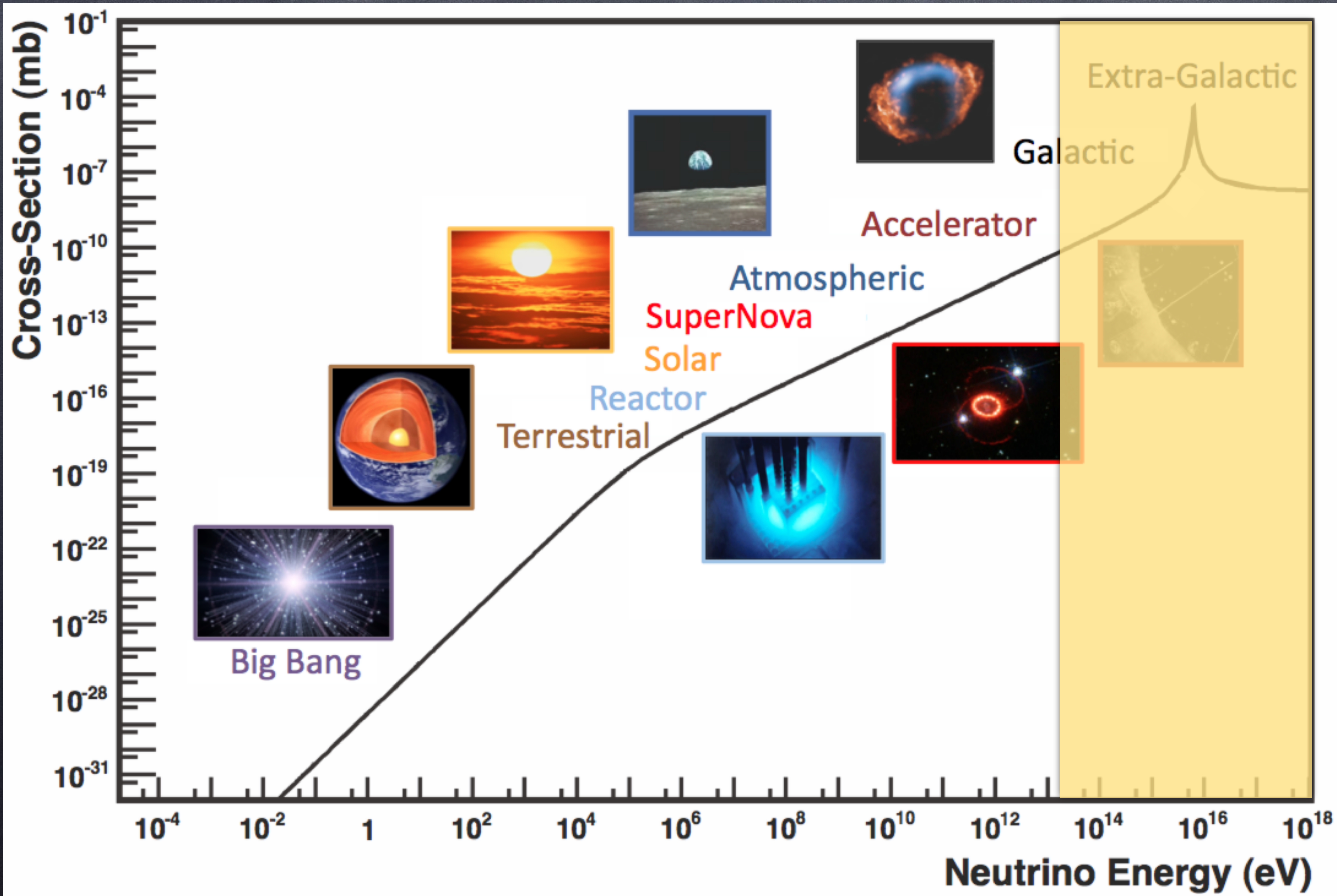
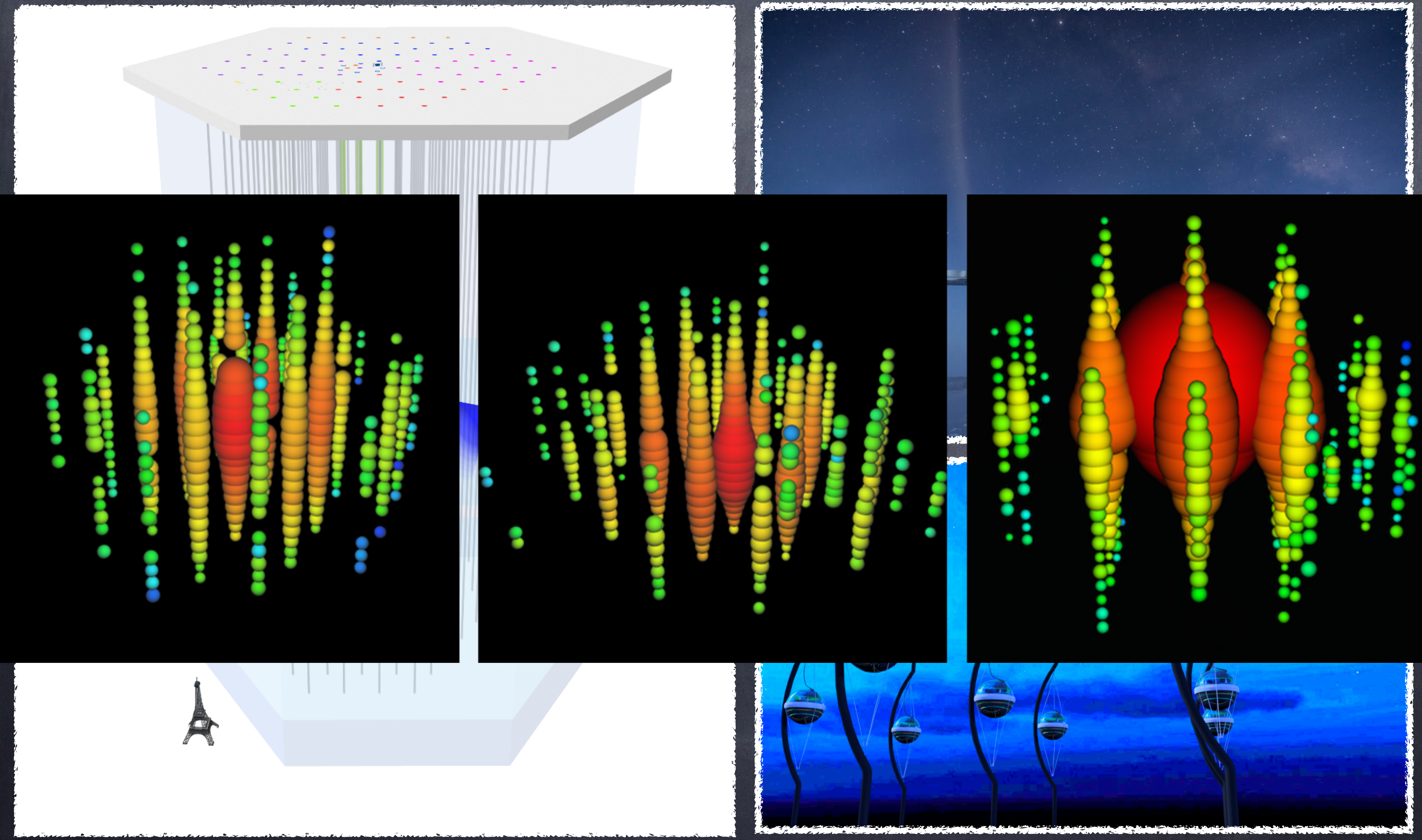
BAIKAL GVD

Status Report
February 21, 2019

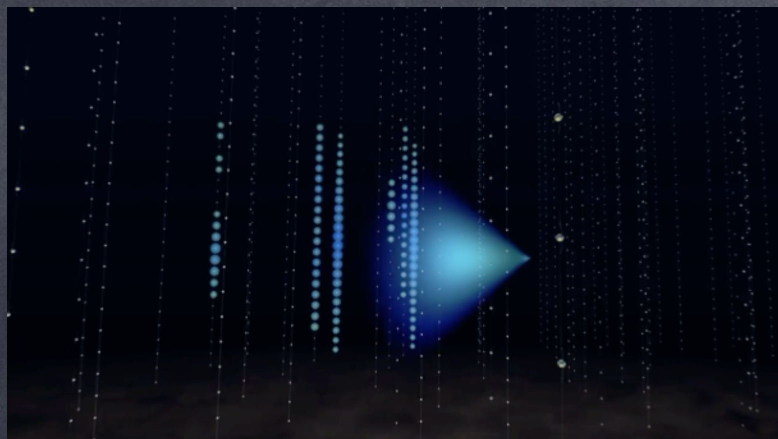
Neutrino Sources



Solar, SN1987A ... and finally astrophysical neutrinos @IceCube



Detection principles



Neutrino interactions

Muon track (ν_μ CC)

Shower
e, τ, hadrons in CC & NC

Cherenkov light

$\delta(\ln E_\mu) = 0.25$ Energy resolution $\delta(E_{sh}) = 0.1\text{-}0.2$

$\delta\theta = 0.3\text{-}0.5^o$ Angular resolution $\delta\theta = 2\text{-}3^o$

Why BAIKAL?

Light re-scattering in ice is large

Why BAIKAL?

Light re-scattering in BAIKAL water is small

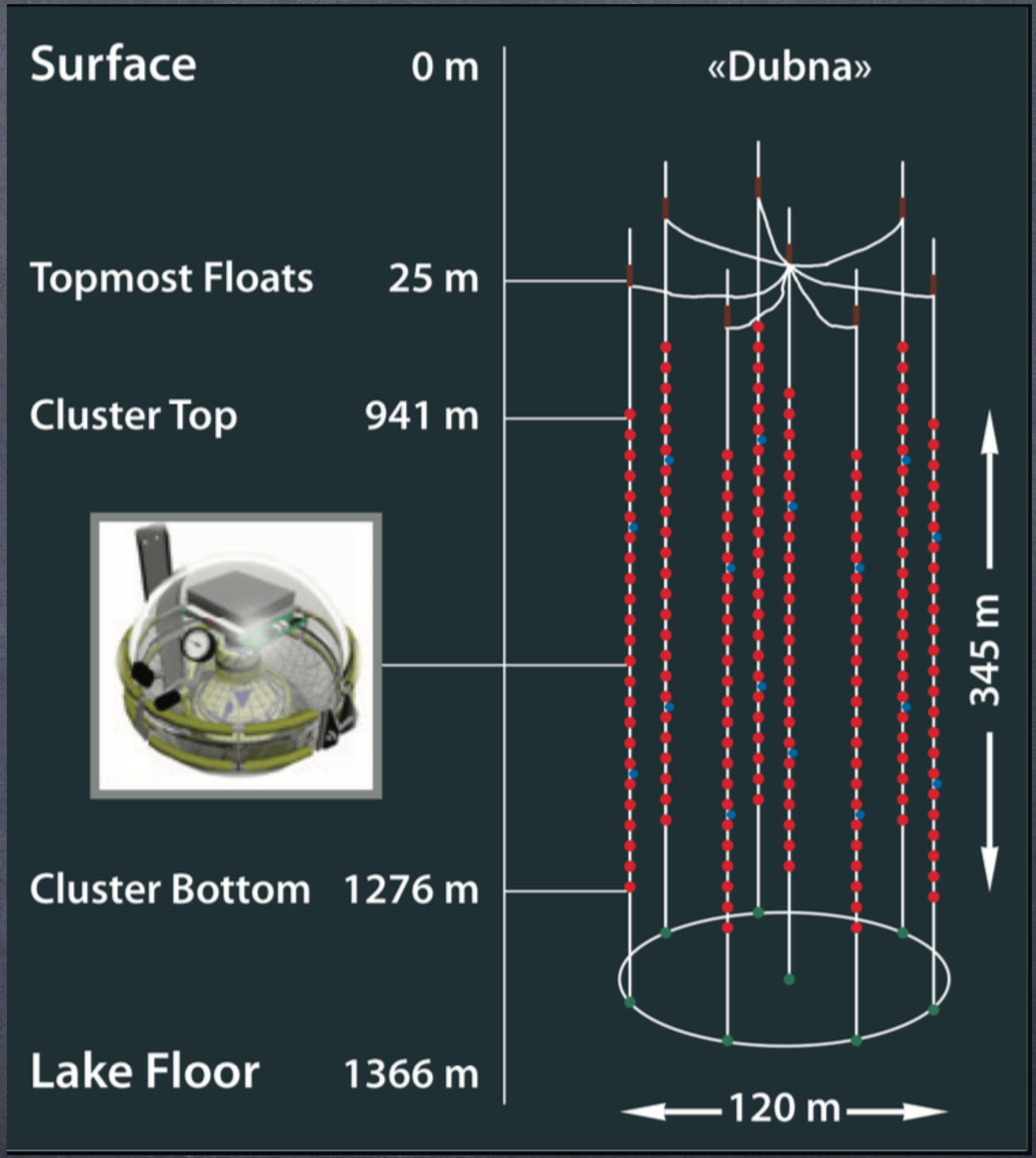
Why BAIKAL?

Experiment	Absorption Length, m	Scattering Length, m	Angular resolution muons	Angular resolution showers	Dark Rate, kHz
IceCube	40-150	0.4-2.4	0.5-1^{0}	15^{0}	0.3-0.6
KM3NET	50-70	30-60	0.2^{0}	2^{0}	30-50
BAIKAL GVD	22-25	30-50	0.3-0.5^{0}	2-3^{0}	15-30

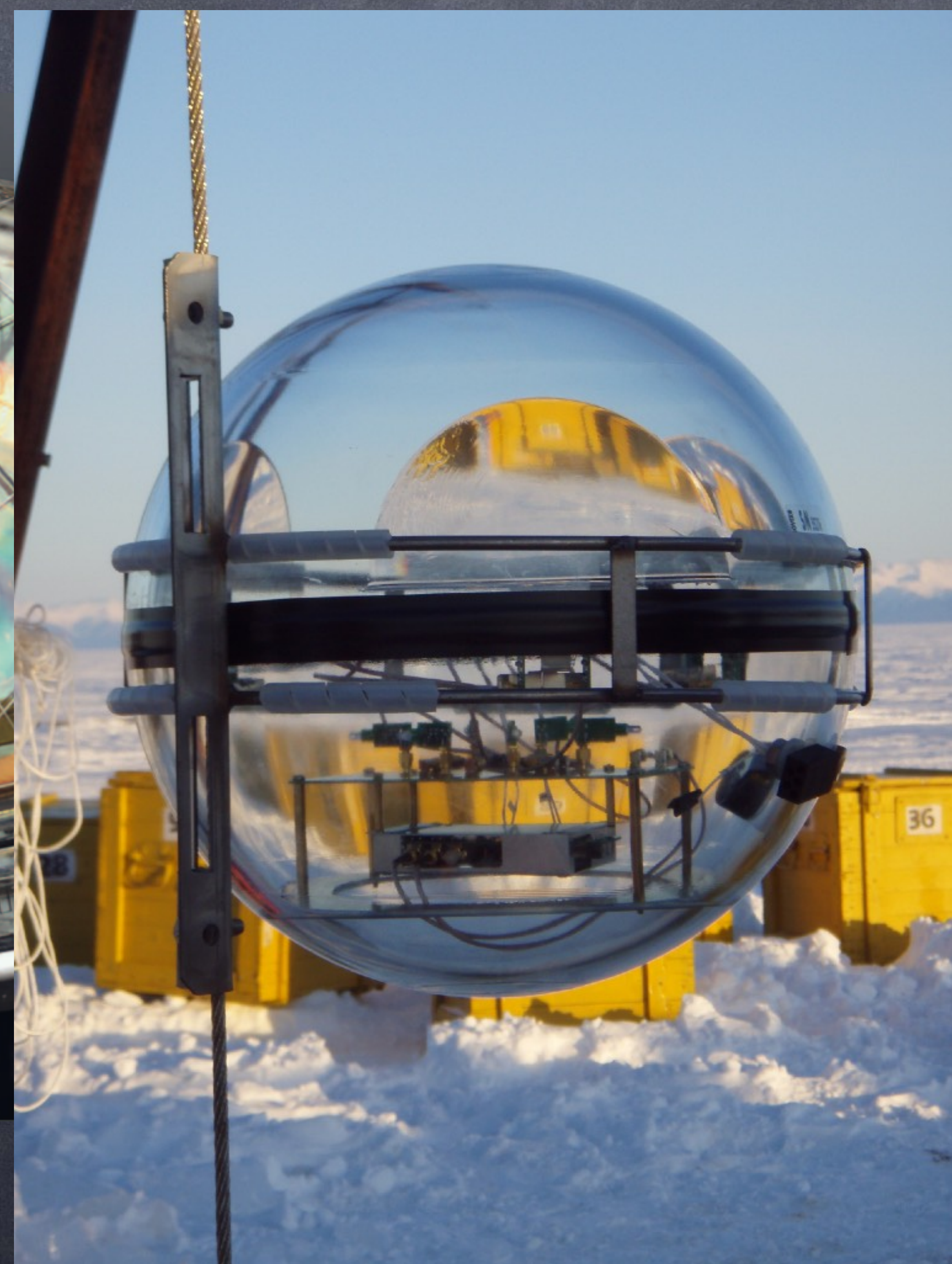
Sensitivity to Galaxy Center

The Plan

- Main Goal
  - Point sources of UHE neutrino
- 3D Array of photo-sensors
  - Phase I: 0.4 km3 (by 2021)
  - Phase II: 1.5 km3 (by 2027)
- Installation site
  - South Baikal
  - Depth 1.4 km
  - Distance from shore 3.5 km
- Requirements
  - Adjustable structure
  - Synchronization < 1ns



Baikal Optical Module (OM)



OM assembling hall @DLNP JINR

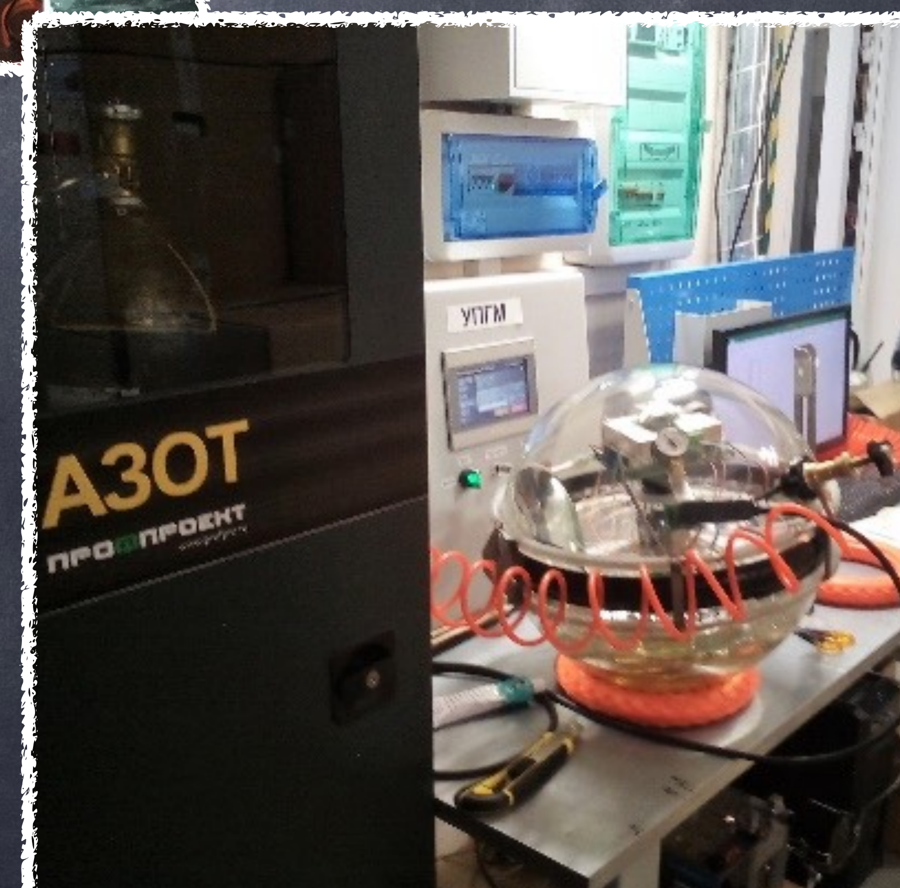
12 OM/day

JINR facilities

Vacuuming

Full testing

Nitrogen drying



DAQ testing @INR

Long-term testing @JINR

- Long term tests
- All cluster components
- Full power load

Infrastructure upgrade

@SITE

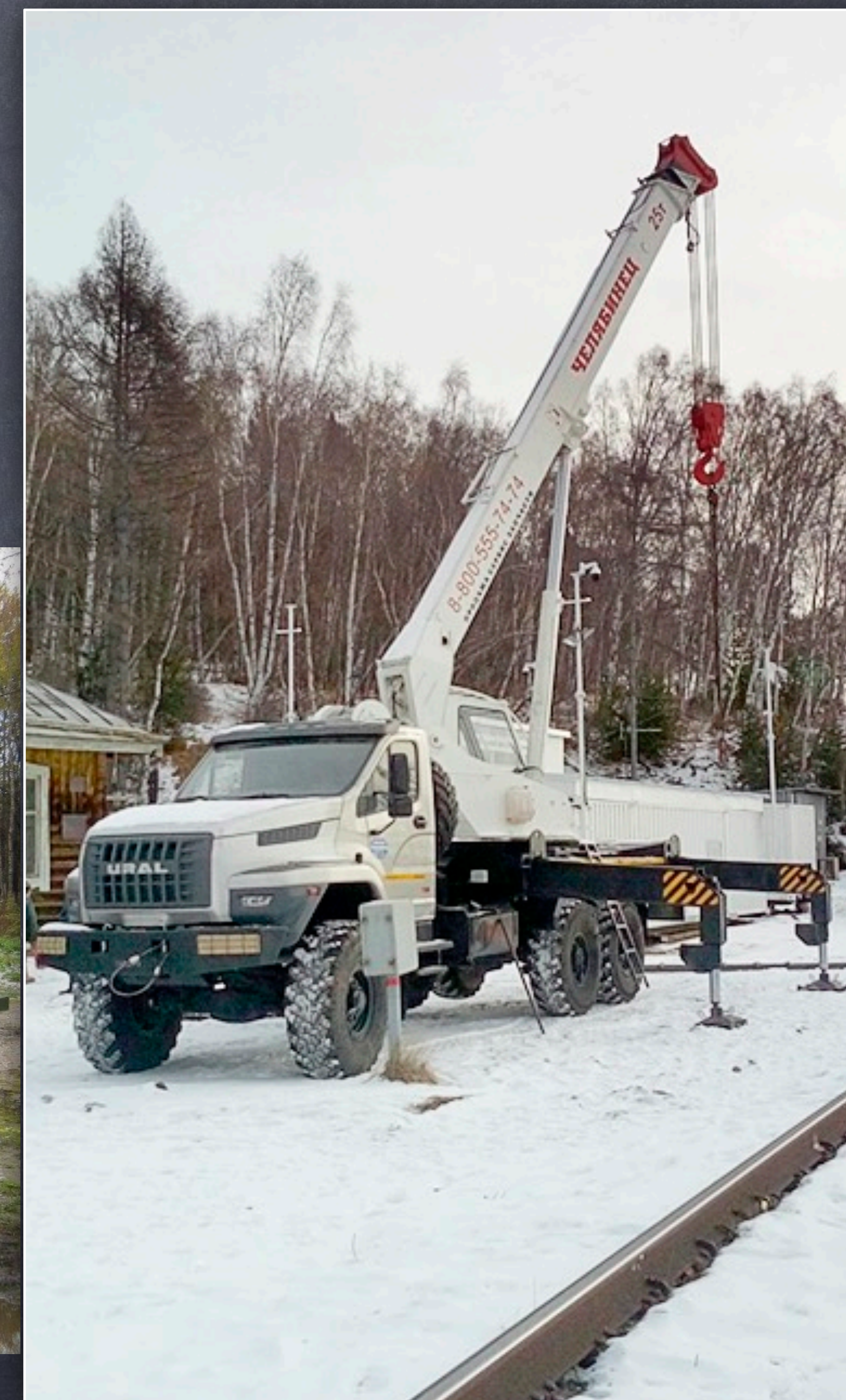
New data taking center

Purchased storage building @ Baikalsk

New shore lab

New living boxes

@SITE
Transportation issues solved



Plans @SITE

Canteen

Restore Houses

Sewage & Water supply

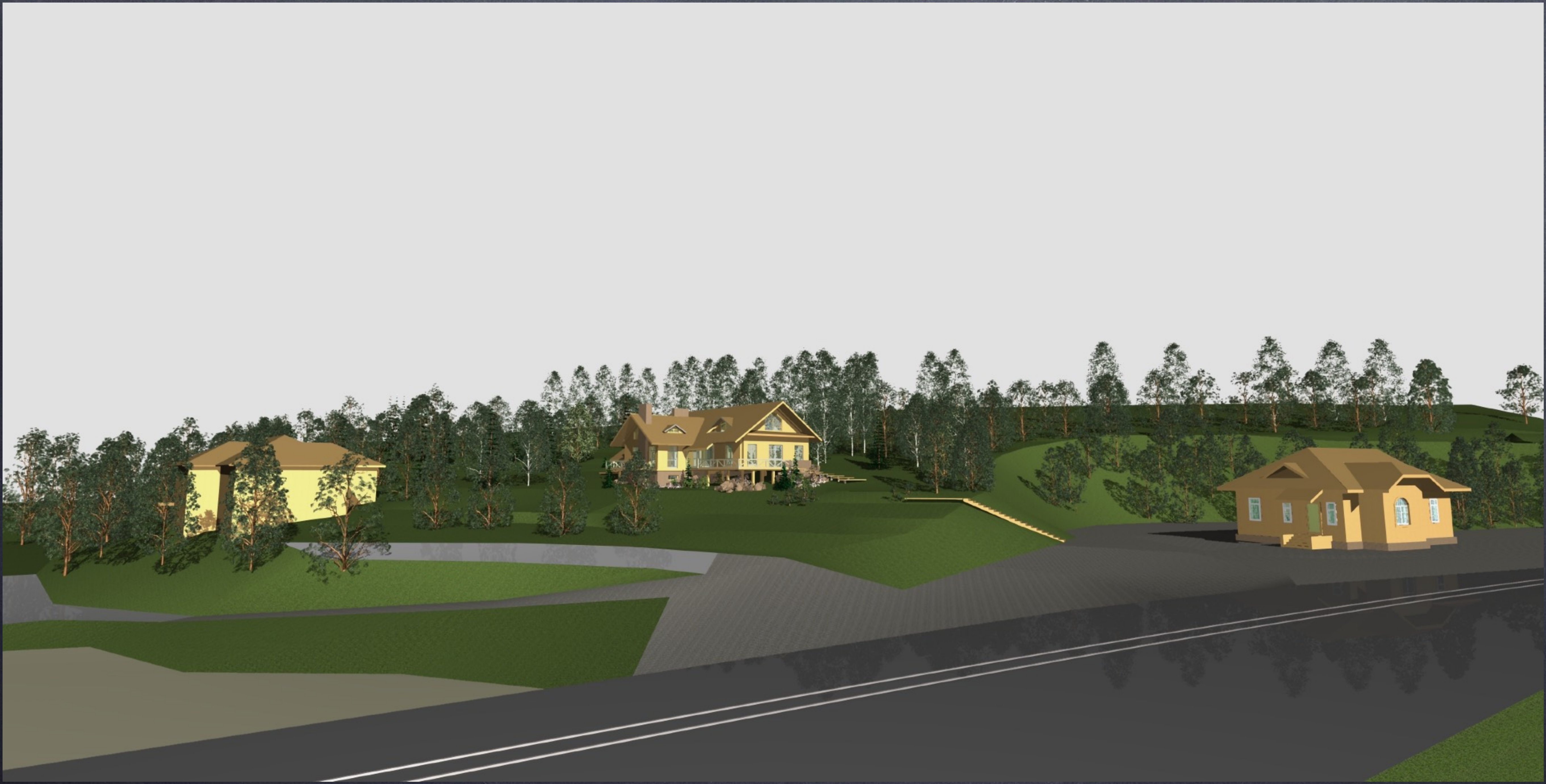
Cable channel

Rennovate Houses

Pier for 2 boats

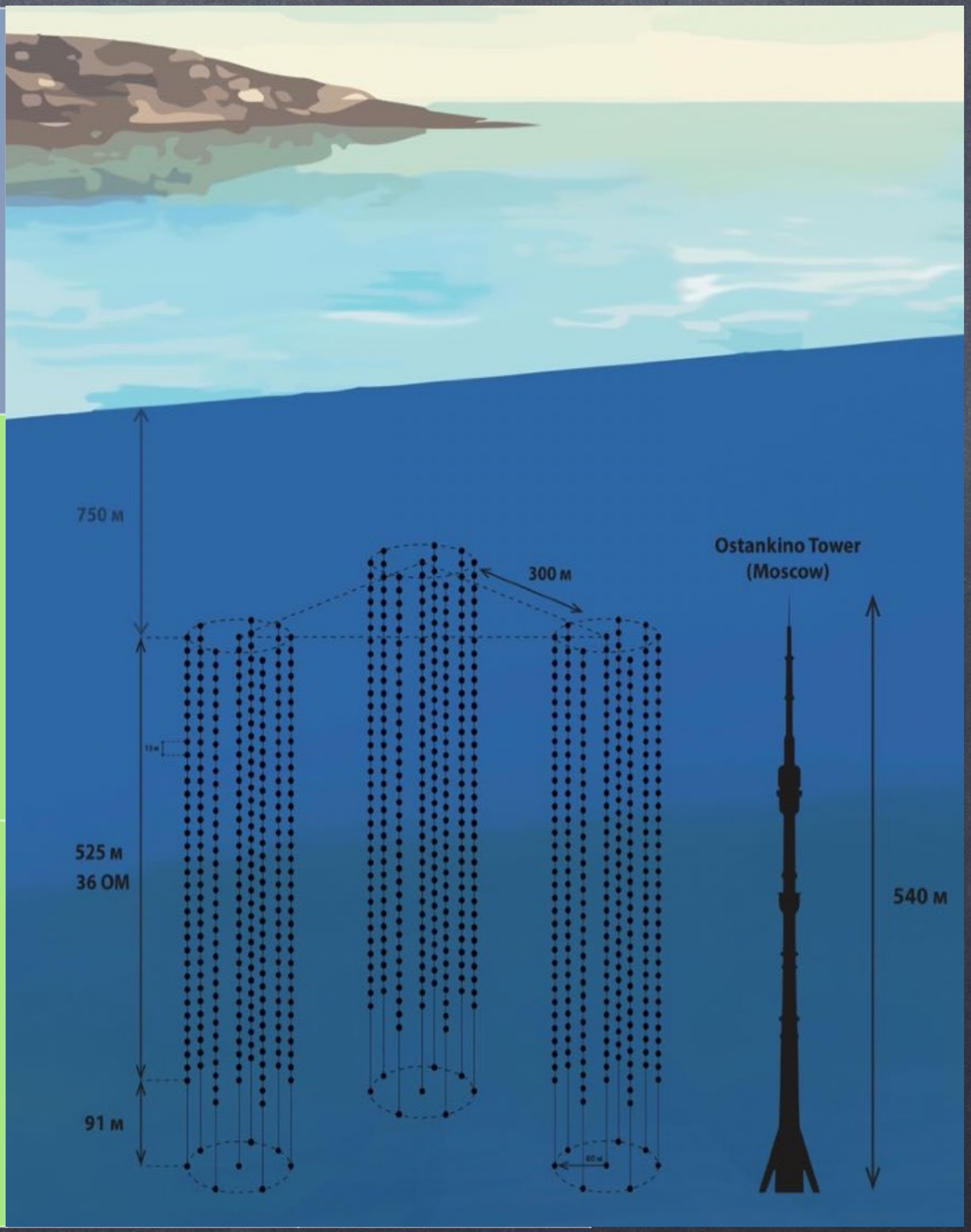
Property

Design view @ 106 km



Deployment status

	2015	2016	2017	2018
Number of clusters	≤1	1	2	3
Number of OM	192	288	576	864



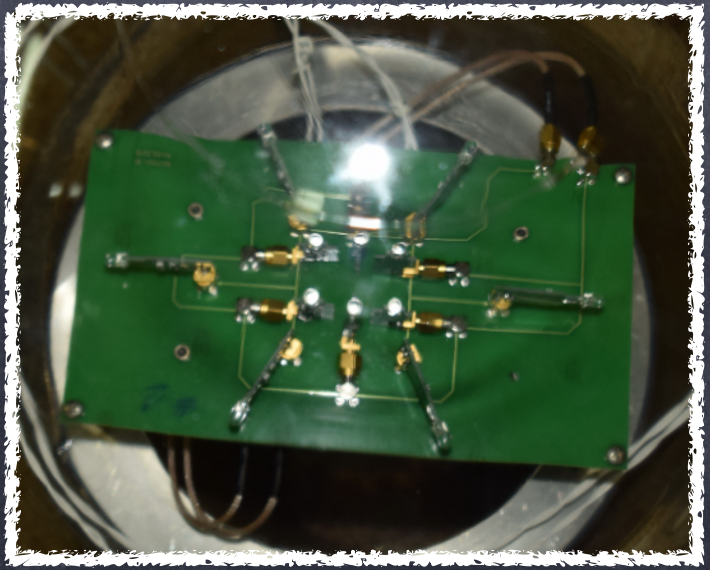
The largest Neutrino Telescope in Northern hemisphere

Detector performance

- Position of OMs
  - Acoustic system (few cm)

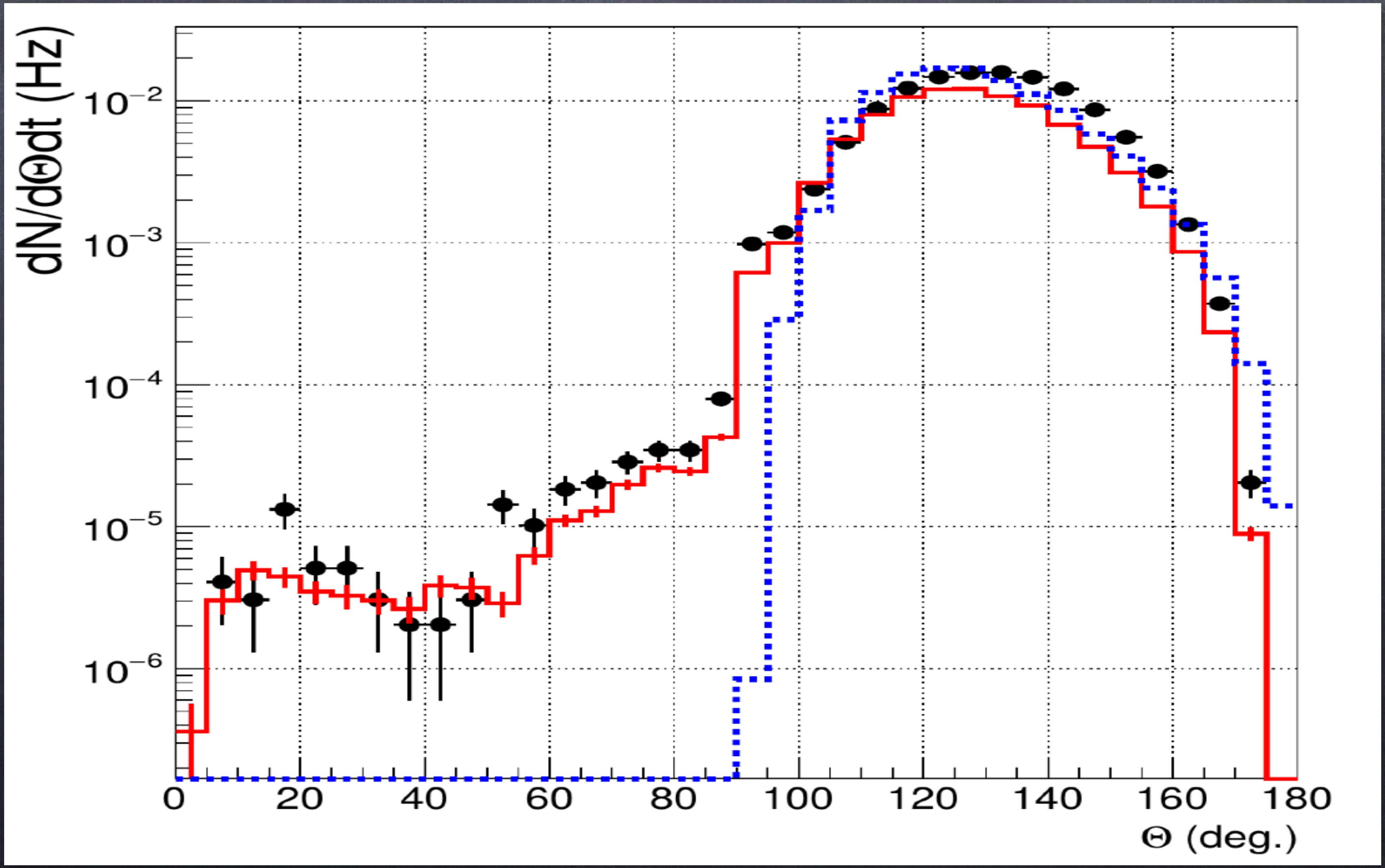
- Time synchronization between OMs @same cluster &between clusters
  - Laser
  - LED matrix

  } 1-2 ns

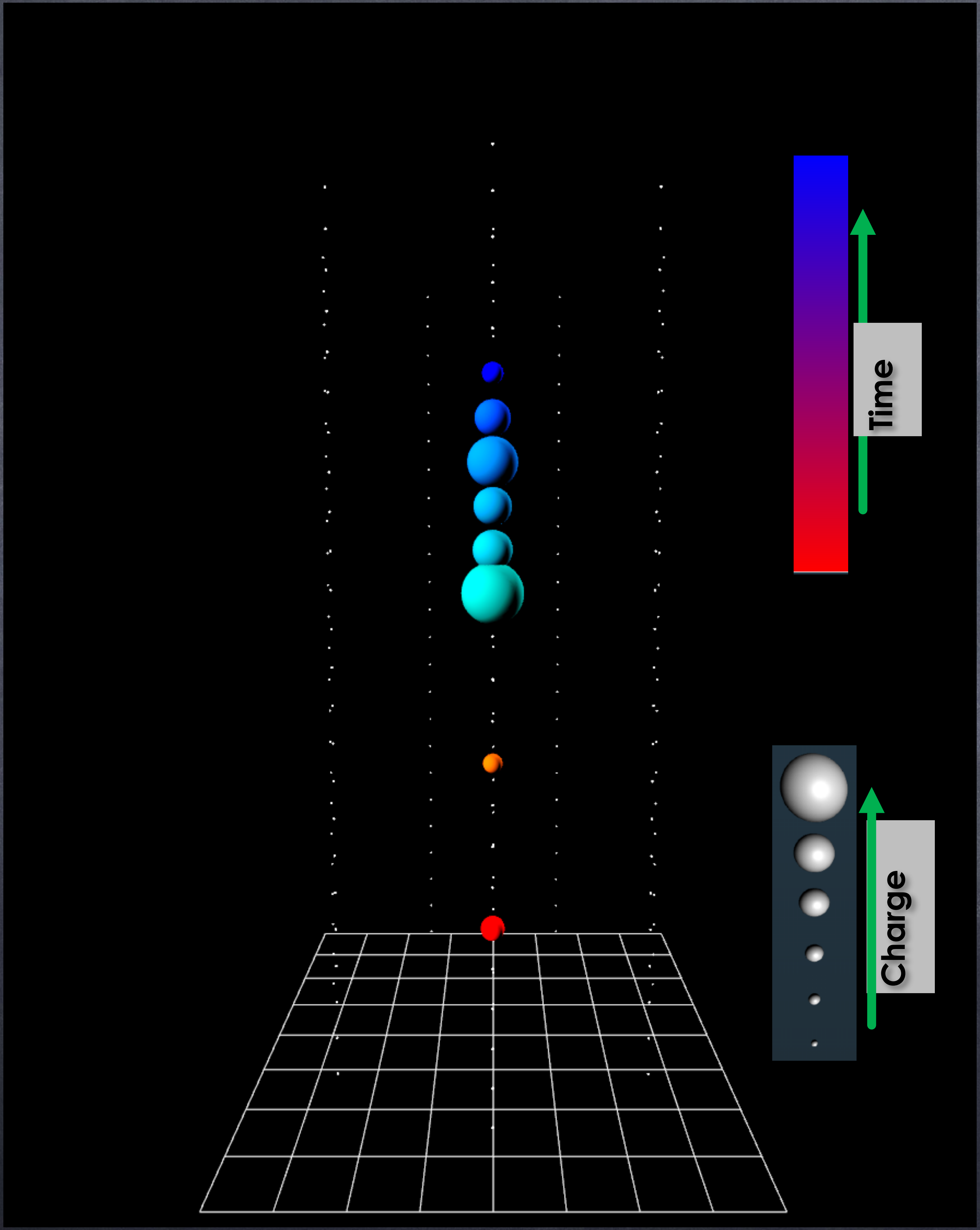


Physics

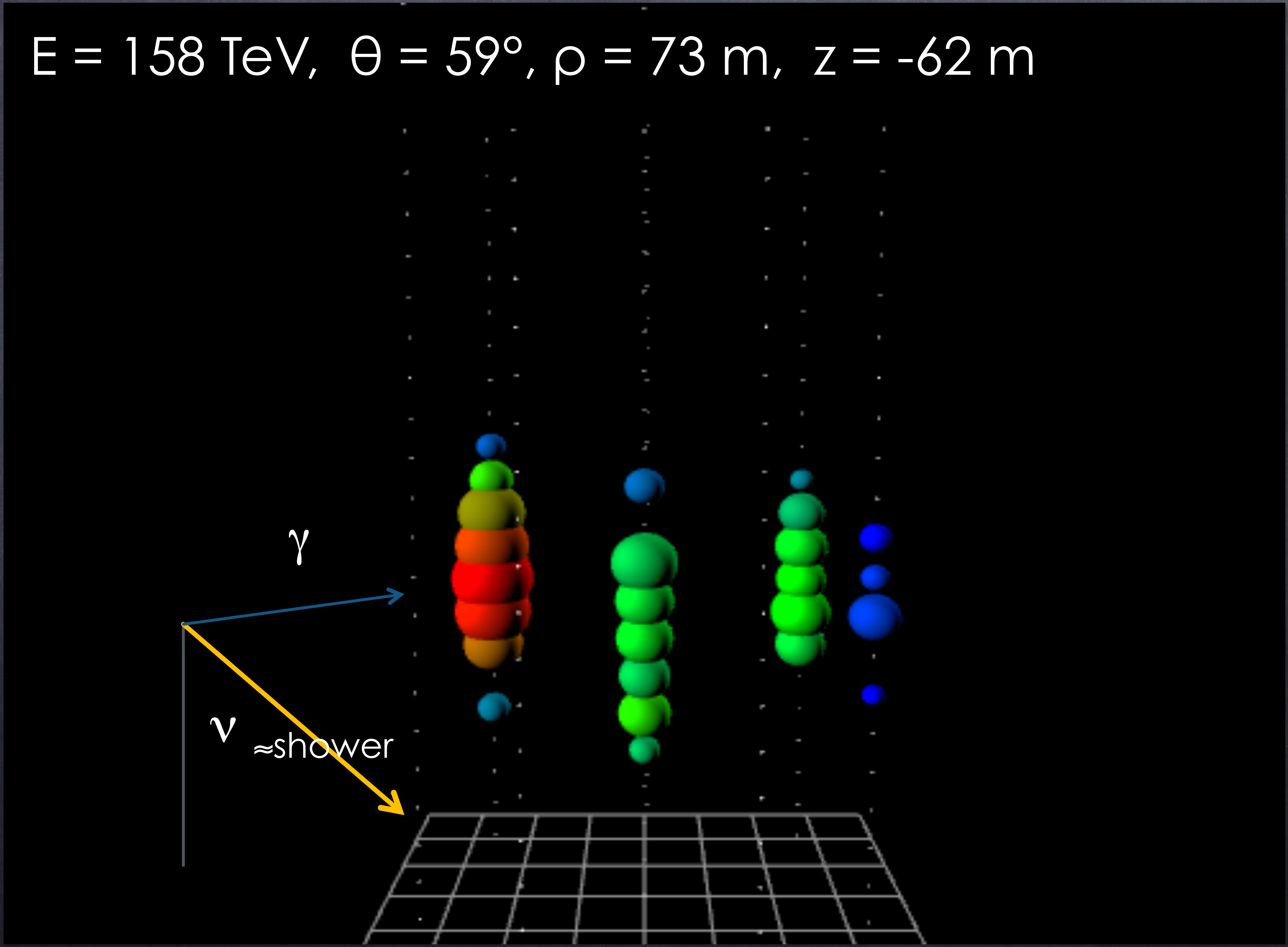
Reconstructed zenith angle Distribution of muons



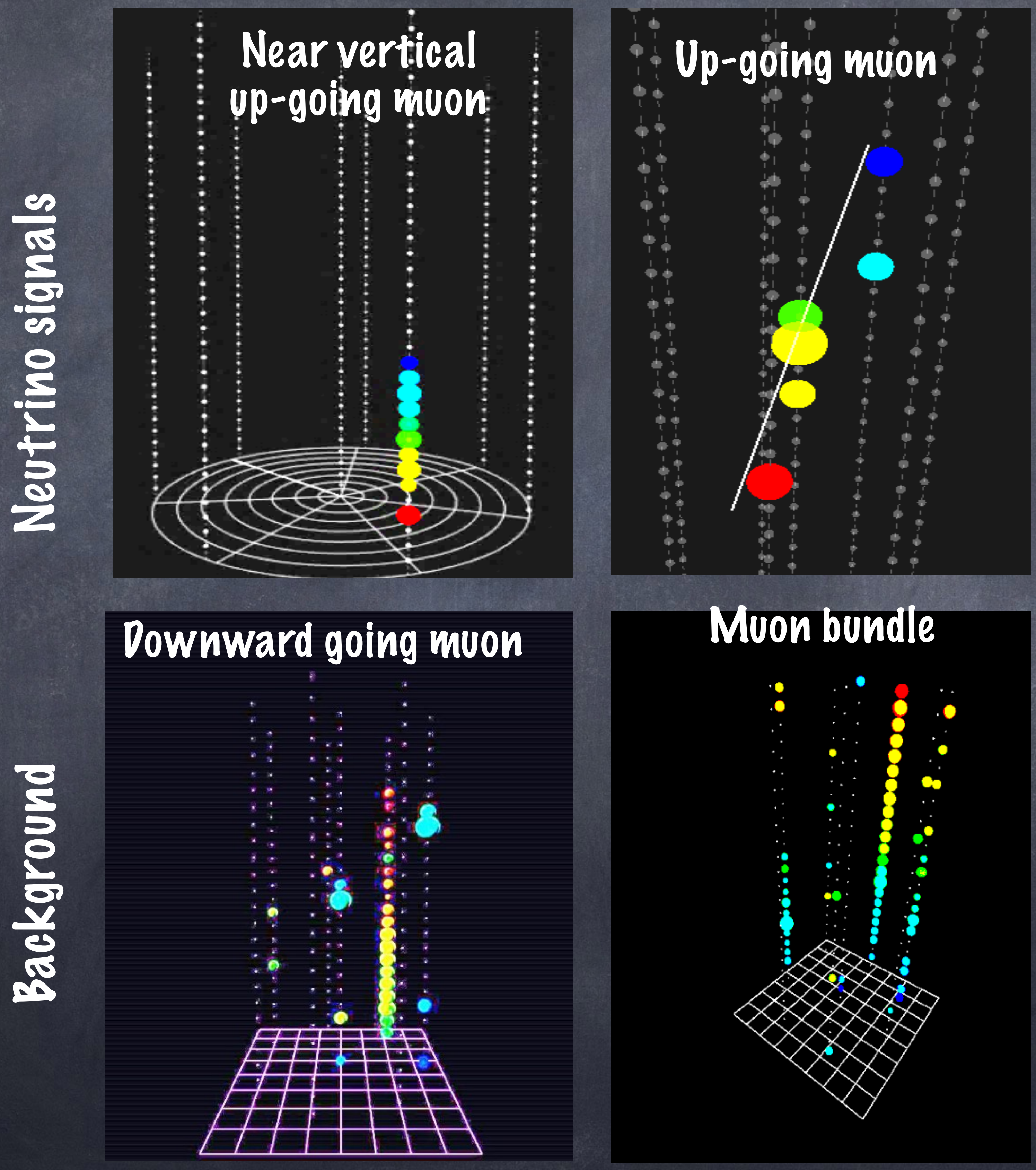
#3101111 - ν candidate



Neutrino candidate



Spectacular events



New forces for MC & Data Analyses

- From end of 2018 D. V. Naumov joined the group of MC development & Data analyses
- A dedicated group is under construction. Expect at least three postdocs and many students in 2019 to join us.

BAIKAL Collaboration

65 physicist & Engeneers

1. Institute for Nuclear Research, Moscow, Russia
2. Joint Institute for Nuclear Research, Dubna, Russia
3. Irkutsk State University, Irkutsk, Russia
4. Skobeltsyn Institute of Nuclear Physics MSU, Moscow, Russia
5. Nizhny Novgorod State Technical University, Russia
6. Saint Petersburg State Marine University, Russia
7. Institute of Experimental and Applied Physics, Czech Technical University, Prague, Czech Republic
8. Comenius University, Bratislava, Slovakia
9. EvoLogics GmbH, Berlin, Germany
10. Krakow Institute of Nuclear Physics PAN, Poland

Main publications for 2015-2018 years.

1. A. Avrorin (Moscow, INR) et al., The optical module of Baikal-GVD, Phys.Part.Nucl.Lett. 13 (2016) no.6, 737-746
2. A. Avrorin et al., Dark matter constraints from an observation of dSphs and the LMC with the Baikal NT200, Published in JETP Vol. 152 (7) (2017) – results in PDG2017
3. A. Avrorin et al., Data acquisition system for the Baikal-GVD neutrino telescope, Phys.Part.Nucl. 47 (2016) no.6, 933-937
4. A. Avrorin et al., Neutrino signal at Baikal from dark matter in the Galactic Center, Phys.Part.Nucl. 47 (2016) no.6, 926-932
5. A. Avrorin et al., Baikal-GVD: first cluster Dubna, PoS EPS-HEP2015 (2015) 418
6. A. Avrorin et al., Search for neutrino emission from relic dark matter in the Sun with the Baikal NT200 detector, Astropart.Phys. 62 (2015) 12-20
7. A.Avrorin et al, (Baikal collaboration), "Search for high-energy neutrinos from GW170817 with Baikal-GVD neutrino telescope", Pis'ma v ZhETF(2018) (in press)
8. A.Avrorin et al, (Baikal collaboration), "Baikal-GVD – neutrino telescope of the next generation", Bulletin of the Russian Academy of Sciences, 2018 (in press)A.Avrorin et al, (Baikal collaboration), "Search for high-energy neutrinos from GW170817 with Baikal-GVD neutrino telescope", Pis'ma v ZhETF(2018) (in press)
9. A.Avrorin et al, (Baikal collaboration), "Baikal-GVD – neutrino telescope of the next generation", Bulletin of the Russian Academy of Sciences, 2018 (in press)

PHD theses:

1. Avrorin A.D. Muons registration with deep underwater neutrino telescope Baikal-GVD, Moscow, 2016
2. Kuleshov D.A. The DAQ system of the telescope NT1000, Moscow, 2014
3. Sheifler A.A. Optical module of the Baikal deep underwater neutrino telescope Baikal-GVD (development and testing of the detecting system), Moscow, 2016

The most romantic experiment ever