

# CERES: A Cryogenic Experiment to Reconstruct Energy Systematics in TeO<sub>2</sub> Bolometers



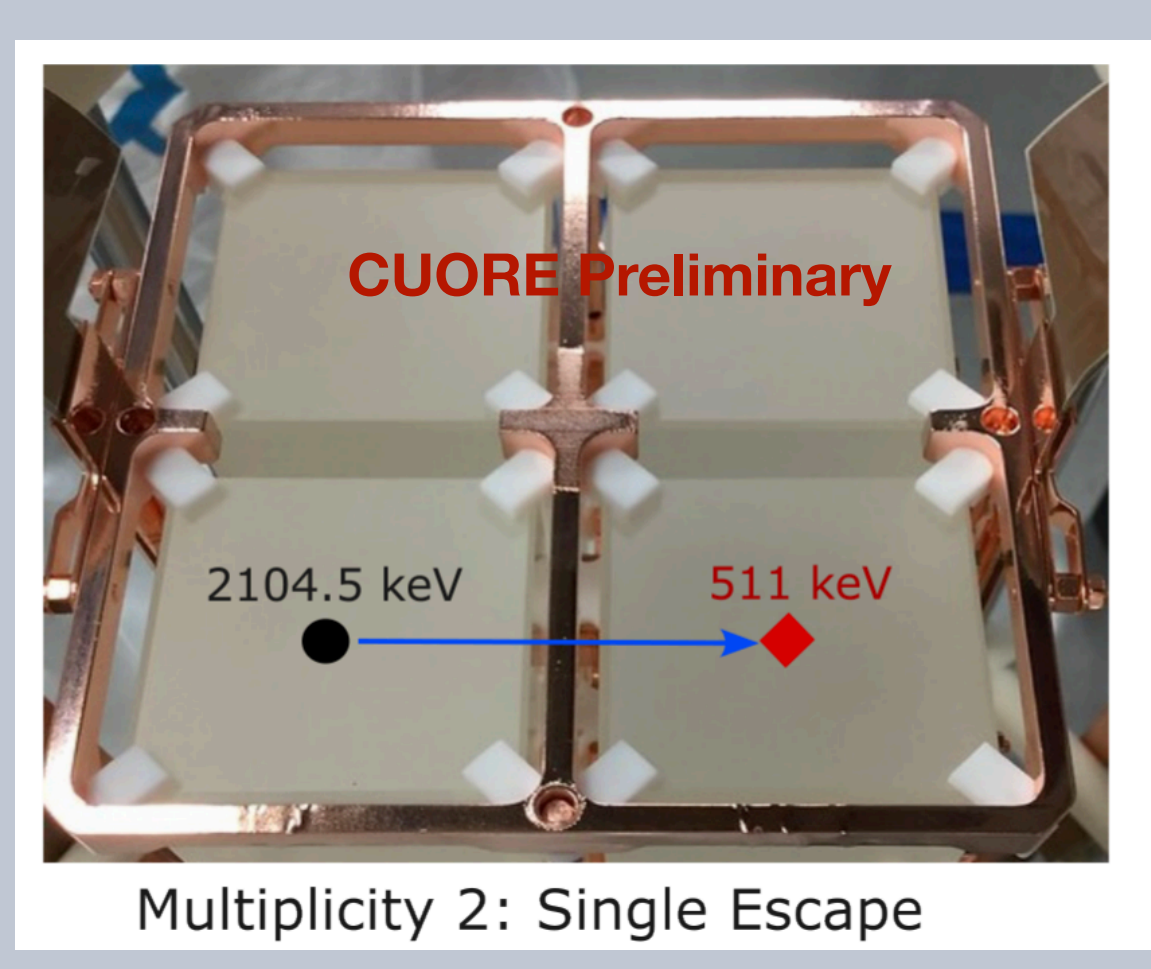
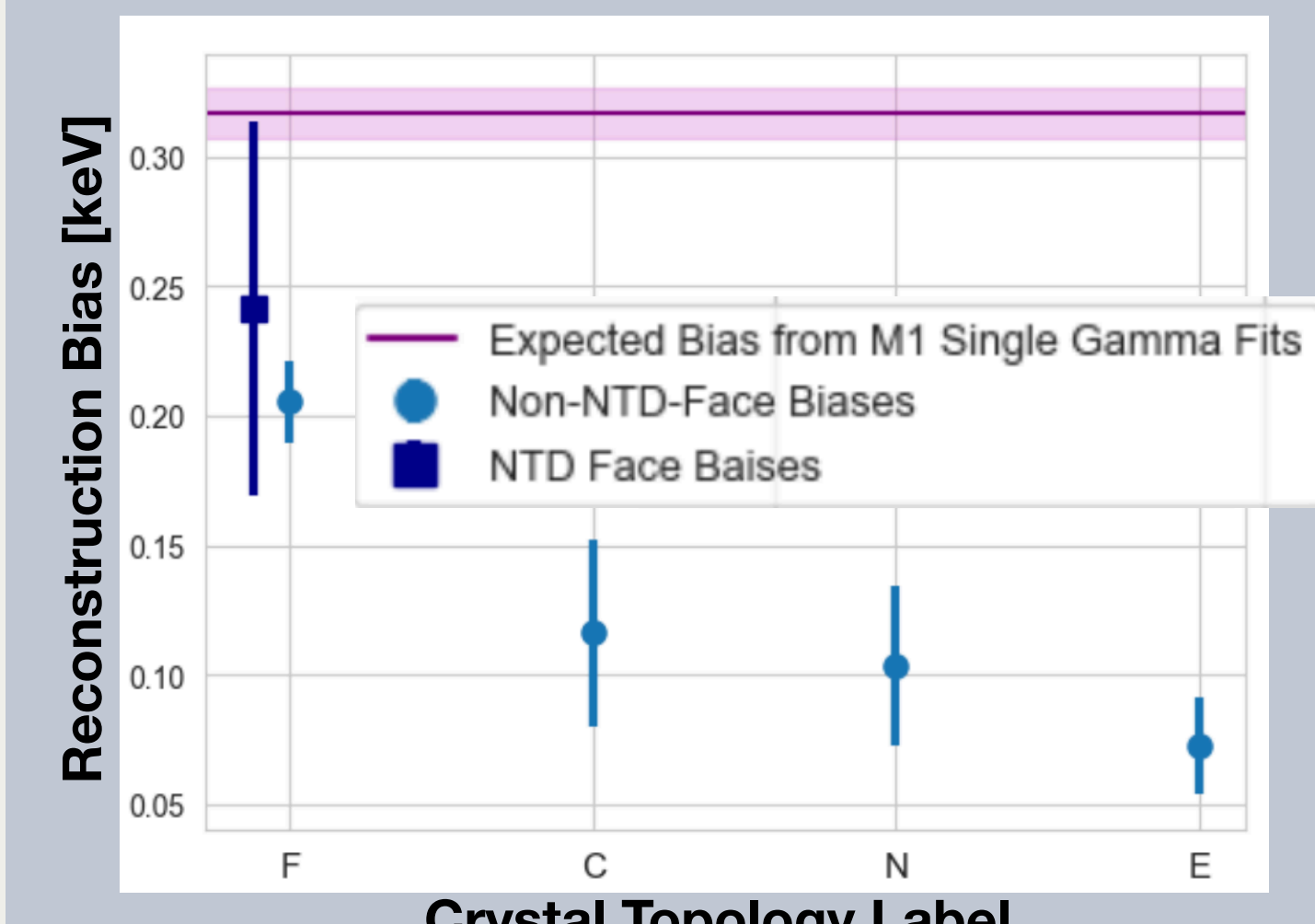
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## Motivation

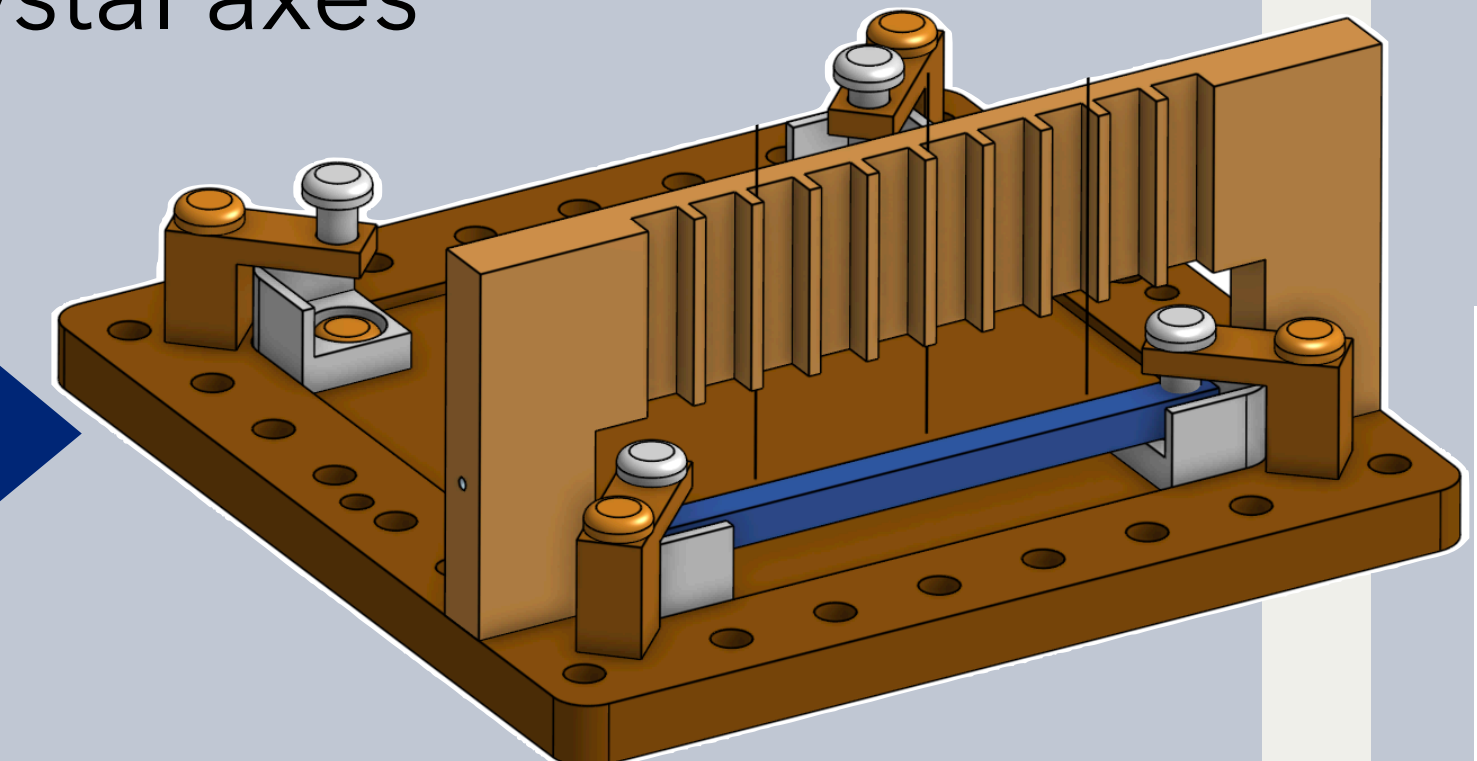
- Low-temperature crystal calorimetry (**bolometry**) with Neutron Transmutation Doped Ge (**NTD-Ge**) Sensors: precise energy resolution, low intrinsic background, highly reproducible detectors
- Considered position independent due to sensitivity to thermal phonons + slow response time
- Study of multi-crystal events at CUORE sees sub keV effect → first hint of position/topological sensitivity!!!



- Possibility for Particle ID (alpha/gamma/beta) for **true backgroundless** bolometer experiments!

## Concept and Design

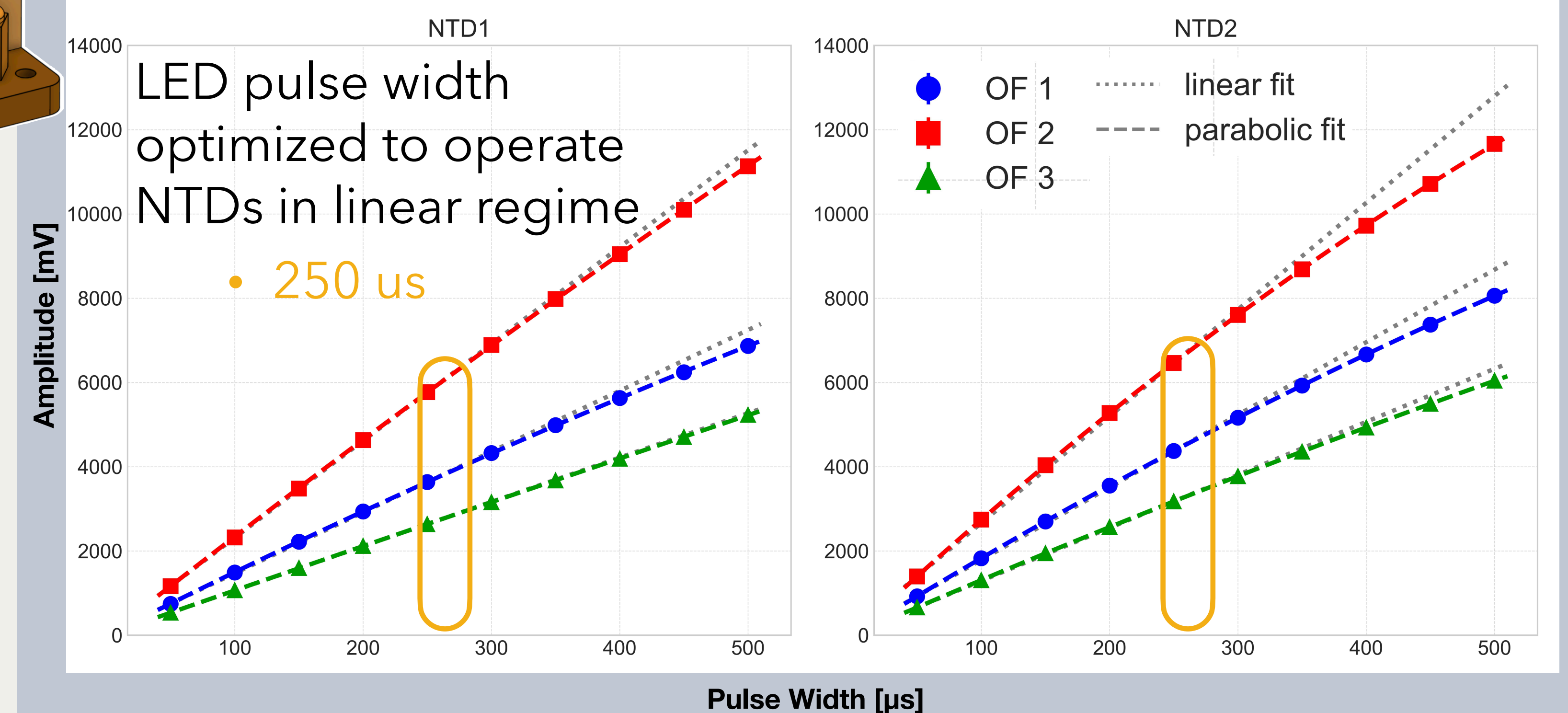
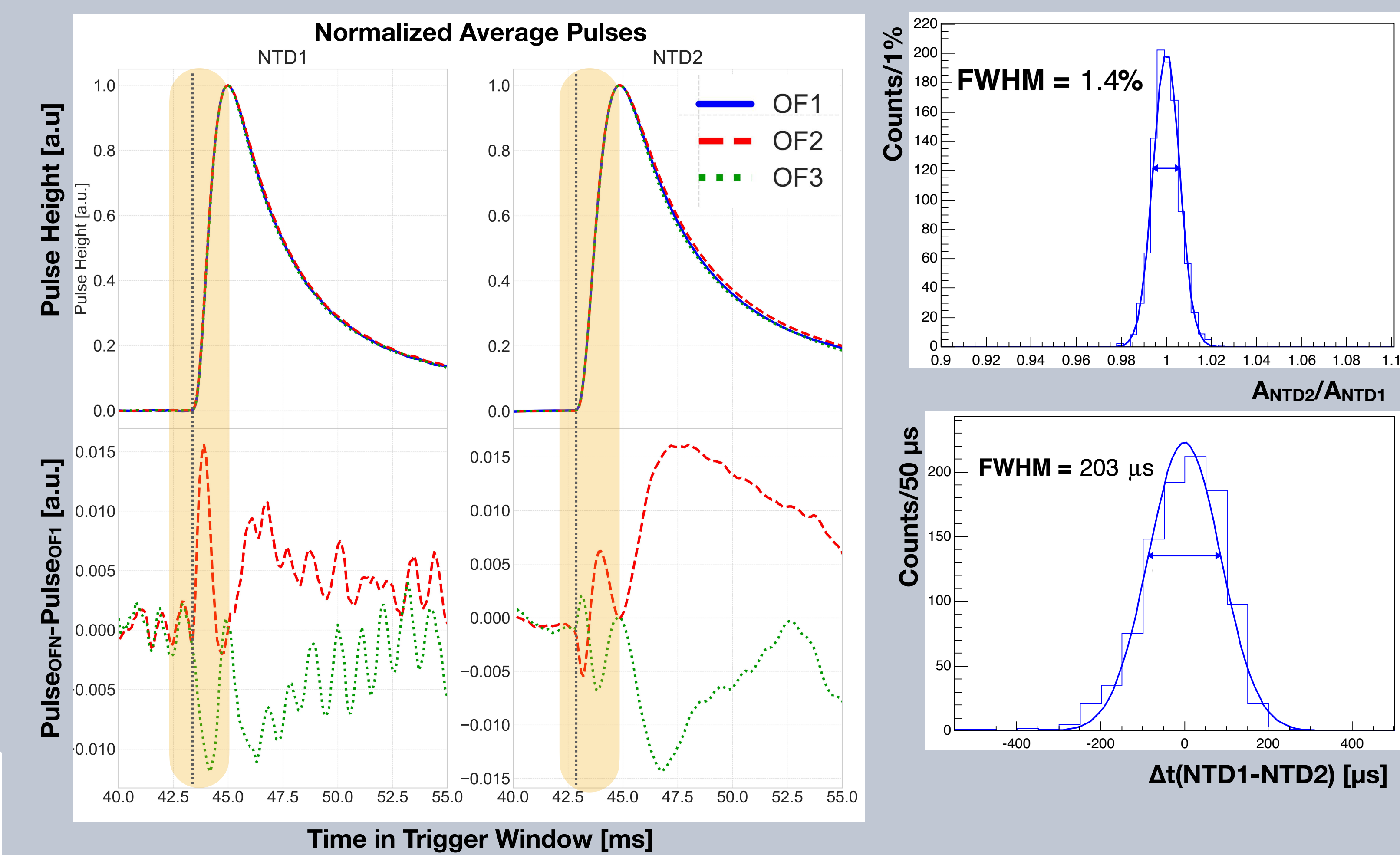
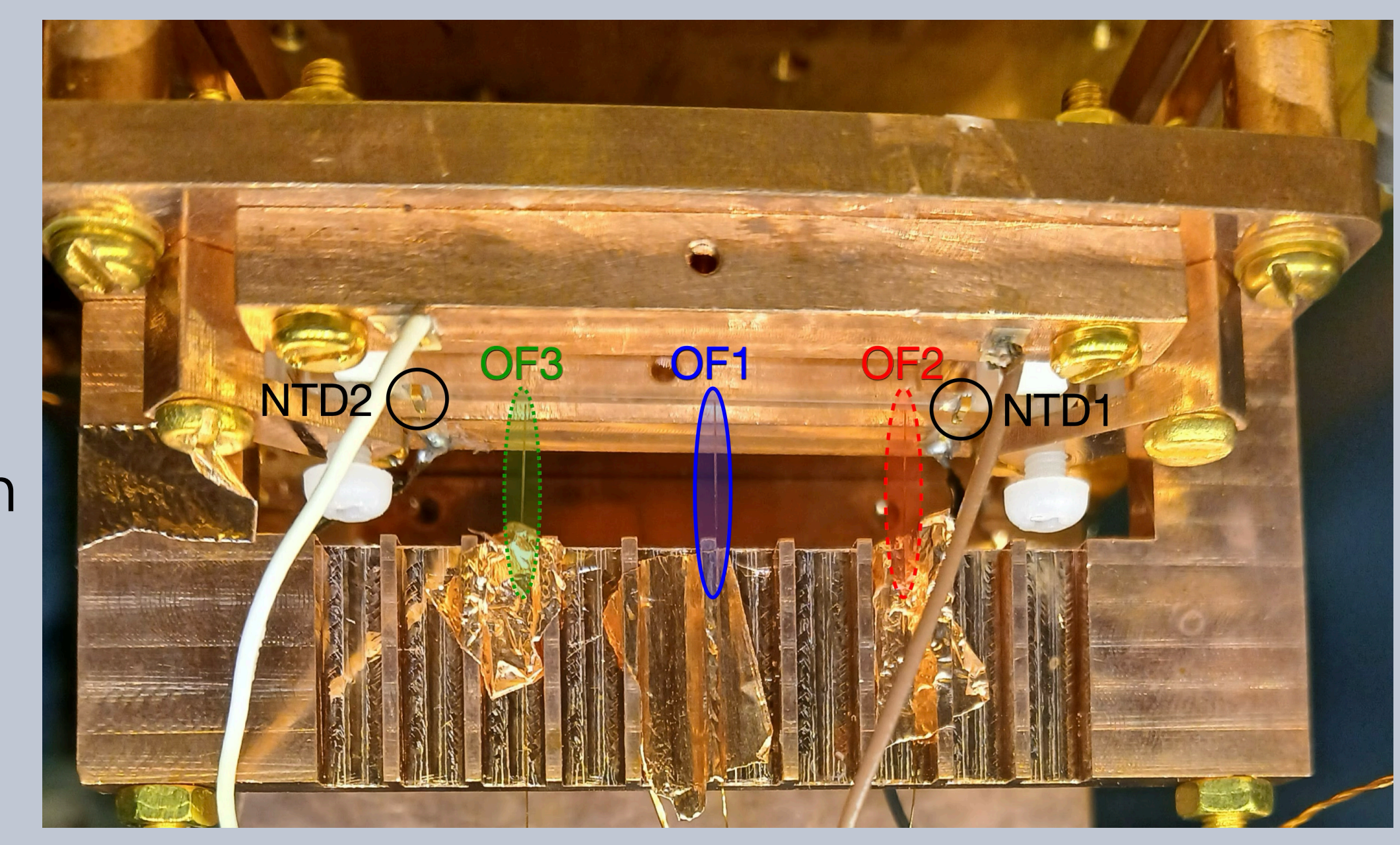
- Want to:
- Study position dependence of crystals in 1 and 2 dimensions along crystal axes



- How?
- Scan with UV light source—with E above TeO<sub>2</sub> band gap @ 255 ± 5 nm LED
  - Place sensors at corners/edges of crystals
    - Designed with NTD-Ge and Transition Edge Sensors (TES) in mind
  - Measure  $\Delta t$ , energy sharing (ratio of pulse amplitudes), as function of radiation deposition position

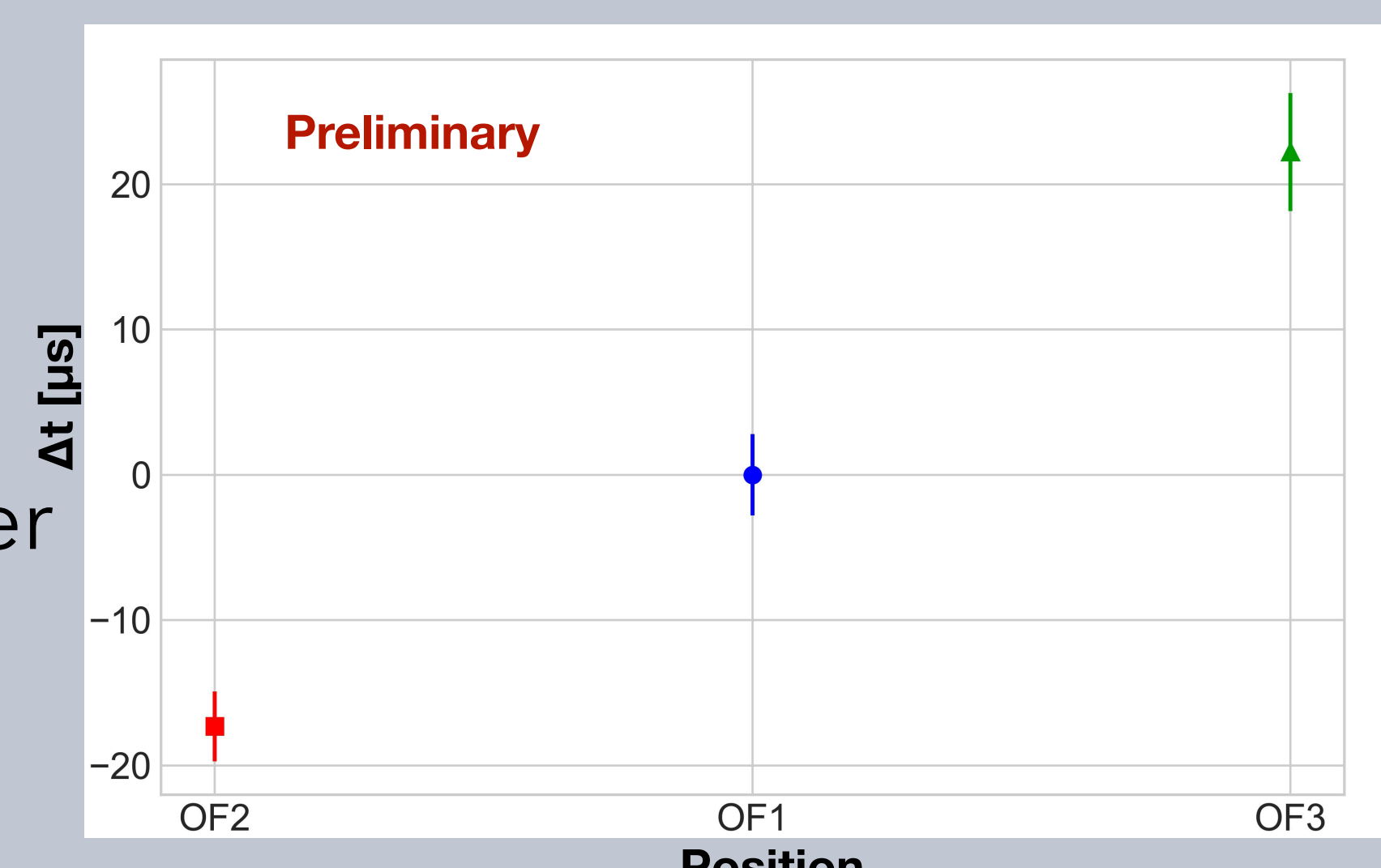
## Initial Commissioning

- 2 NTDs on ends of 1D-like crystal + 3 optic fibers (OFs) with 2 symmetric about central OF
- Measurements taken at 15 and 16 mK in Oxford Instruments Triton 400 DU refrigerator



## Preliminary Results

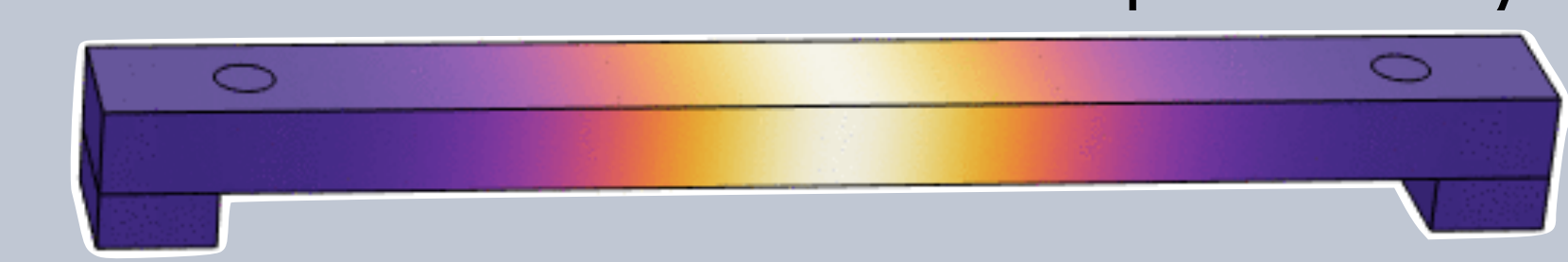
- Define arrival time when the pulse is 10% of max amplitude
- ~40 μs effect over 4 cm of NTD separation



- Similar symmetric effect observed in energy sharing
- Further calibration needed to quantify exact position dependence

## Future Work

- We present the design and testing results of a cryogenic single crystal experiment exploring position-dependent effects in TeO<sub>2</sub> bolometers.
- Developing thermal/ballistic phonon simulations in COMSOL/GEANT4 respectively



- Characterizing array of W TESs for ballistic phonon studies
- Concept paper in **preprint**: [arxiv.org/abs/2605.21941](https://arxiv.org/abs/2605.21941)

## Acknowledgments

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