

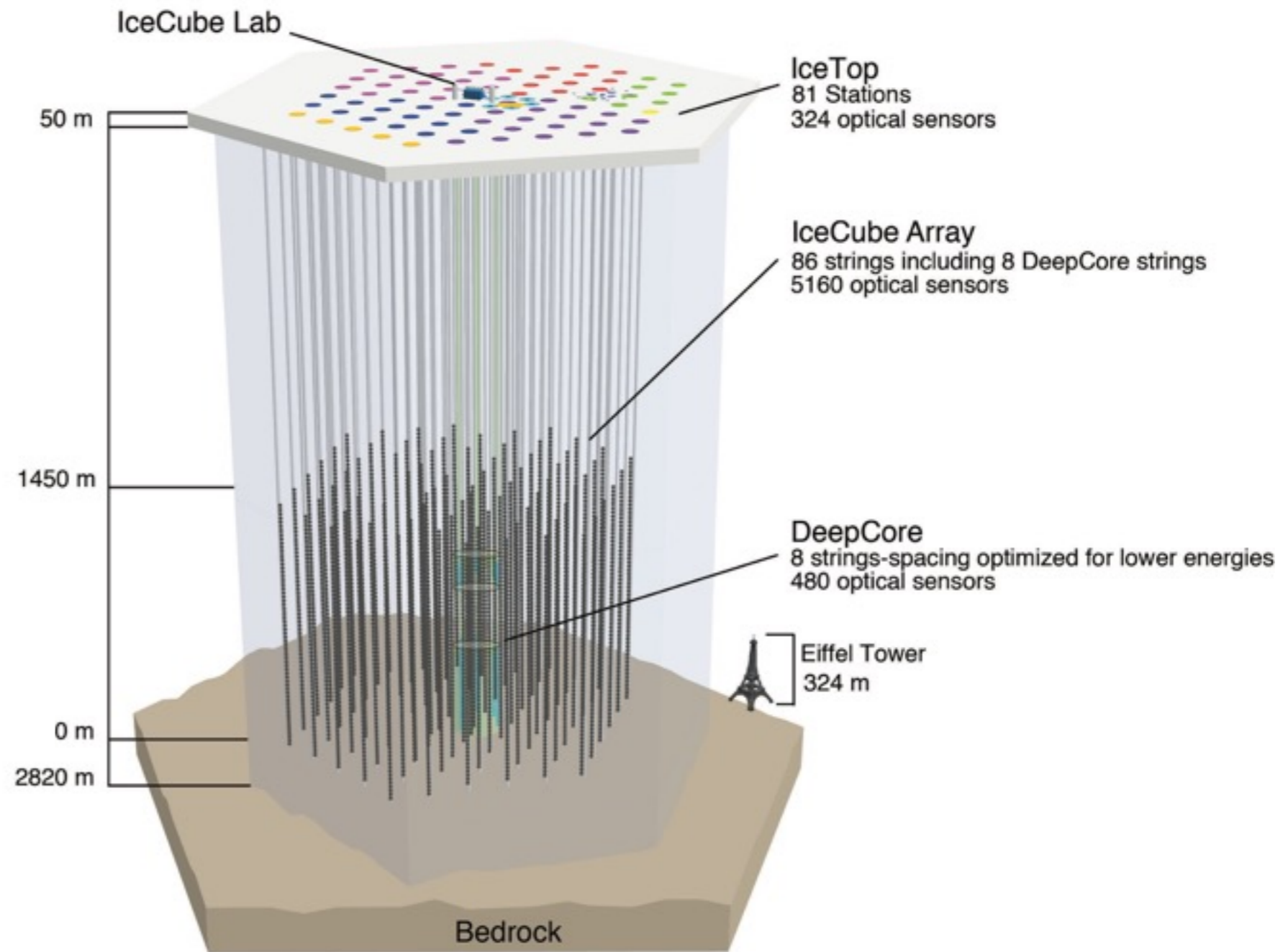
# IceCube Gen2/Phase 1

Ken Clark  
SNOLAB



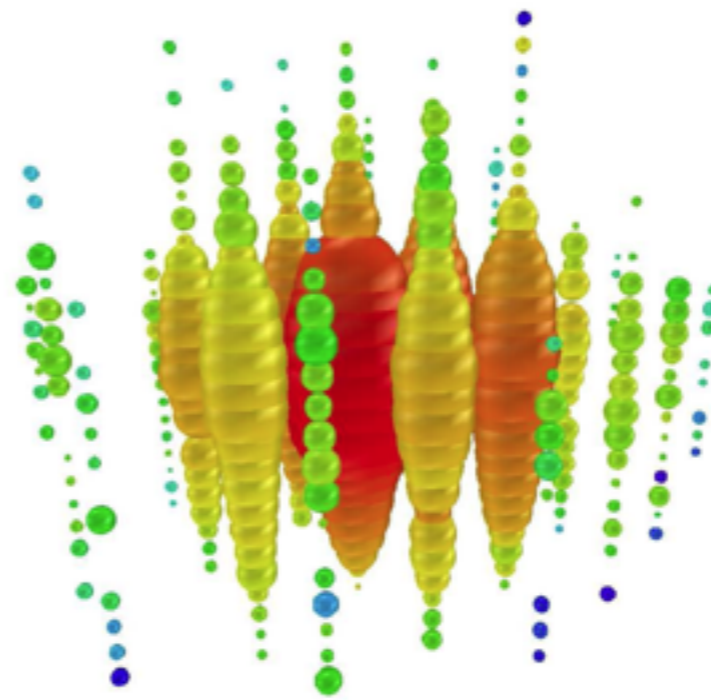
# IceCube - The Past

- Designed to look for high energy neutrinos

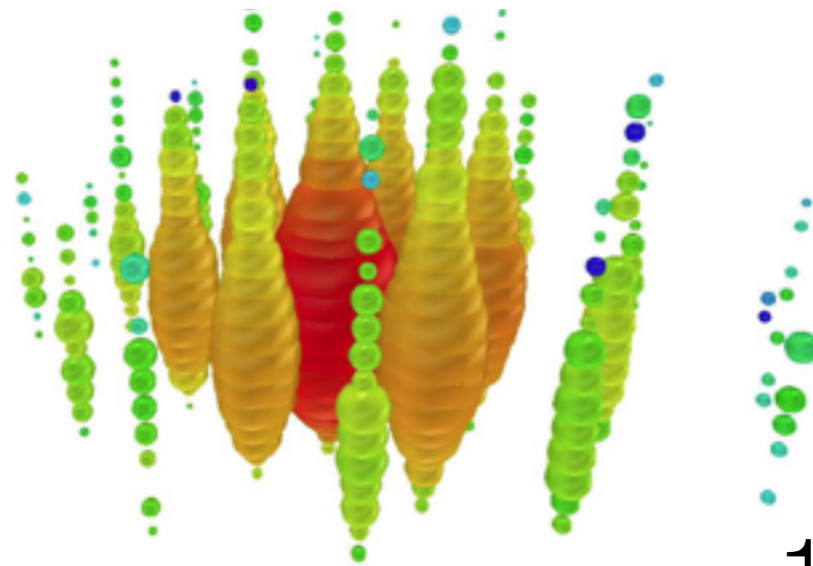


# IceCube - The Past

- Designed to look for high energy neutrinos
- Mission Accomplished



$1.04 \pm 0.16$  PeV

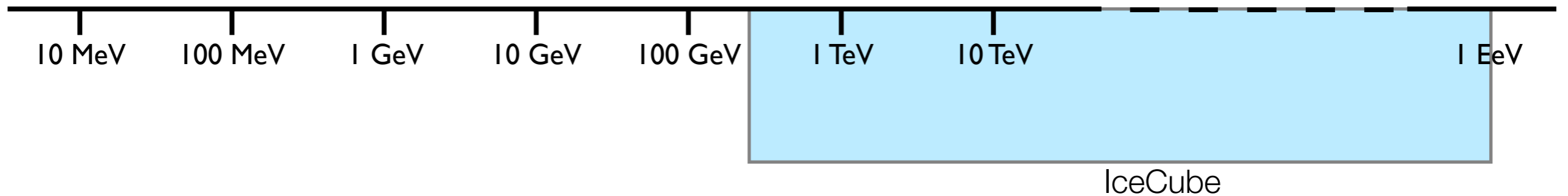
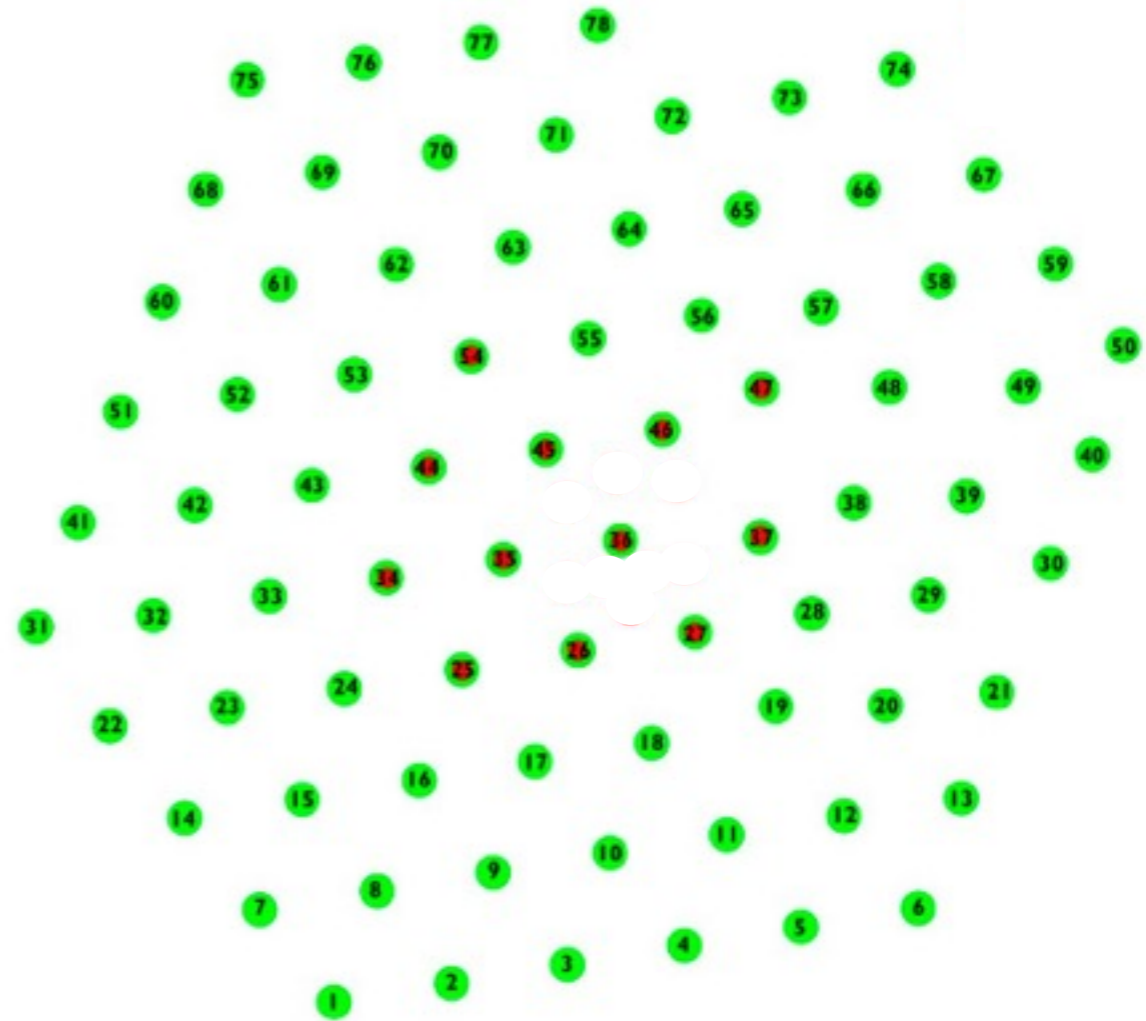


$1.14 \pm 0.17$  PeV

(Covered well in Claudio's talk)

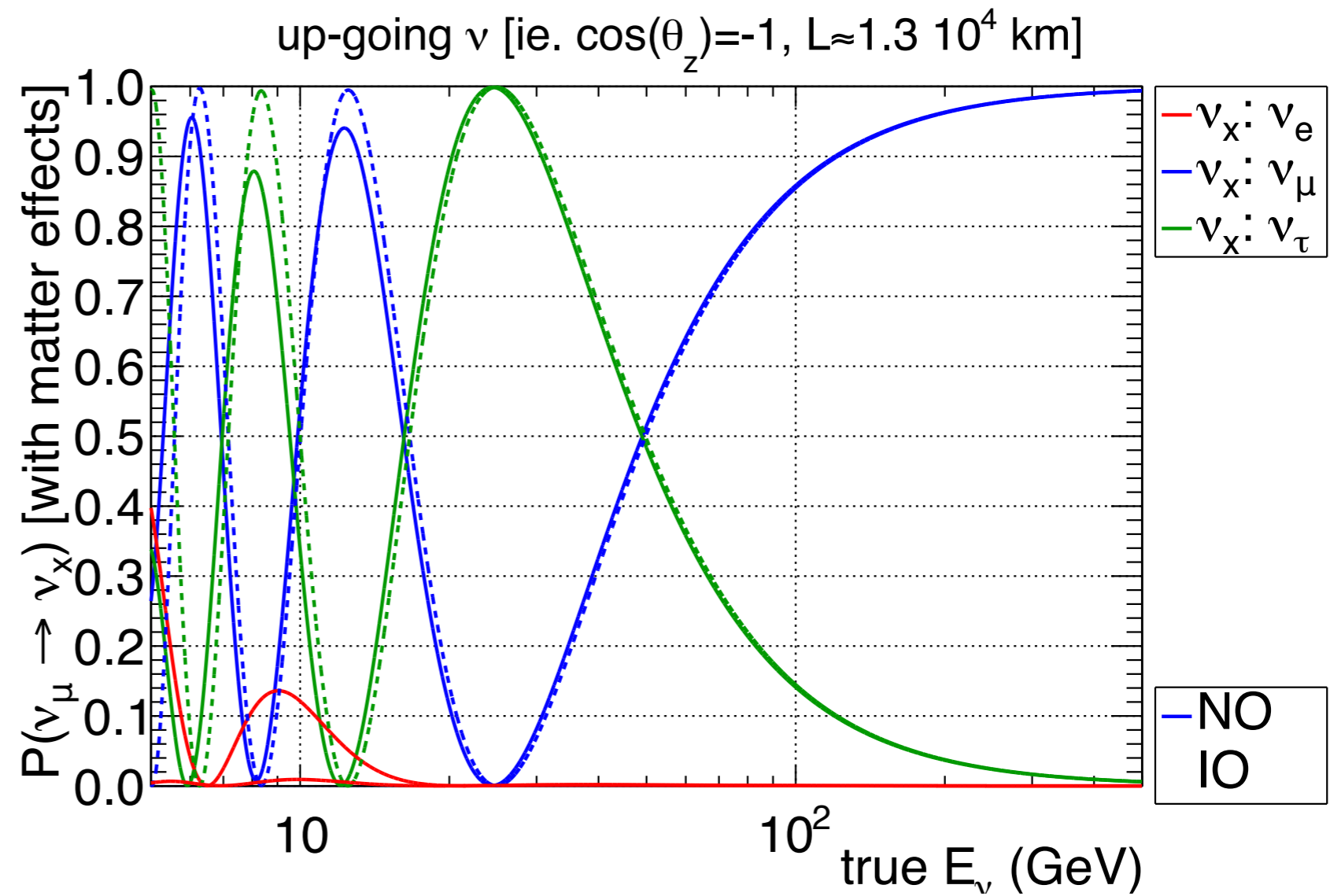
# IceCube

- 78 Strings
- 125m string spacing
- 17m DOM spacing



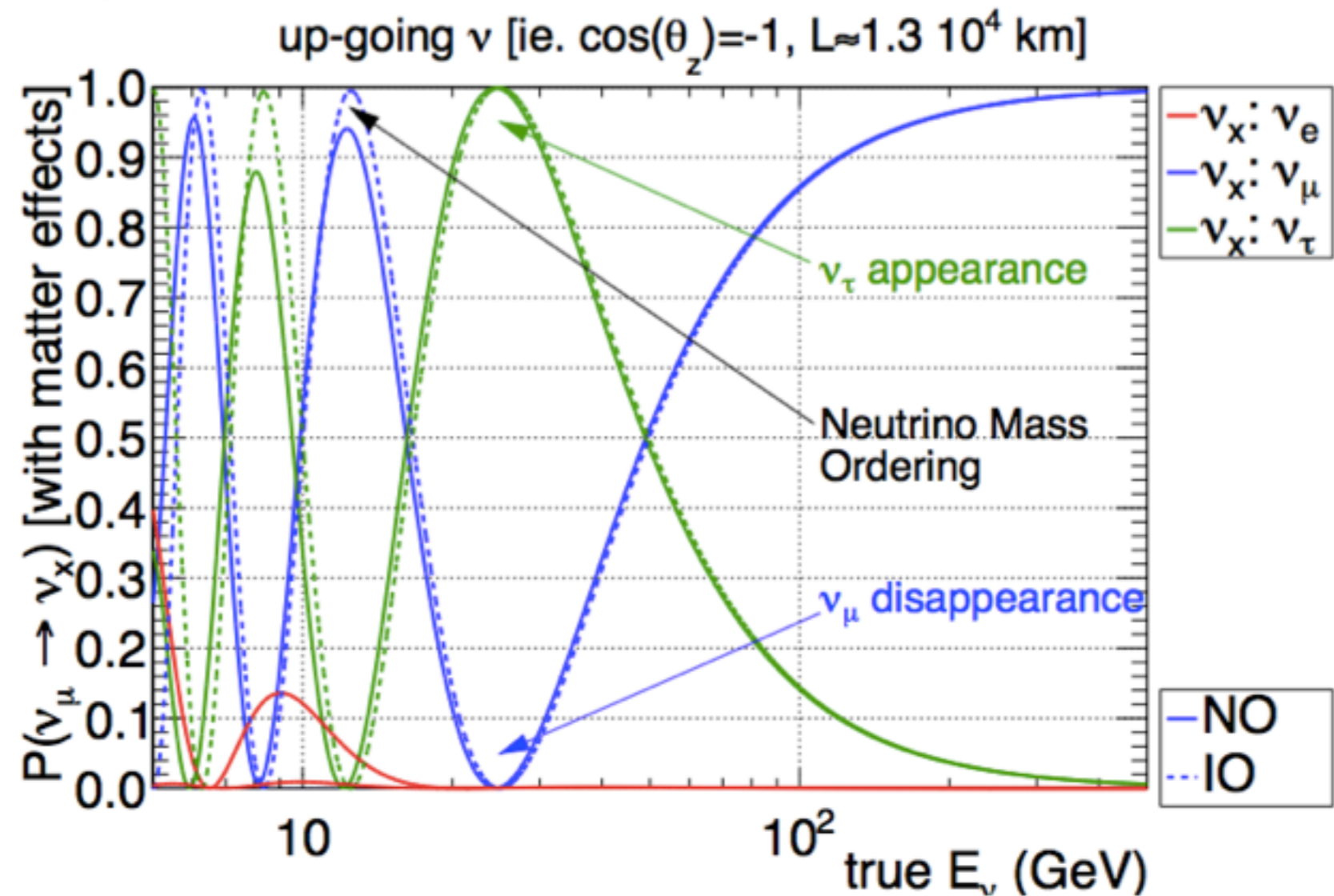
# Can we do anything else?

- A great deal of IceCube's success has come in the search for rare events
- Things become interesting at slightly lower energy...



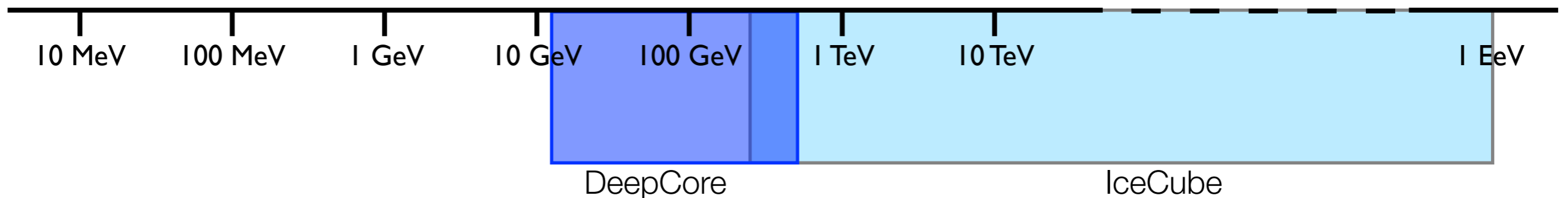
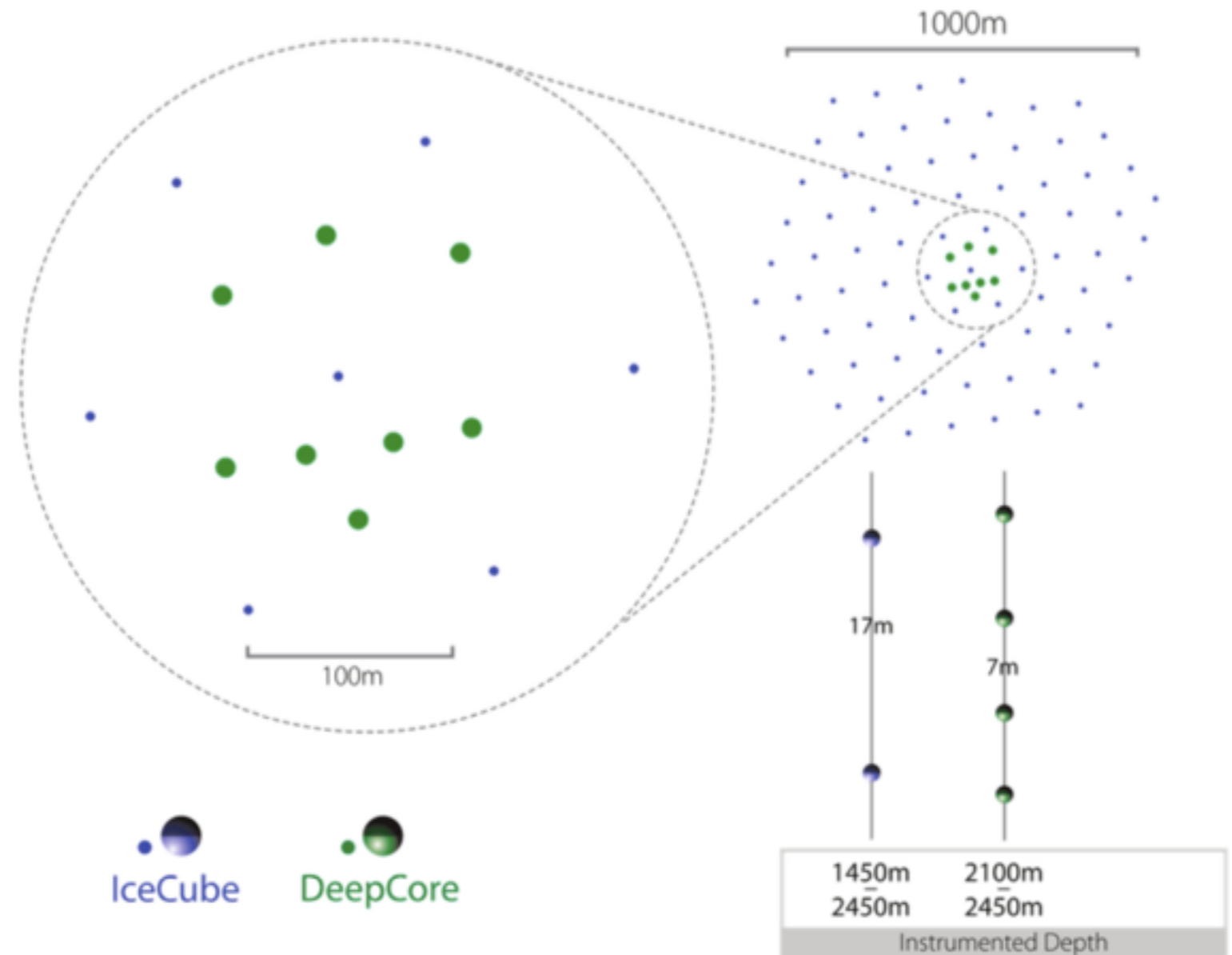
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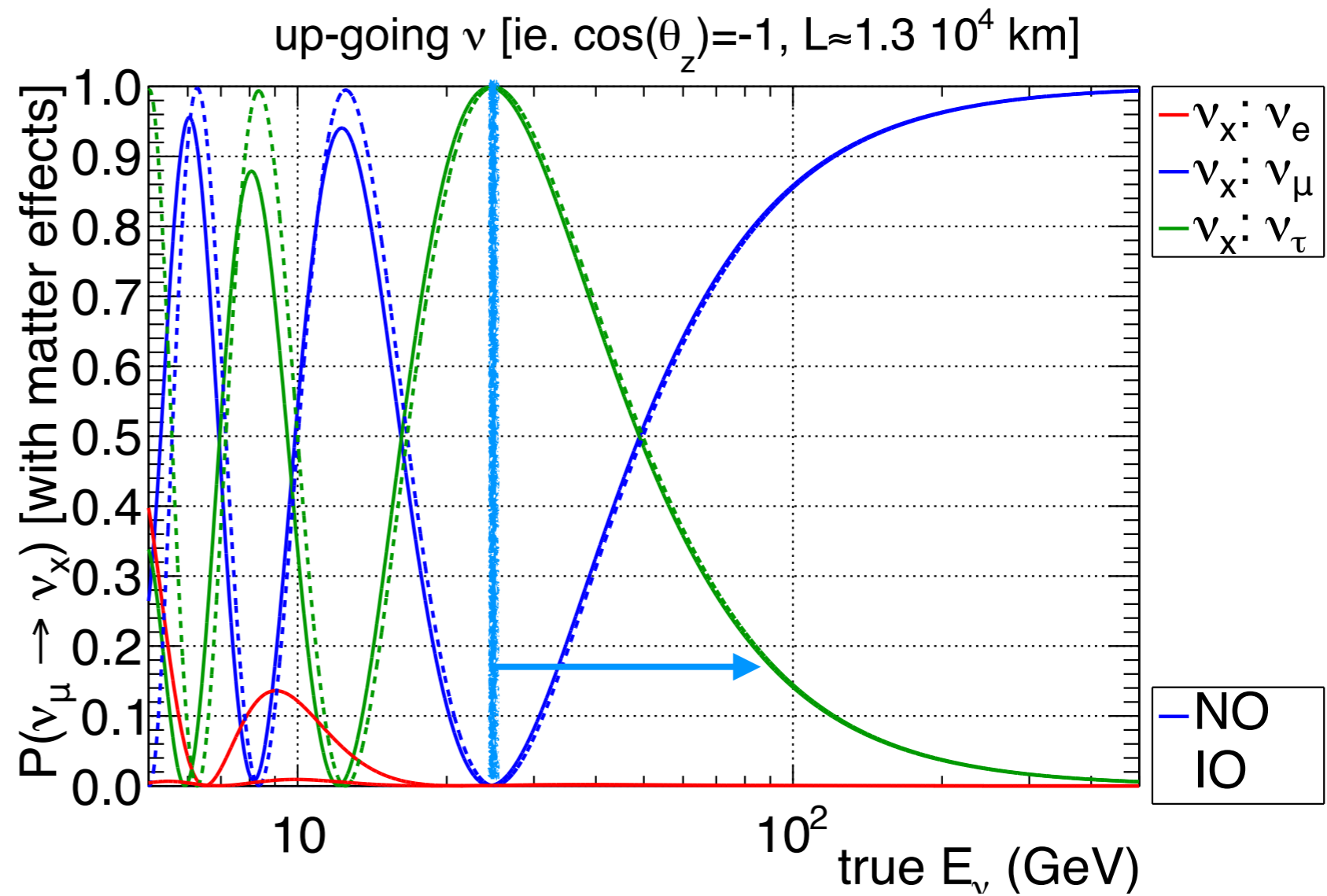
# IceCube + DeepCore

- 78 Strings
  - 125m string spacing
  - 17m DOM spacing
- Add 8 strings
  - 75m string spacing
  - 7m DOM spacing



# Lowering the Threshold

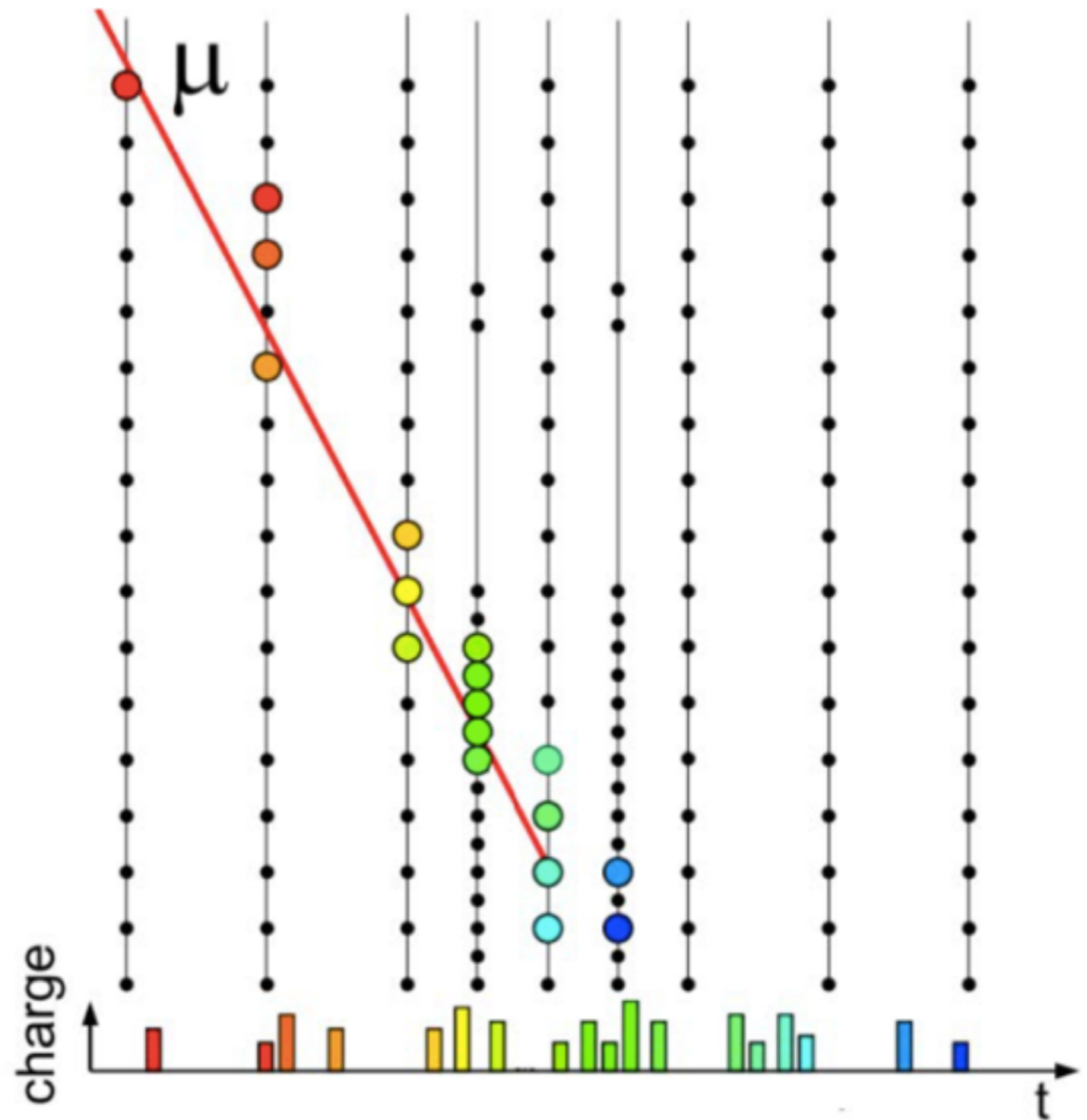
- The energy coverage of DeepCore is roughly right where one would want it





# Muon veto Capabilities

- Primary background is atmospheric  $\mu$
- Use IceCube as a veto to remove these events

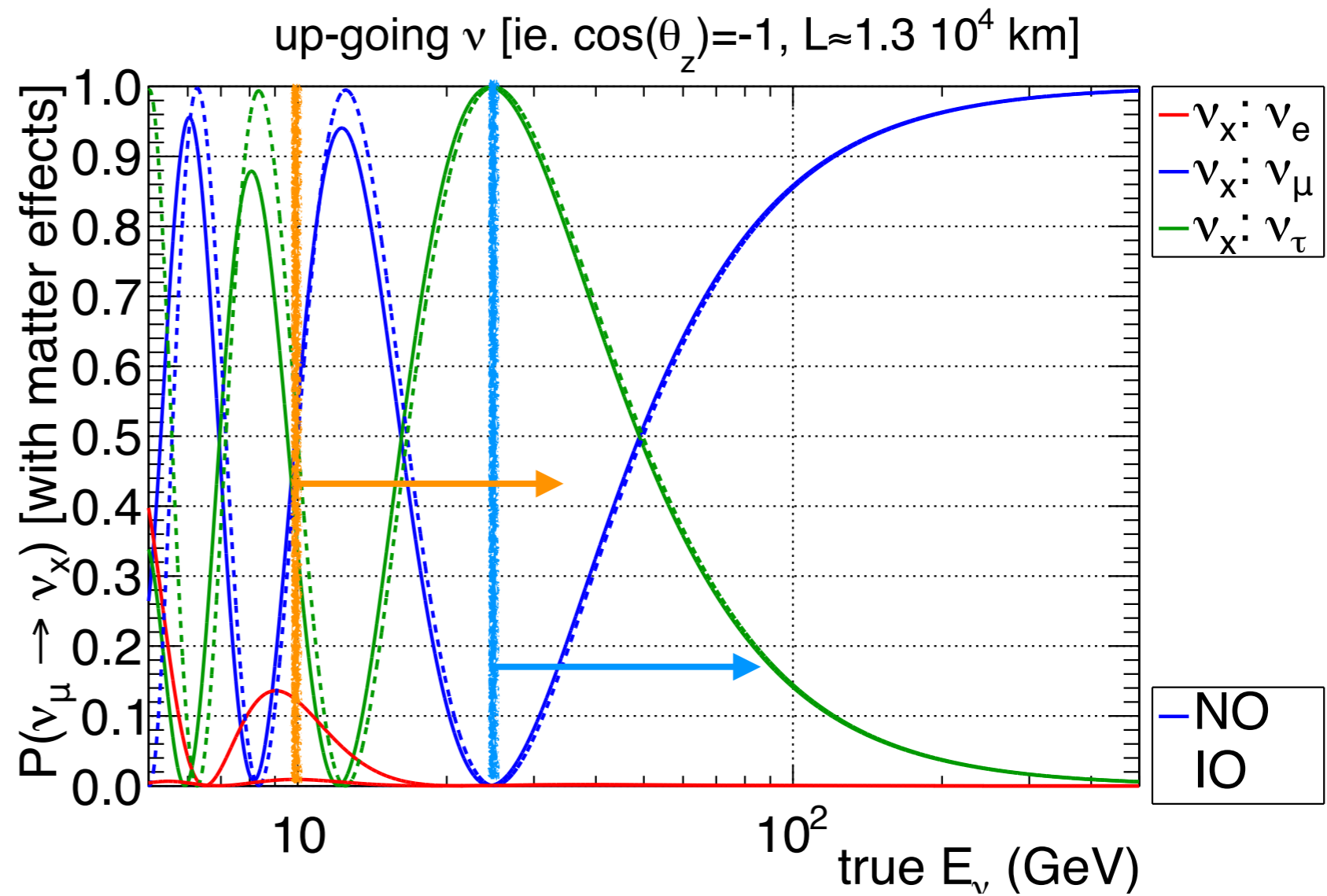


# IceCube - The Present

- Working on many different fronts, as seen at this conference
  - Neutrino oscillations
  - Neutrino mass ordering
  - Tau neutrino appearance
- Can we go even lower?

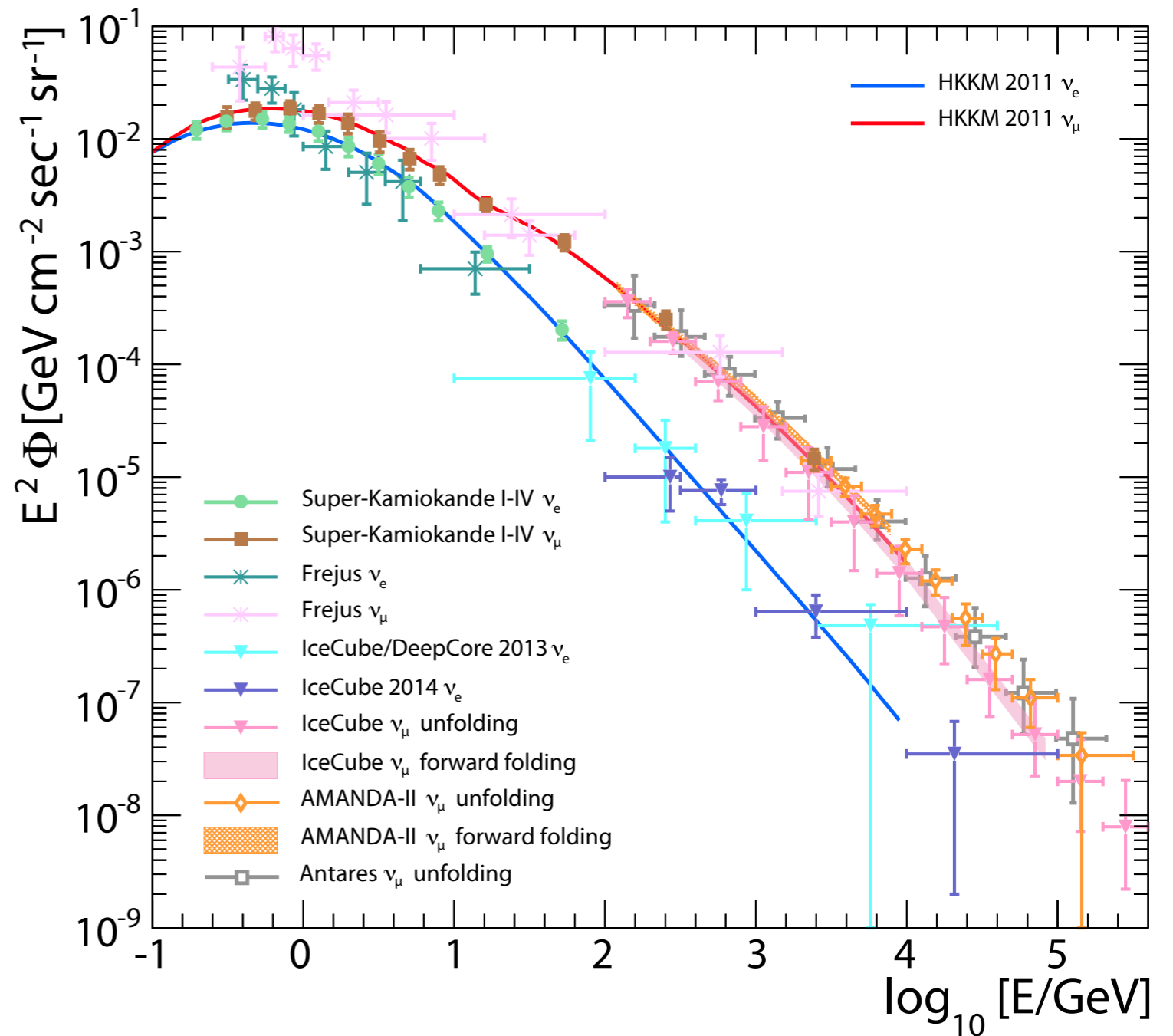
# Perhaps a further lowering?

- Physics reach increased even further

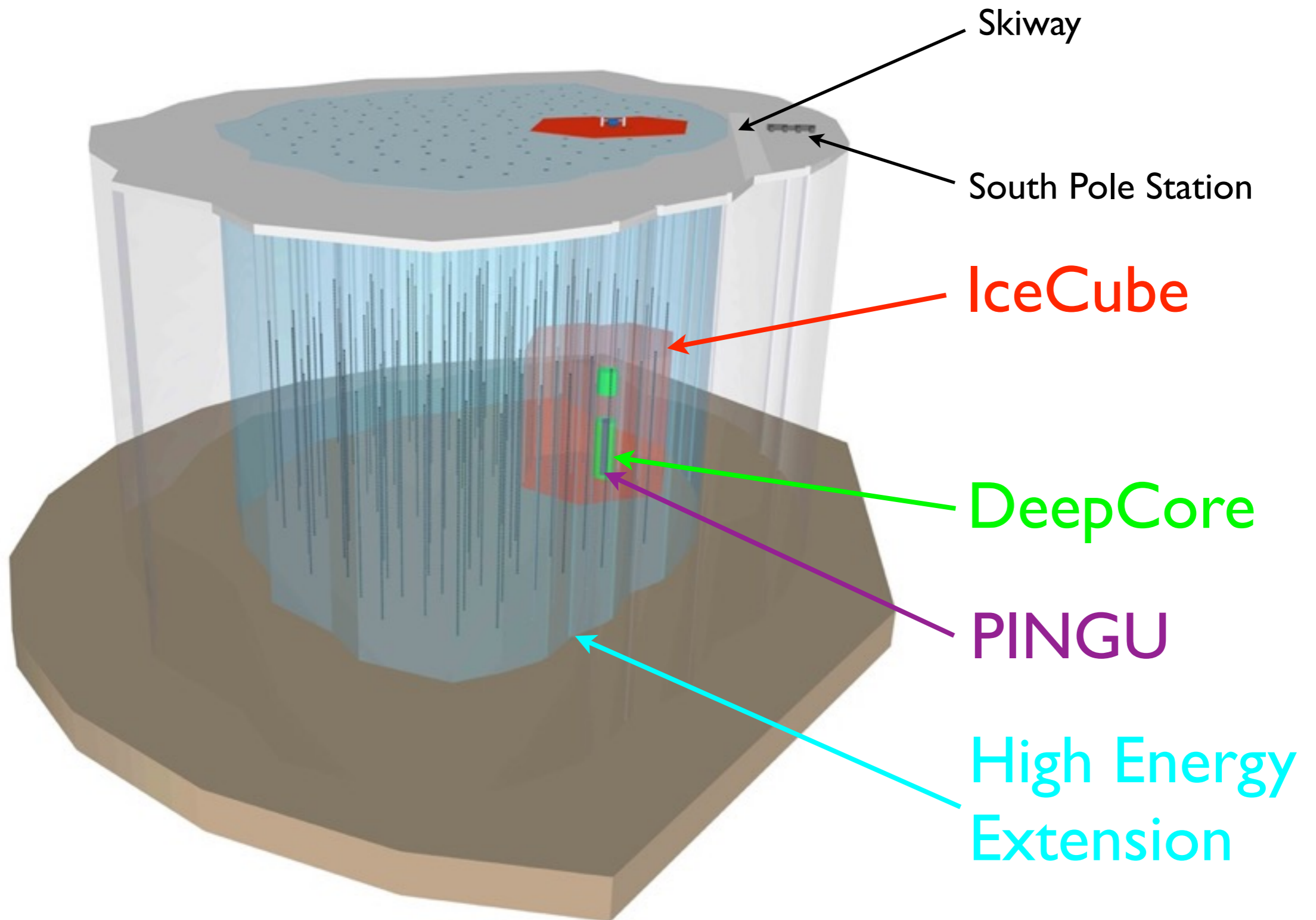


# Perhaps a further lowering?

- Physics reach increased even further
- Flux also increases at lower energies

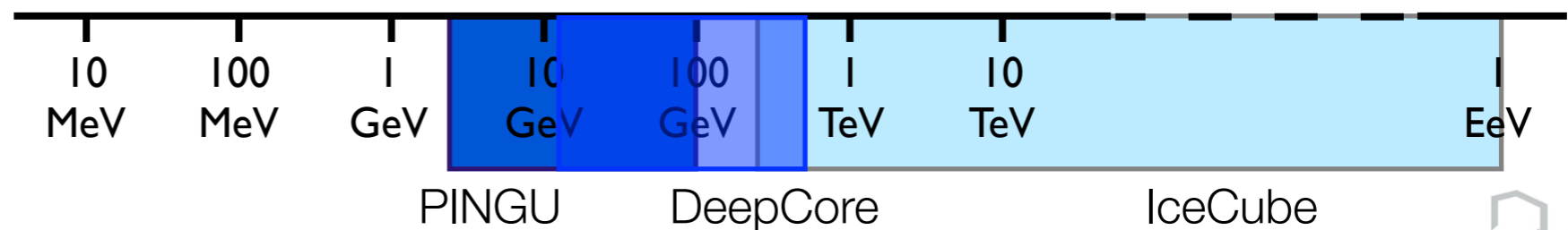
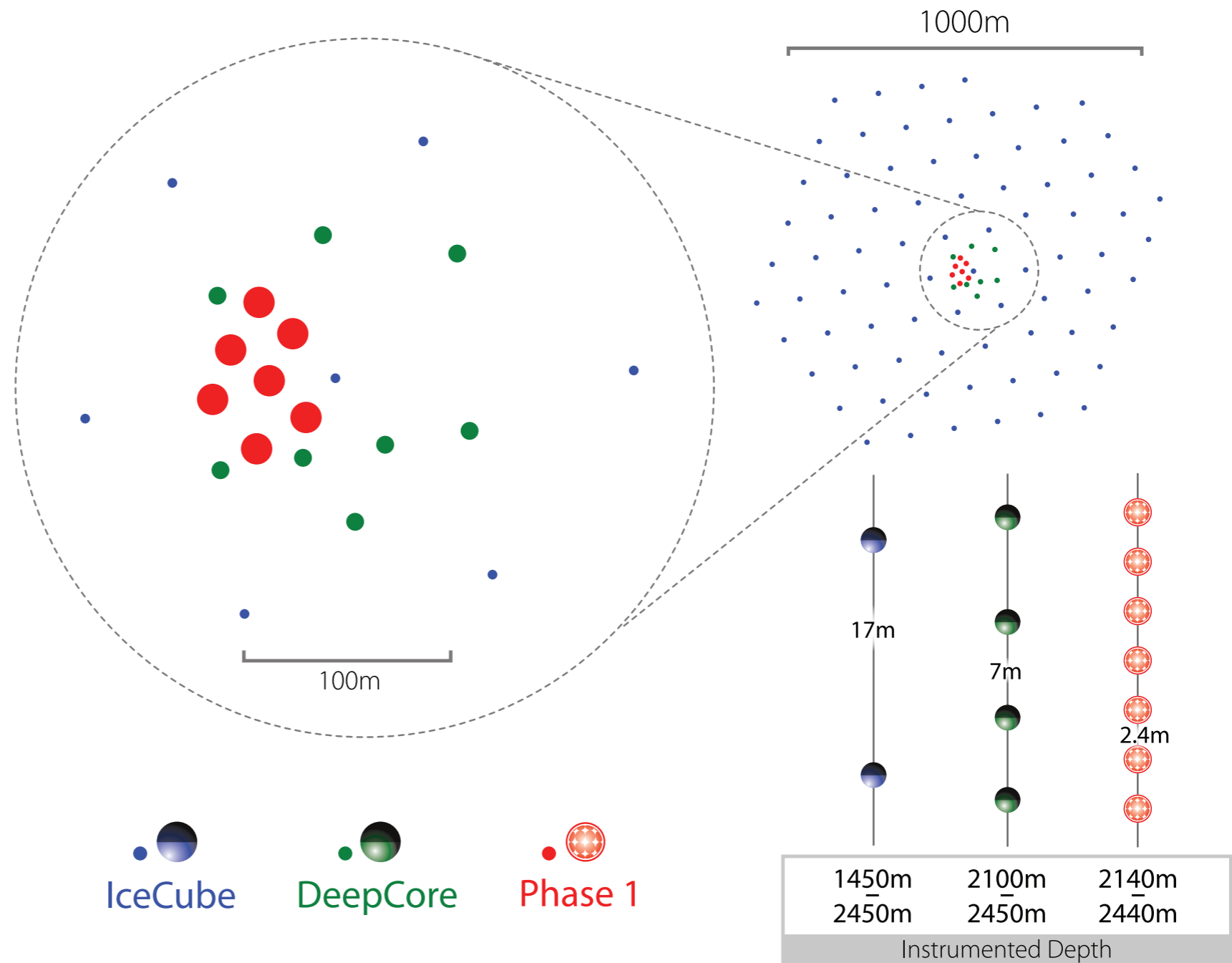


# IceCube - The Future

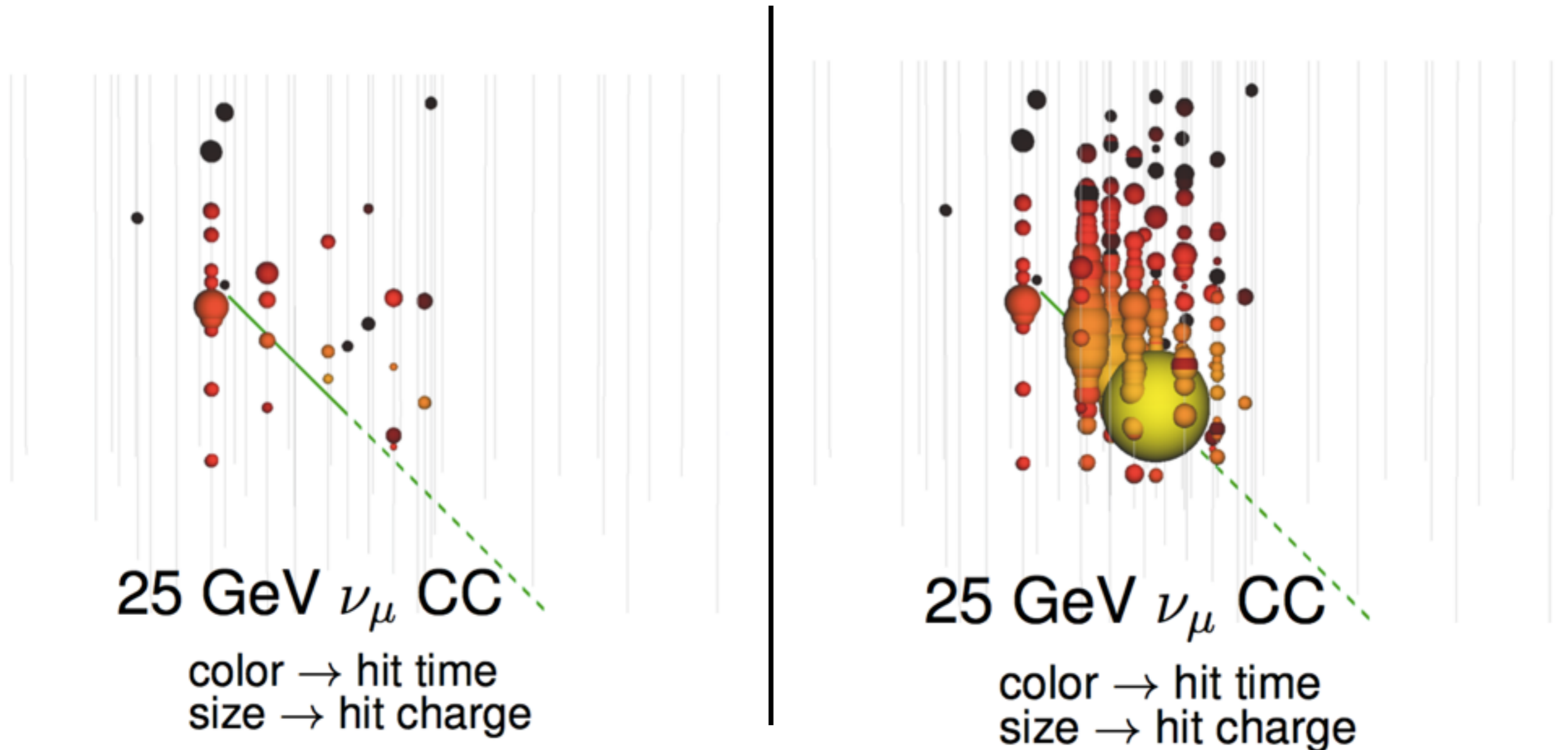


# First Step - Phase 1

- Add 7 strings in the area of DeepCore
- Lowers the threshold to roughly GeV range



# String Density Improvement

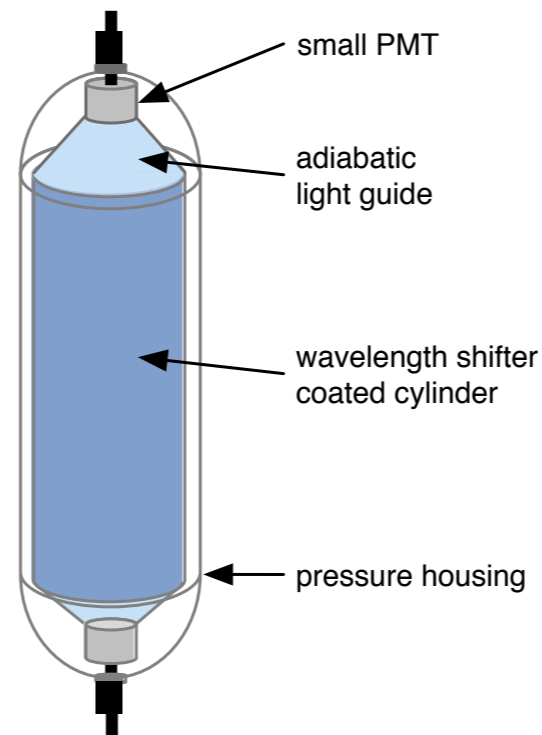


- Inclusion of more strings dramatically improves light collection

# Photodetector Improvement



- Directional information
- Smaller geometry



- More sensitive area per \$
- Small diameter



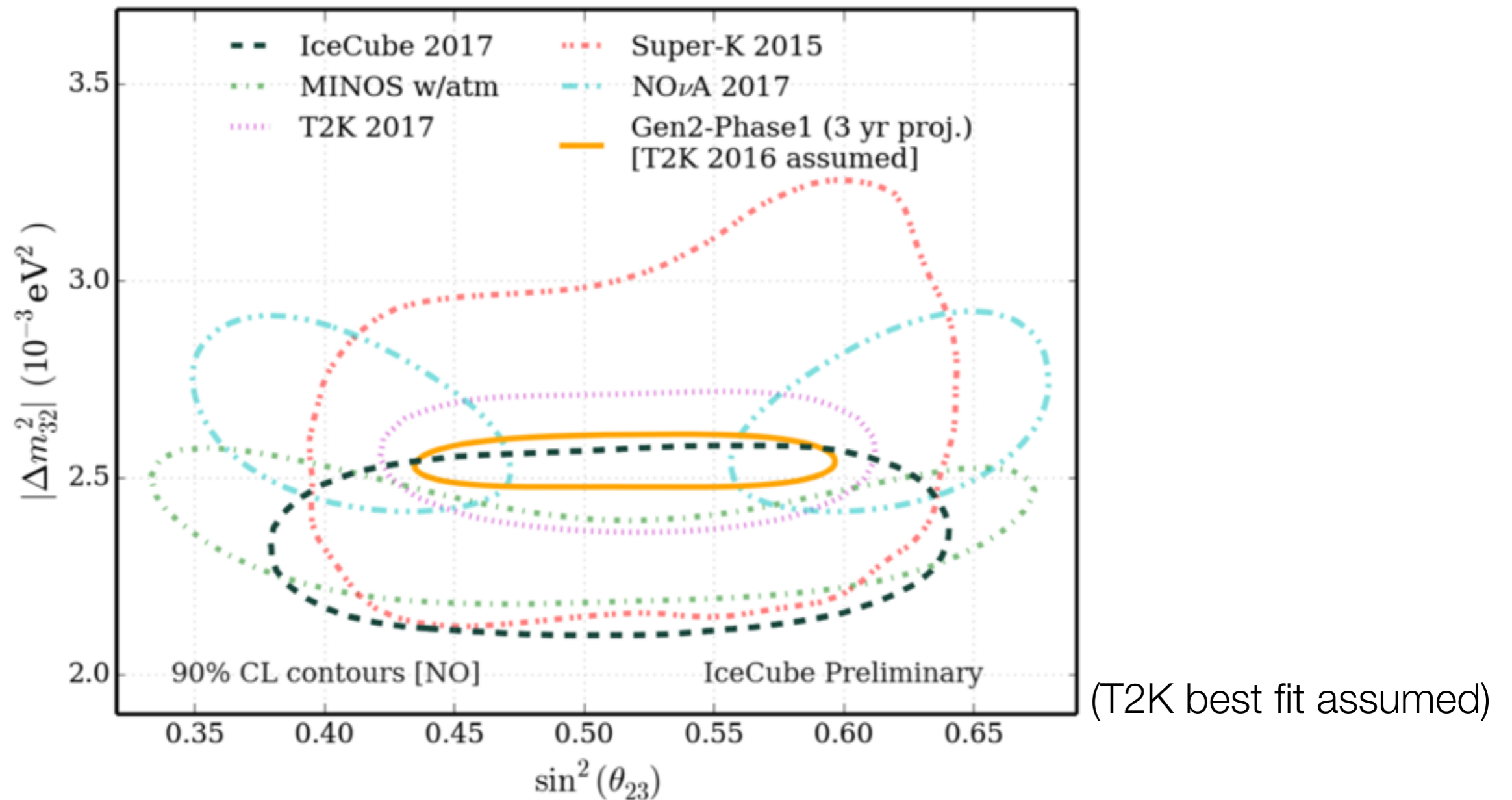
- Directional information
- More sensitive area per module

- Previous modules had one PMT facing down

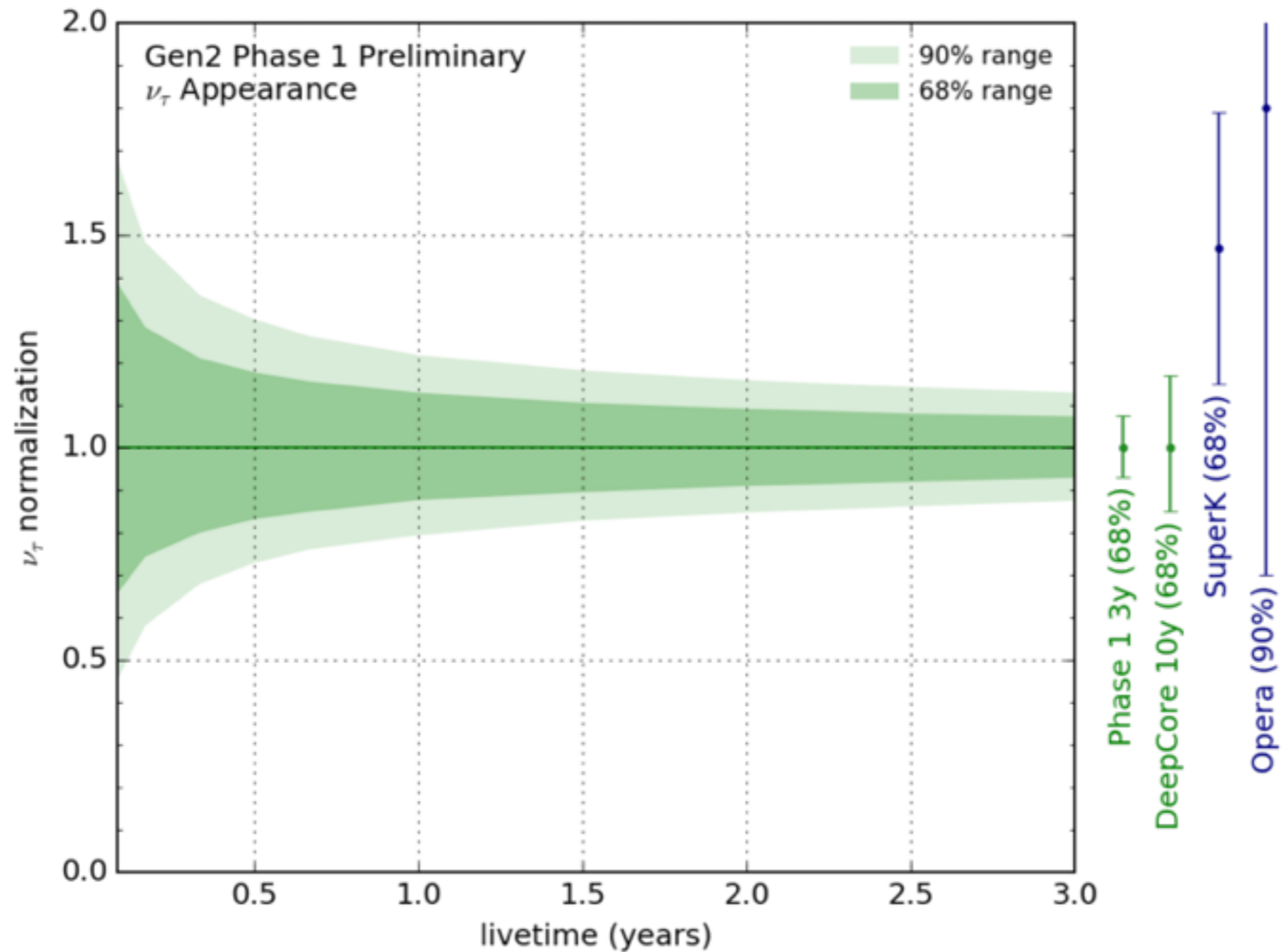


# Oscillations with Phase 1

- Improvement in sensitivity



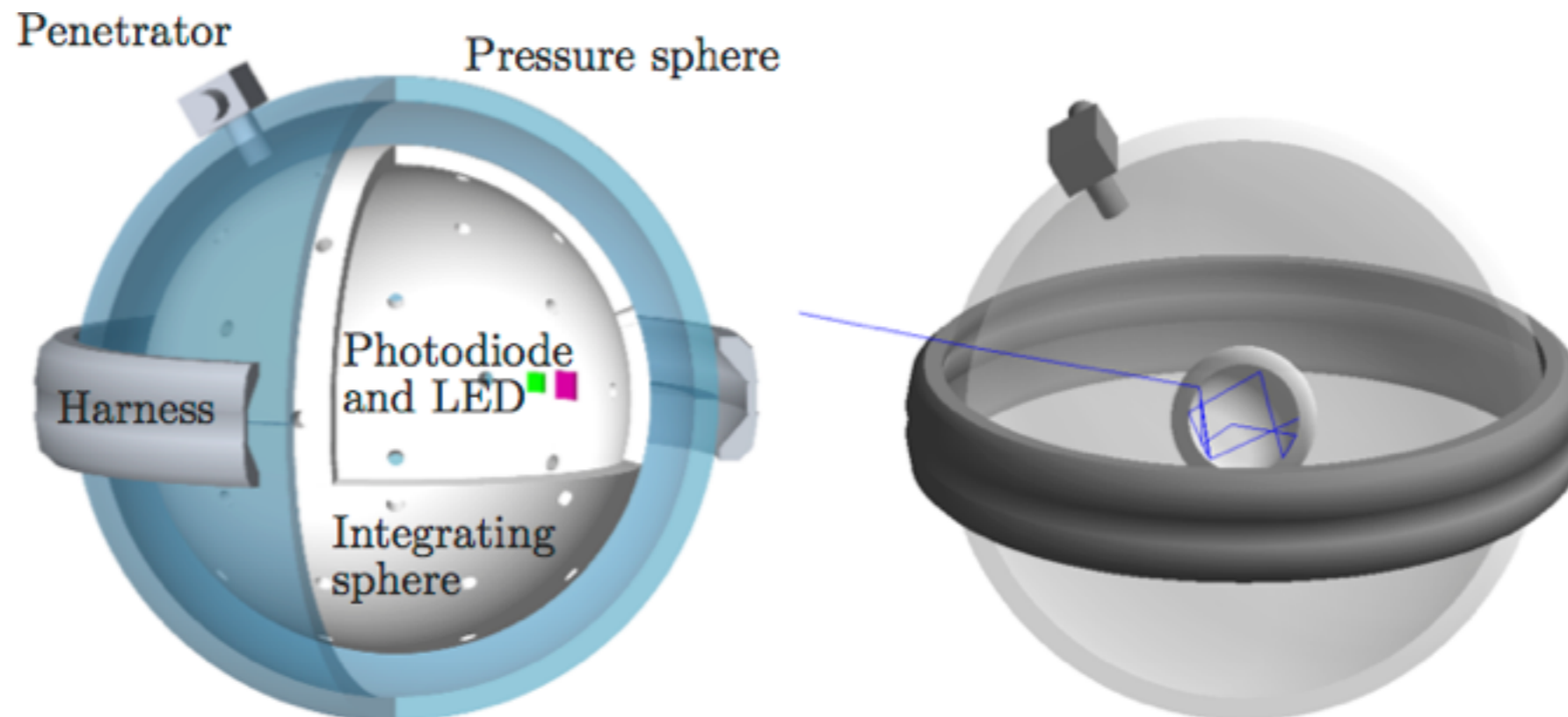
# Oscillations with Phase 1



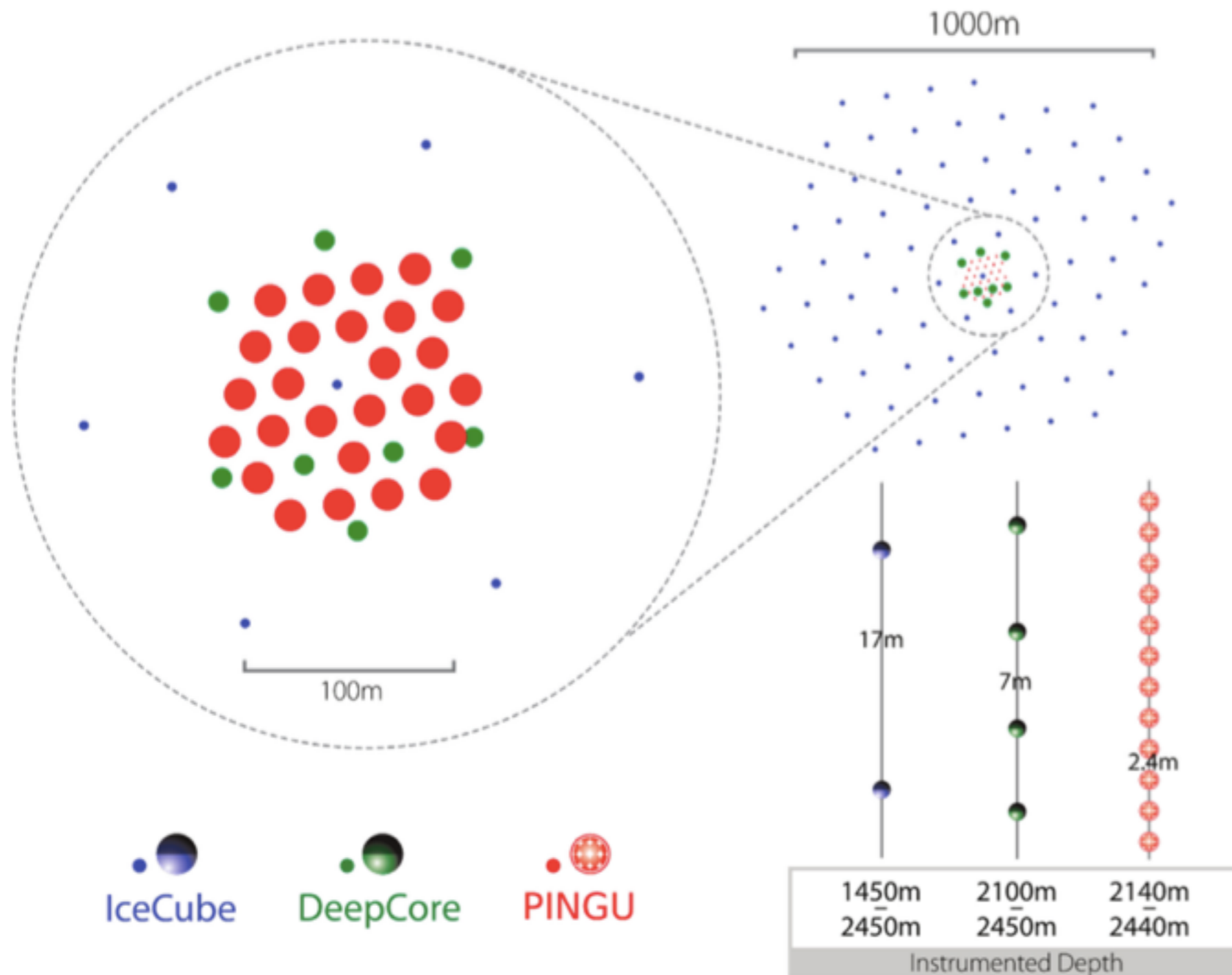
- Also able to continue to search for tau appearance

# Calibration

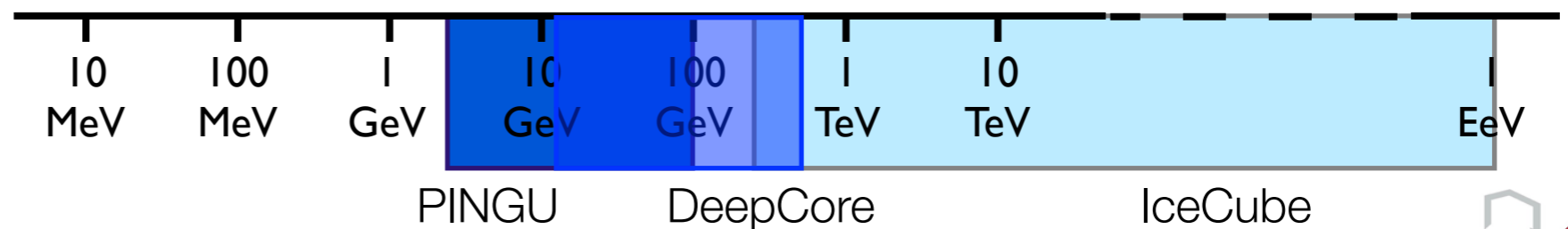
- Phase 1 also allows for the installation of new calibration devices
  - better knowledge of LED output and direction as well as better timing
  - specific devices with known light emission over  $4\pi$



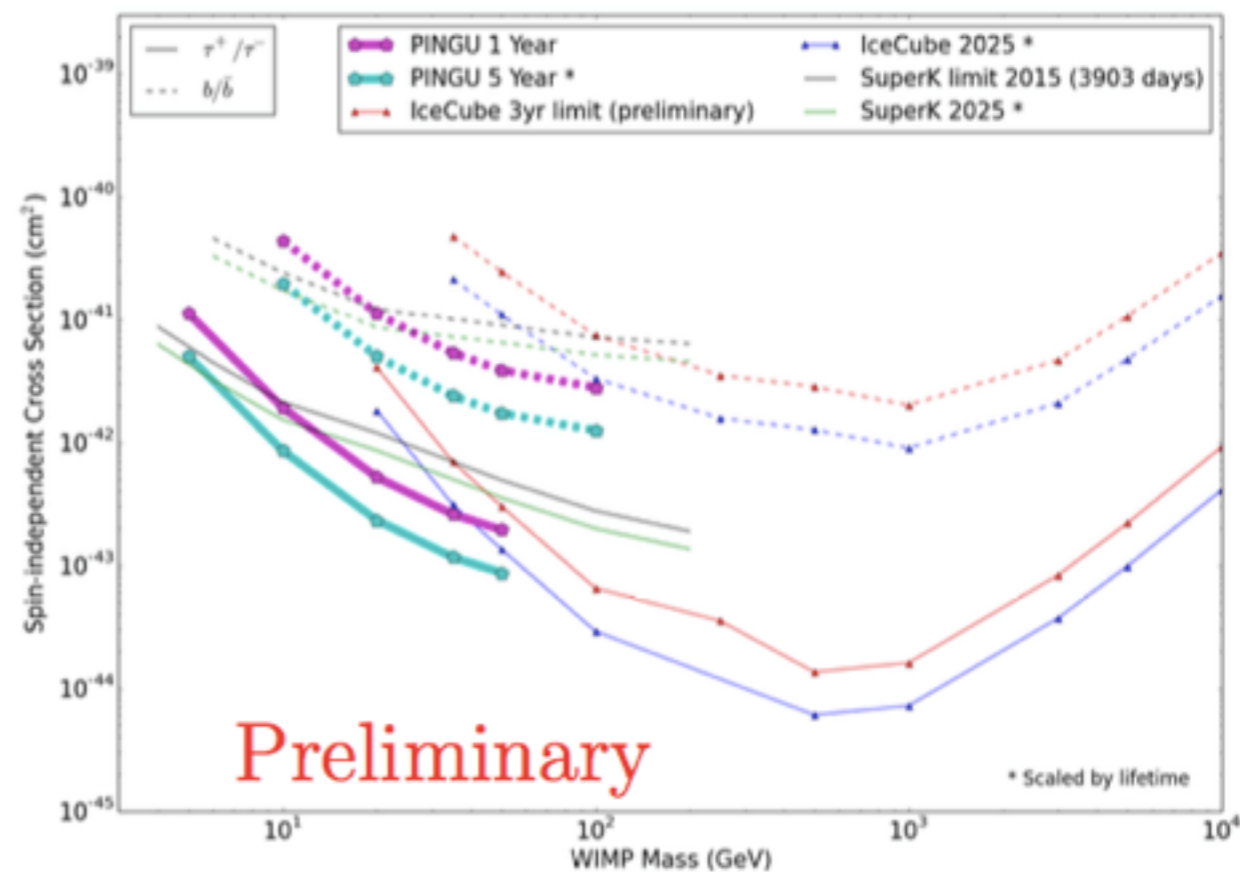
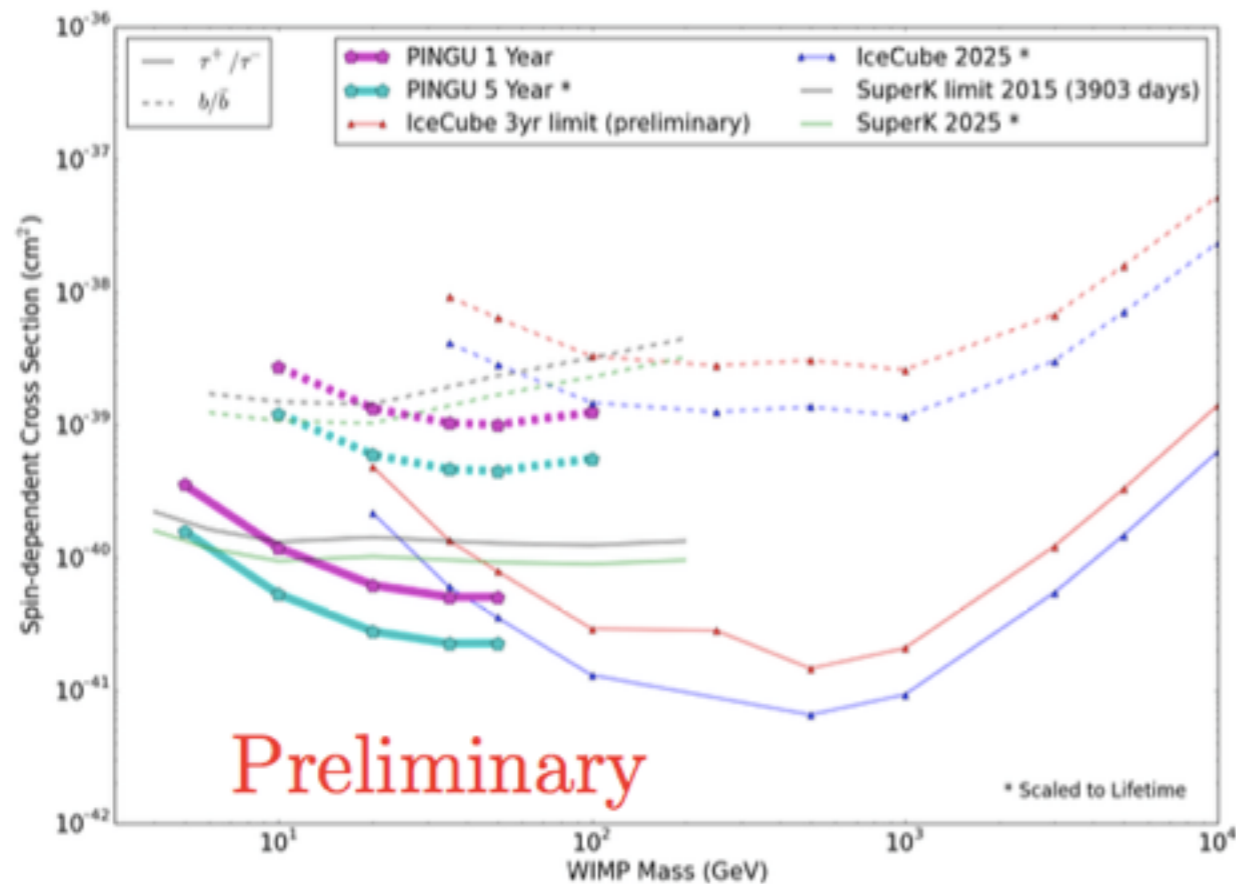
# IceCube + DeepCore + PINGU



- Full 26 densely instrumented strings in the best-vetoed region
- Roughly 6 Mton fiducial with order of GeV threshold



# Dark Matter



- Sensitivity to dark matter is also improved

# Conclusion

- IceCube has been very successful
- PINGU will continue at low energies
- Phase 1 is the first step toward that goal

