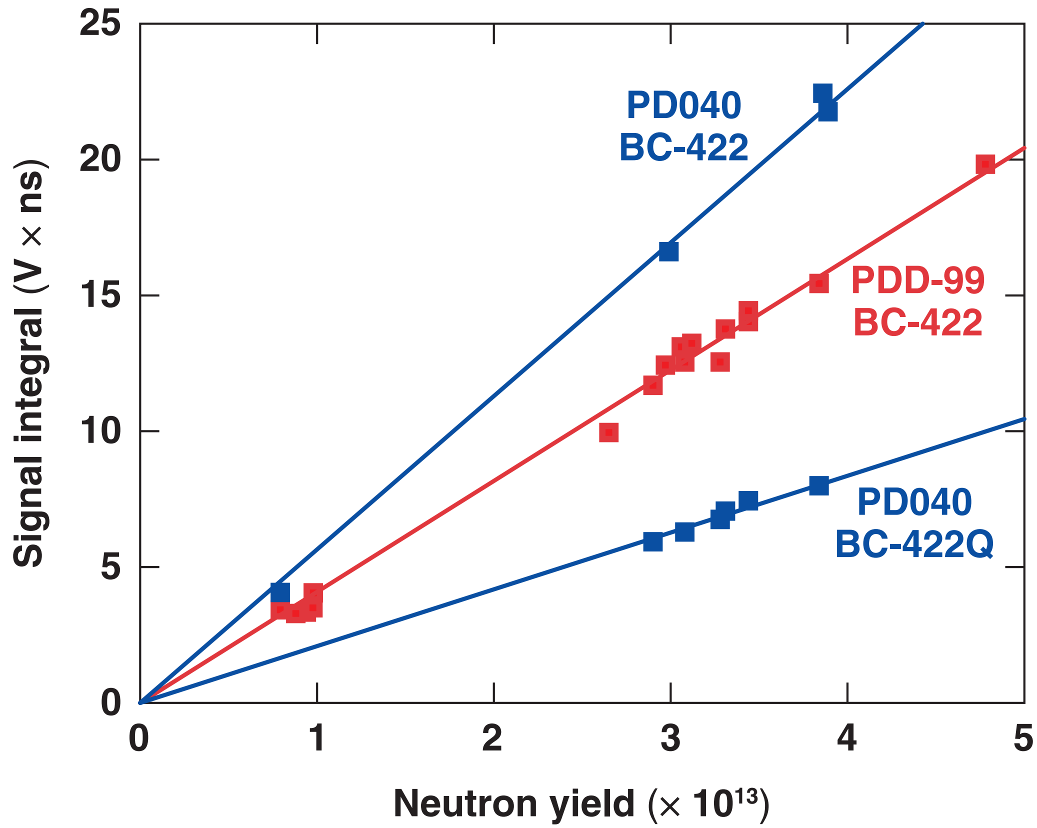
Neutron Time-of-Flight Detectors Based on Vacuum Photodiodes for the NIF and LMJ



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Summary

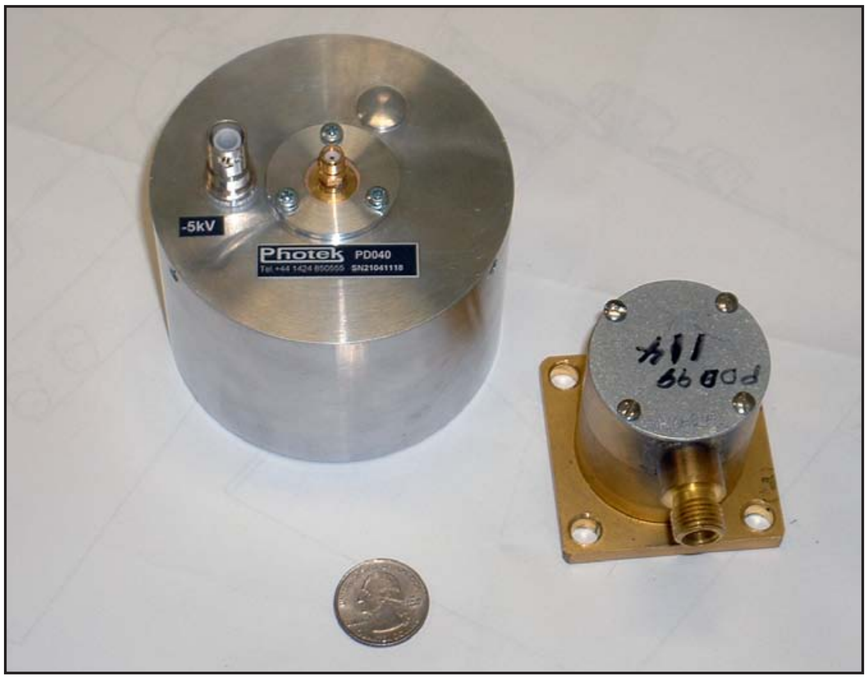
Detectors based on vacuum photodiodes are well suited as nTOF detectors for the NIF and LMJ

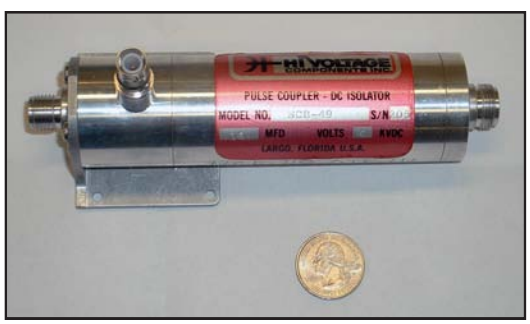
UR LLE

- Vacuum photodiodes have a high bandwidth, a large linear dynamic range, and low background sensitivity.
- The vacuum photodiode detector installed on OMEGA at 5.3 m from TCC can measure DT yields and ion temperatures from 1×10^{12} to 5×10^{15}.
- nTOF detectors based on vacuum photodiodes will complement CVD diamond detectors on the NIF and LMJ.

E14175

Two nTOF detectors with different types of vacuum photodiodes were tested on OMEGA





PD040

- **Vendor: Photek**
- **40-mm S20 photocathode**
- **SMA and SHV connectors**
- **40-mm × 10-mm scintillator**
- **BC-422 and BC-422Q (1%)**
- **HV up to –5 kV**

PDD-99 (discontinued)

- **Vendor: EG&G**
- **22-mm S20 photocathode**
- **One nonstandard connector**
- **Dividing capacitor, HV –3 kV**
- **24-mm × 10-mm BC-422**

Two photodiodes were tested side by side on OMEGA with a CVD diamond detector at 5.3 m from TCC

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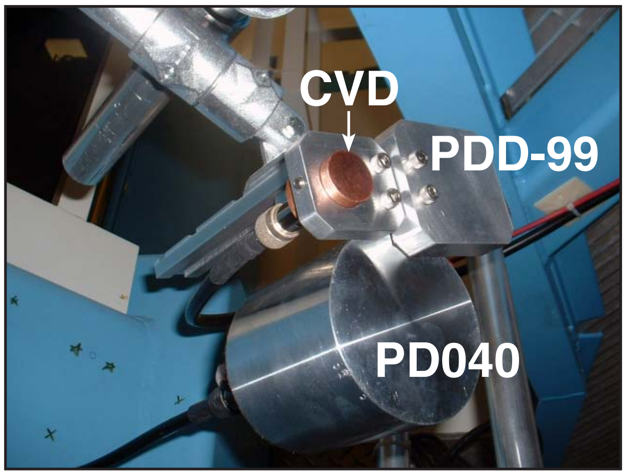
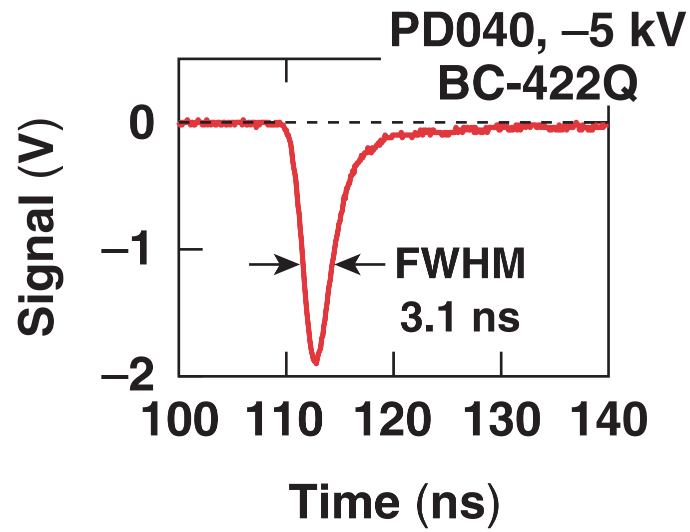
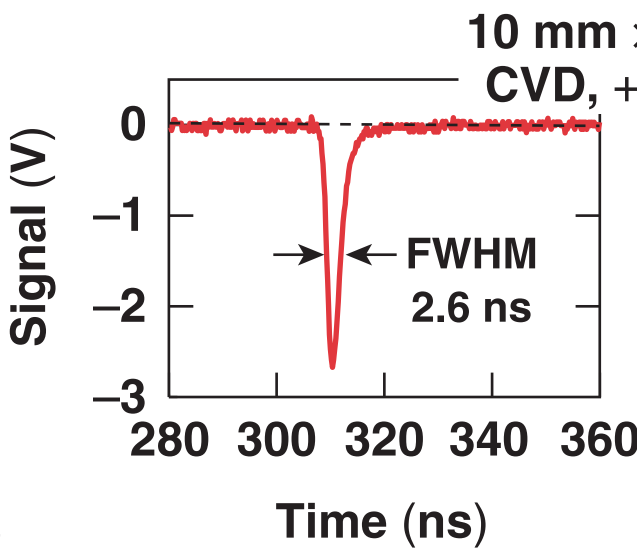
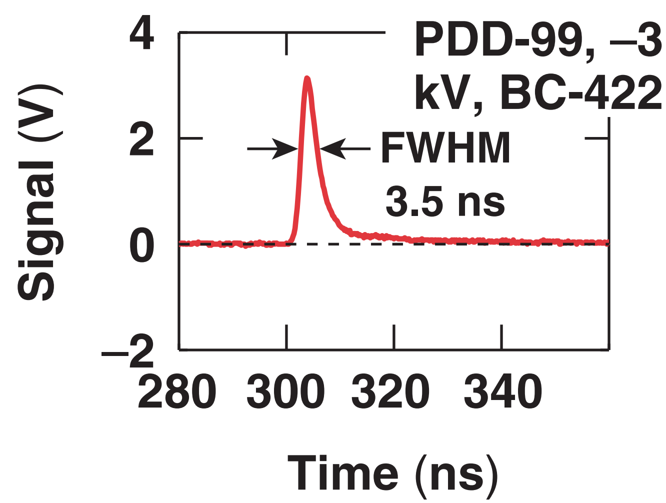
Shot 39810, $Y_n = 3.8 \times 10^{13}$









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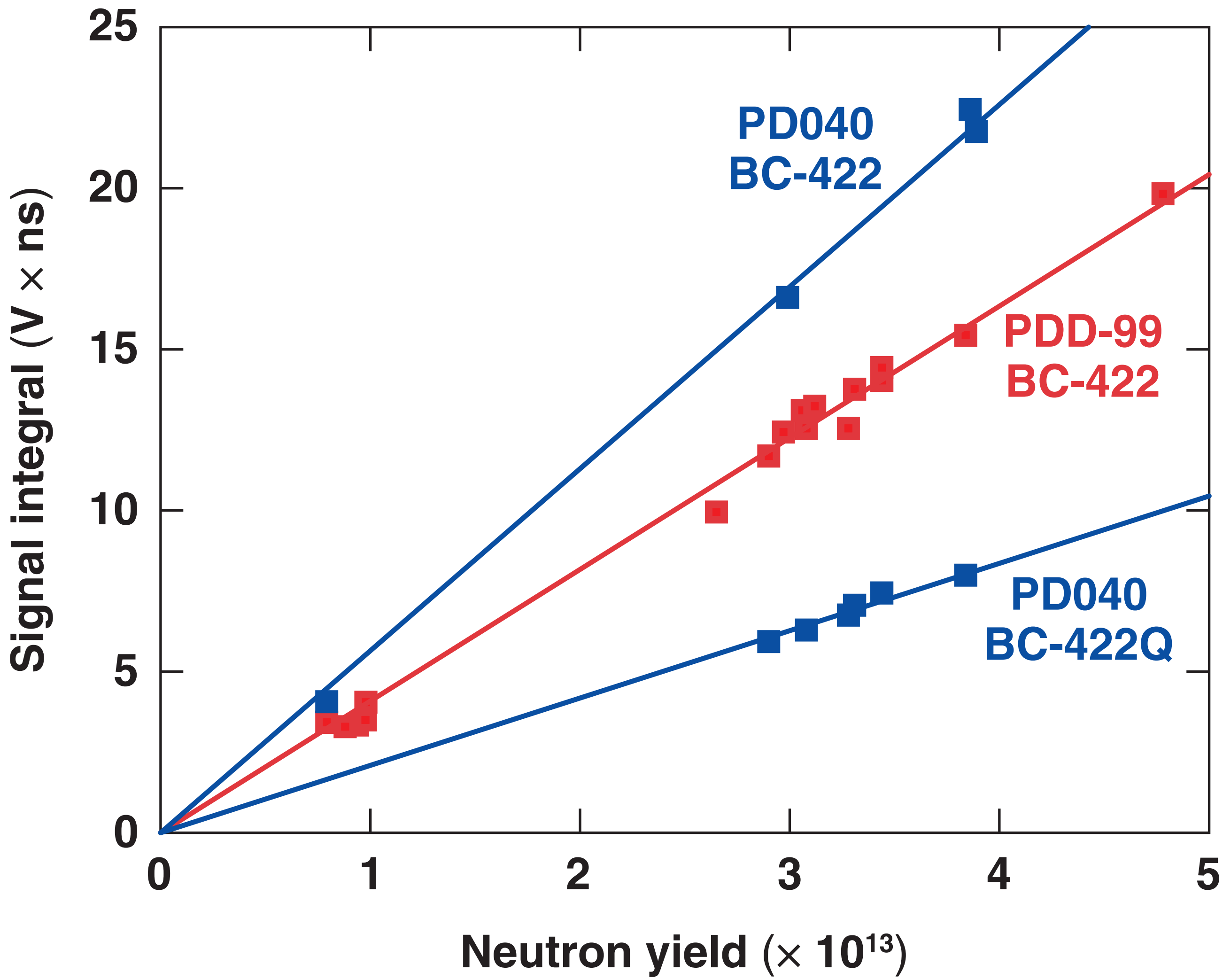
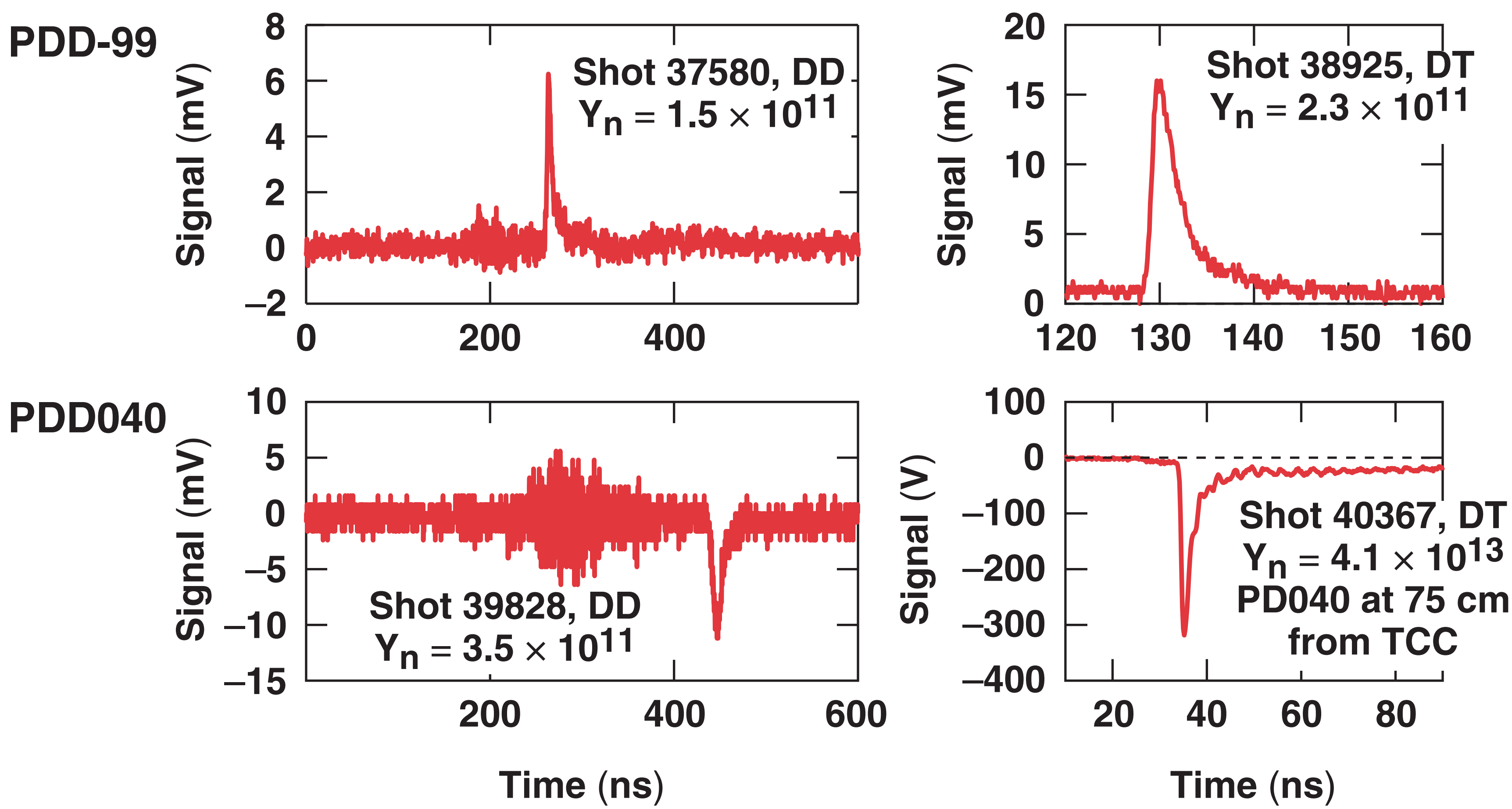
The sensitivity of nTOF detectors based on vacuum photodiodes was measured in high-yield DT shots



E14178

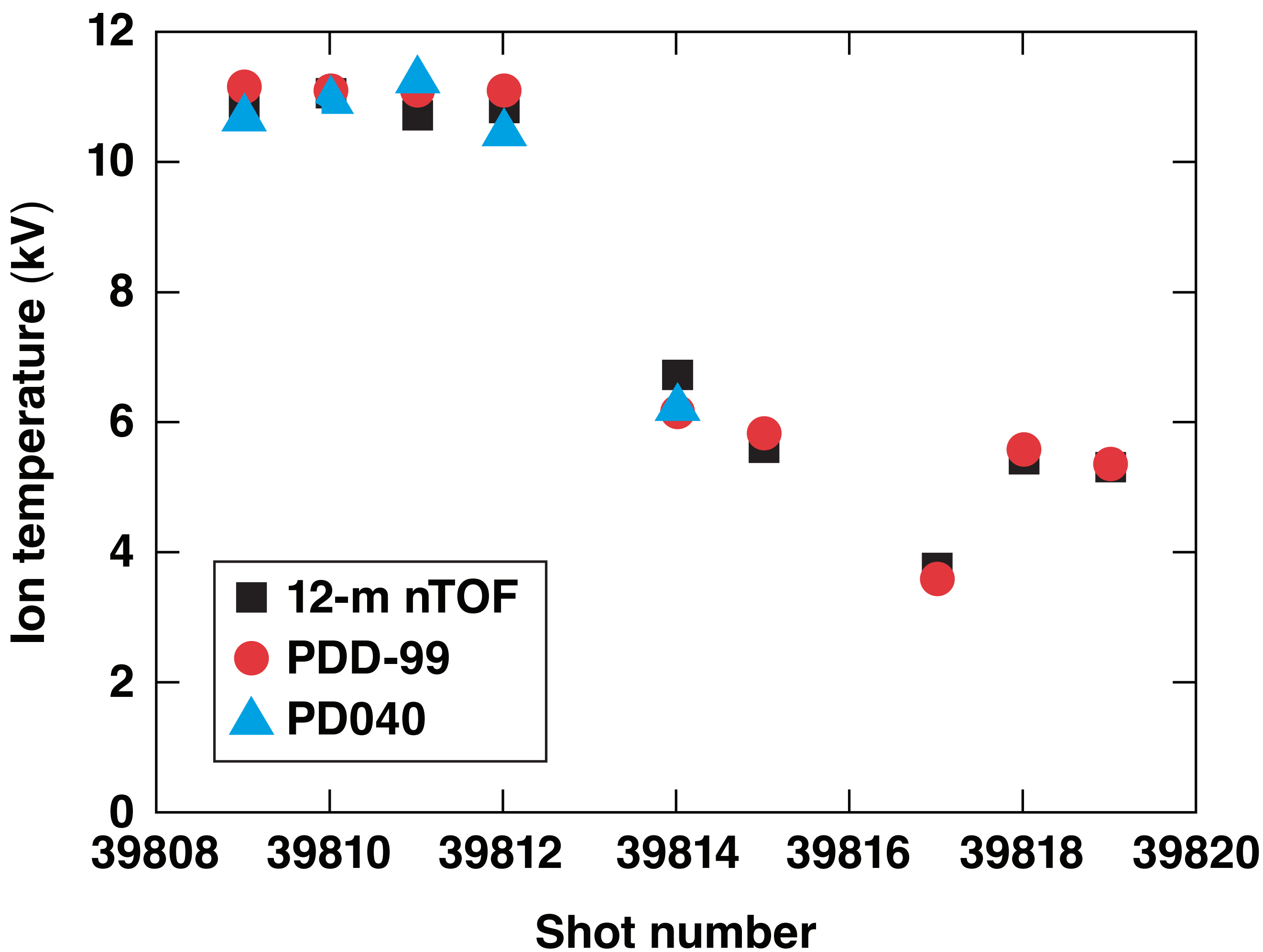
The yield range of photodiode nTOF detectors is limited by EMP noise at low yields and arcing at high yields



The photodiode nTOF detector on OMEGA at 5.3 m from TCC can measure DT yields up to 5×10^{15}.

E14179

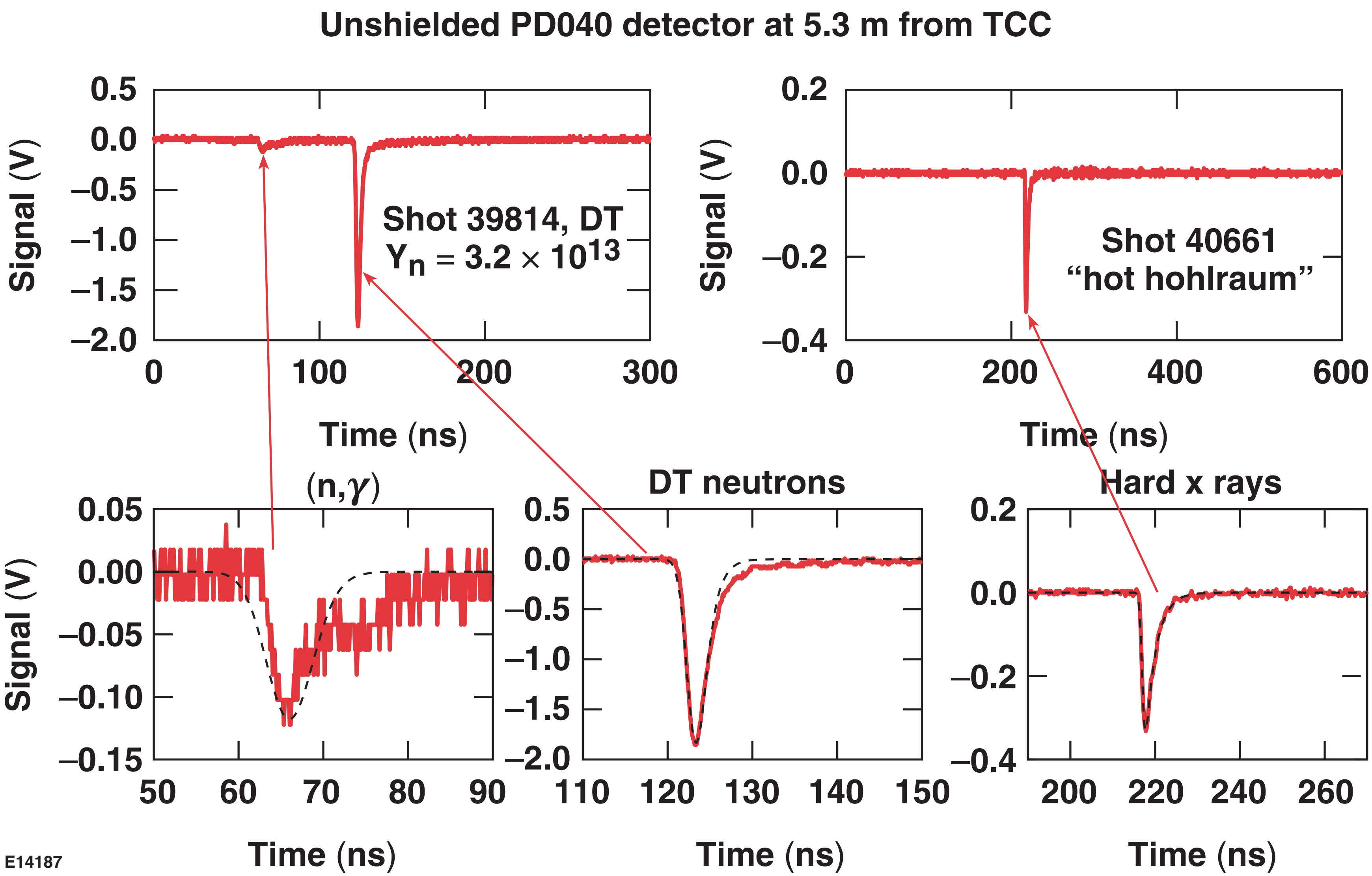
Ion temperatures measured with vacuum photodiodes and PMT-based nTOF detectors are in good agreement



E14180

nTOF detectors based on vacuum photodiodes have a low sensitivity to gamma and hard x rays

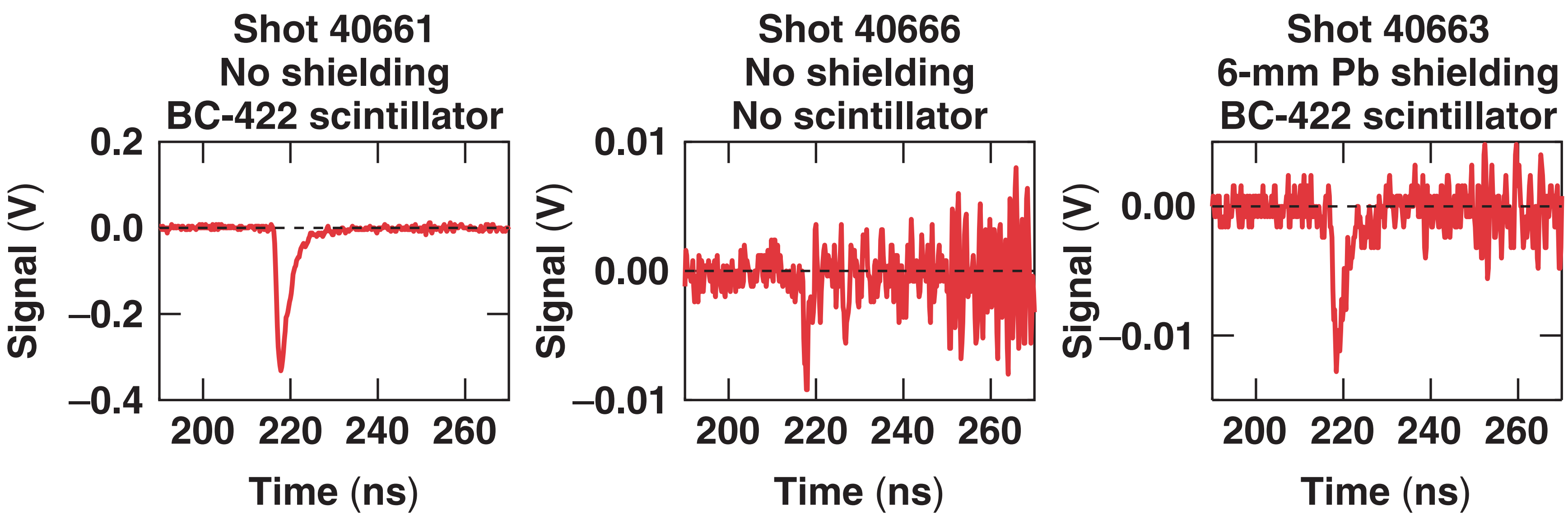
UR LLE



E14187

In photodiode nTOF detectors, 20- to 100-keV x rays interact mostly with the scintillator; it is easy to shield such x rays

- PD040 was tested on "hot hohlraum" shots that produced copious hard x rays.

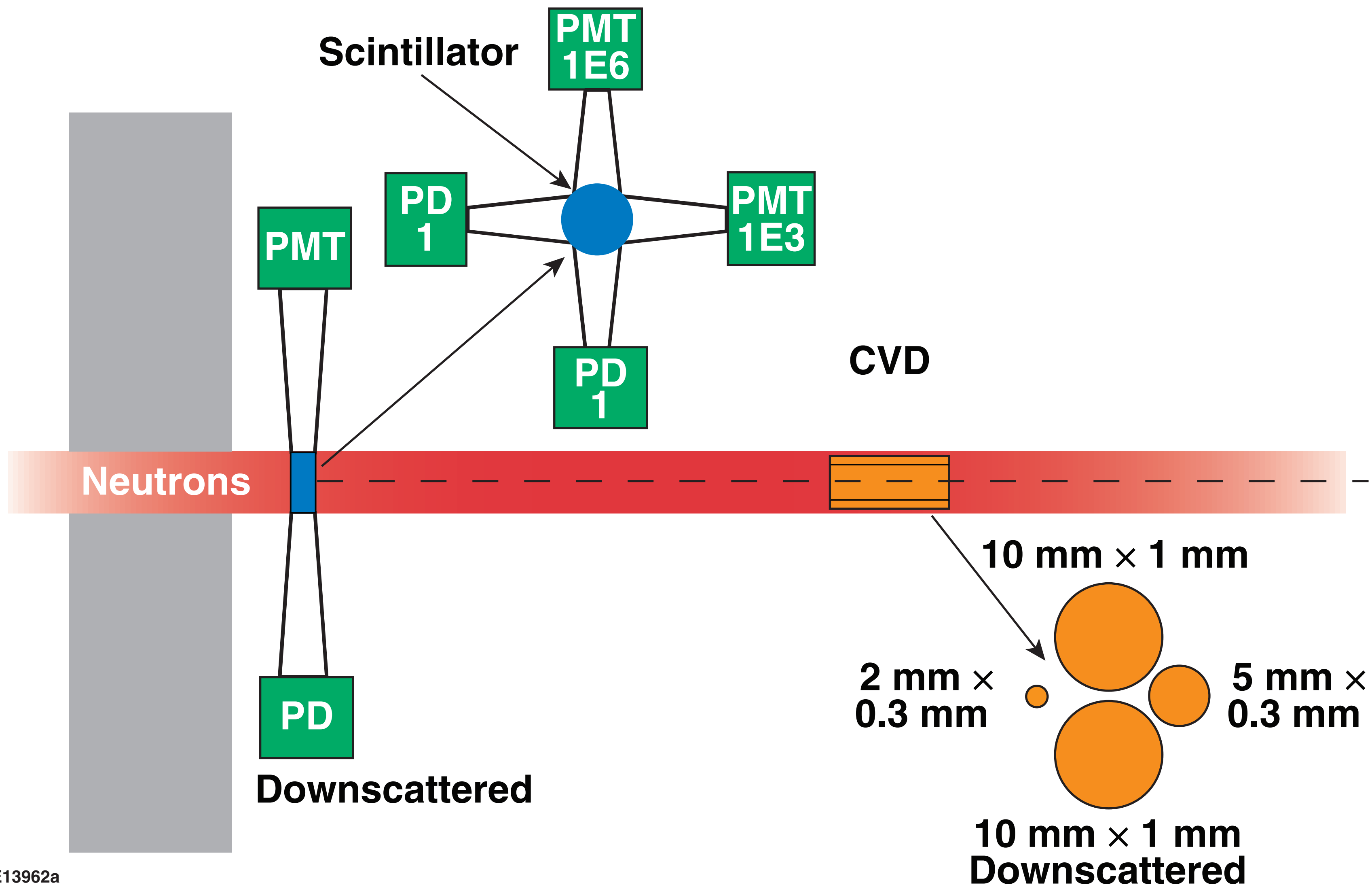


nTOF detectors based on vacuum photodiodes will complement CVD diamond detectors on future facilities

- **Advantages of nTOF detectors based on vacuum photodiodes**
  - bias T not required (no signal reflections, safer)
  - easier to configure for a wide range of yields (ND filters, size and type of scintillator)
  - the photodiode can be located behind shielding, outside of the neutron beam (no neutron-induced signals in cables)
- **Advantages of nTOF detectors based on CVD diamonds**
  - smal, thin CVD diamonds are faster than photodiodes
  - CVD diamond detectors are small (can be located close to the target or several detectors instead of one photodiode)
  - no scintillator decay tail

E14186

The proposed NIF nTOF system consists of a scintillator with a PMT and photodiodes and CVD diamond detectors



E13962a

Summary/Conclusions

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