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Target Normal Sheath Acceleration as a Technique to Measure Cross Sections

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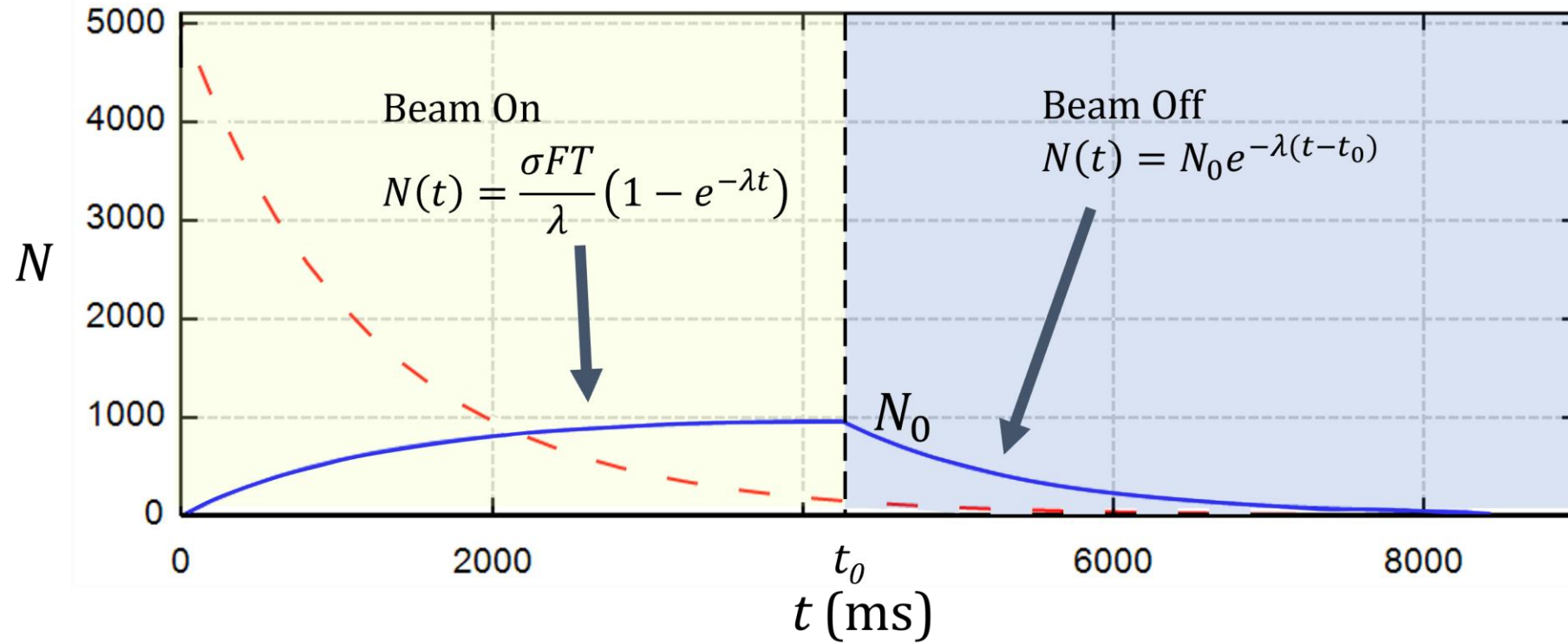
What are Light Ion Cross Sections?

Protons ↑

	¹⁰ N p	¹¹ N p	¹² N 11 ms β+	¹³ N 9.97 m β+	¹⁴ N	¹⁵ N	¹⁶ N 7.1 s β-	¹⁷ N 4.2 s β-
⁸ C p, α	⁹ C 127 ms β+, p	¹⁰ C 19.3 s β+	¹¹ C 20.4 s β+	¹² C	¹³ C	¹⁴ C 5700 y β-	¹⁵ C 2.4 s β-	¹⁶ C 747 ms β-
⁷ B p, α	⁸ B 770 ms β+, α	⁹ B p, α	¹⁰ B	¹¹ B	¹² B 20.2 ms β-	¹³ B 17.3 ms β-	¹⁴ B 12.4 ms β-	¹⁵ B 10.2 ms β-
⁶ Be p, α	⁷ Be 53 d β+	⁸ Be α	⁹ Be	¹⁰ Be 1.5×10 ⁶ y β-	¹¹ Be 13.7 s β-	¹² Be 21.5 ms β-	¹³ Be n	¹⁴ Be 4.4 ms β-
⁵ Li p, α	⁶ Li	⁷ Li	⁸ Li 840 ms β-	⁹ Li 178 ms β-	¹⁰ Li n			
⁴ He	⁵ He n	⁶ He 807 ms β-	⁷ He n	⁸ He 119 ms β-	⁹ He n			
³ He 12 y β-	⁴ H n	⁵ H 2n	⁶ H n	⁷ H 2n				

Neutrons →

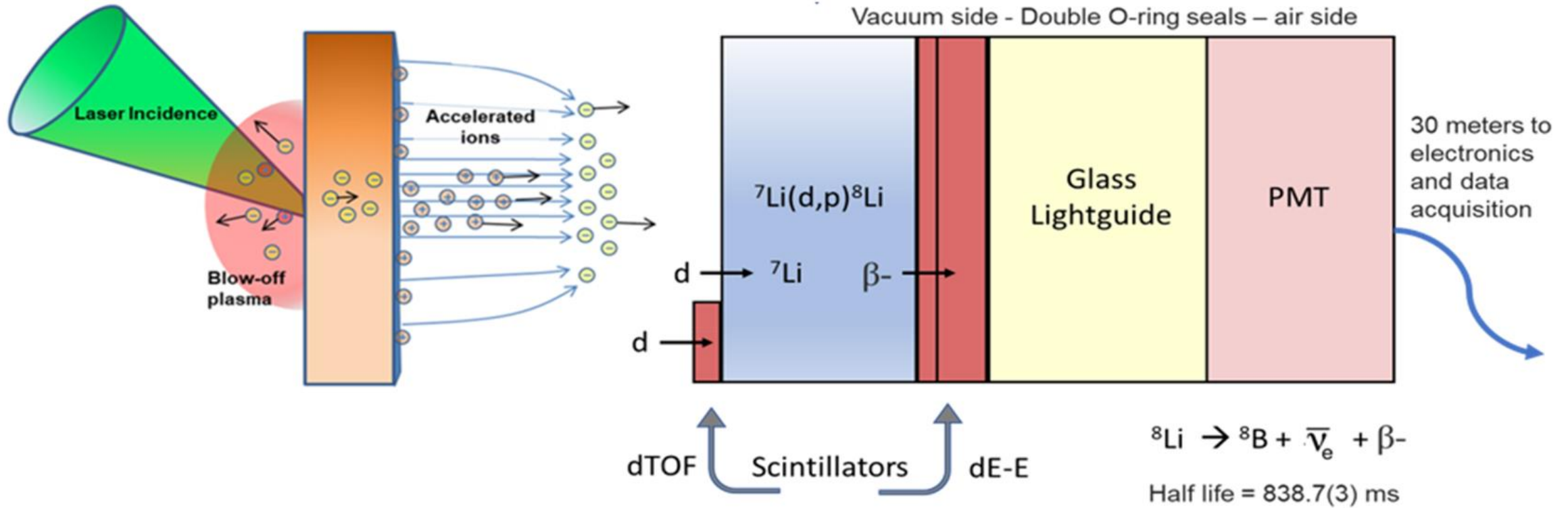
Disadvantage of Traditional Activation Experiments



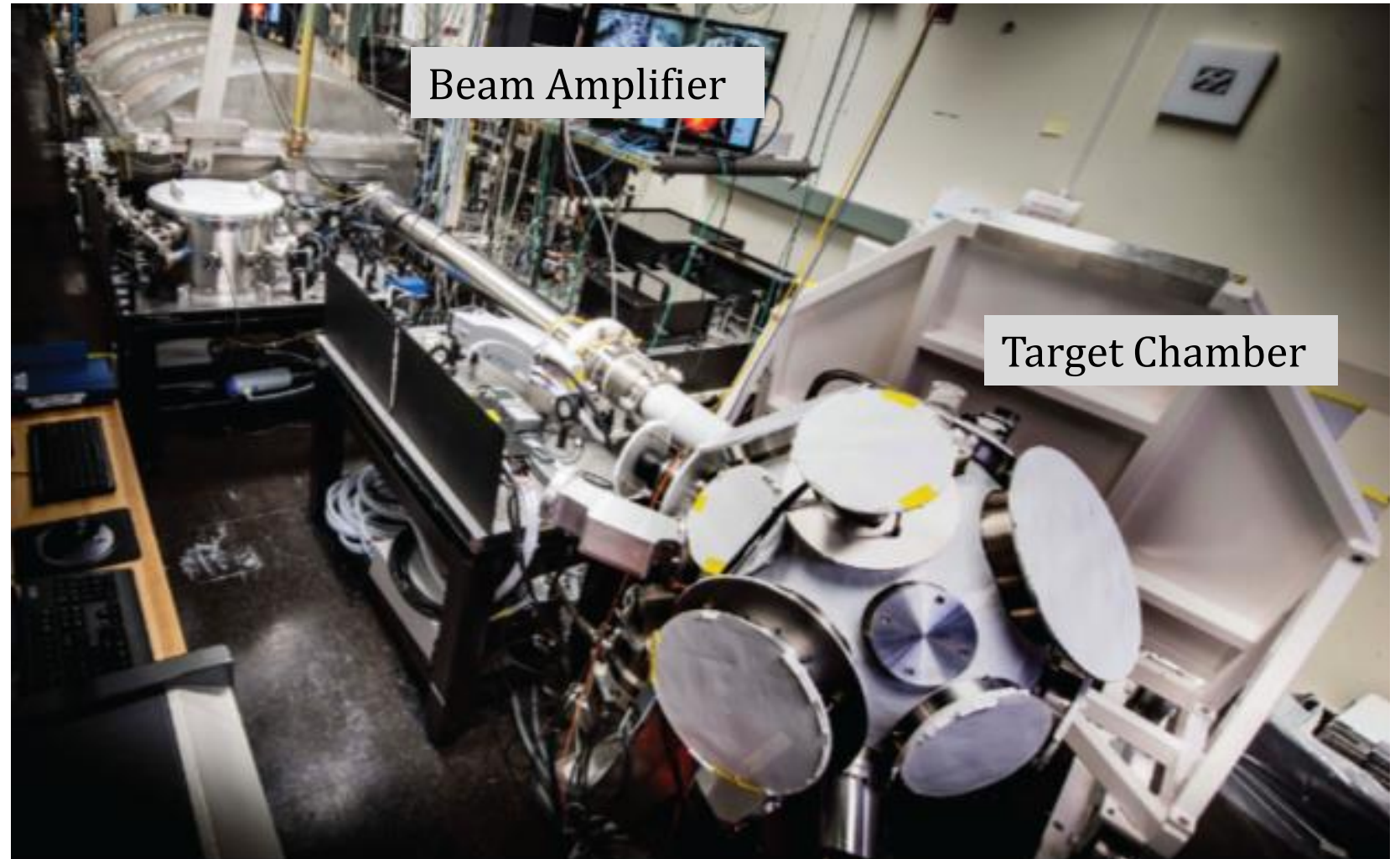
Target Normal Sheath Acceleration Experiment



MTW, Omega or EP



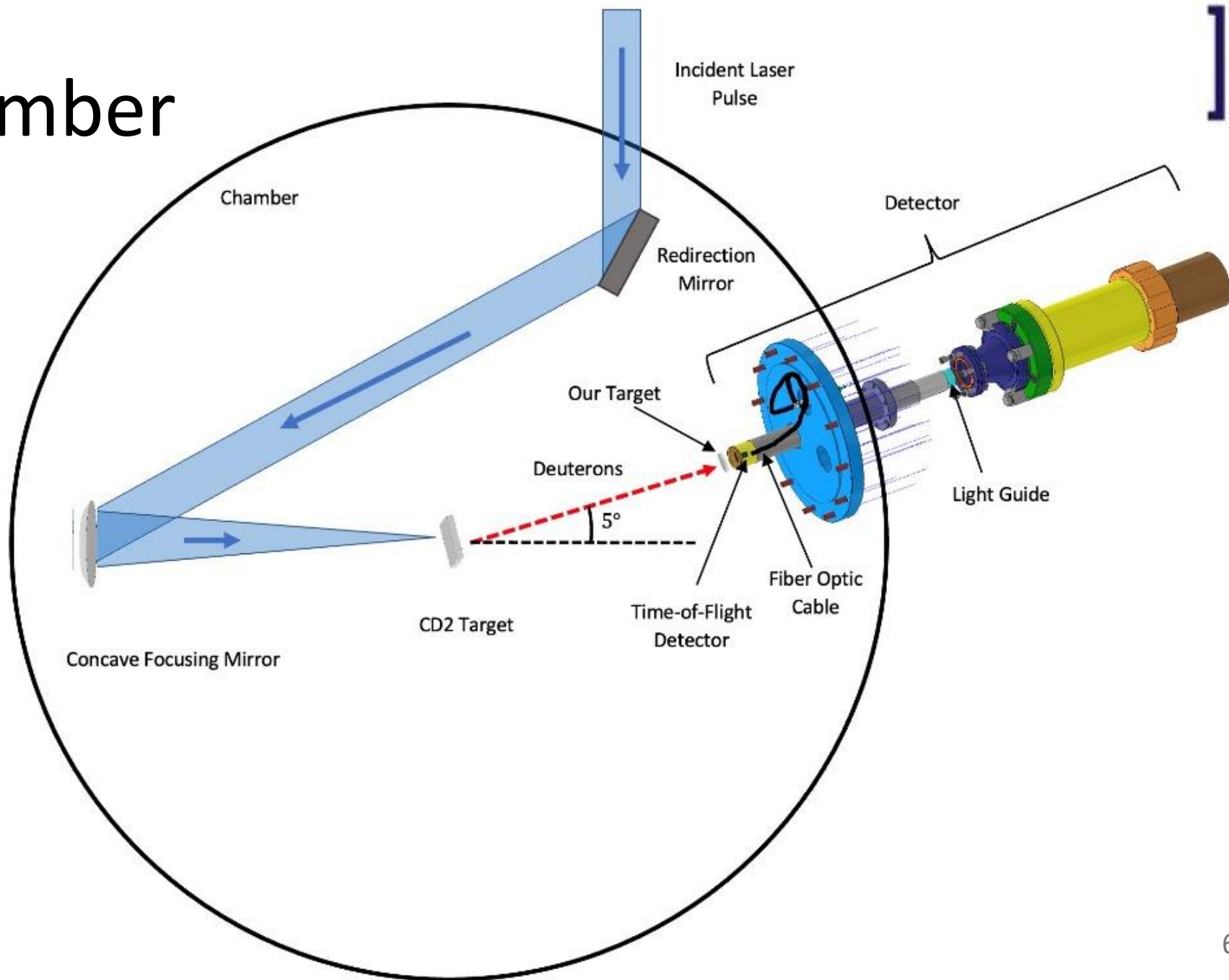
MTW Laser



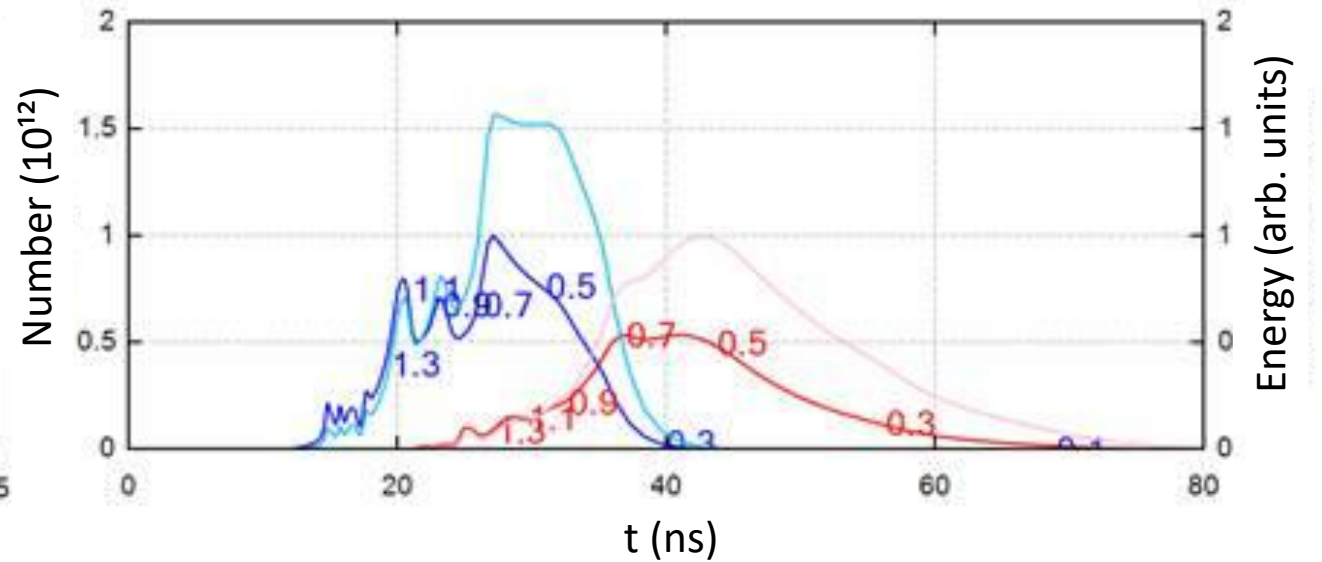
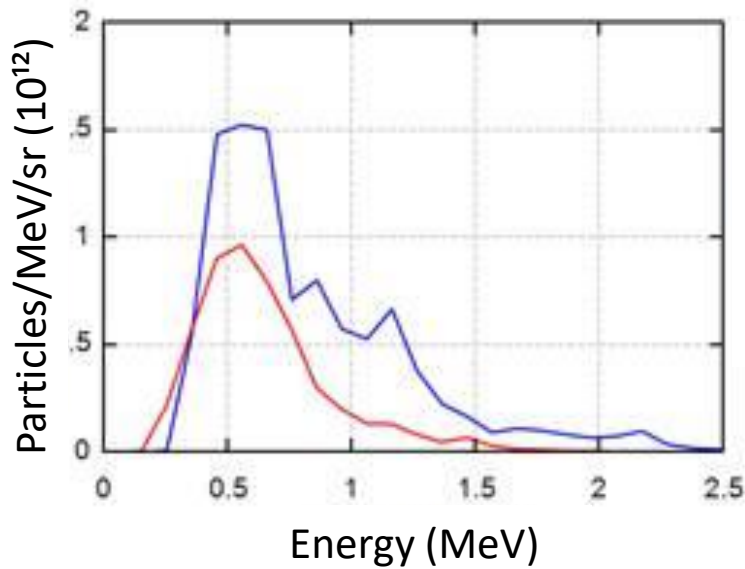
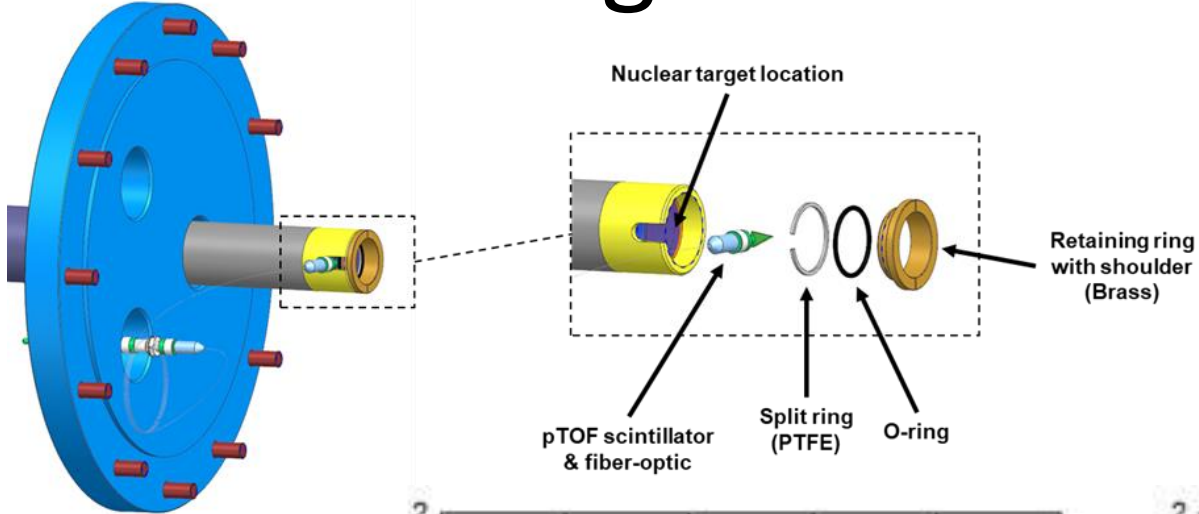
Beam Amplifier

Target Chamber

Target Chamber

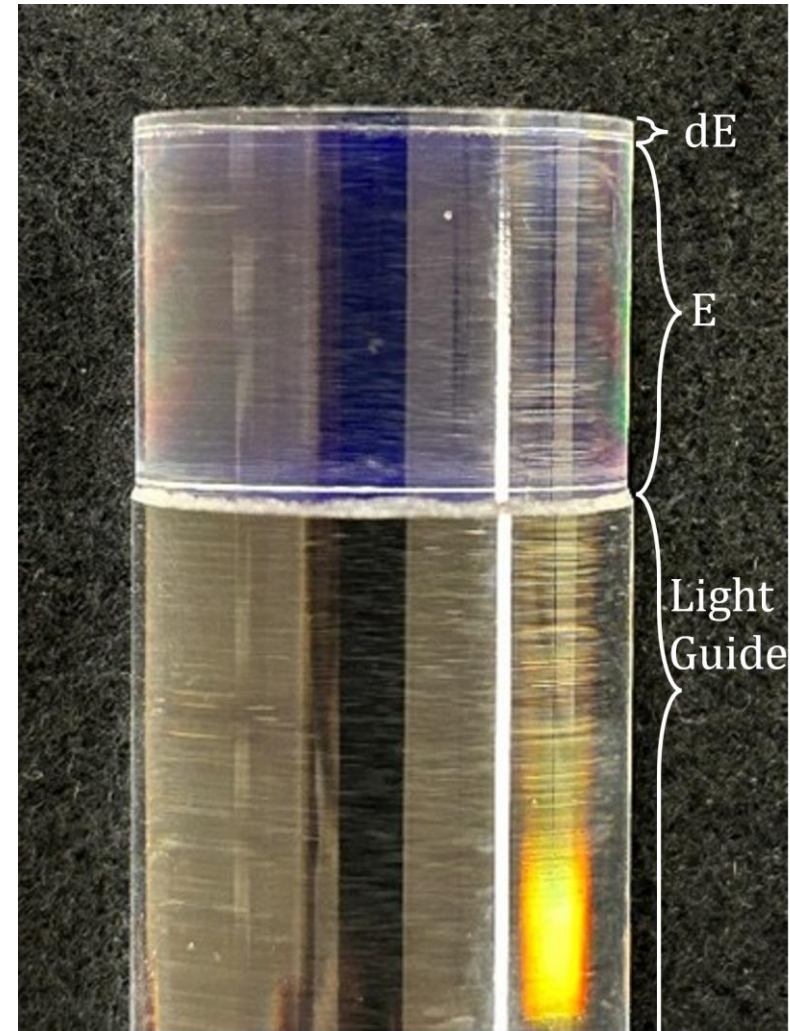
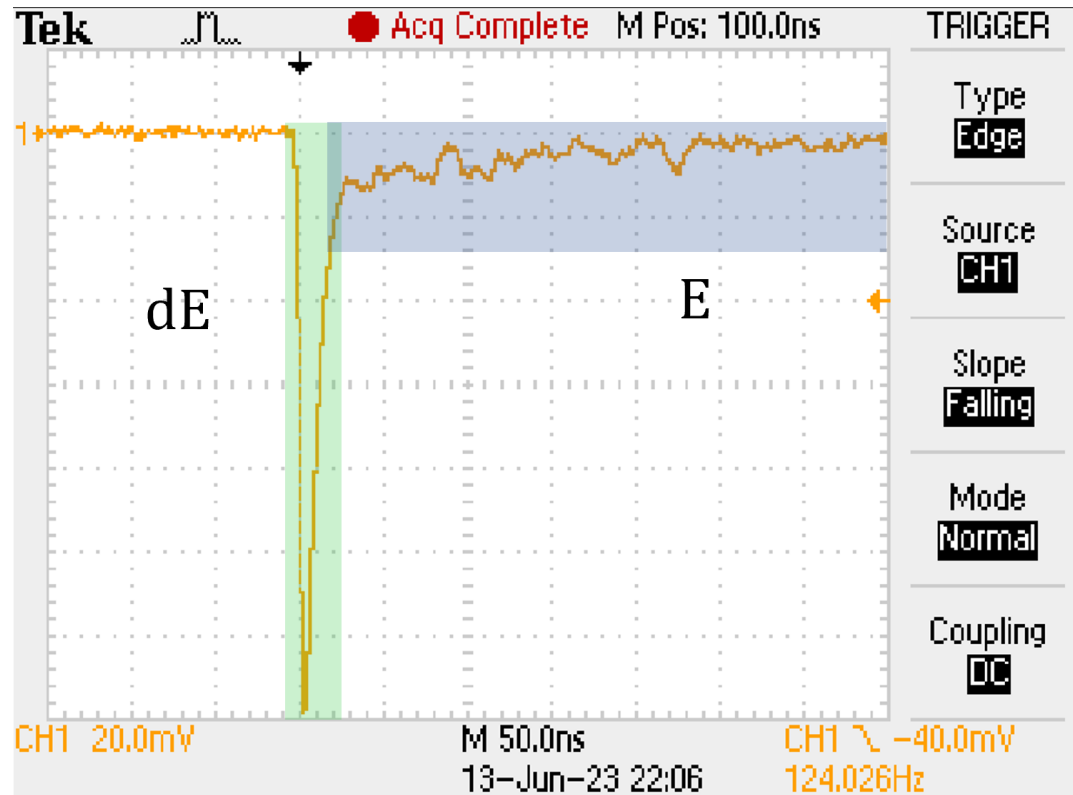


Time of Flight Detector

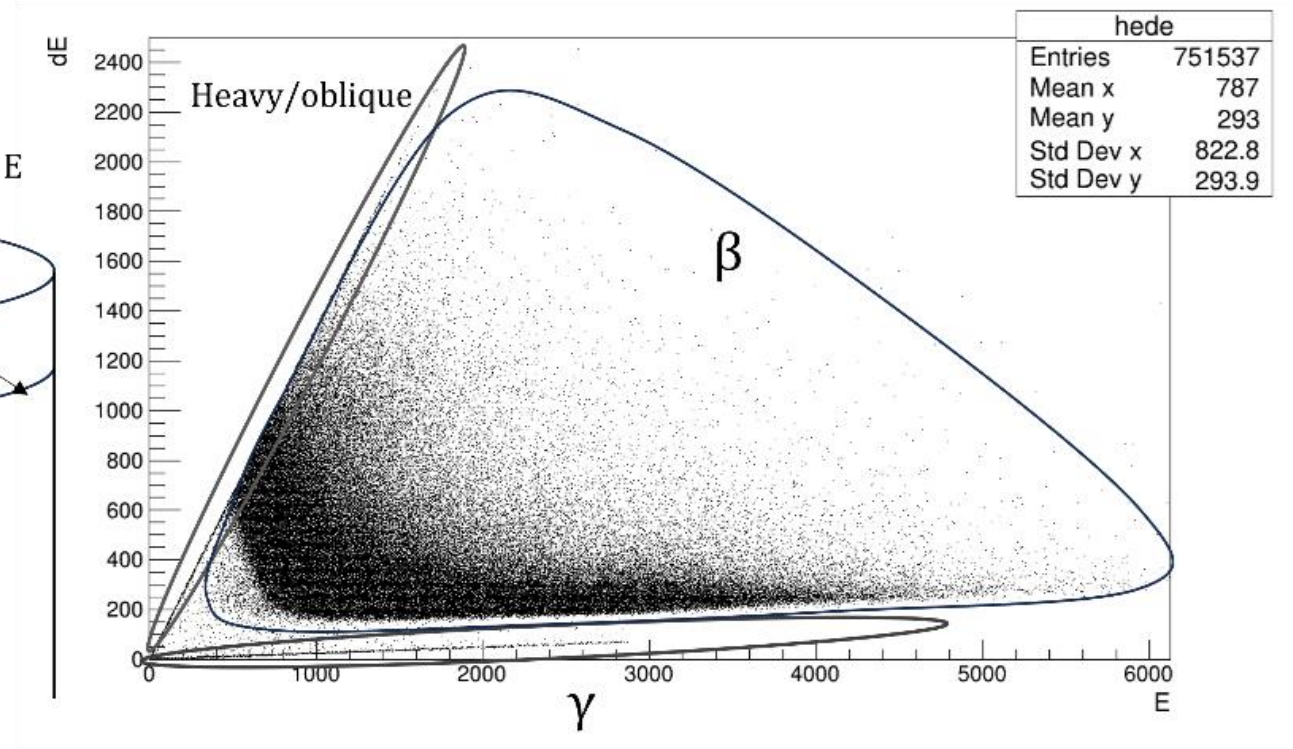
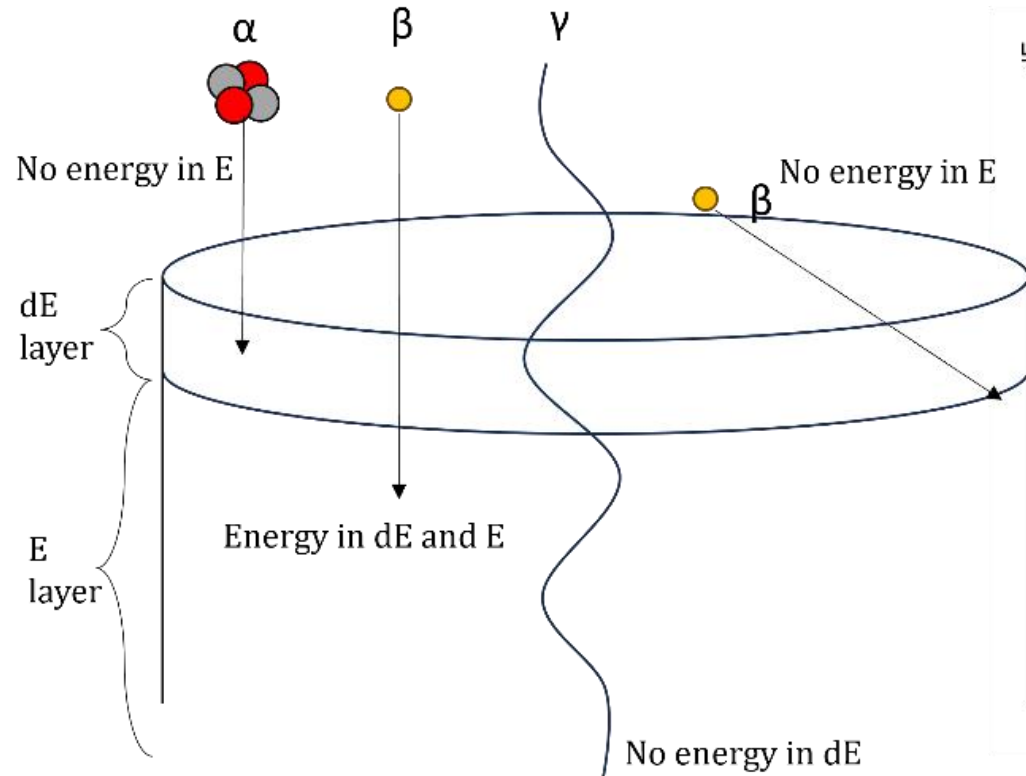




Phoswich Detector

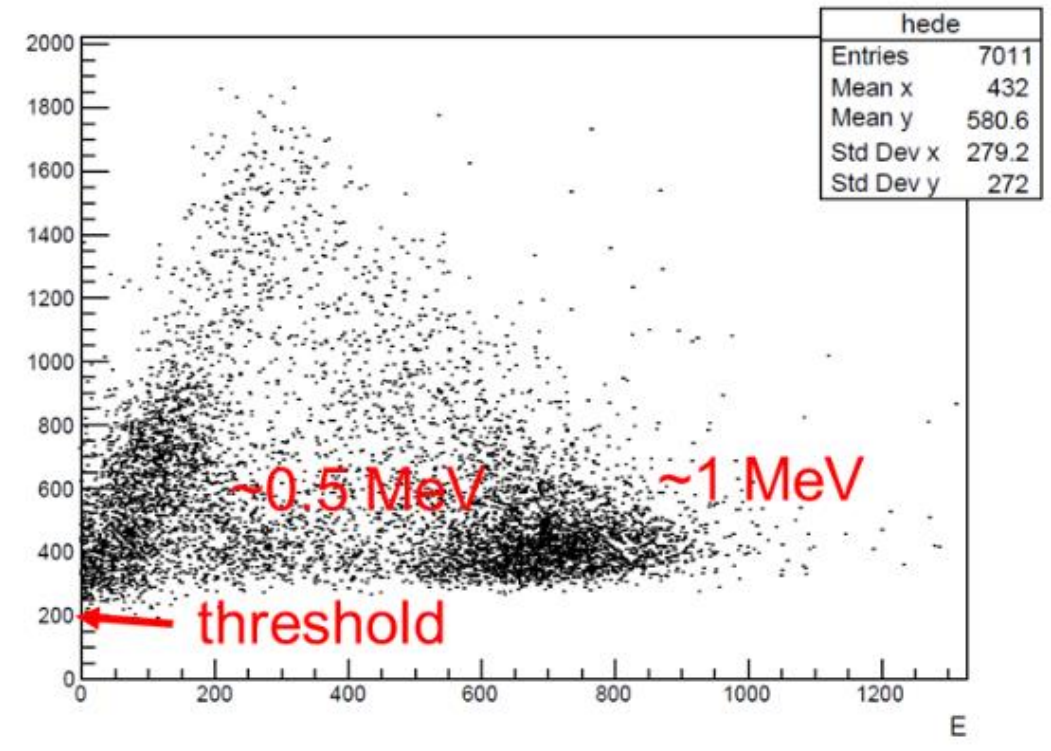
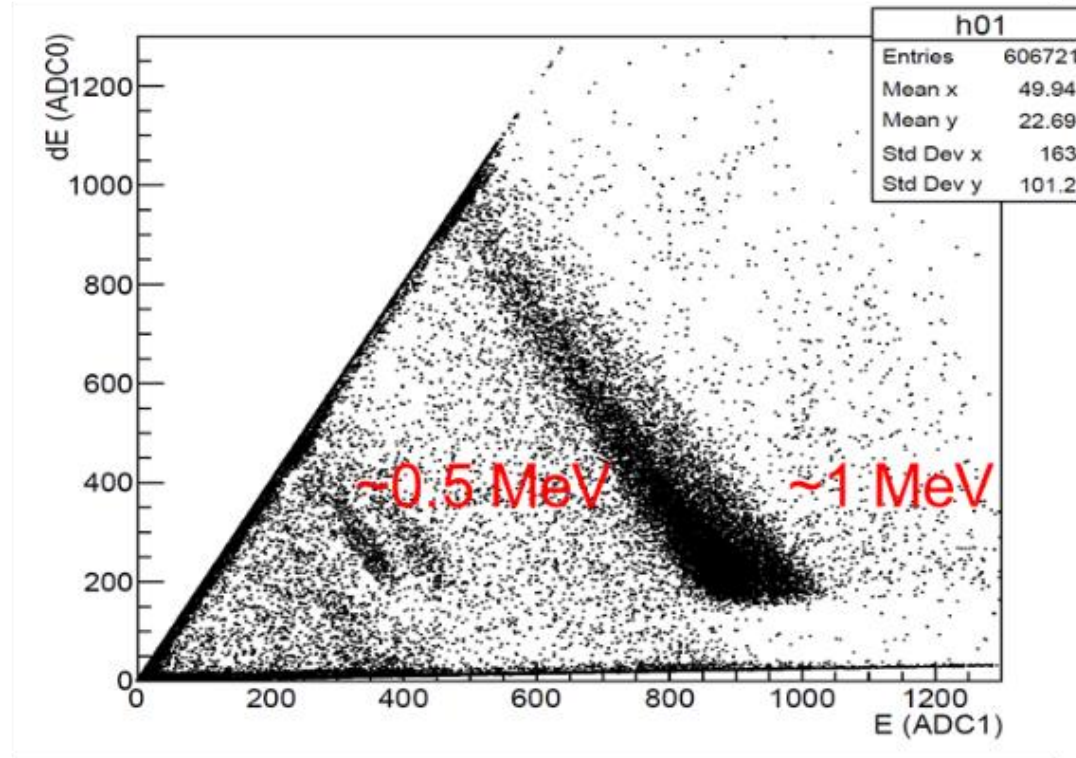


Phoswich

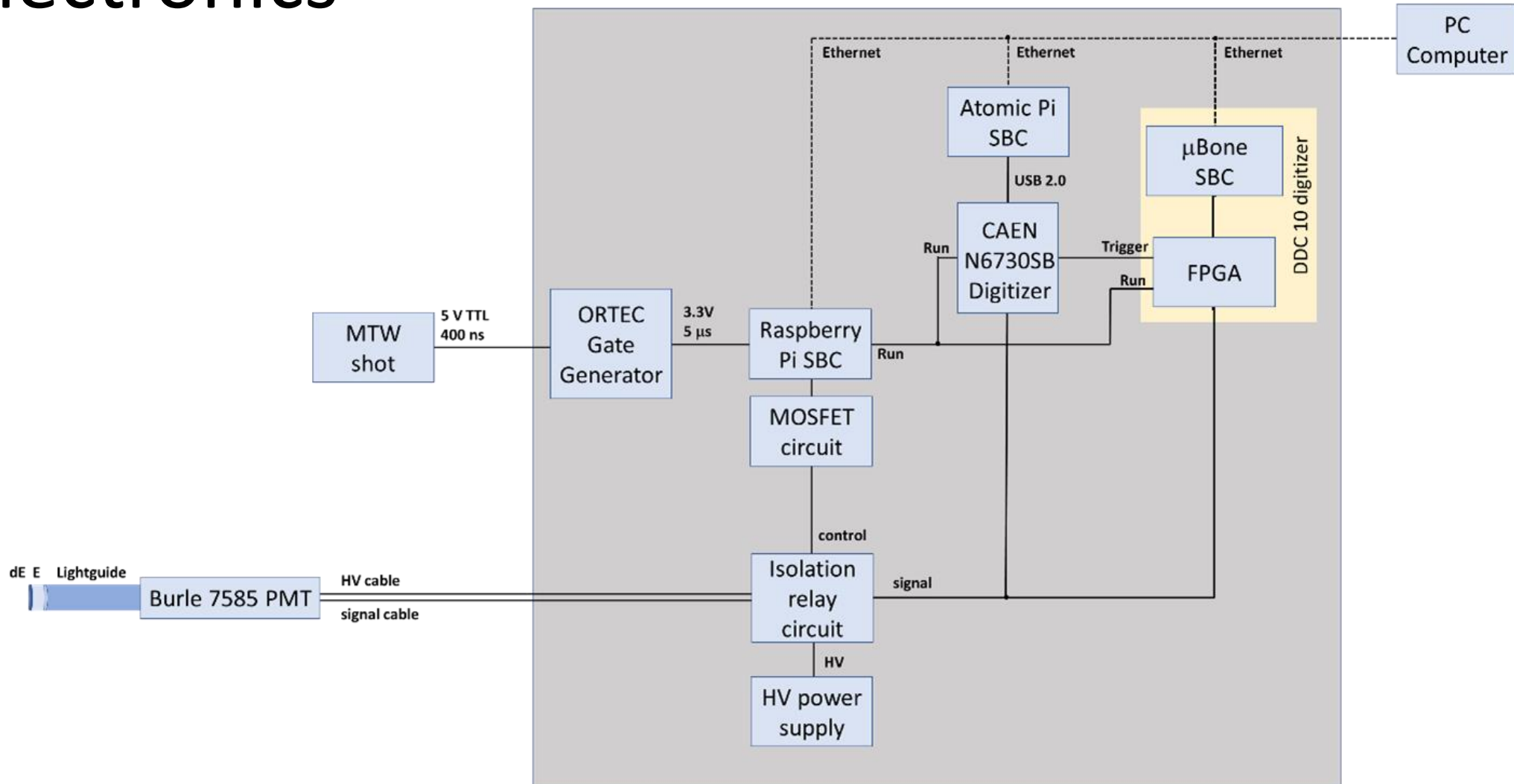




Example 2D Histograms



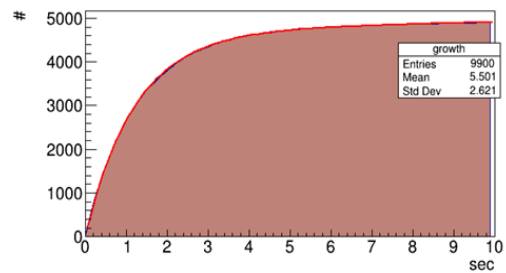
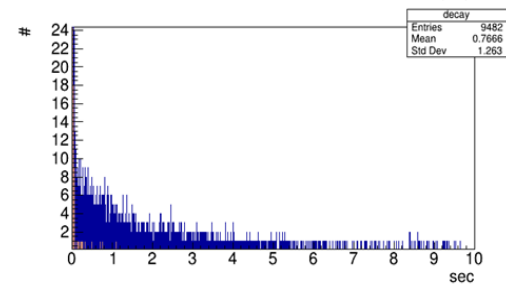
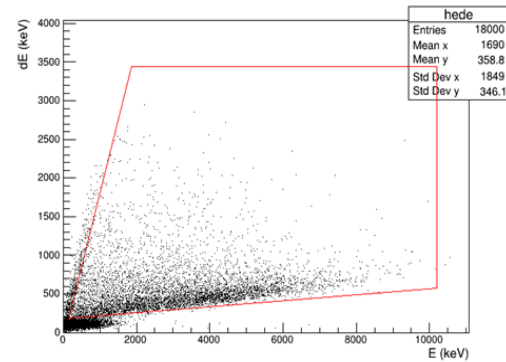
Electronics





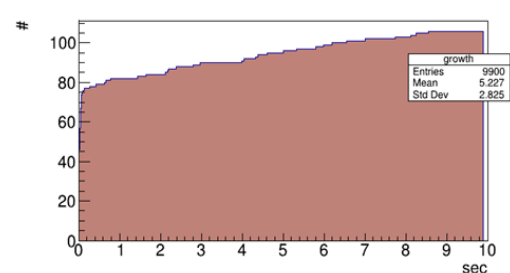
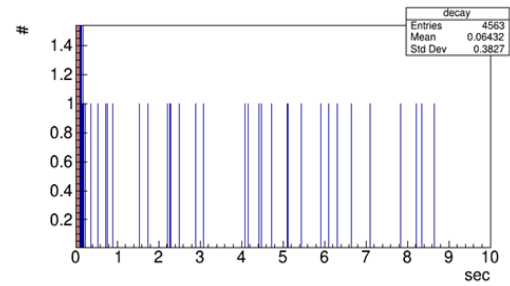
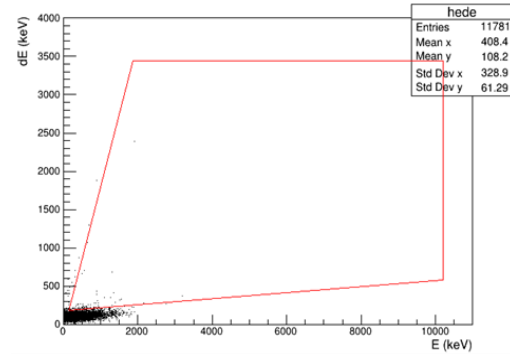
Results

Laser Target: CD
Nuclear Target:
Lithium



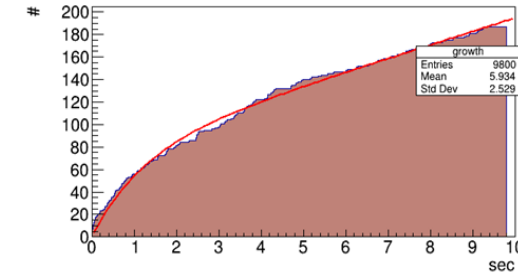
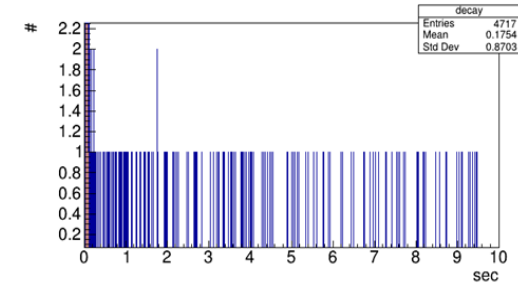
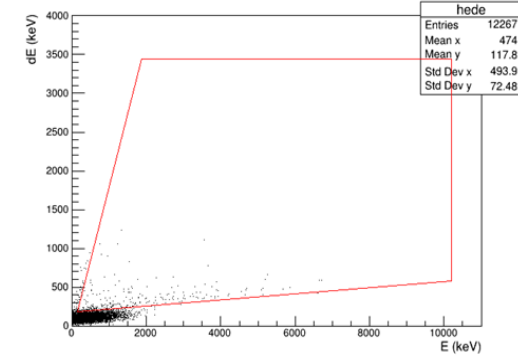
${}^7\text{Li}(d,p){}^8\text{Li}$

Laser Target: CH₂
Nuclear Target:
Lithium



${}^7\text{Li}(p,?)$

Laser Target: CD
Nuclear Target:
Blank

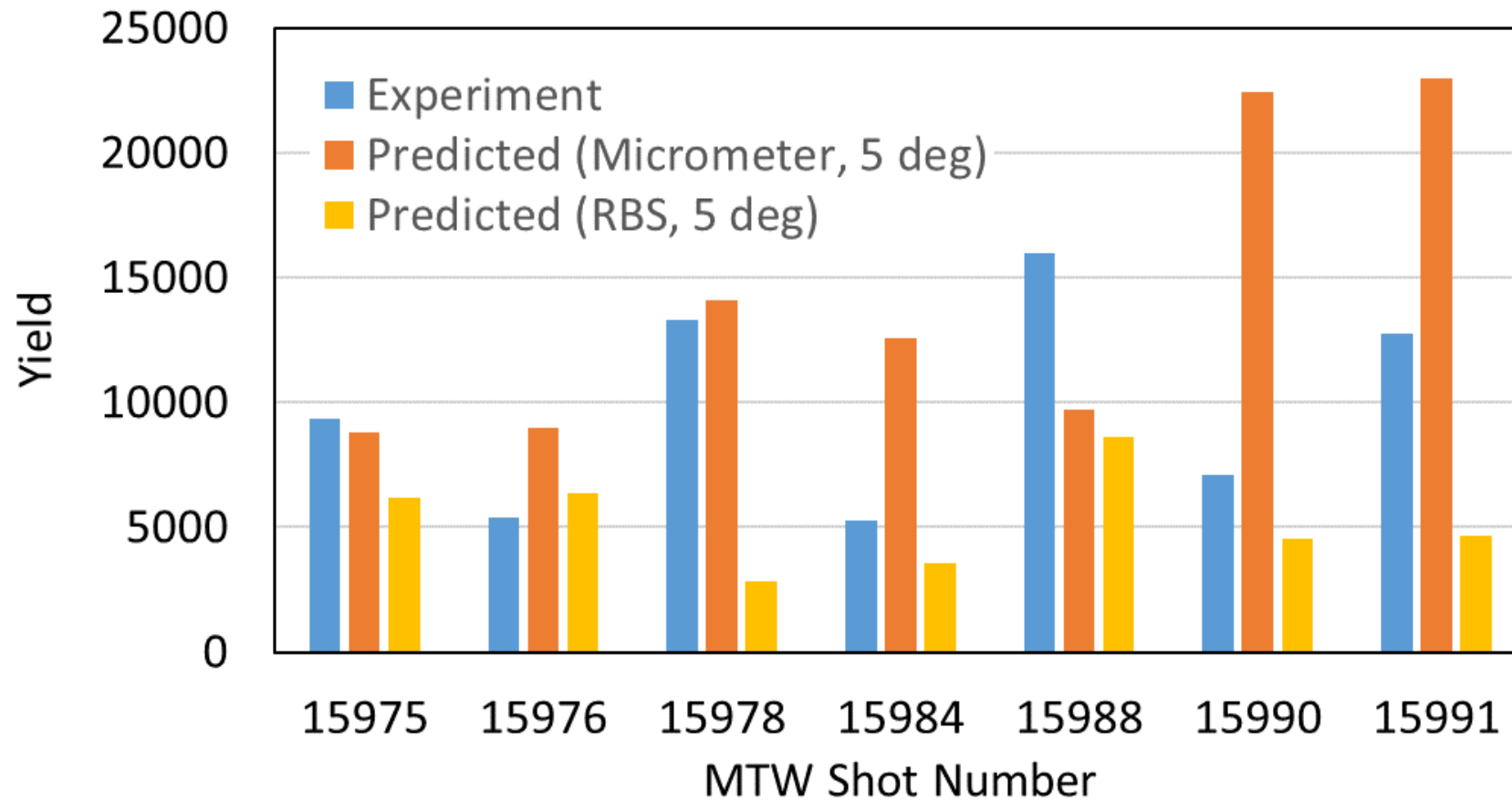


${}^{65}\text{Cu}(d,p){}^{66}\text{Cu}$?

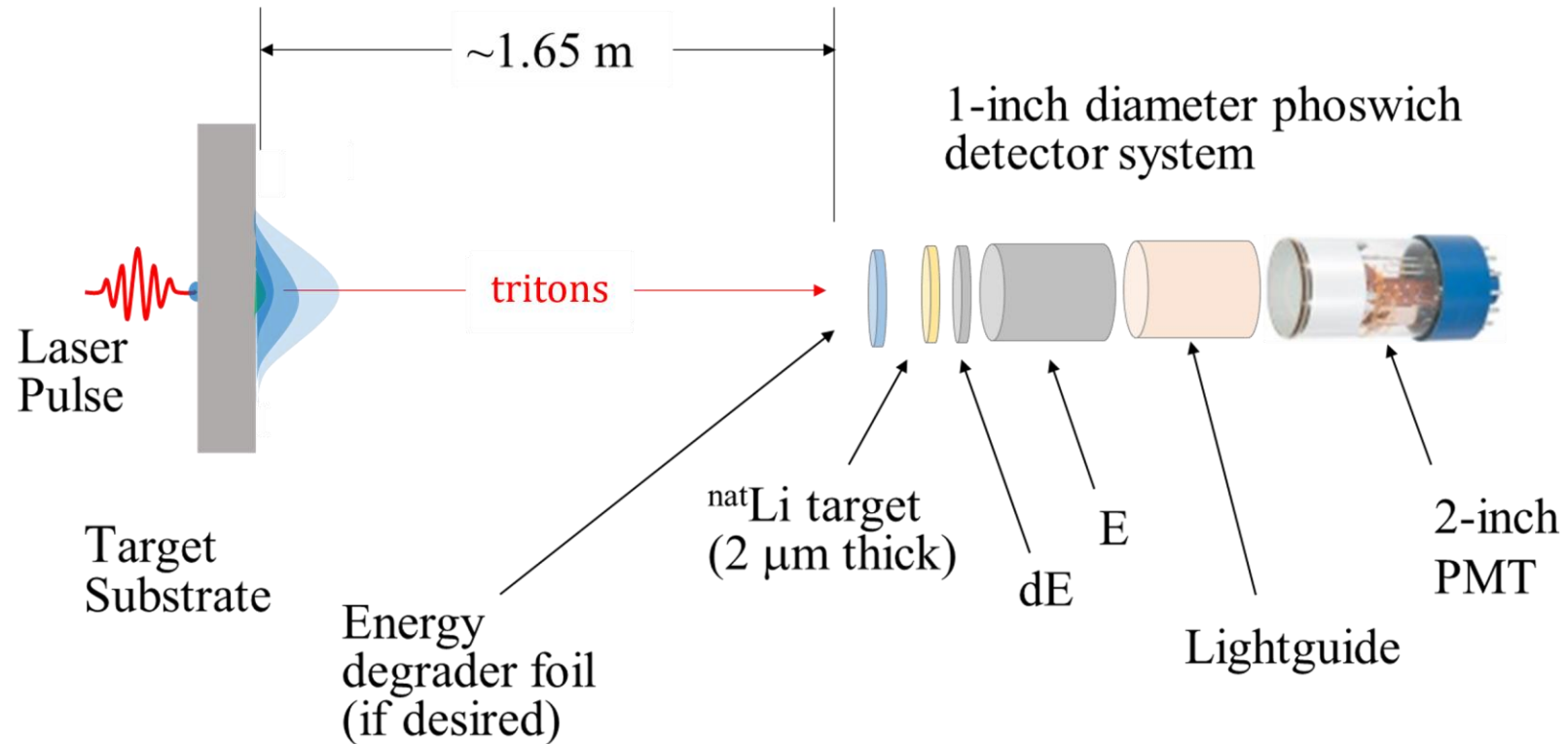


Yield Results

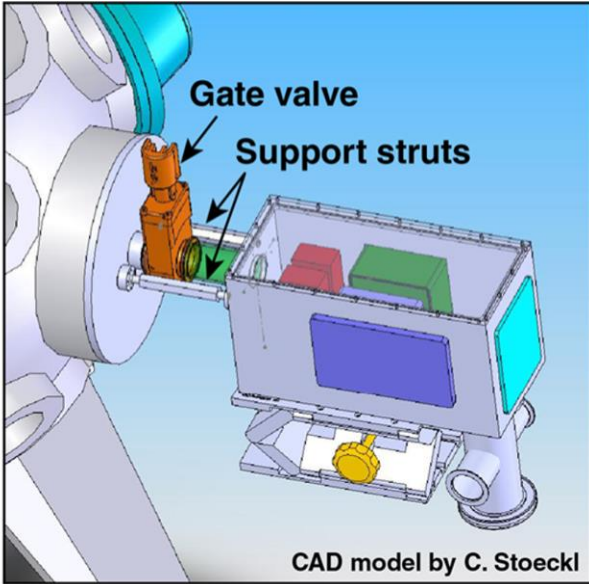
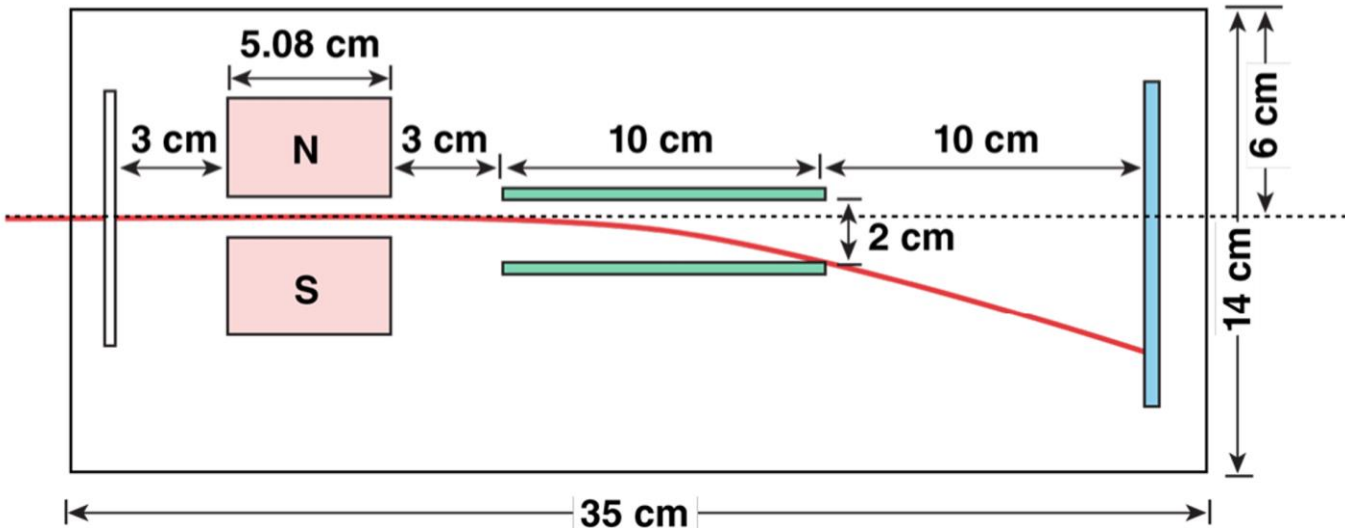
$$Y_{Li} = \int D(E) \cdot N_{Li} \cdot T_{Li} \cdot SA \cdot CS(E) dE$$



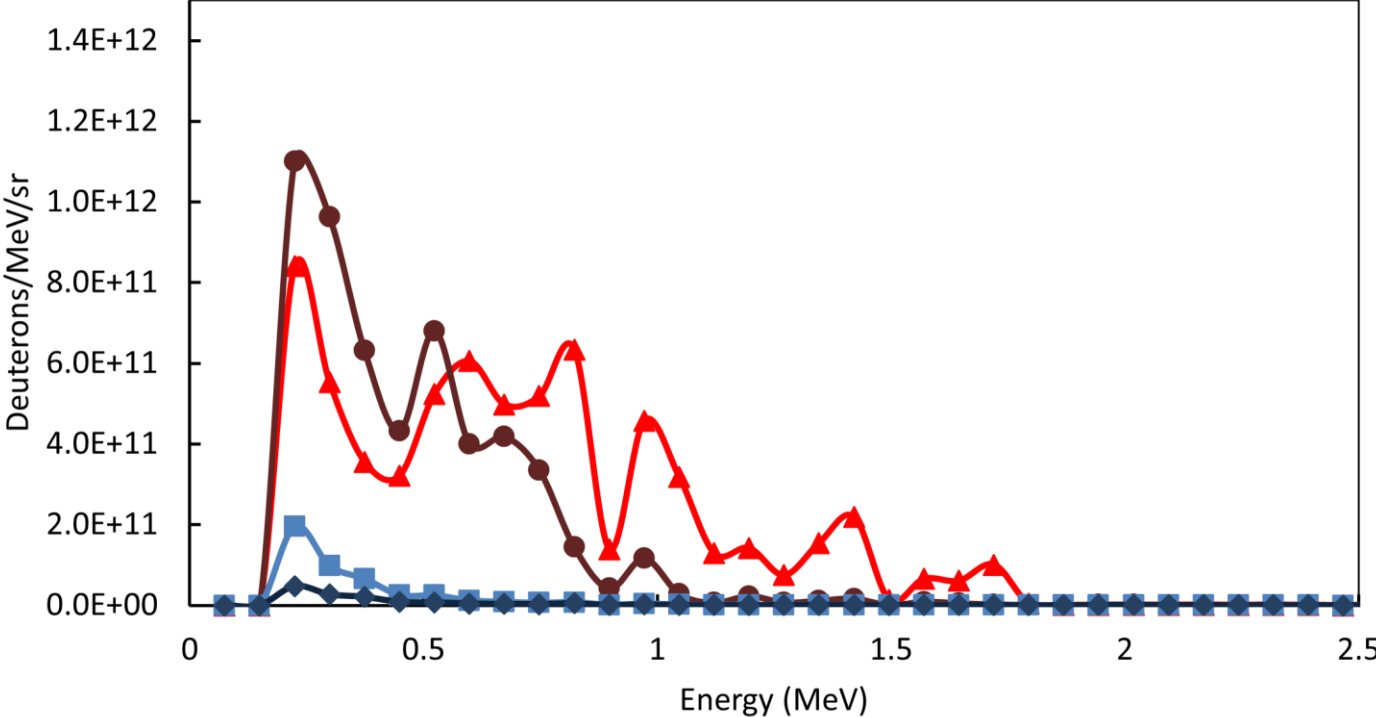
Future Plans



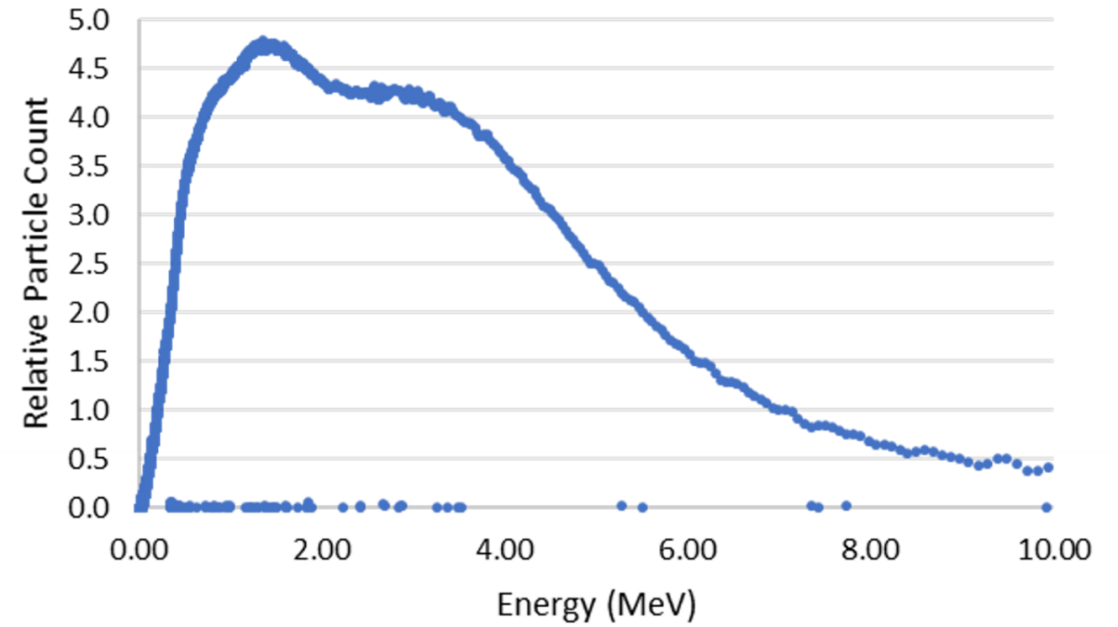
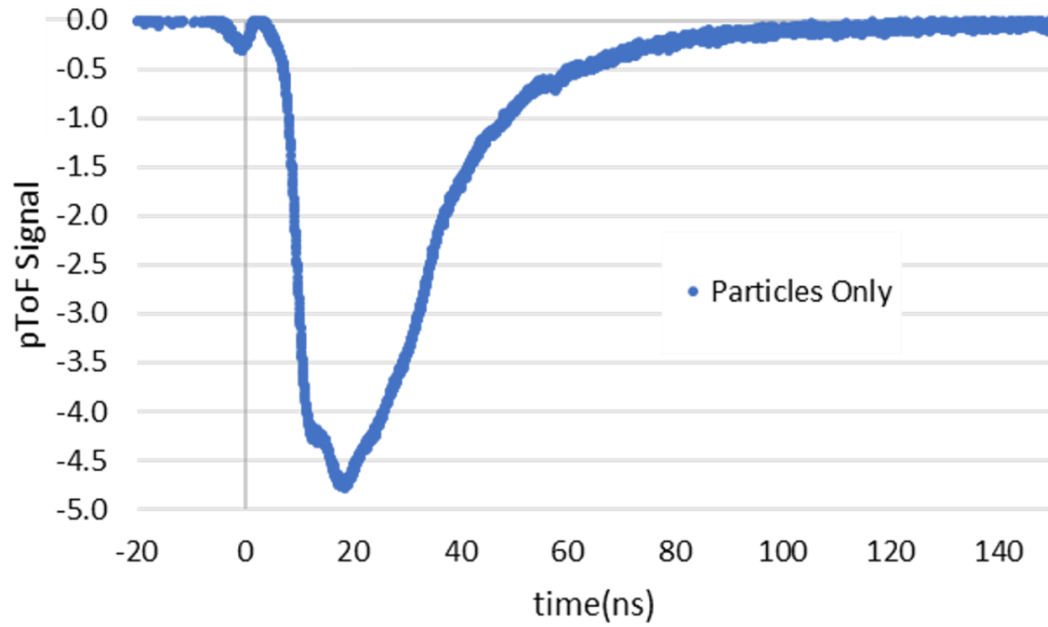
Thomson Parabola



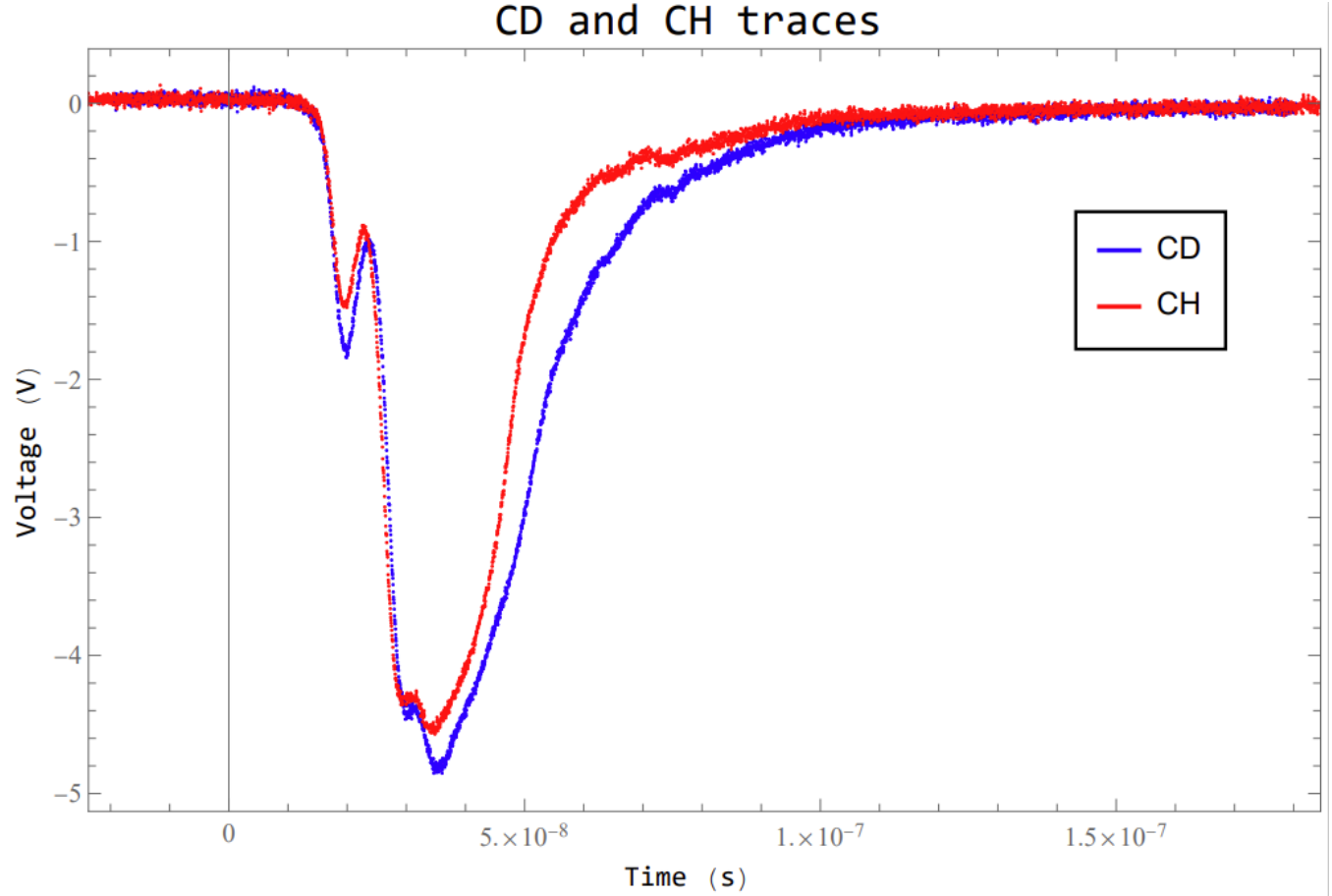
Thomson Parabola



TOF data



TOF data



Bi-207 Spectrum

