

Detector Performance and On-site Maintenance

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Detector Operations Manager

NSF Mid-Term Review
29 April 2024



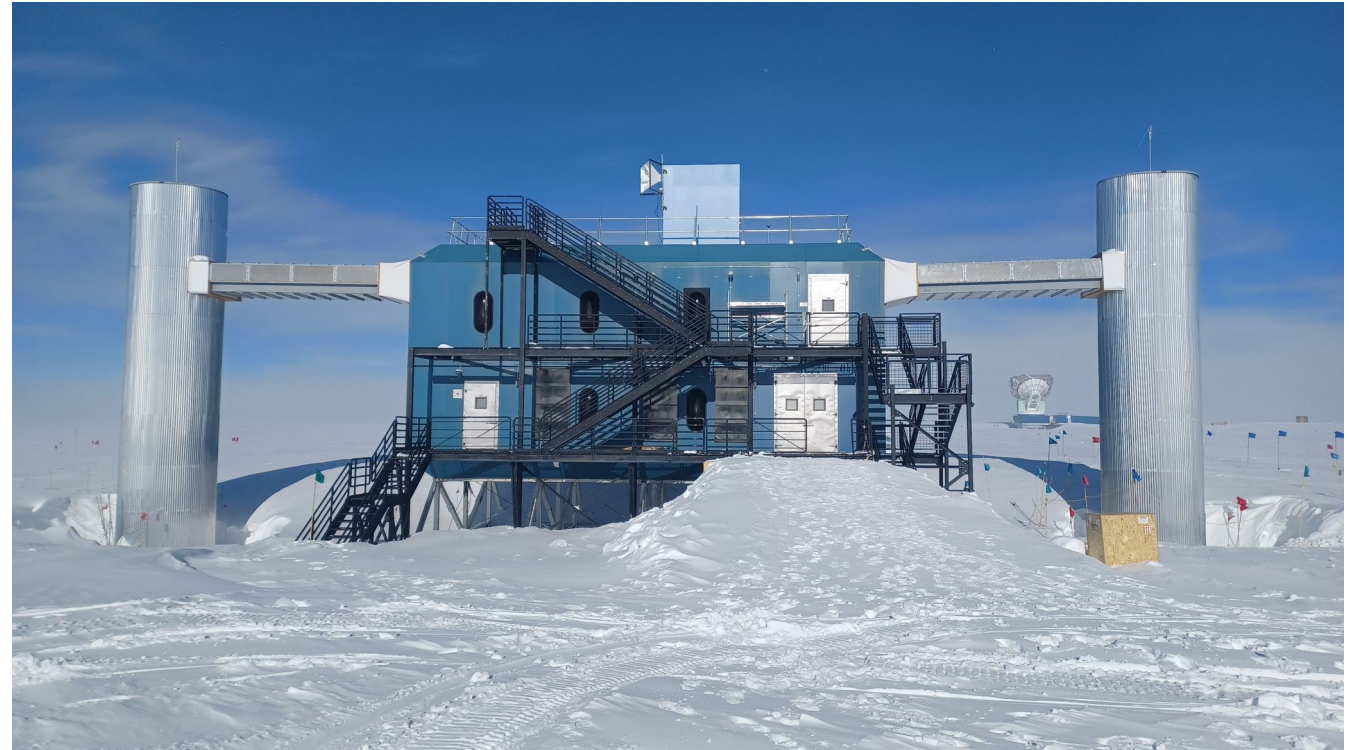
Presenter Background

- PhD 2010 UCL, London
- Joined IceCube 2013
- Assistant Scientist 2021 – present
- IceCube Detector Operations Manager 2023 – present
- 5 summer seasons at South Pole

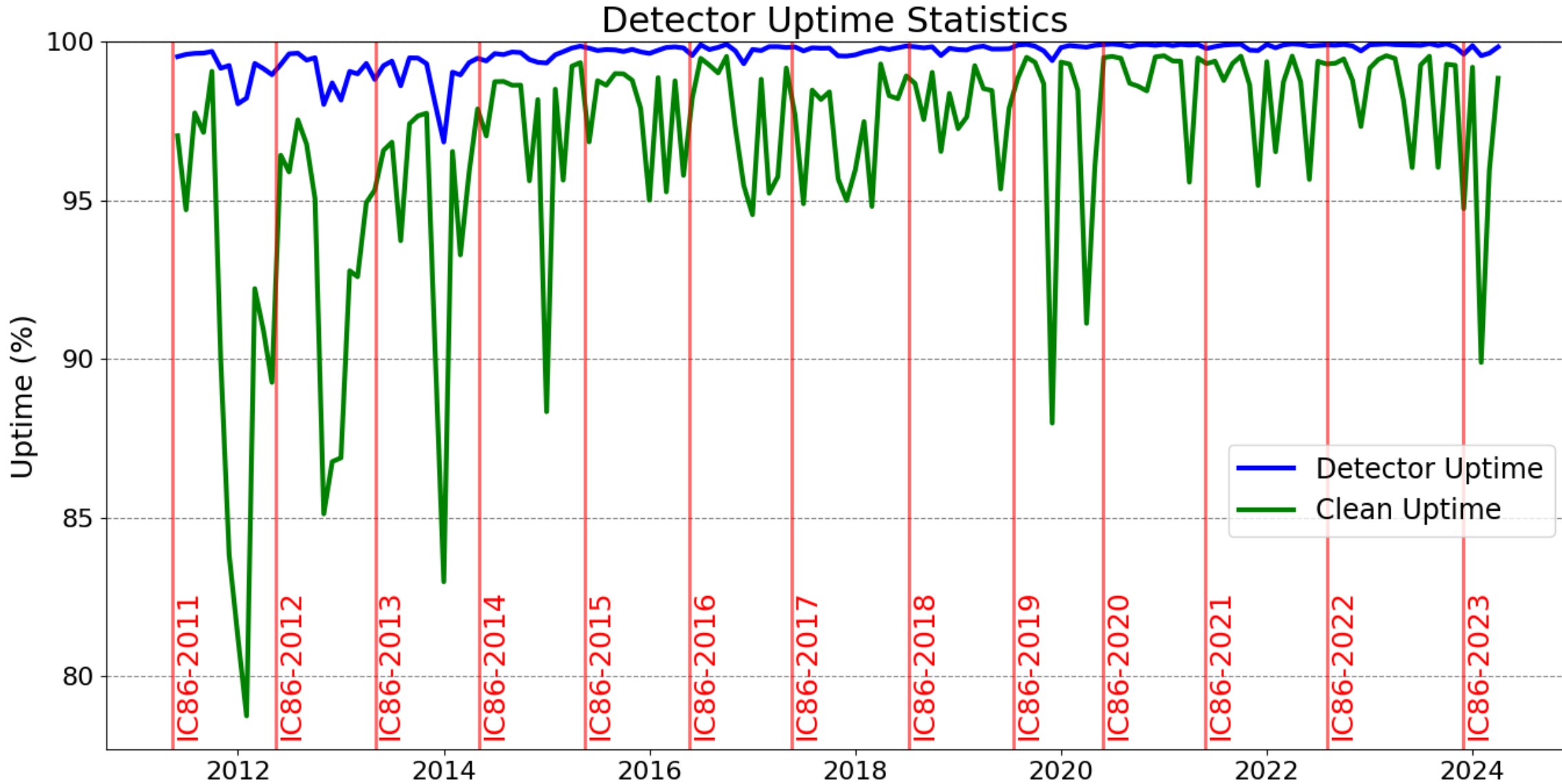


Outline

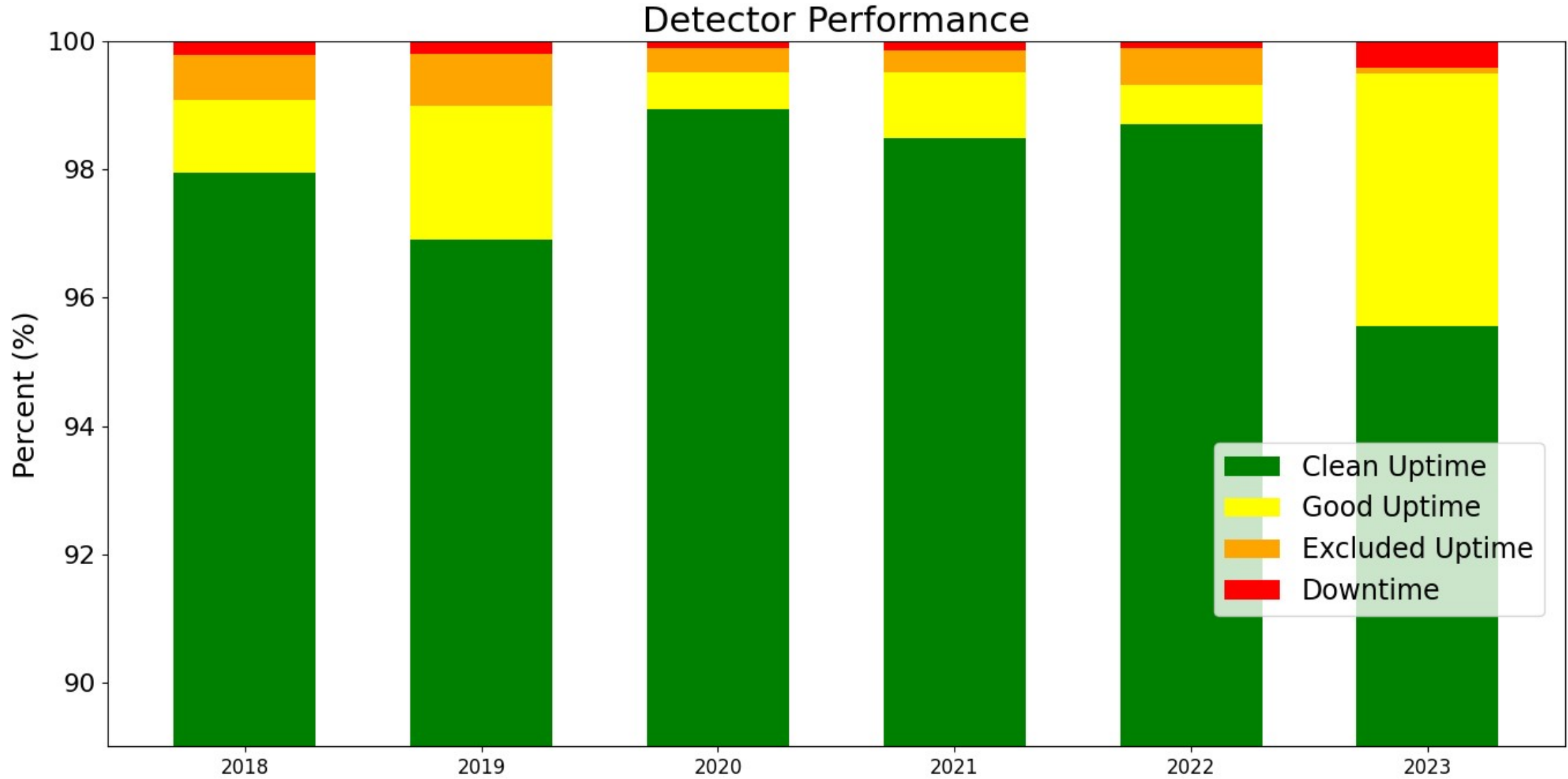
- Detector Uptime
- Sub-system software updates
- Field season review
- Surface Array Enhancement



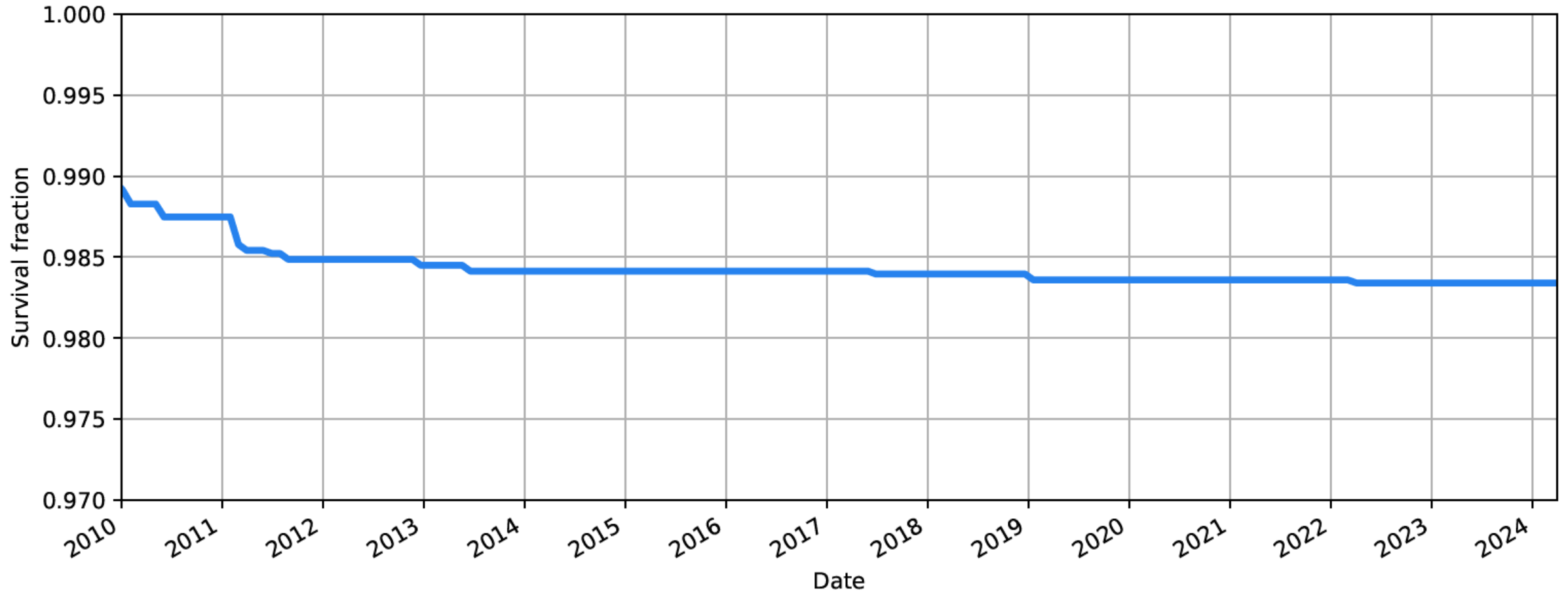
Detector Uptime



Detector Performance



DOM Survival Rate



Data Acquisition

- Python 3 support
- AlmaLinux 8 support
- HitSpool buffer increased
- DM-Ice trigger integration
- Extended DOM operating modes
 - Support calibration of delayed pulses
 - DOM mainboard software updated
- Non-local-coincidence trigger (Upgrade like)

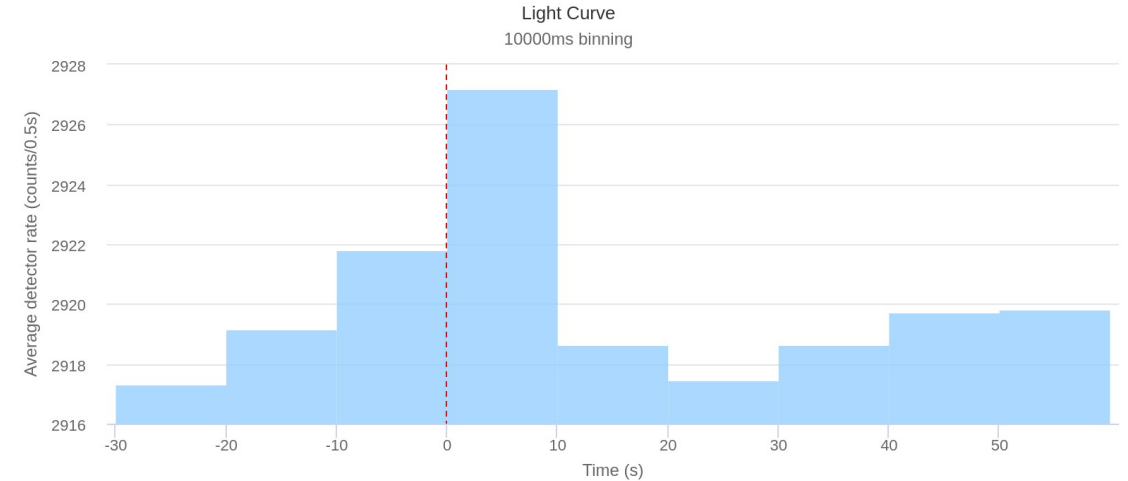
Releases

2021-07-13	Akupara2
2021-11-17	Akupara3
2022-02-10	Akupara4
2022-07-11	Akupara5
2022-12-14	Basilisk
2023-01-25	Basilisk2
2023-02-23	Basilisk3
2023-08-01	Cyclops

Supernova DAQ

Subsystem which tracks the total hit rate of all in-ice DOMs.

- AlmaLinux 8 support
- Cern ROOT 6.x support
- Fast Response System implemented
 - External alerts forwarded for IceCube follow-up (neutron star mergers)
- Continued progress toward PySNDAQ



Releases

2021-06-29	BT-19.1
2021-11-24	BT-20.0
2021-11-25	BT-20.1
2023-04-19	BT-20.2

I3Live

- Python 3 support
- AlmaLinux 8 support
- Updated JavaScript support
- Integrated calendar for coordinating operations
- Improved user control interface
- Support for the Supernova Fast Response System

Releases

- 2021-06-29 v4.4.0 (Enterprise)
- 2021-09-21 v4.4.1 (Enterprise2)
- 2021-10-13 v4.4.2 (Enterprise3)
- 2022-02-08 v4.5.0 (Falcon)
- 2022-03-15 v4.5.1 (Falcon2)
- 2022-07-21 v4.6.0 (Galactica)
- 2023-01-05 v4.6.1 (Galactica2)
- 2023-02-15 v4.6.2 (Galactica3)
- 2023-04-19 v4.7.0 (Hyperion)
- 2023-08-31 v4.7.1 (Hyperion2)
- 2023-11-28 v4.7.2 (Hyperion3)
- 2024-02-20 v4.8.0 (Icarus)



Processing and Filtering

- IceTop hit information added to the realtime analysis
- Memory leak identified and resolved
- Improved user control interface
- Additional monitoring of IceTop DOMs
- Updated for Python 3 and AlmaLinux 8
- New filtering concept for IC86-2023

Releases

2021-05-27	V21-04-00
2021-11-18	V21-10-00
2022-01-17	V21-10-01
2022-03-01	V21-10-02
2022-04-14	V21-10-03
2022-07-12	V21-10-05
2022-08-03	V22-08-00
2023-02-15	V23-01-00
2023-07-18	V23-06-00
2023-11-28	V23-11-00
2023-12-01	V23-11-02
2023-12-07	V23-11-03
2023-12-21	V23-11-04

IC86-2023 Physics Run Start

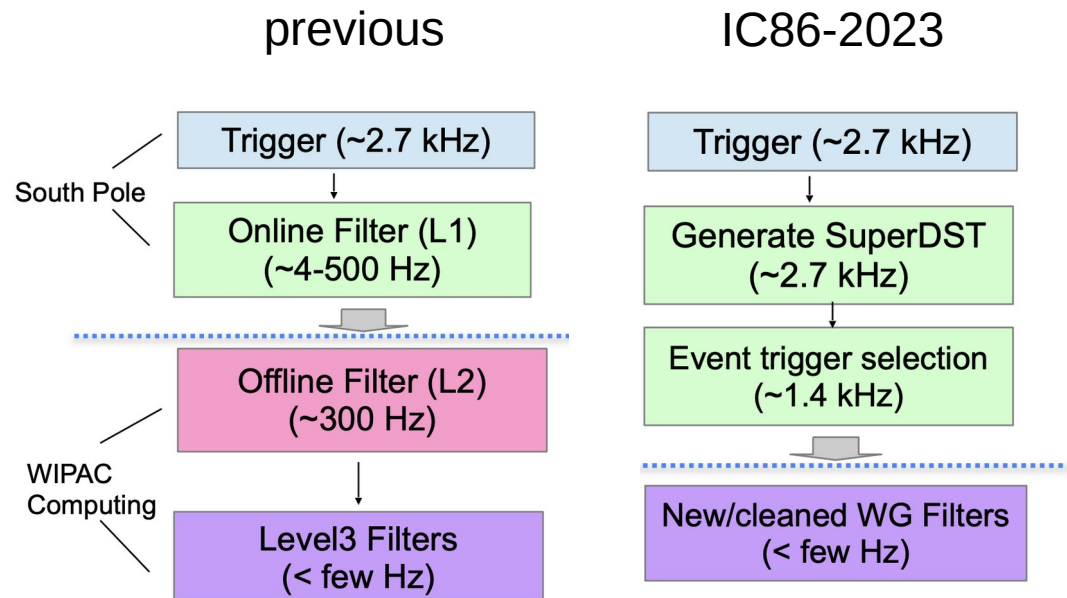
- Run start on Nov 28, 2023
- Two new triggers
- Generalized filtering concept
- Online software SMT-12
- Less computationally expensive at pole
- Working groups have more flexibility

IC86-2022

Name
CascadeFilter_13
DeepCoreFilter_13
DMIceTrigFilter_22
EHEAlertFilter_15
EHEAlertFilterHB_15
EstresAlertFilter_18
FilterMinBias_13
FixedRateFilter_13
FSSCandidate_13
FSSFilter_13
GFUFilter_17
GRECOOnlineFilter_19
HESEFilter_15
HighQFilter_17
I3DAQDecodeException
IceActTrigFilter_18
IceTop_InFill_STA2_17
IceTop_InFill_STA3_13
IceTop_SouthwestNHLCTank1_22
IceTopSTA3_13
IceTopSTA5_13
InIceSMT_IceTopCoincidence_13
LID
LowUp_13
MESEFilter_15
MonopoleFilter_16
MoonFilter_13
MuonFilter_13
OnlineL2Filter_17
ScintMinBias_16
SDST_IceTop_InFill_STA3_13
SDST_IceTopSTA3_13
SDST_InIceSMT_IceTopCoincidence_13
SlopFilter_13
SunFilter_13
VEF_13

IC86-2023

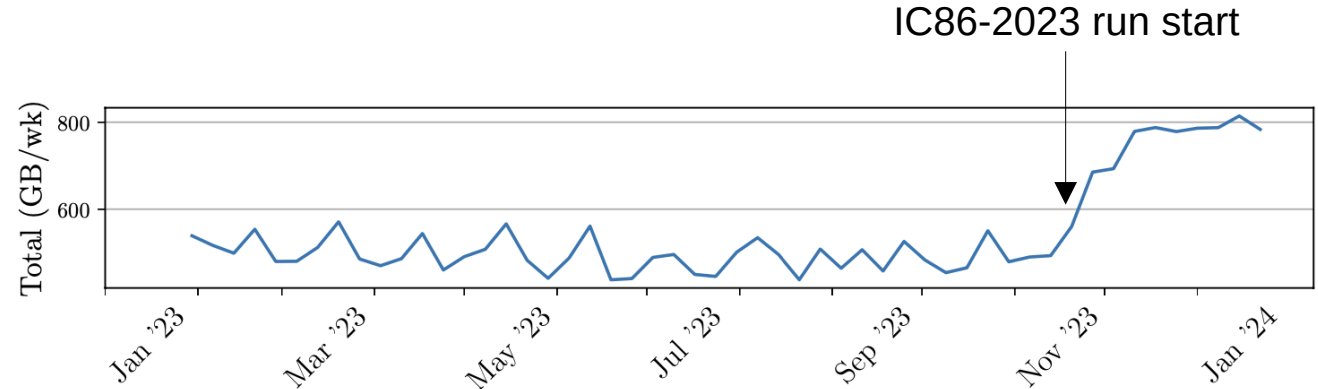
Name
FixedRateTriggerFilter
GFUFilter_23
HESEFilter_23
HighQFilter_23
I3DAQDecodeException
Keep_SuperDST_23
MinBiasFilter
MuonFilter_23
OnlineL2Filter_23
SoftwareSMT12Filt_23



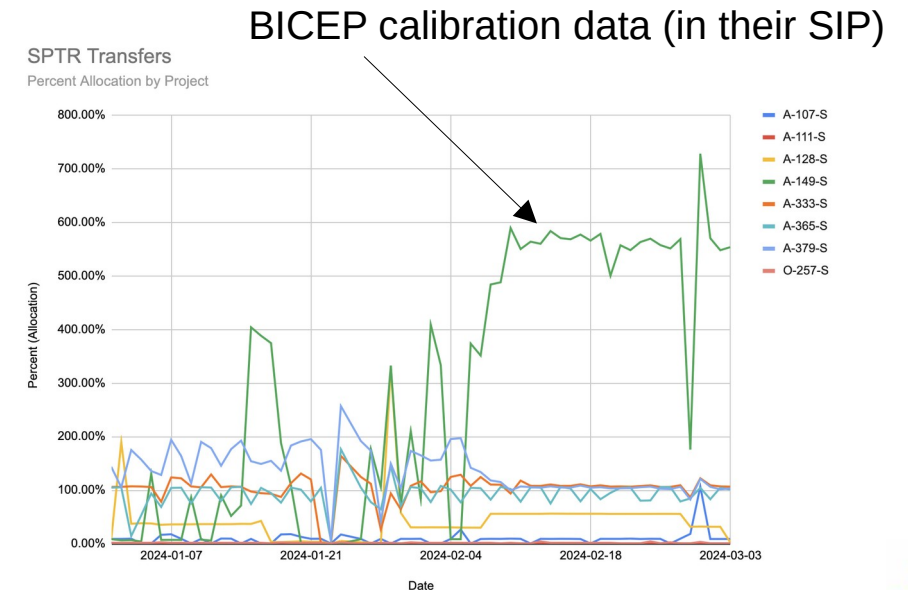
Data Transfer Bandwidth

90 GB/day in July 2023 (low event rate)

110 GB/day in Jan. 2024 (high event rate)

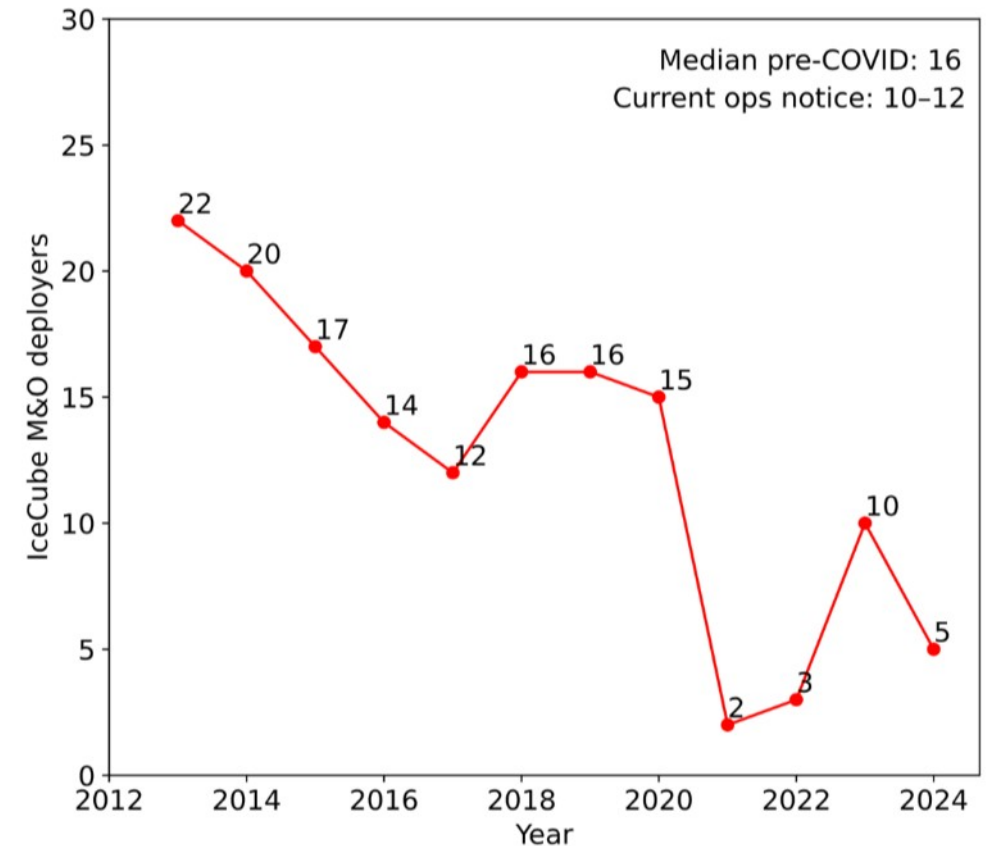


- A little more data since IC86-2023 run start
- Coordinating with SPT and BICEP
- Plan to request 5-10% increase



Logistics Challenges

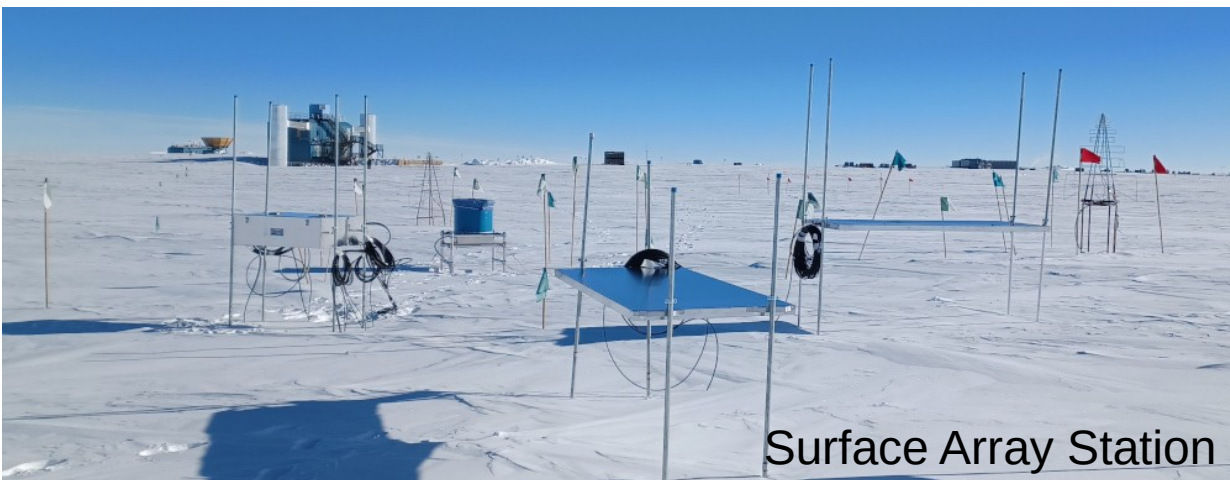
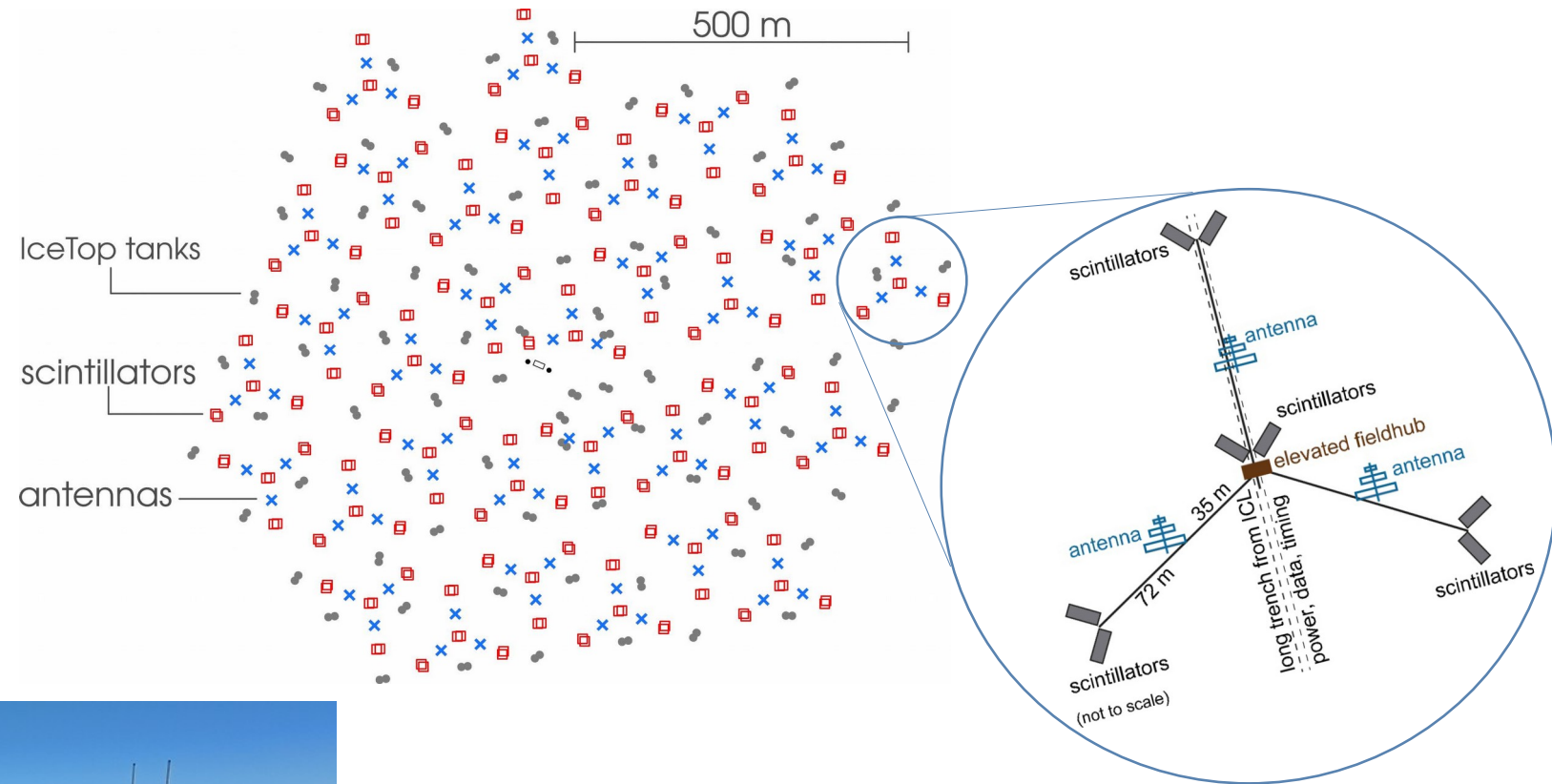
- Population limited since COVID
- Keeping up with critical tasks so far, but it's not sustainable long-term
- Limited personnel rotations is challenging
- Cargo delays



IceTop Surface Array Enhancement

Science and Calibration goals

- IceTop maintenance
- calibrate IceTop snow attenuation
- better estimation of atmospheric backgrounds
- testbed for Upgrade and Gen2



Surface Array Station Mid-Term Review

2021-22 Field Season

- OS upgrade to AlmaLinux 8.4
 - New hard drives
- Surface array maintenance
 - Updated FieldHub electronics
 - Repair scint light leaks
- Wind turbine installation
 - Data logging

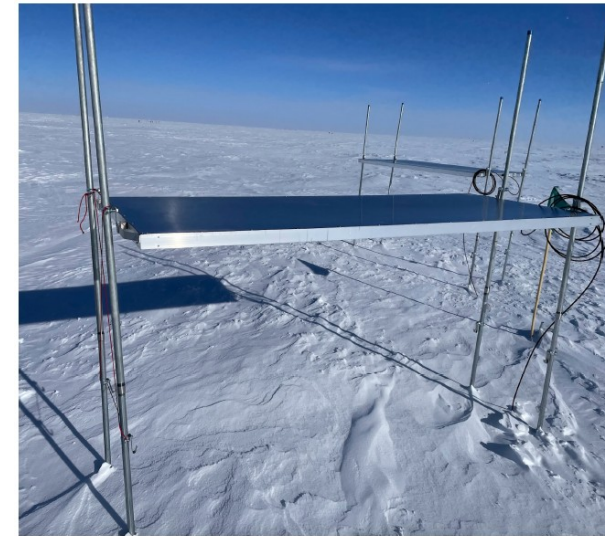
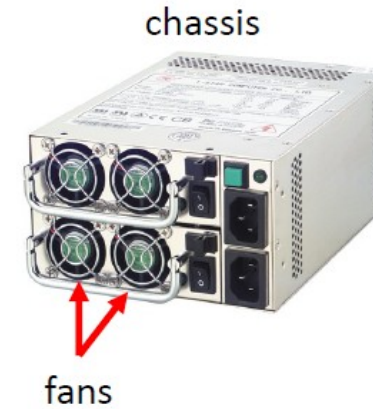


TAXI DAQ inside of the Fieldhub



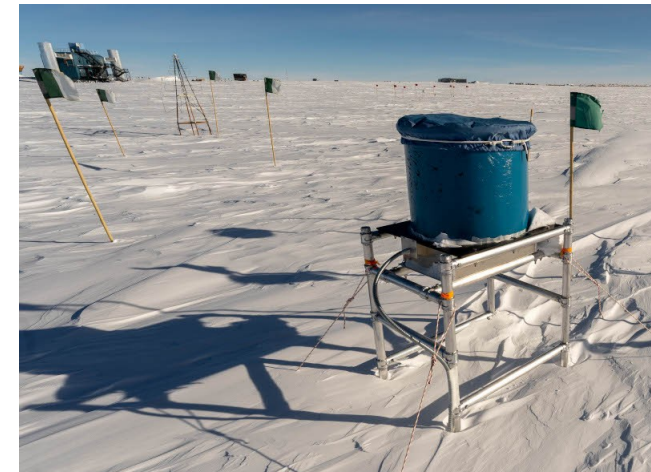
2022-23 Field Season

- ATX power supply maintenance
 - Failed fans and chassis replaced
- Surface array maintenance
 - All instruments raised
 - New scint with improved dynamic range
- ARA-4 DAQ electronics retro
- Starlink beta test
- Prep for Upgrade electronics



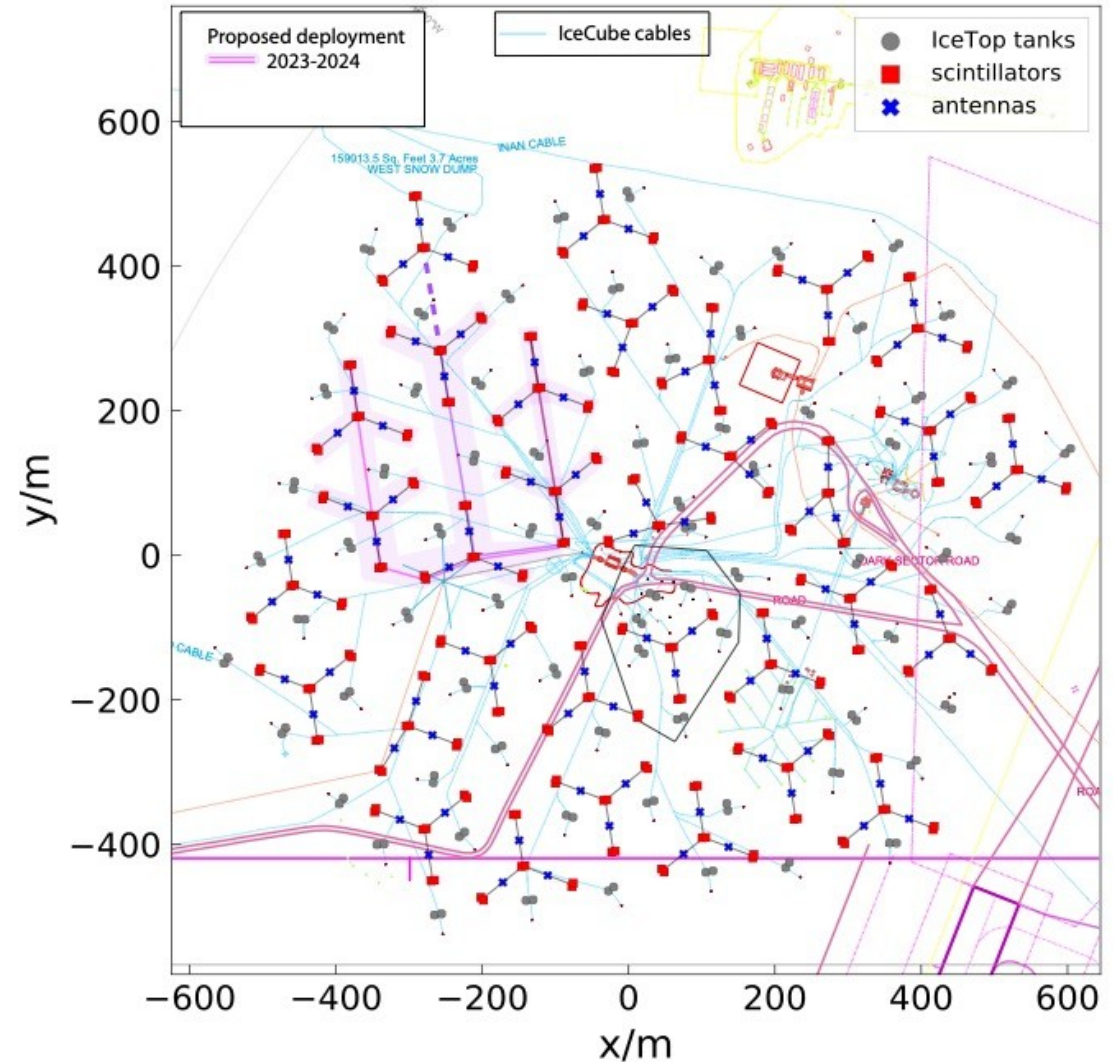
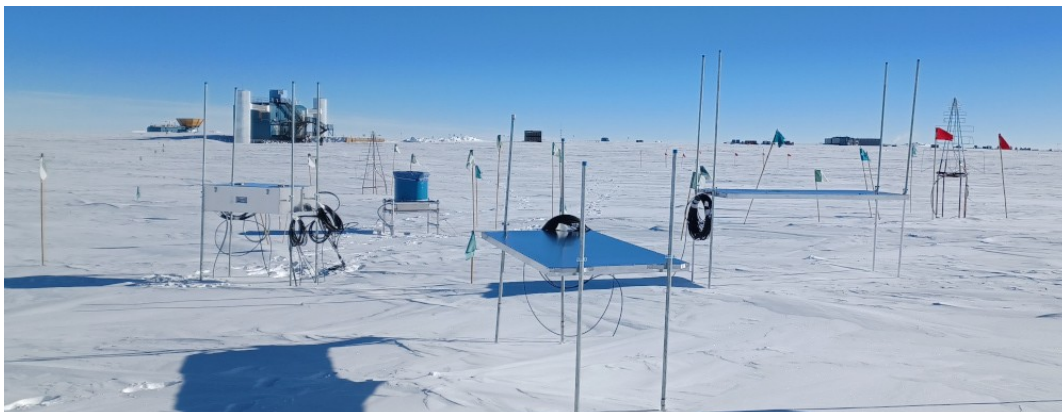
2023-24 Field Season

- Network switch lifecycle replacement
- UPS lifecycle replacement
- Wind turbine upgrade
- IceACT maintenance
- ARA-4 vault extension
- Upgrade cable prep



A Path Forward

- Successful prototype station
- Construction previously limited by COVID, available logistics support, population limitations, etc.
- Detectors produced for 12 stations.
- 2023-24 deployments deferred. Propose resuming deployments for 2024-25.
- Goal: compact sub-array deployed before Upgrade drilling season.
 - can partially achieve most goals of the full surface array.



Summary

- Very high detector uptime and low component failure rate
- Continually developing the online software systems
- Software enhancements supporting expanded science
- Successful IC86-2023 run start and generalized filtering implementation

