Gen2
Detector hardware and drill

M. A. DuVernois

UW—Madison

For the Gen2 Hardware Group, and many folks who are
working on alternate hardware options
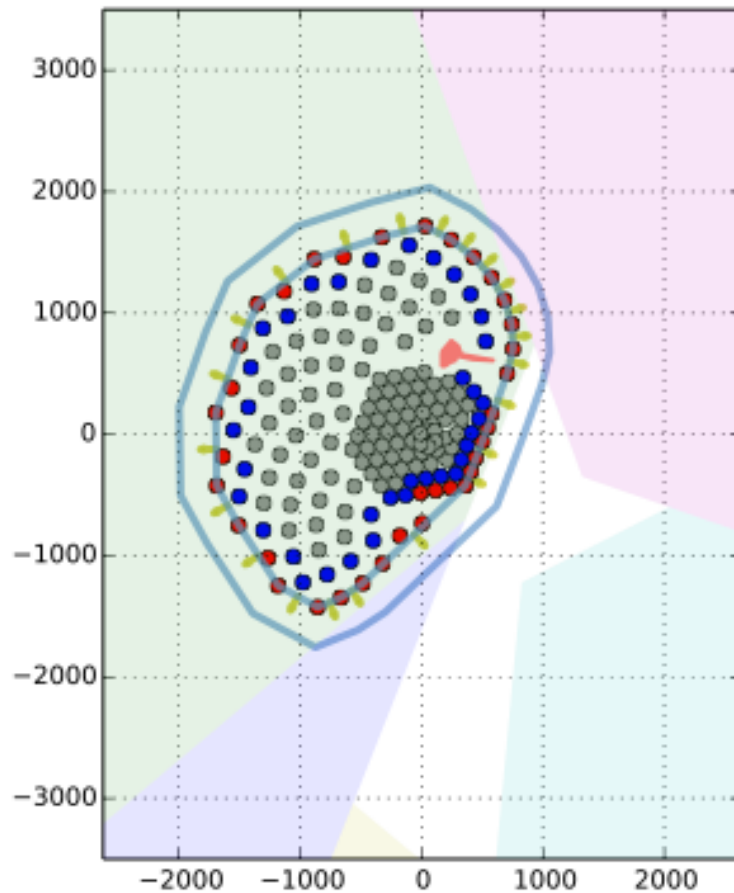
IceCube

WIPAC
WISCONSIN ICECUBE
PARTICLE ASTROPHYSICS CENTER

Gen2,
detector R&D and drilling

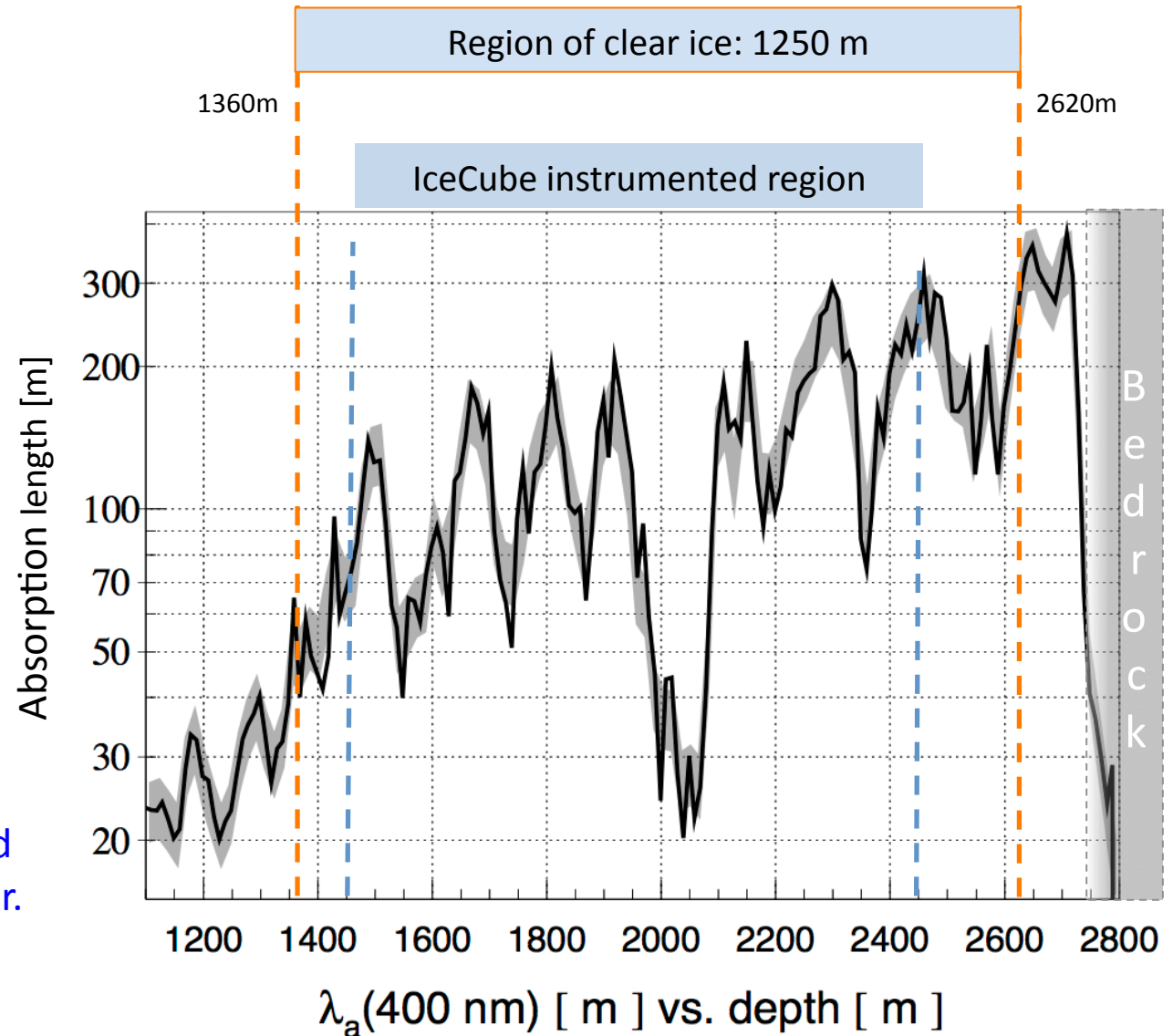Albrecht Karle

Investigation of geometries ongoing.
Initial idea: extend from IceCube.

Configuration shown here:
96 strings, 240m spacing
Surface area: ~5 km^2

Volume: 5 * 1.3 = 6.5 km^3

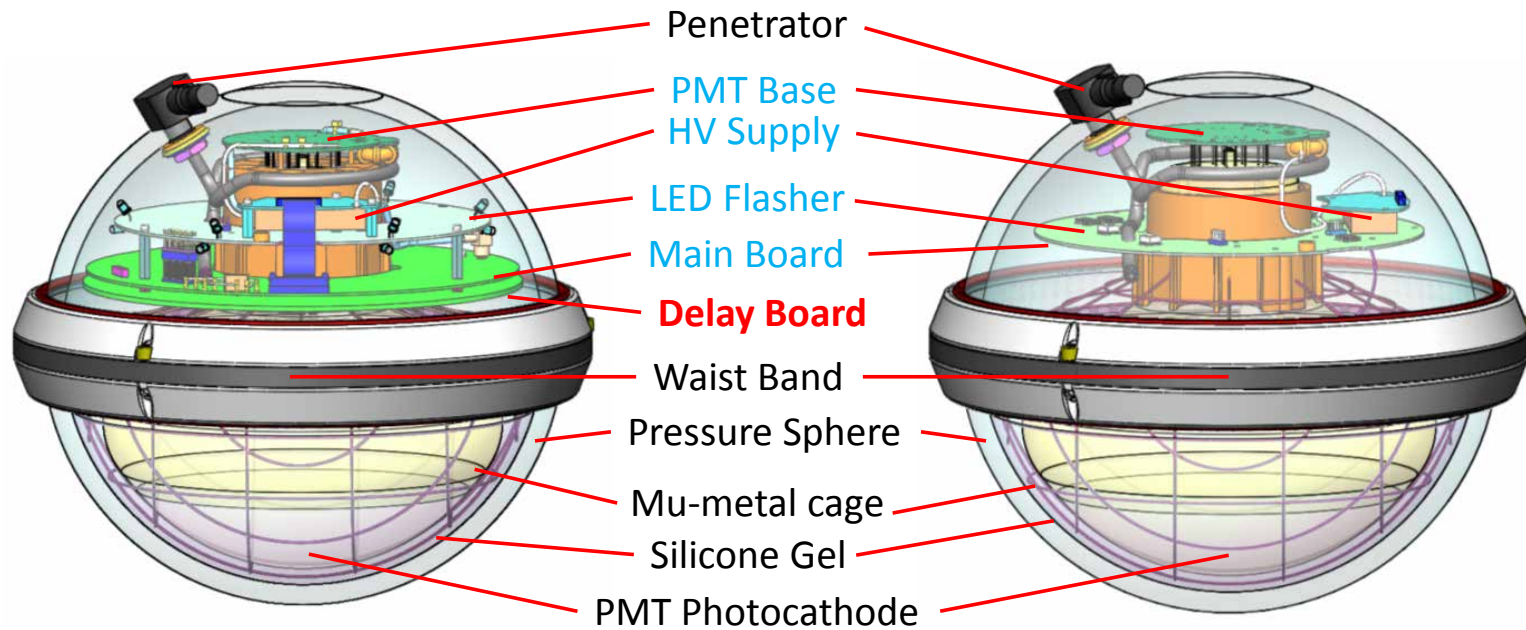# Extending the region of ice to instrument with DOMs

- Bedrock estimated depth 2750m – 2850m

- 150 m to 200 m of very clear and usable ice below IceCube (need safety distance from bedrock)

- 100 m of good ice above

→Can make instrumented region 250 to 300m longer.

Next-Generation DOM

Overall Gen2 DOM Design

Penetrator
PMT Base
HV Supply
LED Flasher
Main Board
Delay Board
Waist Band
Pressure Sphere
Mu-metal cage
Silicone Gel
PMT Photocathode

IceCube
DOM

Gen2
DOM

KEY:
Component identical
Component eliminated
Component re-designed

OFF OF THE BASELINE

The multi-PMT Optical Module (mDOM)

Features

- 14 inch diameter
- 24× 3 inch PMTs
- 2× effective area of standard DOM
- 4π uniforme acceptance
- Directional sensitivity
- Local coincidences

Today update on
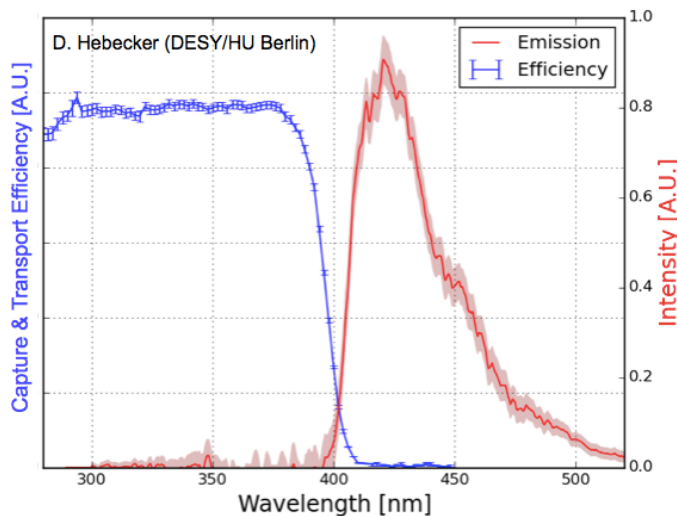
- Pressure vessel
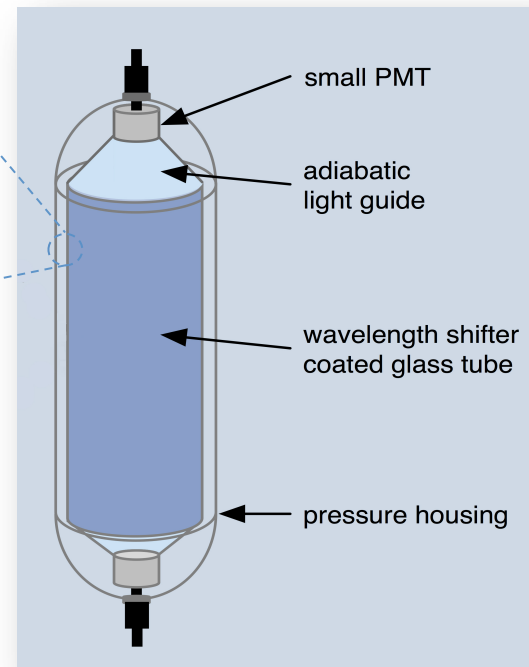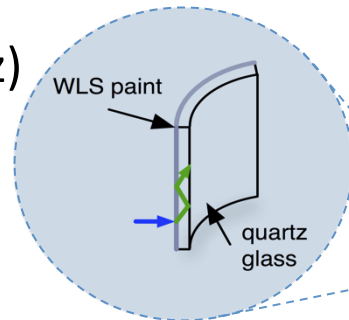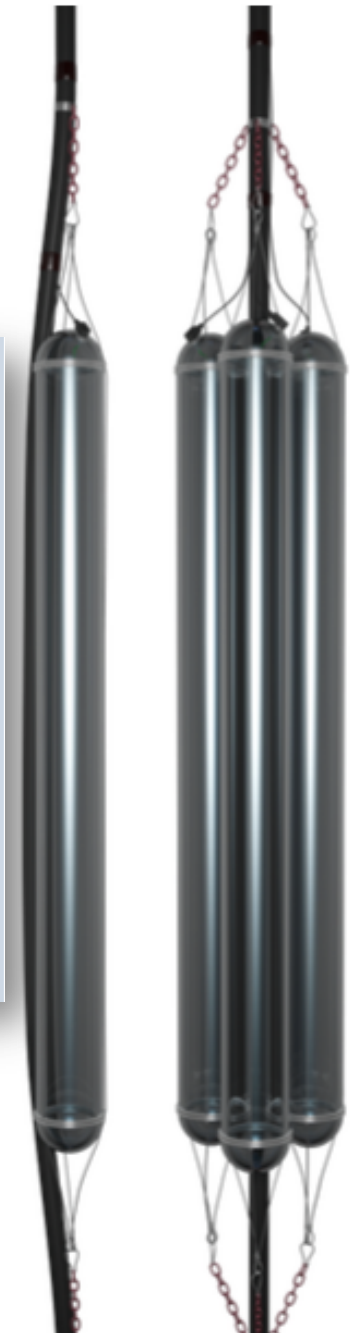- Electronics development
- Simulation

R&D on photodetector modules

WOM: **W**avelength shifting **O**ptical **M**odule

Features
- large collection area
- low noise rate (few Hz)
- better UV sensitivity
- cost effective

WLS paint

quartz glass

small PMT

adiabatic light guide

wavelength shifter coated glass tube

pressure housing

D. Hebecker (DESY/HU Berlin)

Emission
Efficiency

Capture & Transport Efficiency [A.U.]
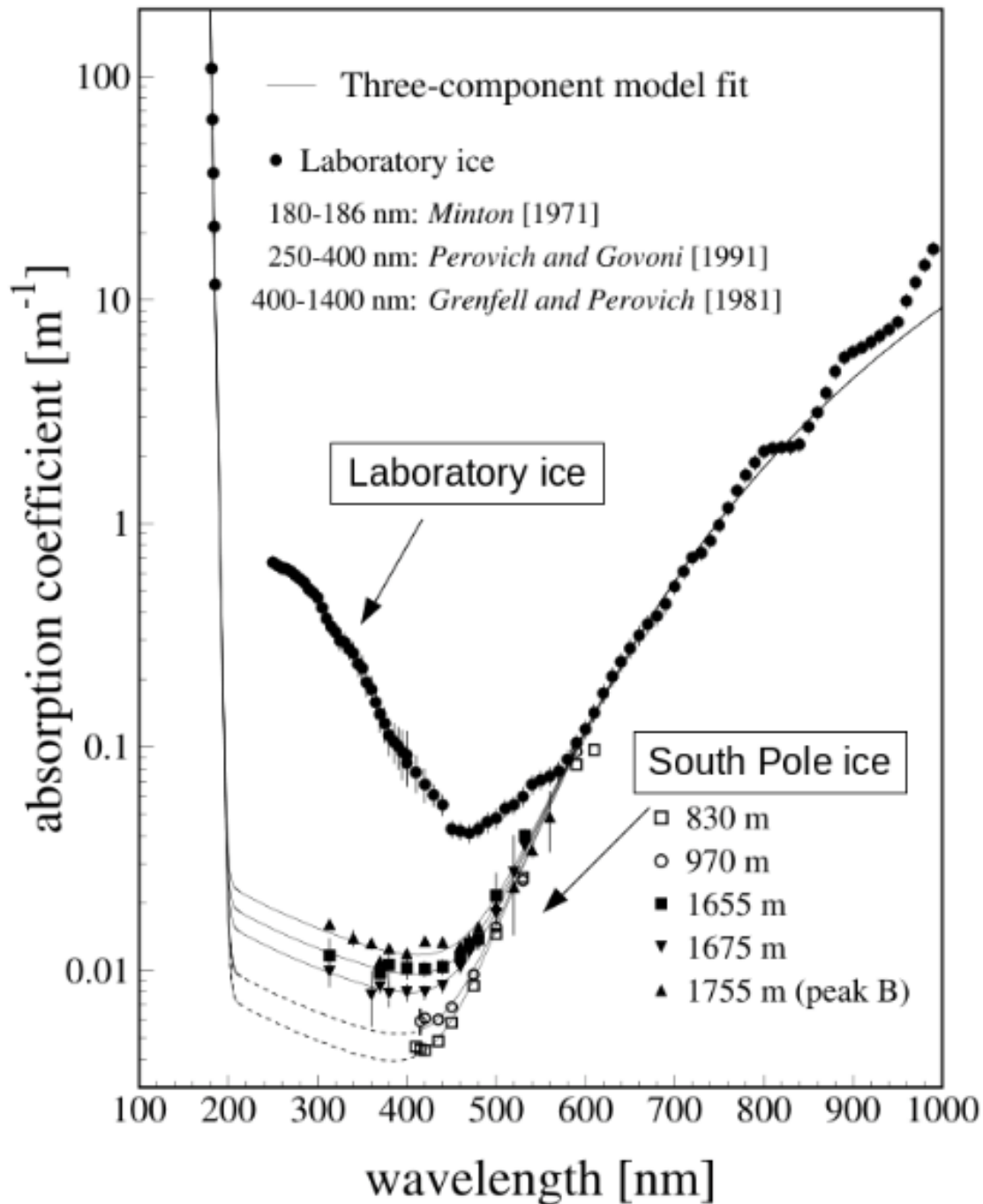
Intensity [A.U.]
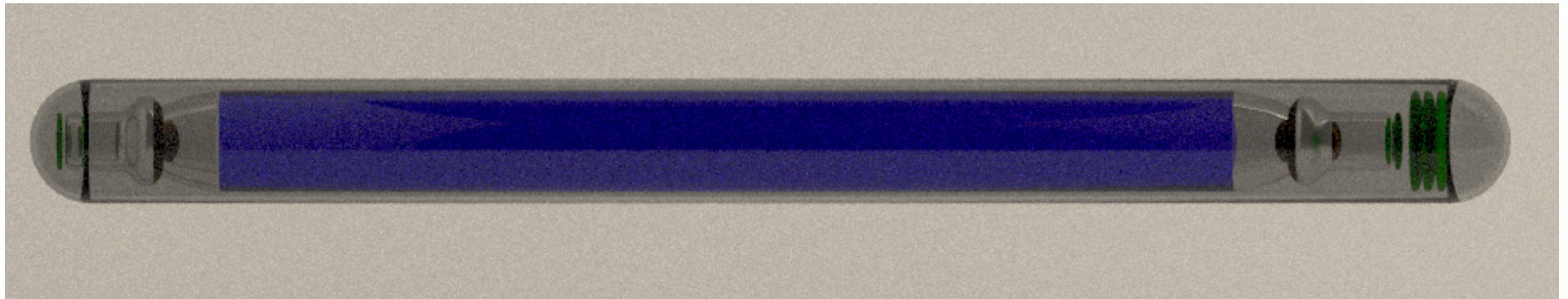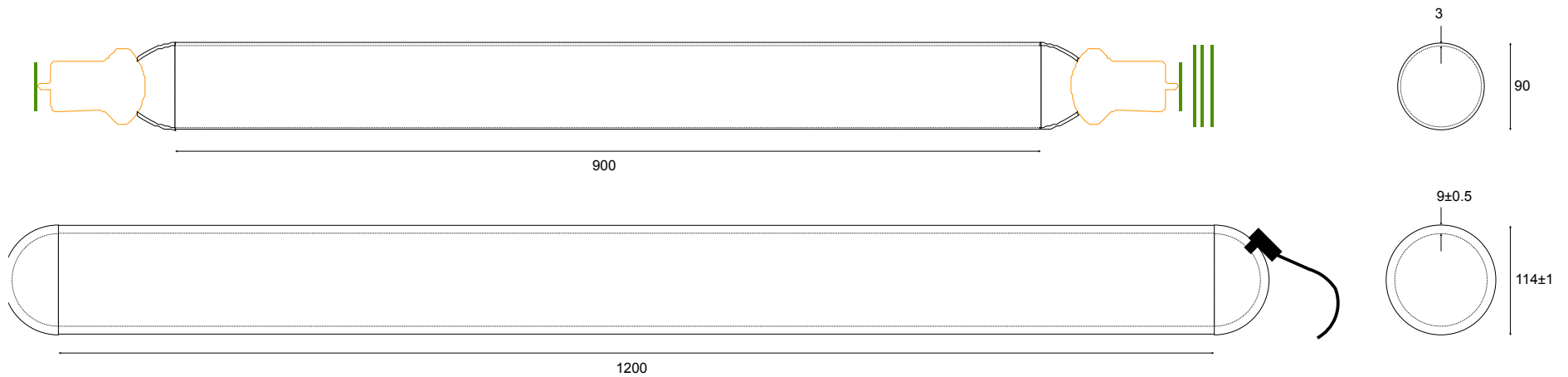
Wavelength [nm]

Mainz, DESY
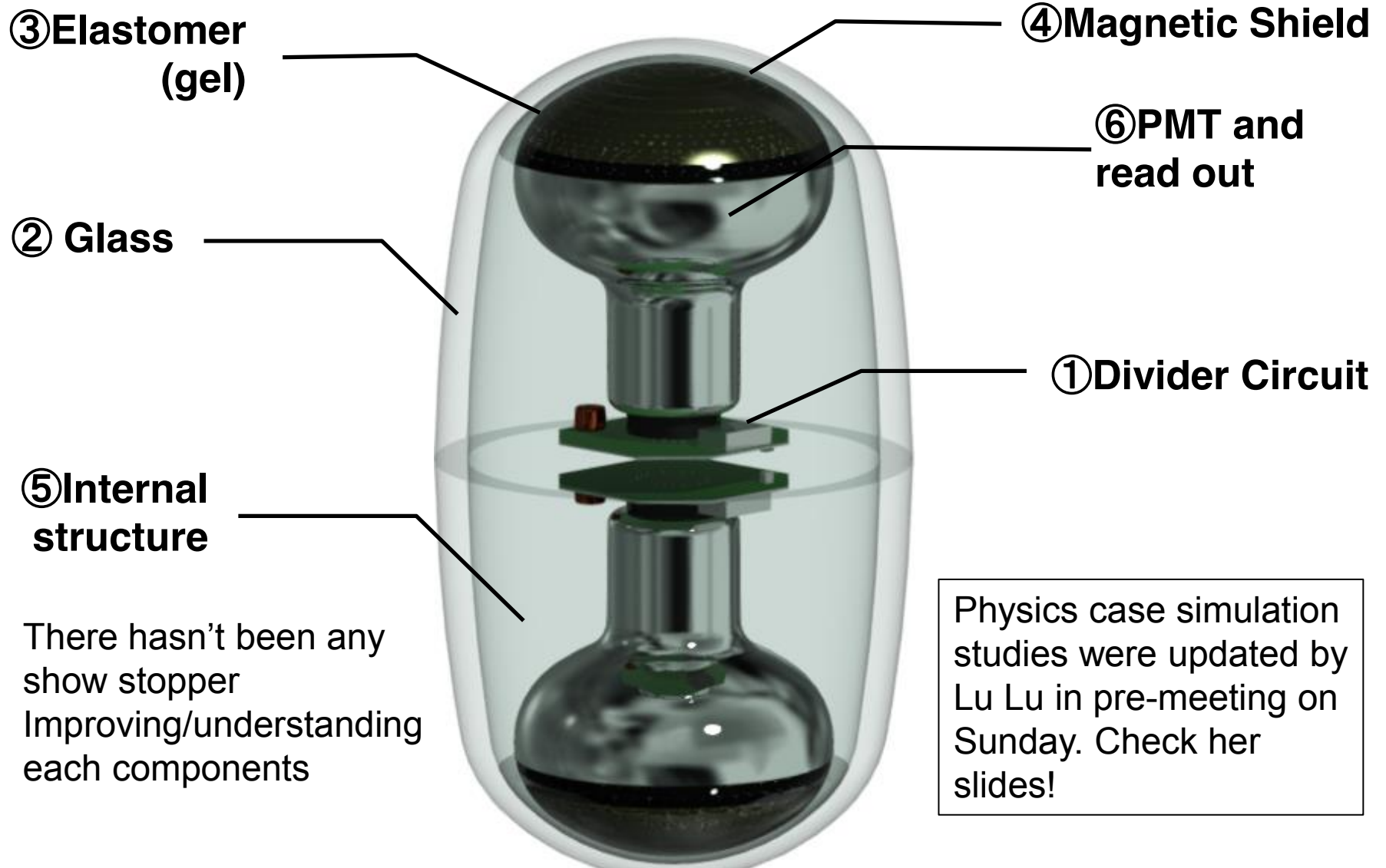
Ice Absorption vs wavelength

Ackermann et al.(2006), Journal of Geophysical Research (Atmospheres), 111, D13203

Next Steps: Prototype with mDOM PMTs

Outline of D-EGG updates

③Elastomer (gel)

④Magnetic Shield

⑥PMT and read out

② Glass
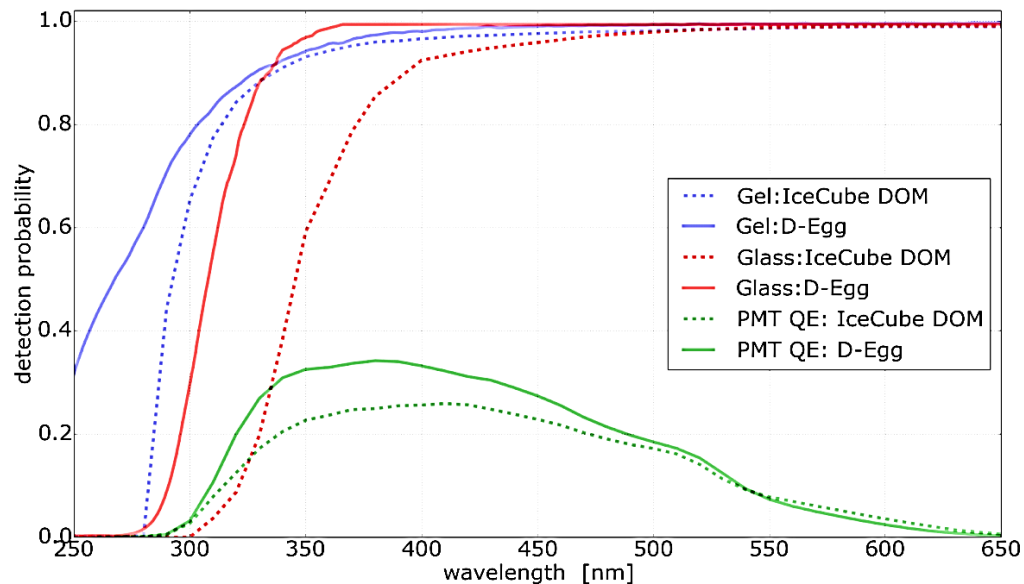
①Divider Circuit

⑤Internal structure

- There hasn't been any show stopper
- Improving/understanding each components
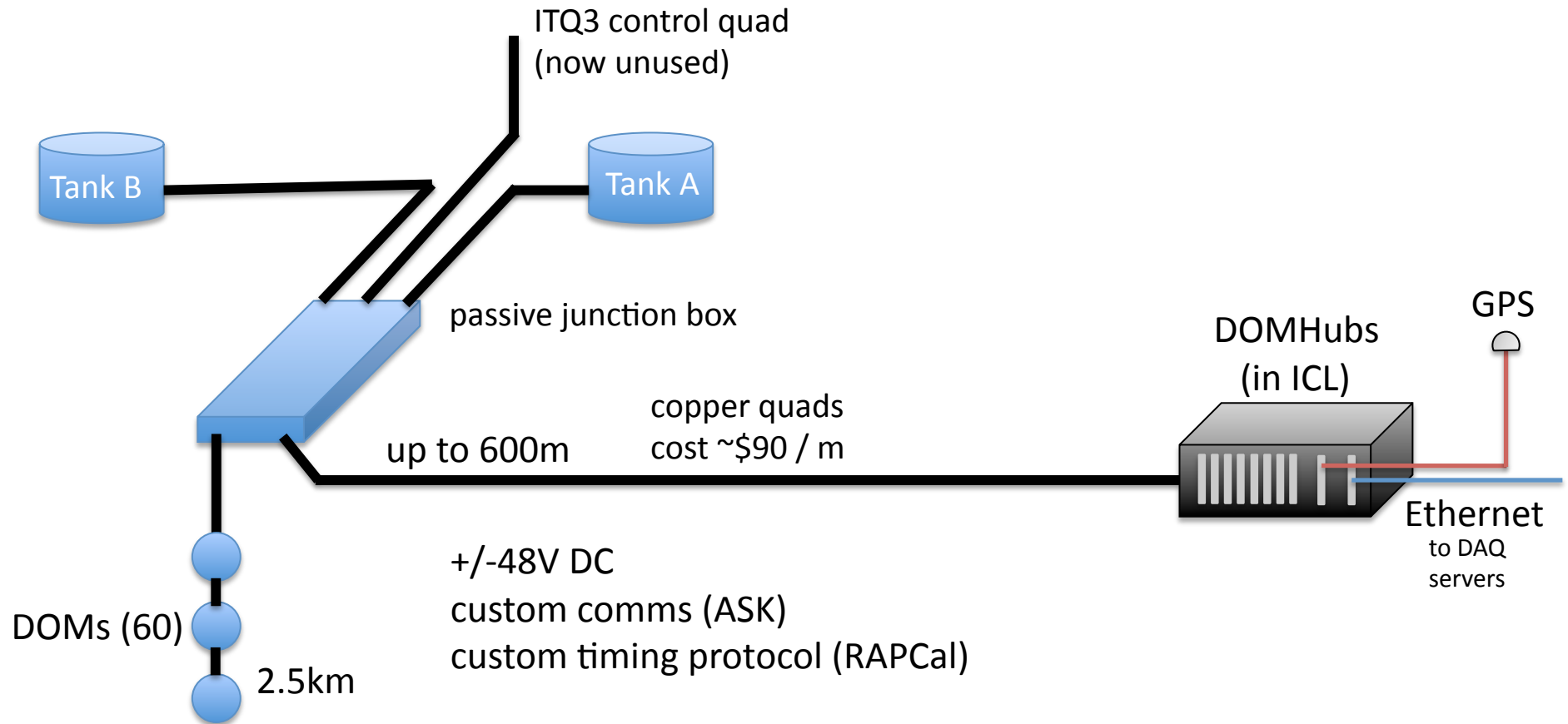
Physics case simulation studies were updated by Lu Lu in pre-meeting on Sunday. Check her slides!

Update on glass

- In the previous slides (before August), referenced transmittance number was incorrect, please reference updated ones (e.g. Lu's slides).

- However, when we convolute PMT QE, the results are unchanged since PMT's glass cut off point unchanged

DOM Readout (IceCube+IceTop)

DOM Readout (Gen2 HEA)

Gen2 DOMs + Gen2 field hubs, fiber to ICL

Field hub
(transformer + hub + DC power supplies)

GPS

hitspool server
+ WR switch

Several km

fiber + power
cost ~$15 / m

600V AC
Ethernet + White Rabbit

Ethernet
to DAQ
servers

Gen2
DOMs

100V DC
QAM comms
2.7km
RAPCal
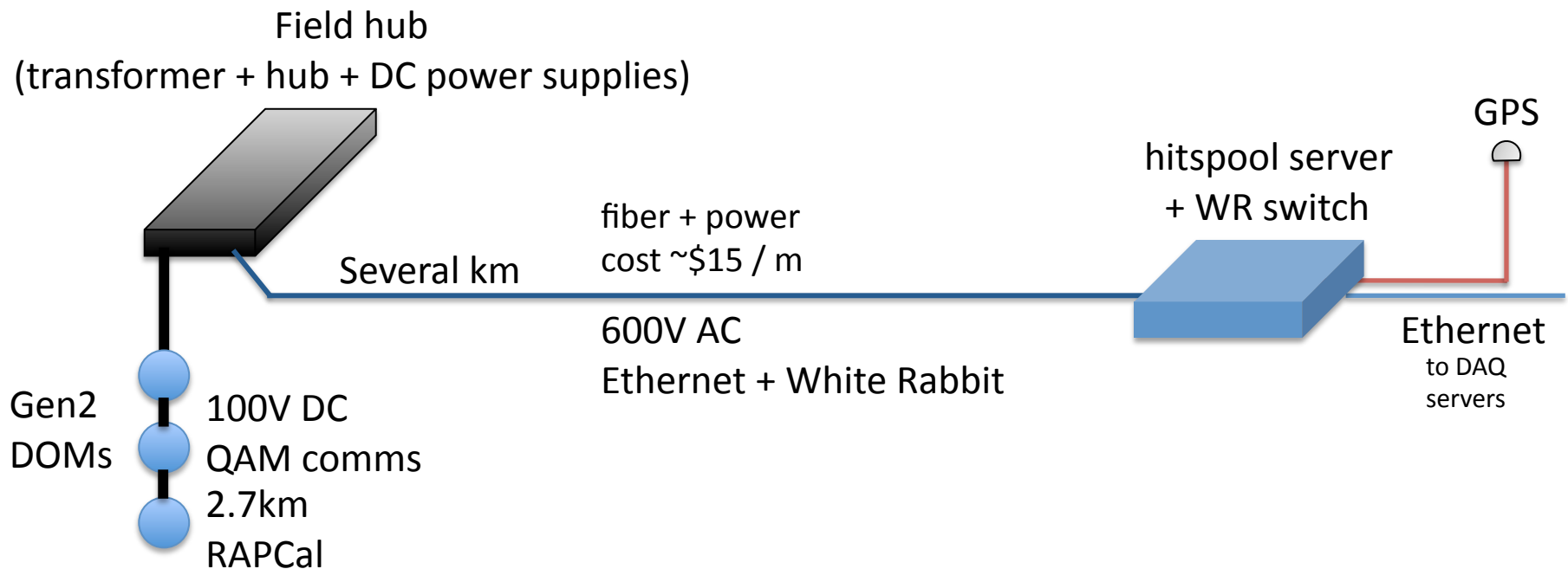
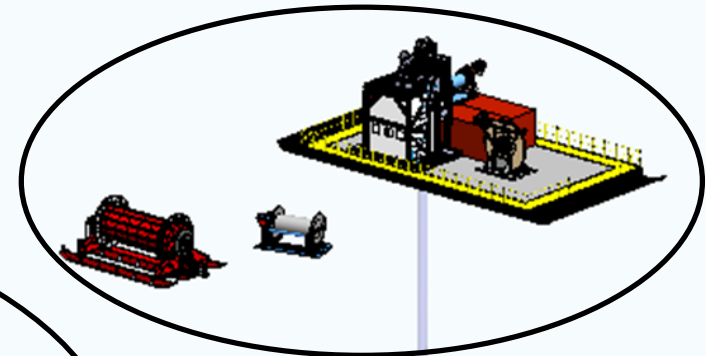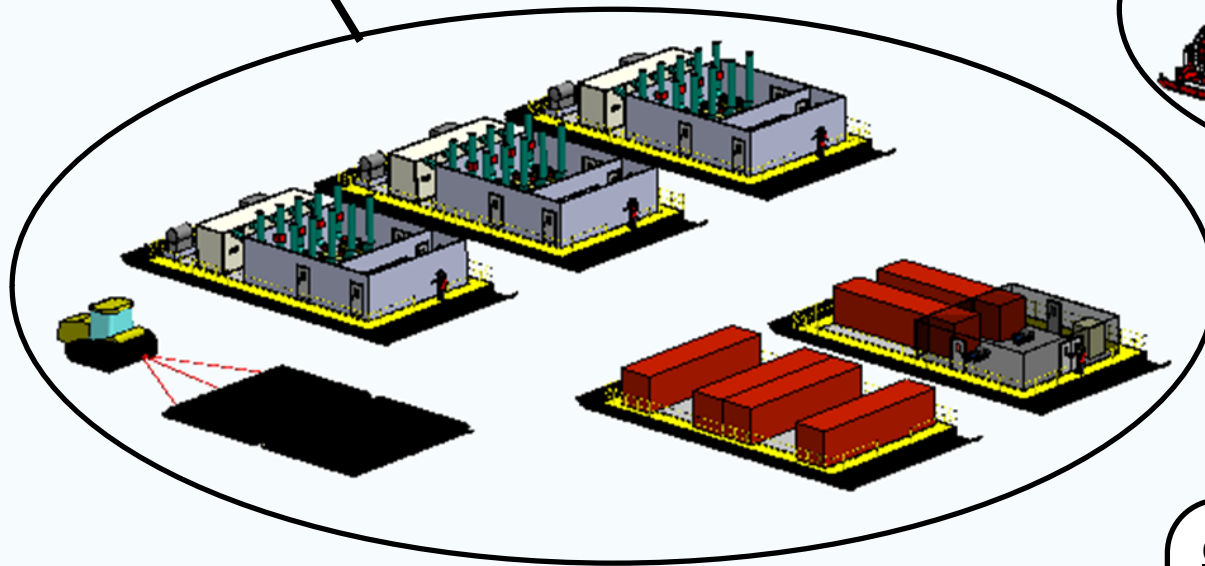# ICECUBE GEN2 DRILL (EHWD-G2)

EHWD-G2
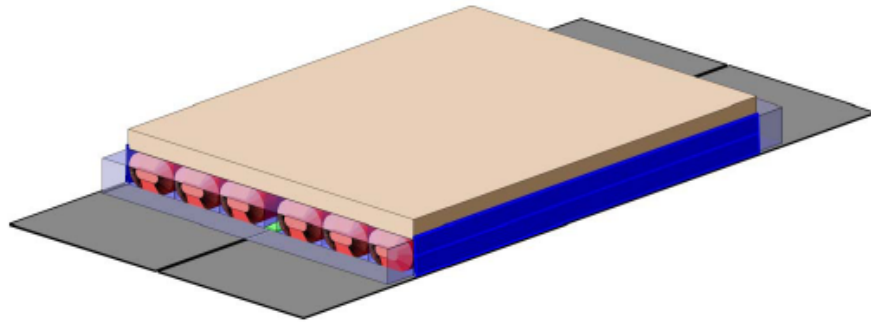
Concept 2015
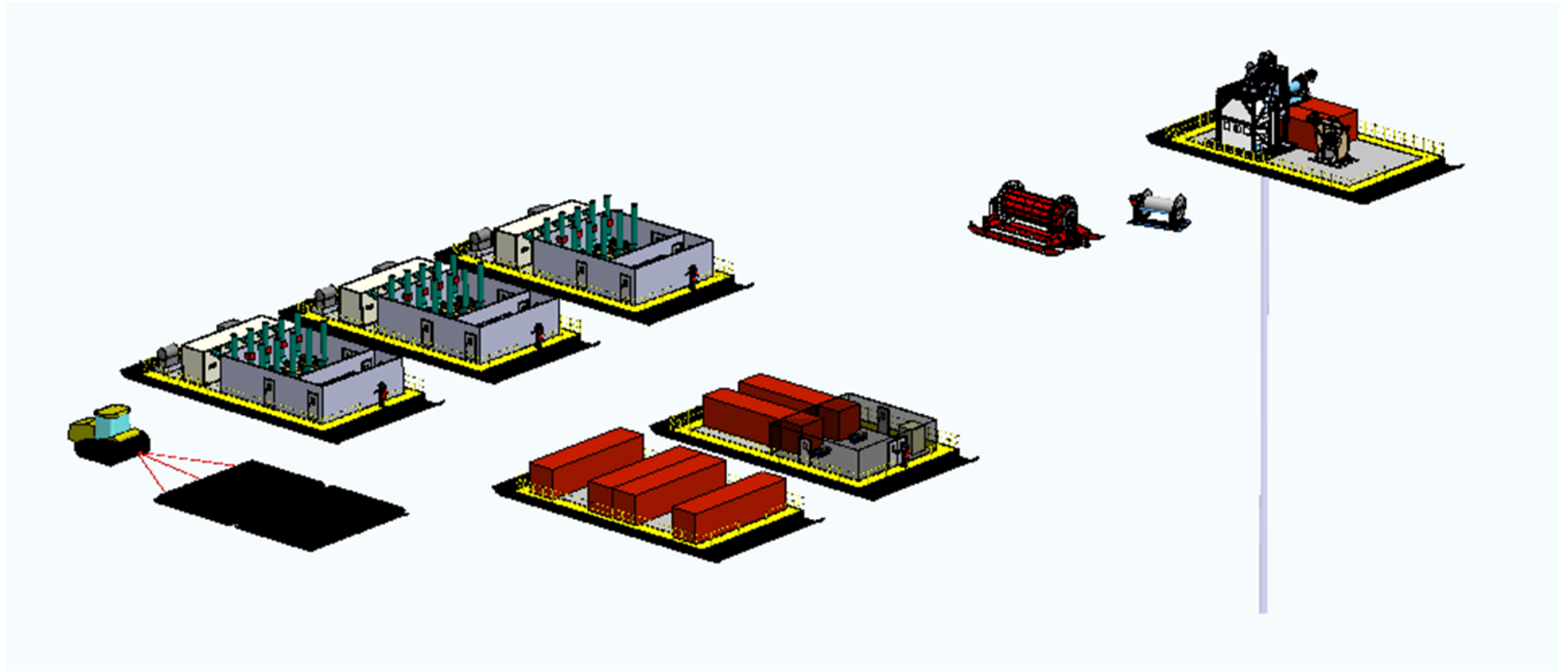
WD-G2 Overview

Mobile Power Plant
- Water storage and filtration
- Water pumping and heating
- Electricity generation
- Drill system hub
- Moves every ~7 holes

Condensed Tower Operations Site
- Deep drilling ops
- Deployment ops
- 1 big hose reel
- 2 sets of tower and reel assemblies
- Moves every hole

- Rigid deck on top of air bladders on top of PE panels
- Far superior to ski-based traverse designs
- In active development for high-payload traverses in Antarctic and Greenland
- Consult with expert Jim Lever, CRREL: EHWD-G2 ARCS-based concept is within feasible envelope and a "good idea"

EHWD-G2 Overview: Power Plant Sled

Electrical Closet

Electric Heater Bank

High Pressure Pumps

Exhaust Heat Exchangers

C1000 Microturbine

Fuel Daytank

Air-Ride Cargo Sled
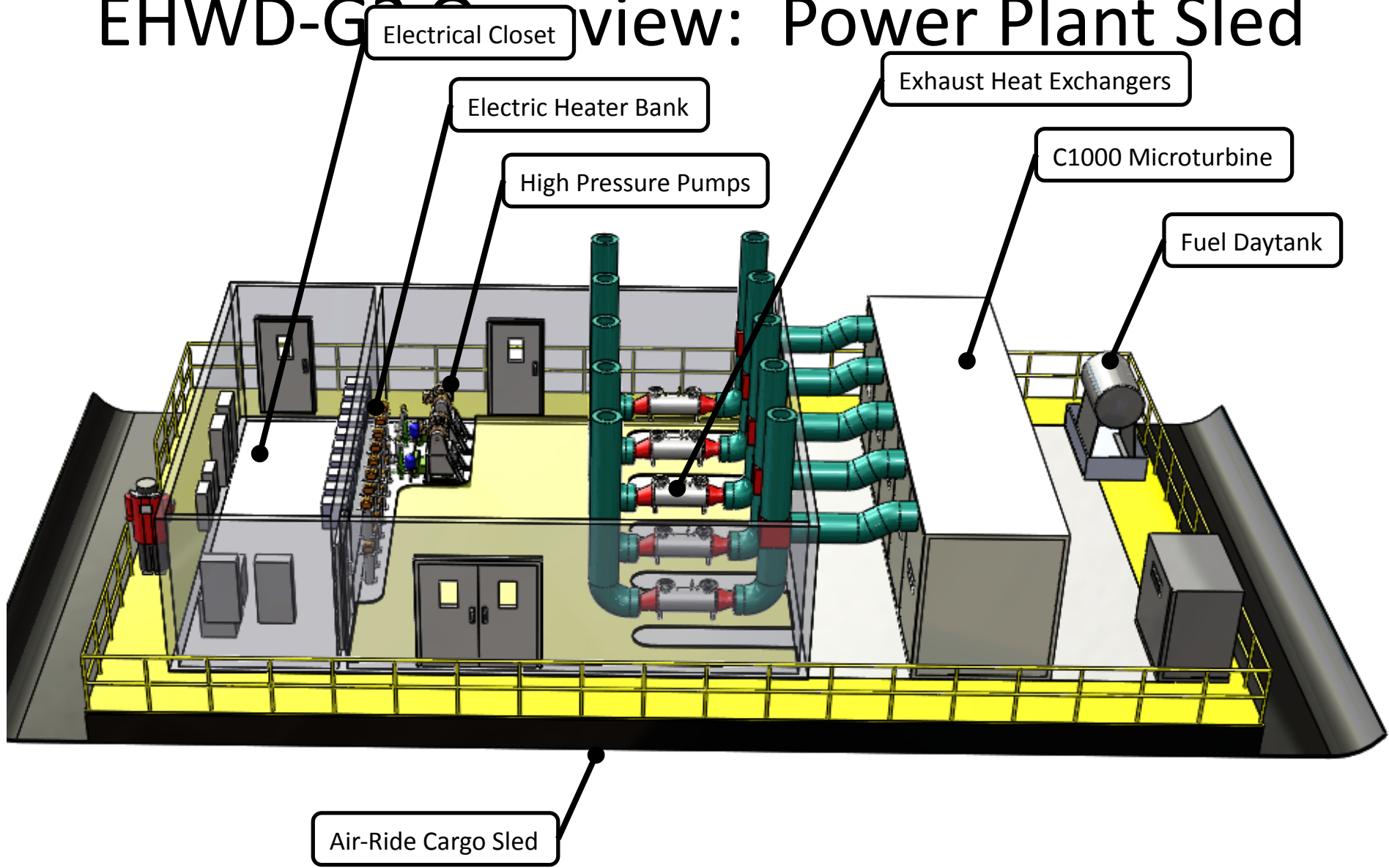
EHWD-G2: Preliminary Cost Estimate (Drill Build)

Equipment	$ 11M
Labor	$ 9M
Total	**$ 20M**

Gen2 Power

Auer, Cherwinka, DuVernois, Haugen, Karle, Kelley, Laundrie, & Sandstrom

UW-WIPAC & PSL

IceCube Bottoms Up Power

Component	Power / ea. (W)	Quantity	Total power (kW)
DOMs	5.7	5404	30.6
DOMHubs	128	97	12.4
Core servers	200	8	1.6
Data Acquisition and Control servers	250	6	1.5
Monitoring / Verification	200	5	1.0
Processing / Filtering master	270	1	0.27
Processing / Filtering slaves	300	20	6.0

Table 1: Power usage of key IceCube components. Total power usage is approximately 53 kW. Figures include efficiency and transmission losses.

Electrical power

- ICL currently consumes 63kW (maybe!)
- Aim for Gen2 DOM @ <2W/each
- Pre-filter part of DAQ will be similar
- So Gen2 is 40-50kW additional
- Benefit in not extracting that heat from hubs at top of strings, computing upgrades…
- Solar power, better HVAC, better transformers, coupled to station power upgrades, possible purchase of power for station…