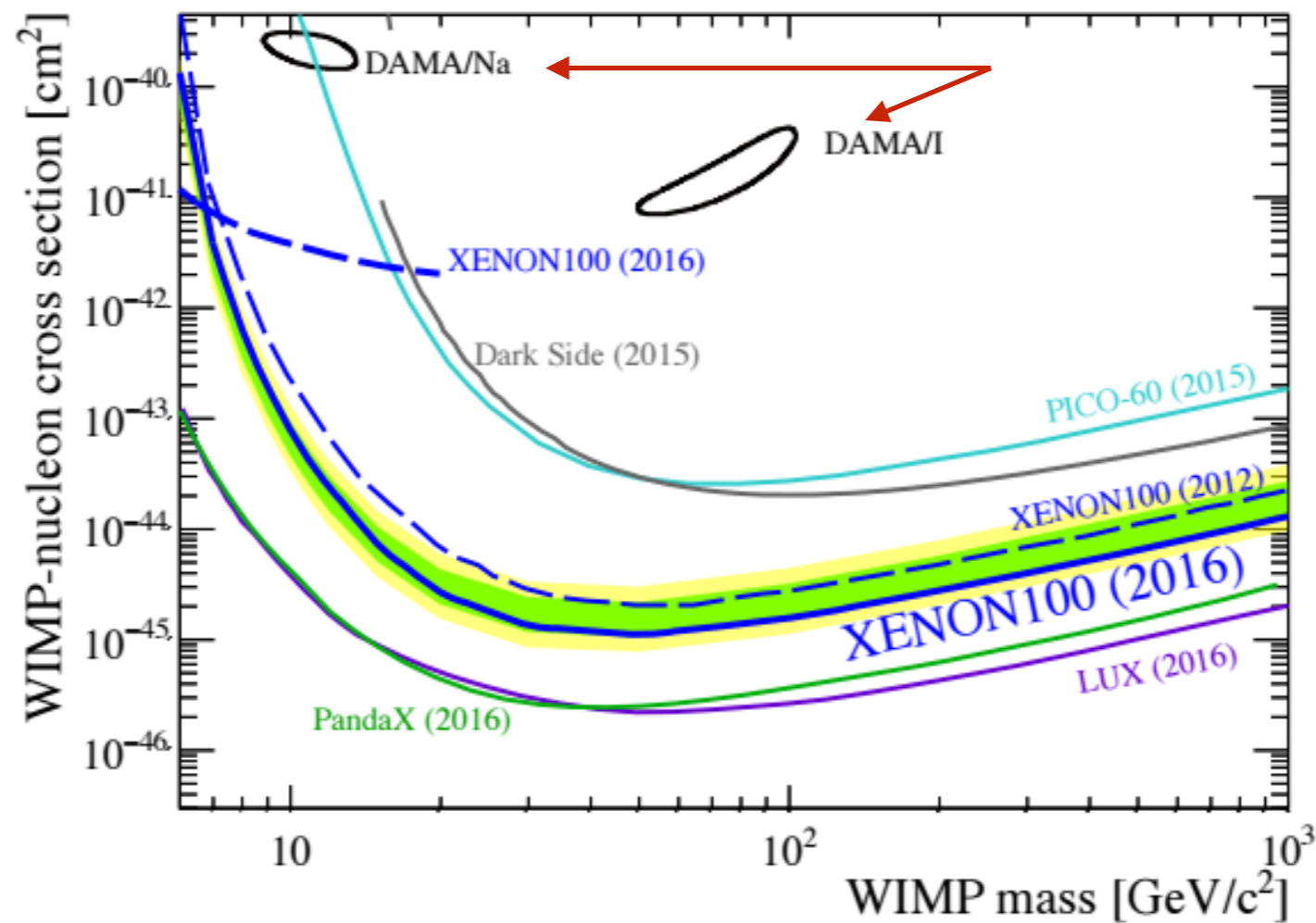


Status of COSINE-100 (and a brief collaboration meeting summary)

Jay Hyun Jo

Wright Lab Monday Meeting
March 19, 2018

Current Dark Matter Field



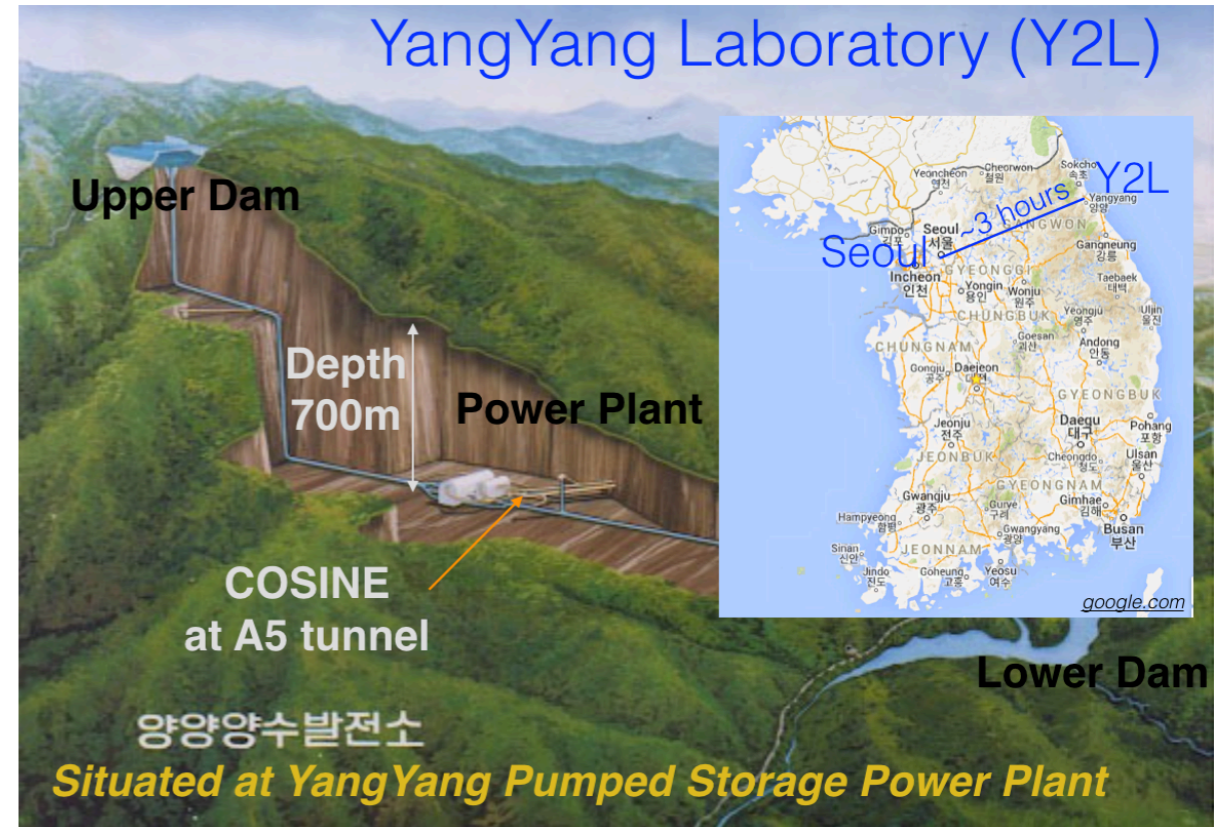
arXiv: 1609.06154

- Liquid Xenon detectors provide currently the best sensitivity to spin-independent WIMP scattering
- No other experiments could confirm the dark matter signal: tension with the DAMA result
- More exclusion limits cannot answer this question

COSINE-100

- A joint effort between DM-Ice and KIMS collaboration
- 8 crystals with 106 kg in total
- Located at Yangyang underground laboratory (Y2L), South Korea, with ~700 m rock overburden
- Physics run started September 2016

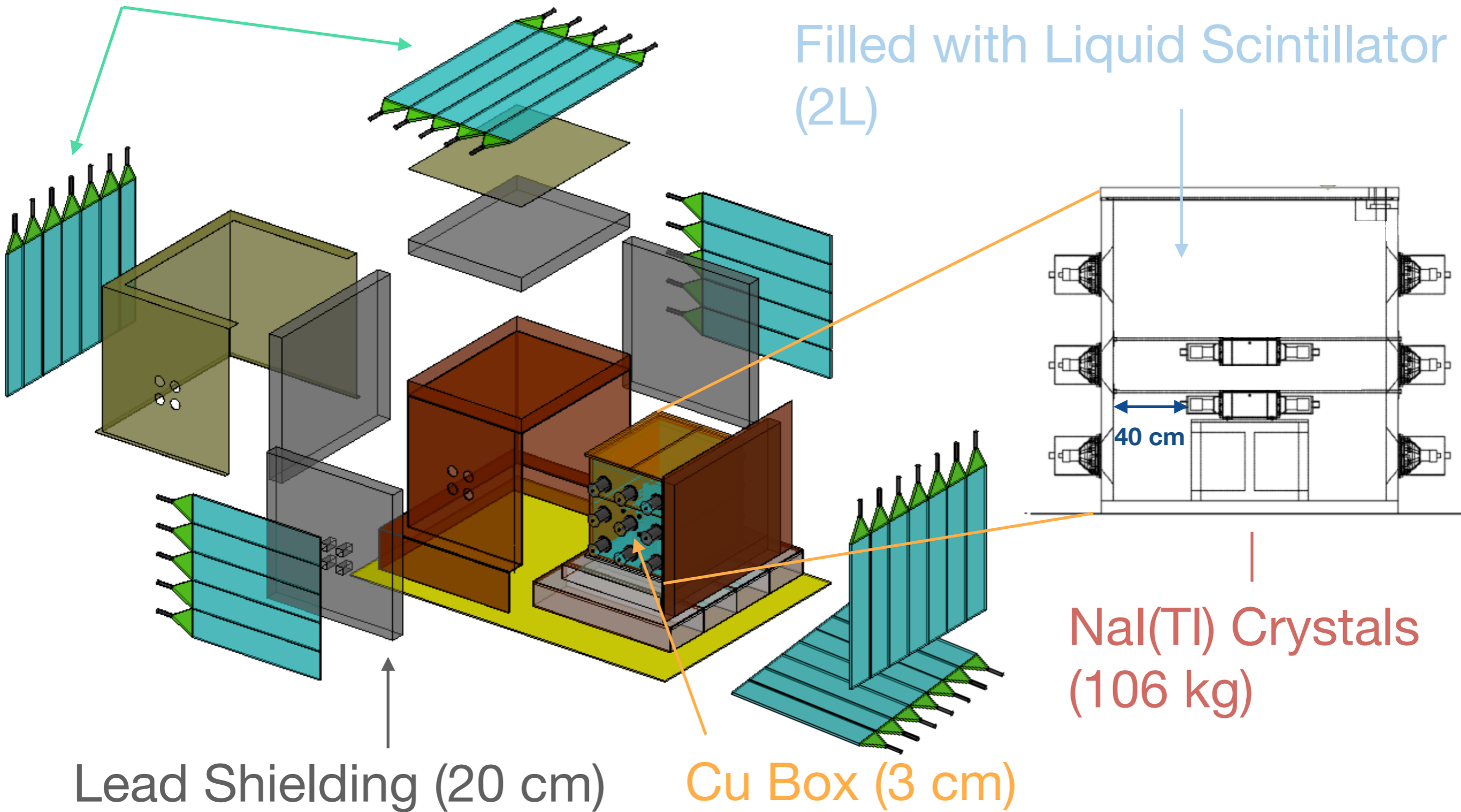
DM-ICE +



COSINE-100 Shielding Structure

Plastic Scintillators

Filled with Liquid Scintillator (2L)



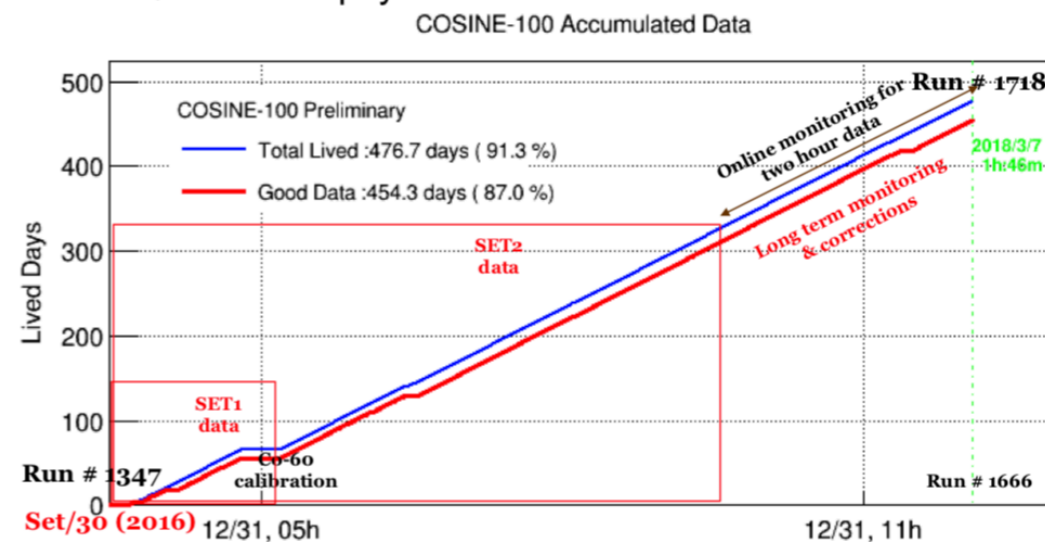
Crystal Installation



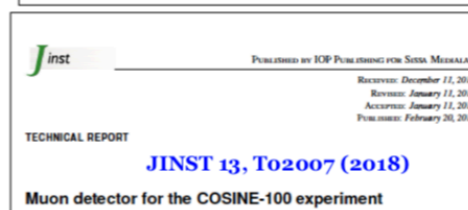
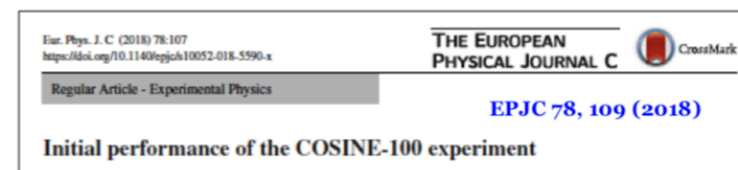
Where are we?

- Still running stable, since September 2016!
 - ~48000 kg*day exposure
 - No major breakdown
 - Major calibration campaign planned in April
- 2 papers published, 1 paper submitted
 - Initial performances of the COSINE-100 experiment (EPJC 78, 109 (2018))
 - Muon detector for the COSINE-100 experiment (JINST 13, T02007 (2018))
- 2+1 papers under internal review
- Physics results under preparation
 - WIMP extraction analysis
 - Annual modulation analysis
 - Others...

• Quite stable physics run



- More than 17 Month operation
- ~ 15 Month of good quality data



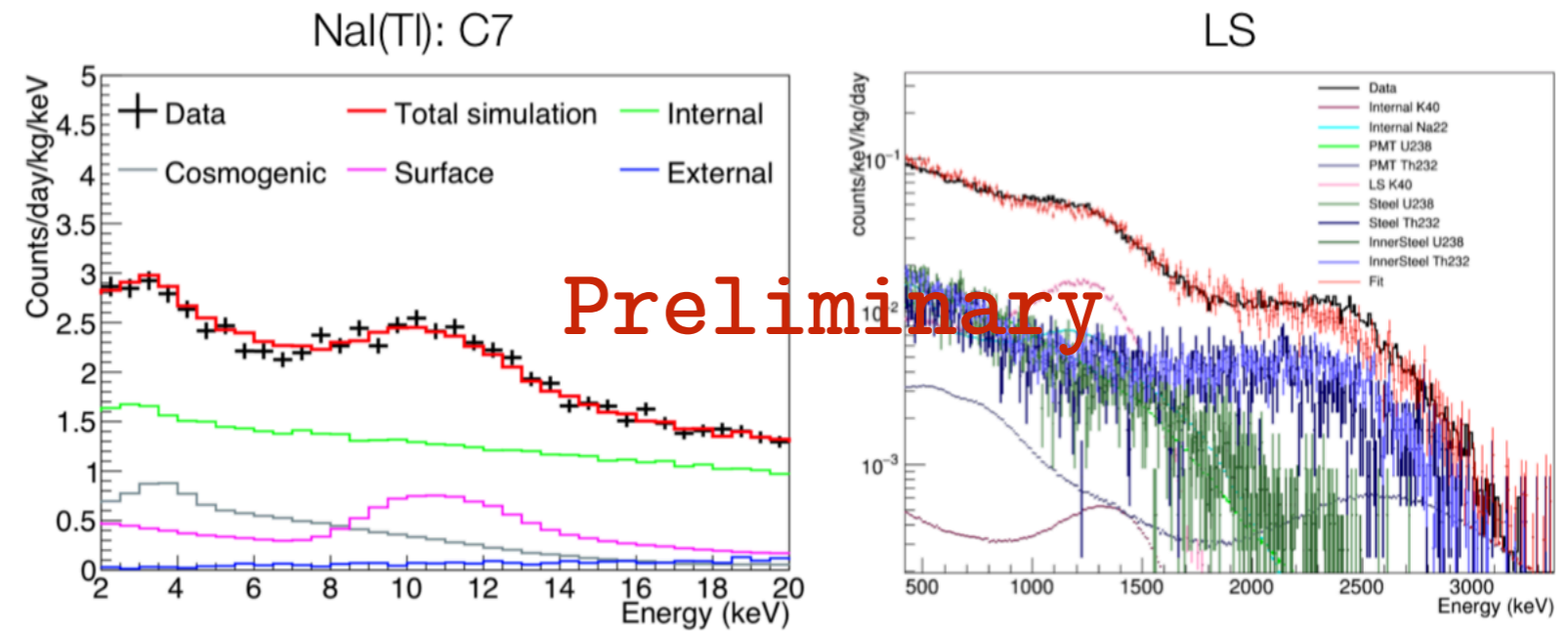
Two are published!!
One is submitted!!



arXiv:1801.06948 (submitted in Astropart. Phys.)

Background simulation

- Simulation of full detector using GEANT 4.9
 - NaI(Tl) crystal and LAB-based liquid scintillator



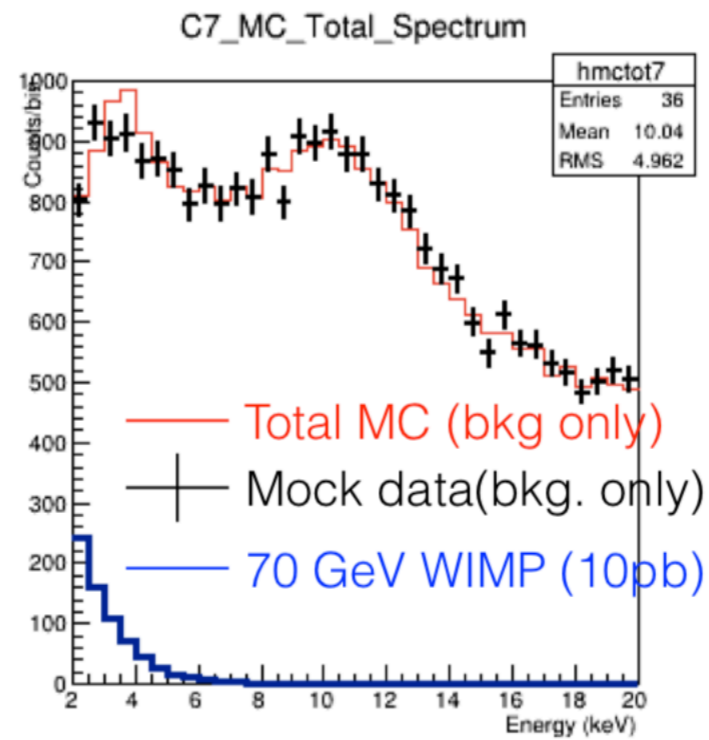
- Multi-channel fit: Low/high energy, single/multiple hit, multiple crystals, ...
- Initial study is close to be finished, will continue to improve

Preliminary

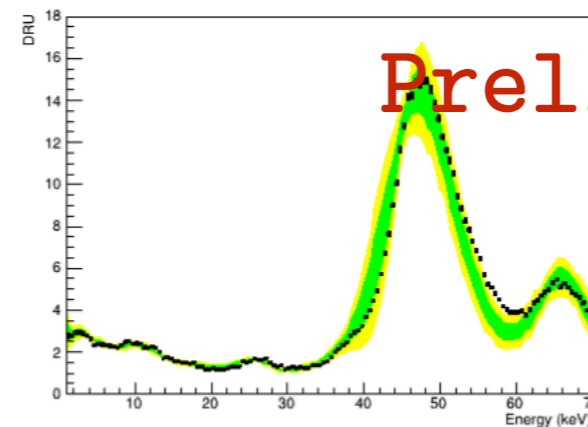
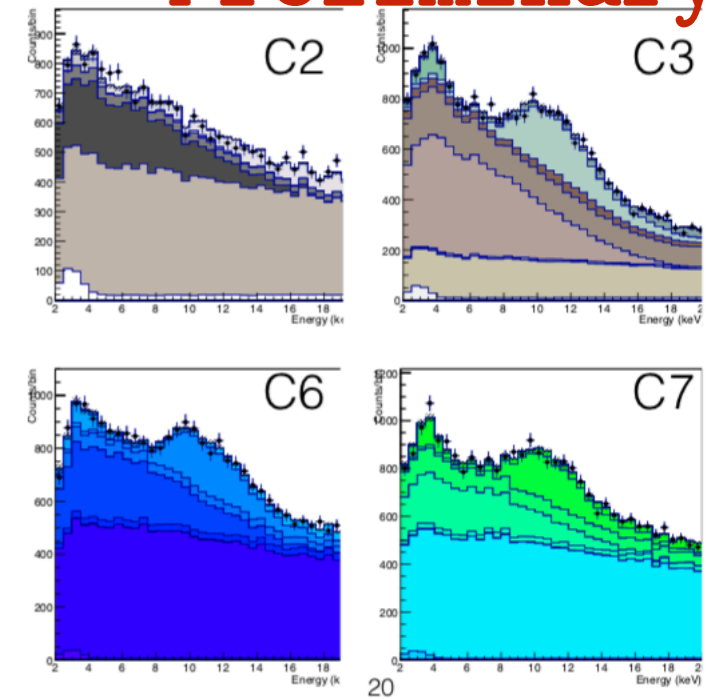
		Crystal-1	Crystal-2	Crystal-3	Crystal-4	Crystal-6	Crystal-7
Internal	^{40}K	0.10 ± 0.02	0.20 ± 0.02	0.10 ± 0.01	0.10 ± 0.01	0.05 ± 0.01	0.05 ± 0.01
	^{210}Pb	2.50 ± 0.10	1.69 ± 0.09	0.57 ± 0.05	0.71 ± 0.05	1.46 ± 0.07	1.50 ± 0.07
	Other ($\times 10^{-4}$)	7.0 ± 0.1	15 ± 1	7.3 ± 0.1	7.7 ± 0.1	14 ± 1	14 ± 1
Cosmogenic	^3H	2.35 ± 0.90	0.81 ± 0.40	1.54 ± 0.77	1.97 ± 0.66	0.69 ± 0.67	0.58 ± 0.54
	^{109}Cd	0.05 ± 0.04	0.009 ± 0.009	0.13 ± 0.06	0.33 ± 0.16	0.09 ± 0.09	0.09 ± 0.09
	Other	-	-	0.02 ± 0.01	0.05 ± 0.02	0.05 ± 0.03	0.05 ± 0.03
Surface	^{210}Pb	0.64 ± 0.64	0.51 ± 0.51	1.16 ± 0.51	0.22 ± 0.16	0.34 ± 0.20	0.38 ± 0.21
External		0.03 ± 0.02	0.05 ± 0.04	0.03 ± 0.02	0.03 ± 0.02	0.04 ± 0.03	0.03 ± 0.02
Total simulation		5.68 ± 1.04	3.28 ± 0.67	3.57 ± 0.76	3.41 ± 0.75	2.74 ± 0.61	2.70 ± 0.51
Data		5.64 ± 0.10	3.27 ± 0.07	3.35 ± 0.07	3.19 ± 0.05	2.62 ± 0.05	2.64 ± 0.05

Physics analysis: WIMP extraction

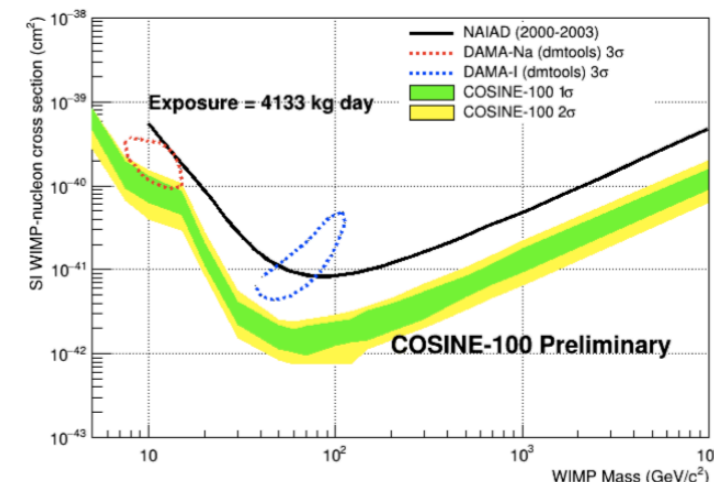
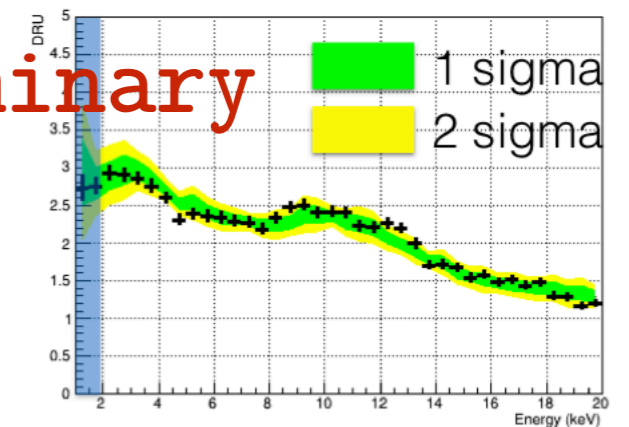
- Spectrum fit for 2-20 keV including WIMP model
- Using 60 days of data: 630€ kg day exposure
- Energy threshold ~ 2 keV, background level ~ 3.5 DRU below 6 keV
- Likelihood analysis to fit data using background model and WIMP signal model, with 2-6 keV region blinded
- Soon to open the data



Preliminary

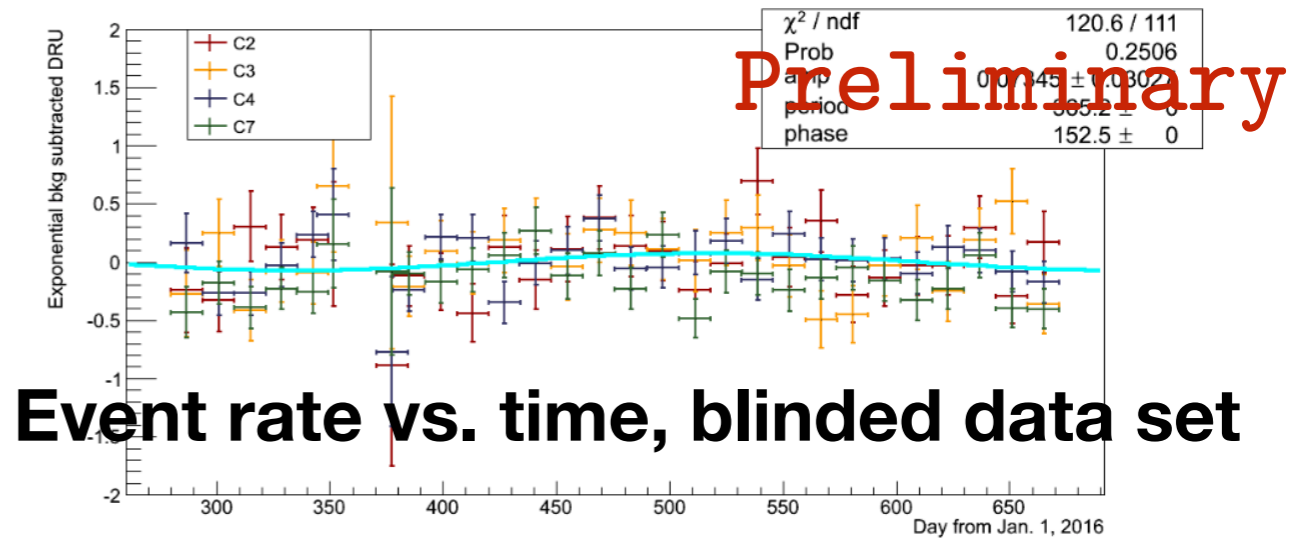


Preliminary

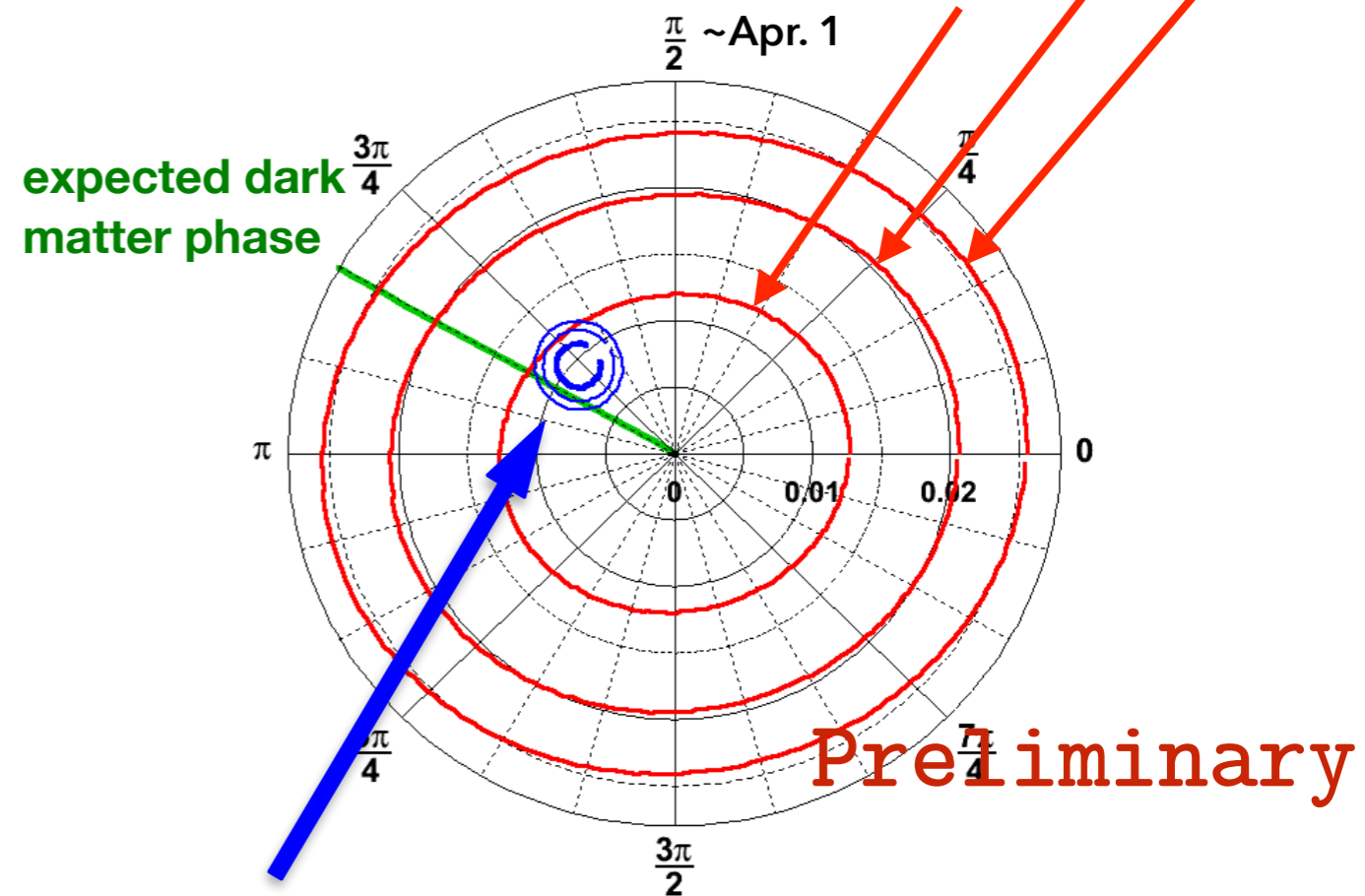


Physics analysis: Modulation analysis

- Using 406 days of data:
24895.92 kg day
exposure
- Currently data is blinded,
only using 1/11 of total
data
- Data quality, cosmogenic
component subtraction,
background modeling
almost done
- Soon to open the data



COSINE-100 2-6 keVee (BF, 68%, 95%, 99%)

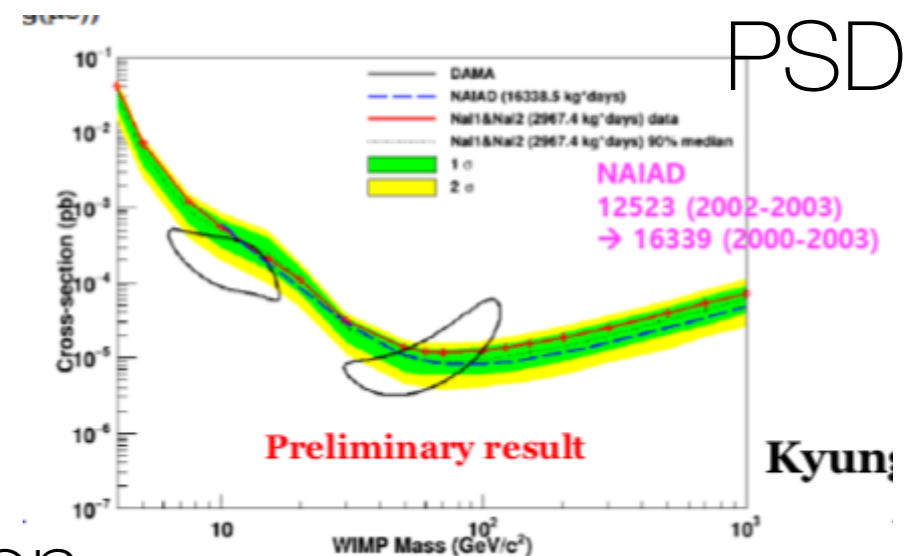


DAMA/LIBRA, 2-6 keVee (68%, 95%, 99%)
analysis on data from arXiv:1308.5109

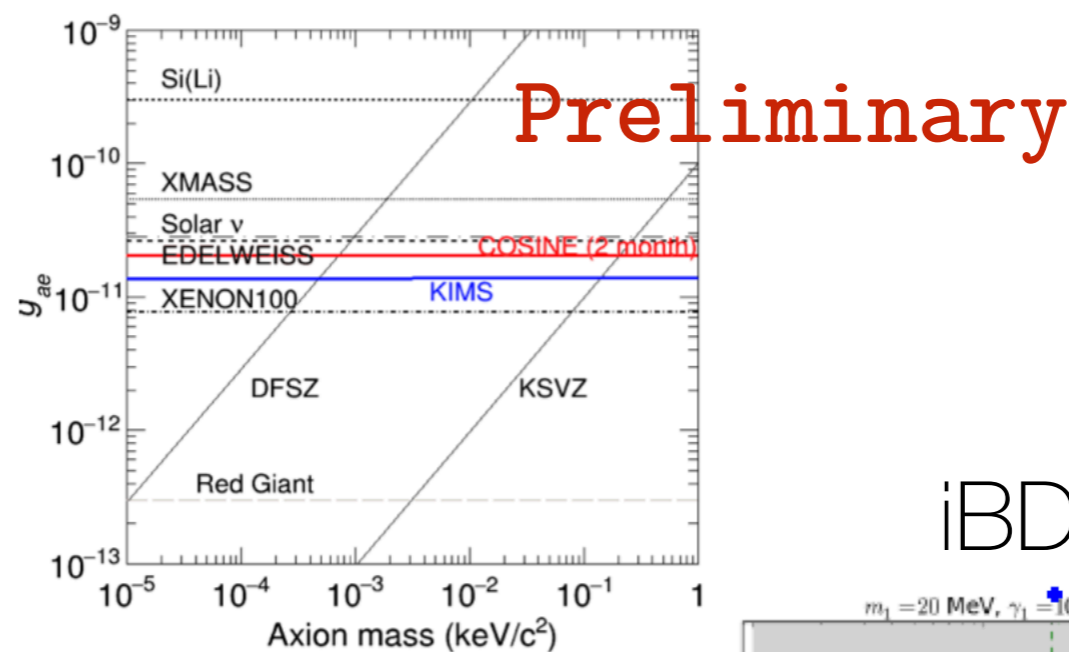
Projection, assuming full data set

Other physics analysis

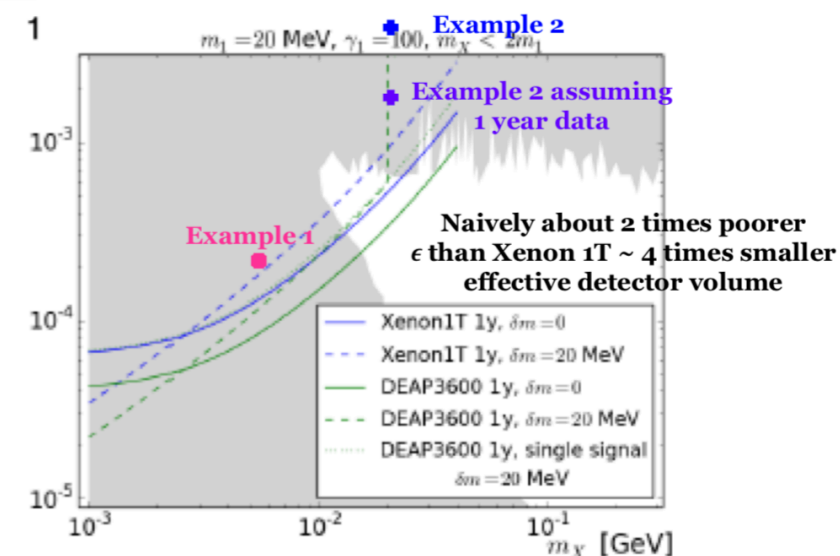
- PSD analysis: looking at different decay time between electron/nuclear recoil within NaI(Tl) crystal
- Bosonic Super-WIMP, Solar axion, inelastic Boosted Dark Matter searches on-going



Solar Axion



iBDM



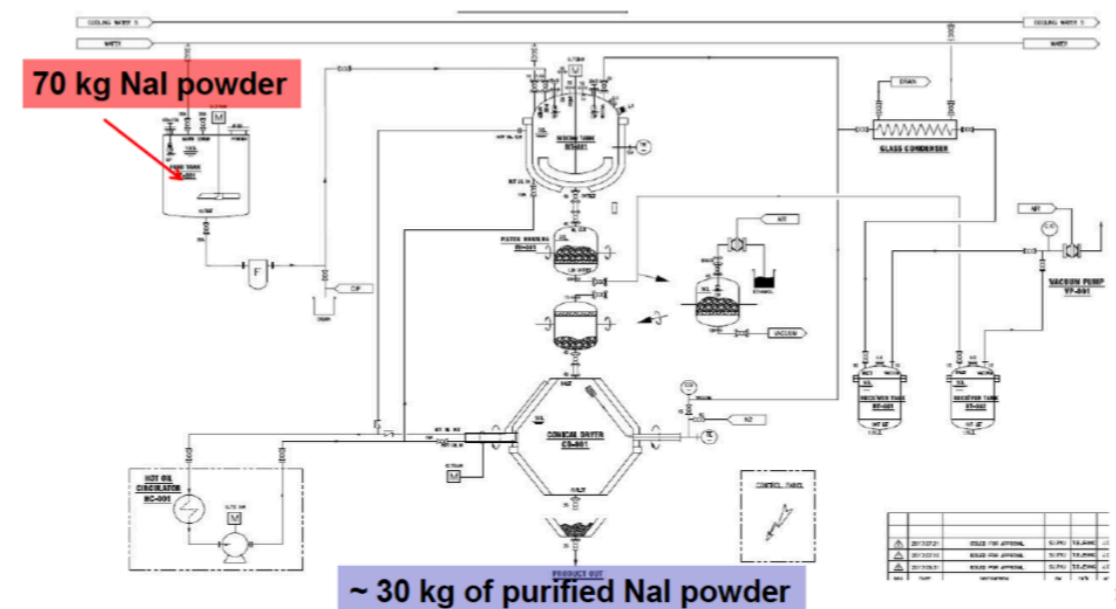
Crystal growing R&D

- Needs to grow our own crystal with low(er) background and better understanding of the crystal
- Powder purification system and crystal growers are available at Korean facility
- Went through many trials and errors, found ways to reduce background contamination in powder & improve growth condition of NaI(Tl) crystals
- Current measurements show great improvements!

~ 100 kg NaI crystal (ingot) grower



Piping & Instrument Diagram



Summary



- COSINE-100 has been running very smooth since September 2016, with more than 450 days of data
- Two detector papers are published, more coming soon
- First two physics results are close to be finished, with many other studies actively on going
- Next phase crystal growing is under development, with very promising results
- Stay tuned for more exciting results to come!