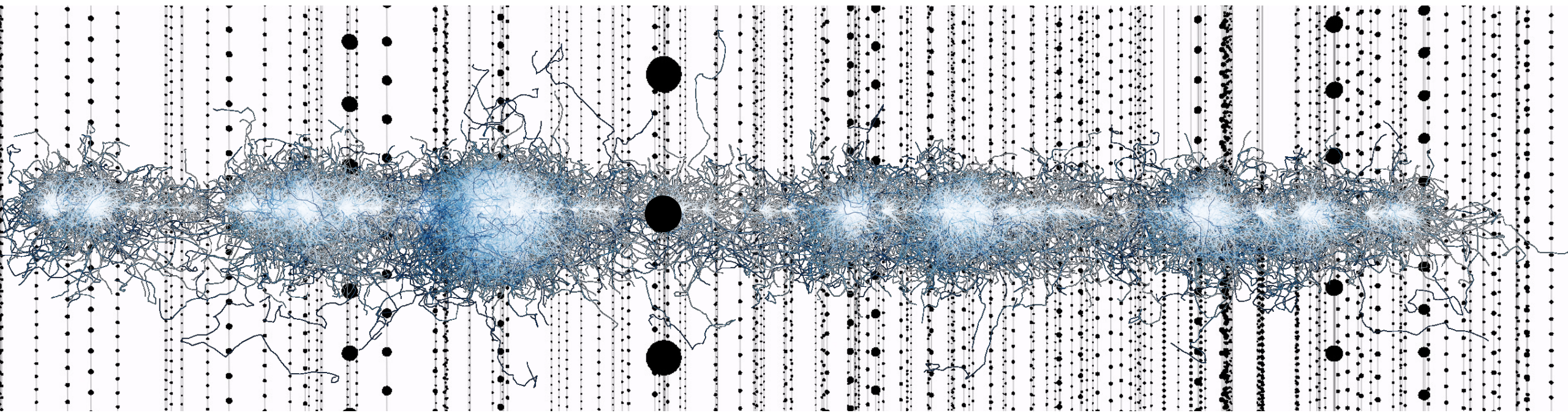


# IceCube-Gen2: the optical array

Tianlu Yuan

GCOS workshop

20 May 2021



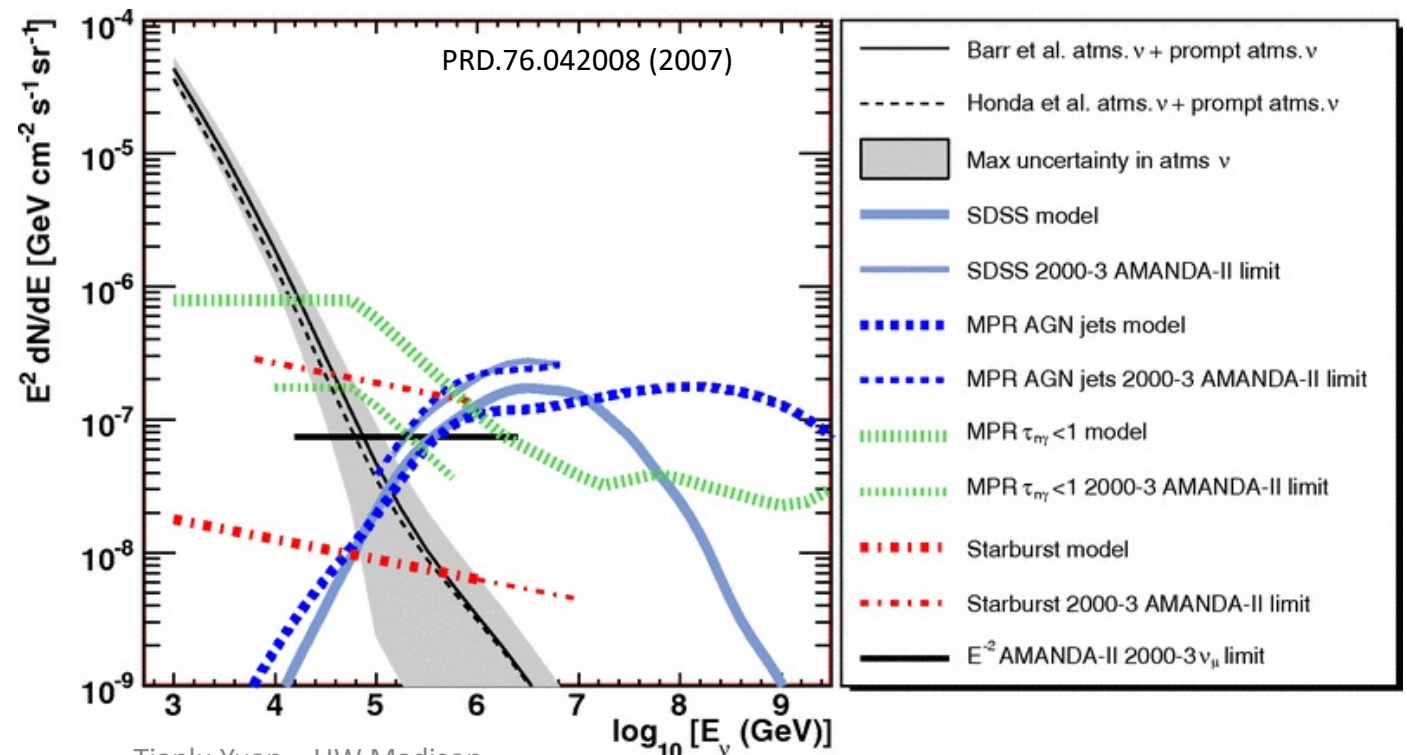
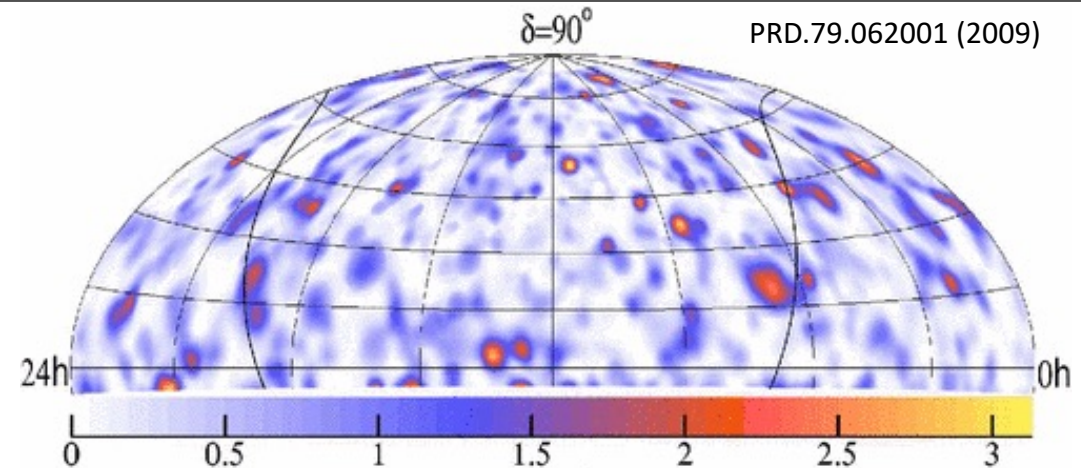
ICECUBE  
GEN2



WISCONSIN  
UNIVERSITY OF WISCONSIN-MADISON

# A decade ago: AMANDA

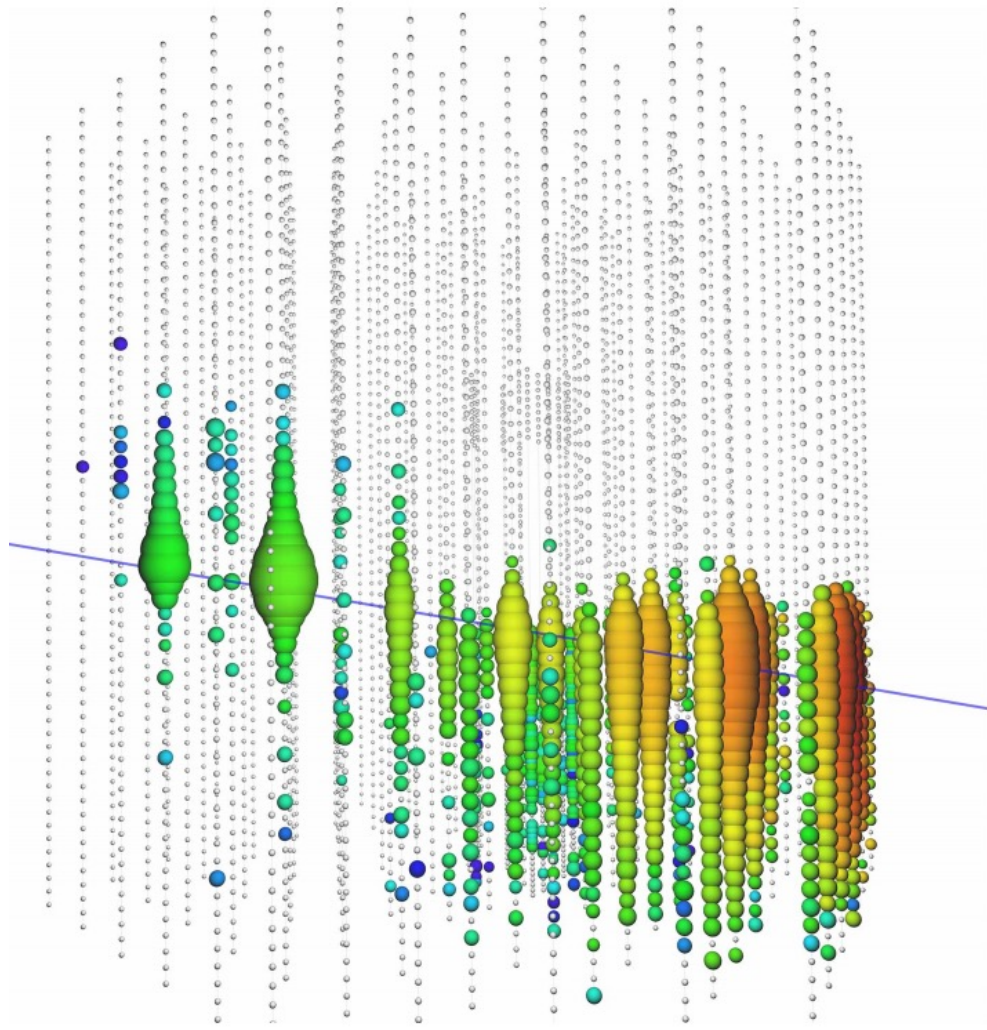
Antarctic Muon And Neutrino Detector Array



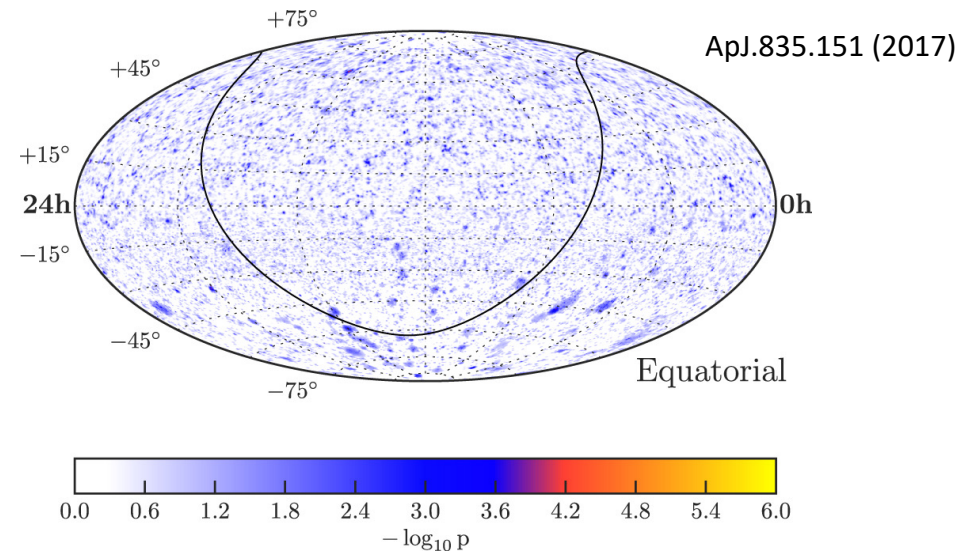
Tianlu Yuan – UW Madison



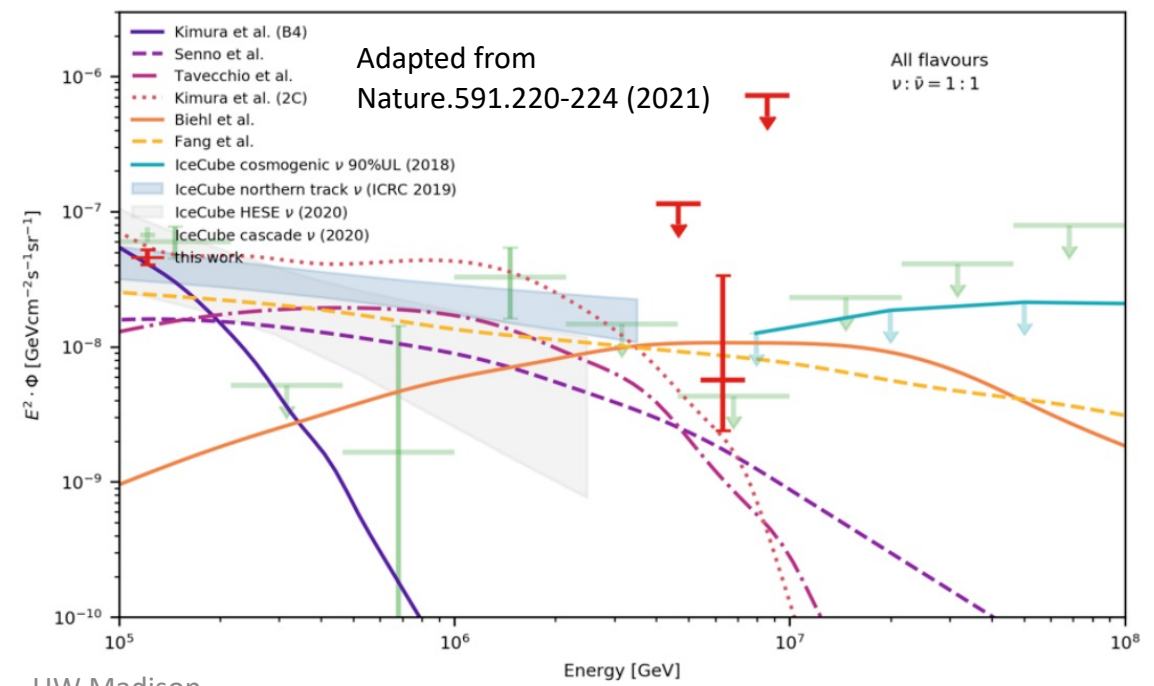
# What we know now



$E_{dep} \sim 2.6$  PeV track in IceCube



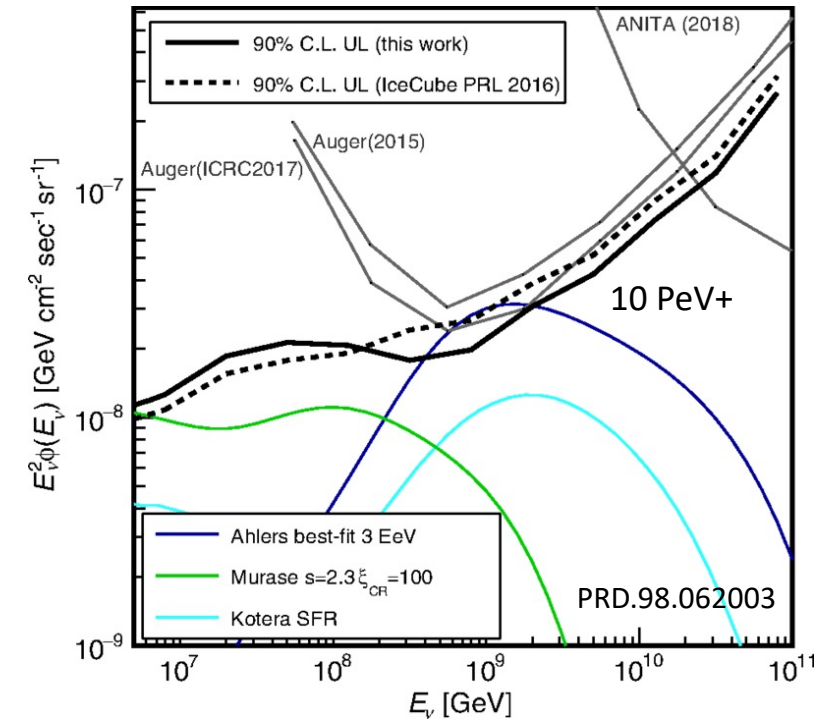
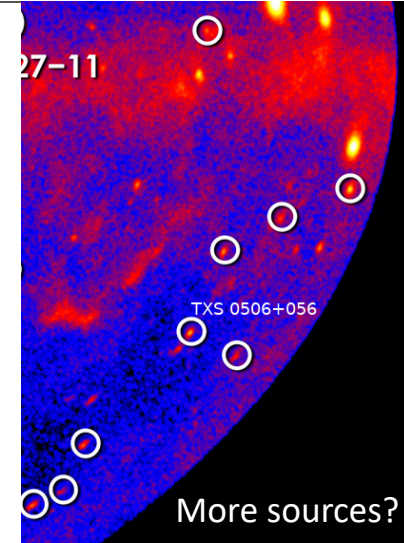
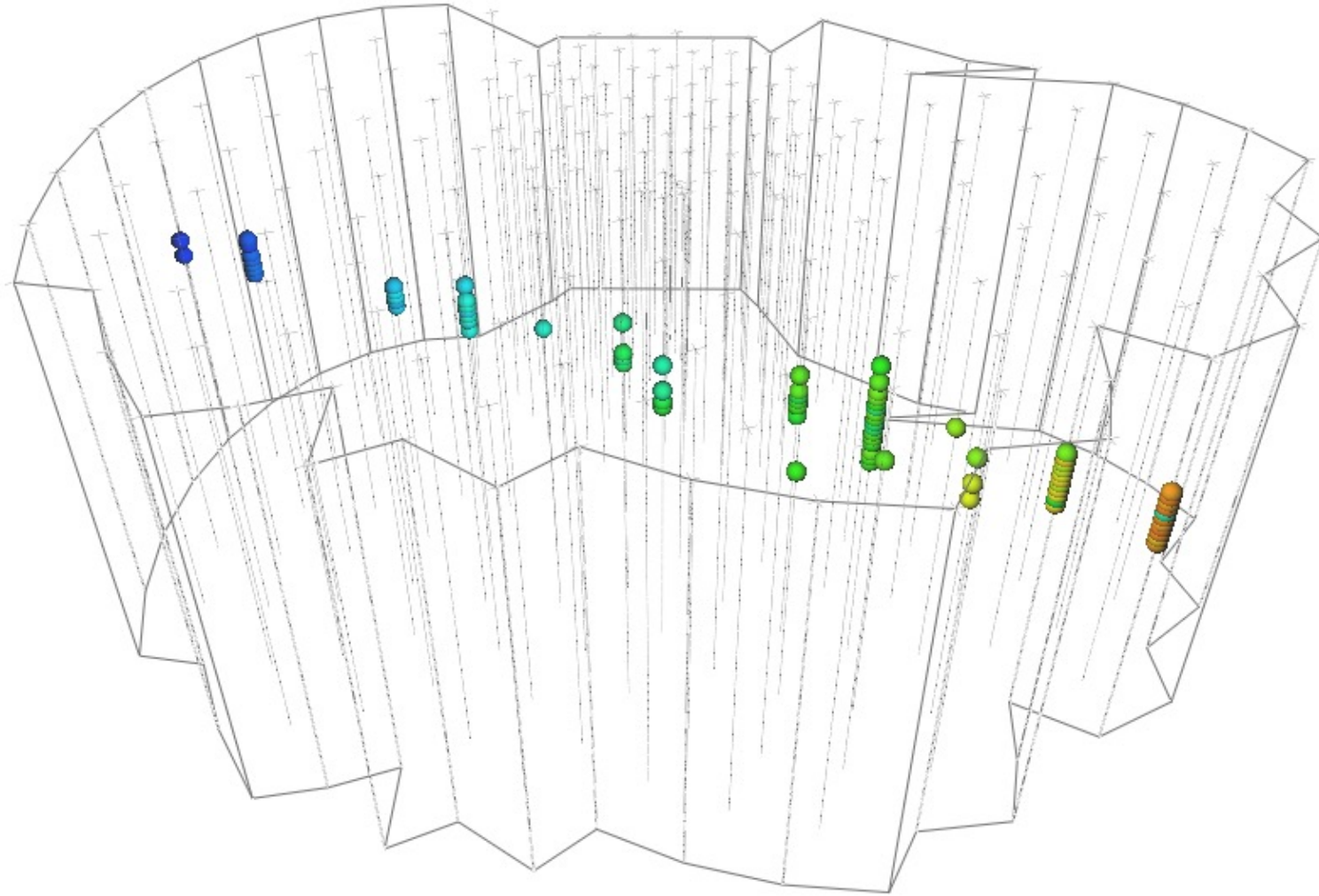
ApJ.835.151 (2017)



Adapted from Nature.591.220-224 (2021)

All flavours  
 $\nu: \bar{\nu} = 1:1$

# What we want to know next

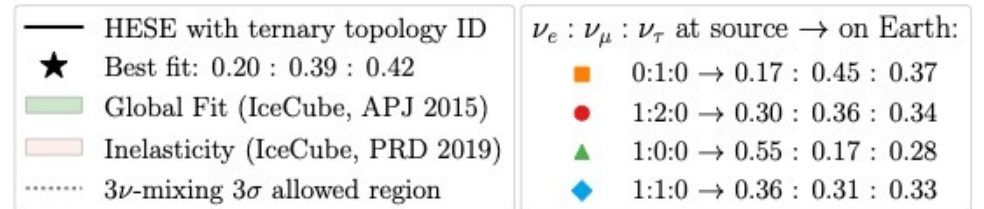
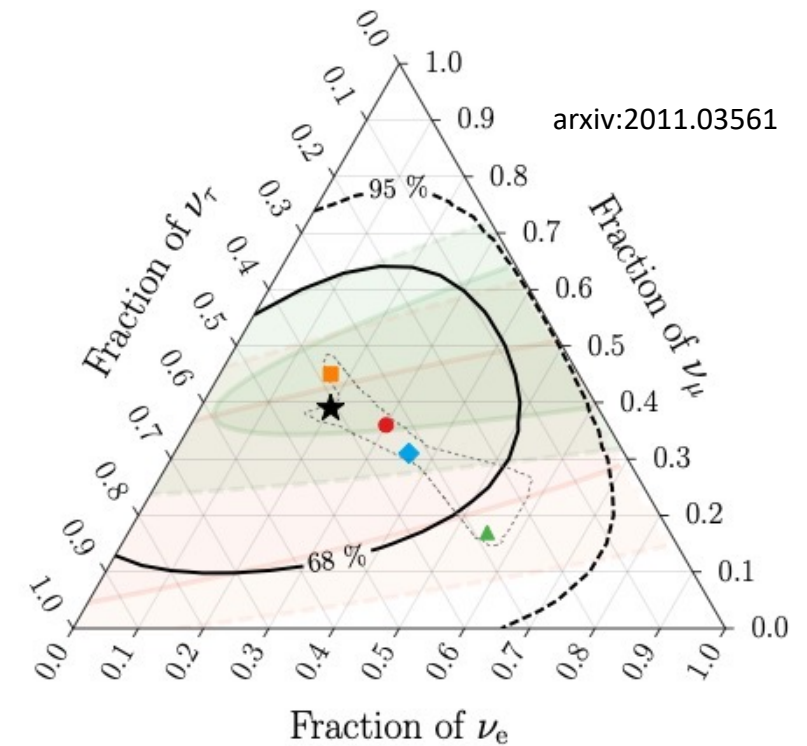
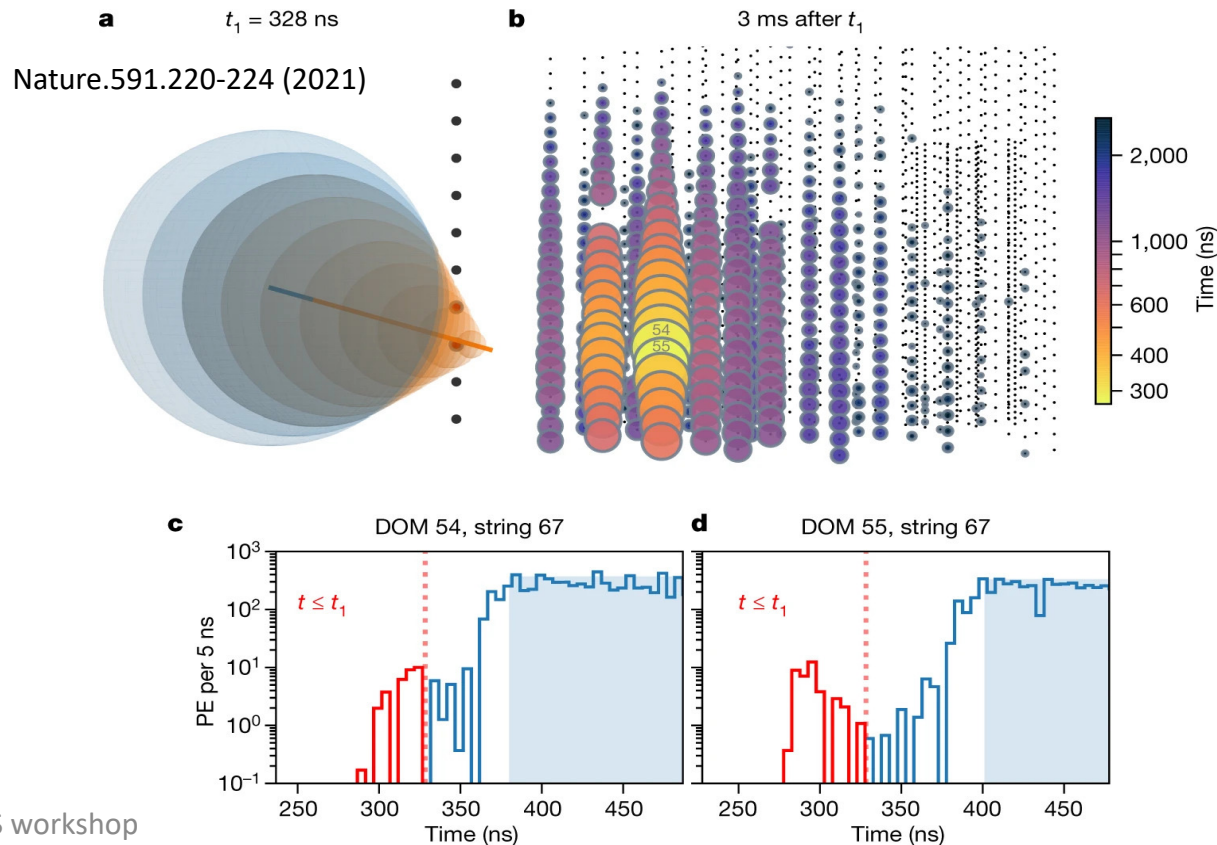




# And flavor composition

More precise determination of flavor yields information on production mechanism

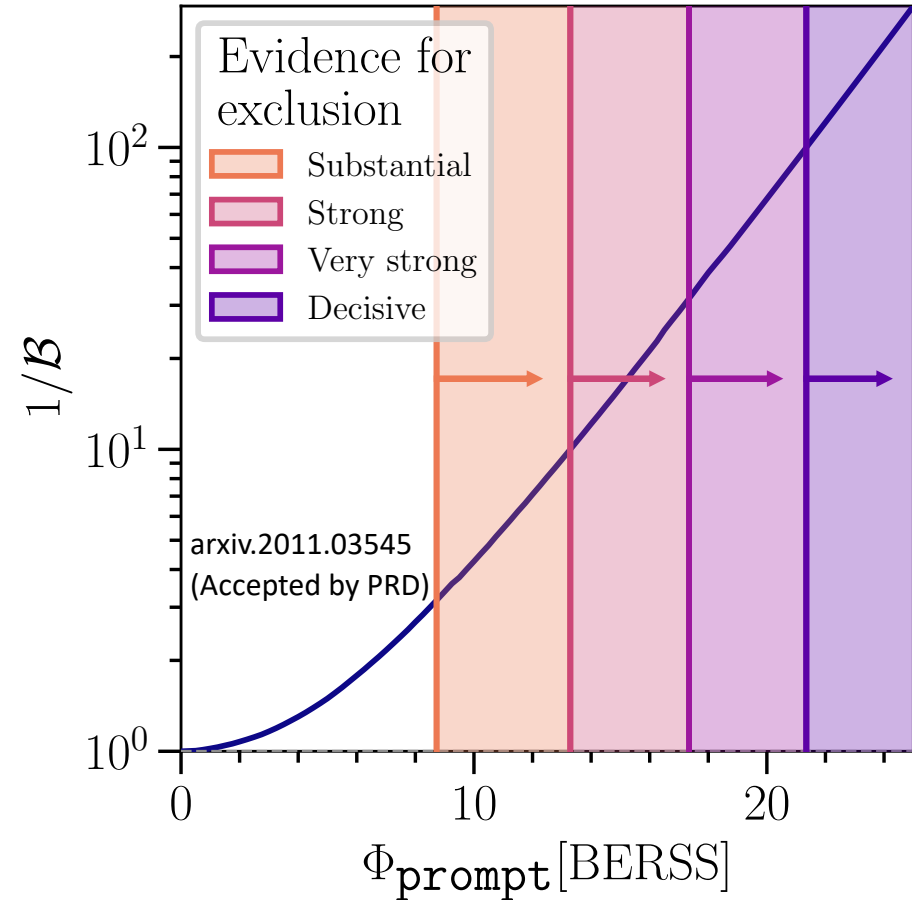
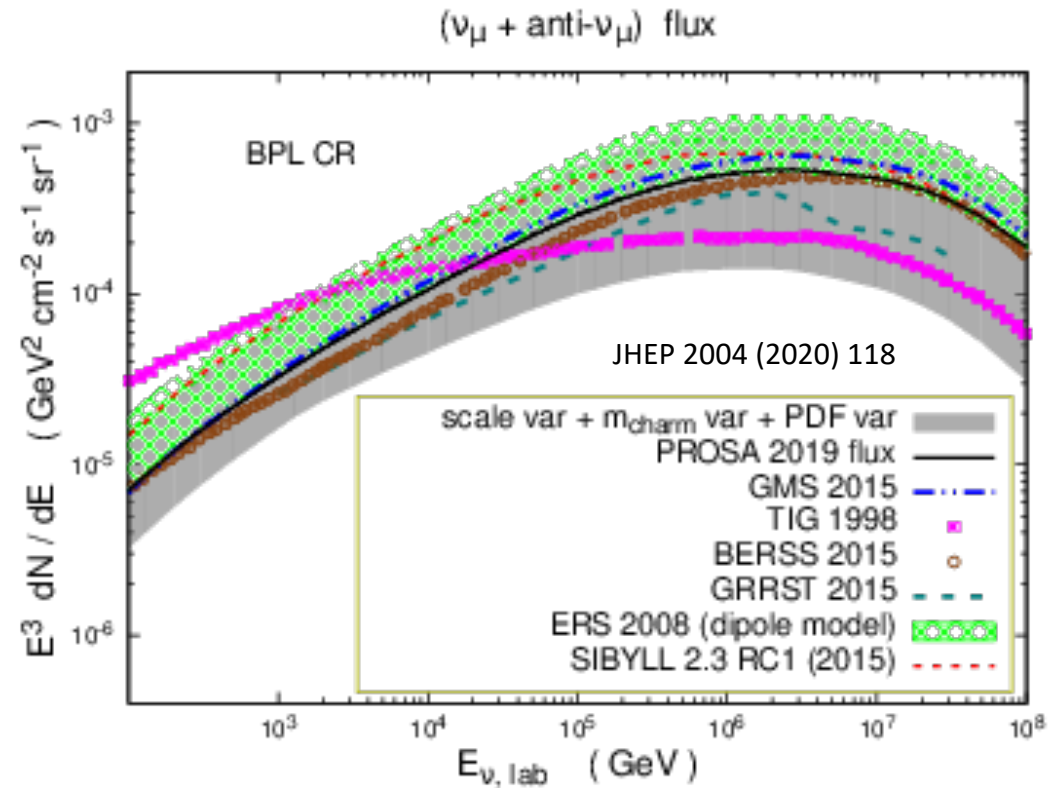
With Glashow resonance,  $\nu$ : $\bar{\nu}$  possible



# And more!

## High-energy neutrinos probe CR-induced hadronic interactions

### Charm component?





# IceCube-Gen2 in ice

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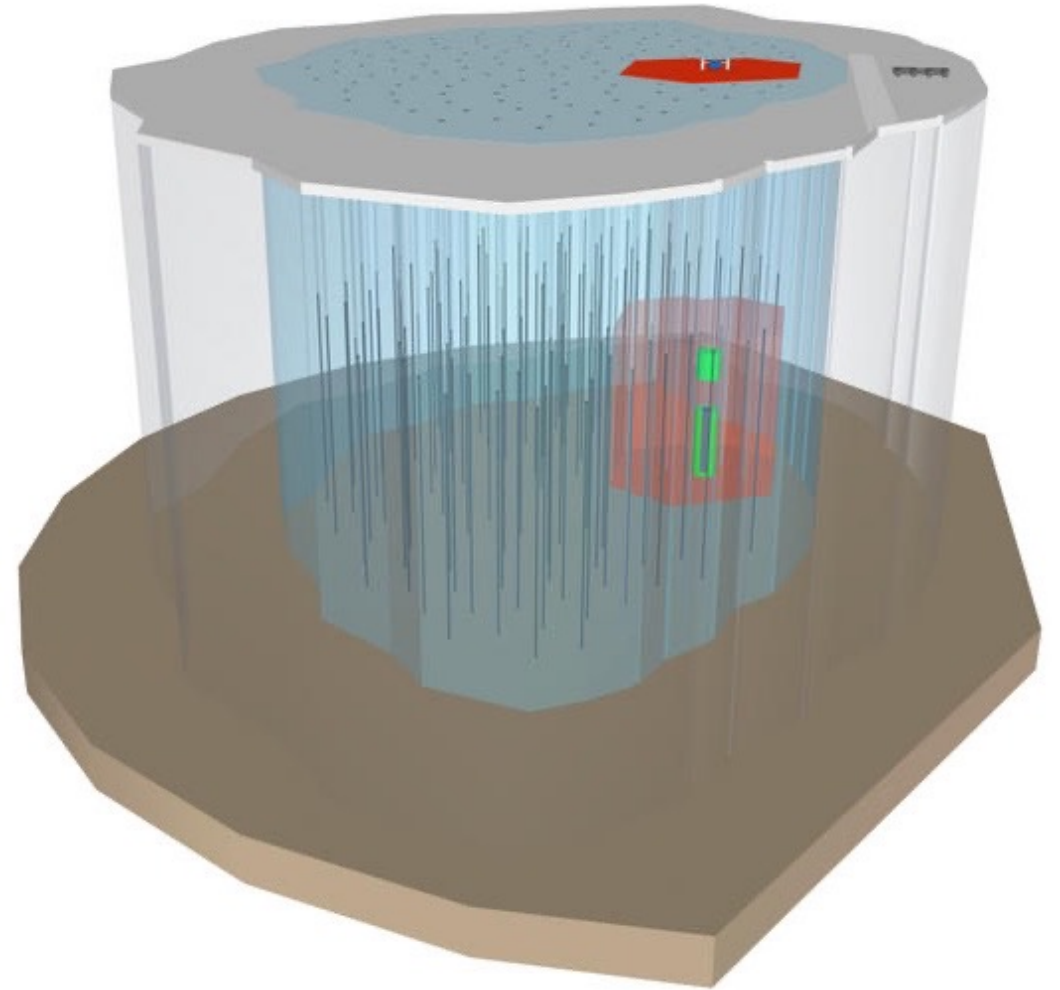
Will extend in-ice volume by  $\sim 10x$

Larger string spacing

More OMs per string

New hardware

- Multi-pmt sensors
- Calibration devices
- Building on top of IceCube Upgrade developments



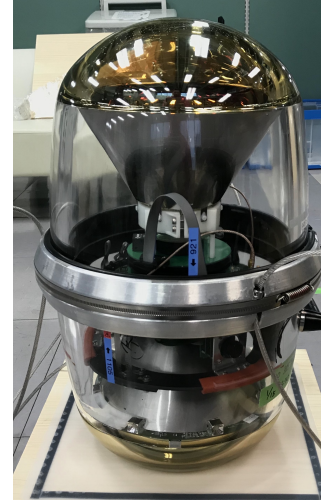
# Pixelated sensors

Amazing progress with IceCube Upgrade

IceCube DOM



DEgg



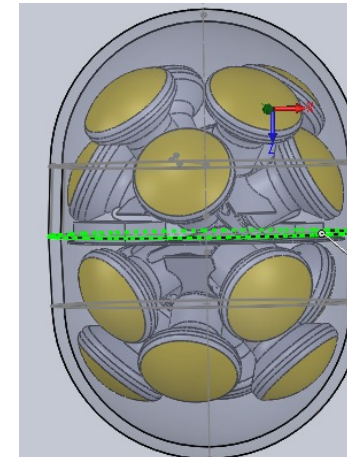
mDOM



Informing Gen2 OM design



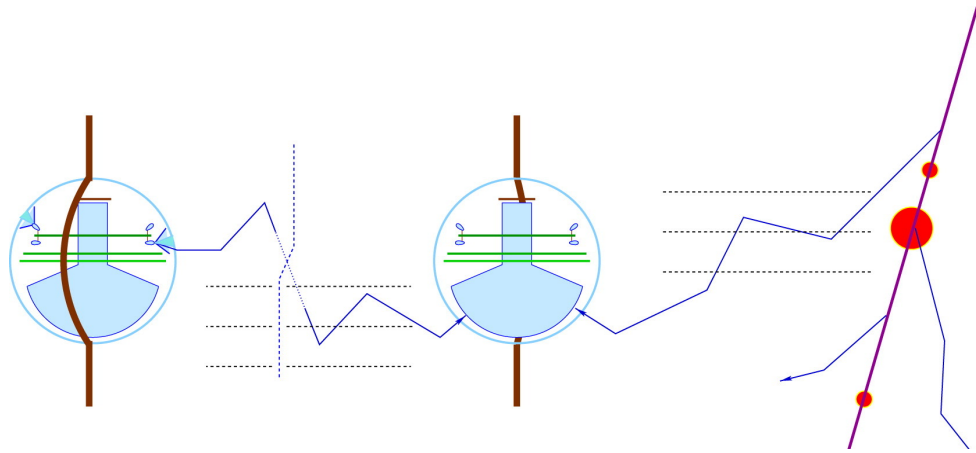
Gen2 LOM





# Improving our knowledge of the ice

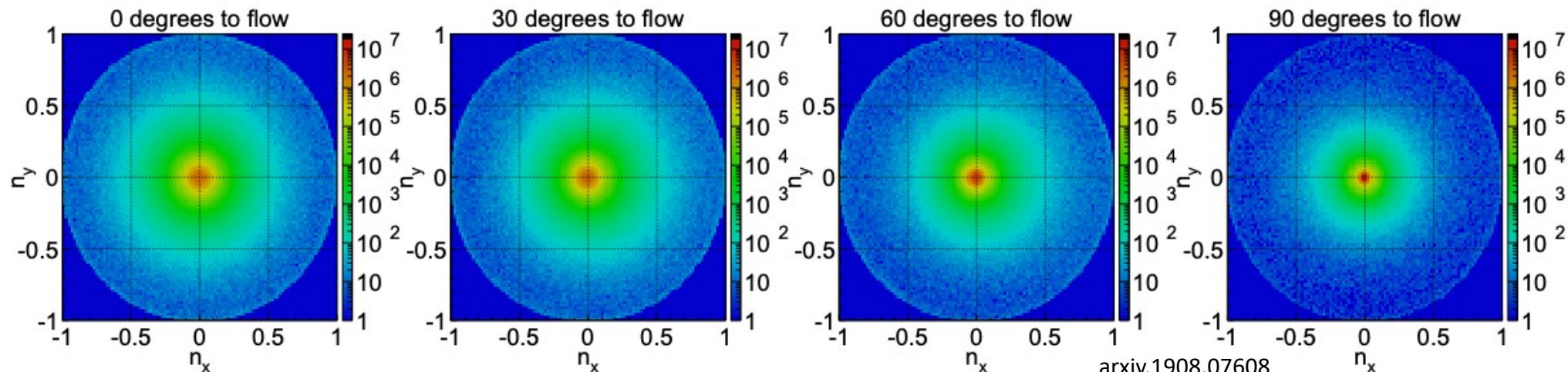
Recent work in IceCube has shown it is possible to characterize ice properties extremely well using on-board calibration devices



New hardware for Upgrade  
Will inform Gen2



j.nima.2012.11.170



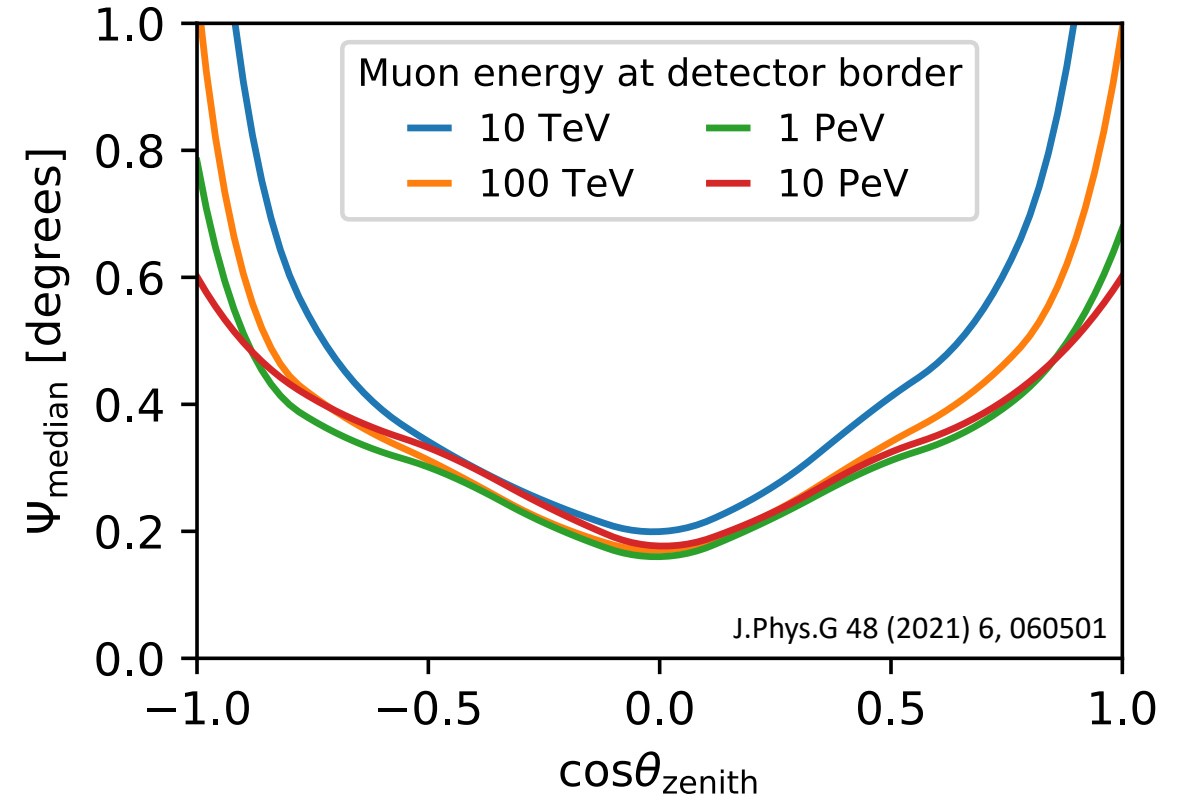
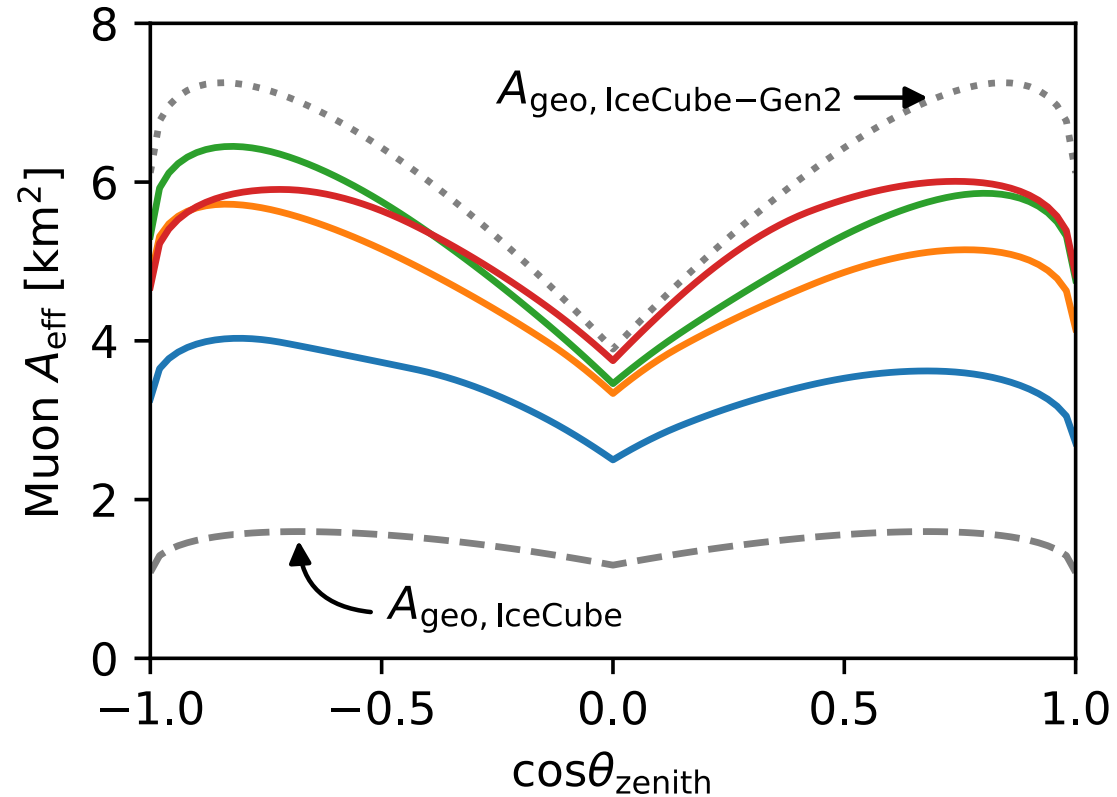
arxiv.1908.07608

# Larger volume and longer lever arm

~ 5x larger effective area

~ 2x improvement in angular resolution (tracks)

Detailed simulations underway...

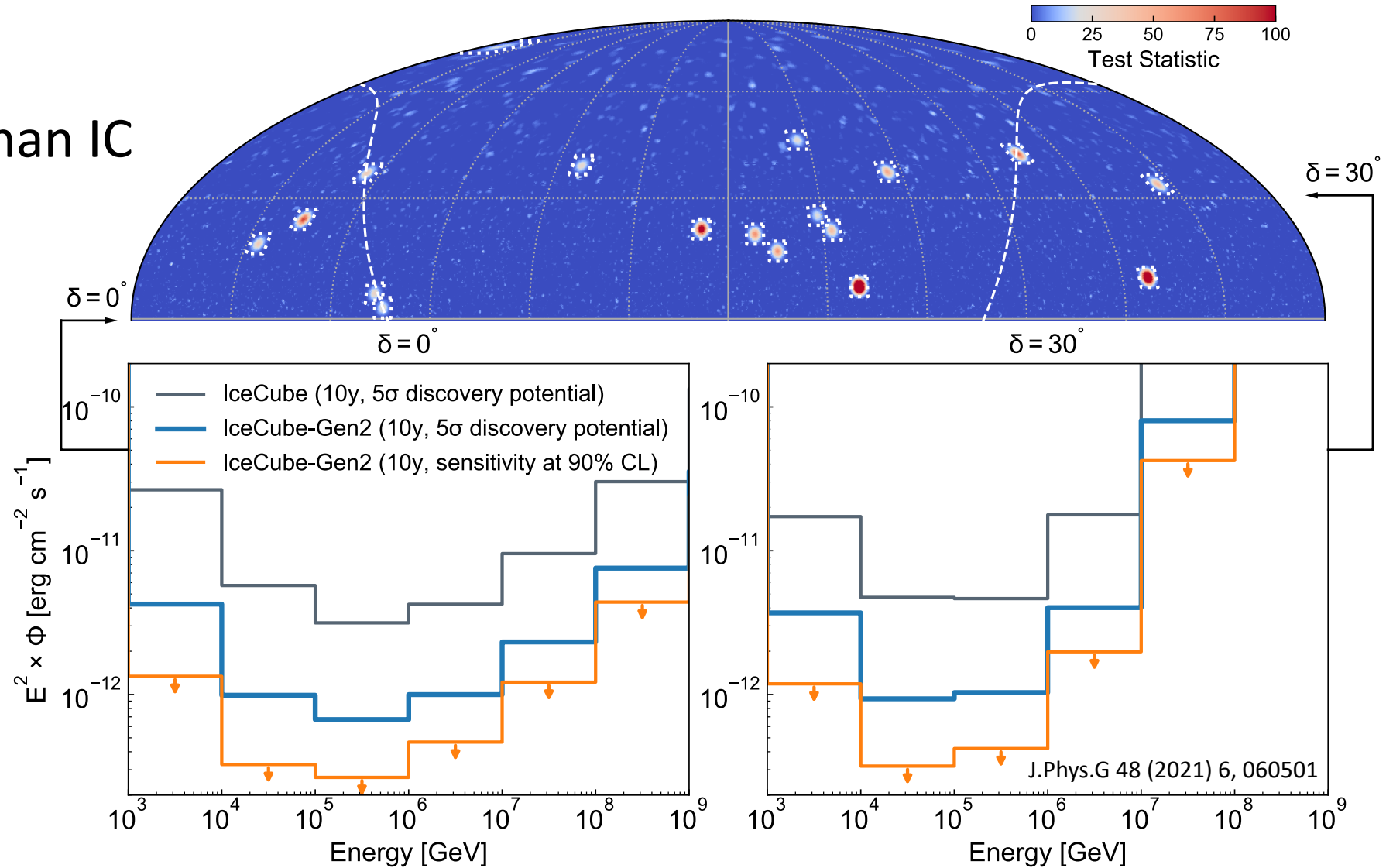




# A decade of Gen2

## Mock skymap

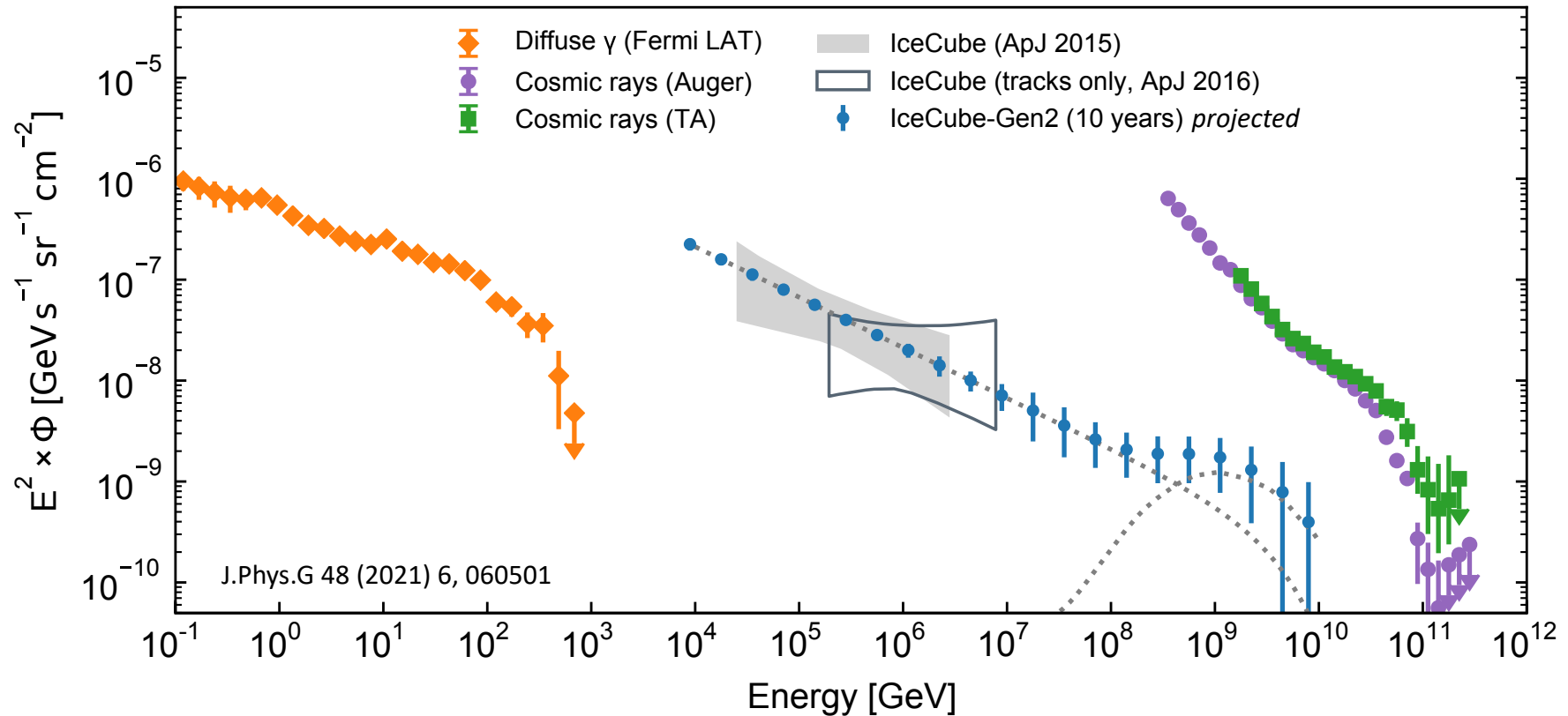
5x more sensitive than IC



# Astrophysical neutrinos

## Precision measurement of diffuse neutrino flux

## Probes particle acceleration in active galaxies





# Constraining flavor ratios

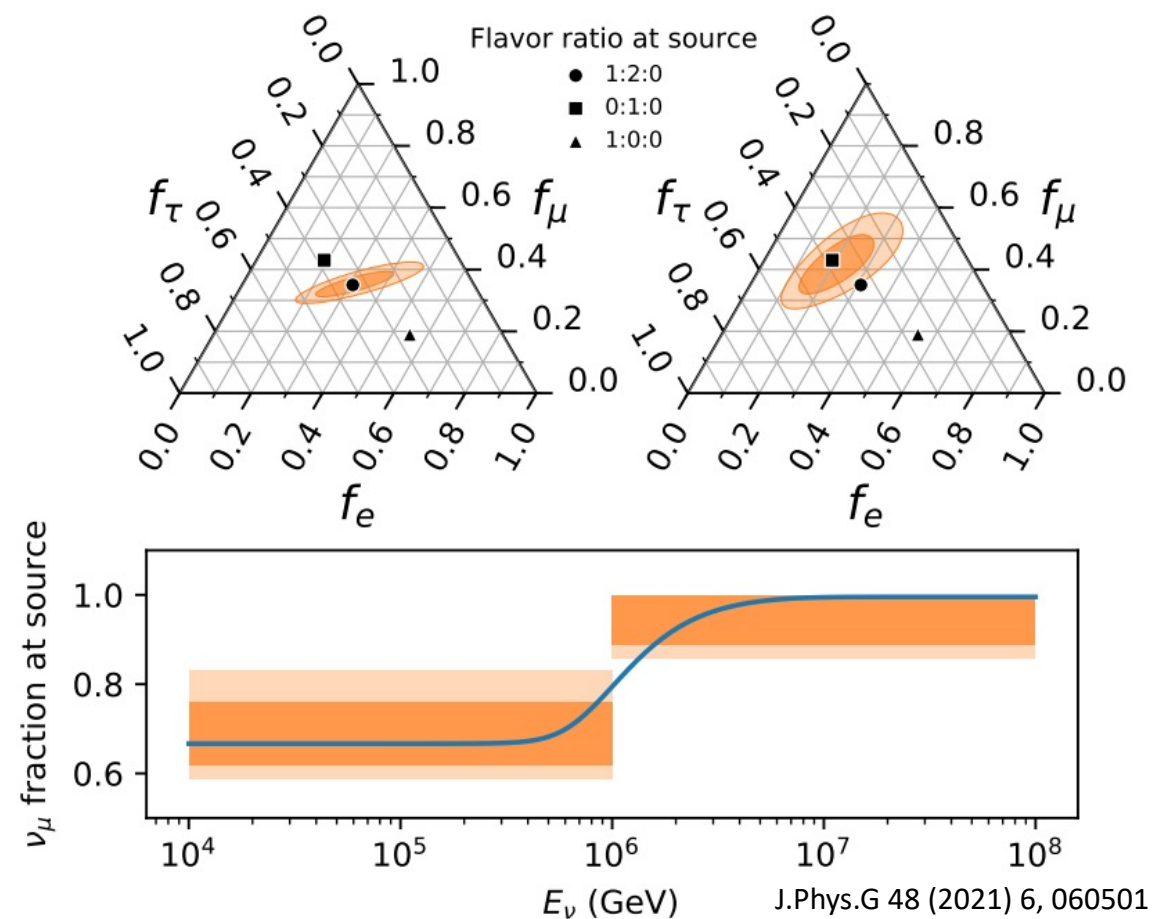
If sources have strong B-fields, charged particles can lose energy via synchrotron radiation

- Muon cooling

Can be probed by flavor composition

Extract energy-dependent flavor compositions

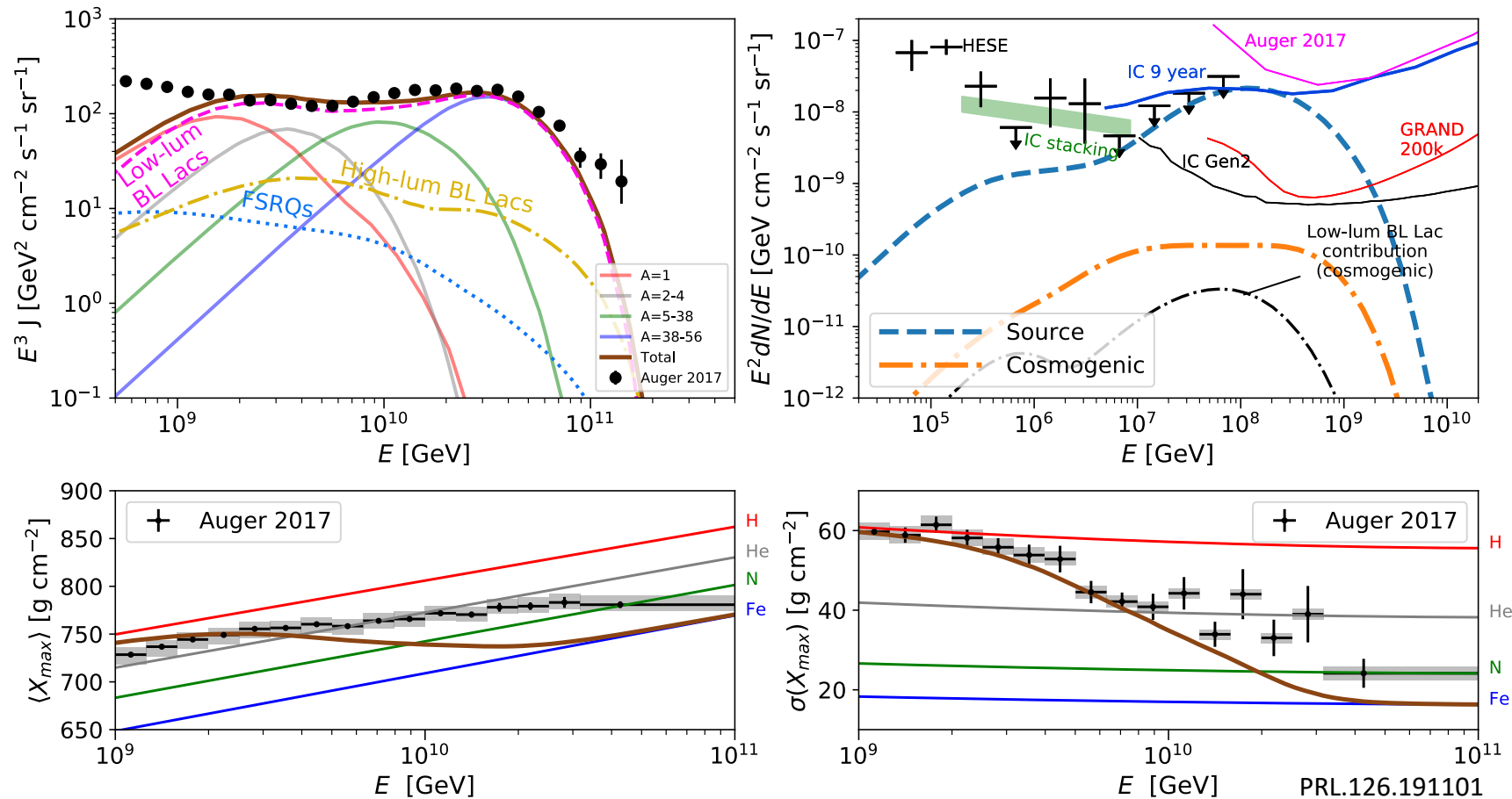
- Below 1 PeV source ratio 1:2:0
- Above 1 PeV source ratio 0:1:0



J.Phys.G 48 (2021) 6, 060501

# Connection with UHECR

Potential for (FSRQ) source neutrinos to outshine cosmogenic nus  
Informs UHECR composition/spectrum

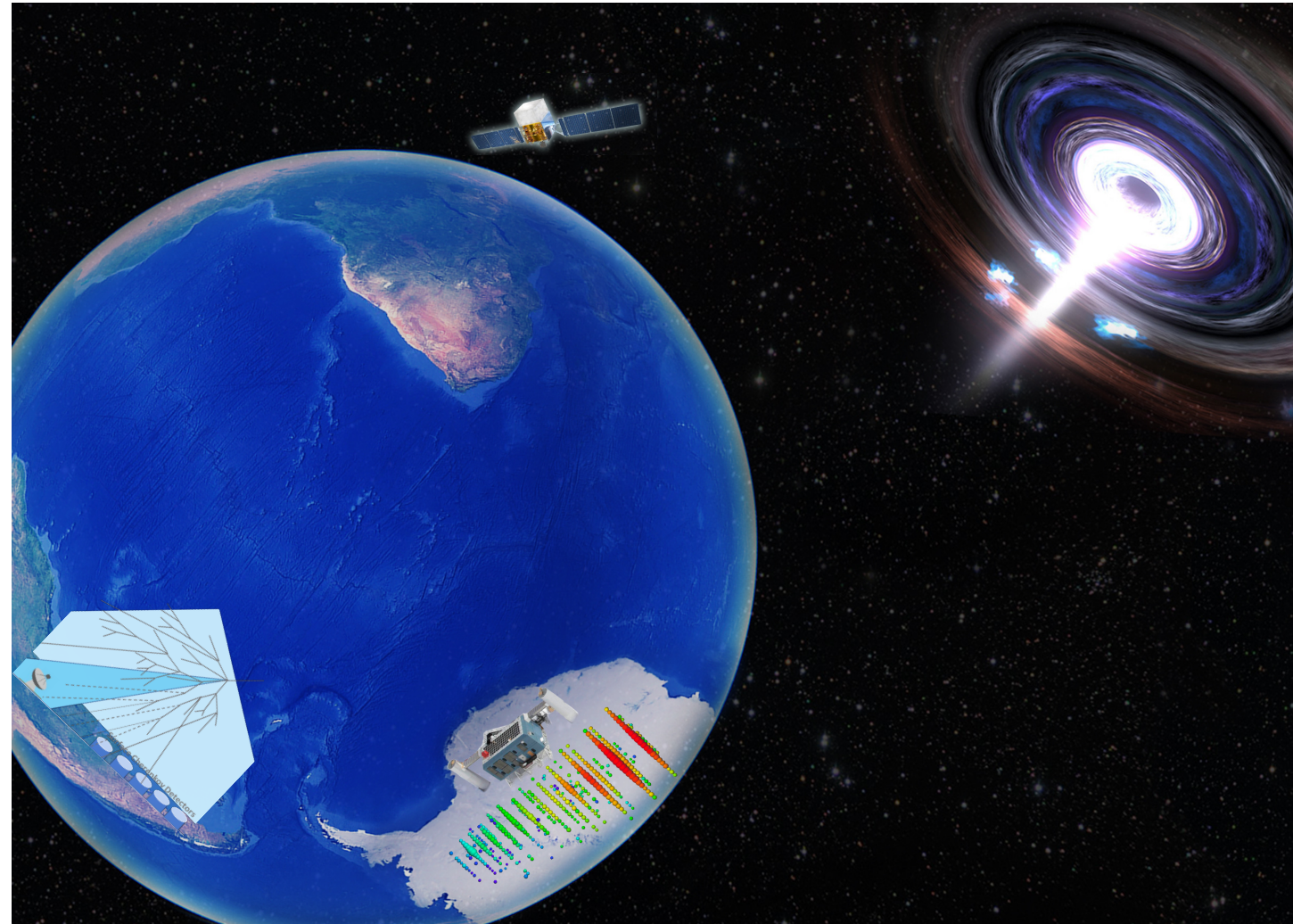


PRL.126.191101

# Multimessenger astrophysics on a global scale

IceCube has already demonstrated the importance of real-time multimessenger efforts

Inline with GCOS, IceCube-Gen2 will provide an avenue to search for correlations online and offline





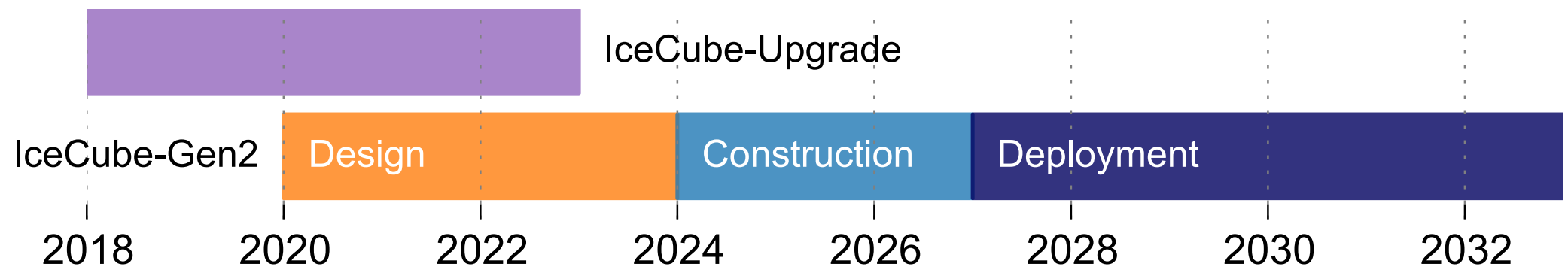
# Timeline

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IceCube Upgrade under construction

IceCube-Gen2 includes not only optical but surface+radio efforts (c.f. next talk by Alan Coleman)

Moving in-step with the GCOS timeline



# Summary and discussion

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In the last decade IceCube has discovered

- Cosmic neutrino flux
- First high-energy (TeV) astrophysical neutrino source
- Glashow resonance candidate with implications for flavor+charge PID

IceCube-Gen2 increases our sensitivities to even higher energies

Plenty of room for multimessenger efforts with new experiments

There remains much to be discovered

# Backups

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