UCN Detection & DAQ

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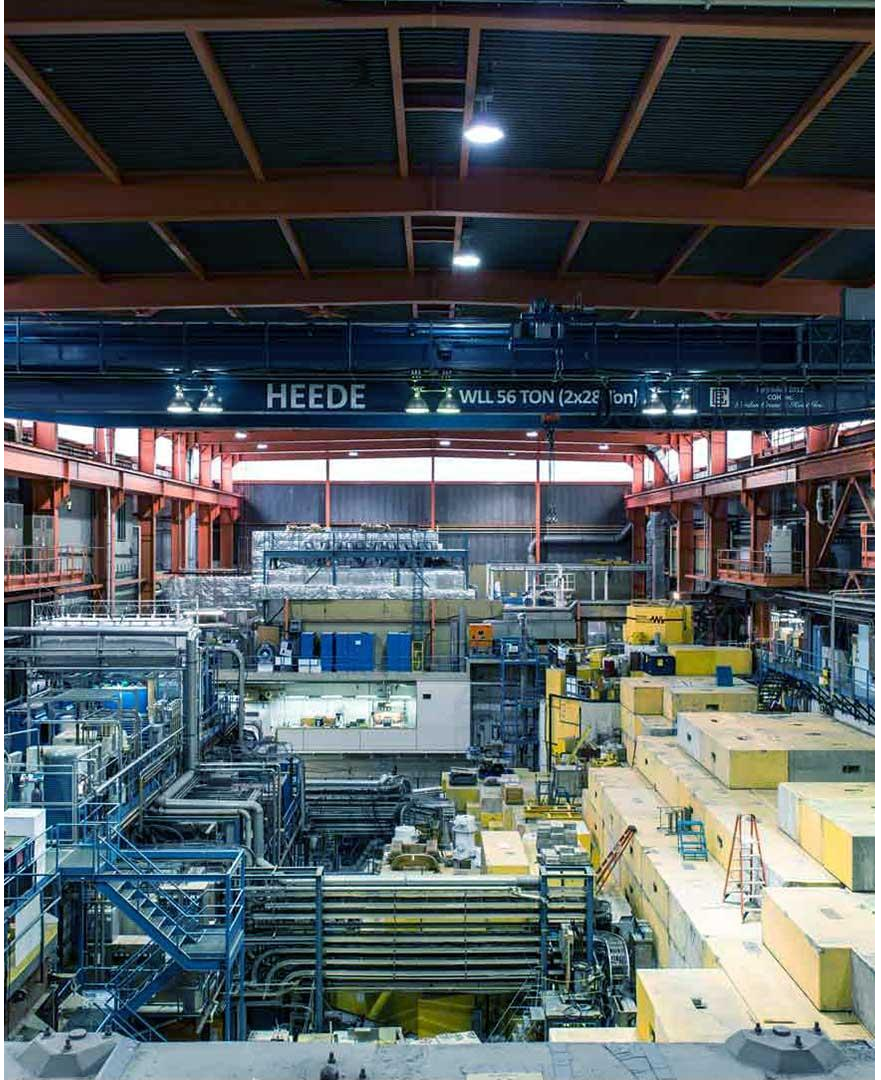
Physical Sciences Division

TUCAN EAC Review 2020

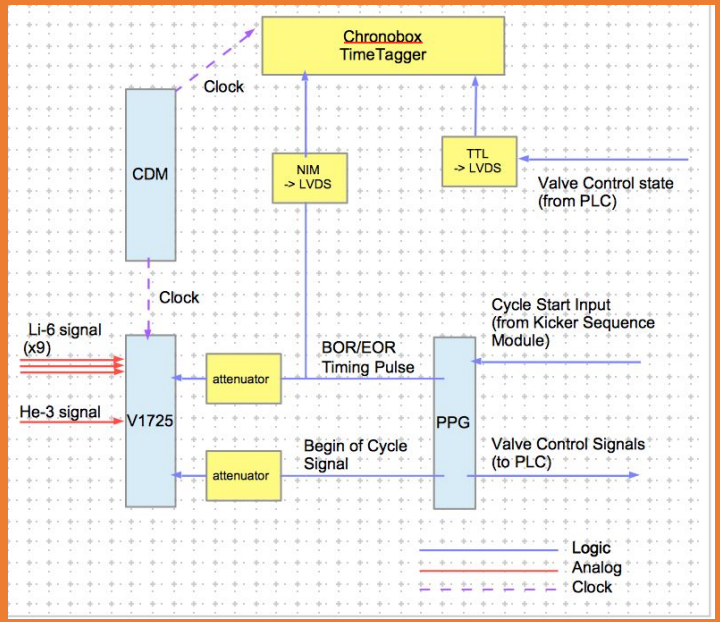


Overview

- DAQ Update
- ^{6}Li Detector
- ^{3}He Detector
- New Detector Ideas
- Polarizers and Spin-Flippers
- Conclusions & Outlook

Detector Digitizer Upgrade

New DAQ Structure



New Digitizer

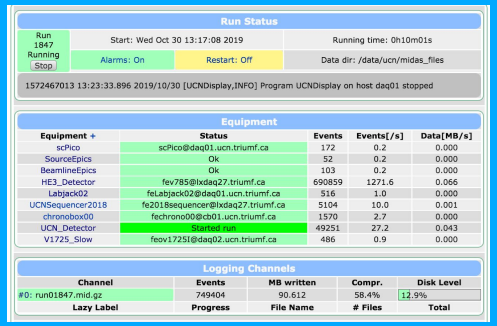
CAEN V1725
14 bit @ 250 MS/s
16 Channels - VME64 Module

Successfully integrated in the DAQ infrastructure.
The new board was used for the 2019 fall-run.

Discovery, accelerated

Updated MIDAS Interface

MIDAS Status Page



Run Status

Run 1847 Running | Stop | Start: Wed Oct 30 13:17:08 2019 | Running time: 0h10m01s | Alarms: On | Restart: Off | Data dir: /data/ucn/midas_files

1572467013 13:23:33.896 2019/10/30 [UCNDisplay,INFO] Program UCNDisplay on host daq01 stopped

Equipment

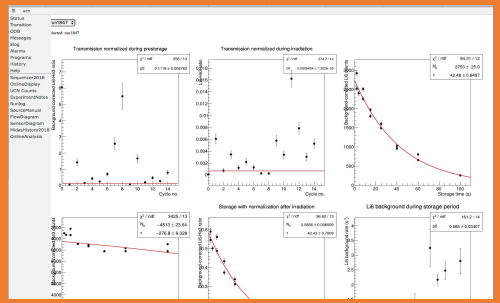
Equipment +	Status	Events	Events[/s]	Data[MB/s]
scPico	scPico@daq01.ucn.triumf.ca	172	0.2	0.000
SourceEpics	Ok	52	0.2	0.000
BeamlineEpics	Ok	103	0.2	0.000
HE3_Detector	fev785@lxdaq27.triumf.ca	690859	1271.6	0.066
Labjack02	feLabjack02@daq01.ucn.triumf.ca	516	1.0	0.000
UCNSequencer2018	fe2018sequencer@lxdaq27.triumf.ca	5104	10.0	0.001
chronobox00	fechrono00@cb01.ucn.triumf.ca	1570	2.7	0.000
UCN_Detector	Started run	49251	27.2	0.043
V1725_Slow	feov1725l@daq02.ucn.triumf.ca	486	0.9	0.000

Logging Channels

Channel	Events	MB written	Compr.	Disk Level
#0: run01847.mid.gz	749404	90.612	58.4%	12.9%
Lazy Label	Progress	File Name	# Files	Total

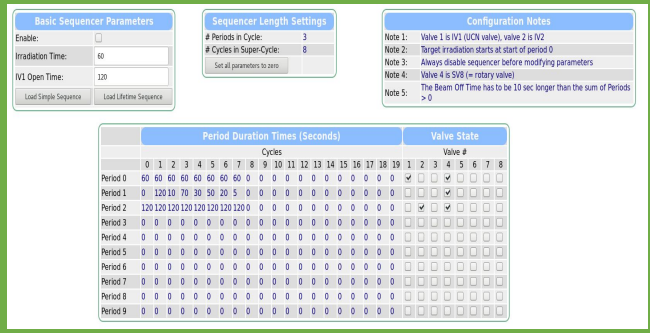
Our Data-taking is controlled with a MIDAS web-interface, which is accessible through any browser (username and password required).

Live Online Monitor



A live detectors monitor enables us to get live-access to multiple detector parameters and distribution.
This helps us ensure that we always take good data.

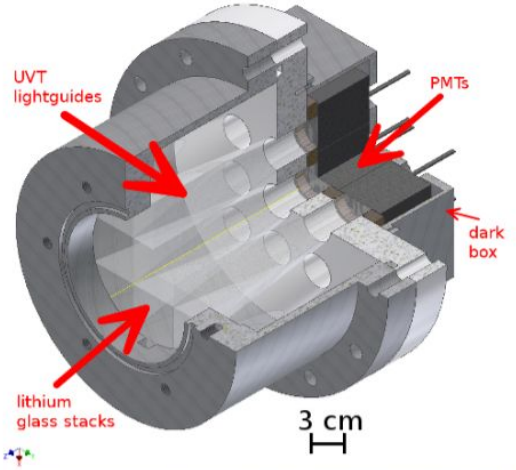
Sequencer Control



Script-interface, simplifies running more complex experiment that requires multiple actions in series.

B. Bell, P. Giampa, S. Hansen-Romu, B. Jamison,
T. Lindner, S. Sidhu, R. Picker, W. Schreyer, S. Vanbergen

^{6}Li Detector

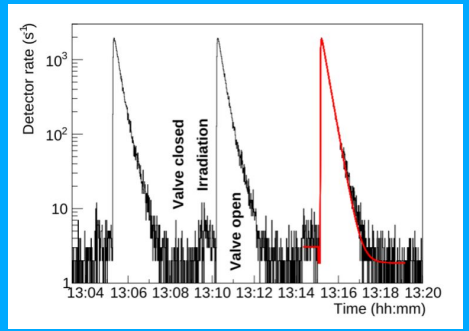


Organic Scintillator:

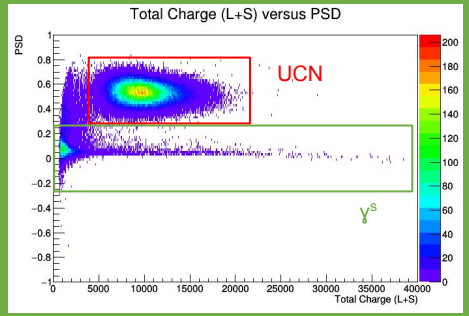
^{6}Li Loaded Glass to measure slow/thermal Ultra-Cold Neutrons.

$$^6Li + n = t(2.05\ \mathrm{MeV}) + \alpha(2.73\ \mathrm{MeV})$$

UCN Counting



Particle ID



Discovery, accelerated

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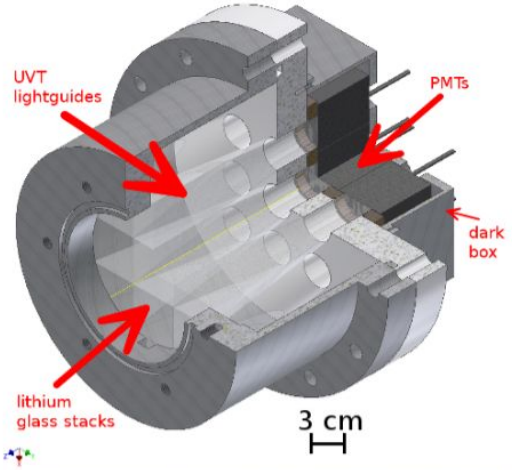
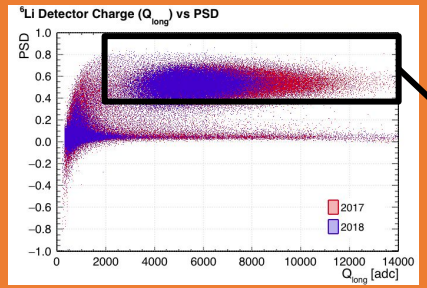
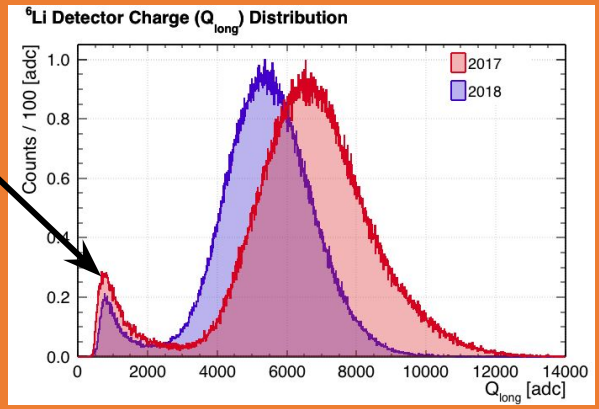
^{6}Li Detector



Outgassing Issue:

The UVT lightguides were generating small amounts of outgas (i.e. introducing contamination into the system). To solve this issue the LGs were coated with a protective materials. However, this reduced the light-yield by ~18%. Using MC we estimated a corresponding drop in UCN detection efficiency of only 1.8%.





Discovery, accelerated

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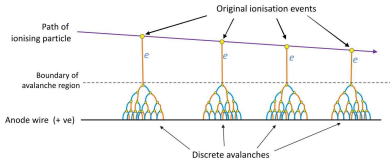
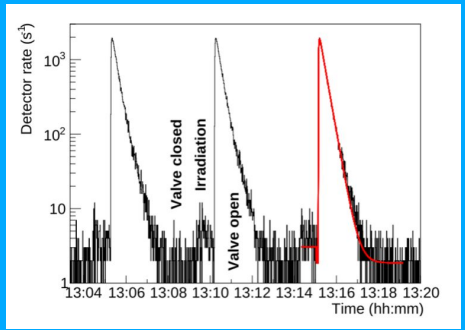
^{3}He Detector

Proportional Wire-Chamber:

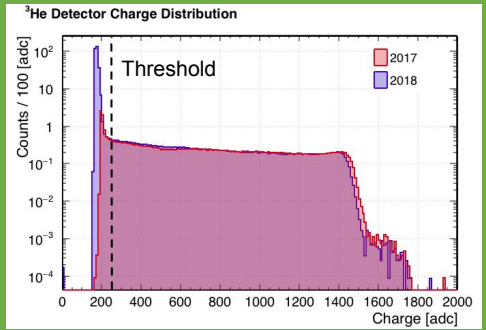
Single-wire proportional gas chamber, filled with Ar+CO2 and spiked with ^{3}He.



UCN Counting

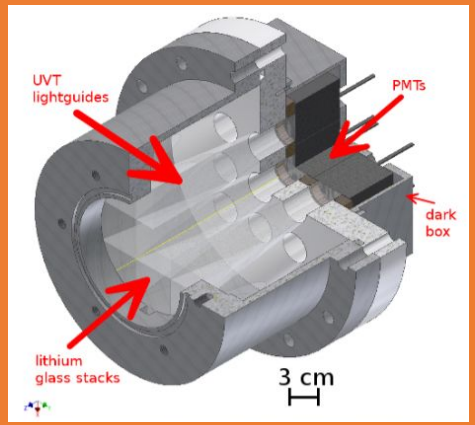


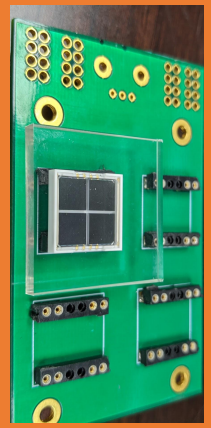
Charge Spectrum



New Detector Ideas

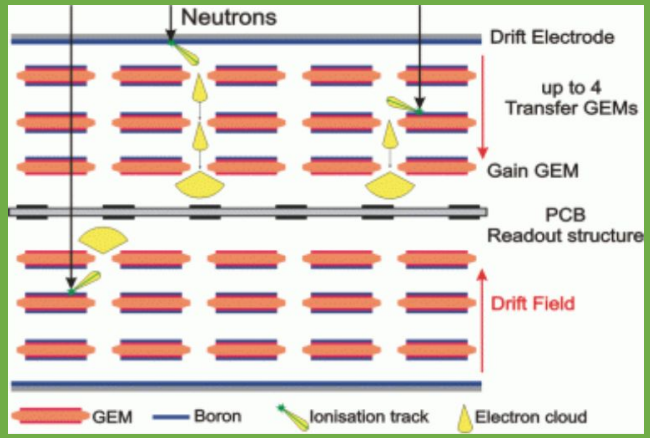
^{6}Li Detector with SiPMs





Re-design the chamber and switch the photo-readout from PhotoMultiplier Tubes (PMT) to Silicon PhotoMultipliers (SiPM). SiPMs are immune to E-fields, more precise single-photon-counting.

CASCADE Detector



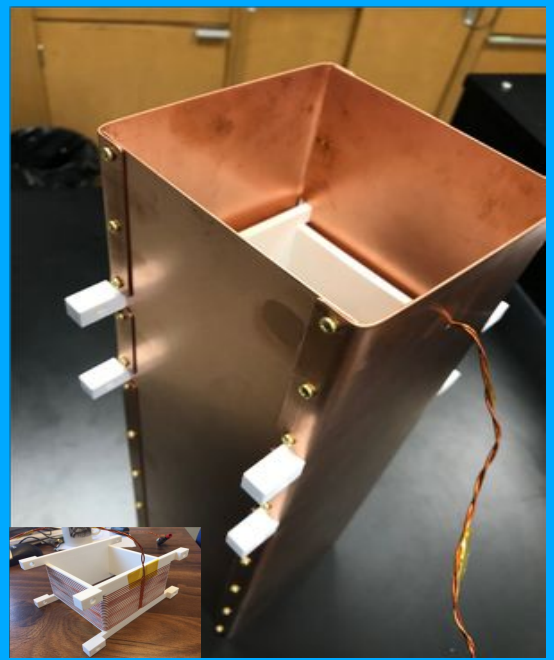
GEM-based hybrid Gas Detector.
The UCNs are capture on the boron-coated drift-electrodes, the product from the capture ionizes the gas and the GEMs amplify the signal. Microseconds resolution.

S. Hansen-Romu, T. Higuchi, B. Jamison, T. Lindner, S. Sidhu, R. Picker, W. Schreyer

Polarizers & Spin-Flippers

Polarizer Foil

Spin-Flipper

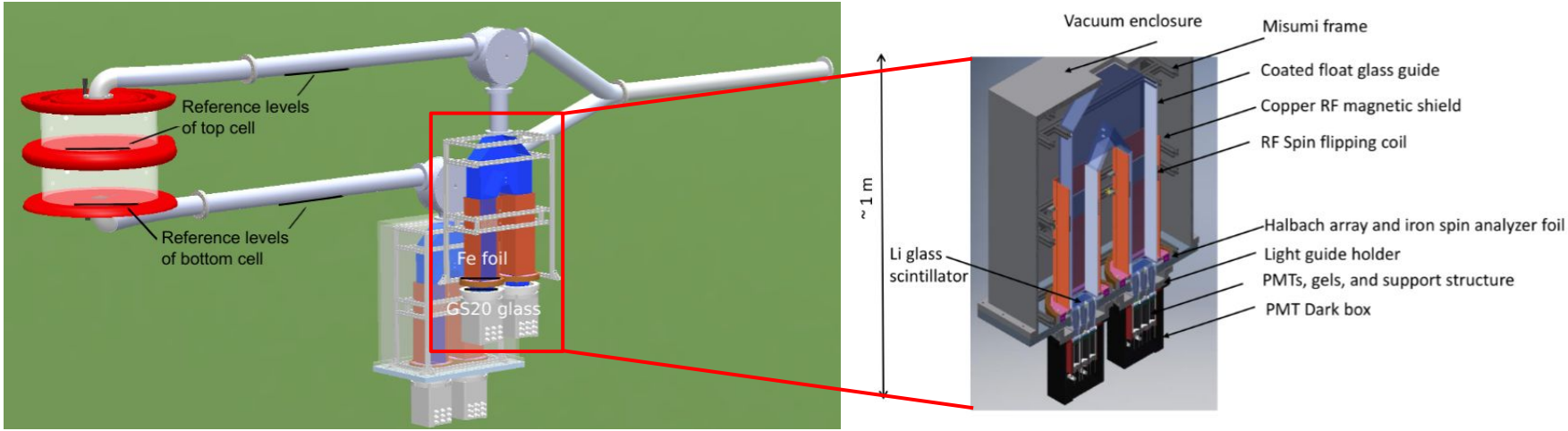


Hardware Installation

- For more info see W. Schreyer Talk Tomorrow.

P. Giampa, S. Hansen-Romu, B. Jamison,
T. Lindner, F. Piermaier, W. Schreyer

Simultaneous Spin Analysis (SSA) System



The purpose of the Simultaneous Spin Analysis (SSA) system is to count neutrons of both spin states at the same time (simultaneous spin analysis). This is done using a pair of detectors instead of a single detector and spin flipper (sequential spin analysis), to increase the statistics of the measurements.

Conclusions & Outlook

- The DAQ has been upgraded with a new Digitizer (v1725). This was used for the 2019 fall-run.
- The MIDAS interface is constantly improving.
- Currently using ^{6}Li and ^{3}He detectors for UCNs detection. But as we learn more about them, we have new ideas for improvement or substitute detectors.
- Polarizer and Spin-Flipper (SSA hardware) were tested during the 2018/2019 run.