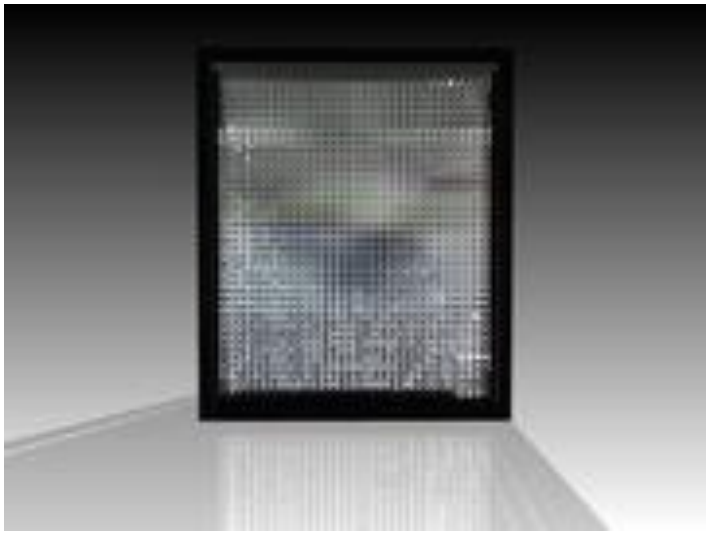
NPS/CPS Collaboration Meeting

Jefferson Lab, Newport News, VA

23 January 2018

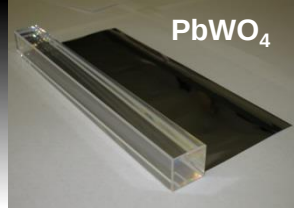
Tanja Horn



History of NPS Meetings

- *10 November 2012*: Workshop on Opportunities for DVCS and other physics with NPS (IPN-Orsay)
- *14 November 2013*: NPS Collaboration Meeting (JLab)
- *19 November 2014*: NPS Collaboration Meeting (JLab)
- *15-16 June 2015*: NPS and $PbWO_4$ Meeting (JLab)
- *21 January 2016*: NPS Collaboration Meeting (JLab)
- *19 January 2017*: NPS Collaboration Meeting (JLab)
- *6-7 February 2017*: High-Intensity Photon Sources Workshop (CUA)
- *23 January 2018*: NPS Collaboration Meeting (JLab)

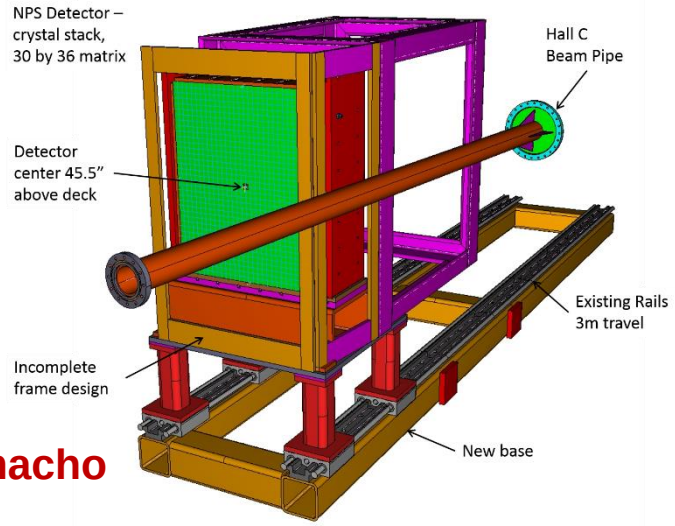
NPS Project Status



Four fully approved experiments, supported by NSF MRI PHY-1530874 (CUA, OU, ODU), international (IPN-Orsay, Glasgow, Yerevan), and JLab

- Magnet: corrector and main coil construction complete, corrector coil is in test lab, yoke steel cutting nearly final, setting up space in test lab for assembly

→ **See talk by C. Hyde**

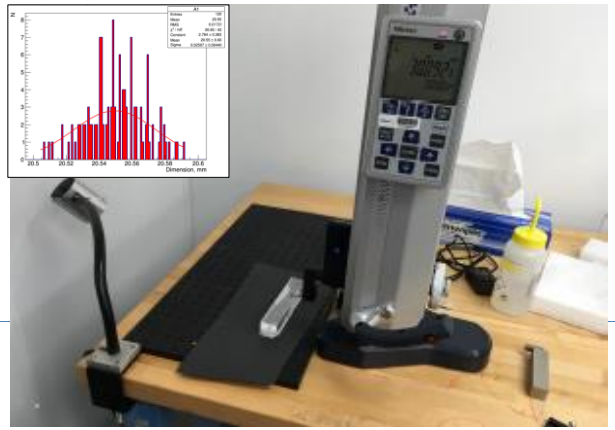


- PMT and HV bases: design drawings final, prototyping, procurements started

→ **See talk by F. Barbosa**

- Frame and integrated systems: concepts and initial design complete, detailed drawings to be presented this week

→ **See talk by C. Munoz-Camacho**



- Crystals: 460 crystals procured from SICCAS, full crystal testing facilities at CUA and IPN-Orsay, chemical analysis and crystal growth in collaboration with the VSL, synergy with EIC crystal calorimeter R&D, cleanroom ready

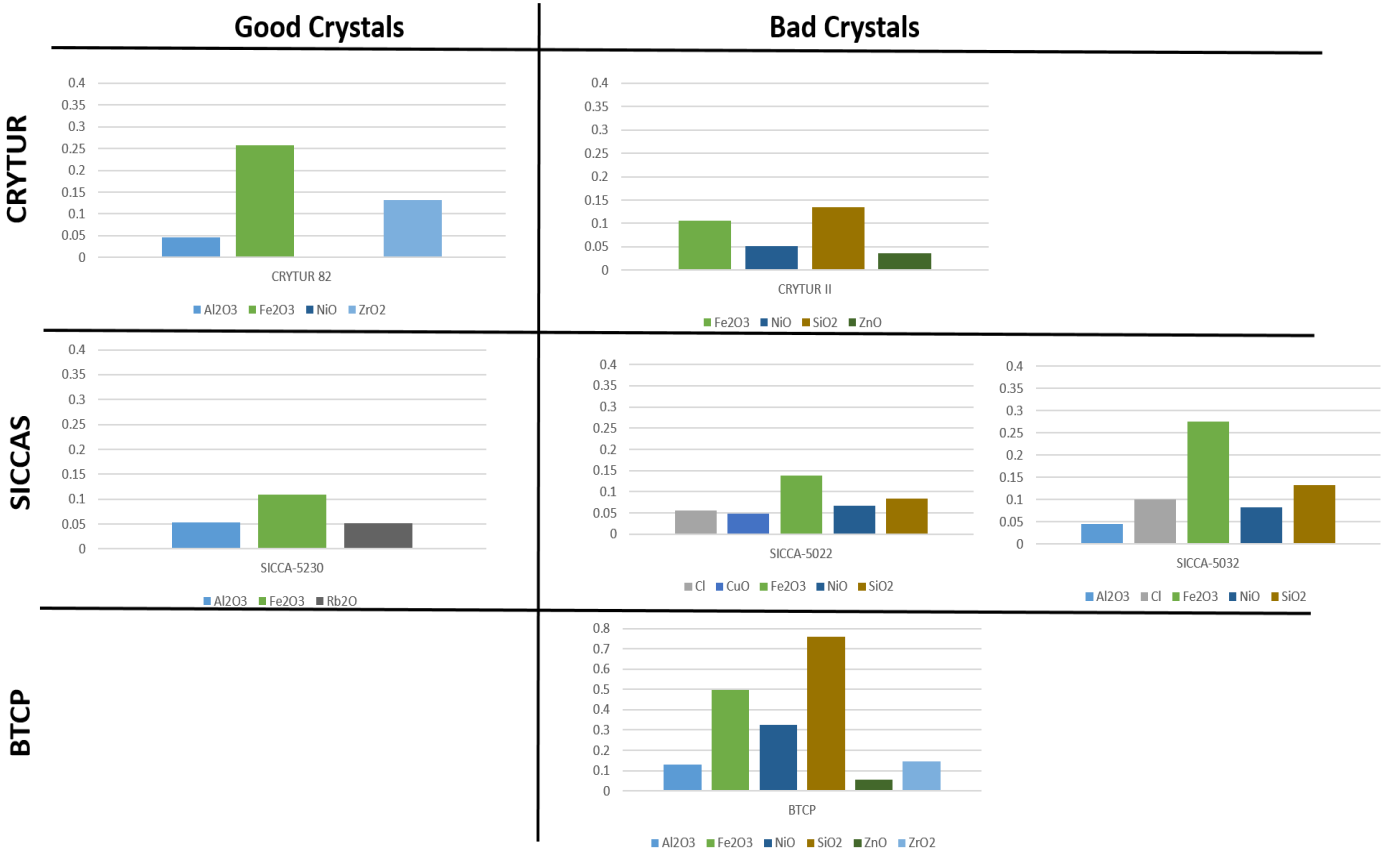
→ **See talk by V. Berdnikov**

Crystal Quality: *Chemical Composition*

The Catholic University of America

- Developed non-destructive sampling method
- XRF of 10-15% of 100 SICCAS 2017 crystals in collaboration with VSL

Overview of variation in chemical composition



Correlations: chemical composition and optical properties

The Catholic University of America

- Importance of variation in lead and tungsten, as well as other elements on crystal optical properties determined by statistical analysis
- For stoichiometry used a multivariate approach, in which correlations are estimated by a pairwise method
  - Clear dependence of transmittance (420nm) on stoichiometry, light yield does not seem to depend on it

	Al2O3	CaO	Cl	Cr2O3	CuO	Fe2O3	NiO	PbO	Rb2O	SiO2	WO3	ZnO	ZrO2	Light Yield	LT 420
Al2O3	1.0000	-0.0637	0.0500	0.0222	-0.5035	0.6193	-0.1994	0.2246	0.1136	-0.4142	-0.3617	0.2726	0.2487	0.2094	-0.1775
CaO	-0.0637	1.0000	-0.1947	-0.0910	-0.0910	-0.2581	-0.3309	-0.0255	-0.0910	-0.1440	0.2046	-0.1271	-0.2315	-0.3779	-0.1202
Cl	0.0500	-0.1947	1.0000	-0.1337	0.2209	0.4481	0.6386	0.0721	-0.1337	-0.0945	-0.3613	-0.1868	0.0636	-0.2777	-0.1756
Cr2O3	0.0222	-0.0910	-0.1337	1.0000	-0.0625	0.0620	0.3061	0.3970	-0.0625	-0.2357	-0.3078	-0.0873	-0.1590	-0.2804	-0.4934
CuO	-0.5035	-0.0910	0.2209	-0.0625	1.0000	-0.1440	0.2086	0.2237	-0.0625	0.0827	-0.1630	-0.0873	-0.1590	-0.0919	-0.1861
Fe2O3	0.6193	-0.2581	0.4481	0.0620	-0.1440	1.0000	0.1952	0.4125	-0.2305	-0.4911	-0.7115	0.3980	0.4512	-0.1540	-0.2958
NiO	-0.1994	-0.3309	0.6386	0.3061	0.2086	0.1952	1.0000	0.1406	-0.2273	-0.0730	-0.2637	-0.1491	-0.3345	-0.3974	-0.1615
PbO	0.2246	-0.0255	0.0721	0.3970	0.2237	0.4125	0.1406	1.0000	-0.0700	-0.4356	-0.8960	0.3456	-0.0146	-0.1618	-0.7324
Rb2O	0.1136	-0.0910	-0.1337	-0.0625	-0.0625	-0.2305	-0.2273	-0.0700	1.0000	-0.2357	0.2155	-0.0873	-0.1590	0.0512	0.0207
SiO2	-0.4142	-0.1440	-0.0945	-0.2357	0.0827	-0.4911	-0.0730	-0.4356	-0.2357	1.0000	0.3862	-0.0763	-0.1999	0.2082	0.6228
WO3	-0.3617	0.2046	-0.3613	-0.3078	-0.1630	-0.7115	-0.2637	-0.8960	0.2155	0.3862	1.0000	-0.4071	-0.2302	0.1556	0.6197
ZnO	0.2726	-0.1271	-0.1868	-0.0873	-0.0873	0.3980	-0.1491	0.3456	-0.0873	-0.0763	-0.4071	1.0000	0.1292	-0.2337	0.0767
ZrO2	0.2487	-0.2315	0.0636	-0.1590	-0.1590	0.4512	-0.3345	-0.0146	-0.1590	-0.1999	-0.2302	0.1292	1.0000	0.4764	-0.0142
Light Yield	0.2094	-0.3779	-0.2777	-0.2804	-0.0919	-0.1540	-0.3974	-0.1618	0.0512	0.2082	0.1556	-0.2337	0.4764	1.0000	0.1931
LT 420	-0.1775	-0.1202	-0.1756	-0.4934	-0.1861	-0.2958	-0.1615	-0.7324	0.0207	0.6228	0.6197	0.0767	-0.0142	0.1931	1.0000

Correlations: chemical composition and optical properties

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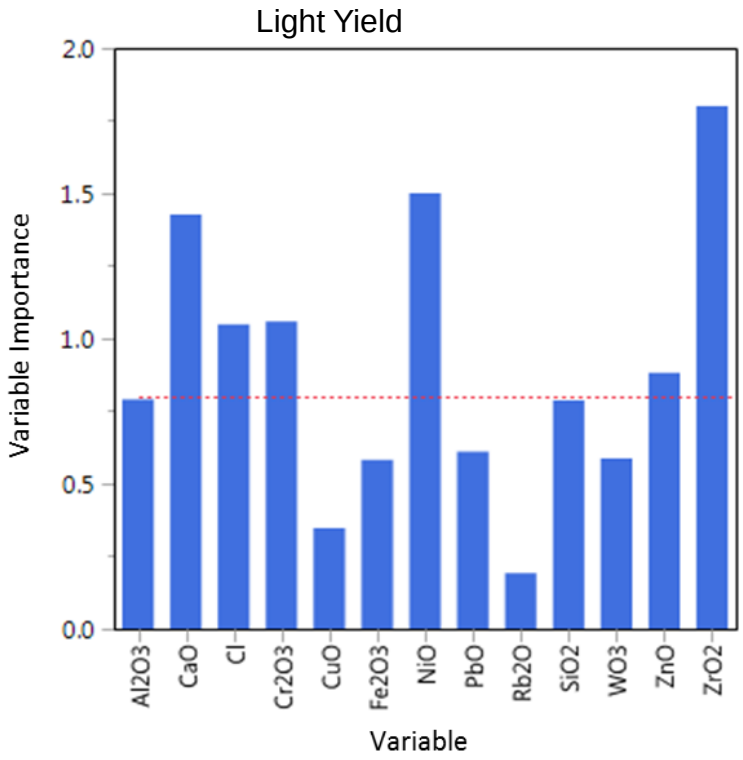
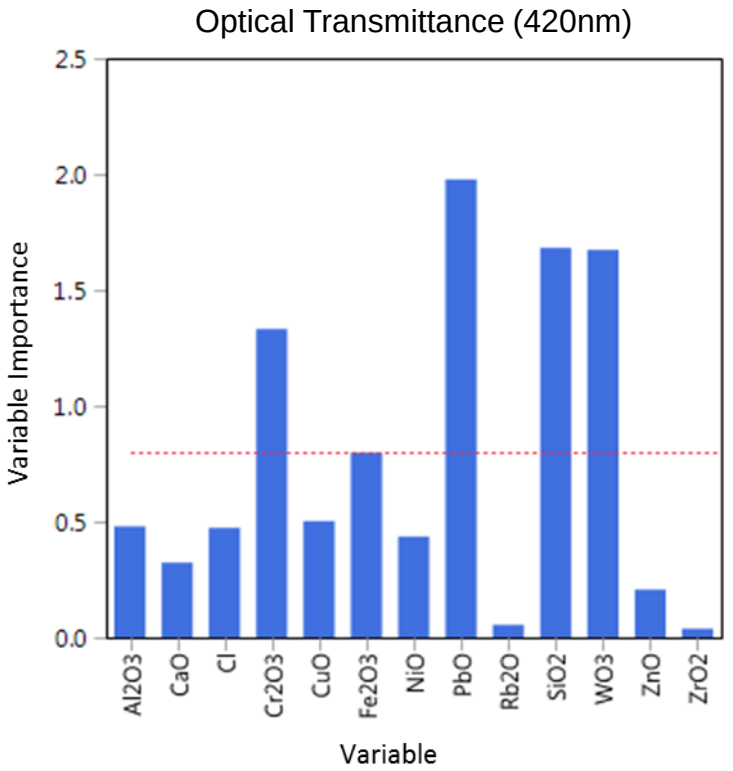
- To assess the impact of individual chemical components, correlation models were constructed using partial least squares





- Next steps:
  - Radiation hardness
  - Additional crystal samples – so far focused on samples that failed at least one optical specification

Review of 2017 Action Items

- NPS Magnet
  - Procure components — **DONE**
    Corrector coil at Jlab, main coil on boat, yoke parts to arrive by 9 Feb.
  - Determine magnet mapping needs — **ONGOING/DONE**
    Space planning complete
  - Determine a plan to complete the required mapping data — **DONE**
  - Map NPS magnet to confirm fringe field estimates — **Moved to 2018**
  - Finalize design for fringe field mitigation — **NOT DONE**
- NPS High-Voltage Bases
  - Finalize concept for board layout and connectors for HV and signals — **Ongoing/ DONE**
  - Identify Board vendors — **DONE**
  - Procure 35 bases through OU — **DONE**

Review of 2017 Action Items

- NPS Frame and Support
  - Complete removal in design of last small interference at small angles — **DONE**
  - Finalize light monitoring and curing and integrate with design of frame — **Ongoing**
  - Finalize integration of temperature-stabilization system — **DONE?**
  - Complete design of support of cantilevered platform
  - Complete design for cooling water and power lines for magnet

- NPS Crystals and readout
  - Finalize setting up infrastructure for crystal tests at IPNO and CUA — **DONE**
  - Define and document QA methods, procedures, specifications etc. — **DONE**
  - Test (some of) the PbWO4 crystals acquired — **DONE**

Done (100), 460 purchased from SIC, 110 first (?) go to Hall D, Anticipate to purchase 450 from CRYTUR now

Review of 2017 Action Items

- Platform for NPS
  - Complete design of support of cantilevered platform — **Planned for 2018**
  - Complete design for cooling water and power lines for magnet — **NOT DONE**
  - Complete integration of use of SOS detector rails — **DONE**
  - Complete design of removable guard (personnel safety) rails — **Concept DONE**
- Cabling Concept, DAQ and Electronics
  - Complete final cabling layout for HV and signal cables — **NOT DONE**
  - Complete layout of patch panels and DAQ/electronics racks in SHMS hut — **NOT DONE**
  - Complete full chain test of fADC readout with NPS 3x3 prototype — **NOT DONE**

Review of 2017 Action Items

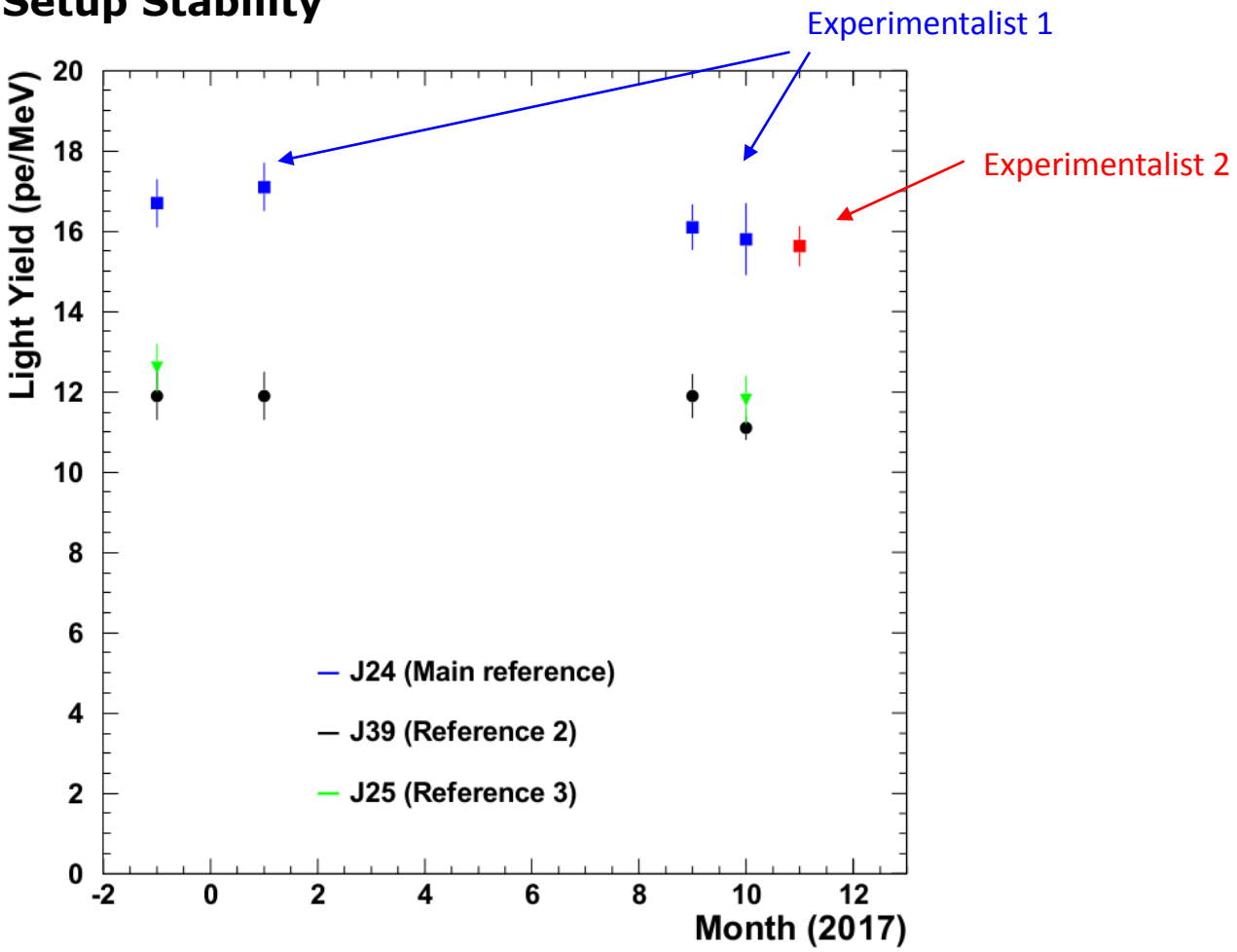
- ❑ Start software and simulation development — **NOT DONE**
- ❑ Finalize design of a high-intensity photon source — **ONGOING, Great progress**
- ❑ Future Physics with NPS
  - ○ Identify unique physics with polarized WACS and CPS — **DONE**
  - ○ For TCS, address two points: does experiment with NPS and transverse target provide unique access to GPD E, 2) is it competitive with other methods on the market — **ONGOING**
  - ○ Consider further high quality science that could be considered with NPS and CPS — **ONGOING /DONE**

HIPS2017 workshop and ideas of run group with TCS

Goals of this meeting

- Formulate 2018 action items for NPS construction and science
- Discuss the timeline of engineering and design for NPS
- Discuss optimization of NPS components
  - Discussion of PbWO4 and PMT and QA planning
  - Frame design and cooling
- Discuss activities related to cabling, DAQ and electronics
- Discuss path forward for photon source and future experiments with NPS
- Publication of crystal testing results

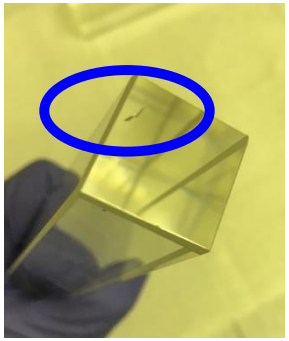
CUA Light Yield Setup Stability



Pictures of crystals Box 2-1 and Box #4

Box 2-1: 5061-70

Box #4: 5021-30



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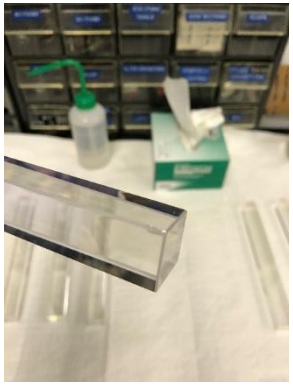

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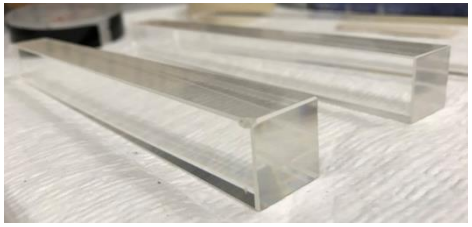

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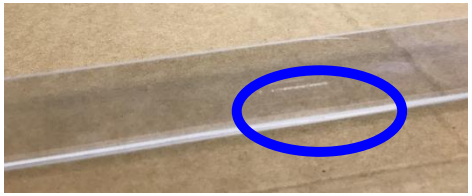
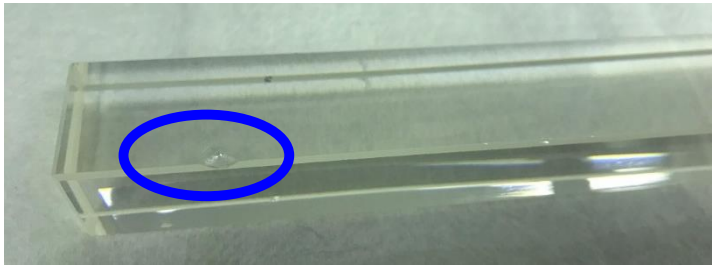


5023 – long scratch



5022 – chipped after thermal annealing

Temperature Profile - Thermal Annealing

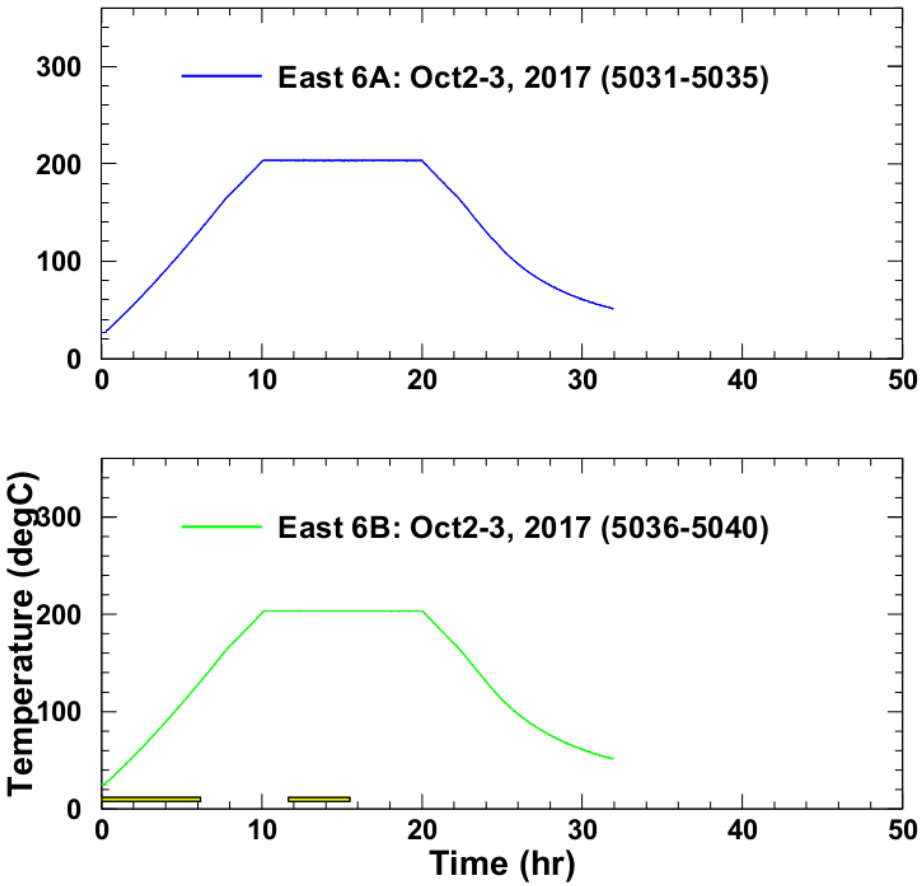


Illustration: single P.E. peak and signal