Crystals overview

Vladimir V. Berdnikov (CUA)

Crystal delivery status

- All crystals for NPS delivered to Jlab and located on site in NPS cleanroom

- Total number of crystals

  - CRYTUR 1379 pcs (ready to go)
  - SICCAS   446 pcs (portion of crystals are still questionable)

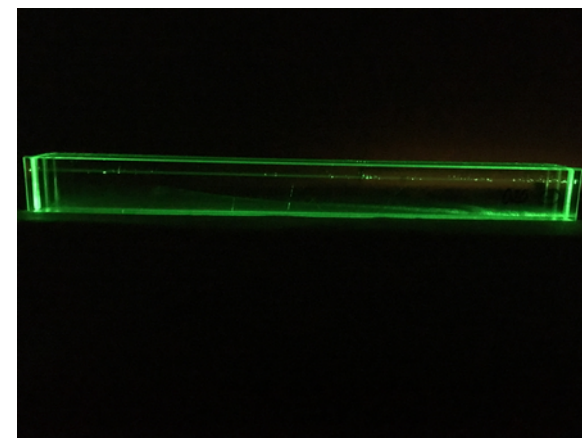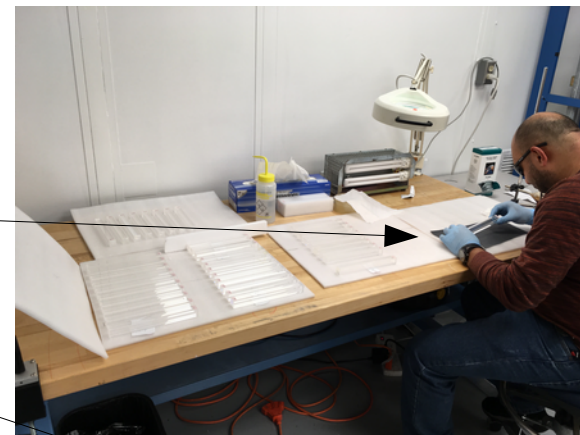**2019**   **2022**

Crystals quality assurance protocols

CRYTUR QA log

Dimension measurements

Visual inspections

Internal structure visual inspection with green laser

December 10 2019
Invoice 30/2019/523
Crytur PWO 10pcs

100796	20.464	20.459	look clean, area of dots bottom (incidence, low) +; 20% dots area GL
	20.466	20.463	small scratches, 1mm chip at the edge
	20.465	20.464	
030802	20.464	20.445	looks clean
	20.461	20.450	small scratches, 13mm scratch
	20.466	20.455	
050789	20.445	20.458	looks clean
	20.446	20.462	small scratches
	20.456	20.473	
120795	20.438	20.468	looks clean
	20.451	20.466	small scratches
	20.467	20.464	
070794	20.455	20.456	looks clean, dots area center ~15%
	20.453	20.456	small scratches
	20.455	20.458	
020787	20.461	20.459	looks clean
	20.462	20.458	small scratches, 3 mid deep scratches
	20.465	20.460	
040790	20.463	20.475	looks clean
	20.466	20.481	small scratches, 23 mm mid deep scratch
	20.459	20.483	
200792	20.460	20.457	looks clean, some dots <15% area
	20.460	20.450	small scratches, 24 mm scratch
	20.463	20.447	
610781	20.458	20.471	looks clean, some dots <15% area
	20.458	20.466	small scratches, 28 mm scratch
	20.460	20.462	
020804	20.465	20.468	looks clean
	20.464	20.461	small scratches, few <1mm² chips at the edge
	20.470	20.456	

https://wiki.jlab.org/cuawiki/index.php/File:Crytur_dimensions.ods
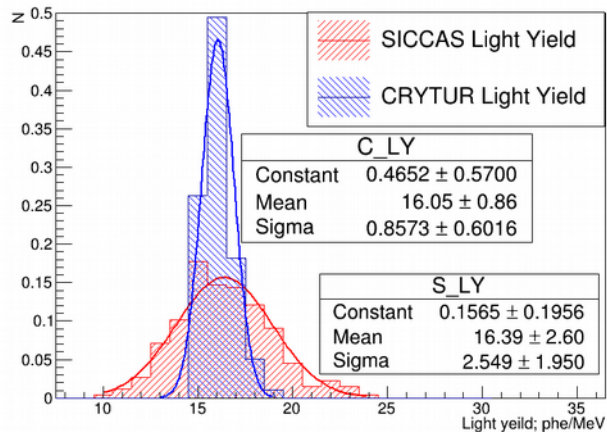
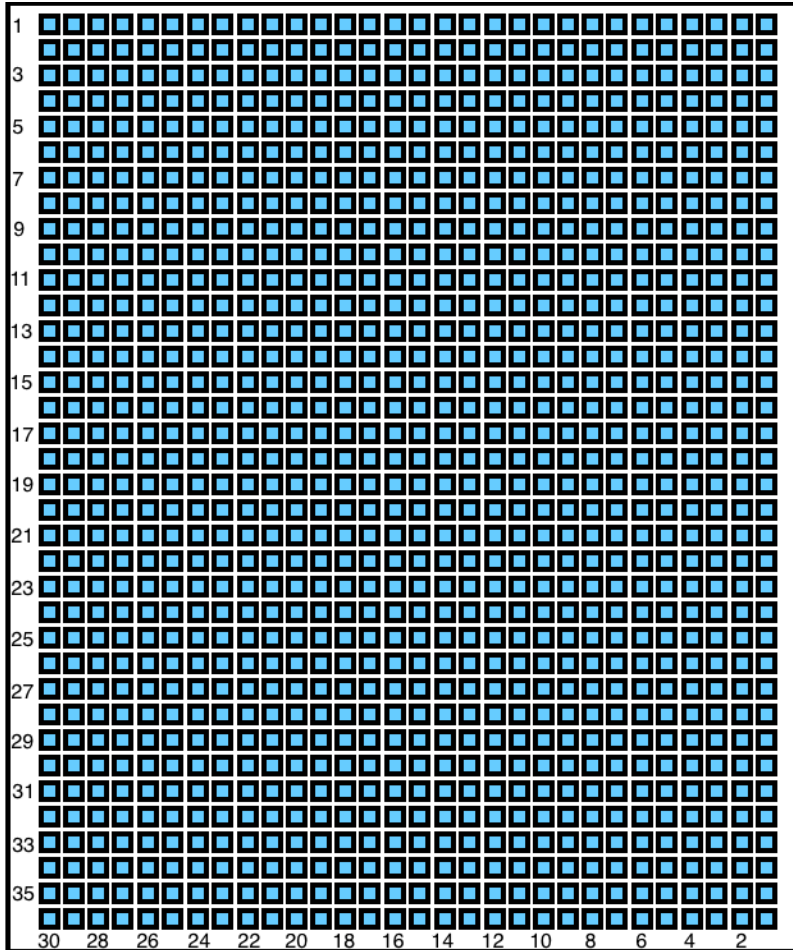# Crystals characteristics
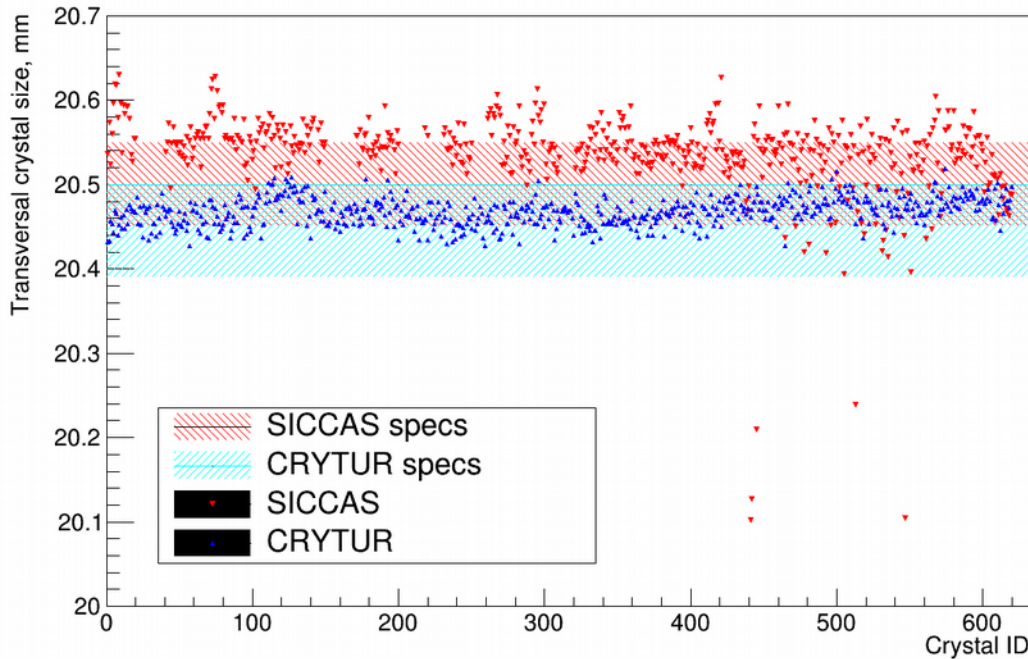
CRYTUR crystals are excellent quality
- Rejection rate 0%
- Better Transmittance
- Uniform Light Yield
- Dimensions within specification

SICCAS crystals are low medium quality
- Rejection rate 30%
- Worse transmittance compare to CRYTUR
- Nonuniform LY
- Dimensions outside of specification for significant portion of crystals
- Preselection required
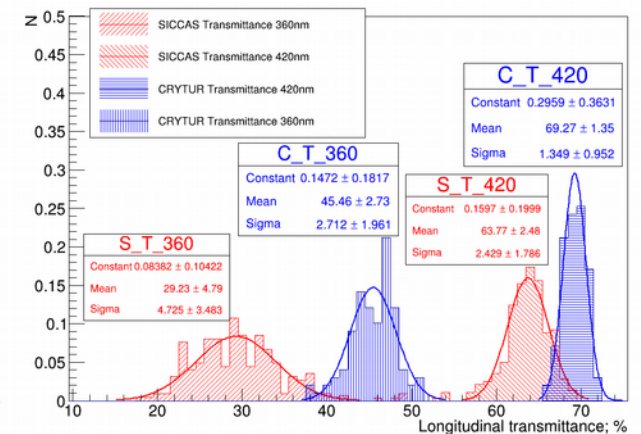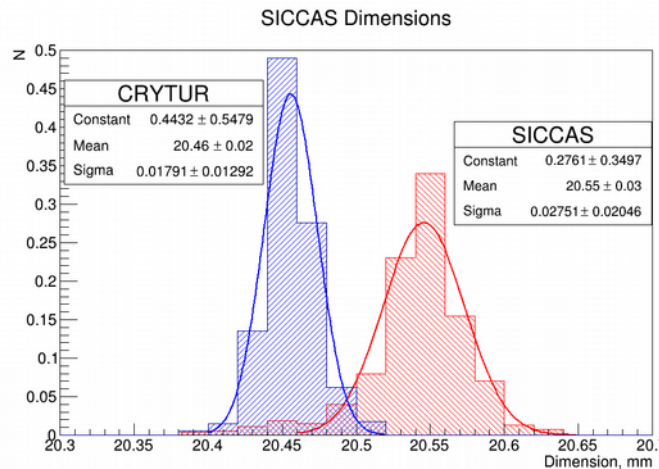
NPS stacking with crystals

- NPS Calorimeter will consist of 1080 crystals, matrix 36x30

- NPS Collaboration decision is to stack NPS with <u>all CRYTUR</u> crystals

  - Satisfied to quality requirements
  - All crystals have uniform characteristics
  - Radiation hard
  - Crystal selection not needed for stacking
  - Good constant term

Possible assembly procedure protocols and serial numbers tracking

- Experience gained during CCAL detector assembly
- Tracking of crystals movement from cleanroom to wrapping pre-assembly area
- Note with crystal serial number, initials , date, etc to track pre-assembly modules
- In case of issues it allows to step back and figure out if an issue is person or method dependent
- Protocols can be adjusted for NPS assembly

### Crystal movement from cleanroom to wrapping area

Crystal Number	Box Number	Name of Person Accepted	Date Accepted.
XXXX	Box X-X	John Q. Public	XX/XX/XXXX
5344	B3-3	Vlad	07/20/2018
5346	B3-3	Vlad	07/20/2018
5347	B3-3	Vlad	07/20/2018
5349	B3-3	Vlad	07/20/2018
5255	B2-10	Vlad	07/20/2018
5256	B2-10	Vlad	07/20/2018
5131	B1-14	Vlad	07/20/2018
5132	B1-14	Vlad	07/20/2018
5134	B1-14	Vlad	07/20/2018
5135	B1-14	Vlad	07/20/2018
5136	B1-14	Vlad	07/20/2018
5138	B1-14	Vlad	07/20/2018
5139	B1-14	Vlad	07/20/2018
5140	B1-14	Vlad	07/20/2018
5251	B2-10	Vlad	07/26/2018
5253	B2-10	Vlad	07/26/2018
5255	B2-10	Vlad	07/26/2018
5259	B2-10	Vlad	07/26/2018
5260	B2-10	Vlad	07/26/2018
5151	B1-16	Vlad	07/26/2018
5152	B1-16	Vlad	07/26/2018
5153	B1-16	Vlad	07/26/2018
5154	B1-16	Vlad	07/26/2018
5155	B1-16	Vlad	07/26/2018
5157	B1-16	Vlad	07/26/2018
5158	B1-16	Vlad	07/26/2018
5159	B1-16	Vlad	07/26/2018
5223	B2-7	Vlad	07/26/2018

Tracking of CCAL detector module assembly

Module Number	Crystal Number	PMT Number	Base Number	Initials	Date Assembled
Comp Cal XXX	XXXX	CX XXXX	Base X	X.X.X.	XX/XX/XXXX
Assembly 40	5349	CX 6966		H.V.	07/24/18
Assembly 41	5150	CX 6967		H.V.	07.24.18
Assembly 42	5218	CX 6977		H.V.	07.24.18
Assembly 43	5220	CX 6979		H.V.	07.24.18
Assembly 44	5131	CX 6980		H.V.	07.24.18
Assembly 45	5132	CX 6981		H.V	07.24.18
Assembly 46	5255	CX 6982		H.V	07.25.18
Assembly 47	5134	CX 6969		H.V.	07.25.18
Assembly 48	5135	CX 6968		H.V.	07.25.18
Assembly 49	5136	CX 6972		H.V.	07.25.18
Assembly 50	5256	CX 6974		H.V.	07.25.18
Assembly 51	5138	CX 6985		H.V.	07.25.18
Assembly 52	5139	CX 7076		H.V.	07.25.18
Assembly 53	5140	CX 7077		H.V.	07.25.18
Assembly 54	5349		CX 7087	VC	07/26/18
Assembly 55	5061		CX 7088	VC	07/26/18
Assembly 56	5062	CX 7079		H.V.	07.26.18
Assembly 57	5064	CX 7081		VC	07/26/18
Assembly 58	5066	CX 7082		H.V	07.26.18
Assembly 59	5067	CX 7083		VC	07/26/18
Assembly 60	5068	CX 7084		H.V.	07.26.18
Assembly 61	5069	CX 7085		H.V.	07.26.18
Assembly 62	5070	CX 7074		VC	07/26/18
Assembly 63	5223	CX 7089		VC	07/27/18
Assembly 64	5225	CX 7090		VC	07/27/18
Assembly 65	5226	CX 7093		VC	07/27/18
Assembly 66	5228	CX 7094		VC	07/27/18
Assembly 67	5230	CX 7095		VC	07/27/18
Assembly 68	5241	CX 7039		VC	07/27/18

Summary

- All crystals on site

- Quality assurance is done for all crystals and vendors

- NPS will be stack with CRYTUR crystals

- Assembly protocols (crystals tracking) under development
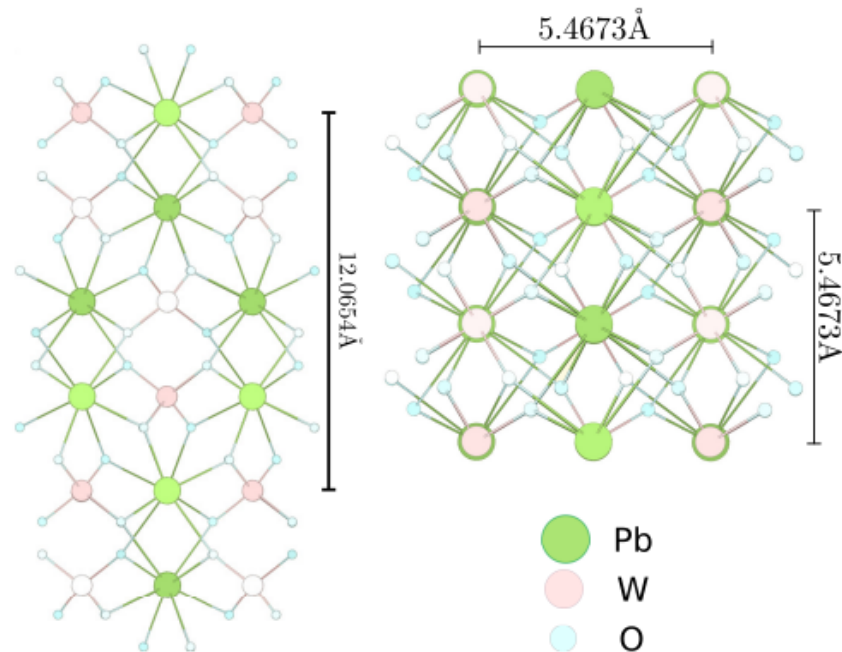
(a) Crystal Structure of PWO (b) Cross section of PWO crystal structure
along the long crystal axis. perpendicular to the long crystal axis.