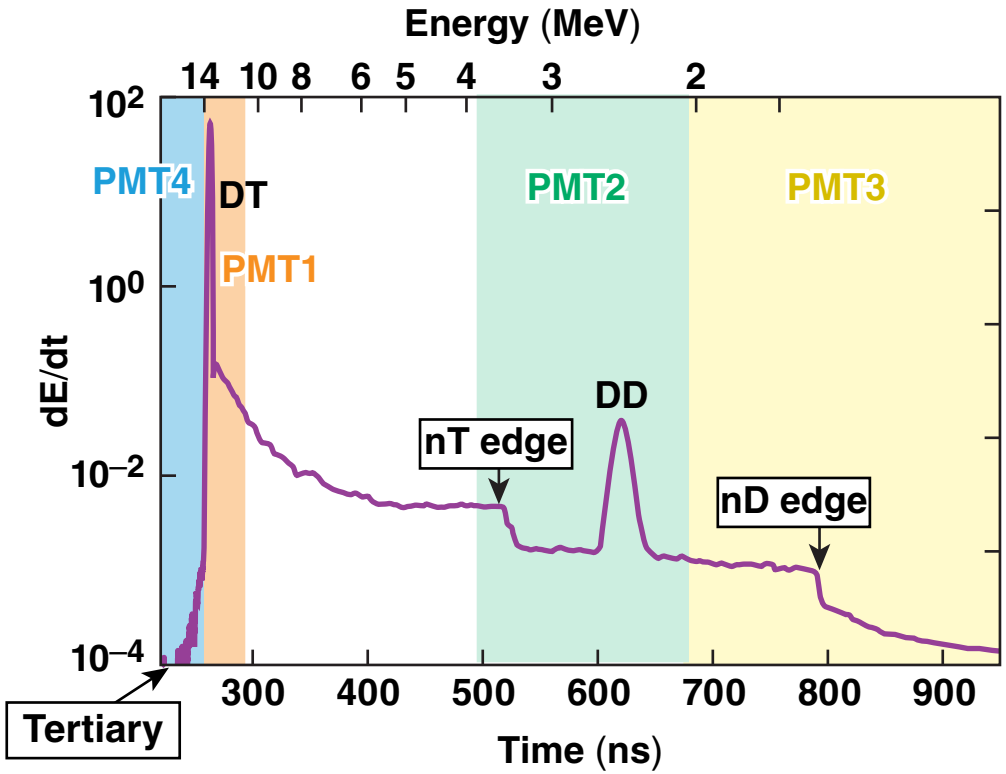
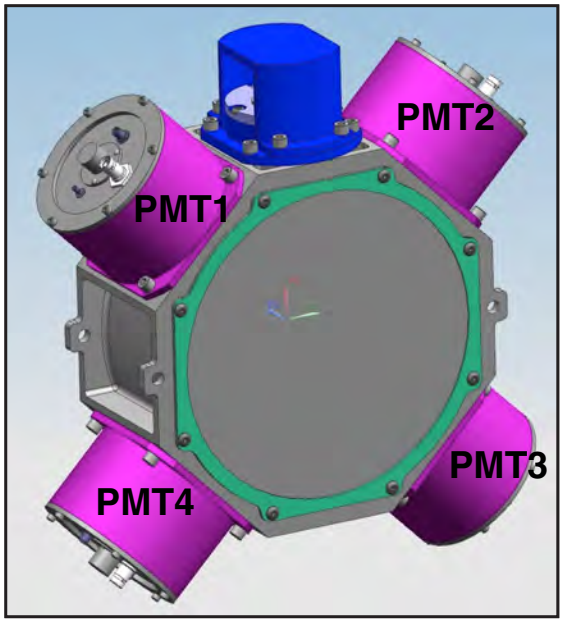
A New Neutron Time-of-Flight Detector for Areal Density Measurements on OMEGA





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Summary

A new neutron time-of-flight (nTOF) detector for areal-density measurements was implemented on OMEGA

UR LLE

- The new OMEGA 8 × 4 nTOF detector
  - has an 8-in.-diam, 4-in.-thick scintillator cavity
  - uses an oxygenated xylene scintillator
  - uses four fast-gated photomultiplier tubes (PMT's) with different gains
- More measurements can be made on a single shot
  - measure primary DT yield
  - measure nT – edge part of the spectrum to calculate* ρR
  - measure nD – edge part of the spectrum to calculate* ρR
  - to study neutrons with $E > 14$ MeV

E22601

*C. J. Forrest *et al.*, UO4.00013, this conference.

Collaborators

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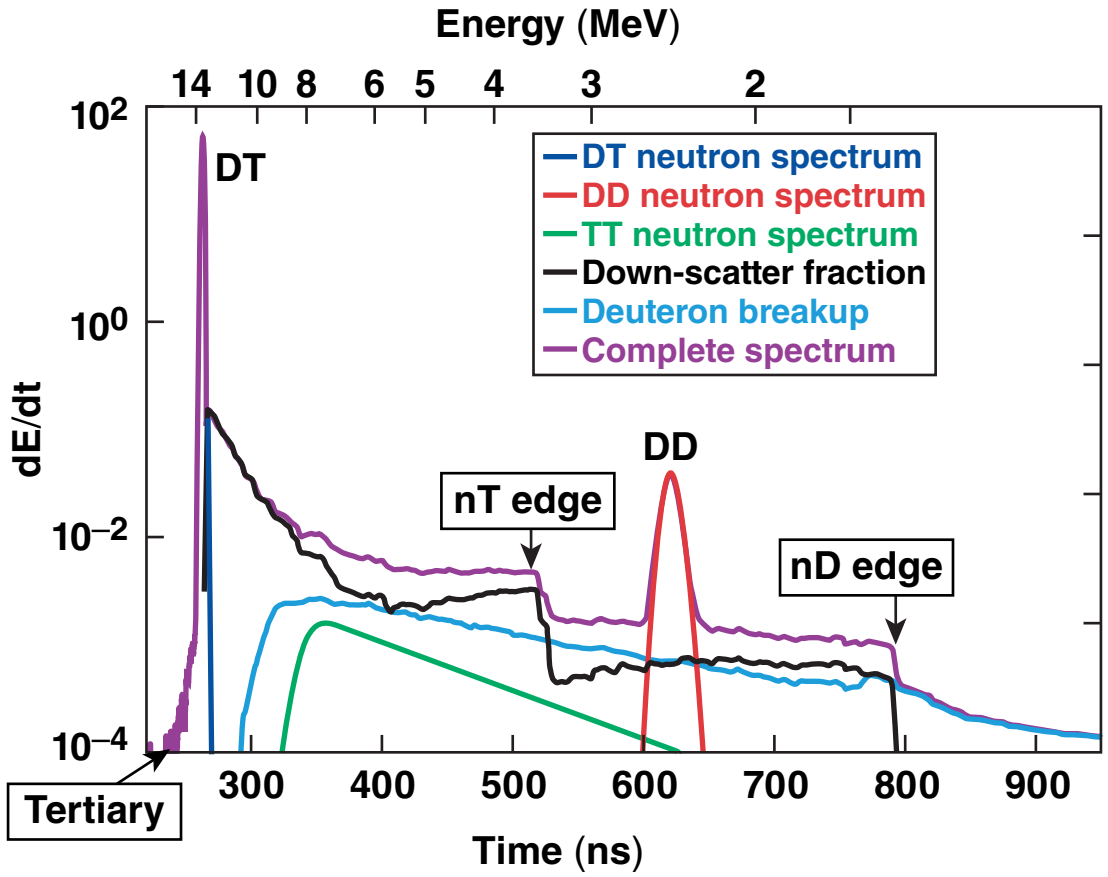
A time-of-flight neutron spectrum in DT implosion consists of at least six separate neutron contributions



Neutron reaction	%
DT fusion	95.6
DD fusion	0.8
TT fusion	0.3
Downscattered	0.0 to 3.5
Deuteron breakup	0.0 to 1.6
Tertiary neutrons	~0.0001

Several gated PMT's with different sensitivity are needed to record separate parts of neutron spectrum.

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The 8 × 4 nTOF detector has a thin-wall stainless-steel cavity filled with an oxygenated xylene scintillator*

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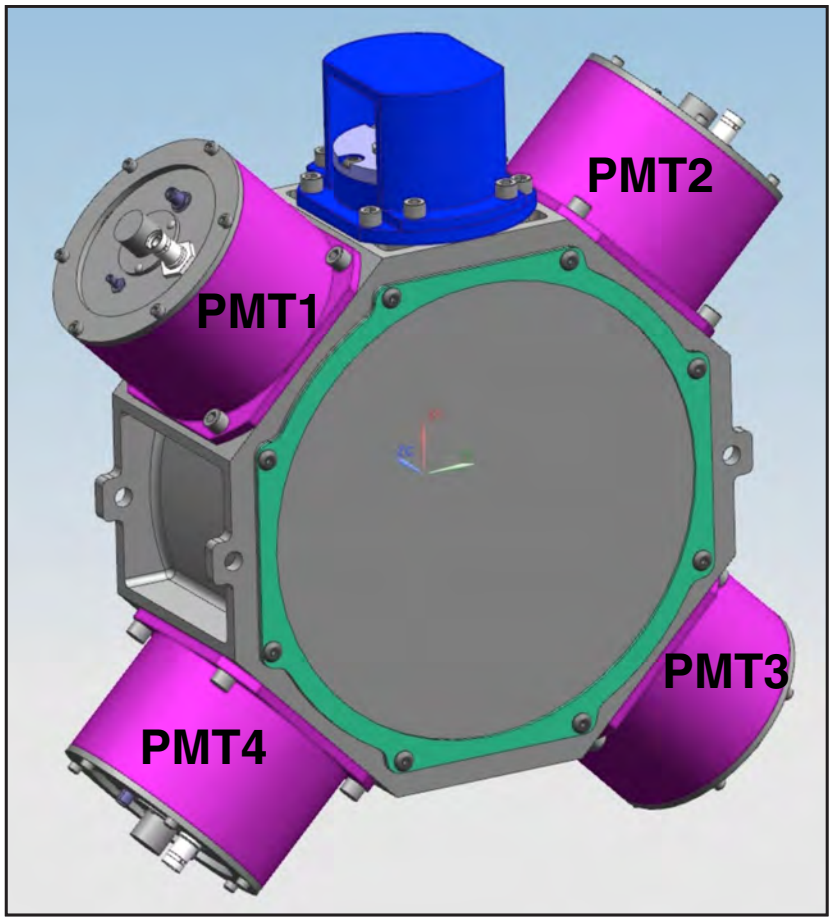
Detector model

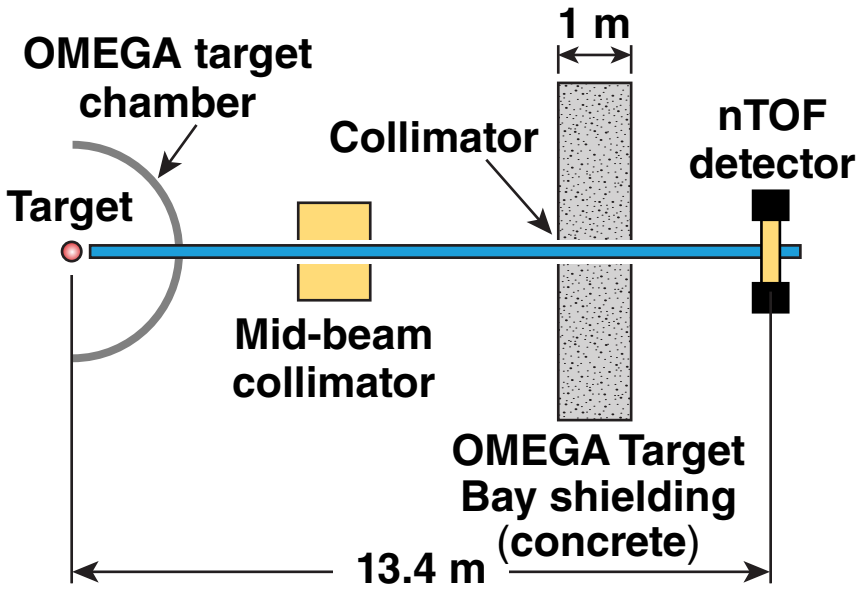


Scintillator body during manufacturing

E22603

*C. Stoeckl *et al.*, Rev. Sci. Instrum. 81, 10D302 (2010).

The 8 × 4 nTOF detector is located in the collimated line of sight 13.4 m from target chamber center (TCC) on OMEGA



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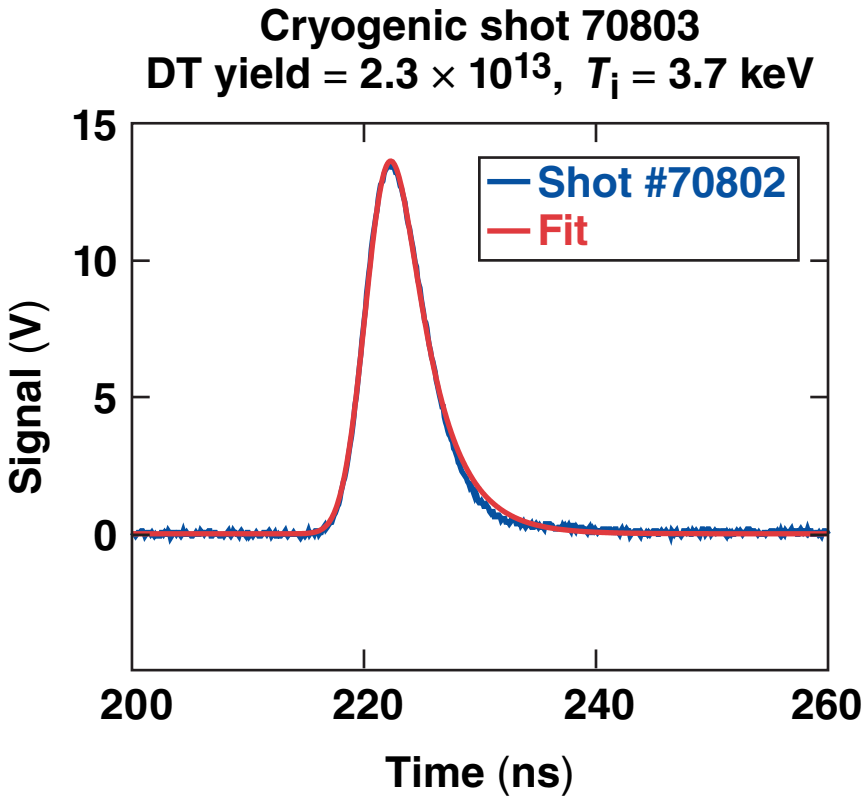
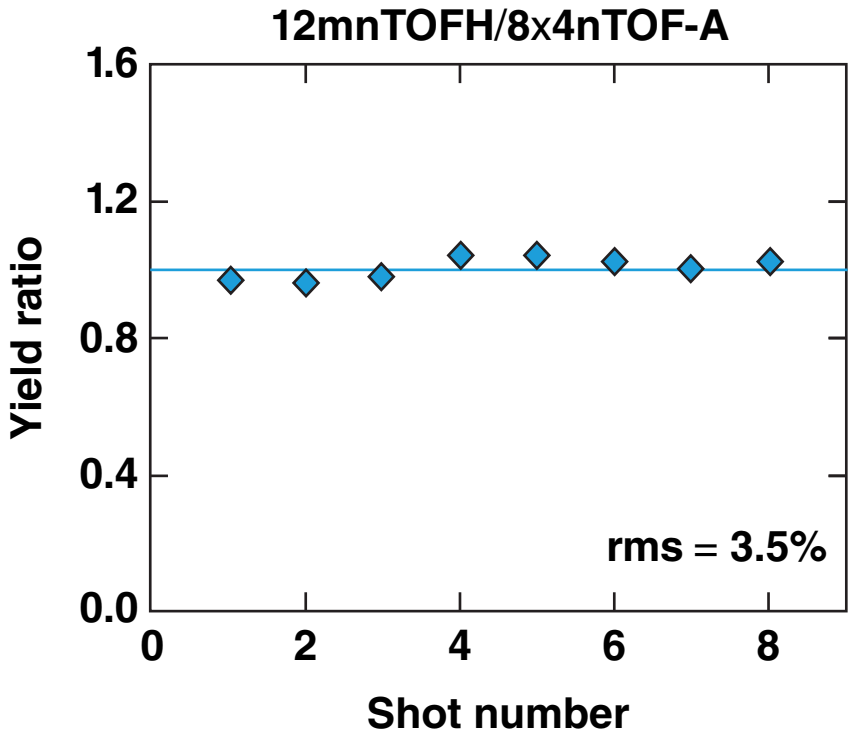
The primary DT neutrons were measured by an ungated PMT140 with gain of 8.6×10^2





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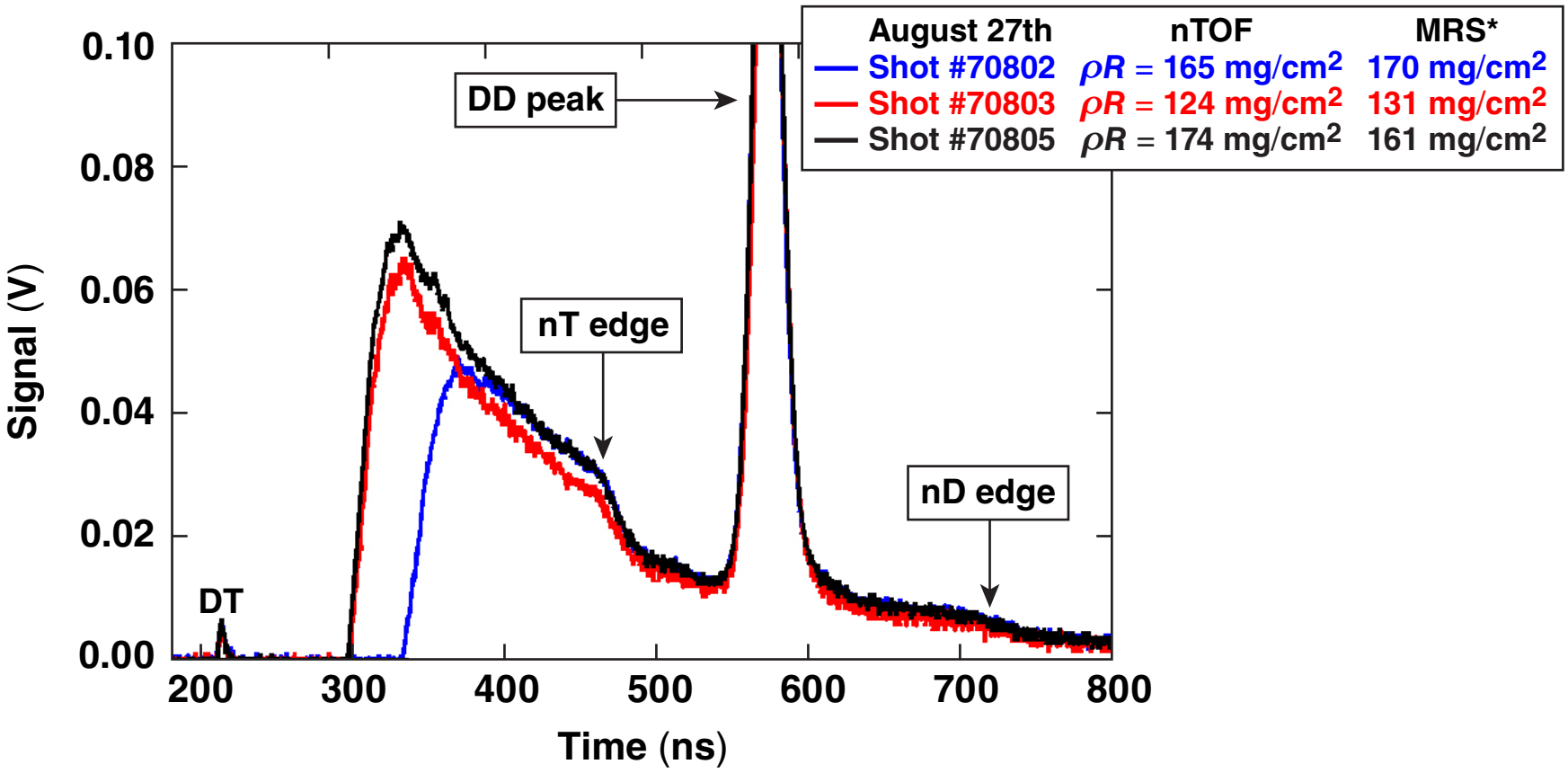
The areal density is measured in the nT-edge region by gated PMT240 with gain of 6.2×10^3

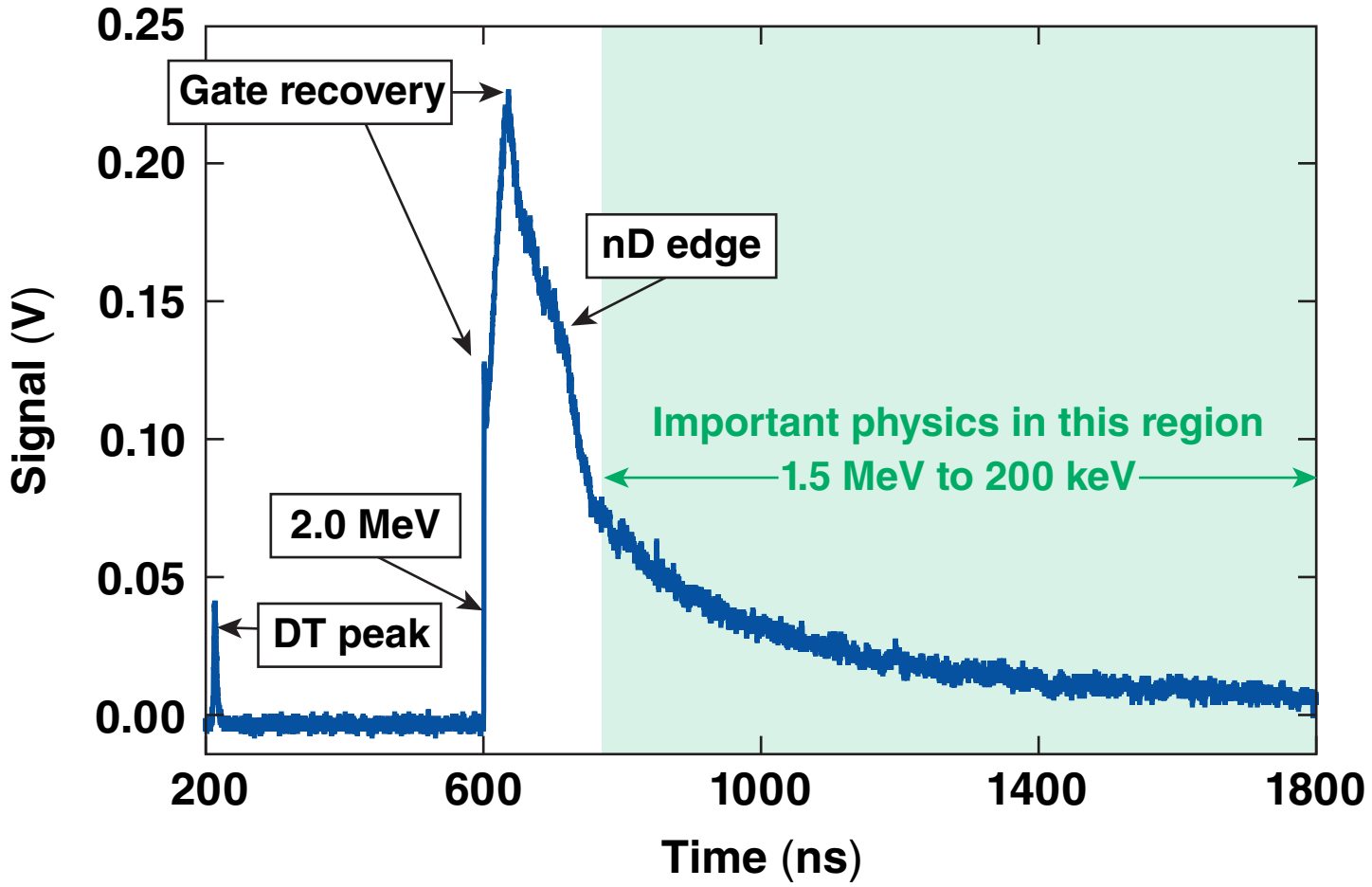


Accurate measurement of nD edge requires a different PMT with gated-out DD peak.

E22606

*Magnetic recoil spectrometer

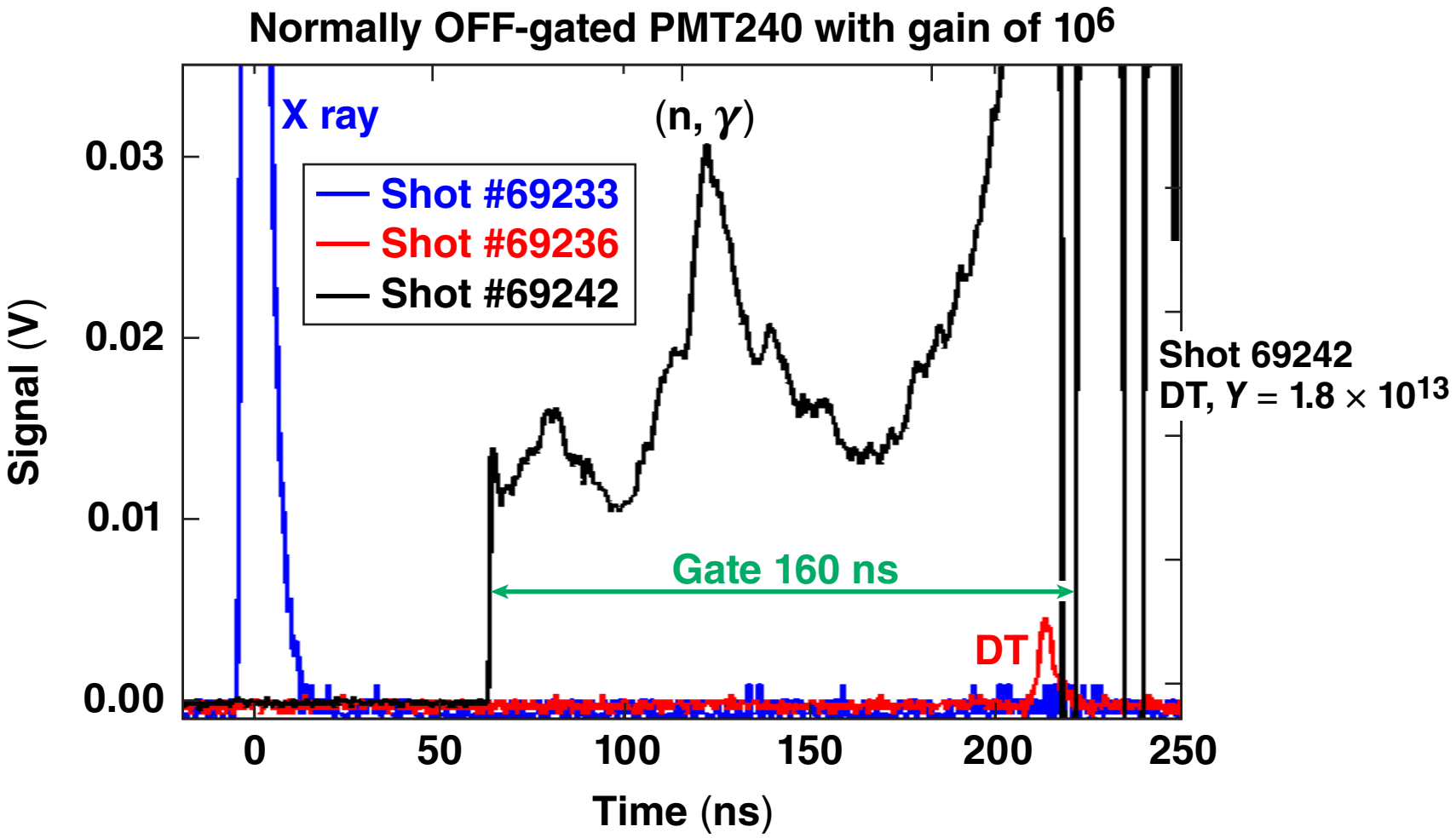
The 8 × 4 nTOF detector with a fast gated PMT measured a high-resolution nD kinematic edge below 2 MeV



The signal below 1.5 MeV consist of the residual neutron scattering background, TT reaction , and a deuteron breakup contribution.

E22607

The 8 × 4 nTOF with a new PMT demonstrated the technical ability to measure neutrons with $E > 14$ MeV



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Summary/Conclusions

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