

Assembly of the **PROSPECT** neutrino detector



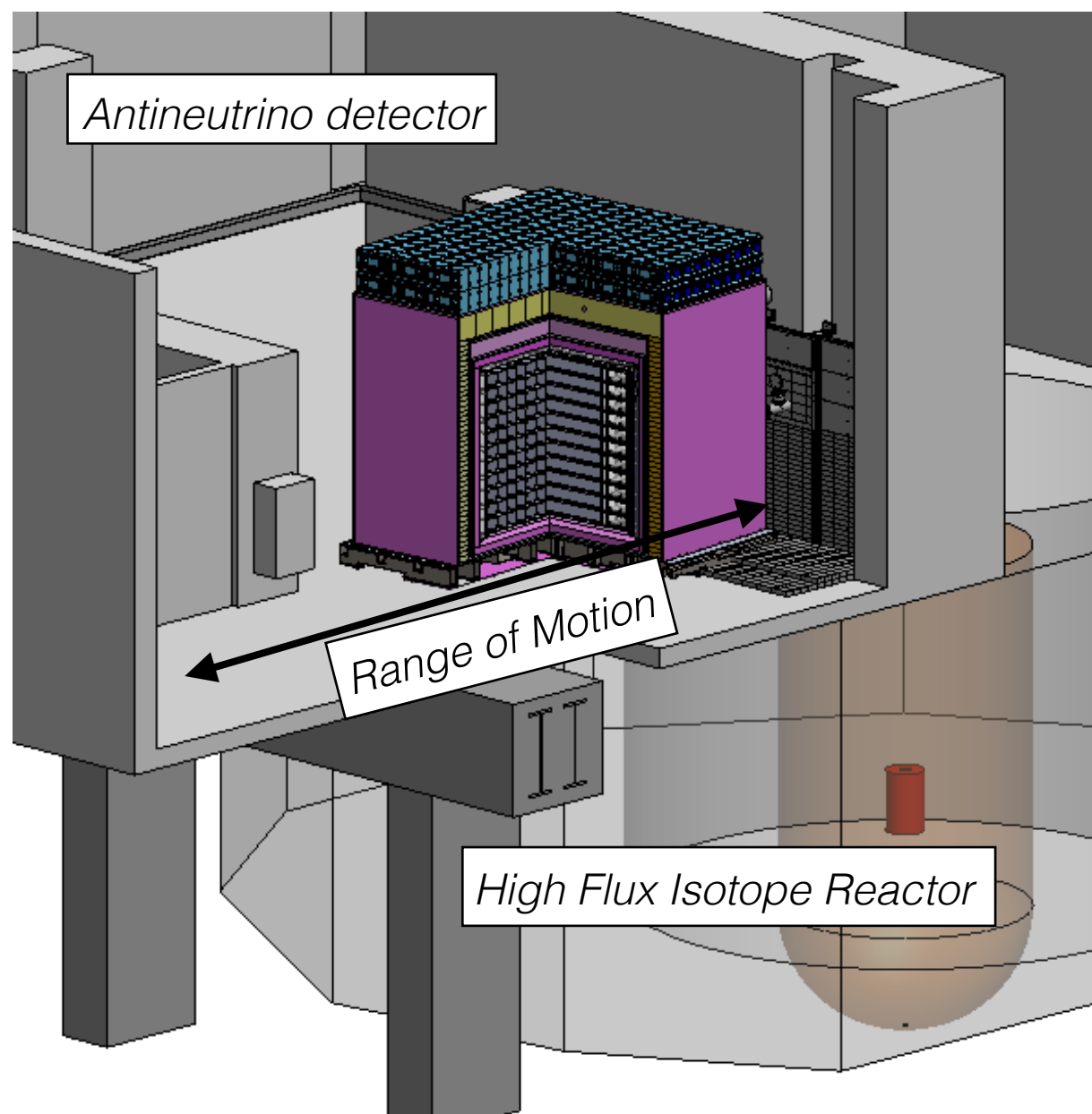
Danielle Norcini



PROSPECT in a nutshell

Solving reactor antineutrino flux and spectrum anomalies:

1. search for short-baseline oscillations of eV-scale sterile ν at distances <10 m
2. perform a precision measurement of ^{235}U reactor $\bar{\nu}_e$ spectrum



Requirements:

- energy resolution of $4.5\%/\sqrt{E}$ for spectral measurement (~ 500 p.e./MeV)
- good position resolution for comparing spectra between baselines
- excellent background rejection capabilities at near-surface, reactor site

Detector features:

- 4 tons ^6Li -loaded EJ-309 liquid scintillator
- 11x14 segmented array
- segment size: $120 \times 15 \times 15$ cm³
- low-mass optical separators
- optical and radioactive calibration
- double-ended PMT + light guide readout
- movable, baseline coverage 7-11m

Phased detector development at Wright Lab

PROSPECT-0.1

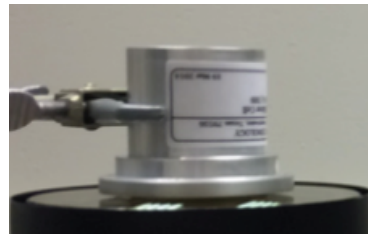
Characterize LS

Aug 2014-Spring 2015

5cm length

0.1 liters

LS, $^6\text{LiLS}$



PROSPECT-2

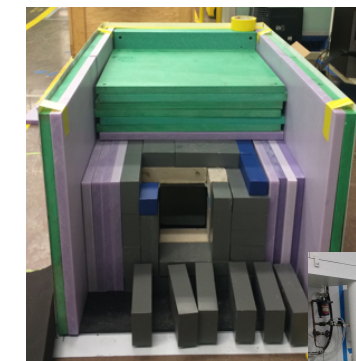
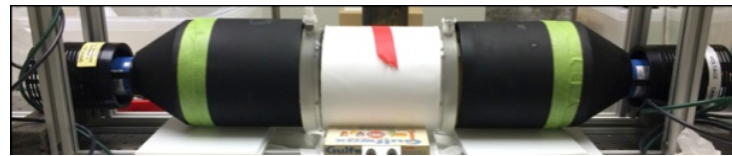
Background studies

Dec 2014 - Aug 2015

12.5 length

1.7 liters

$^6\text{LiLS}$



multi-layer
shielding

PROSPECT-20

Segment characterization

Scintillator studies

Background studies

Spring/Summer 2015

1m length

23 liters

LS, $^6\text{LiLS}$



PROSPECT-50

Validation of design

Simulation benchmark

2017-2018

1x2 segments

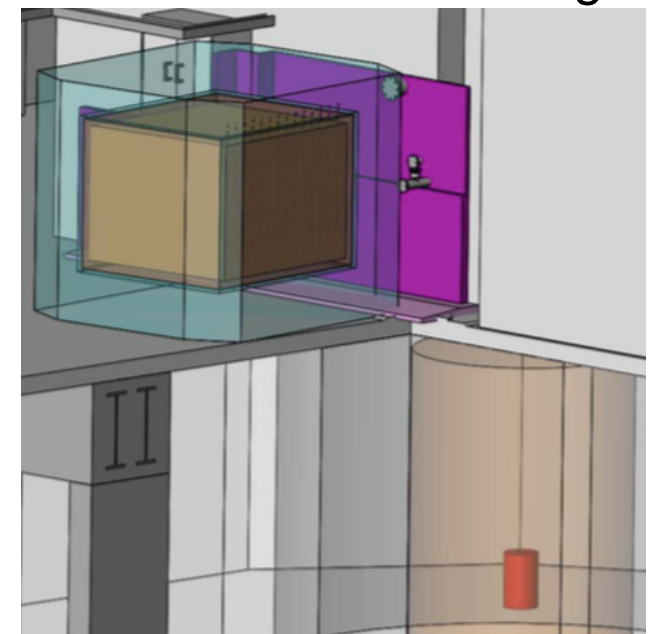
1.2m length

50 liters

LS, $^6\text{LiLS}$



local reactor shielding



PROSPECT AD

Physics measurement

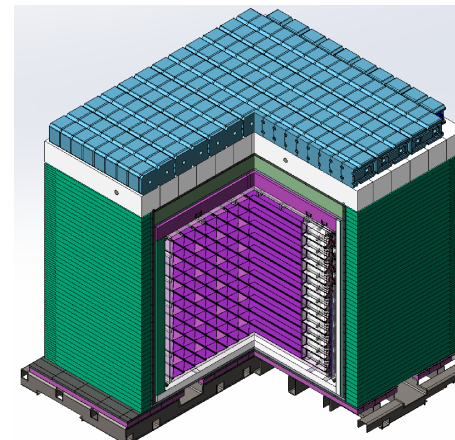
data taking 2018

11x14 segments

1.2m length

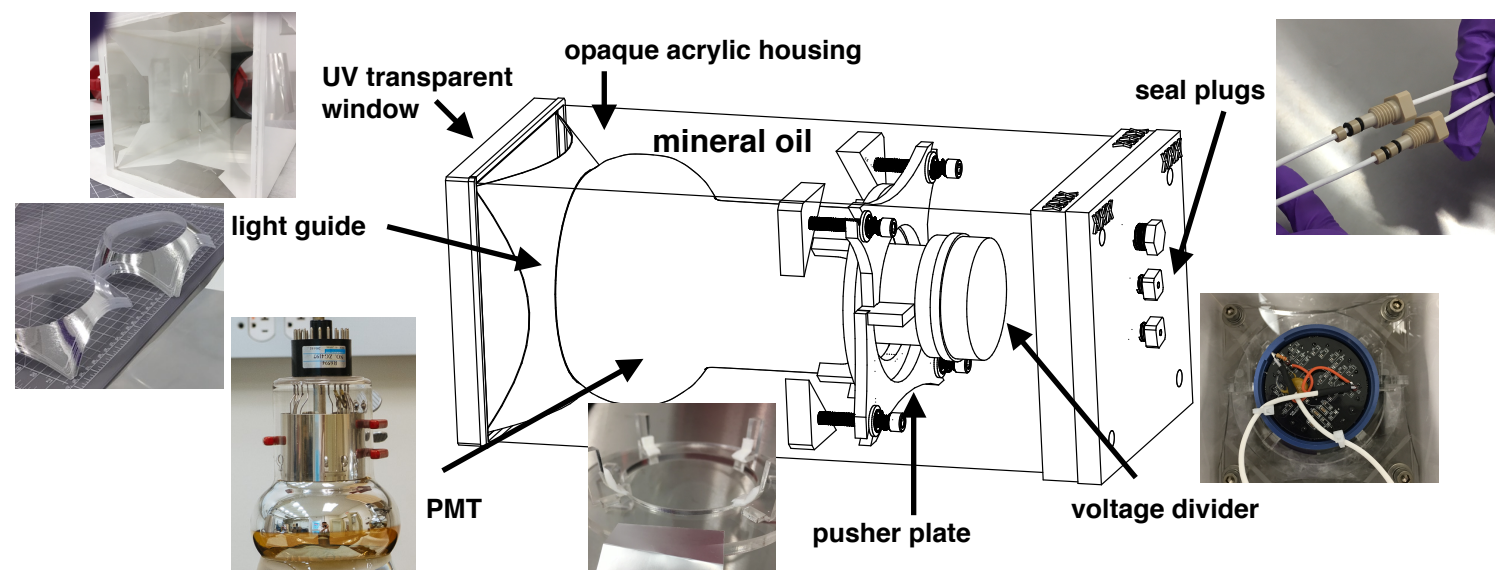
4 tons

$^6\text{LiLS}$



Optical modules ~1 year

Scintillator approved!



cementing reflectors



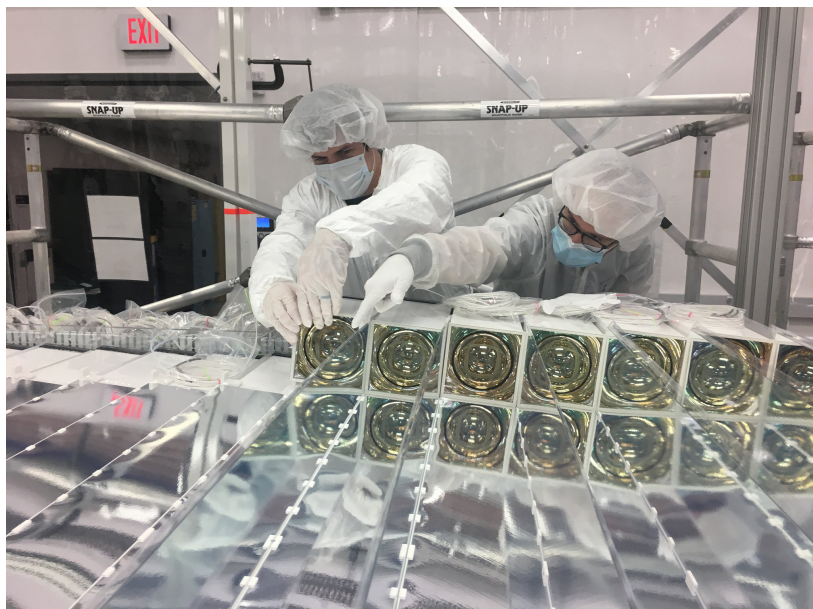
installing PMTs



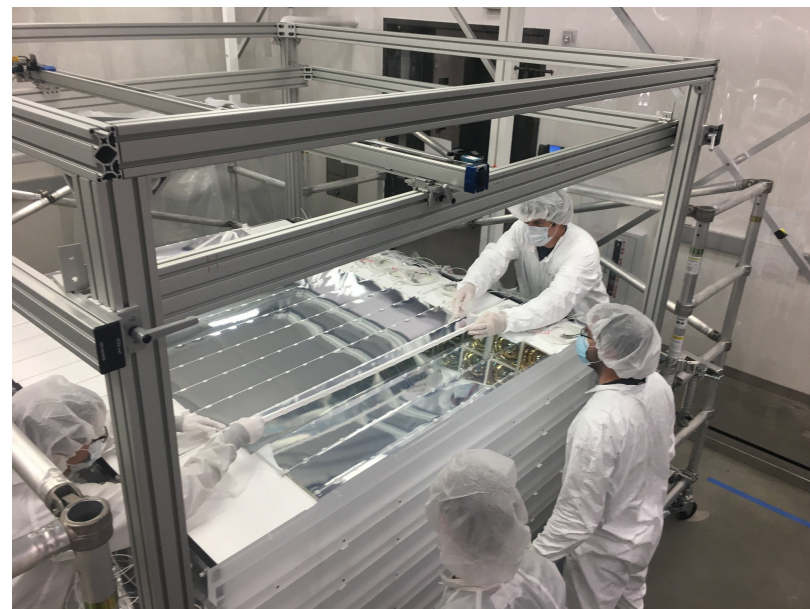
testing



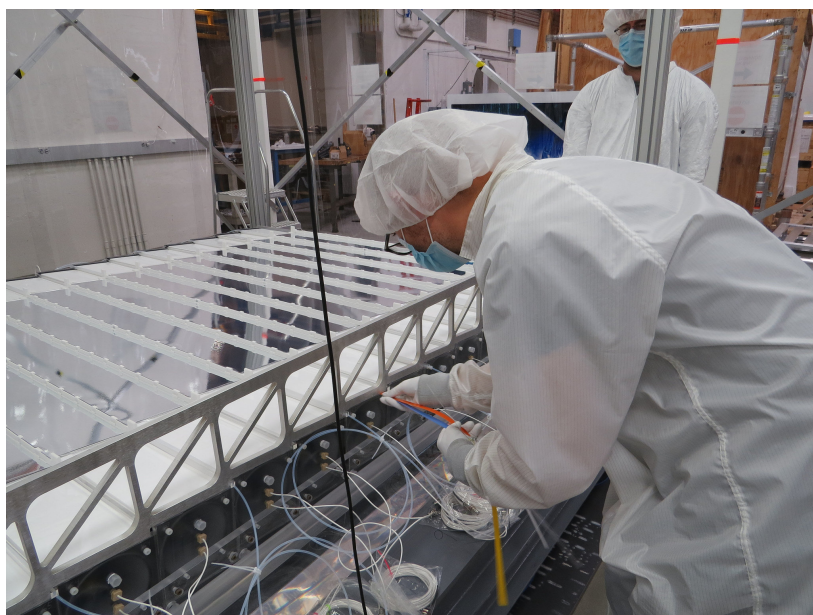
Construction of inner detector



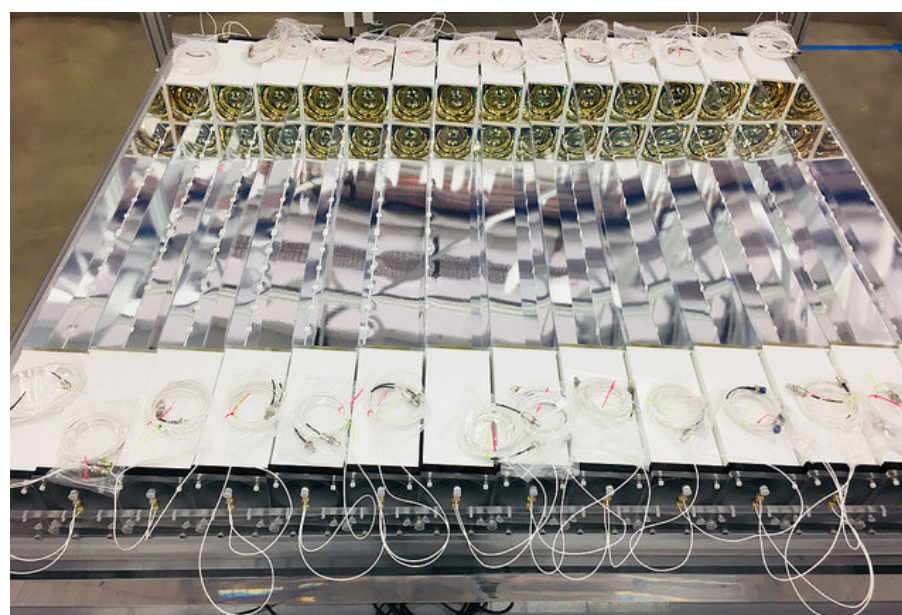
PMT placement



pinwheel + panel insertion



QA

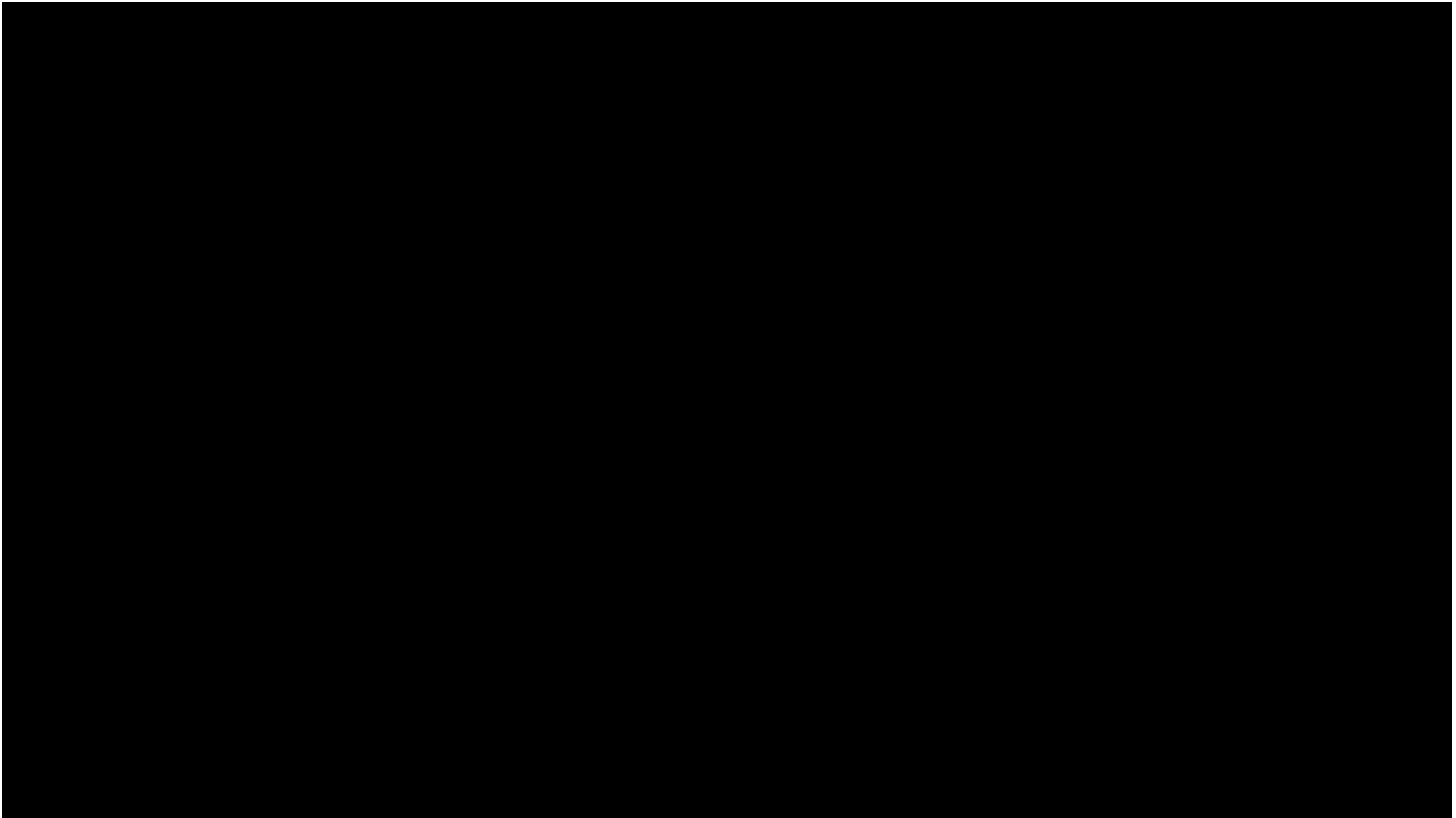


birdseye view

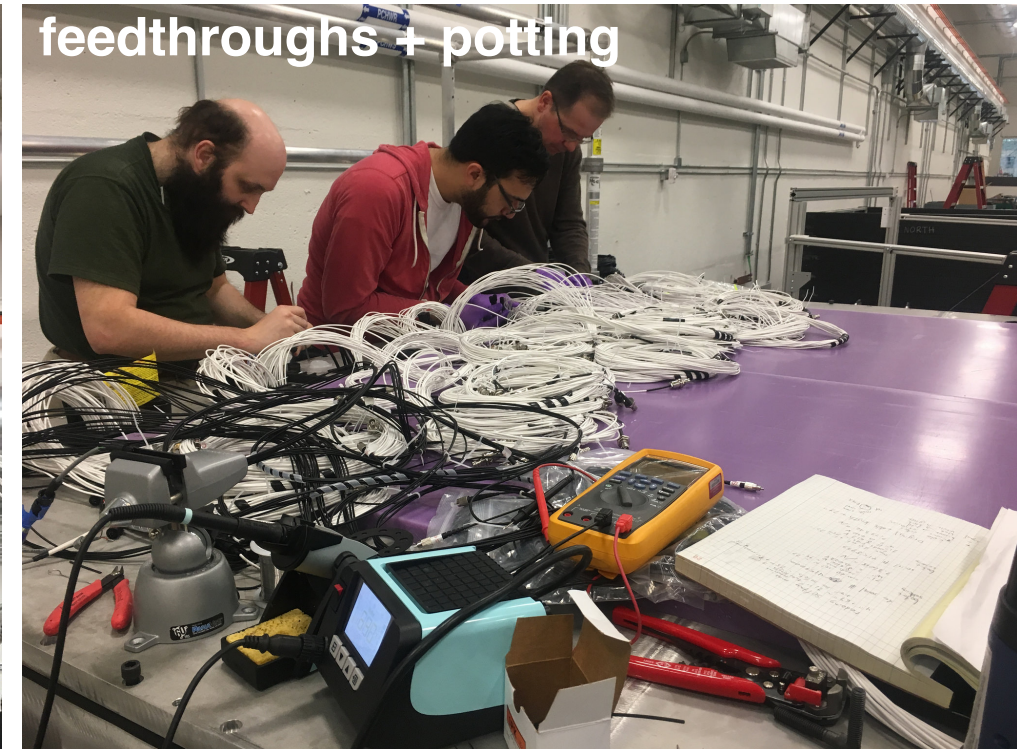


**lots of channels = lots of cables
lots of calibration = lots of tubes**

In action: courtesy of Frank!



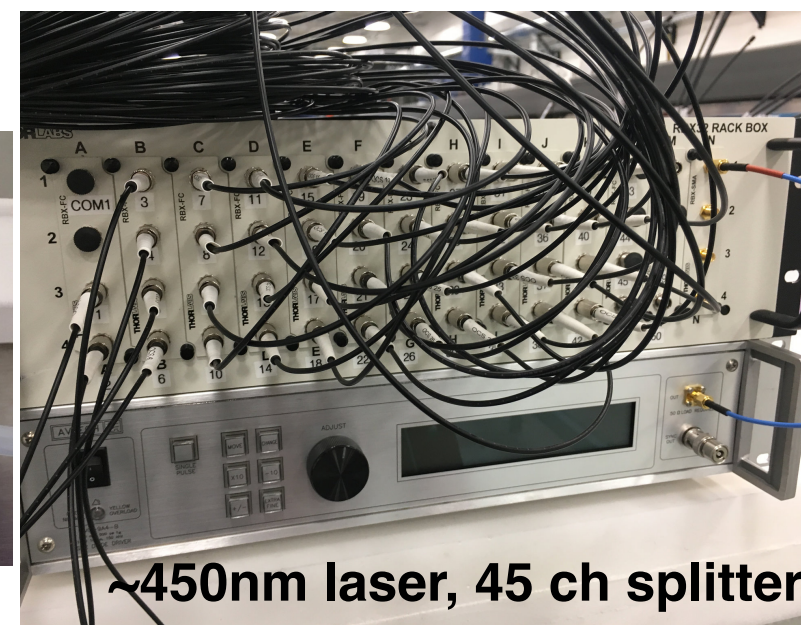
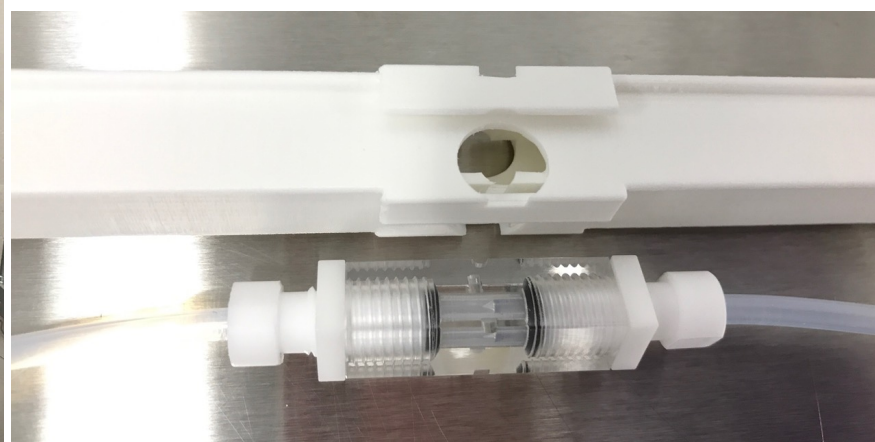
Finishing the detector package



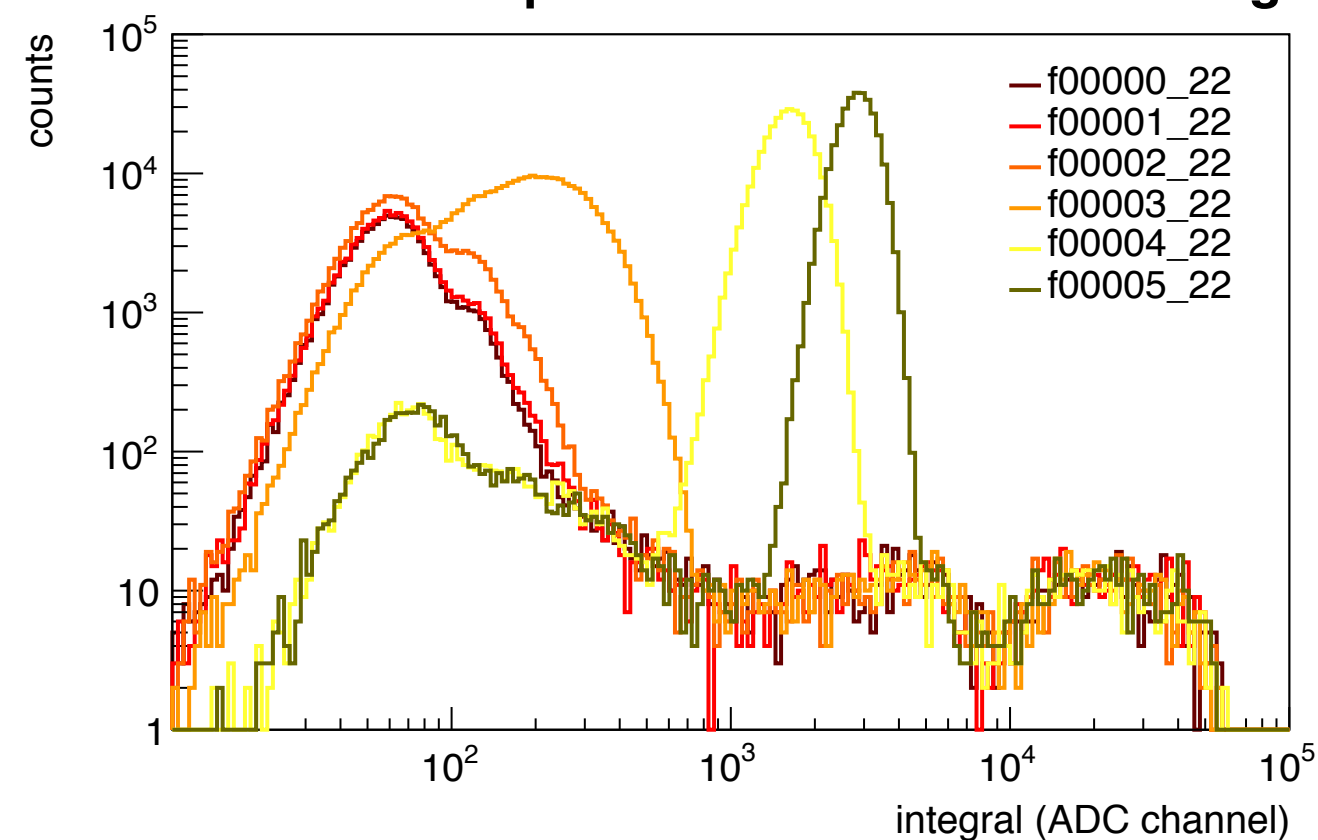
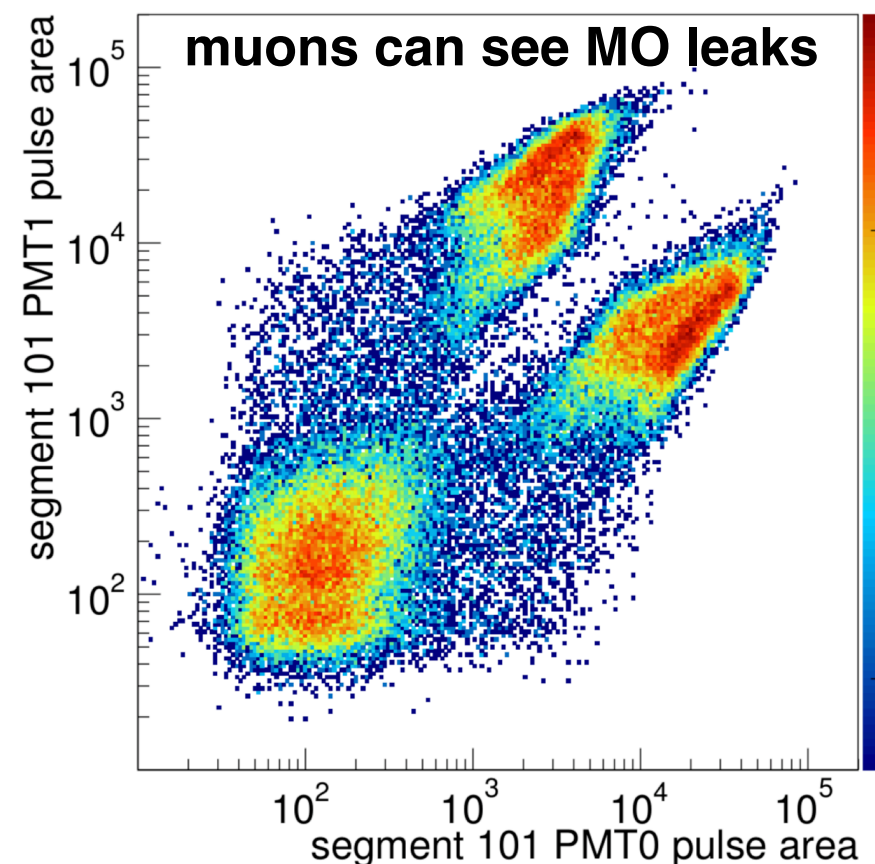
Dry commissioning with muons + laser



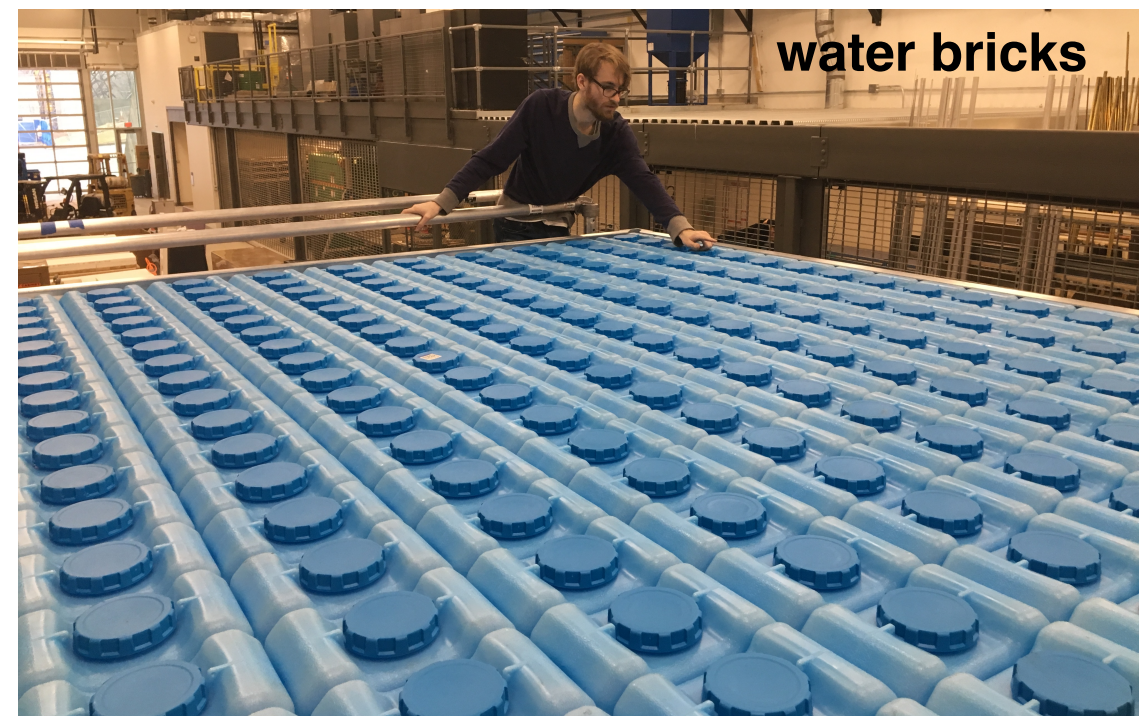
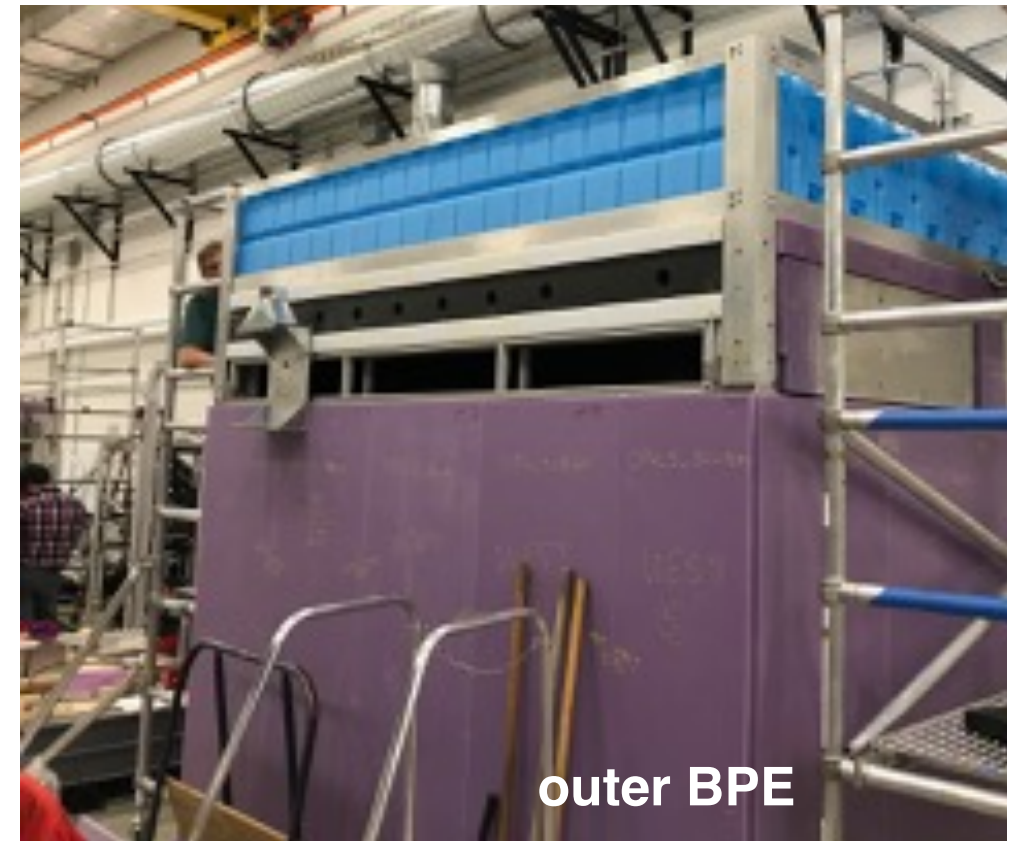
Optical calibration



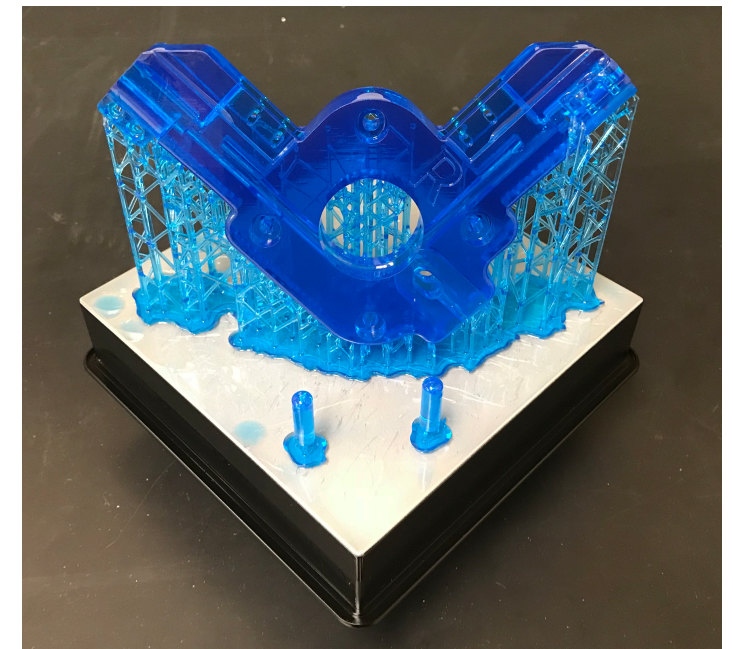
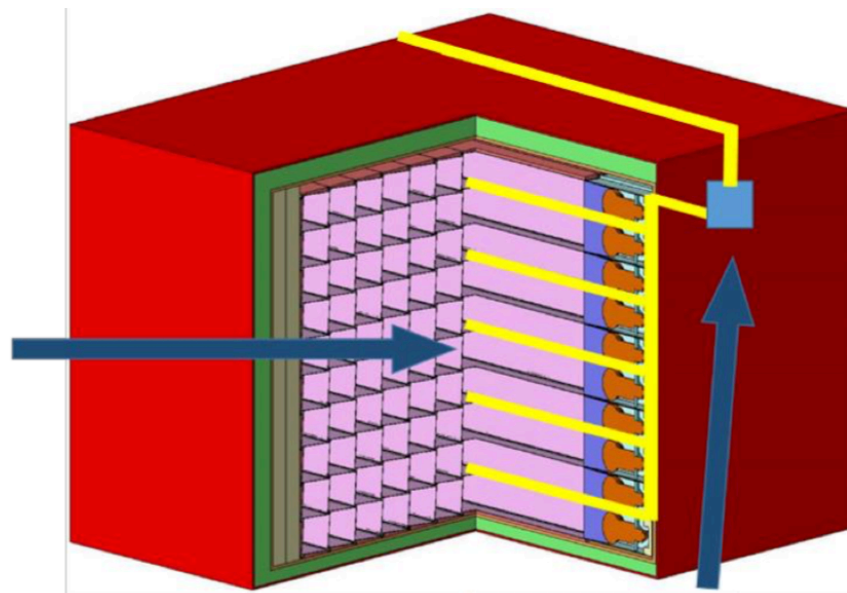
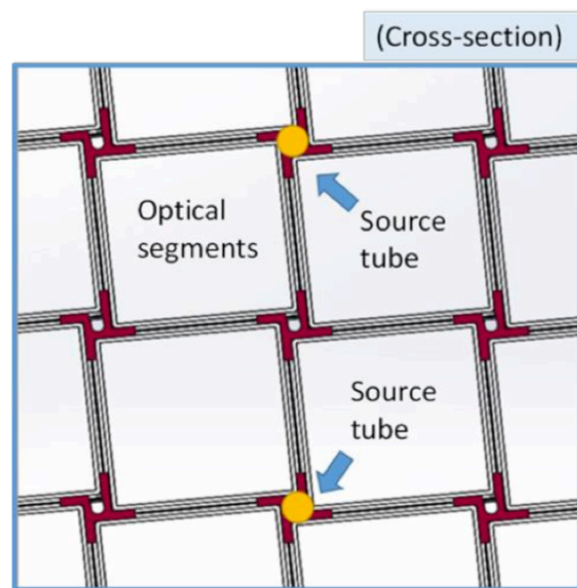
spe calibration and PMT timing



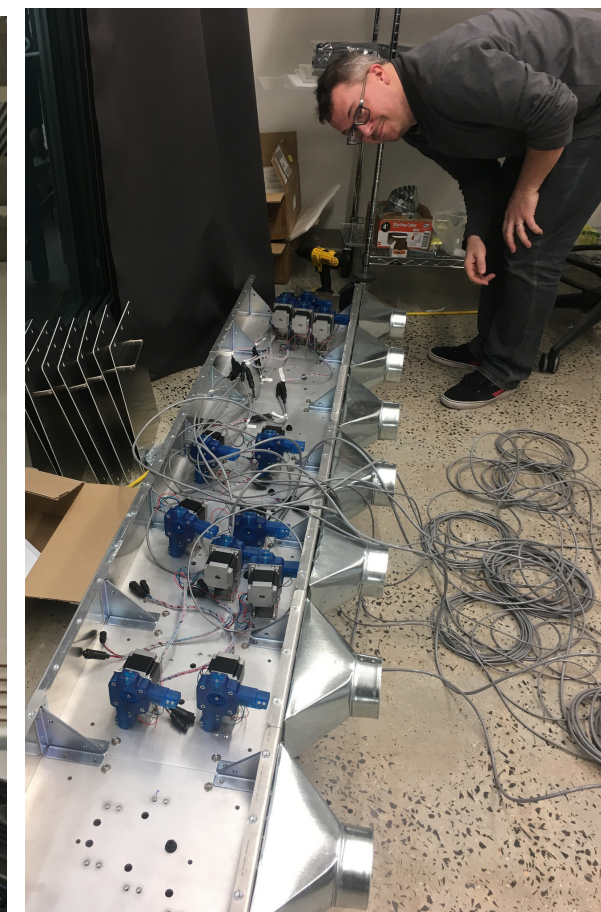
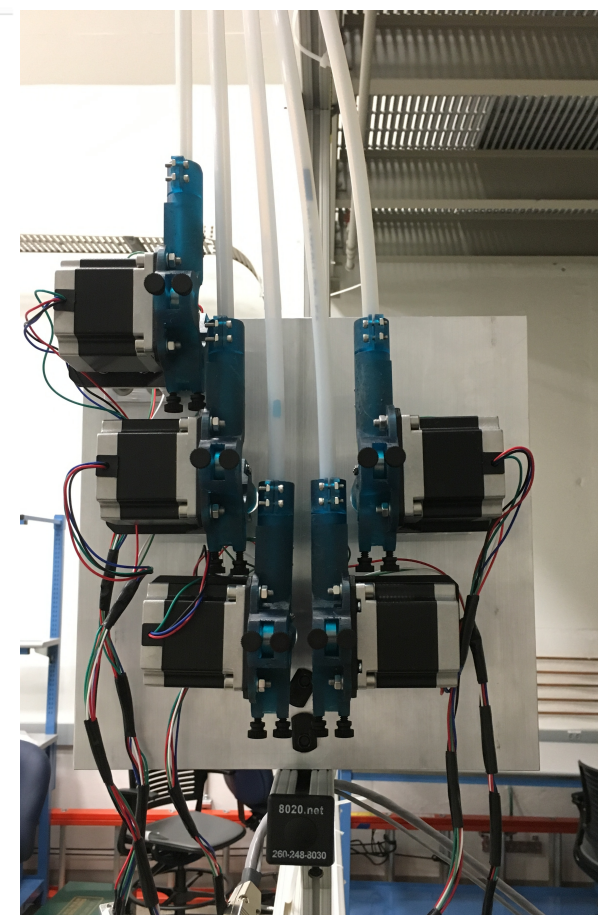
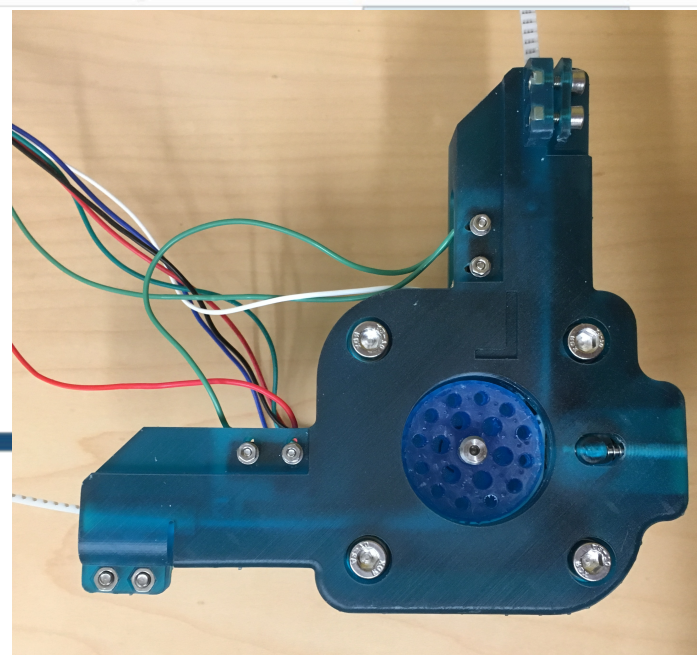
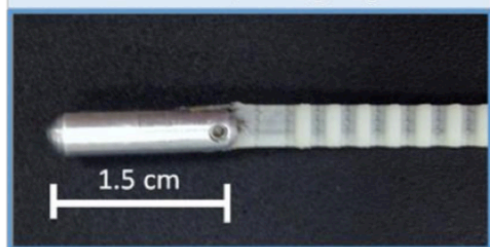
Lots of shielding!



Radioactive source calibration



Source, located inside capsule, attached to timing belt. The belt is driven by the motor through the source tube, along segment.



from Arina

See you in Oak Ridge!

Installation at HFIR:

now - March

- prepare scintillator
- dry commissioning
- fill detector
- wet commissioning
- install shielding
- install calibration motors

First physics:

March - Summer

- reactor on/off data
- 2-3 cycles (24 days/cycle)
- probe sterile parameter space
- spectrum comparison

1 year of data:

2018 - 2019

- 4σ sterile search at best fit
- leading ^{235}U spectrum $\sim 100\text{k } \nu$



Reactor on - reactor off

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First physics:

March - Summer

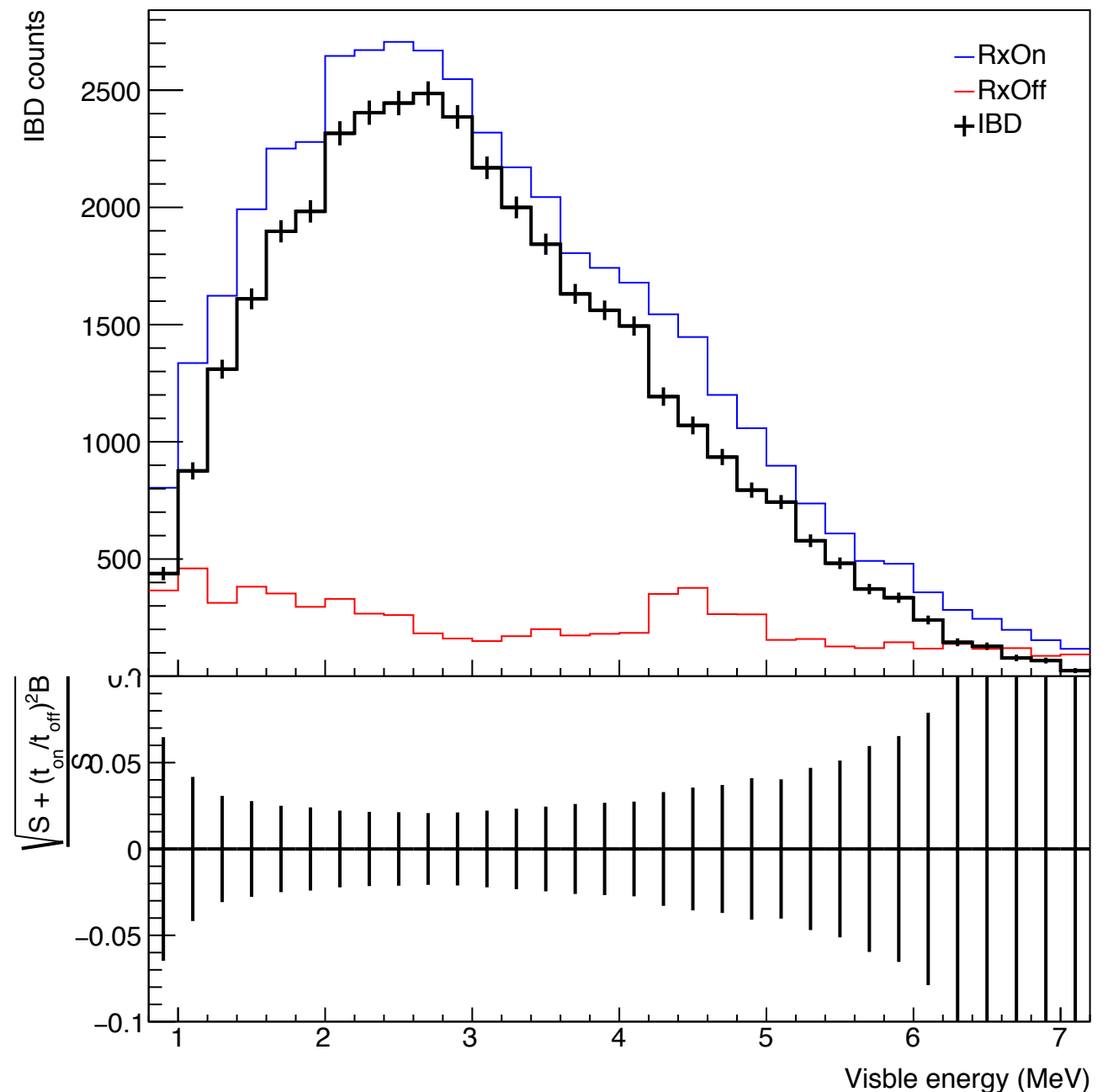
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- leading ^{235}U spectrum $\sim 100\text{k } \nu$

simulation: 50 days reactor on/off



Sterile search

Installation at HFIR:

now - March

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First physics:

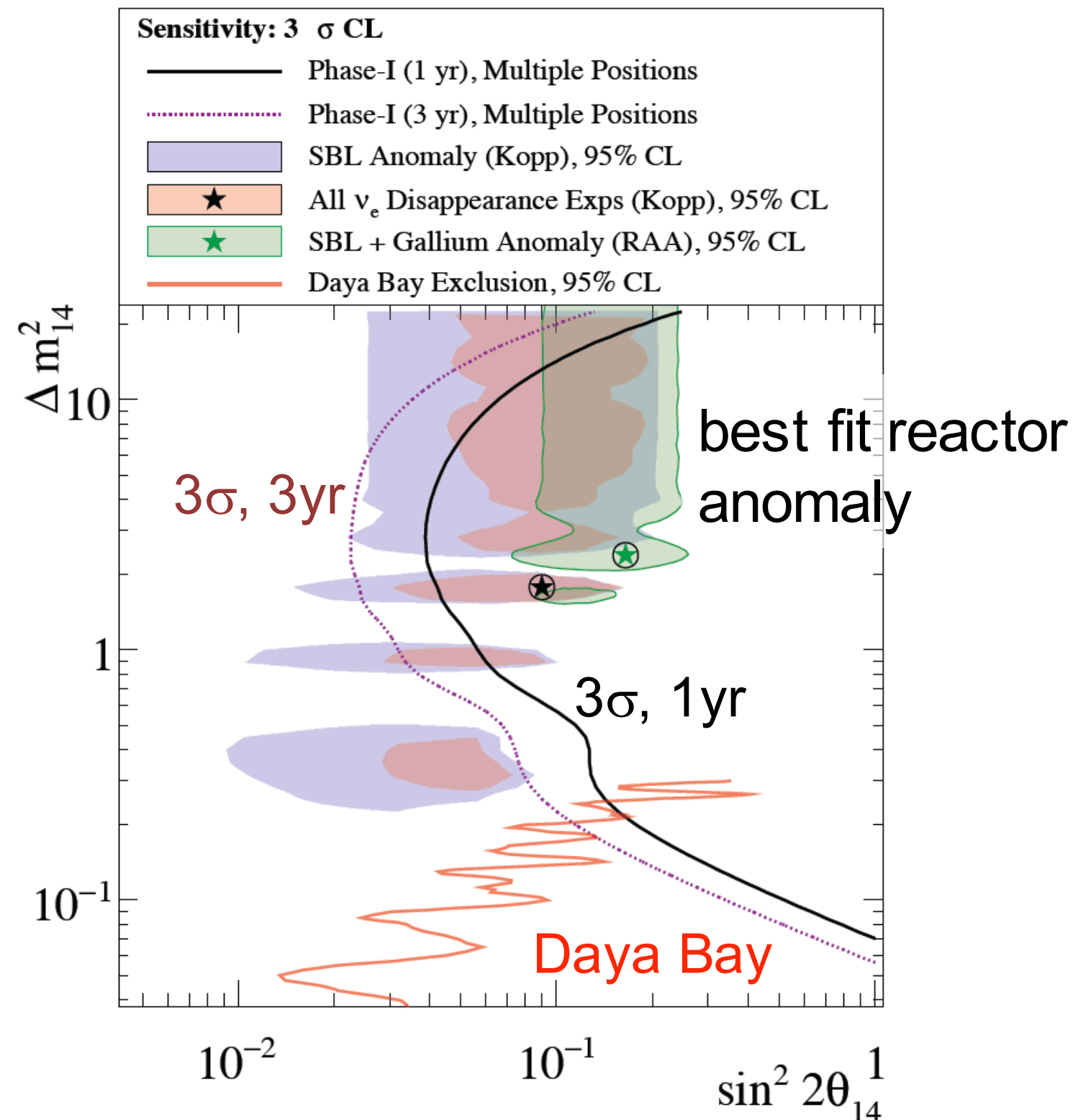
March - Summer

- reactor on/off data
- 2-3 cycles (24 days/cycle)
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1 year of data:

2018 - 2019

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HEU spectrum

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now - March

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- dry commissioning
- fill detector
- wet commissioning
- install shielding
- install calibration motors

First physics:

March - Summer

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- 2-3 cycles (24 days/cycle)
- probe sterile parameter space
- spectrum comparison

1 year of data:

2018 - 2019

- 4σ sterile search at best fit
- leading ^{235}U spectrum $\sim 100\text{k } \nu$

