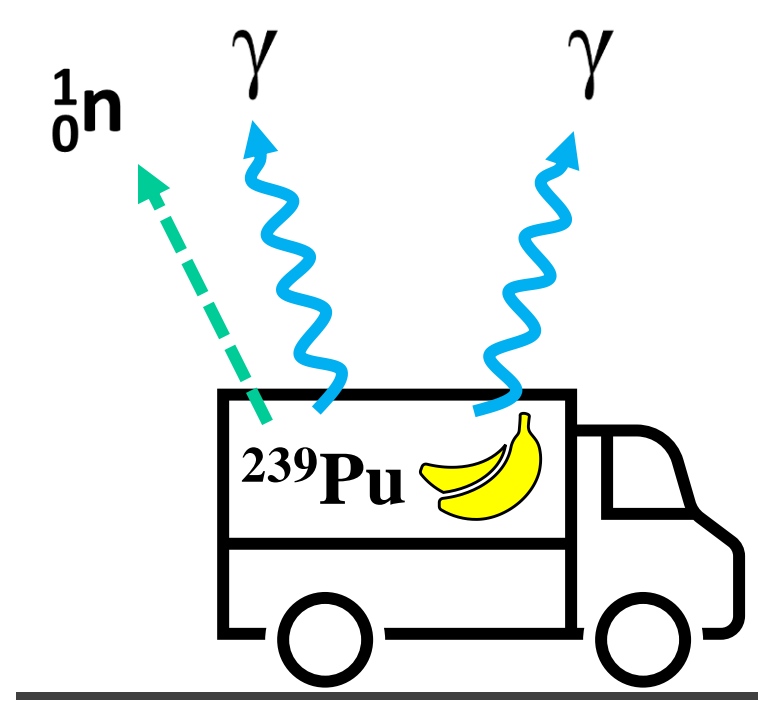
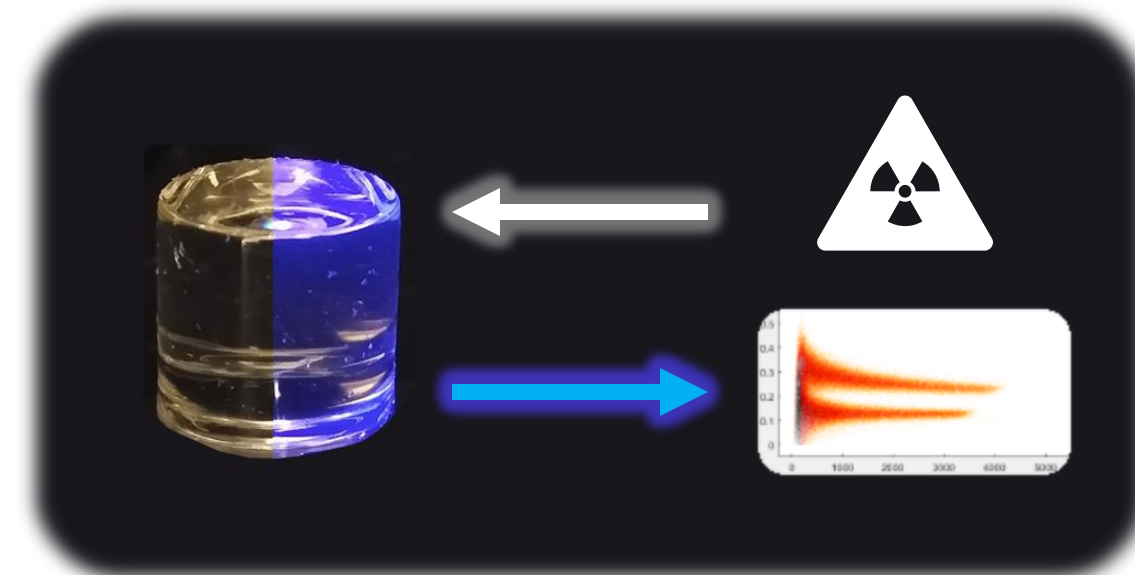


Introduction

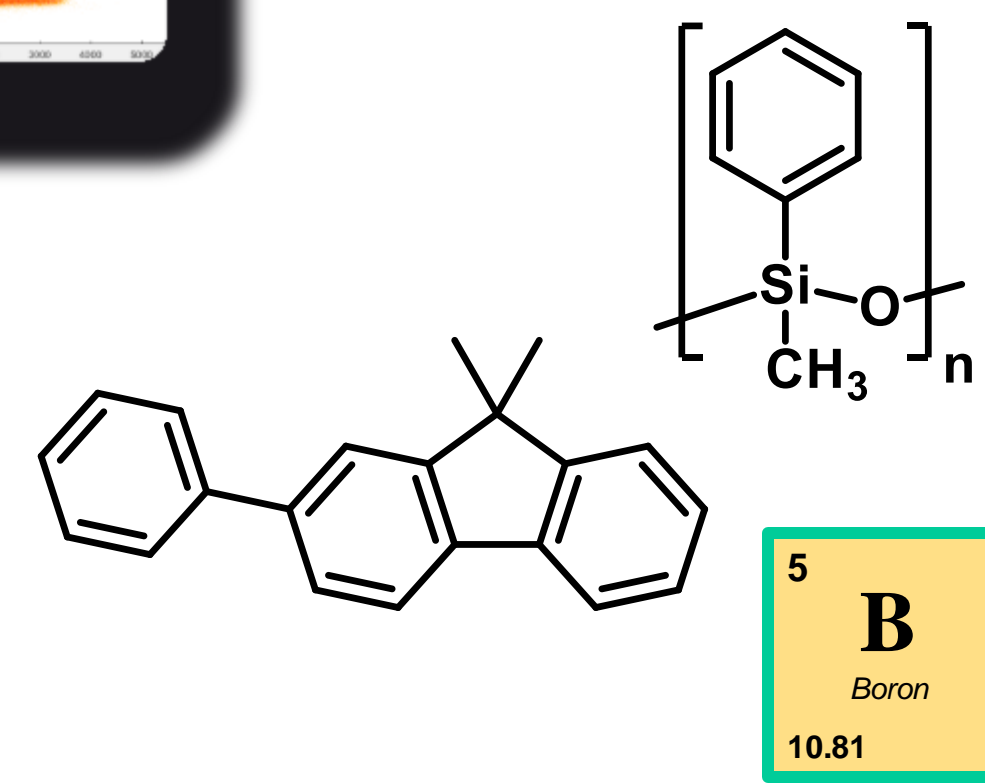


- Scintillators produce light from ionizing radiation



Composition

- Matrix - (60-100 wt%)
- Fluorophore - (0.1 - 30 wt%)
- Boron-10 (0 - 5 wt%)



Goals and Objectives

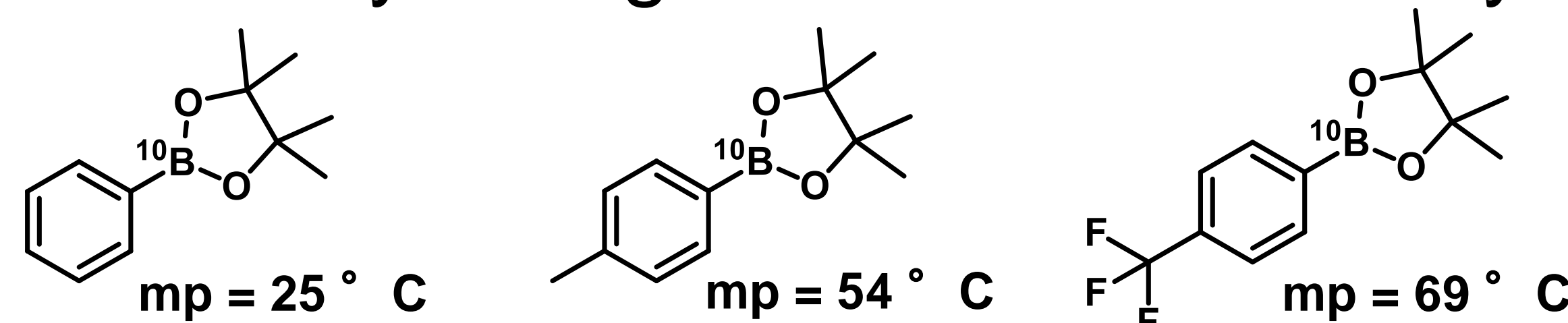
Temperature Dependence

- Build test apparatus to control temperature
- Observe *figure of merit* (FoM) and *light yield* (LY) as a function of temperature
- Test several matrix materials and dopants



Boron-10 Loading

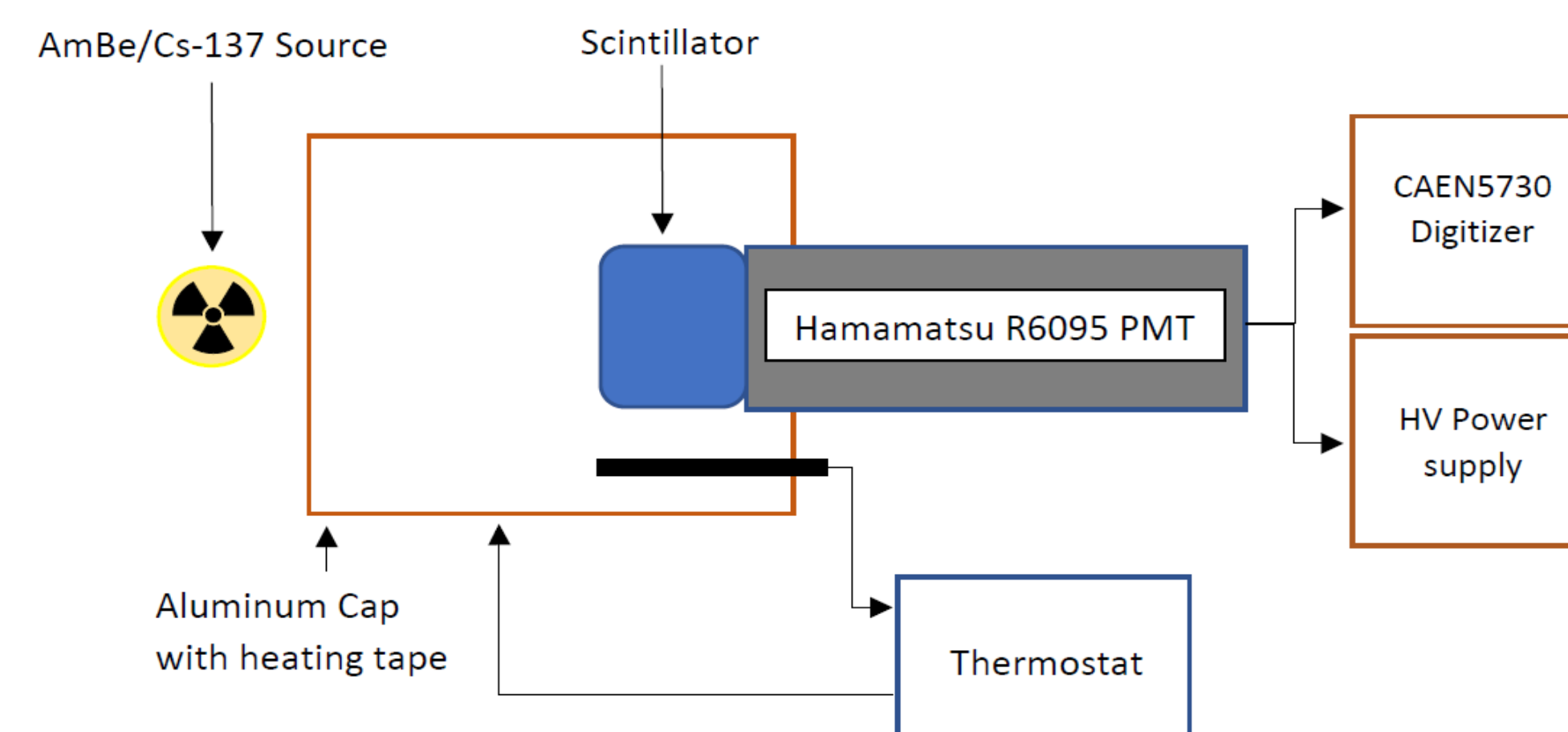
- Synthesize soluble boron-10 compounds
- Incorporate into siloxane matrix with fluorophore
- Quantify change in neutron sensitivity



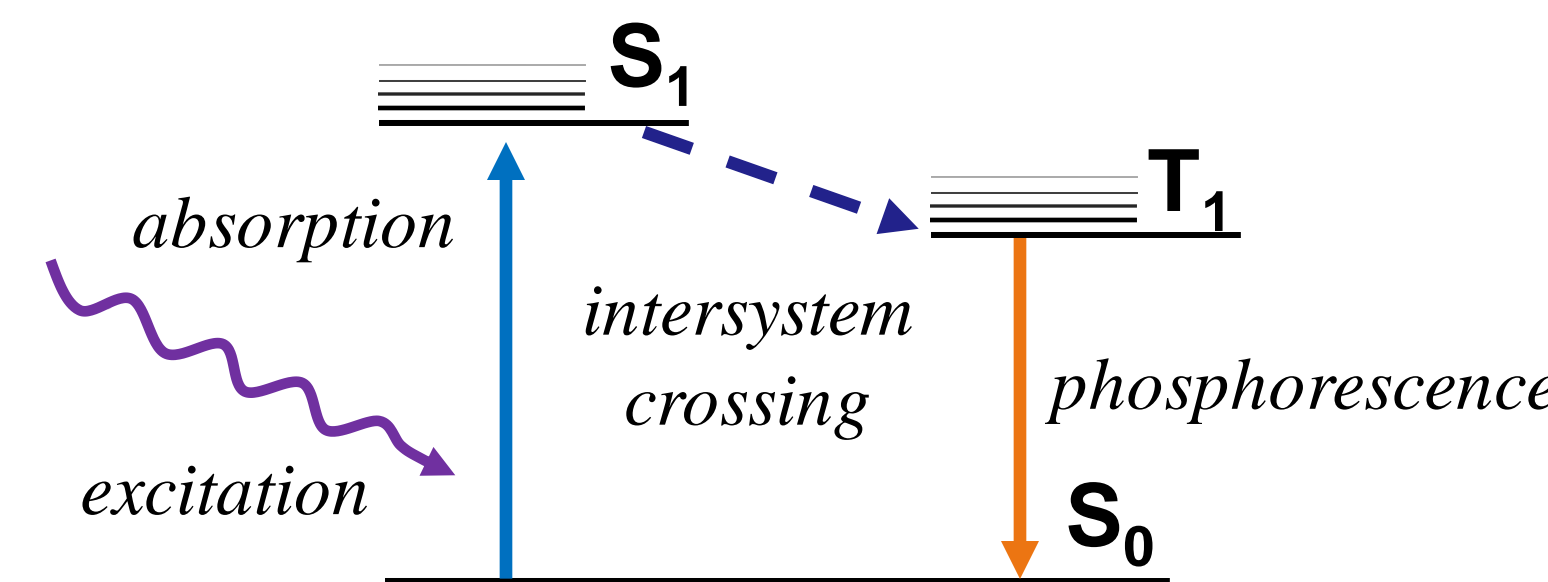
Lim, A. et al. *ACS Appl. Polym. Mater.* **2020**, 2 (8), 3657–3662
Zaitseva, N. et al. *Nucl. Instrum. Meth. A.* **2012**, 668, 88–93.
Carturan, S. M. et al. *Eur. Phys. J. C* **2020**, 80 (11), 1057.

Temperature Dependence

- 20 – 50 ° C range tested



- Increased temperature may increase T mobility
- Triplet mobility aids T-T annihilation
- Same phenomenon may decrease LY



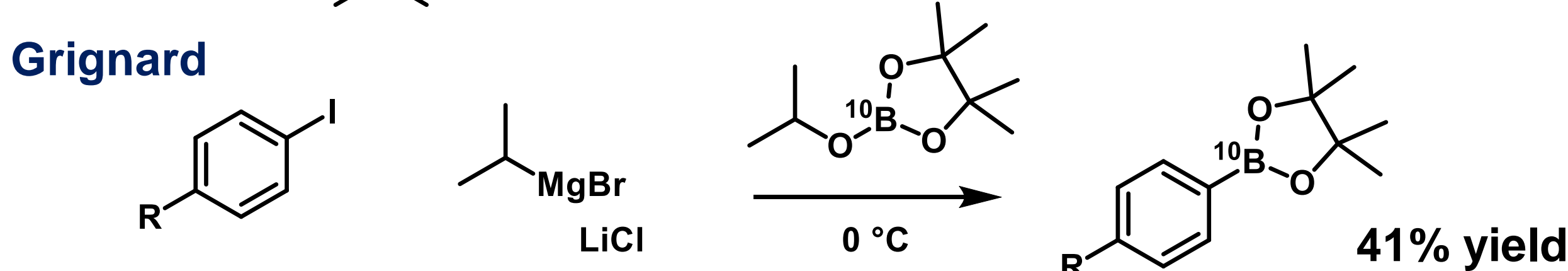
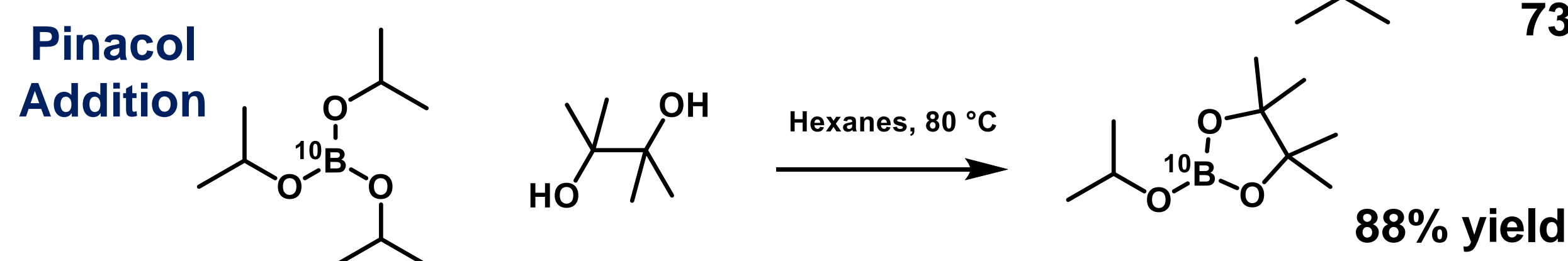
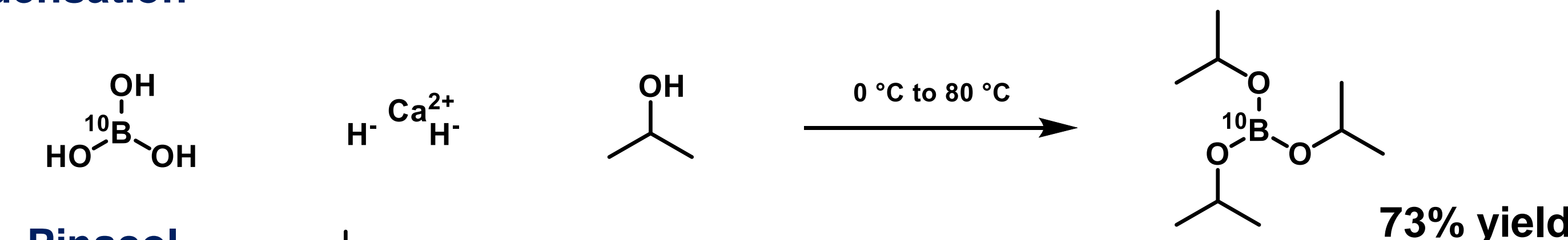
Boron Loading

- Boron-10 has high thermal neutron cross-section
- Decay reactions produce gamma rays



- Synthesis of aromatic boron compounds with higher melting points

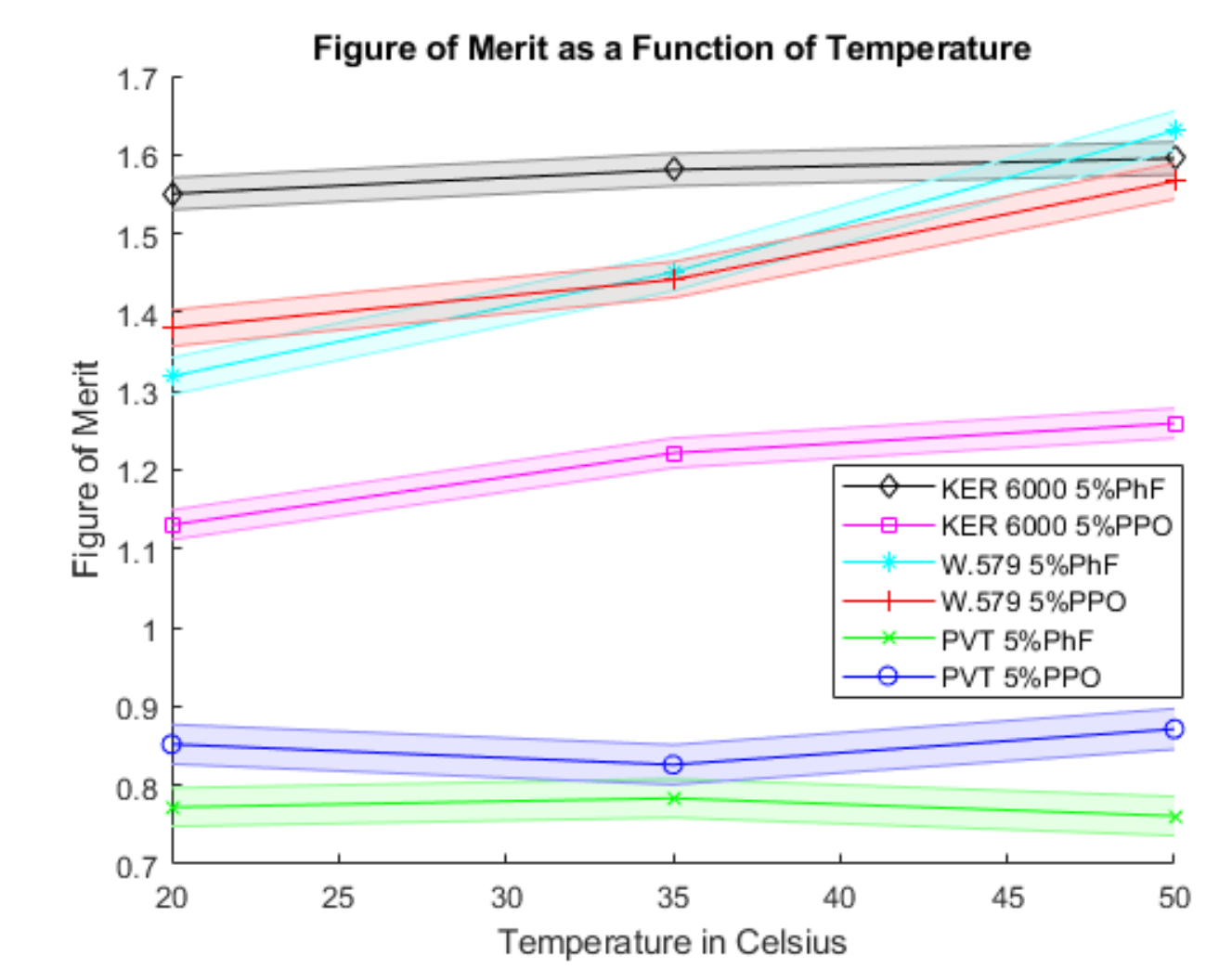
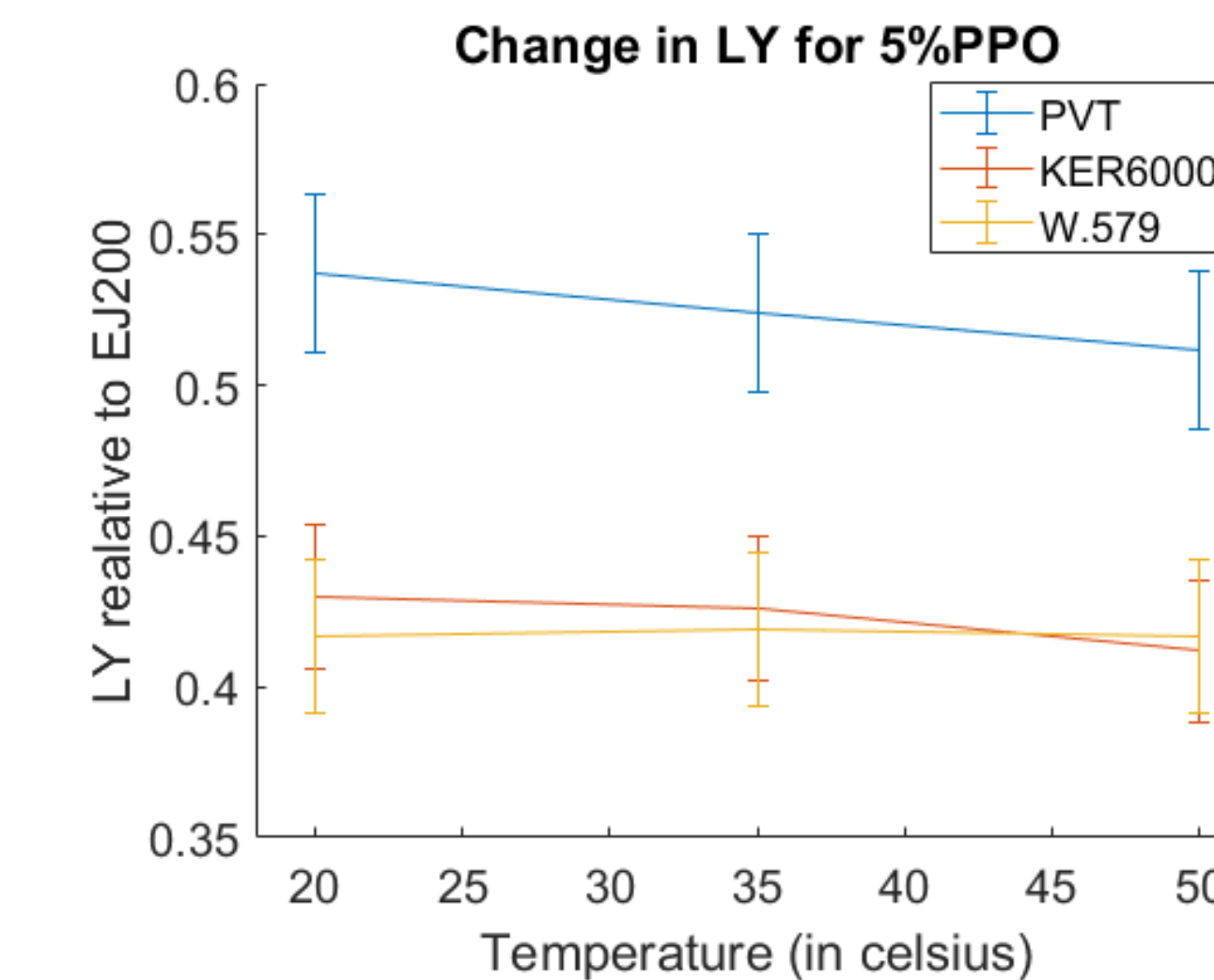
Condensation



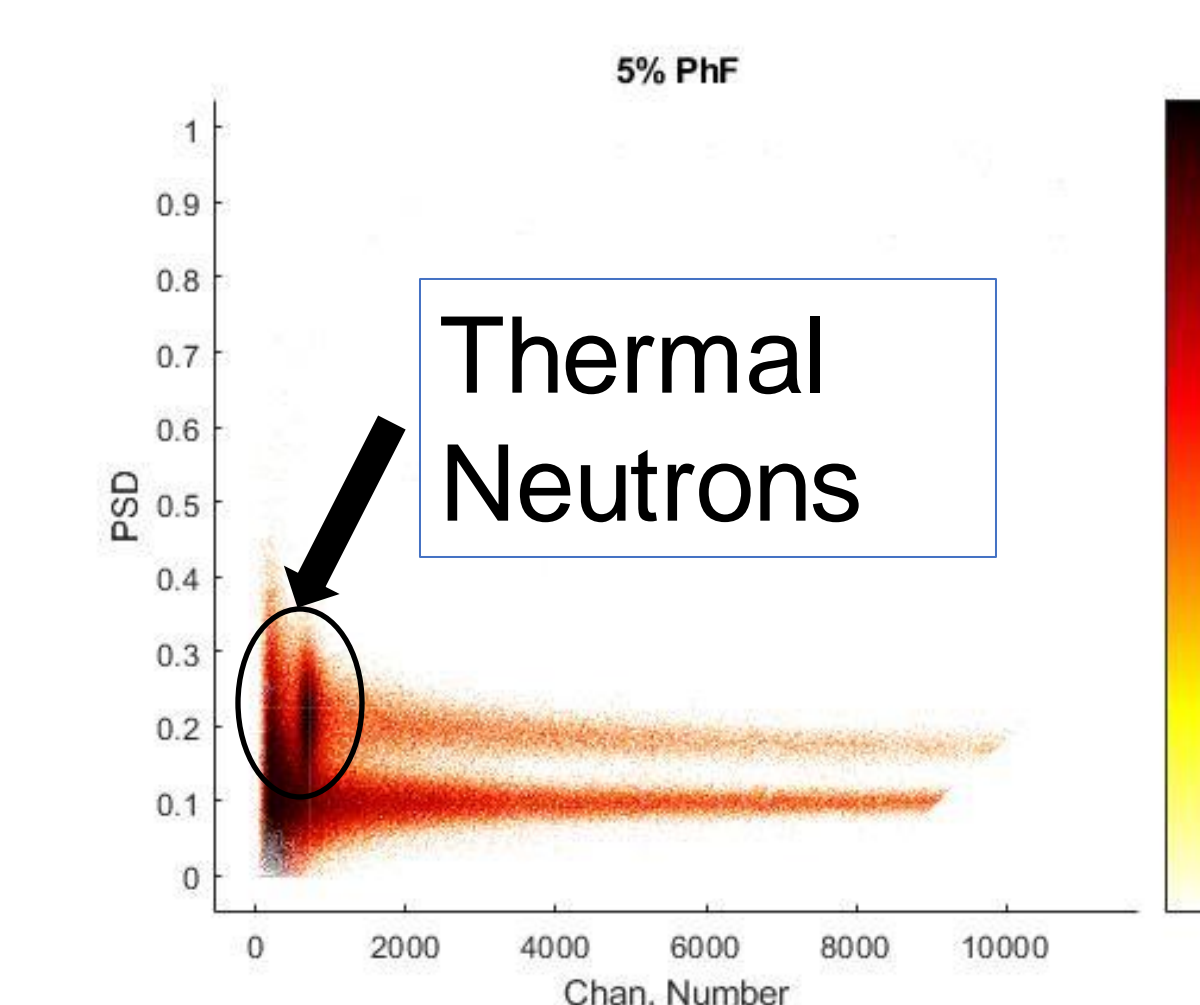
Mahl, A. et al. *NIMA* **2018**, 884, 113–118.
Yemam, H. A et al. *Chem. Eur. J.* **2017**, 23 (37), 8921–8931.
Kobylka, et al. *NIMPR:A* **2021**, 1019, 165858

This material is based upon work supported by the Department of Energy / National Nuclear Security Administration under Award Number(s) DE-NA0003921.

Results



- Larger free volume of polysiloxane vs PVT
- LY decreased for both PVT and polysiloxanes by approximately 3%



5% PhF in KER6000 with 1%PPB

- Successfully detected thermal neutrons
- Analysis will be refined
- Similar FoM analysis

	$FoM_{\gamma-n \text{ thermal}}$
EJ-309B	0.65
KER6000 5%PhF 1%PPB	0.58

Conclusions + Future Work

- Temperature , FoM
 - For polysiloxane only, not PVT
- Temperature , LY
- Doped with boron-10 compound and detected thermal neutrons
- Synthesize 3 targeted boron-10 compounds
- Incorporate into various silicone resins

