

Fluorescent Properties of Clevios For Use As Electrodes In DarkSide-20K

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Land Acknowledgement

Queen's University is situated on the territory of the Haudenosaunee, Anishinaabek, and Huron-wendat people. Banff is in the traditional territory of Kootenay, Stoney, Peigan, Siksika, and Tsuu T'ina First Nations. I am grateful to be able to live and work, on these traditional territories.

Overview

- ▶ DarkSide-20K is a two-phase Liquid Argon (LAr) detector, scintillation and time projection chamber (TPC) located at LNGS.
- ▶ Materials used in the detector can fluoresce when excited by UV light that can come from the scintillation, or Cherenkov light.
- ▶ DarkSide-20K experiment will use Clevios coating on the acrylic vessel, that will provide the voltage gradient of the TPC.

Scientific motivation

- ▶ Fluorescence properties of acrylic when stimulated by UV radiation are known.
- ▶ Indication that Clevios might fluoresce when stimulated by UV radiation.
- ▶ It is important to understand how much light these materials produce since they can be a background source in the experiment.

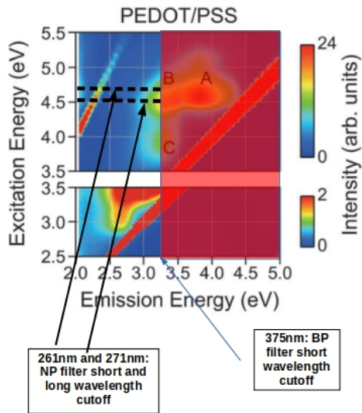
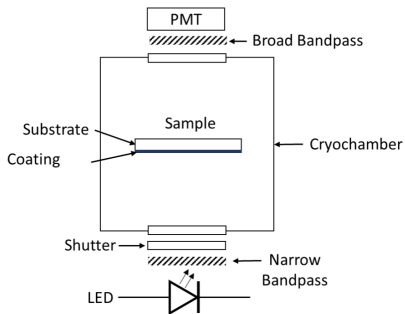


Fig credit: T. Koyama et al. (2015)

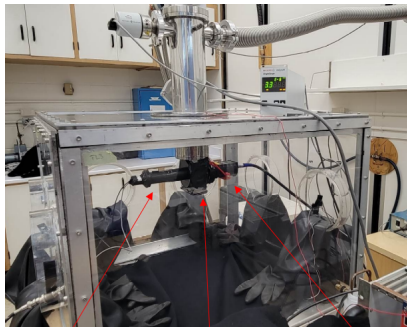
Experimental Set-up

- ▶ Sample is held within an optical cryostat and two types of measurements can be found using this set-up.
 1. Light-yield measurements
 2. Spectral measurements
- ▶ Cryostat uses a closed cycle coolers that can operate from 3.4K to 300K.



Light-yield Measurements

- ▶ Excited by a 267nm pulsed LED
- ▶ Resulting fluorescence detected by a PMT, then digitized
- ▶ 45 000 events taken for each temperature in a range from 300K to 4K
- ▶ Light-yield is found by integrating the signal over 50ns



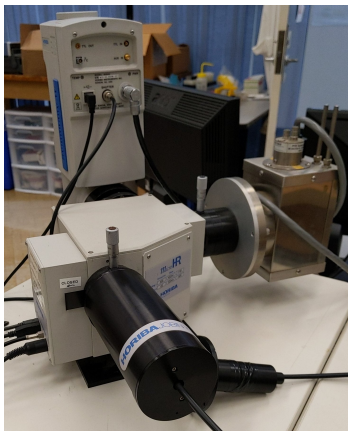
Visible light sensitive PMT

Vacuum shroud (sample contained inside)

Pulsed UV LED

Spectral Measurements

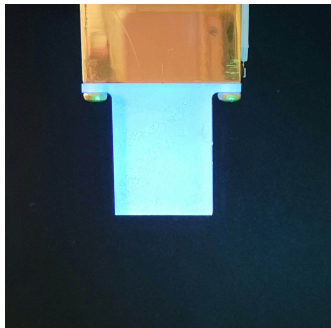
- ▶ Sample is irradiated by 260nm continuous LED
- ▶ Signal is detected by an optical fibre attached to the spectrometer
- ▶ 400nm longpass filter built into the spectrometer is used to remove the LED from the spectra.



Samples

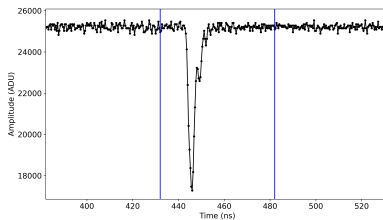
Tested 3 samples for their fluorescent properties.

1. Acrylic
2. TPB coated acrylic - wavelength shifter for DarkSide. UV \rightarrow visible
3. Clevios coated acrylic (10 nm thickness)

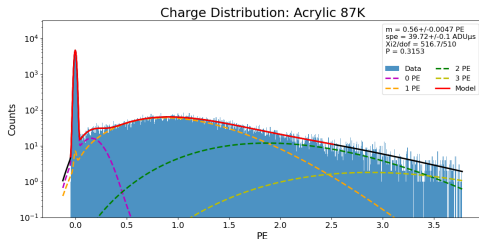


Example fluorescence from TPB

Acrylic Light-yield Measurements

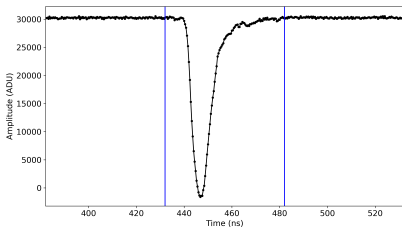


Example signal from the PMT of the fluorescence of acrylic at 87K.

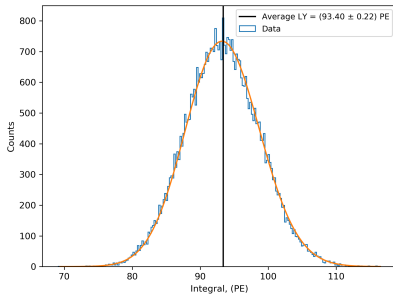


Distribution of integrals for all pulses at 87 K.

TPB Light-yield Measurements

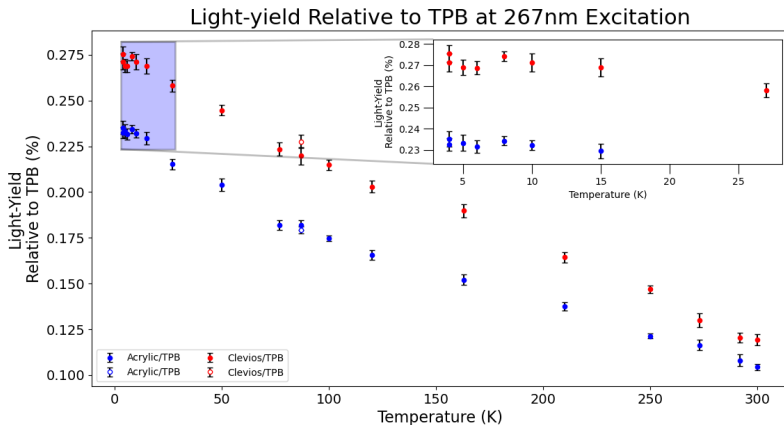


Example signal from the PMT of
the TPB at 87 K

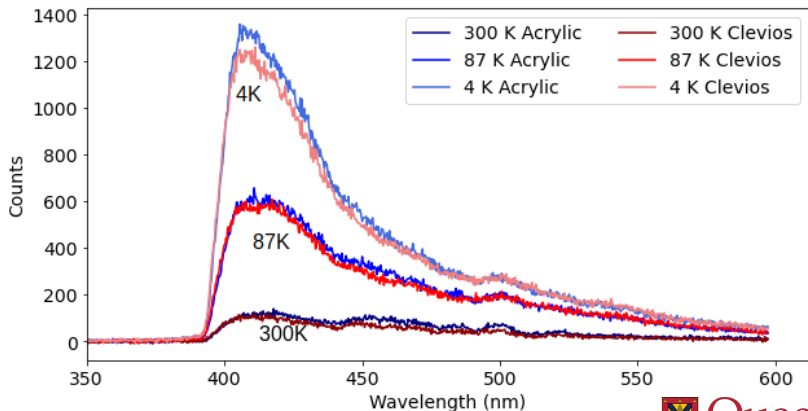


Distribution of integrals for all
pulses at 87 K.

Light-yield Comparison



Spectral Measurements



Future Work

- ▶ Received thicker sample of Clevios ($\approx 100nm$) to determine if there is more fluorescence.
- ▶ Interest in doing a triple sample TPB - Clevios - acrylic.
- ▶ Discussions ongoing about testing for scintillation properties in Clevios.



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