High energy neutron induced fission cross section in ^{235}U

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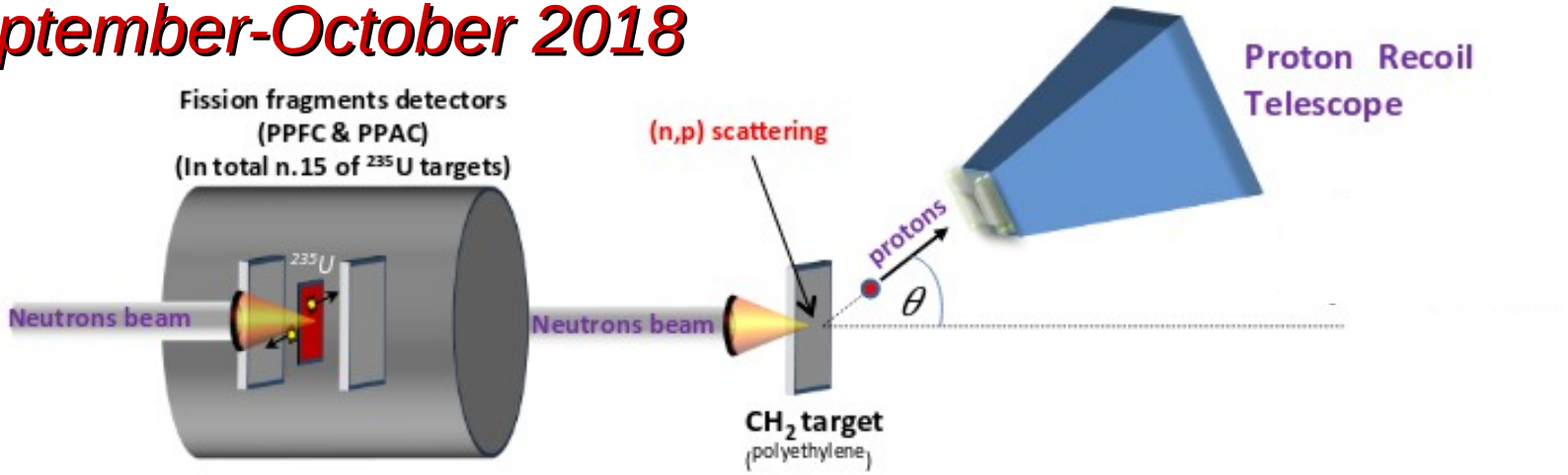
XXX NATIONAL SEMINAR of NUCLEAR AND SUBNUCLEAR PHYSICS
"Francesco Romano" Otranto, June 6 – 11, 2018

The measurement

Istituto Nazionale di Fisica Nucleare

September-October 2018



The goal: the simultaneous measurement of

→ **the neutron induced fission cross section of ^{235}U**

The measurement

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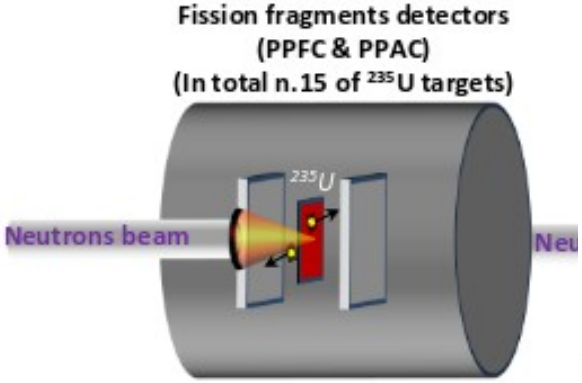

The goal: the simult

→ **the neutro**
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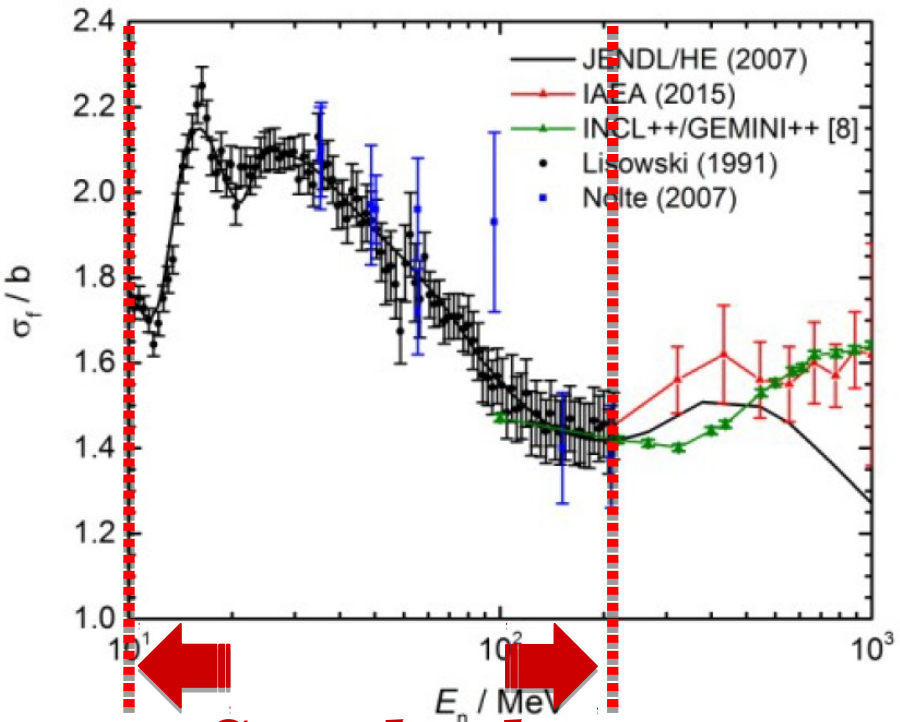
Proton Recoil Telescope



Standard:
0,15 - 200 MeV

The measurement

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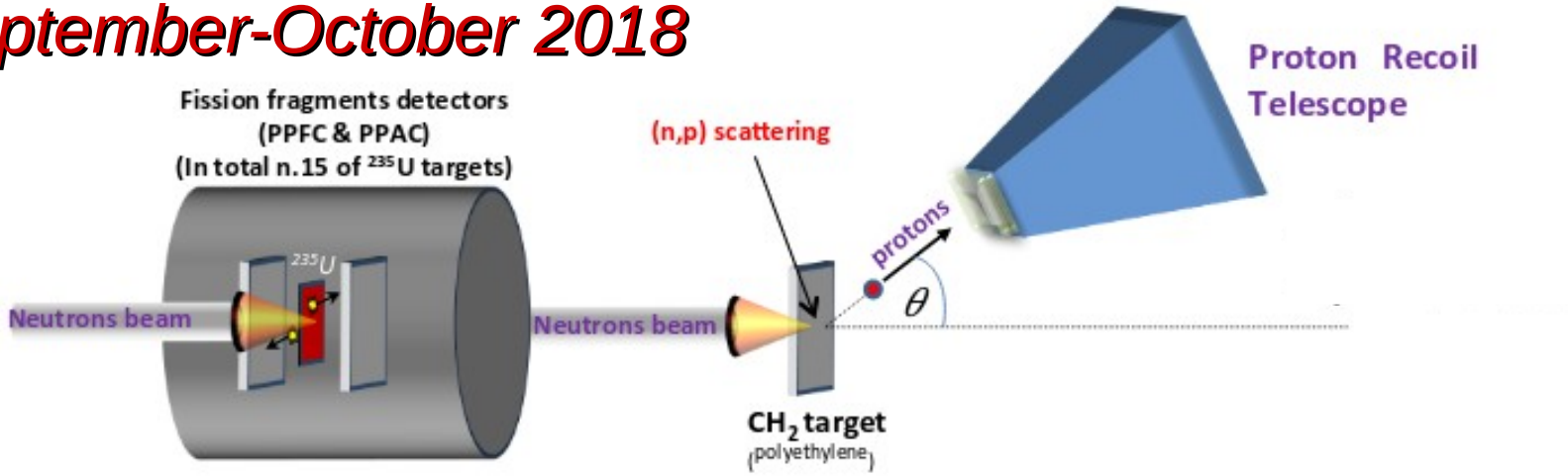

The goal: the simultaneous measurement of

- **the neutron induced fission cross section of ^{235}U**
- **the (n,p) scattering → flux**

@ n_TOF, CERN

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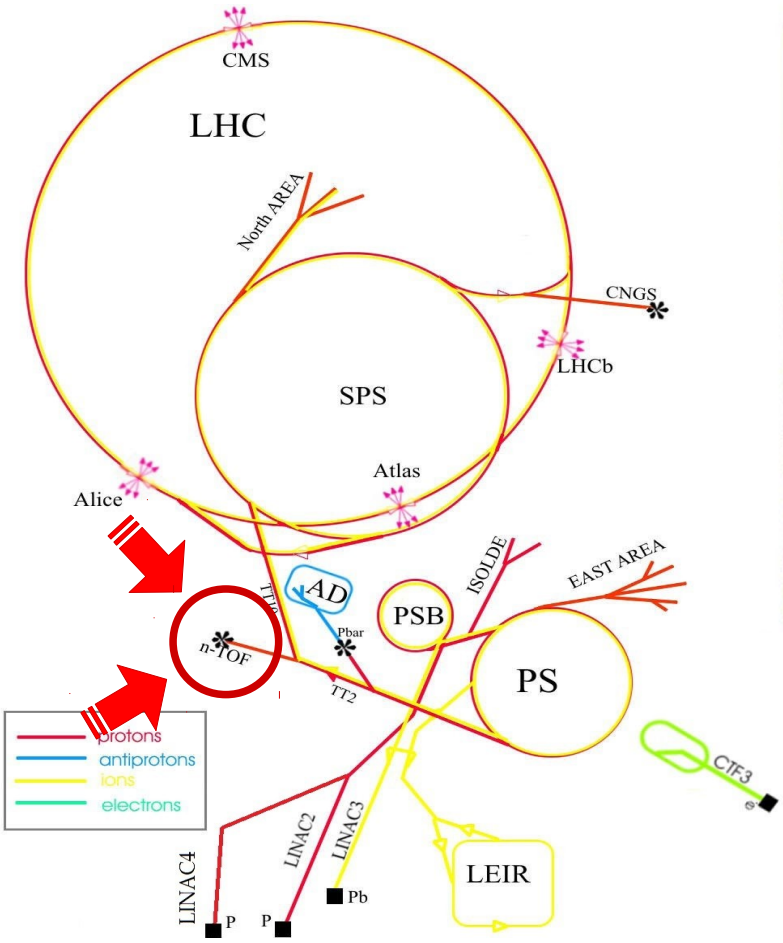
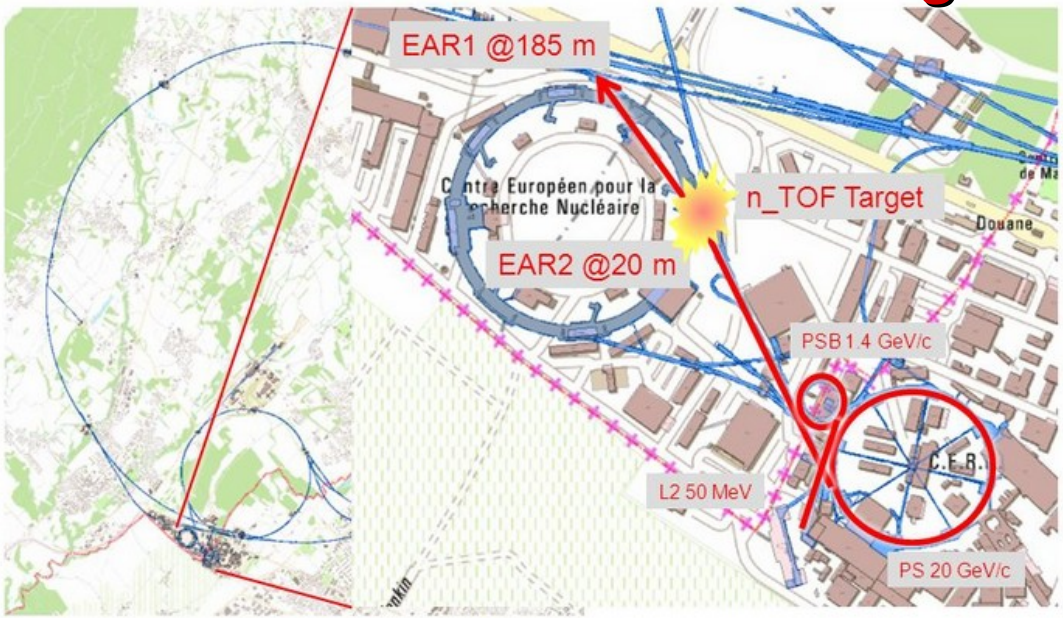
Neutron Time Of Flight





@ n_TOF, CERN

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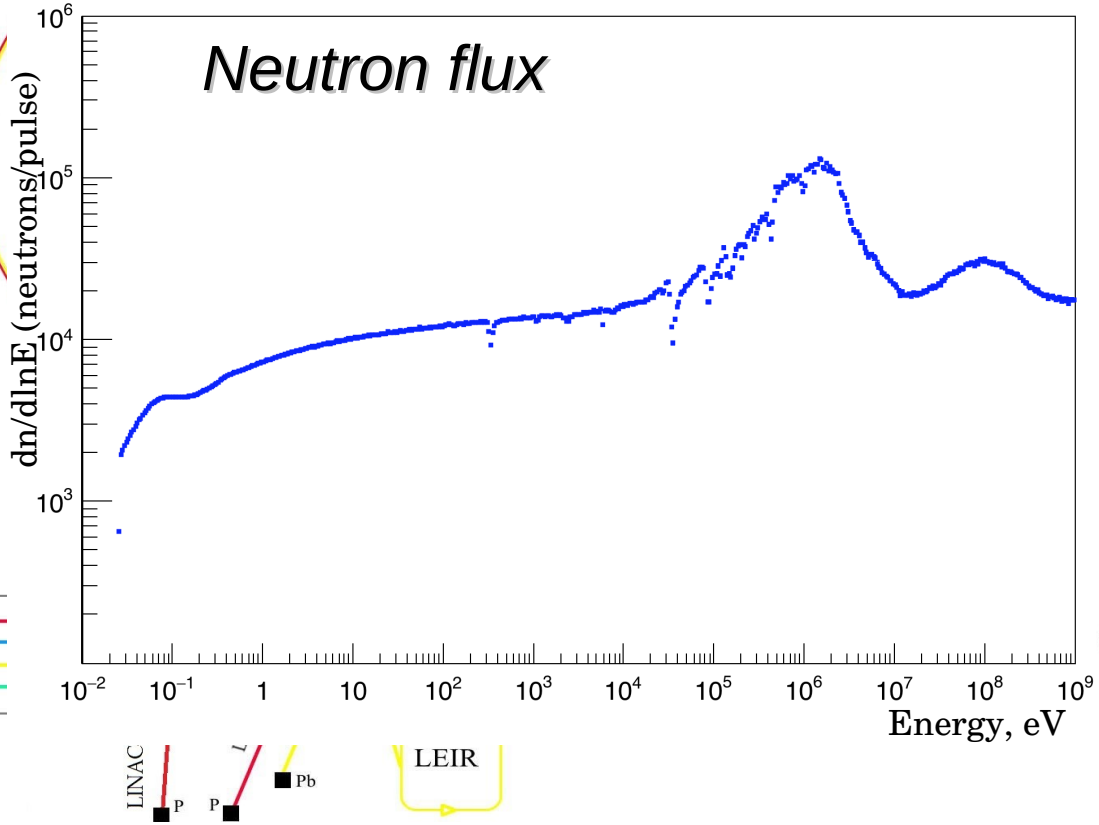
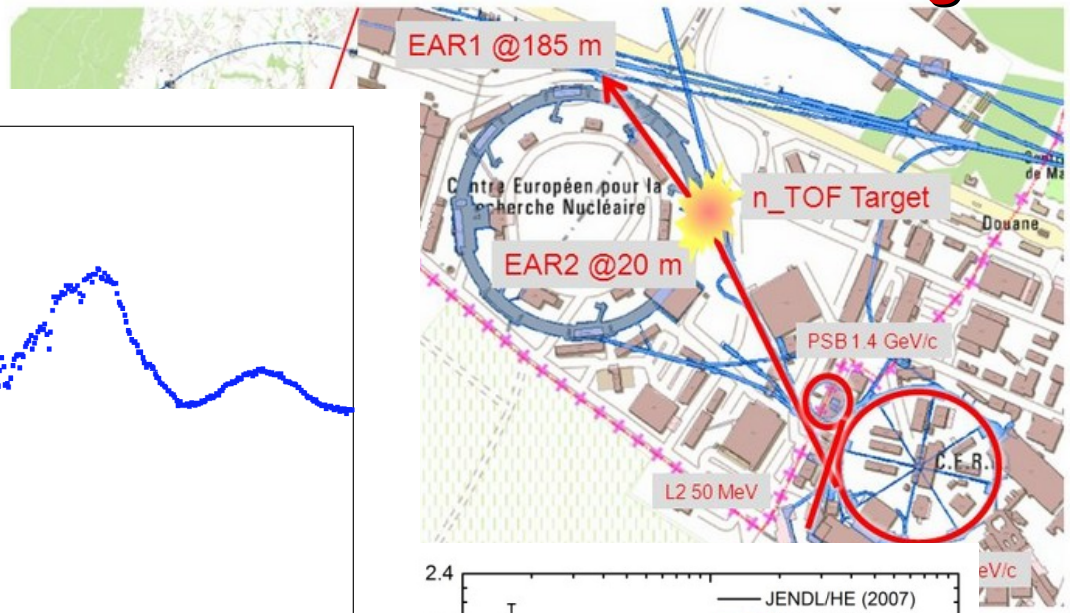
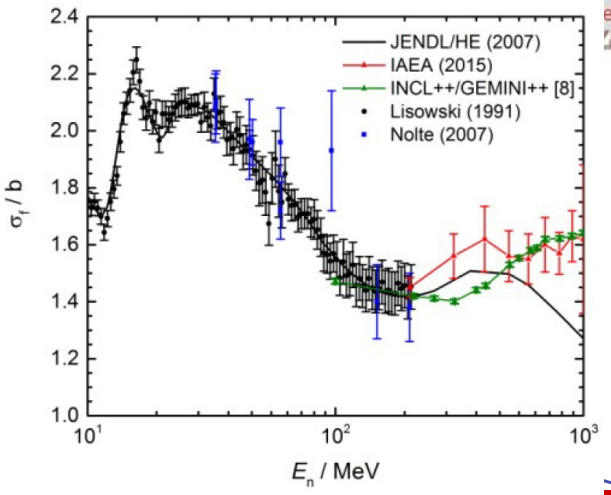
Neutron Time Of Flight

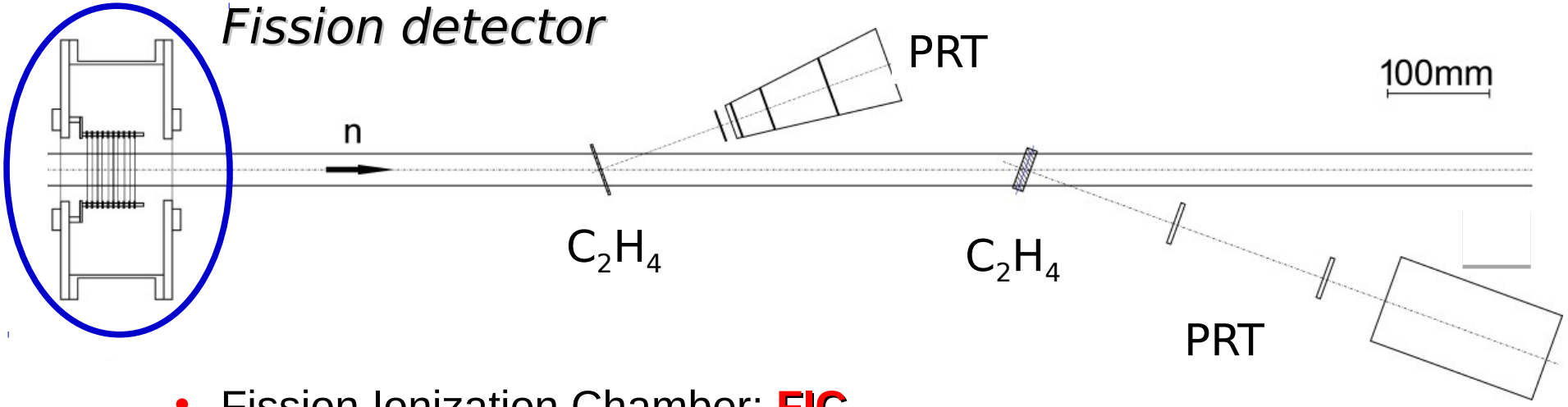






nTOF

Experimental set-up



- Fission Ionization Chamber: **FIC**
- Parallel Plane Avalanche Counter: **PPAC**

⇒ **The idea:**

- Calibrate the PPAC using FIC
- Measure FF up to 1 GeV using PPAC

Proton Recoil Telescope

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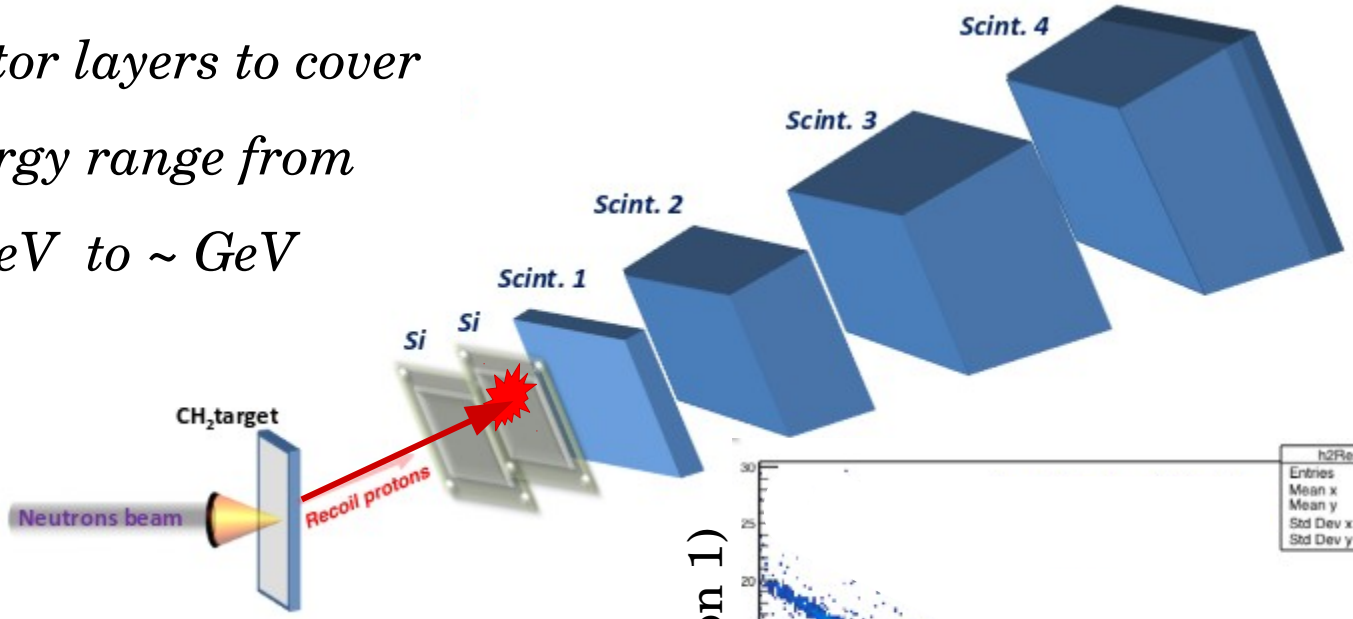
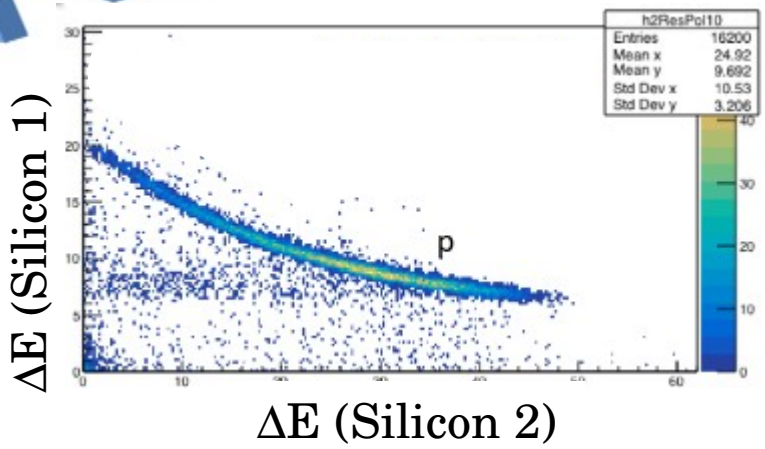
Six detector layers to cover the energy range from ~ MeV to ~ GeV



~ 10 MeV



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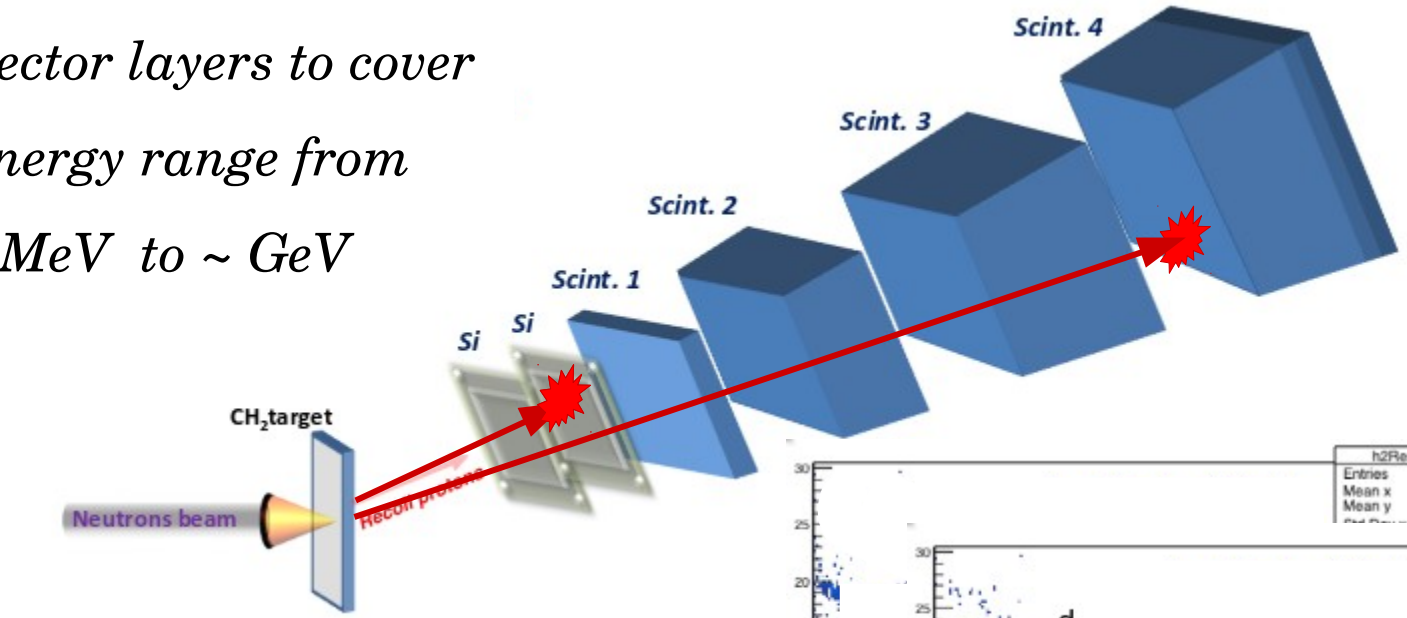
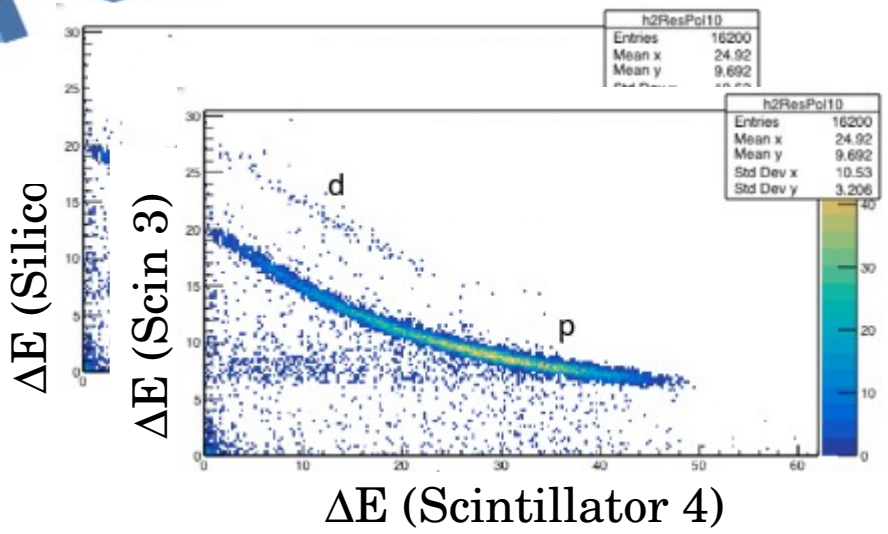


~ 10 MeV → *~ 180 MeV*



Proton Recoil Telescope

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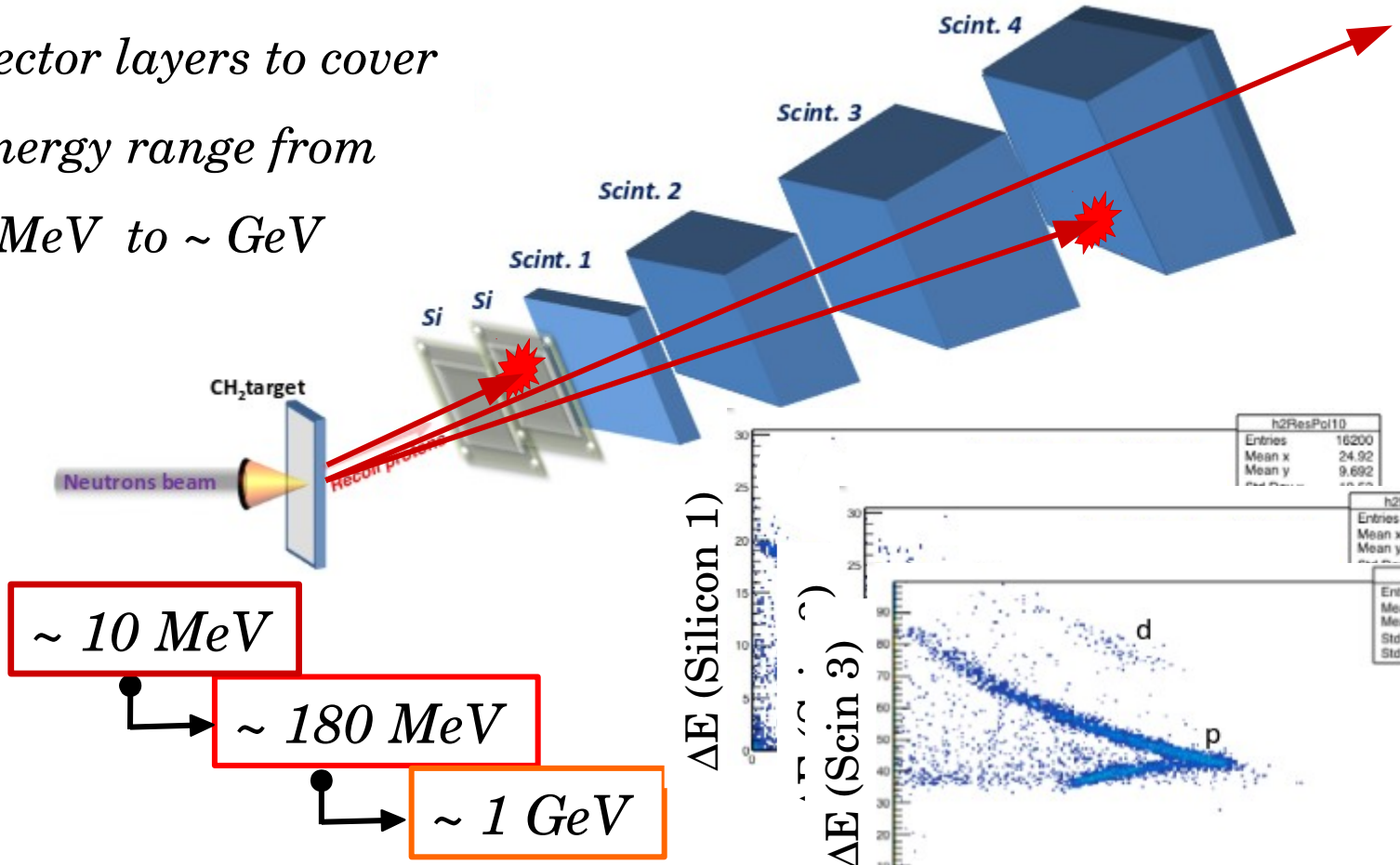
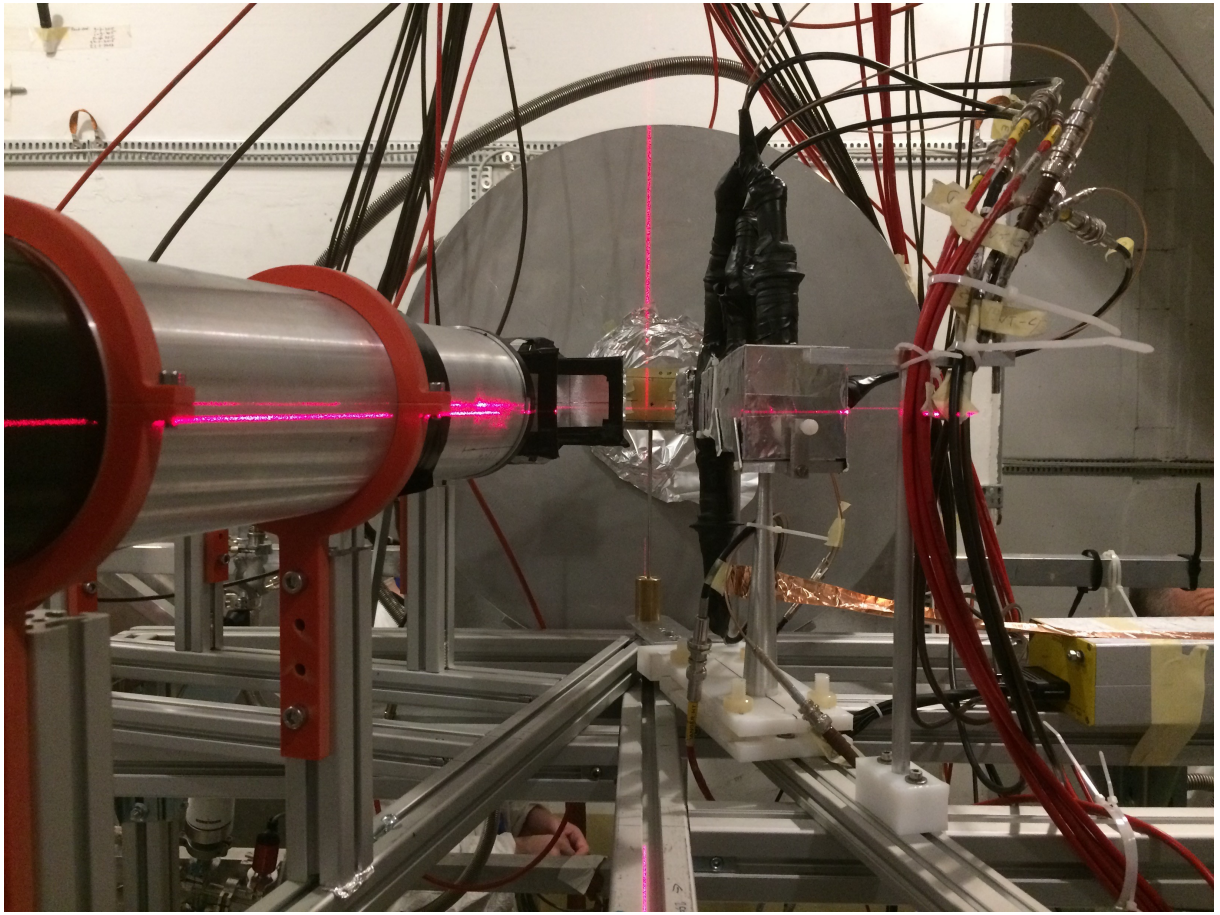


9 - 23 October 2017 → Total: 7,87 • 10^{17} proton



Plot ΔE-ΔE

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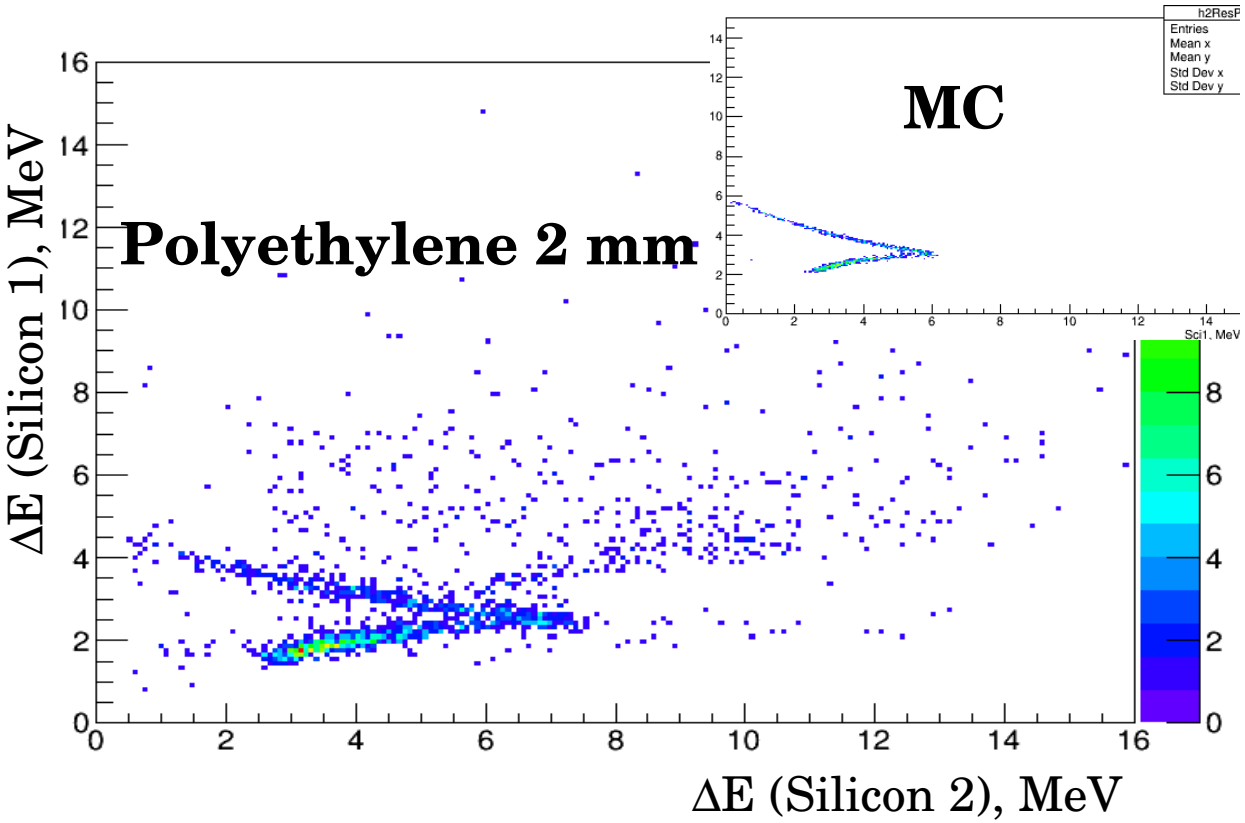
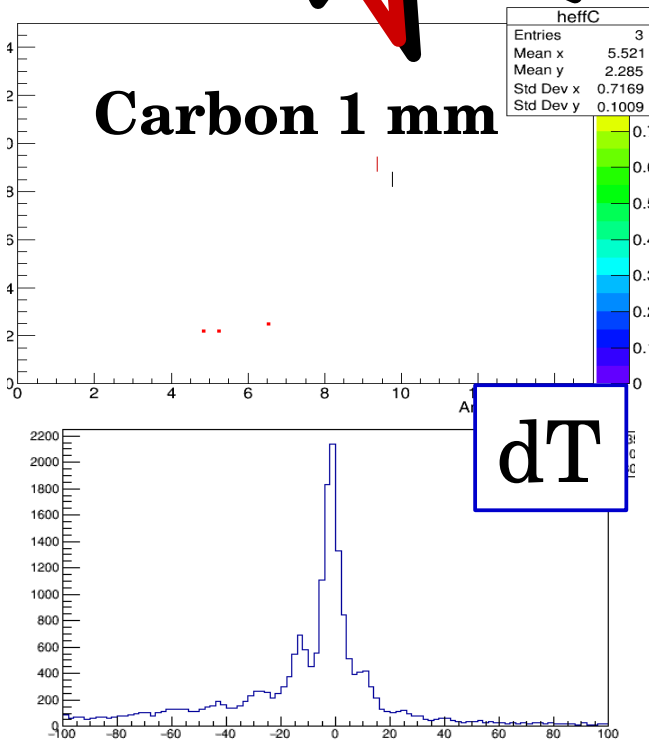
1st & 2nd Silicon

Energy neutrons (TOF): ***15 MeV***





Plot ΔE-ΔE

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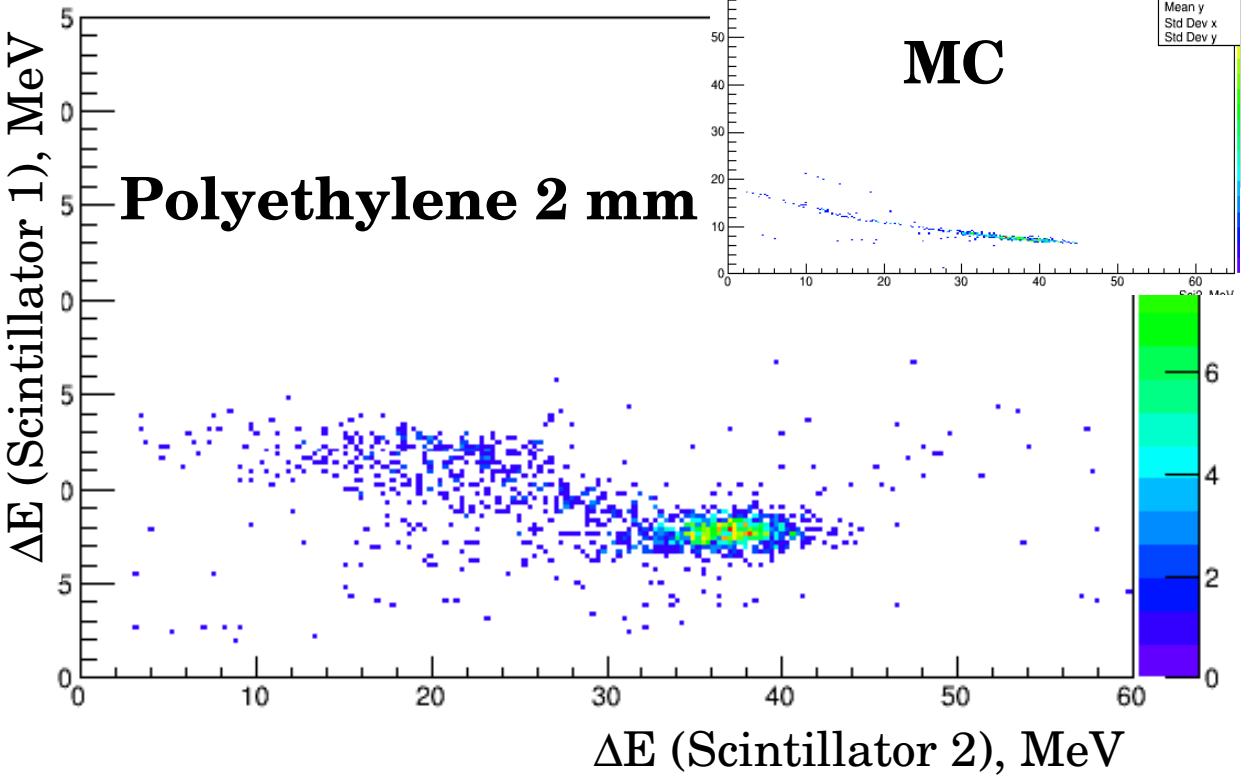
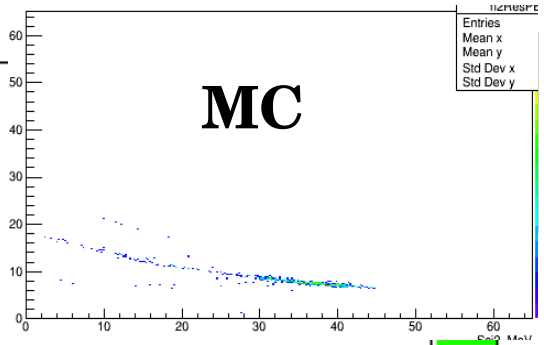
1st & 2nd Scintillators

Energy neutrons (TOF): ***60 MeV***

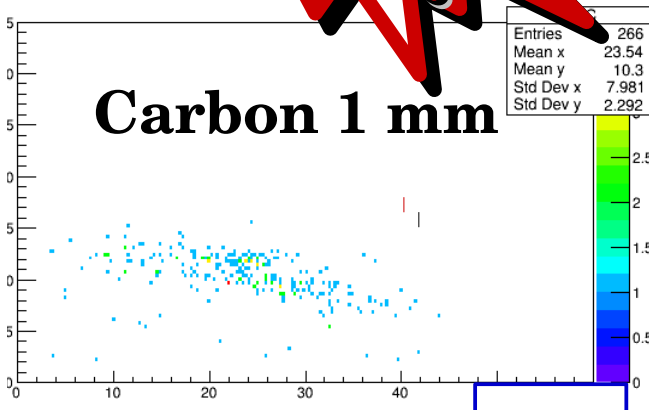
Polyethylene 2 mm



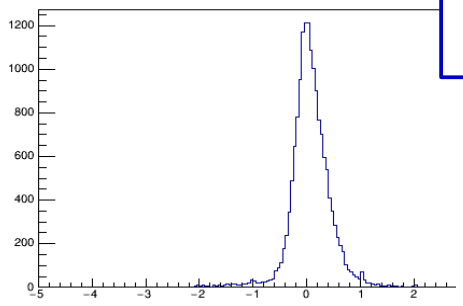
MC



Carbon 1 mm



dT



nTOF

Plot ΔE-ΔE

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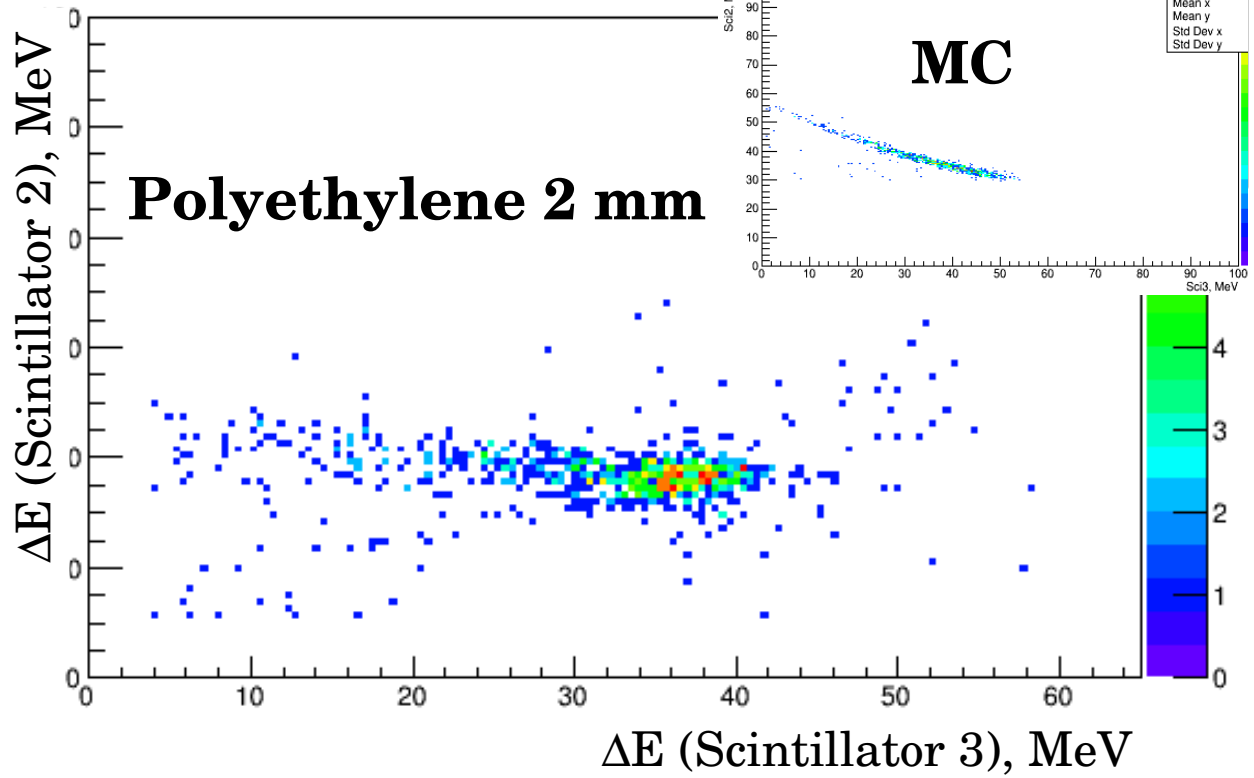
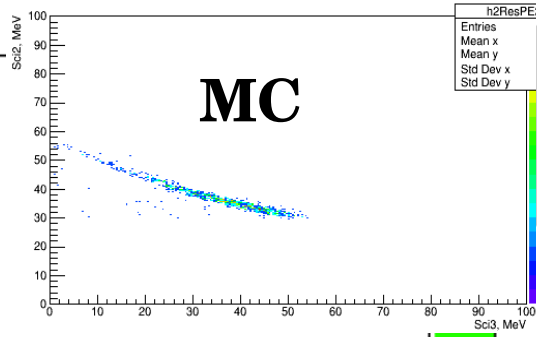
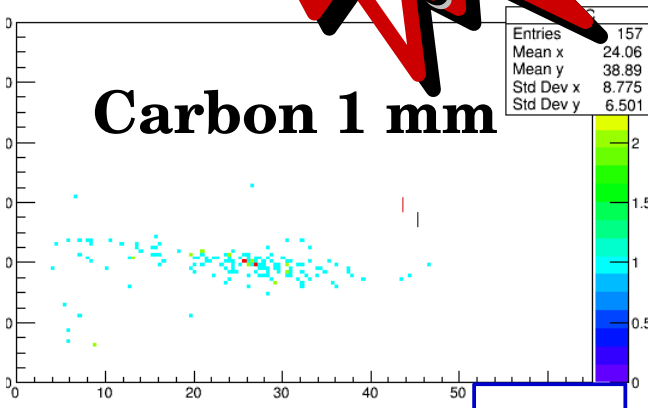
2nd & 3th Scintillators

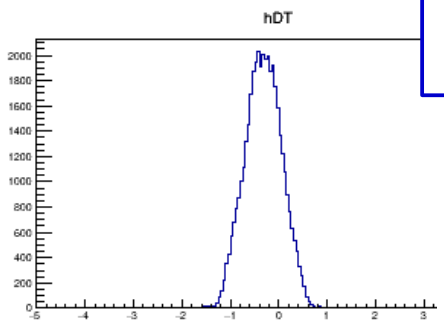
Energy neutrons (TOF): ***100 MeV***







dT



nTOF

Plot ΔE-ΔE

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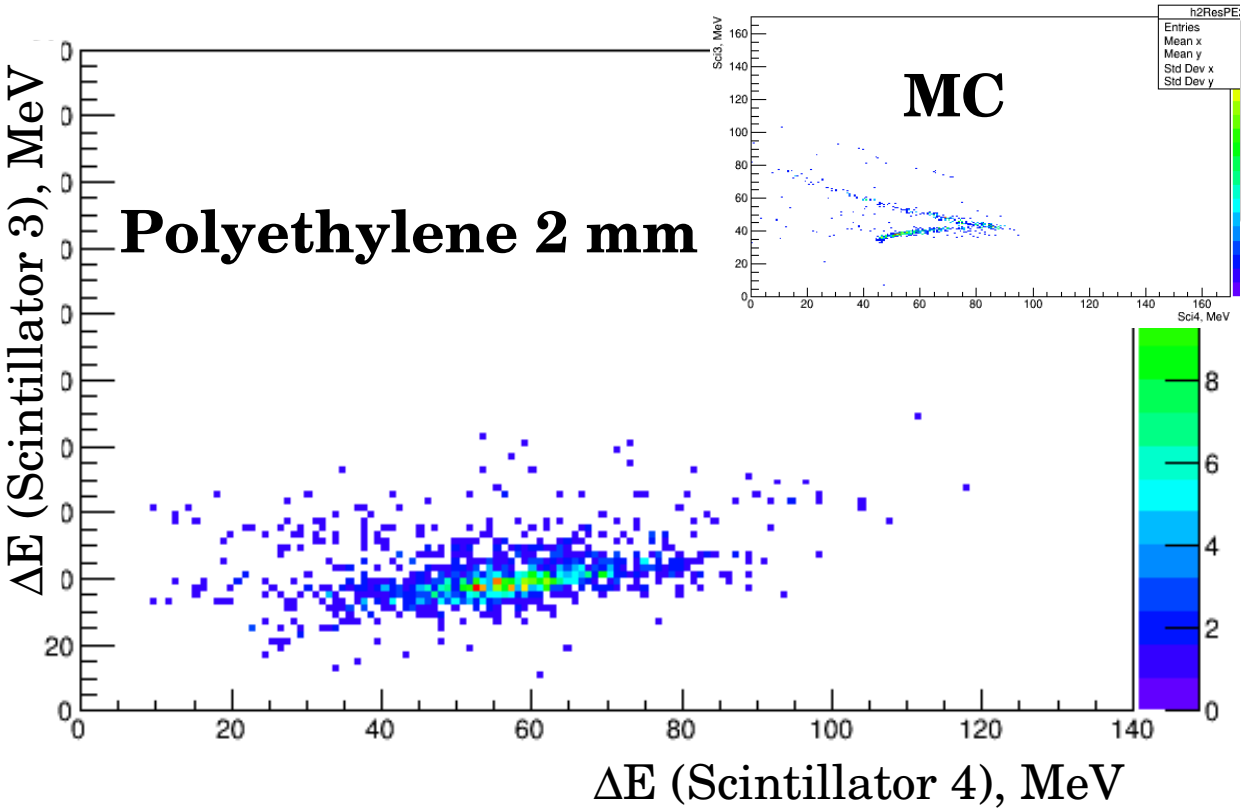
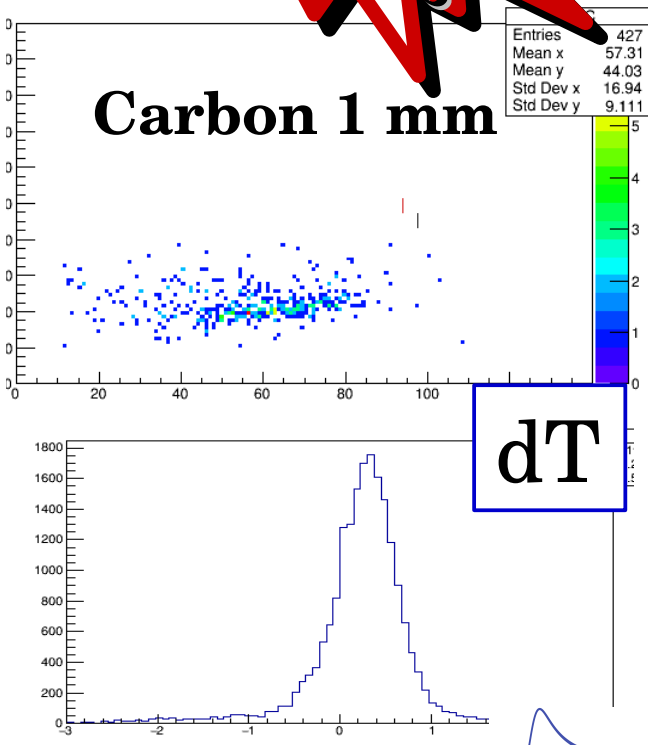
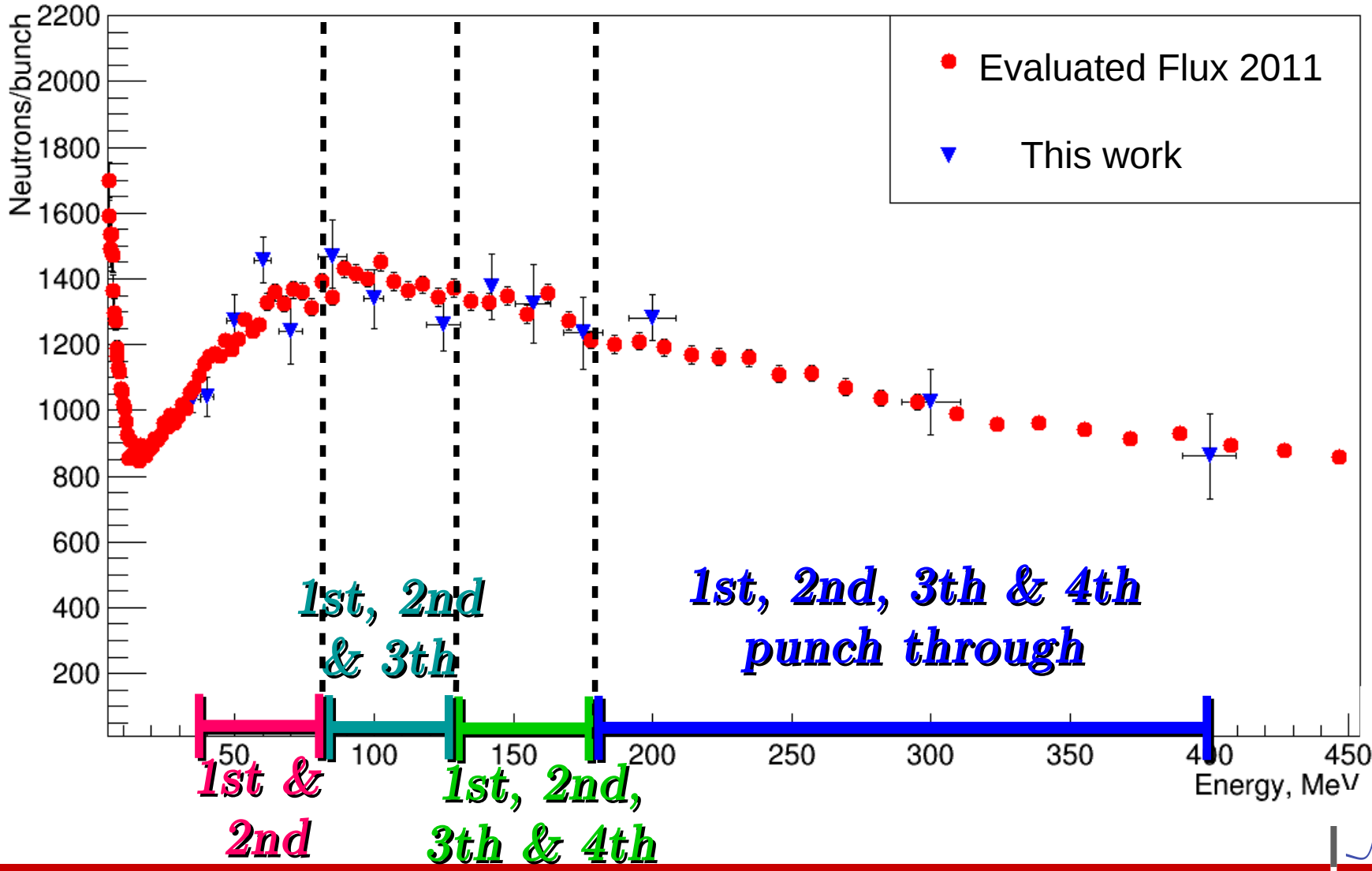
3th & 4th Scintillators

Energy neutrons (TOF): ***200 MeV***





Neutron flux



Conclusion

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- Silicon detectors work fine!
- Good particle discrimination at low energies

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Reaction $n+^{12}C \rightarrow \ldots$

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	Reaction Products	Q-value MeV	Threshold MeV
α →	$^{9}Be + \alpha$	-5.7	6.2
	$n + 3\alpha$	-7.3	7.9
	…	…	…
p →	$^{12}B + p$	-12.6	13.6
	$^{11}B + n + p$	-16.0	17.3
	…	…	…
d →	$^{11}B + d$	-13.7	14.9
	…	…	…
t →	$^{10}B + t$	-19.0	20.5