OAK RIDGE National Laboratory

Concepts for Integral Electron Measurements of ^{233,235}U and ^{239,241}Pu at HFIR

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On behalf of the super-e2-U focus group (ANU-BNL-UTK-ORNL)

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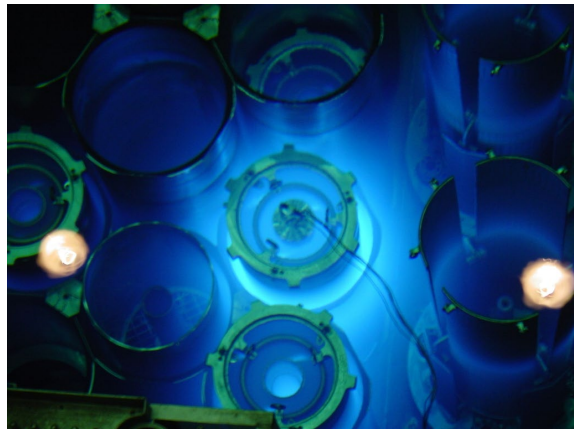
U.S. DEPARTMENT OF ENERGY

Primary Resources and Hardware Required

HFIR + REDC
(exists)



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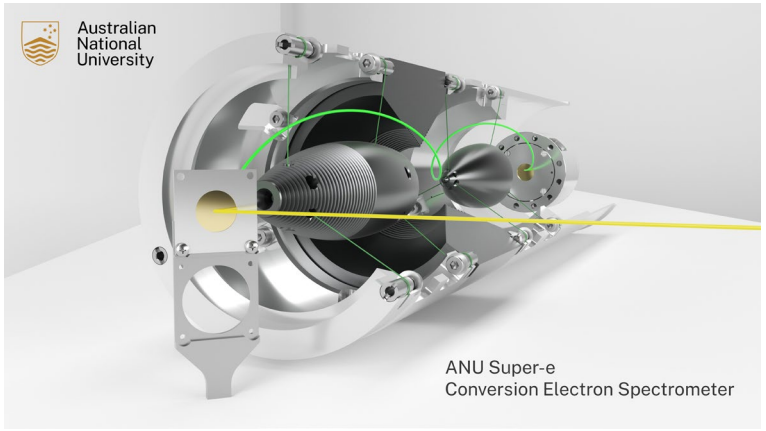
Solenoid
(build new super-e2)



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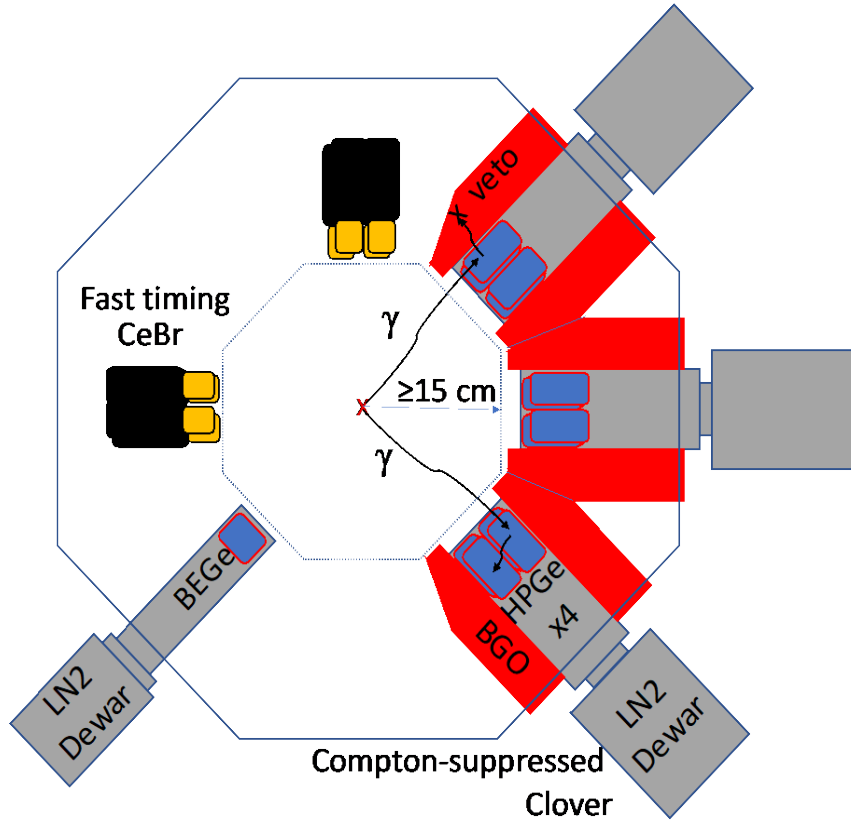
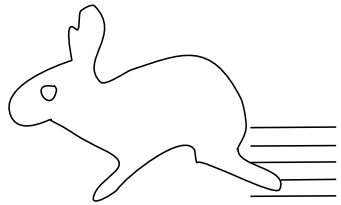
Gamma Array
(build new advanced γ-ray array)



*cost range $10-15M (includes labor, overhead, and contingency)

Scenario 1 (offline): Rabbit + Thin Foil + super-e2

A) Rabbit (irradiation in reactor core)



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Thin "pure" U/Pu foil (~100-150 μg/cm^2)
Thin Be backing / sandwich (~50-100 μg/cm^2)
*Need "blank frame + Be too for background

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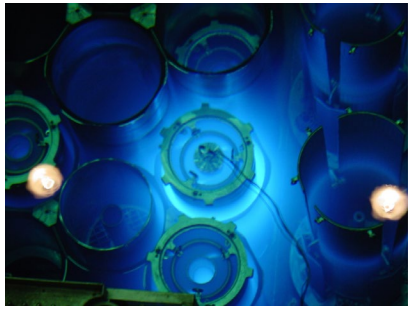
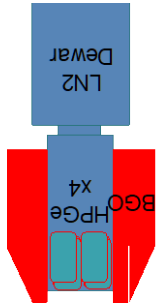


n flux ~ 10^{15}

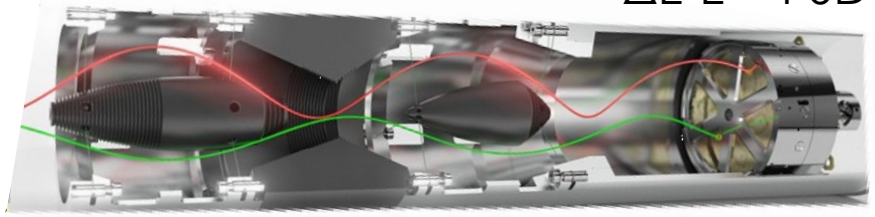
B) Offline Count far from reactor core

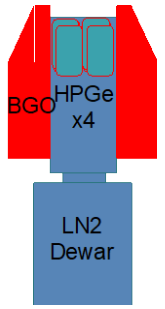
Measure:
Y(electron Energy; ^{235}U)
Y(electron Energy; ^{239}Pu)



(new Super-e2) Solenoid

(SiPM-scintillator) ΔE-E + PSD





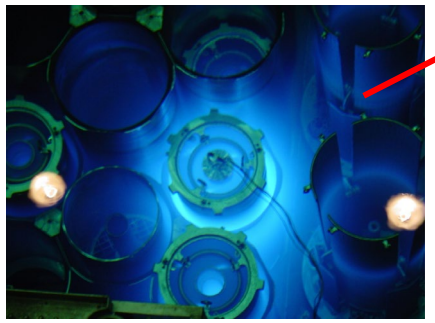
Notes:

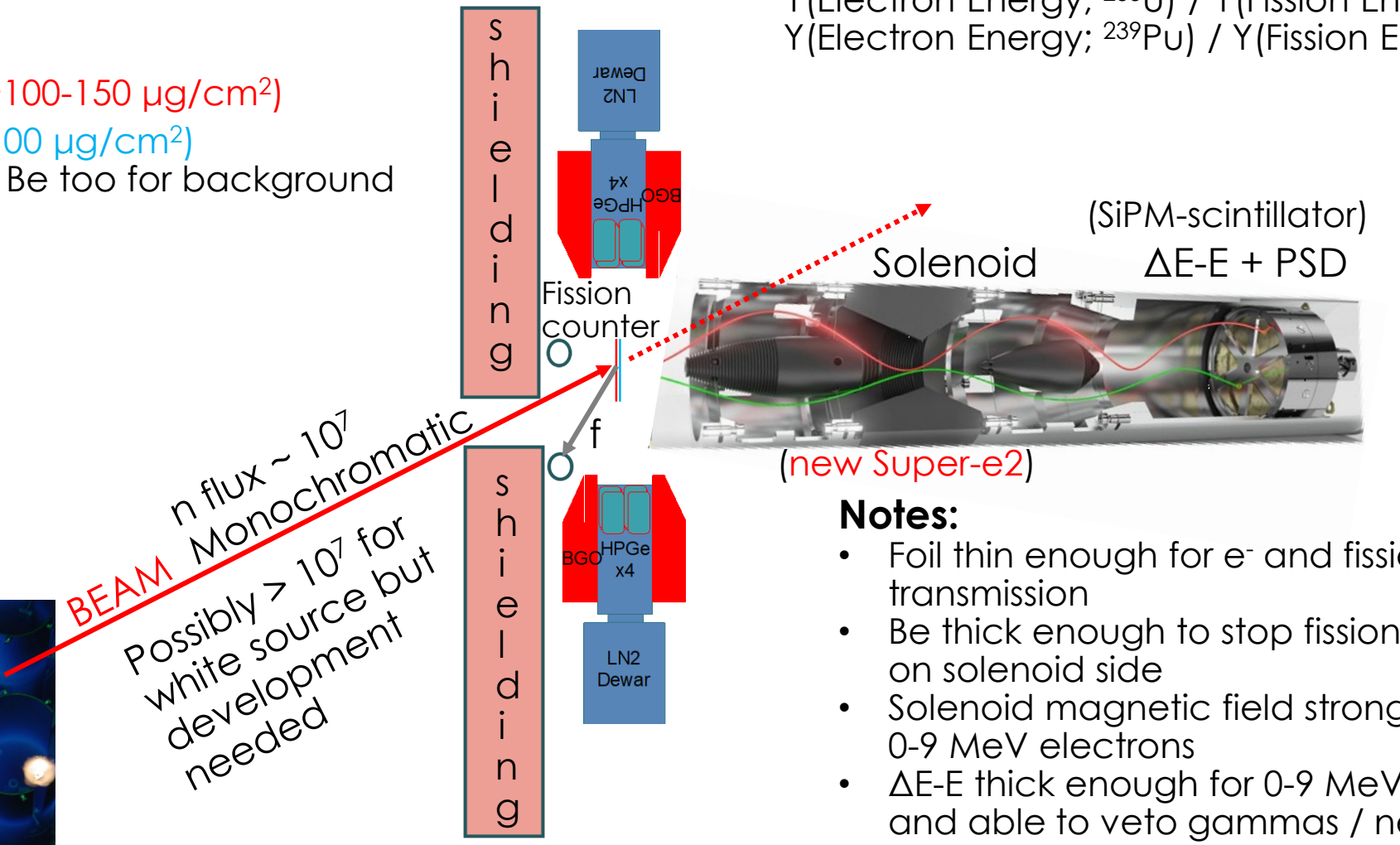
- Foil thin enough for e$^-$ transmission
- Foil / Be thick enough to stop fission fragments
- Solenoid magnetic field strong enough for 0-9 MeV electrons
- ΔE-E thick enough for 0-9 MeV electrons and able to veto gammas / neutrons
- No direct line of sight between foil and ΔE-E detector.

Scenario 2 (online): n-beam + Thin Foil + super-e2

A) Online Count near the reactor core

Thin "pure" U/Pu foil (~100-150 μg/cm^2)
Thin Be backing (~50-100 μg/cm^2)
*Need "blank frame + Be too for background





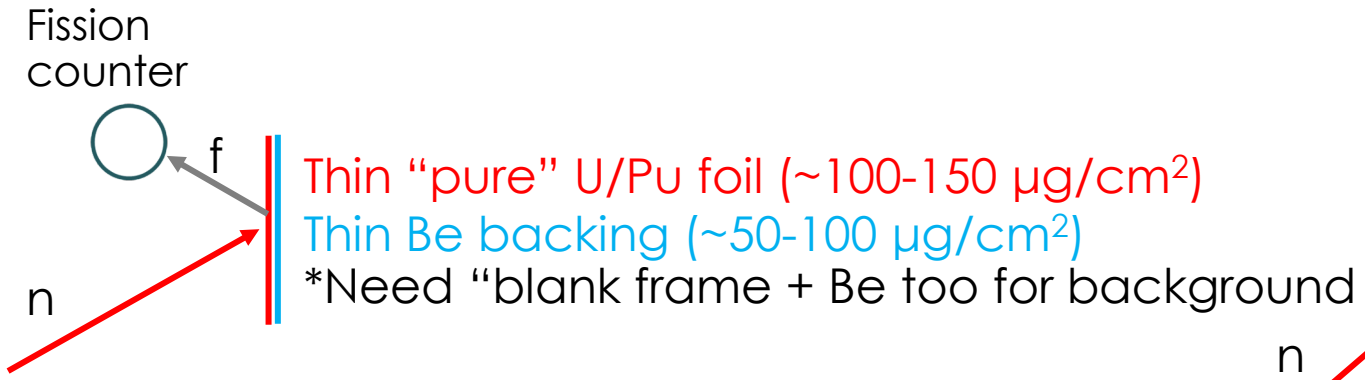
Measure:
Y(Electron Energy; ^{235}U) / Y(Fission Energy; ^{235}U)
Y(Electron Energy; ^{239}Pu) / Y(Fission Energy; ^{239}Pu)

Notes:

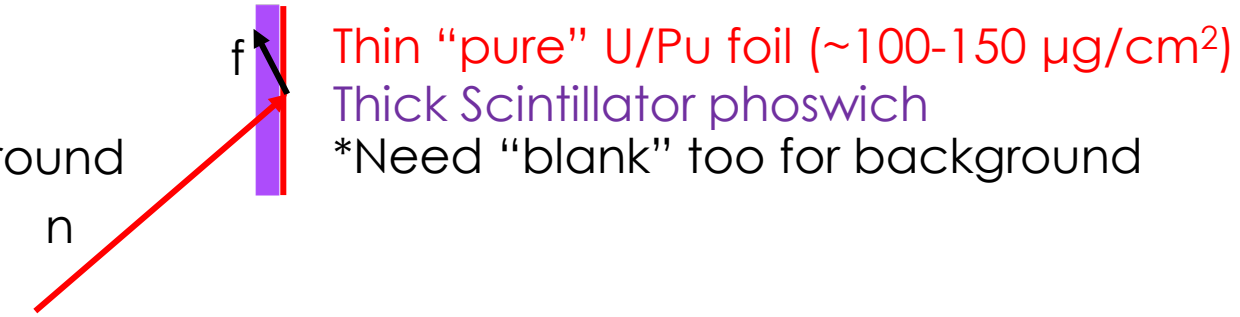
- Foil thin enough for e$^-$ and fission fragment transmission
- Be thick enough to stop fission fragments on solenoid side
- Solenoid magnetic field strong enough for 0-9 MeV electrons
- ΔE-E thick enough for 0-9 MeV electrons and able to veto gammas / neutrons
- No direct line of sight between foil and ΔE-E detector.

Fission Counter Concepts for "Online" (normalization)

A) Backward detector



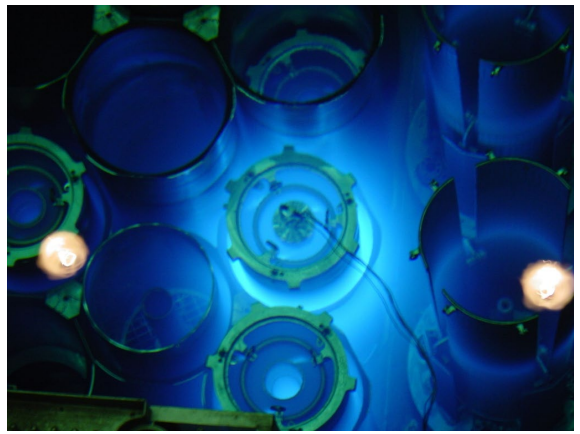
B) Active "Backing"



What Would Come After Measurements? Transform Device into a General Purpose HFIR Decay Station (HDS)

- Cross division / directorate / mission device
- U/Pu Detection Science
- Forensics / Monitoring
- Neutron-induced cross sections
- Decay heat
- Nuclear Structure (e.g., Precision E0s, branches, …)

HFIR + REDC
(exists)



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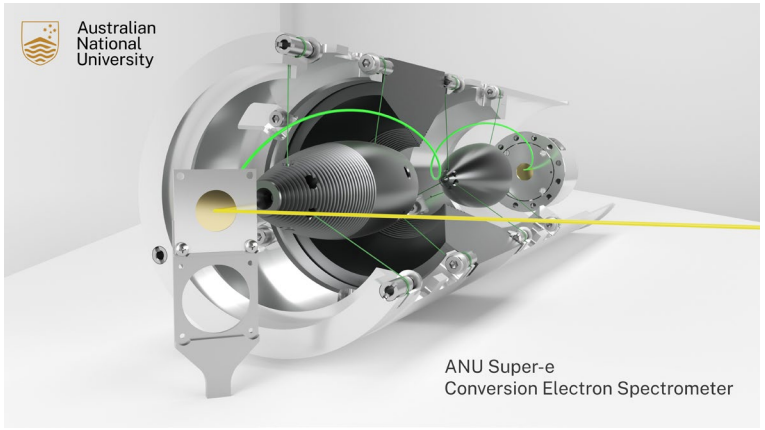

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