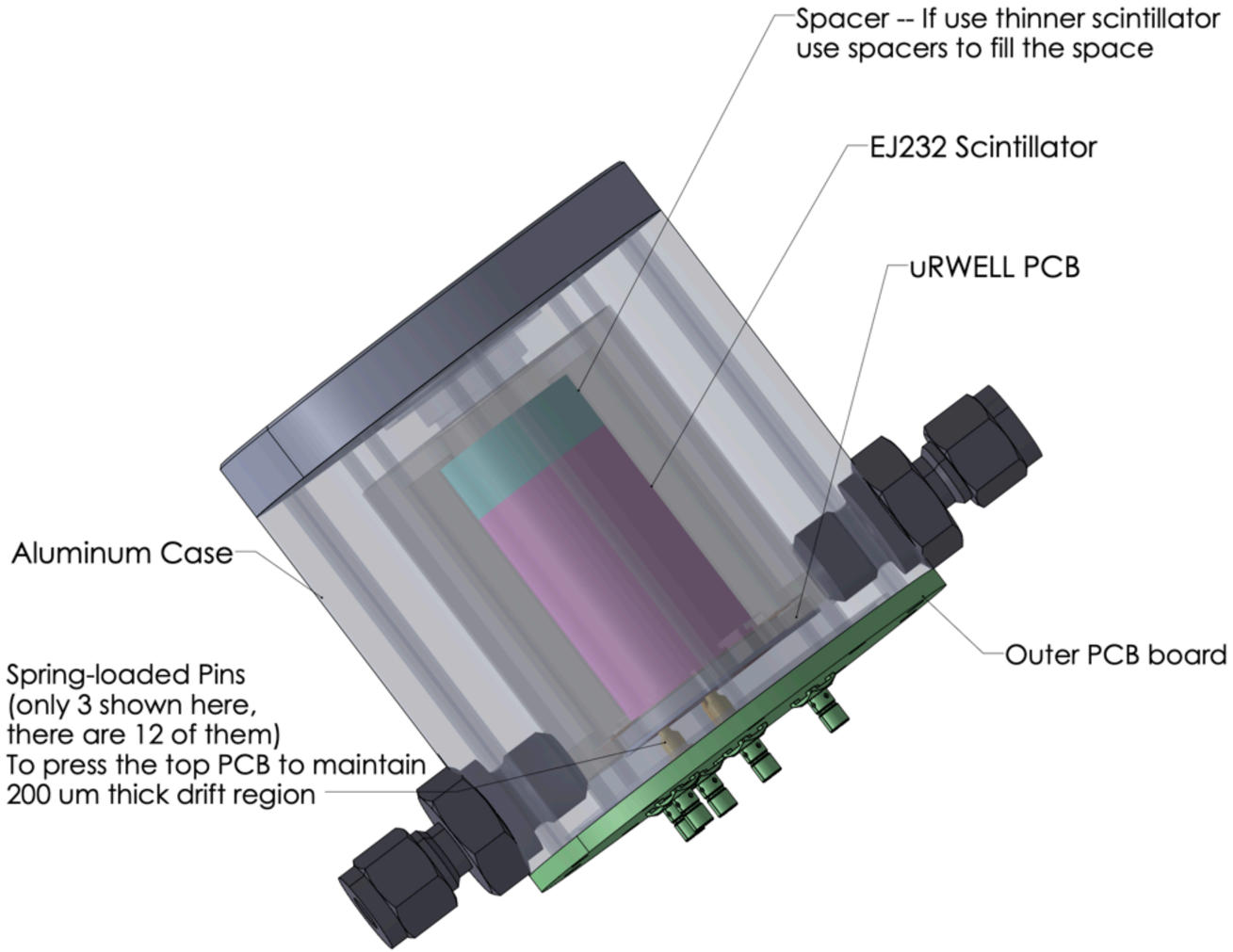
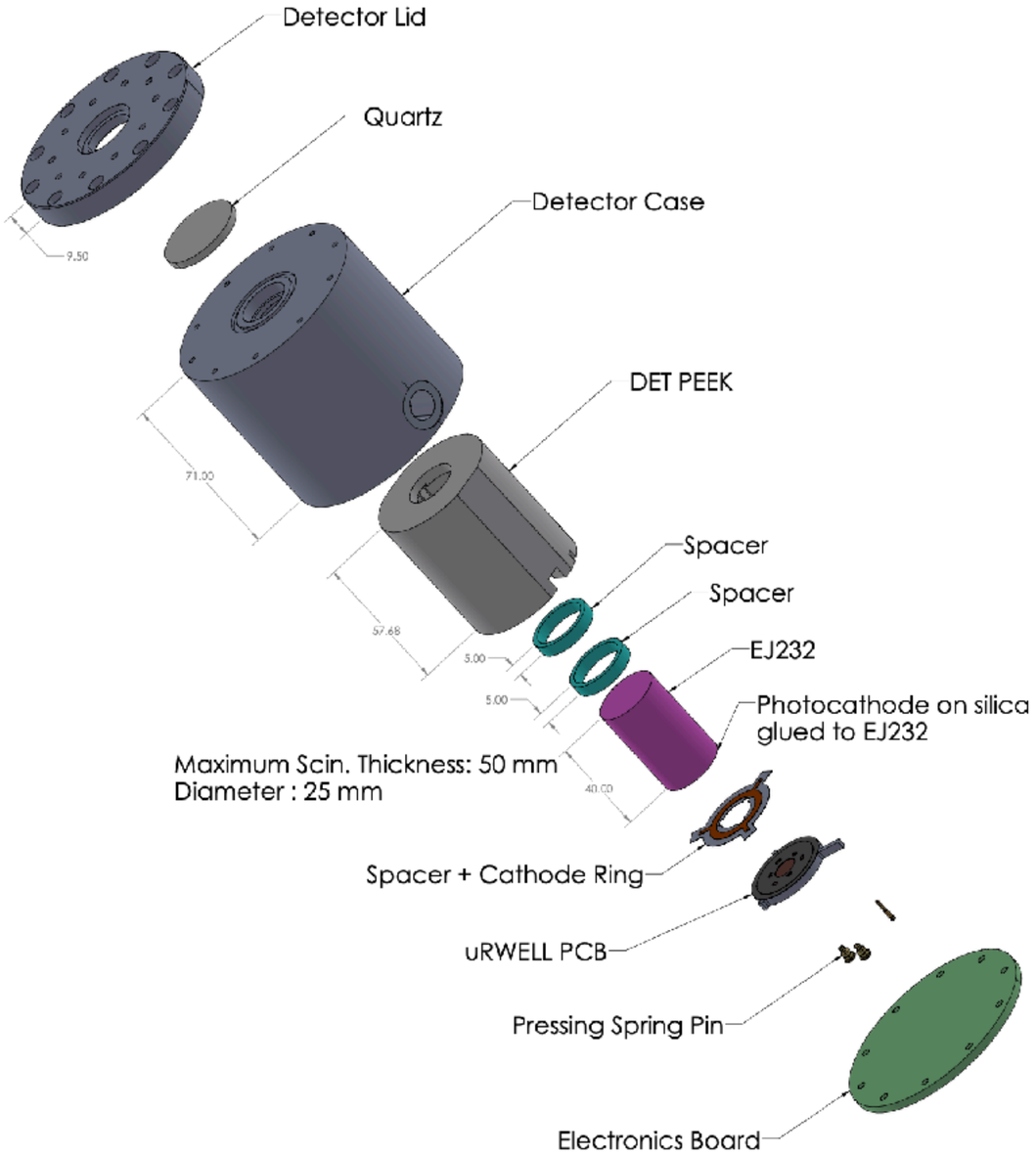
MPGD-nTOF Biweekly Meeting

November 19, 2025

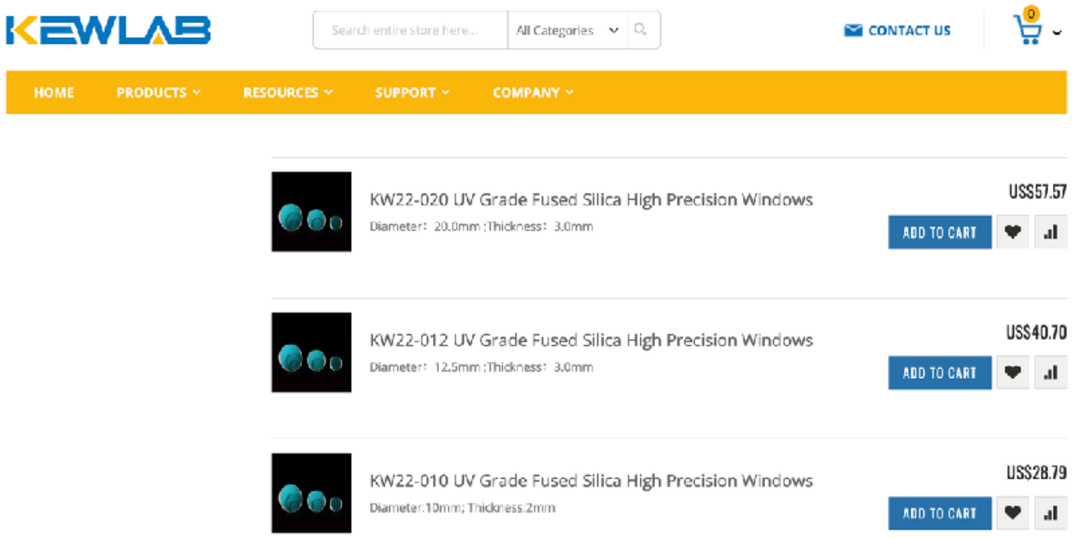
Detector CAD Design

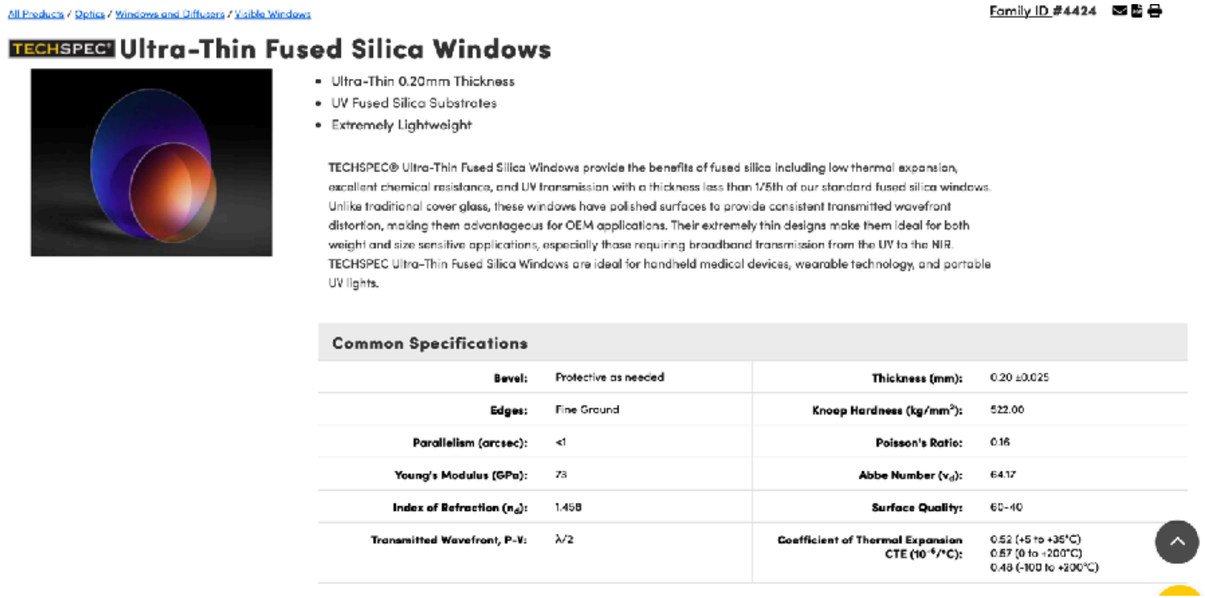




Substrate for photocathode K_2CsSb

- Deposit photocathode on 25 mm diameter, 0.2 mm - 2 mm thick, UV-rated Fused Silica





[KW22-UV Grade Fused Silica High Precision Windows - KEWLAB]
[Ultra-Thin Fused Silica Windows | Edmund Optics]

Preparation of Photocathode Manufacturing at JLab

1. Preparation for Photocathode manufacturing in JLab
    1. HTC not an option — concern of pollution to deposition chamber
    2. Loading dock option
    3. Coordinating CIS for vacuum chamber design to fit the loading dock
    4. Photocathode assembly to detector

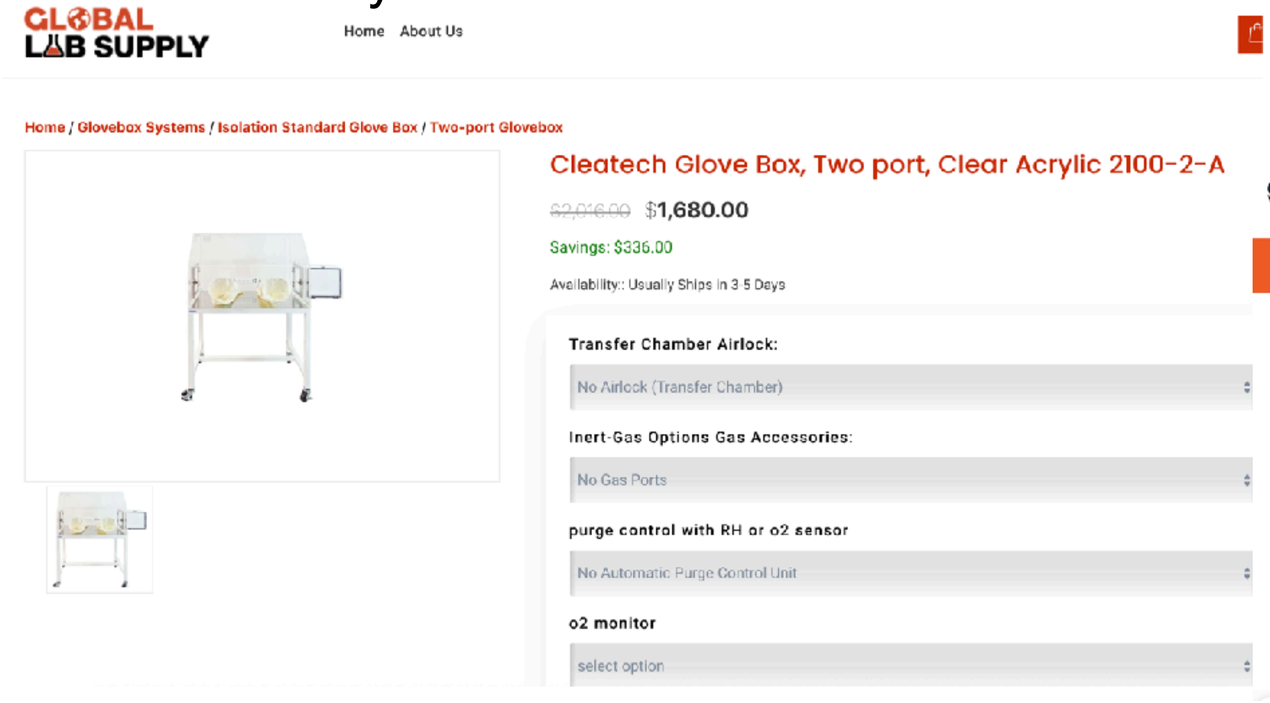
Photocathode Assembly Plan

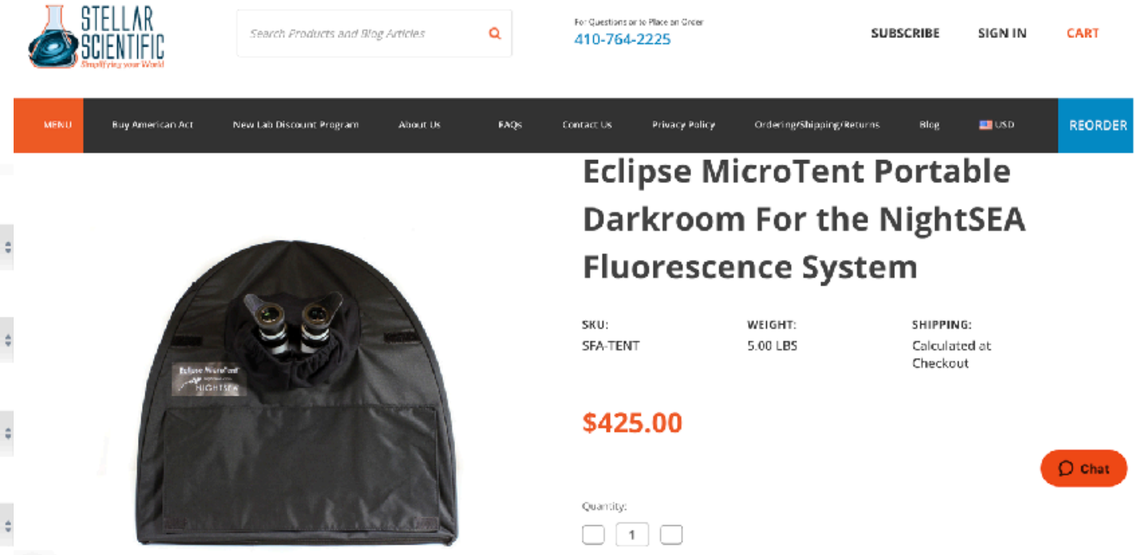
according to John, UHP N2 doesn't work,
Need to keep H2O less than 10^{-10} level,
otherwise it kills photocathode instantly

Plastic glove box won't work, need to have vacuum condition first

- Assemble photocathode to detector in a ~~UHP N2 gas~~ sealed glove box
- ~~Light-controlled environment, IR red light only~~
- Assembly stand in cleanroom

Per John's suggestion, this is not necessary, as long as there is no bias voltage on the photocathode, it is fine, they did this asssembly before

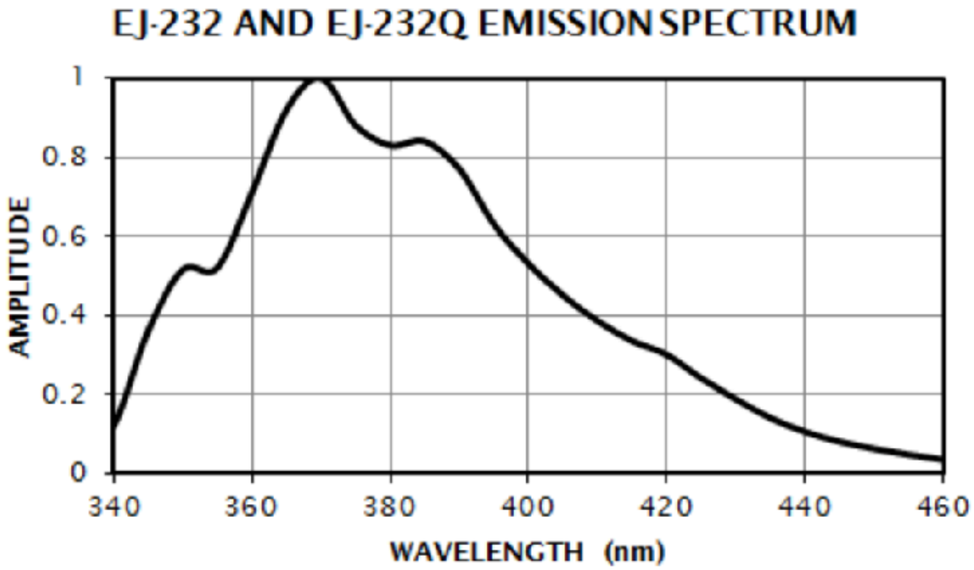




https://www.globallabsupply.com/Two-port-Glovebox-Acrlic-p/2100-2-a.htm?utm_source=Google%20Shopping&utm_campaign=google_product_gls&utm_medium=cpc&utm_term=6055&srsltid=AfmBOop9pPXiF_mF2rncwJYnERoeHrE_hrIfMerrzmL6mv6a2U4fy-X9Mnw
https://www.msesupplies.com/collections/glove-boxes/acrylic-gloveboxes?srsltid=AfmBOooqT22oanXSClhLOVTsNPtAb9GIldbNZCsgVzx51Anbg2EPZ_CqH
https://www.stellarscientific.com/eclipse-microtent-portable-darkroom-for-the-nightsea-fluorescence-system

Plastic Scintillator — EJ232

PROPERTIES	EJ-232	EJ-232Q (% Benzophenone)				
		0.5	1.0	2.0	3.0	5.0
Light Output (% Anthracene)	55	19	11	5	4	3
Scintillation Efficiency (photons/1 MeV e^-)	8,400	2,900	1,700	770	610	460
Wavelength of Maximum Emission (nm)	370	370	370	370	370	370
Rise Time (ps)	350	110	105	100	100	100
Decay Time (ps)	1600	700	700	700	700	700
Pulse Width, FWHM (ps)	1300	360	290	260	240	220
No. of H Atoms per cm^3 ($x10^{22}$)	5.13	5.12	5.12	5.12	5.12	5.12
No. of C Atoms per cm^3 ($x10^{22}$)	4.66	4.66	4.66	4.66	4.66	4.66
No. of Electrons per cm^3 ($x10^{23}$)	3.30	3.38	3.38	3.38	3.38	3.38
Density (g/cm^3)	1.023	1.023	1.023	1.023	1.023	1.023
Polymer Base	Polyvinyltoluene					
Refractive Index	1.58					
Softening Point	75°C					
Vapor Pressure	Vacuum-compatible					
Coefficient of Linear Expansion	7.8×10^{-5} below 67°C					
Light Output vs. Temperature	At 60°C, L.O. = 95% of that at 20°C. No change from -60°C to 20°C.					
Temperature Range	-60°C to 60°C					



https://eljentechnology.com/products/plastic-scintillators/ej-232-ej-232q

Questions & Discussion

1. Are there any different photocathode that can work for the application?

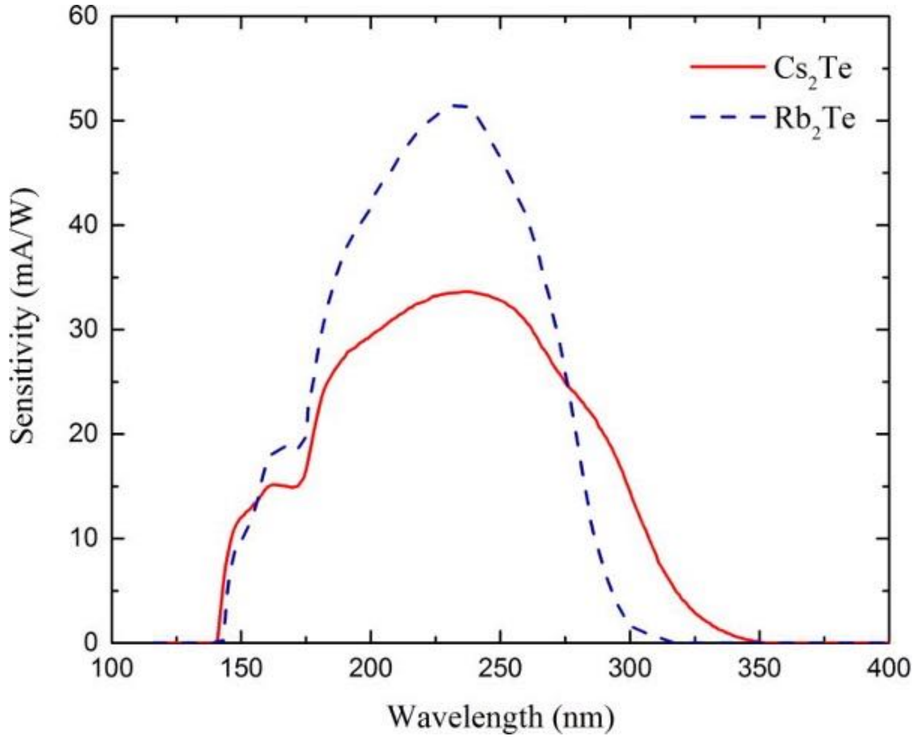
Photocathode	QE (370 nm)	Sensitive to O2, H2O, CO2 (relative to K_2CsSb)
Cs_3Sb	10-15%	Very sensitive (Similar or less robust)
Na_2KSb:Cs	10-20%	Sensitive (Similar robust)
Cs_2Te	Very low (cut-off: 342 nm)	More robust than K2CsSb, can survive higher partial pressure and tolerate handling mistakes

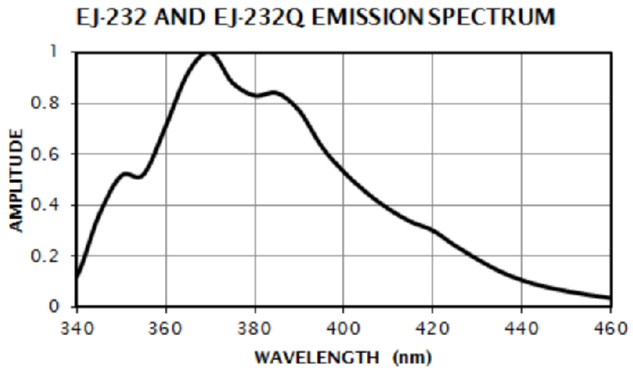
Na2KSb is probably better, more robust

2. Other activities currently on-going
    1. Garfield simulation currently on going
    2. Detector prototype CAD, Loading Dock Interface Vacuum Chamber CAD

Spectral response characteristics of transmission-mode alkali telluride photocathodes working from vacuum-ultraviolet to ultraviole band

J. Vac. Sci. Technol. B 35, 061202 (2017)





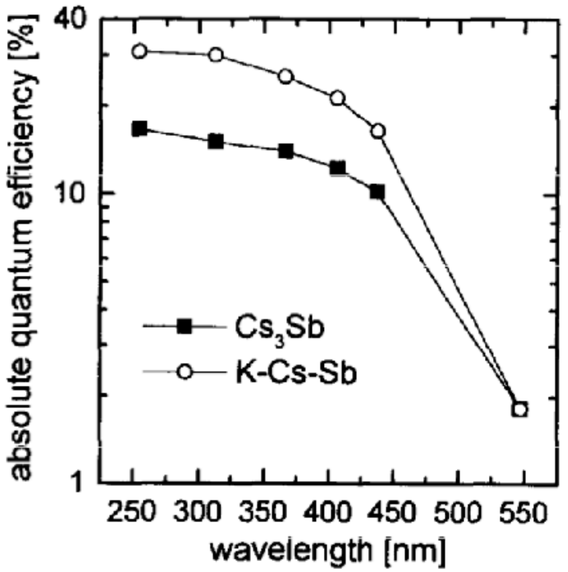


Fig. 3. Typical absolute quantum efficiency spectra of Cs_3Sb and K–Cs–Sb reflective photocathodes, prepared in this work.

Laboratory production of efficient alkali-antimonide photocathodes
Nuclear Instruments and Methods in Physics Research A 411 (1998) 383-388