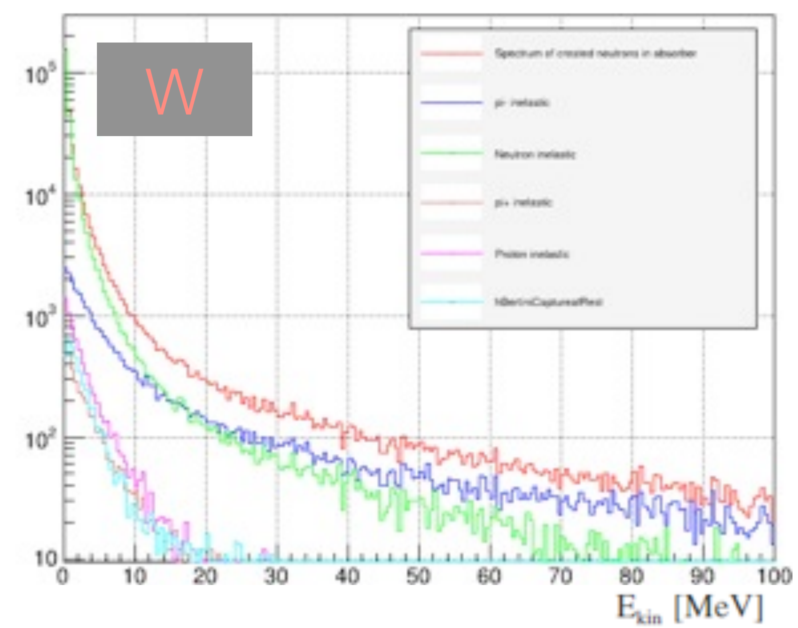
Huge difference when compared to W and Fe!

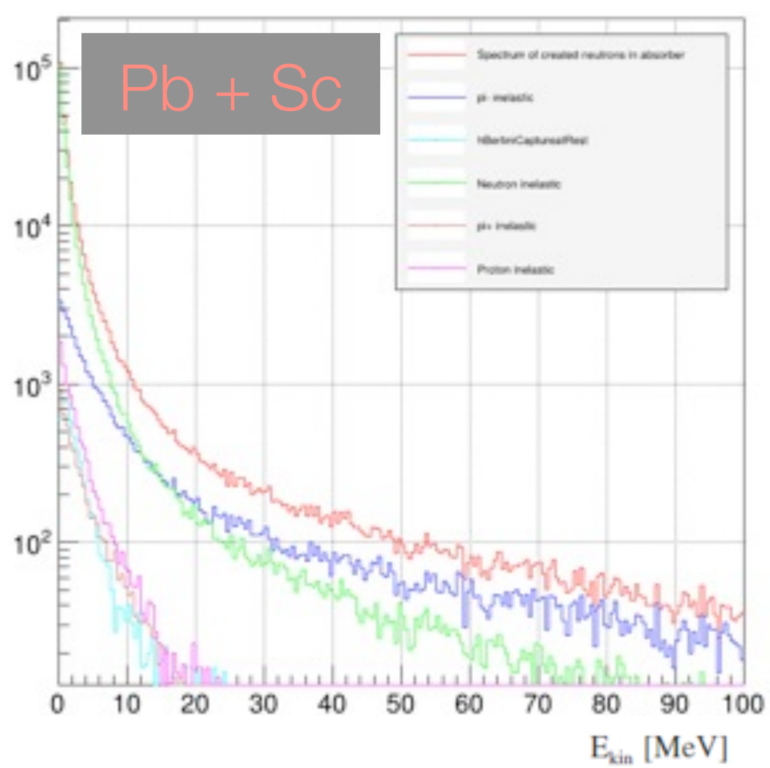
- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

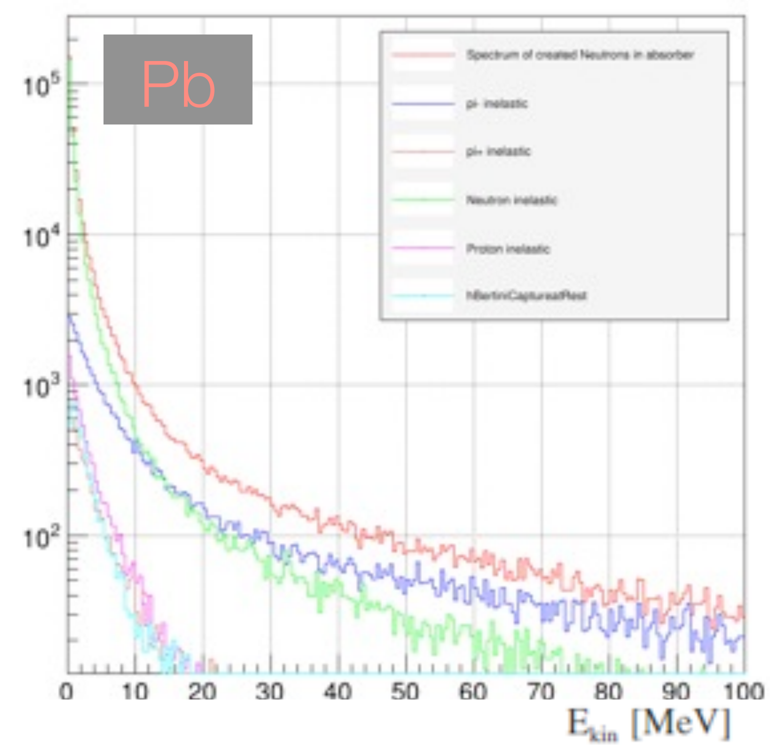


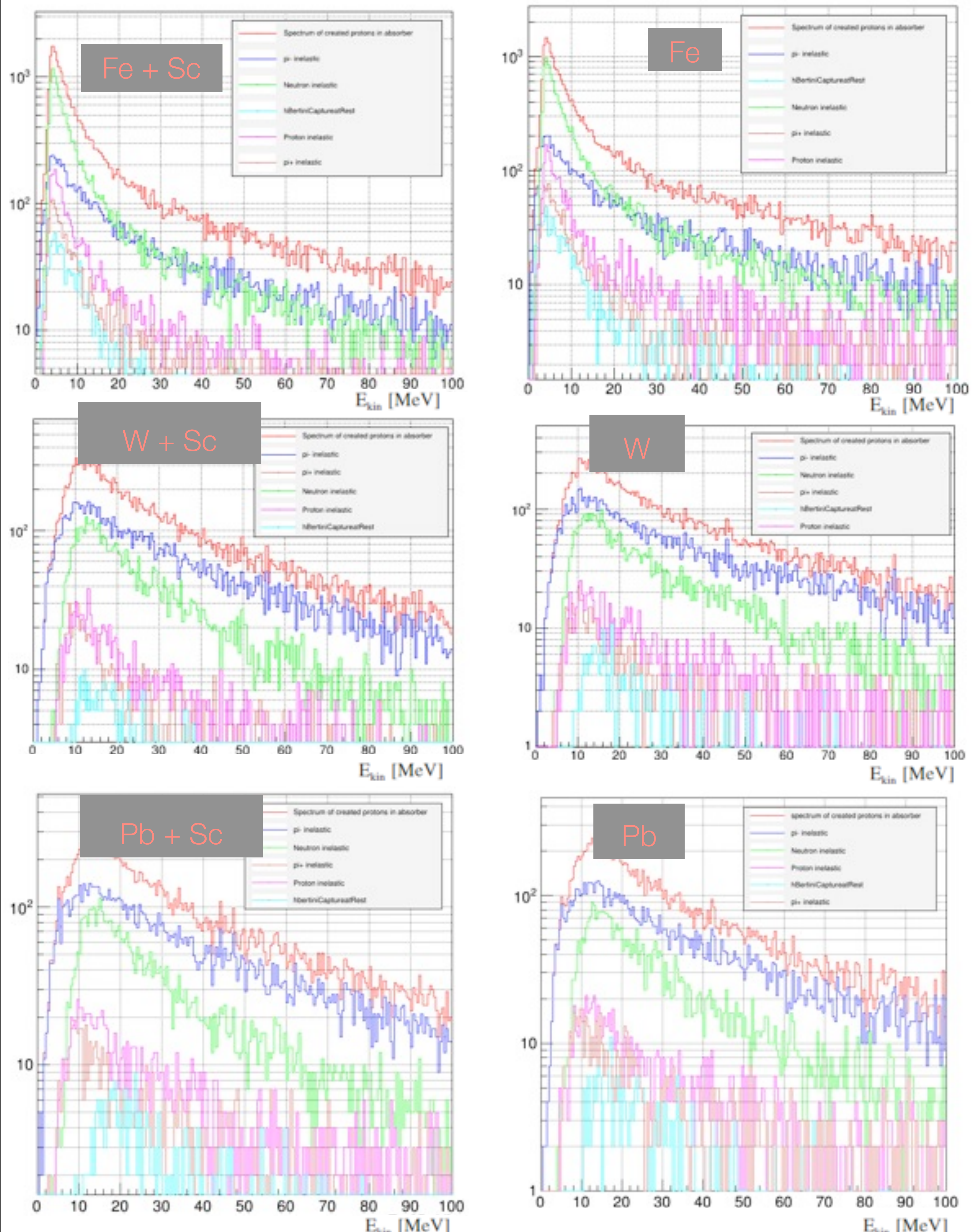

# Spectrum of created neutrons in absorber (by creation process)

➡ Easier to produce faster neutrons in Fe!

➡ At low momentum, cross section for neutron inelastic processes is very high.

- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

# Spectrum of created protons in absorber (by creation process)

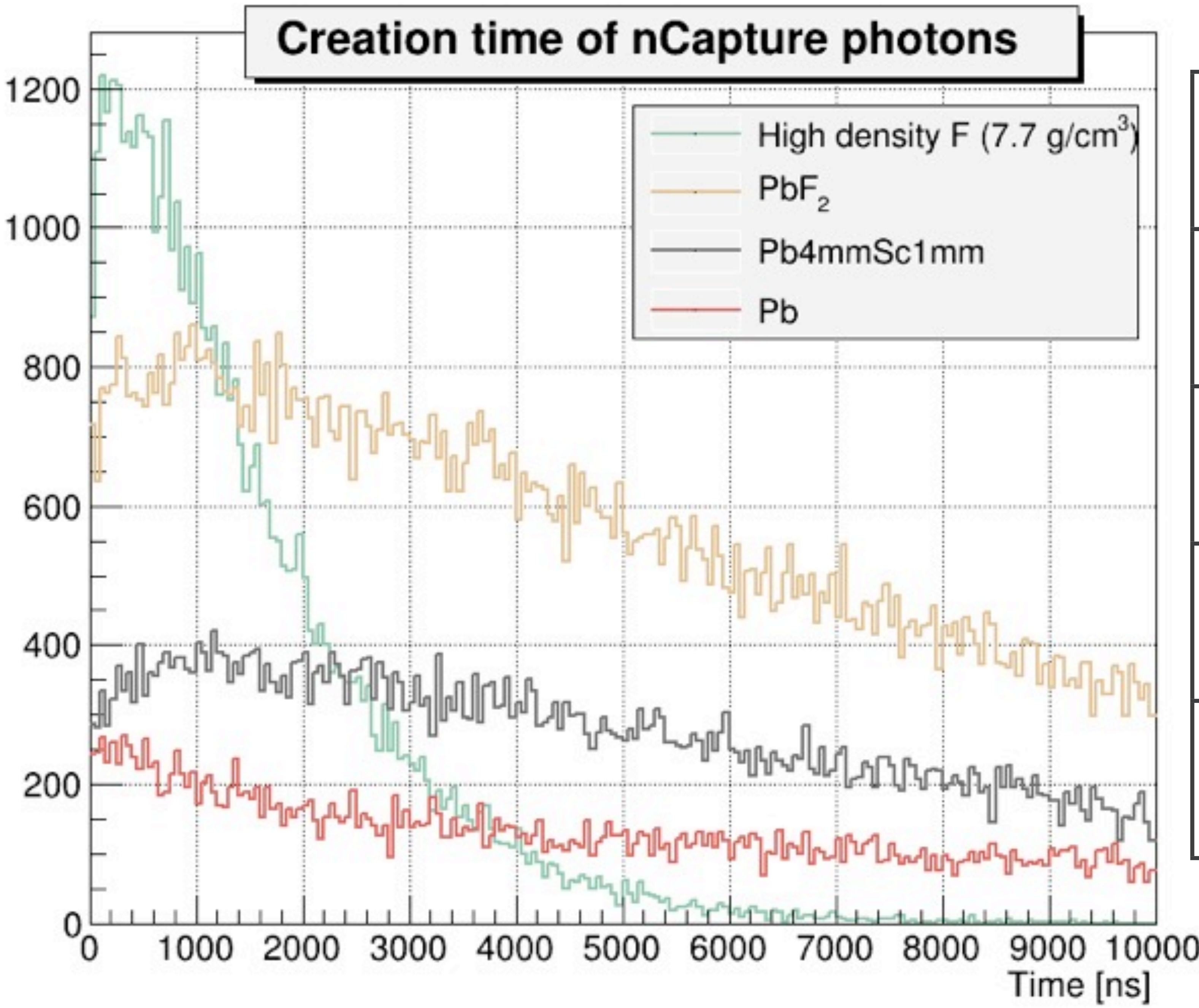



➡ Most of the protons created in Fe are result of neutron inelastic processes.

➡ Most of protons created in Pb and W are result of pi- inelastic processes.

- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

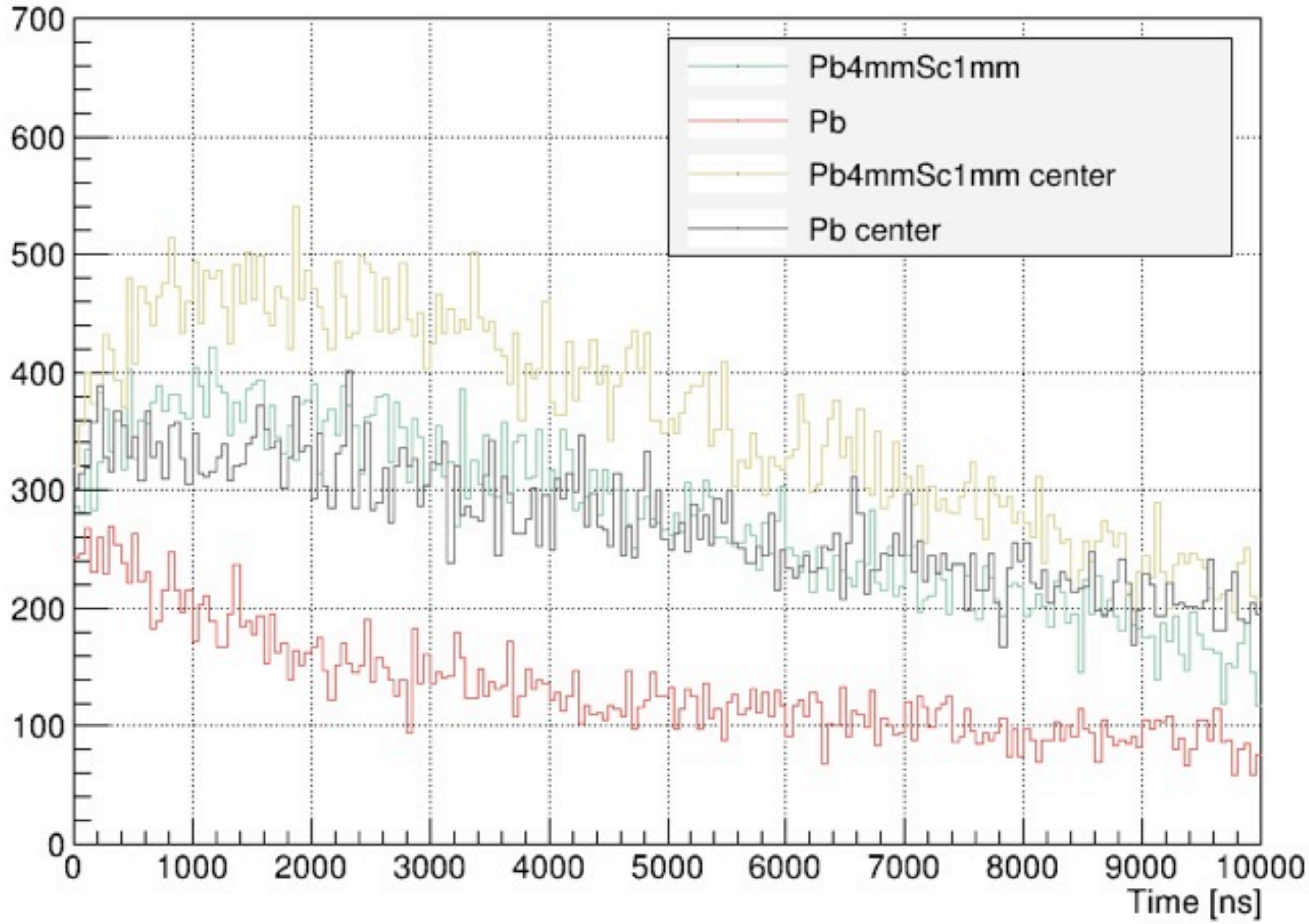
# Creation time of neutron capture photons




| Material | # of photons (in 1000 evts.) |
|---|---|
| Pb | 26,523 |
| Pb4mmSc1mm | 56,572 |
| F | 47,769 |
| PbF2 | 115,807 |

- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

# Creation time of neutron capture photons

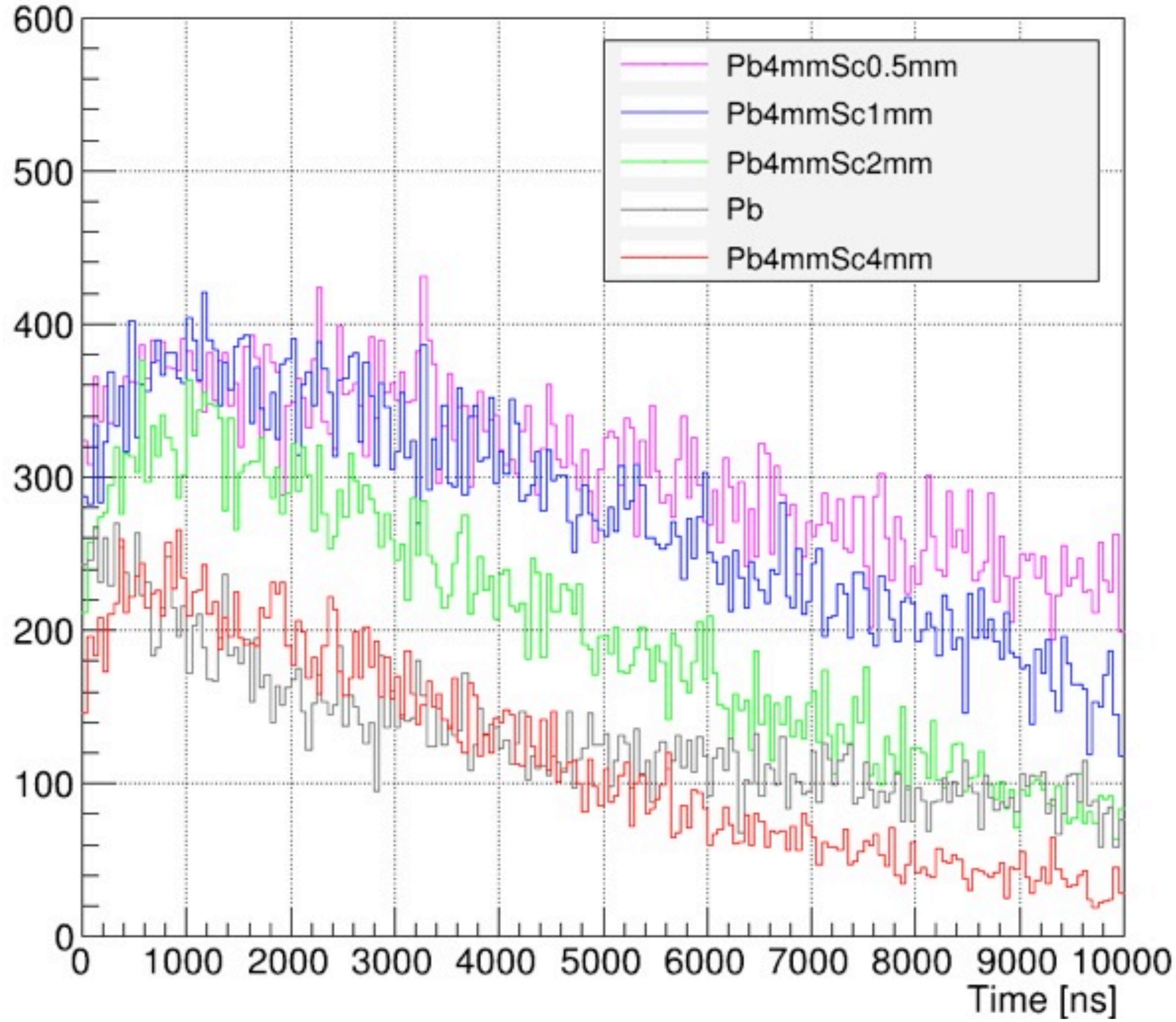



| Material | # of photons (in 1000 evts.) |
|---|---|
| Pb | 26,523 |
| Pb4mmSc1mm | 56,572 |
| Pb (center) | 54,488 |
| Pb4mmSc1mm (center) | 73,964 |

- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list
- Particle gun at front end or center of calorimeter

# Creation time of neutron capture photons

| Material | # of photons (in 1000 evts.) |
| --- | --- |
| Pb | 26,523 |
| Pb4mmSc0.5mm | 62,542 |
| Pb4mmSc1mm | 56,572 |
| Pb4mmSc2mm | 41,036 |
| Pb4mmSc4mm | 23,879 |




- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

# Number of created protons and neutrons in 1000 evts.

| | # created neutrons/ 1000 | # created protons/ 1000 | # neutrons/ protons |
|---|---|---|---|
| Fe4mmSc1mm | 130,213 | 33,876 | 1.46 |
| Fe | 124,436 | 28,083 | 1.68 |
| W4mmSc1mm | 361,902 | 22,356 | 1.21 |
| W | 330,686 | 17,558 | 1.45 |
| Pb4mmSc1mm | 311,158 | 20,765 | 5.50 |
| Pb | 336,583 | 17,504 | 12.69 |
| PbF2 | 224,835 | 19,736 | 1.94 |
| F(7.7g/cm3) | 55,010 | 24,177 | 1.15 |
| Pb4mmSc1mm (center) | 331,425 | 21,270 | 4.48 |
| Pb (center) | 365,674 | 17,606 | 6.71 |
| Pb4mmSc2mm | 274,104 | 20,151 | 6.68 |
| Pb4mmSc0.5mm | 341,628 | 21,496 | 5.46 |
| Pb4mmSc4mm | 229,965 | 18,865 | 9,63 |

- 5 GeV incident pi-
- 1000 events
- FTFP_BERT Physics list

# Summary

- We confirmed leakage from the front-end of the calorimeter volume. We observe 23.5% more photons created in neutron capture processes for the case of plastic and lead calorimeter and 51.3% for the case of pure lead. This can also be seen from the ratio of created neutrons to the number of photons created by neutron capture, this ratio differs by a factor of two for the case of pure lead.

- We observed a trend for scintillator improving containment for the three simulated materials. This can be explained in terms of the neutrons slowing down in the active material, keeping them from traveling as far as they would without the presence of the scintillator.

- Although we see an improvement in containment when using plastic, we also see that more neutrons are captured when we use the less amount of plastic in our system.