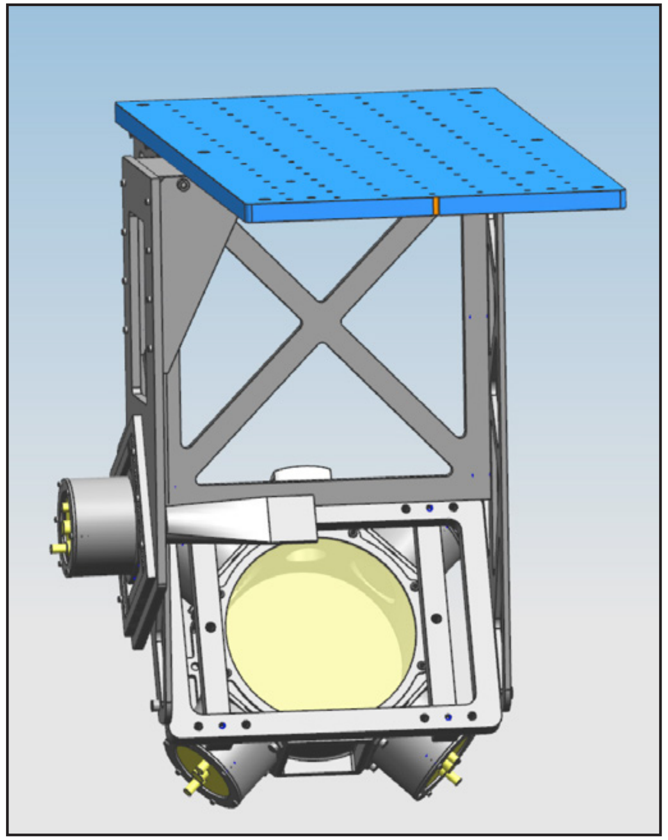
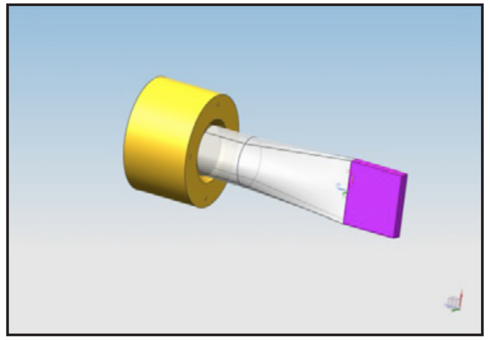
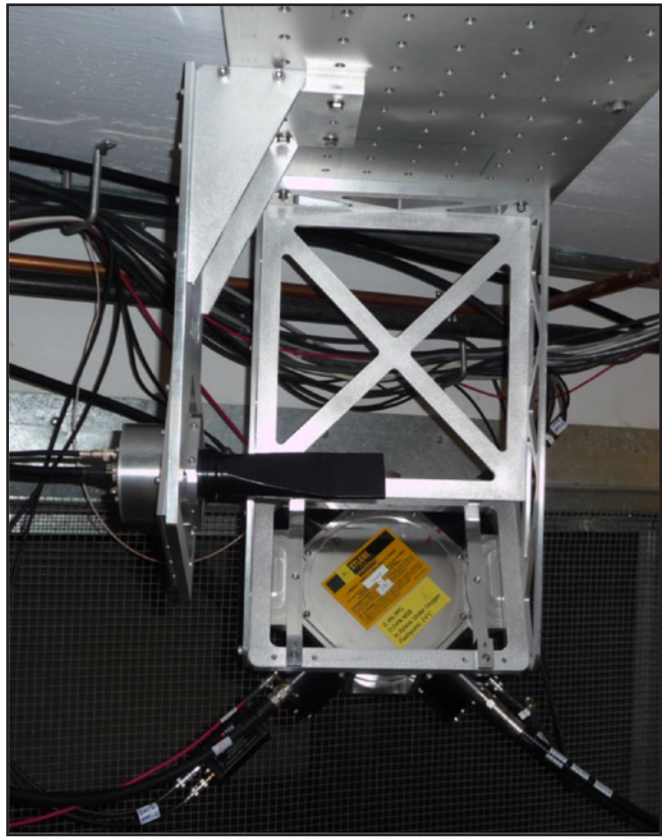
Upgraded Neutron Time-of-Flight Detectors for DT Implosions on OMEGA



Petal nTOF in TIM-6 line of sight





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Six detectors measure yield and ion temperature and are used to study 3-D effects in DT implosions on OMEGA

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- Using one new nTOF detector it is possible to measure x-ray instrument response function (IRF), construct neutron IRF, and calculate ion temperature with the forward-fitting method
- The ion-temperature fitting parameters for the other detectors were adjusted to match the ion temperature of the forward-fitting detector

Collaborators

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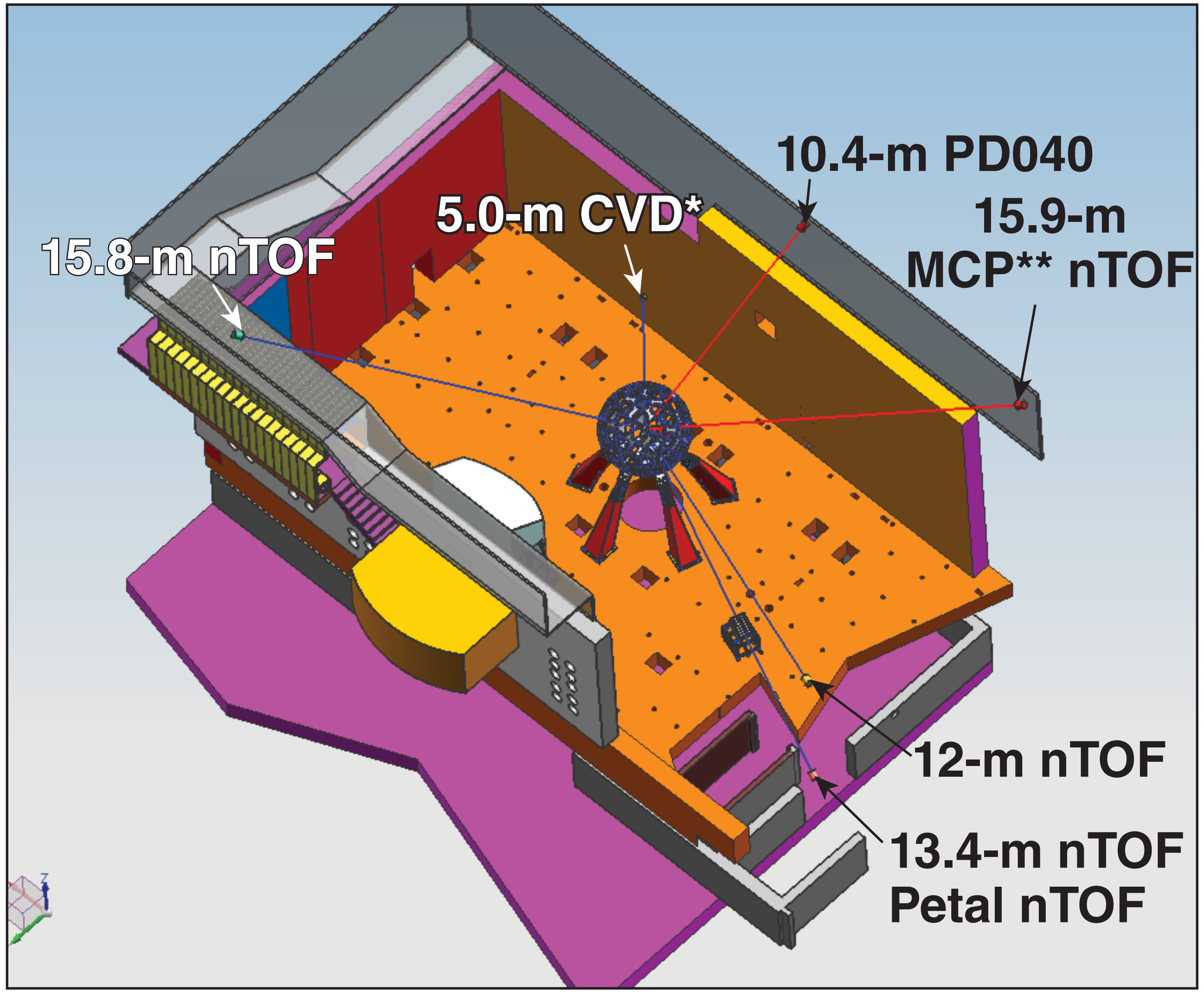
The 3-D view of six DT nTOF detectors on OMEGA



*CVD: chemical vapor deposition
**MCP: microchannel plate

Six nTOF detectors measure yield and ion temperature in DT implosions with yields larger than 10^{12}

#	Name	Distance from TCC*	θ, ϕ	Detector	
1	5.0-m CVD	5.0 m	79.30, 314.27	10 × 1 mm CVD	
2	10.4-m PD040	10.4 m	38.42, 249.60	40 × 10 mm BC422Q PD040	New
3	12-m nTOF-N	12.4 m	87.86, 161.24	40 × 20 mm BC422Q PMT**140	
4	Petal nTOF	13.0 m	116.57, 162.0	50 × 50 × 5 mm EJ-232Q PMT140	New
5	15.8-m nTOF	15.8 m	61.32, 47.64	40 × 10 mm BC422Q PMT140	
6	15.9-m MCP nTOF	15.9 m	62.15, 205.626	MCP inside PMT140	New

*TCC: target chamber center
**PMT: photomultiplier tube

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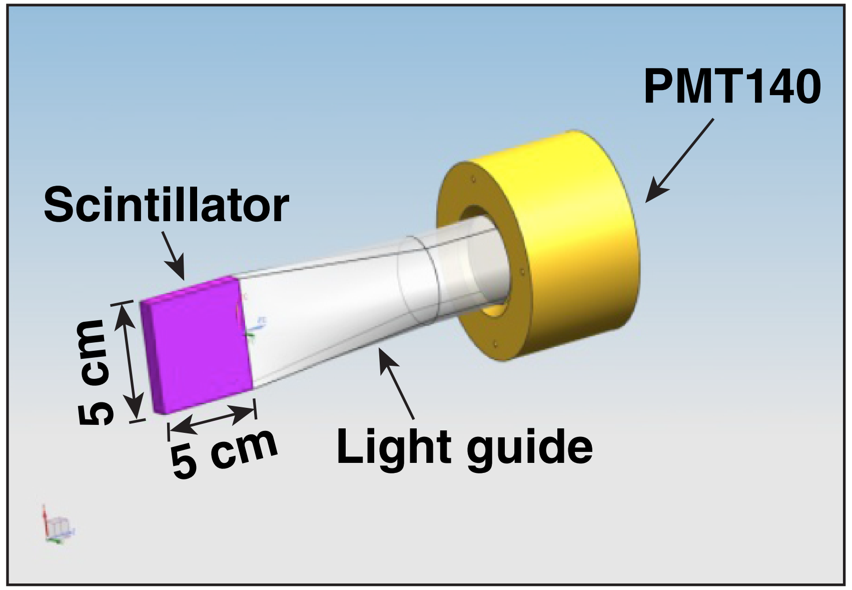
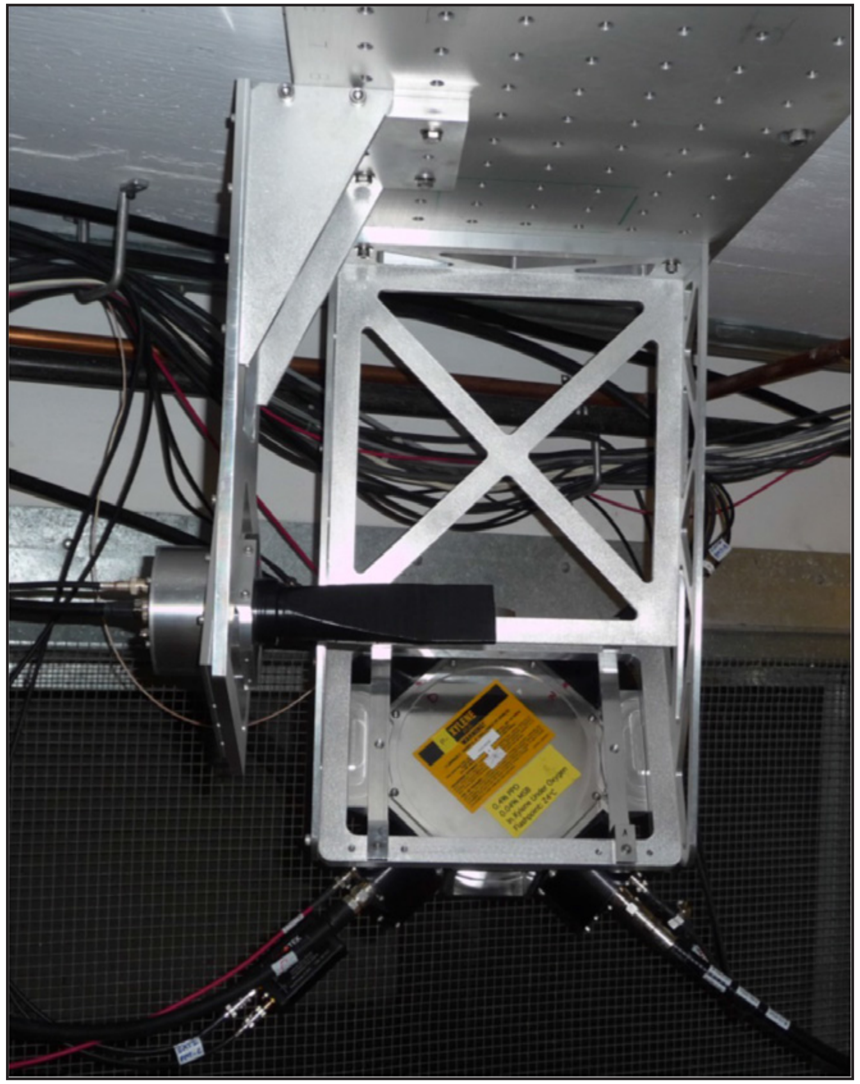
The Petal nTOF detector was designed to improve T_i measurements on OMEGA

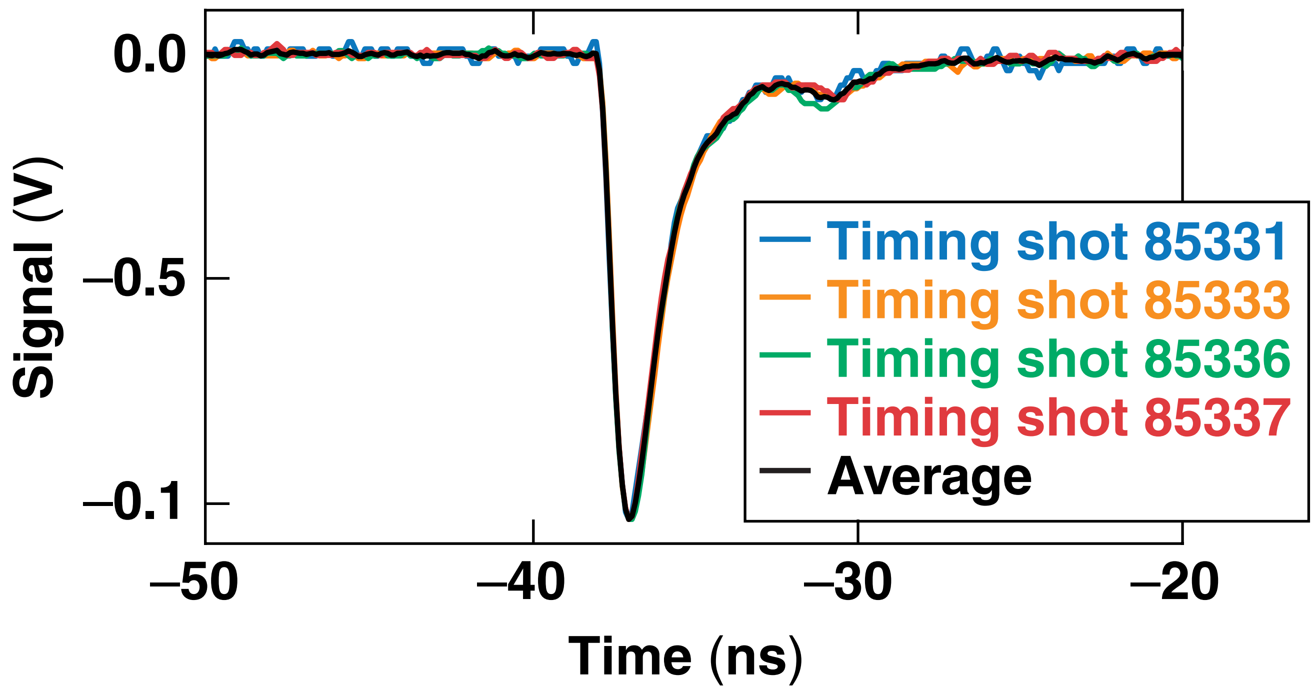
- Measures DT and DD T_i in the same line of sight
- Takes *in-situ* x-ray IRF measurements
- Absolute T_i by forward-fitting
- High T_i precision and accuracy
- Neutron energy measurements (fiducial)



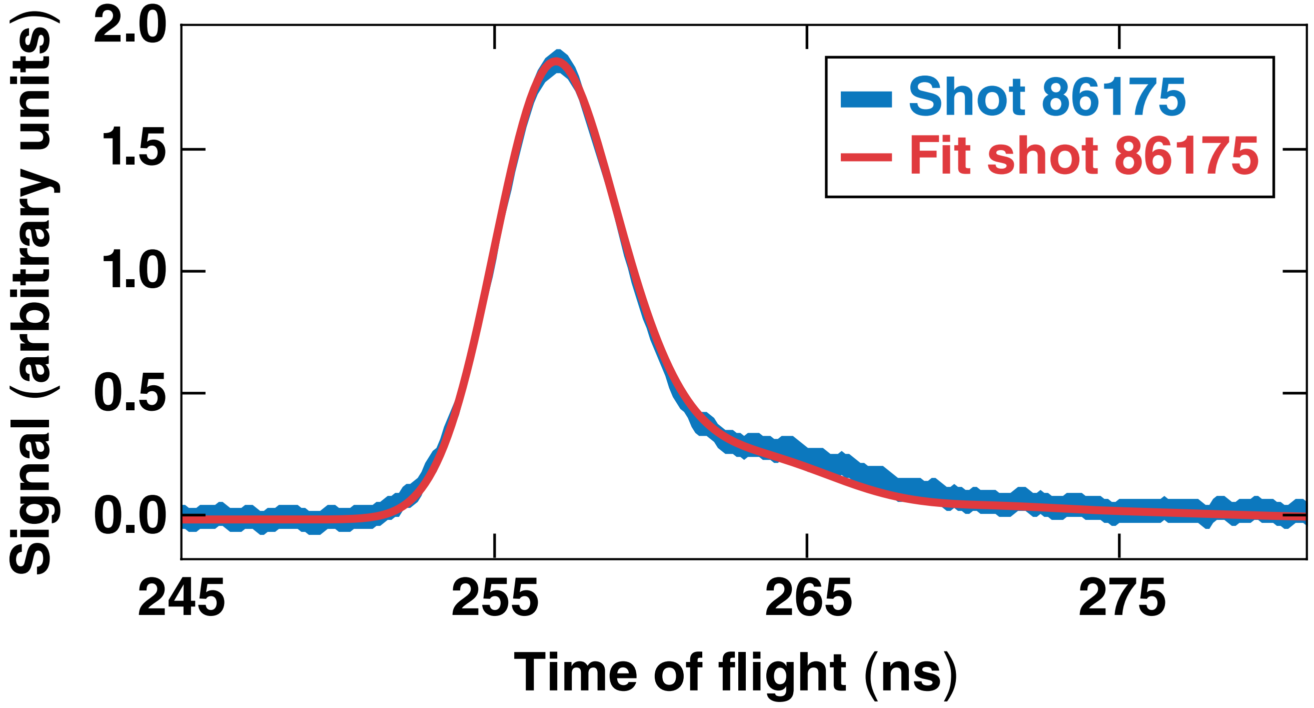


For the Petal nTOF detector, x-ray IRF was measured, neutron IRF was constructed, and T_i was inferred by the forward-fitting method*

X-ray IRF measurement with 100-ps laser pulse on a 1-mm gold target



Forward fitting of the Petal data in shot 86175 with DT yield 1.0×10^{14} and T_i = 4.2 keV



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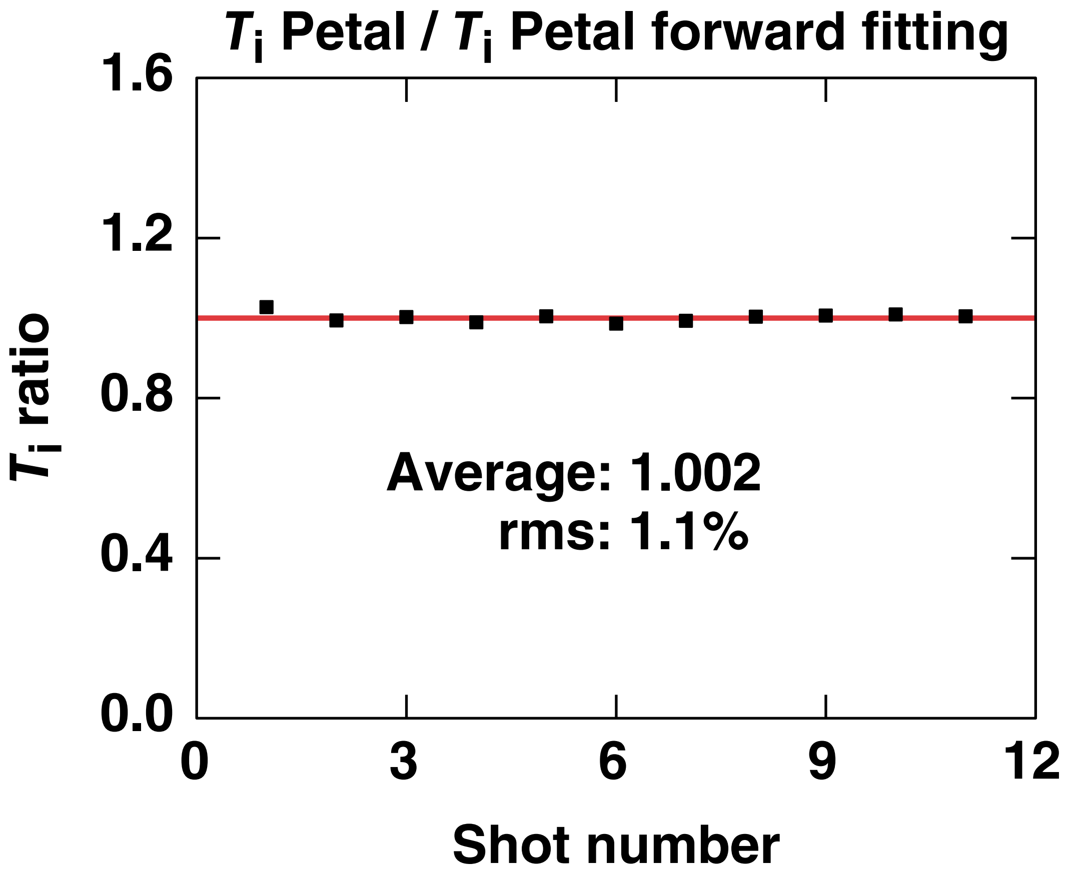
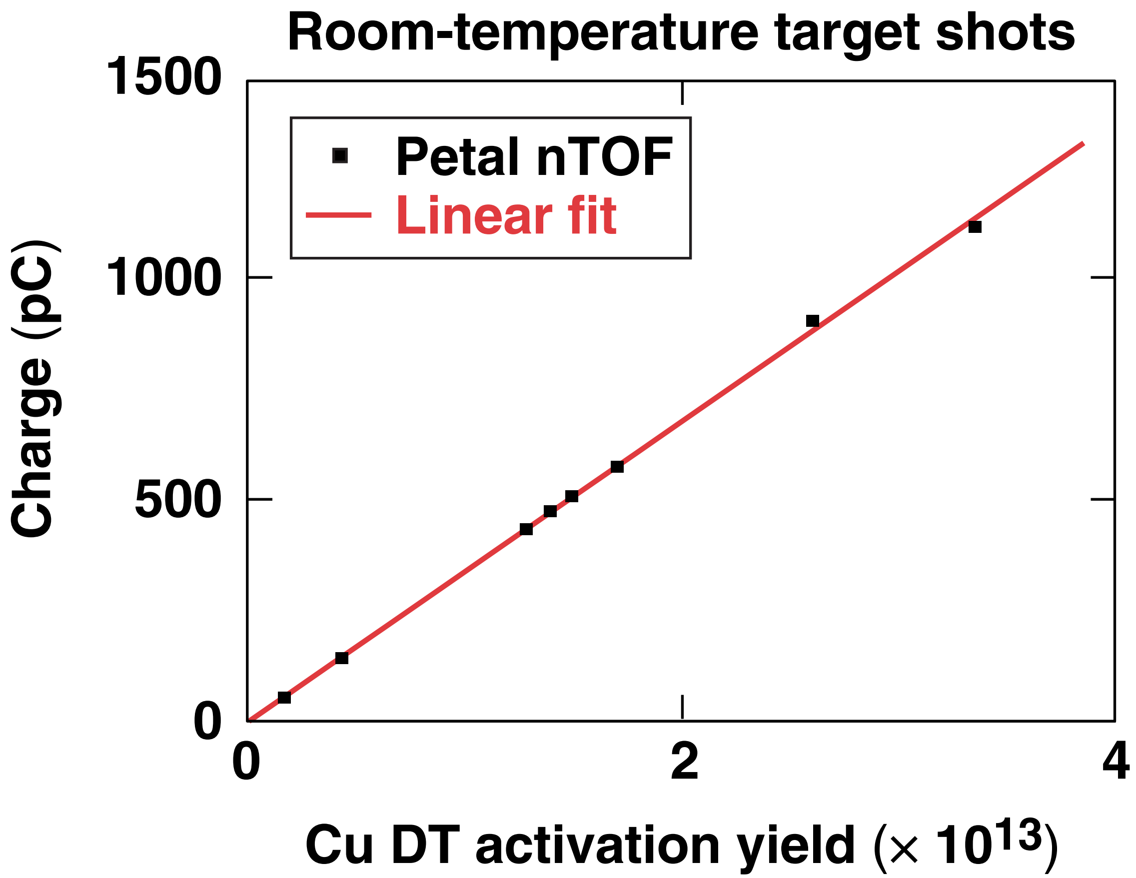
*R. Hatarik *et al.*, J. Appl. Phys. 118, 184502 (2015).

The Petal-modified Gaussian $m(t)$ fit parameters were adjusted to match the Petal forward-fitting analysis



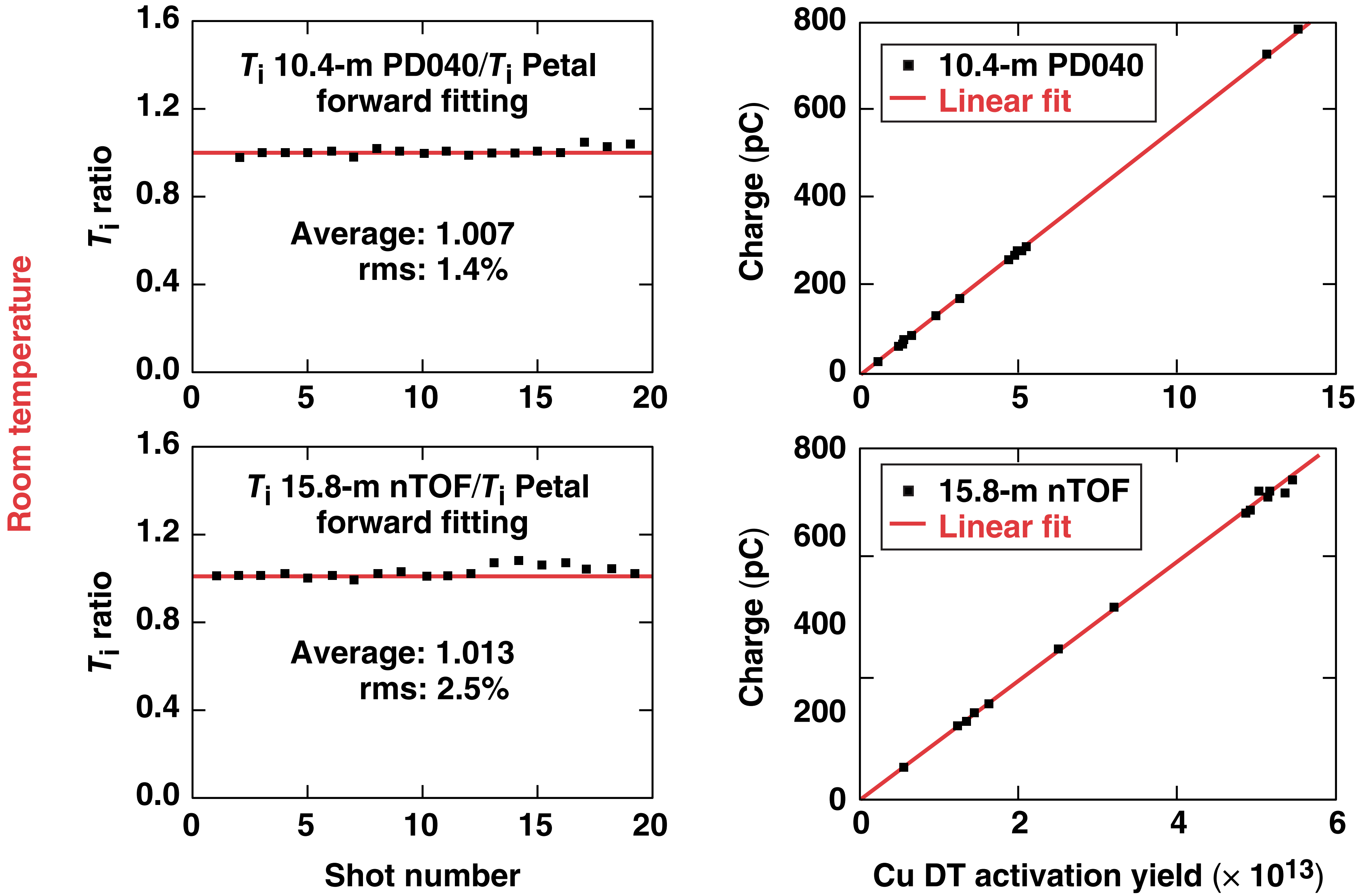


$$m(t) = \frac{A}{2\tau} \exp\left[-\frac{(t-t_1)}{\tau}\right] \times \exp\left(\frac{\sigma^2}{2}\right)\left\{1 + \text{erf}\left[\frac{(t-t_1) - \sigma^2/\tau}{\sqrt{2\sigma^2}}\right]\right\}^*$$

E26830

* T. J. Murphy, R. E. Chrien, and K. A. Klare, Rev. Sci. Instrum. 68, 610 (1997).

The 10.4-m PD040 and 15.8-m nTOF fitting parameters were adjusted to match the Petal forward-fitting analysis



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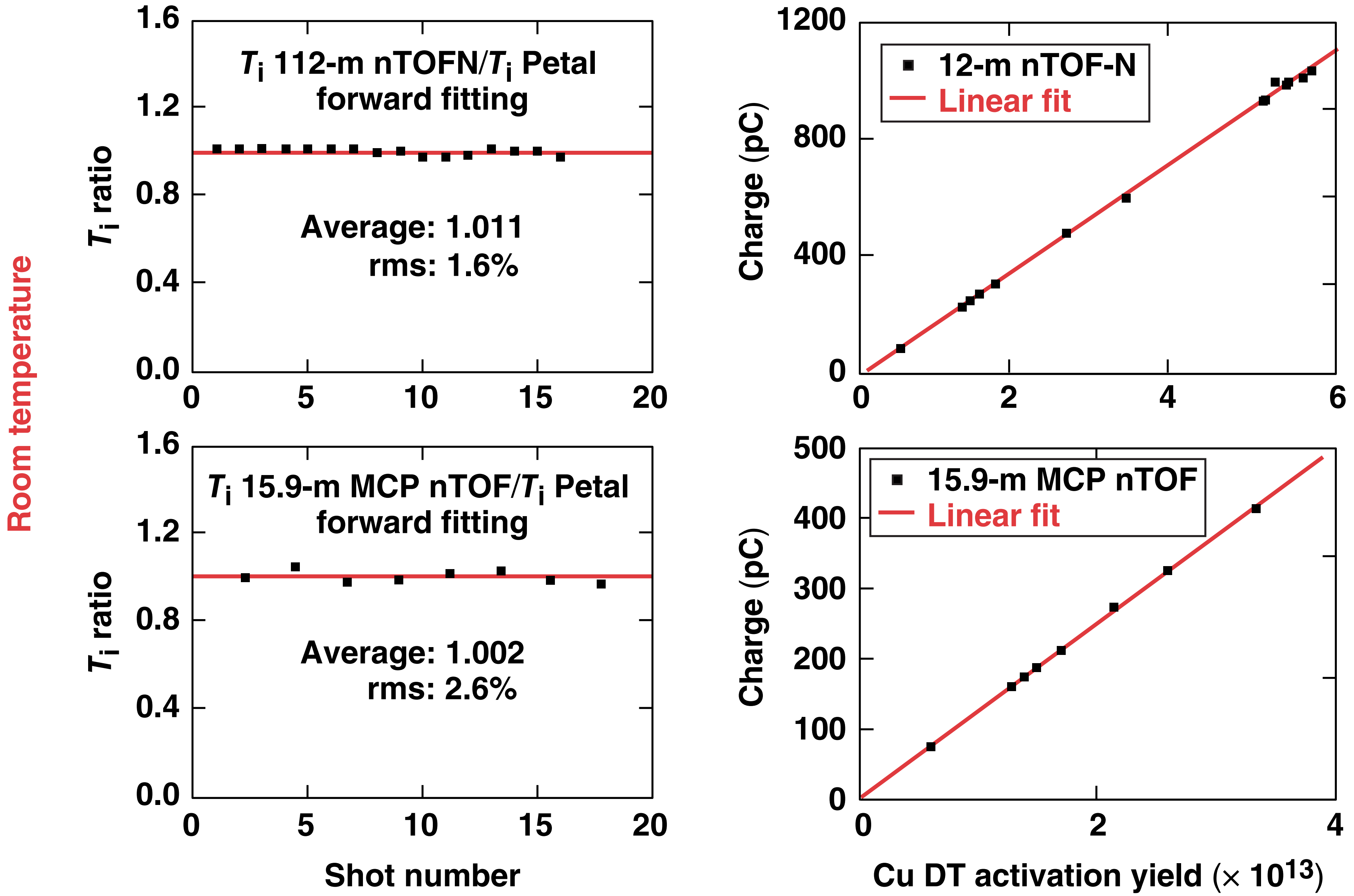
The 12-m nTOF-N and 15.9-m MCP nTOF fitting parameters were adjusted to match the Petal forward-fitting analysis



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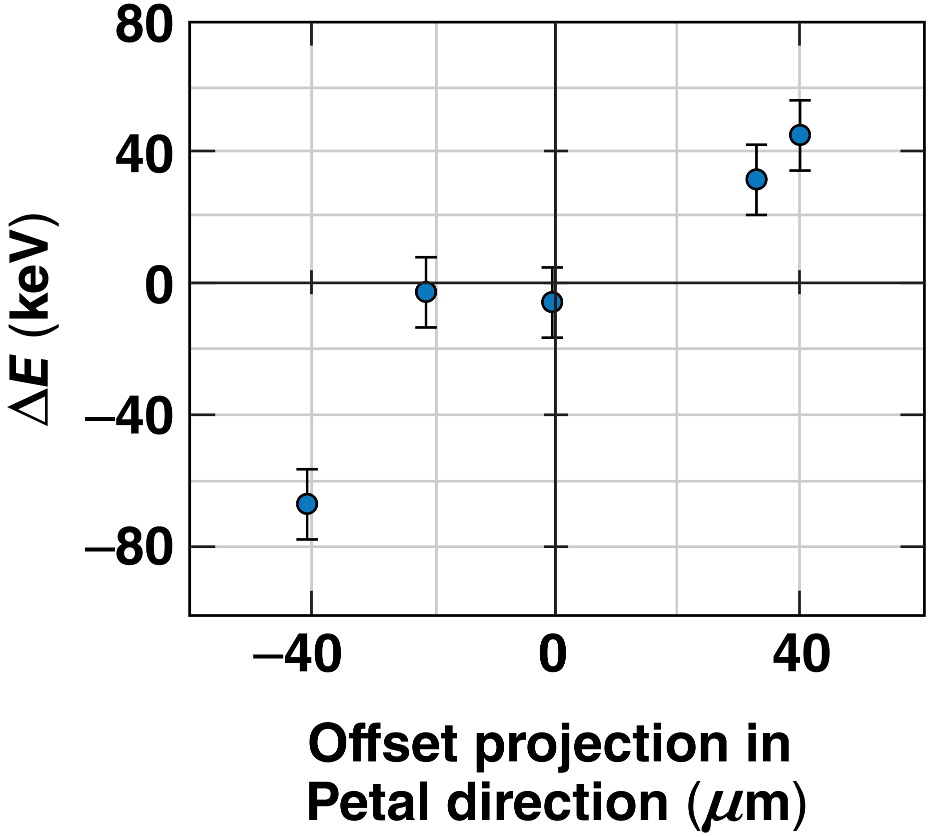
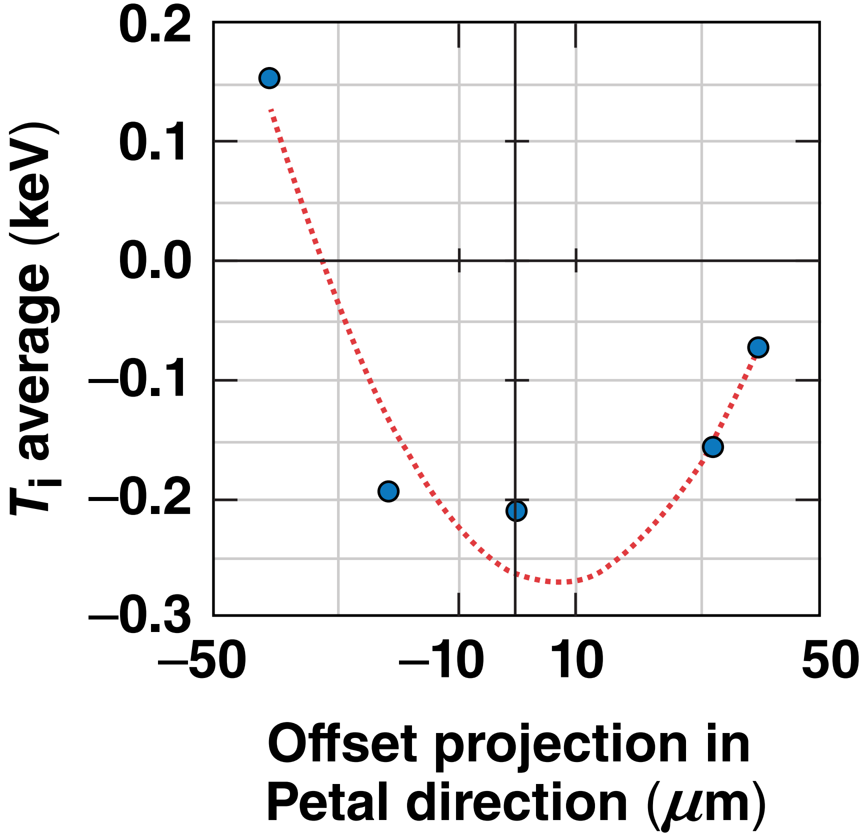
The impact of the target offset on T_i and position of the neutron peak was demonstrated on OMEGA

Data from the Petal nTOF detector in La Cave on OMEGA





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O. M. Mannion *et al.*, CO8.0003, this conference.

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