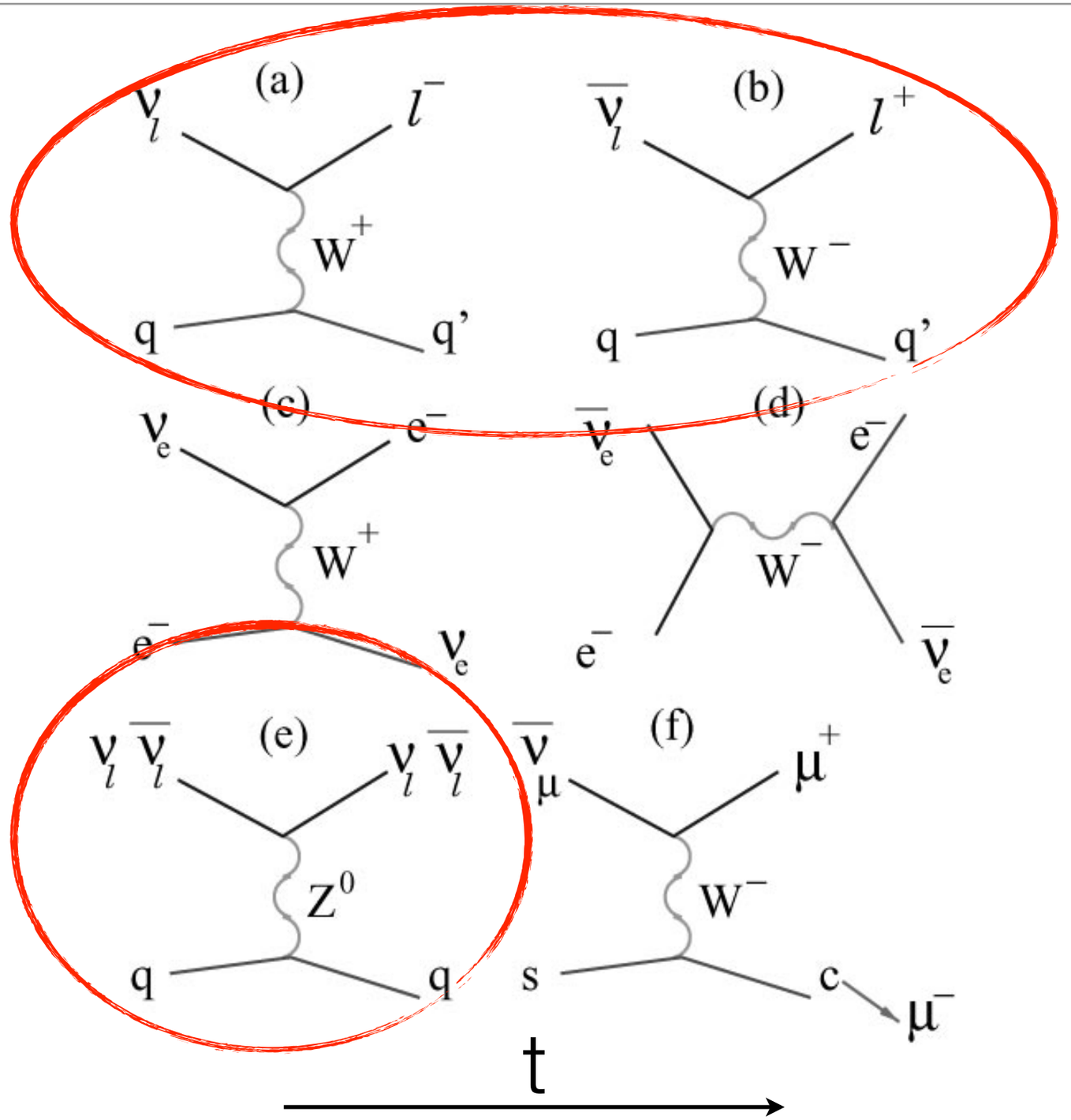
The IceCube Neutrino Observatory

IMPRS Retreat 2011, Hamburg

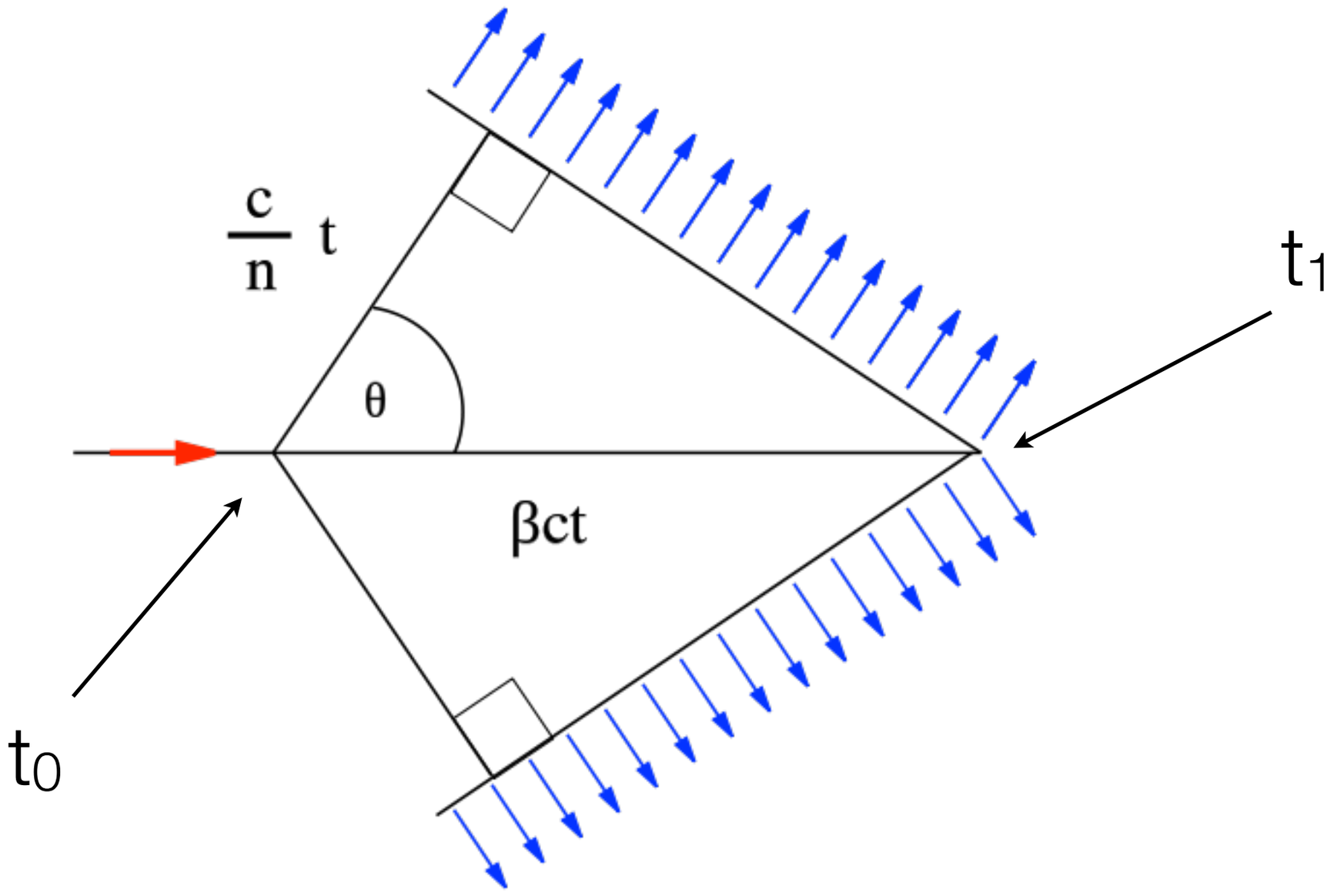
Lars Flöer

Neutrinos produce secondary particles by scattering with a nucleus



Gomez-Cadenas & Harris, 2002

Particles emit Cherenkov radiation if they exceed the speed of light in the ambient medium



http://en.wikipedia.org

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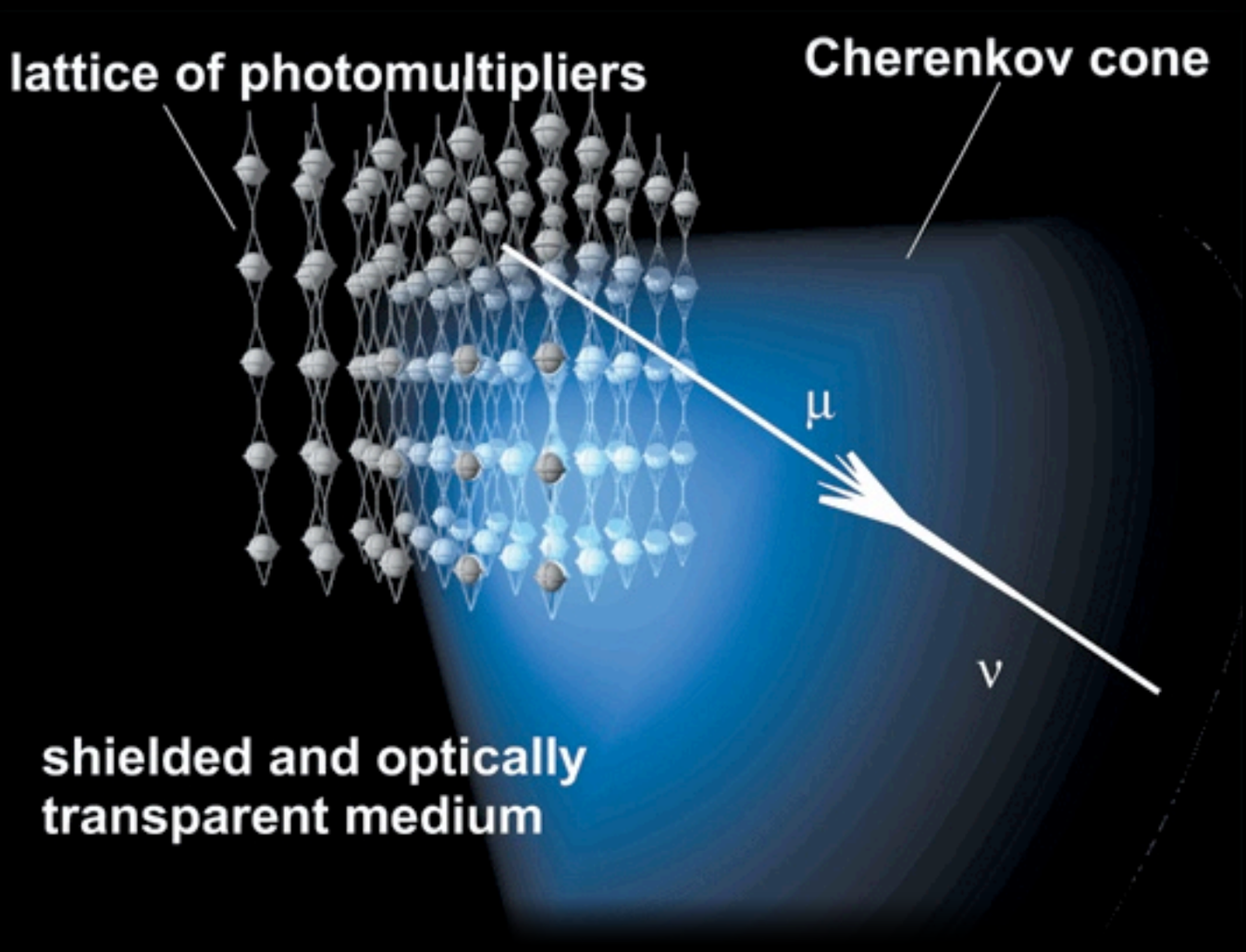
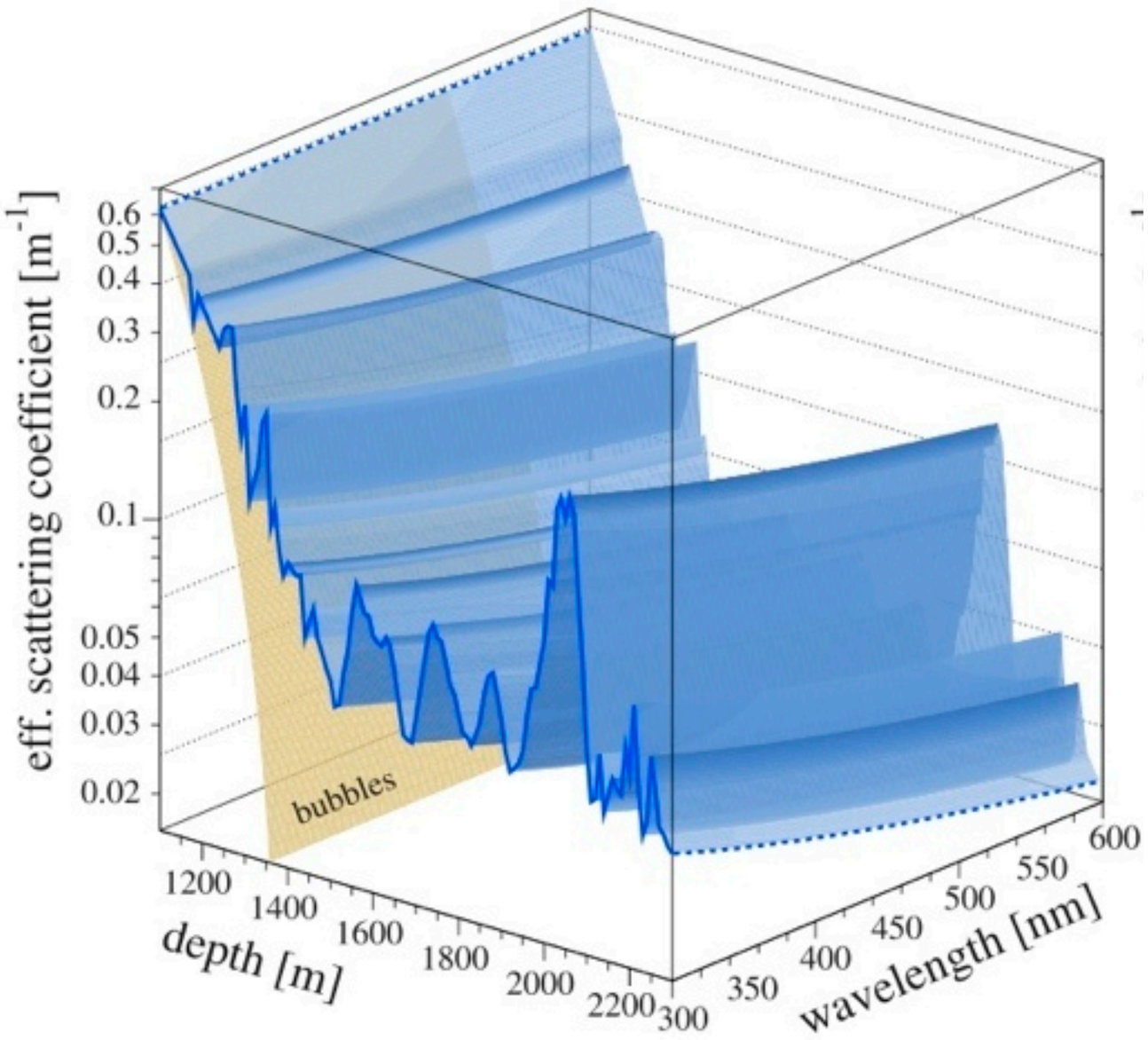
Neutrinos are detected by observation of Cherenkov radiation from secondary leptons



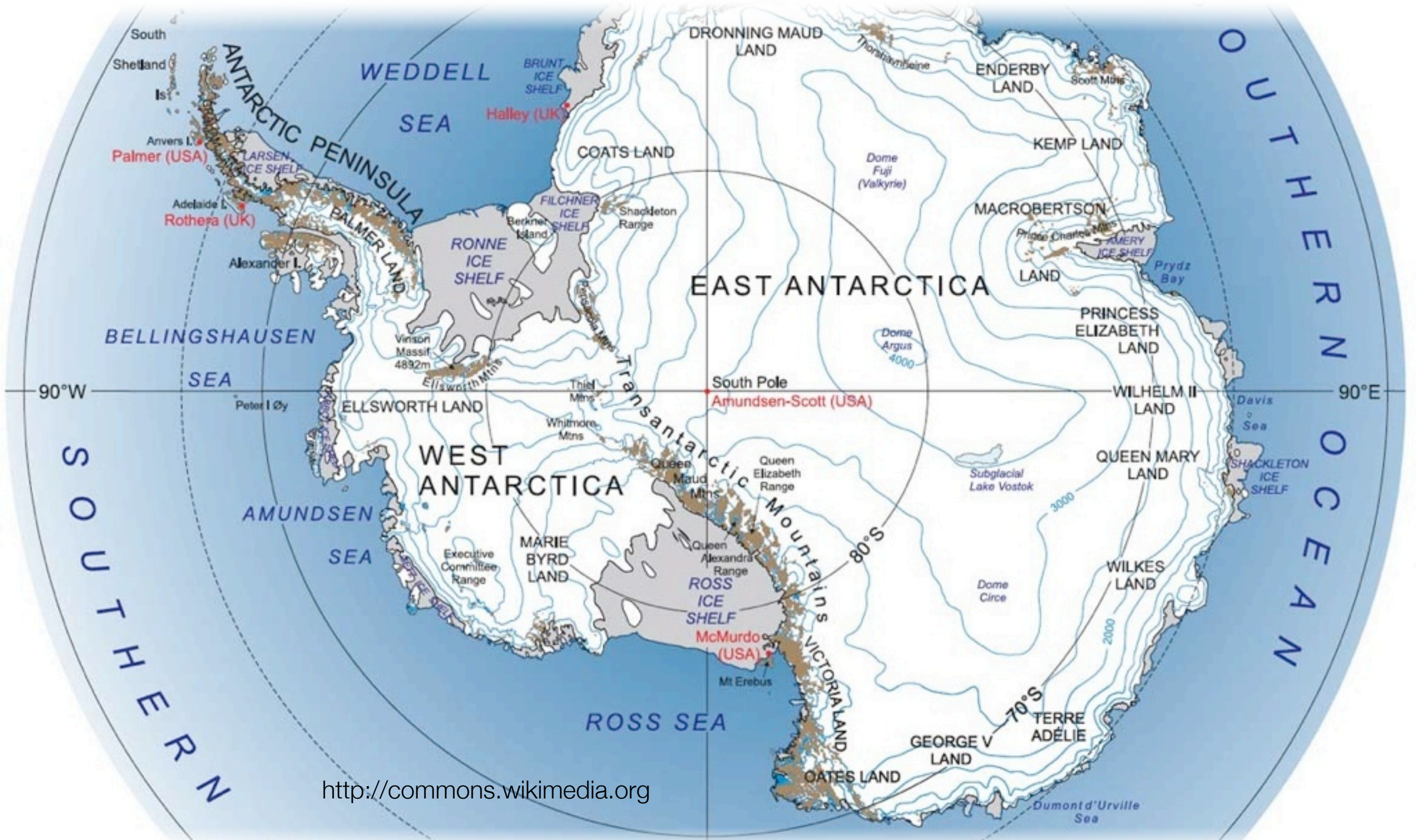
Francis Halzen, "IceCube neutrino observatory," in AccessScience, ©McGraw-Hill Companies, 2011, http://www.accessscience.com

Antarctic ice at >1450m depth is the ideal detector medium



Halzen & Klein, 2010

IceCube is located at the south pole



http://commons.wikimedia.org

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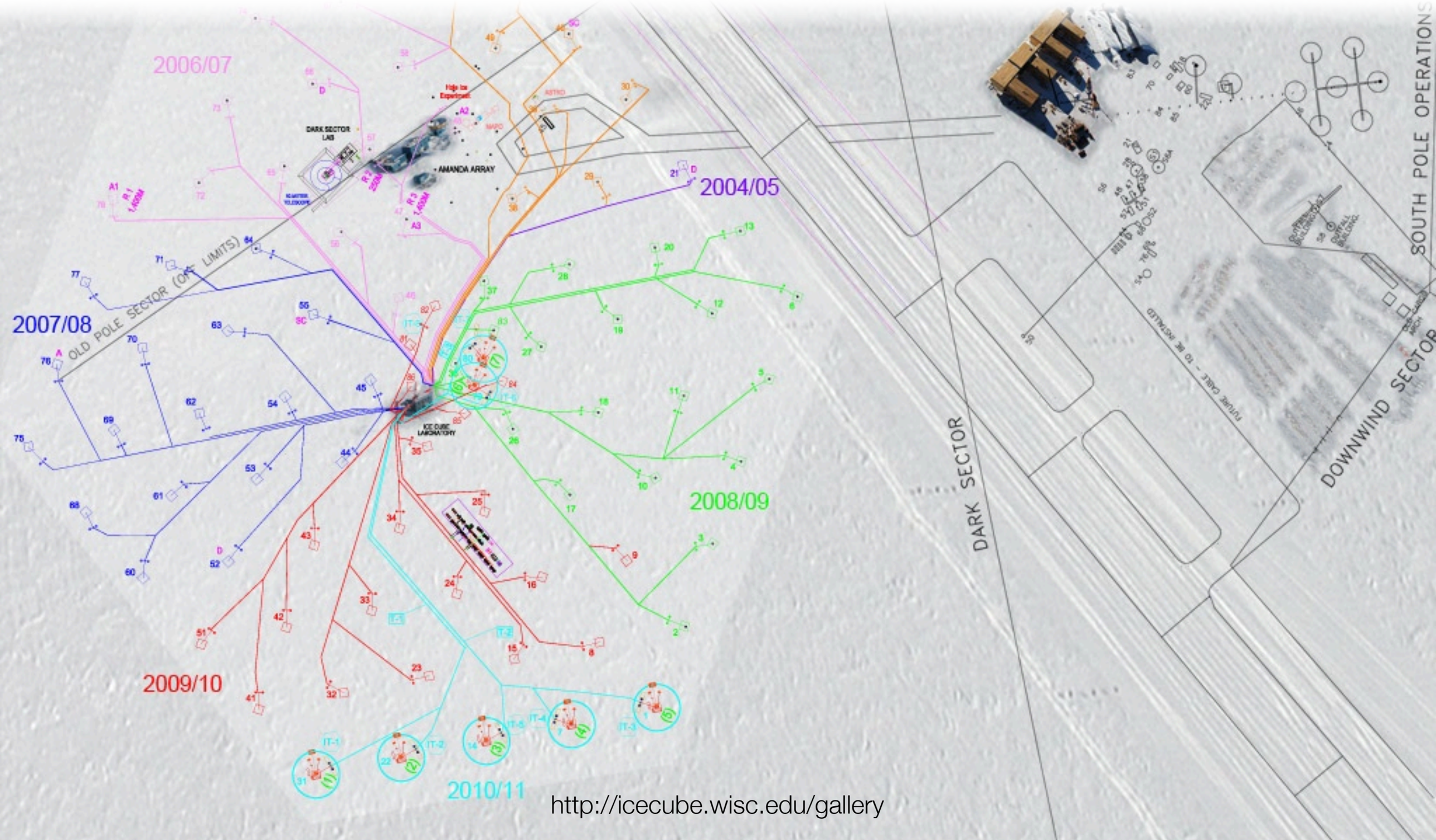
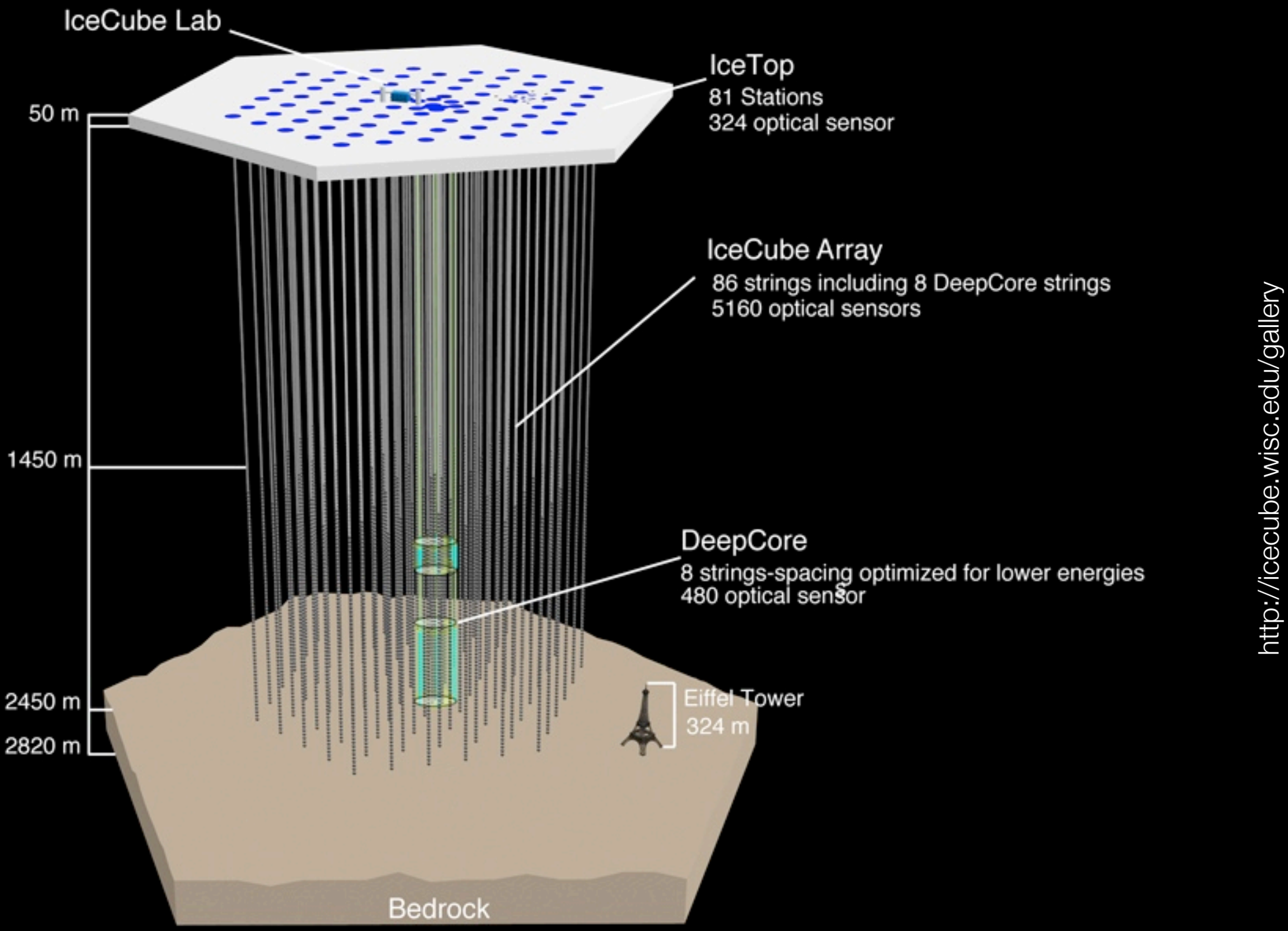


http://icecube.wisc.edu/gallery

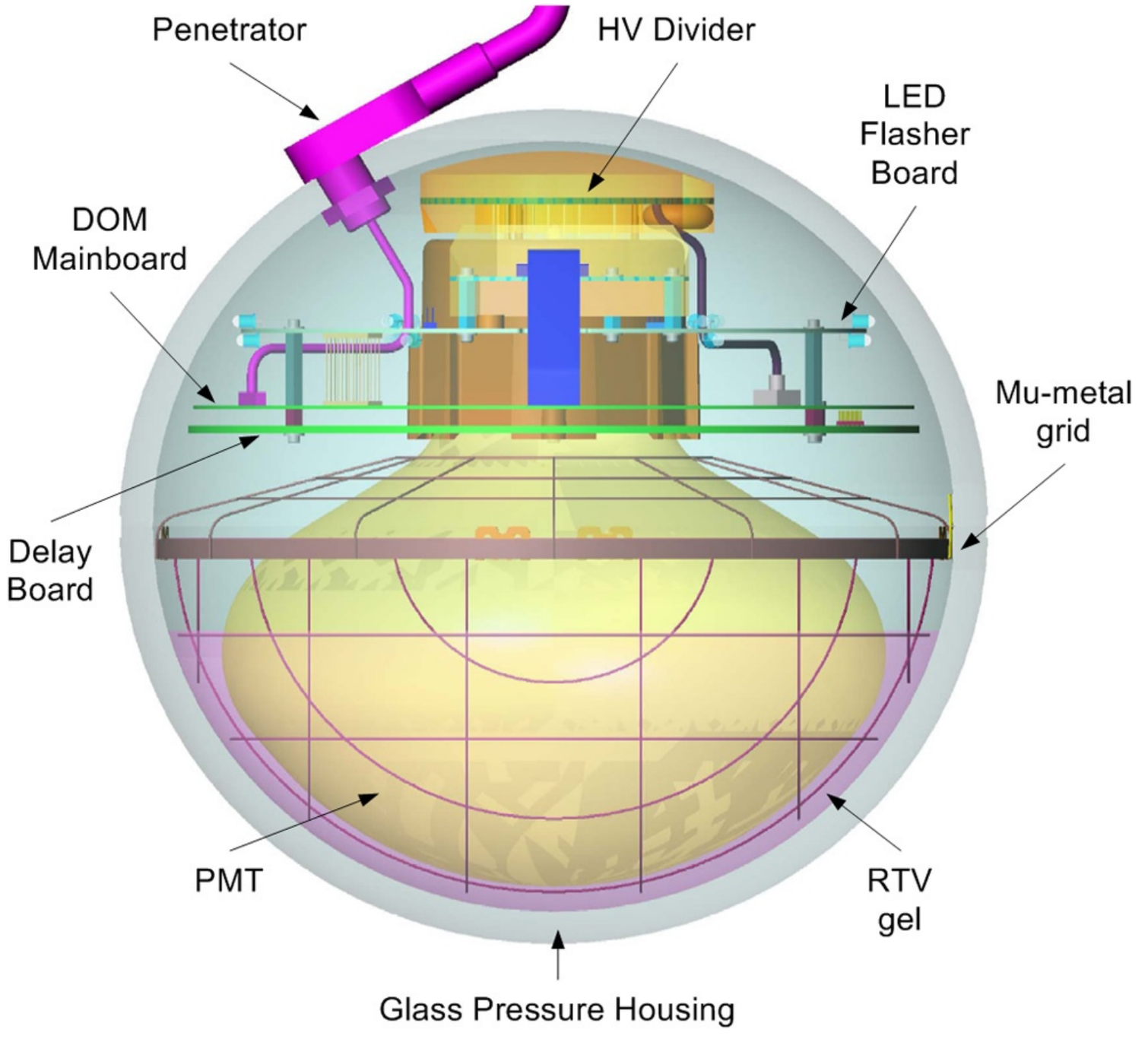
Assembly during the austral summer months with hot-water drills

http://icecube.wisc.edu/gallery

IceCube
An in-ice Cherenkov detector at the south pole



Digital-Optical-Modules send events to the surface



http://icecube.wisc.edu/gallery

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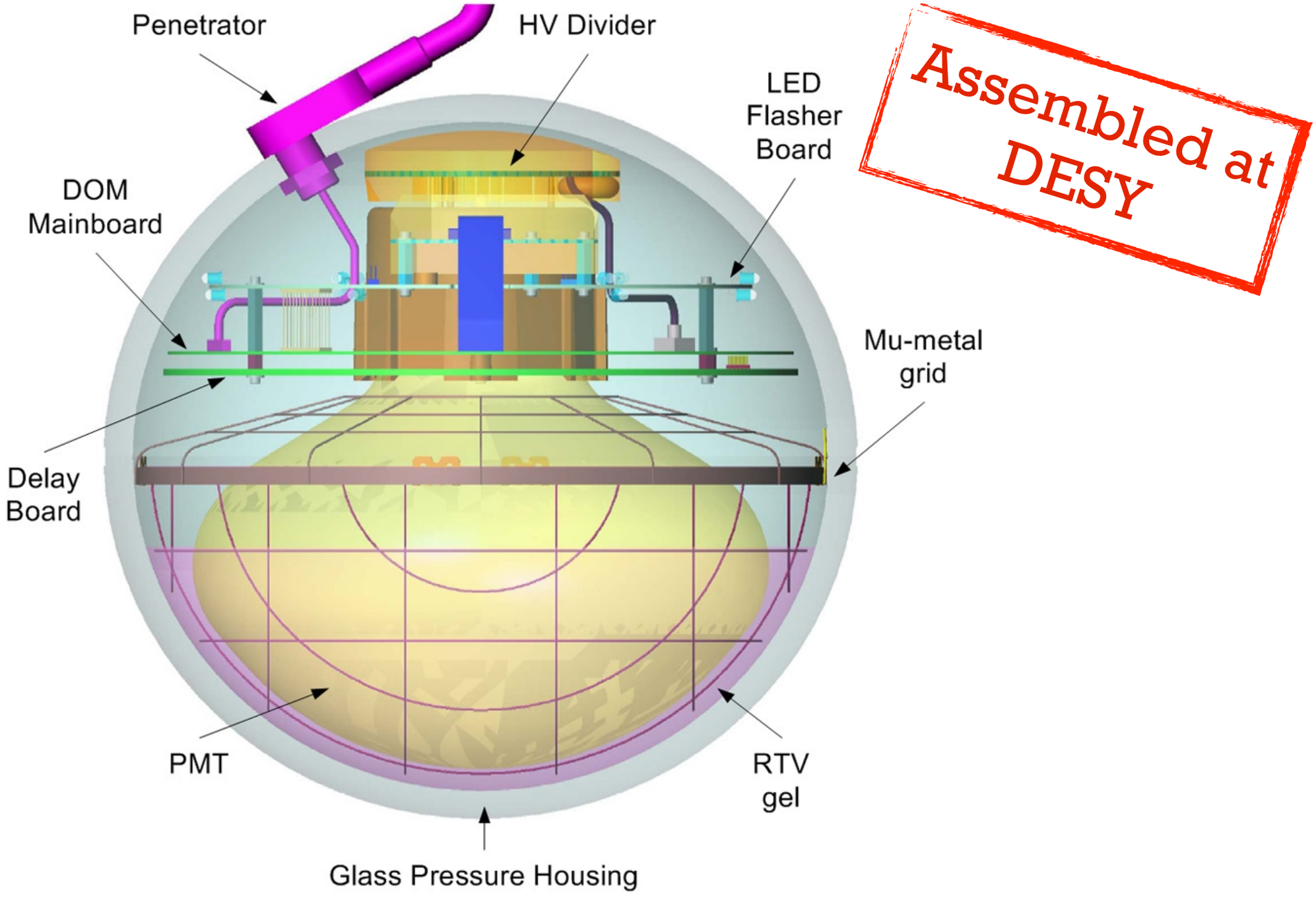
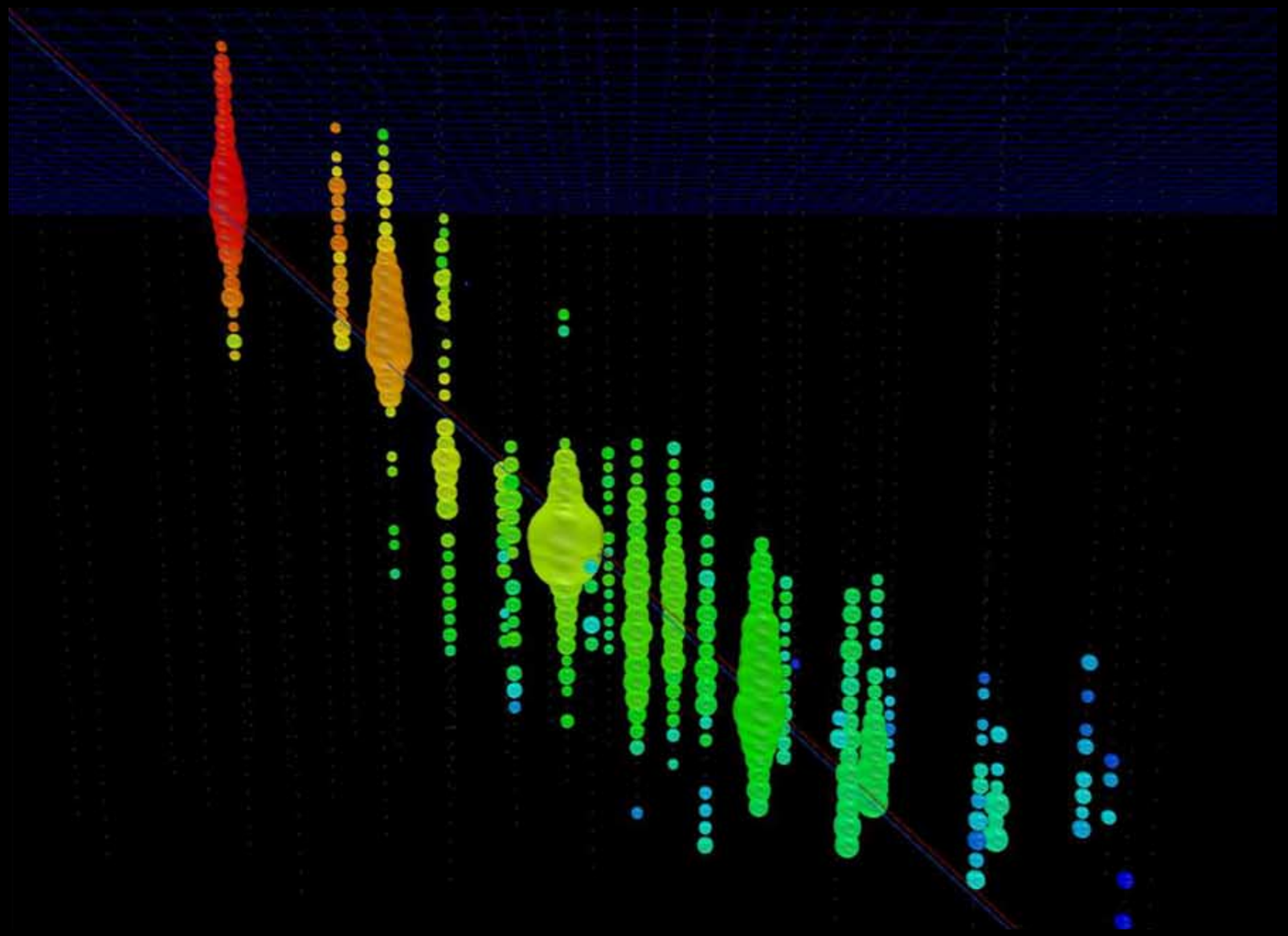


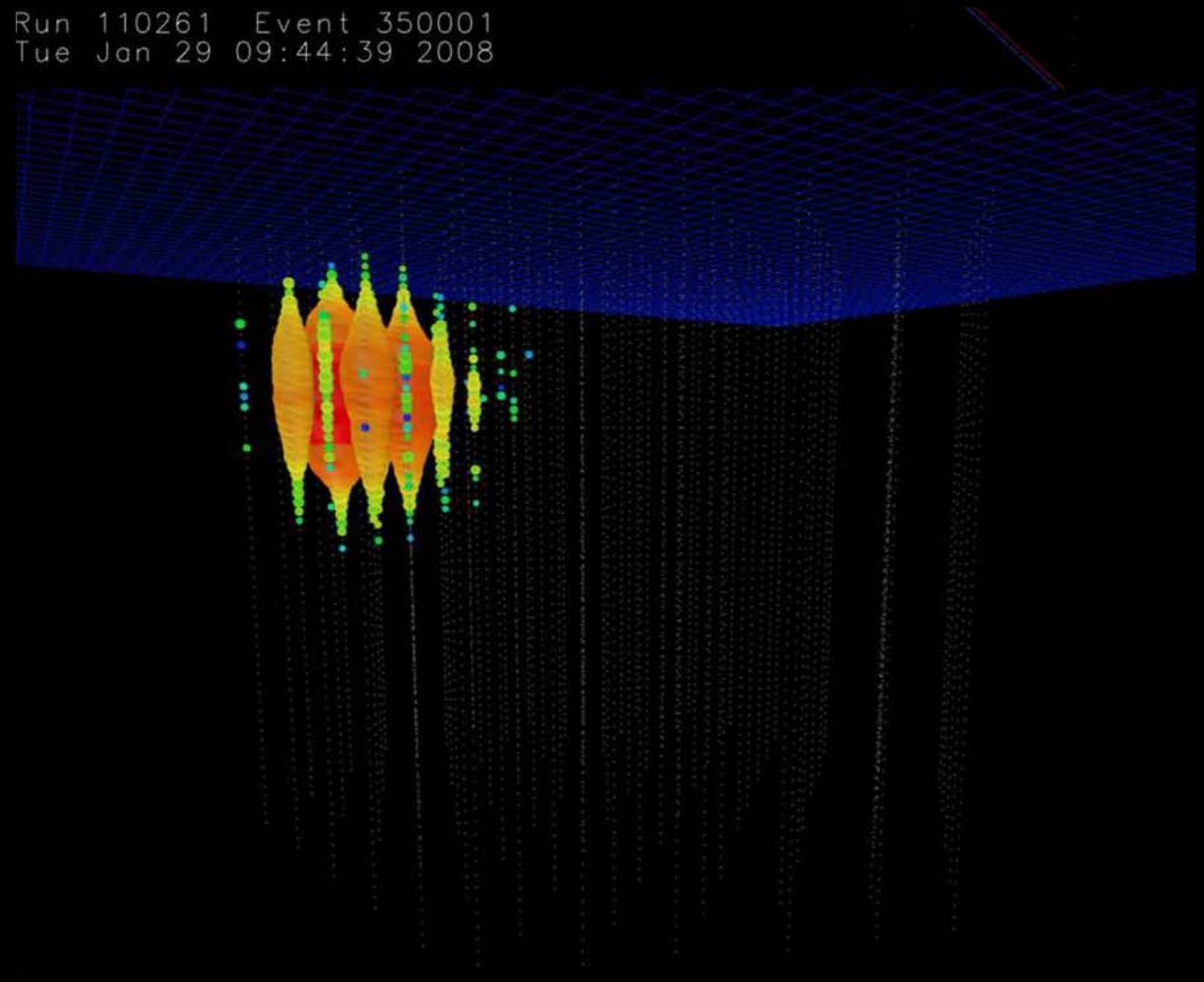
http://icecube.wisc.edu/gallery

Muon neutrinos produce tracks



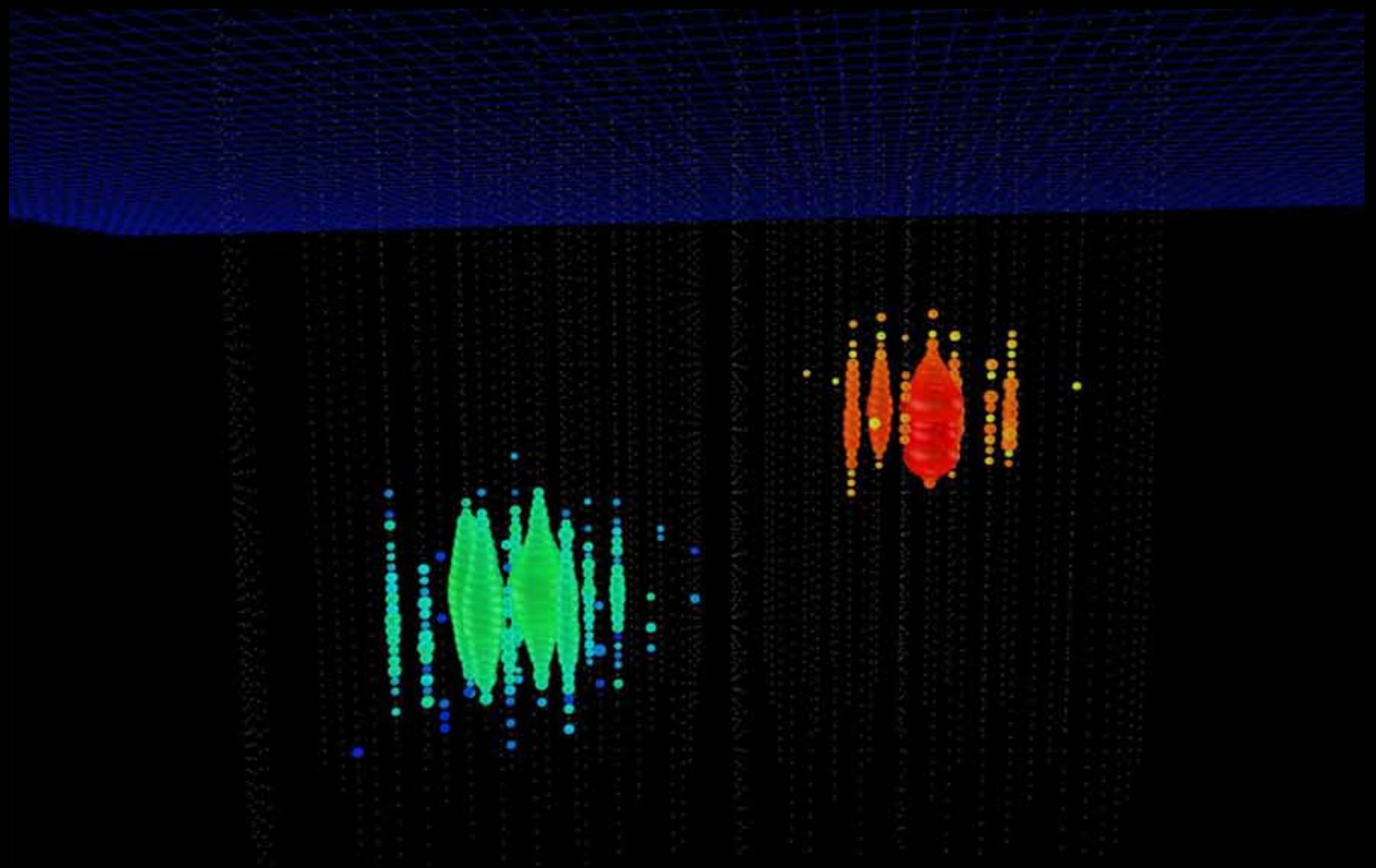
Halzen & Klein, 2010

Electron neutrinos produce cascades



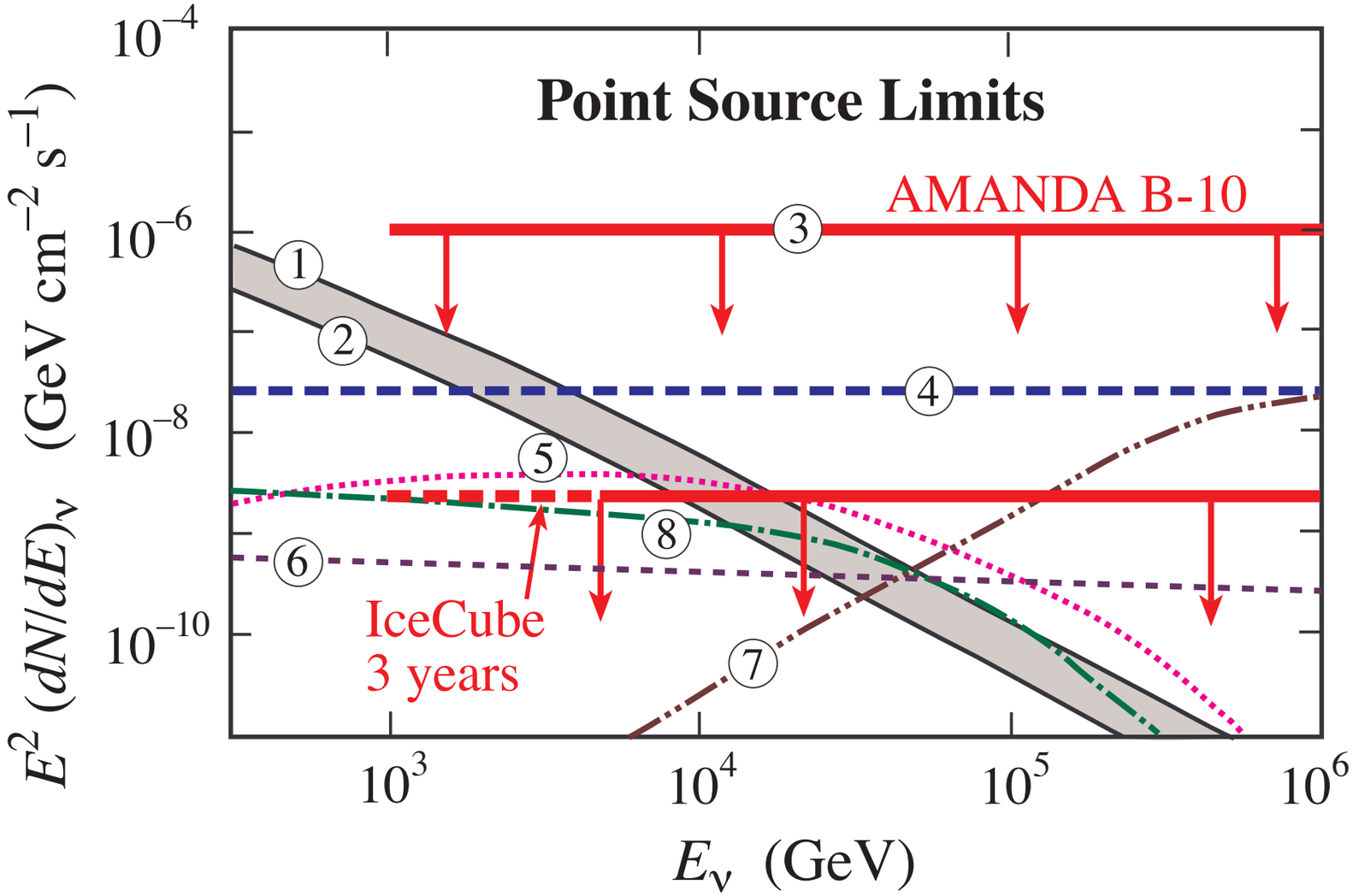
Halzen & Klein, 2010

Tau neutrinos produce a cascade followed by a secondary cascade from tau lepton decay



Halzen & Klein, 2010

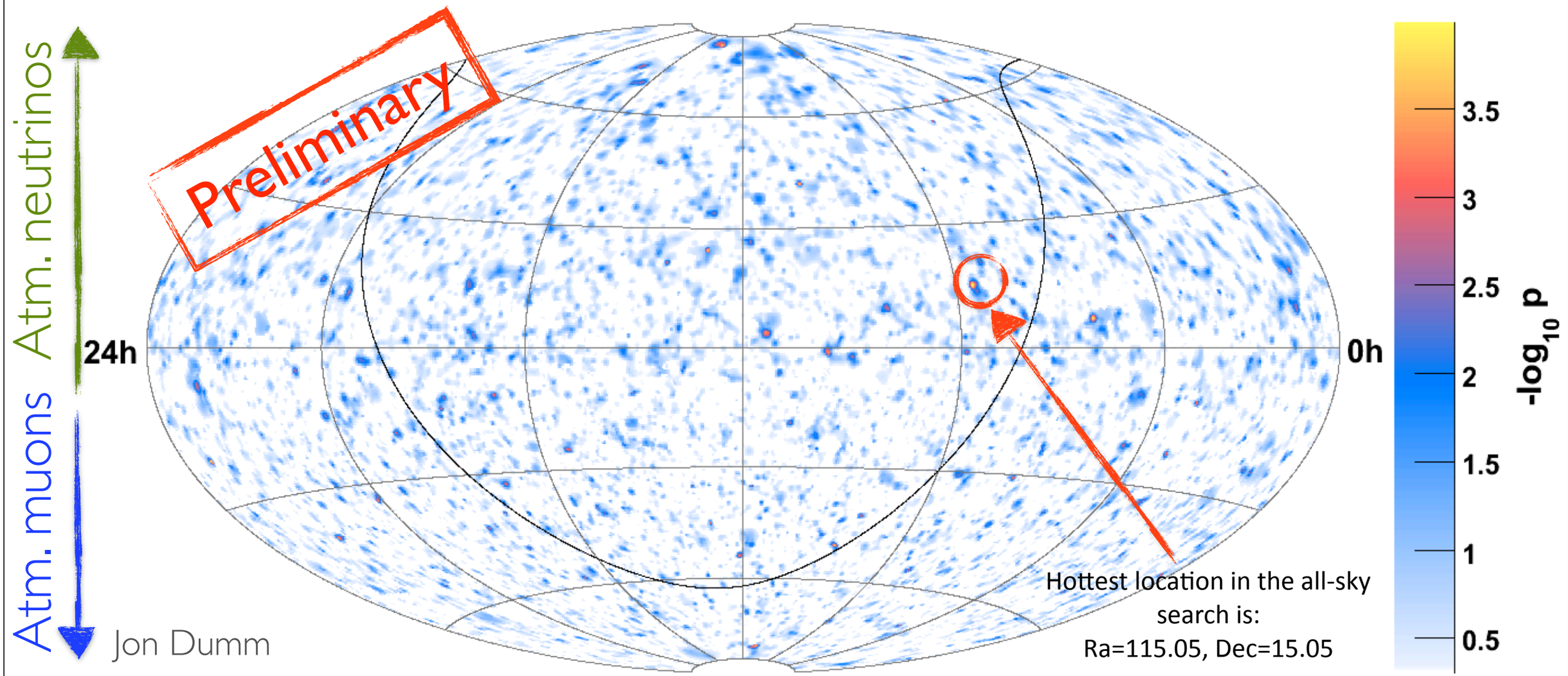
IceCube Science:
High-energy neutrino point sources



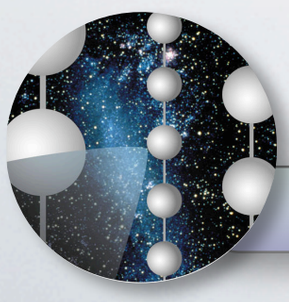
4: 3C273 pp-Neutrinos
5: Crab Nebula
6: Coma Cluster
7: 3C273 pγ-Neutrinos
8: Supernovae

IceCube Preliminary Design Document, 2001

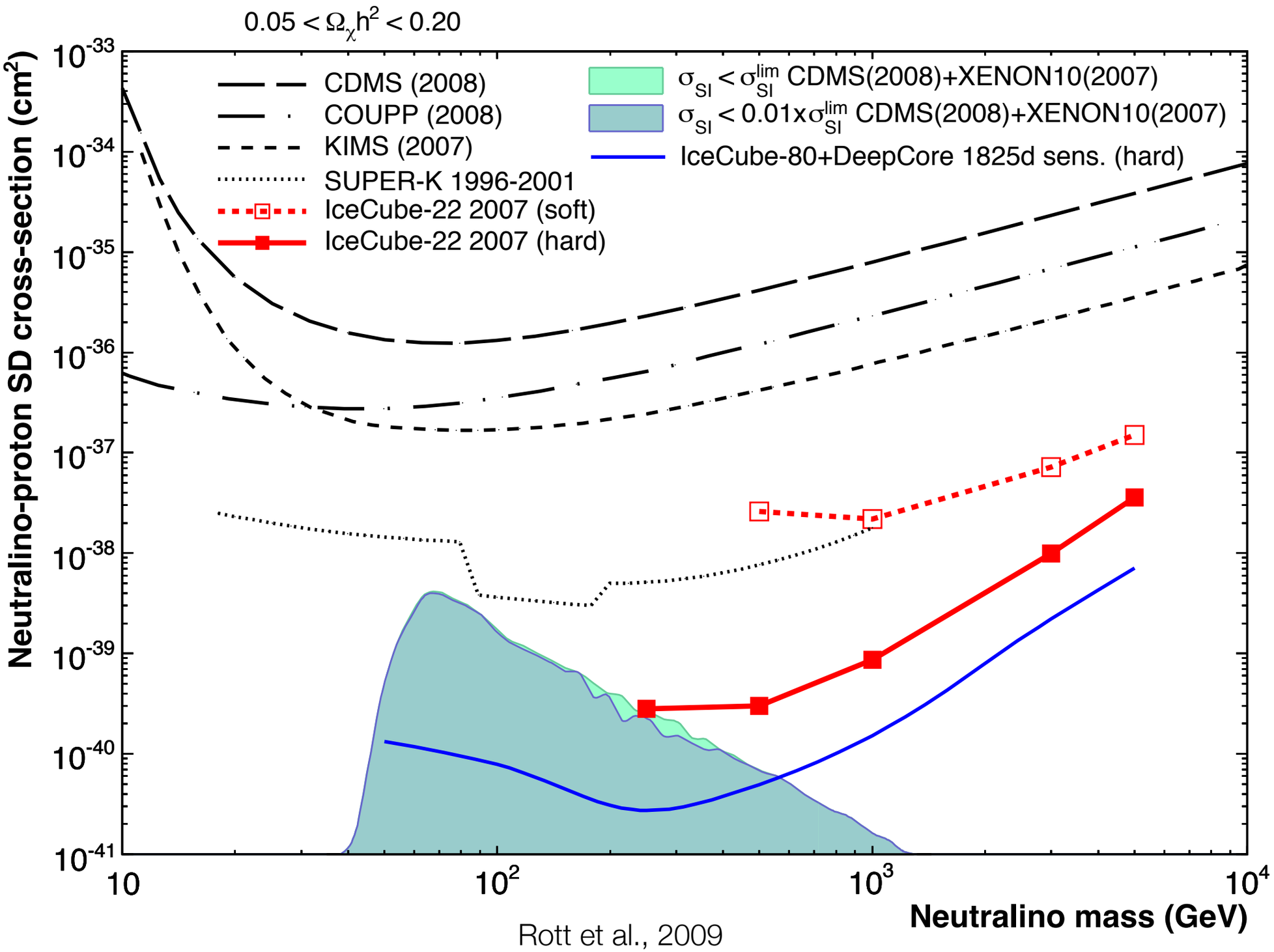
IC40 SIGNIFICANCE MAP



- Log-likelihood is calculated on a fine grid: 0.1° x 0.1°
- Significance comes from the hottest single spot, calculated as the fraction of scrambled trials with equal or higher significance – robust result

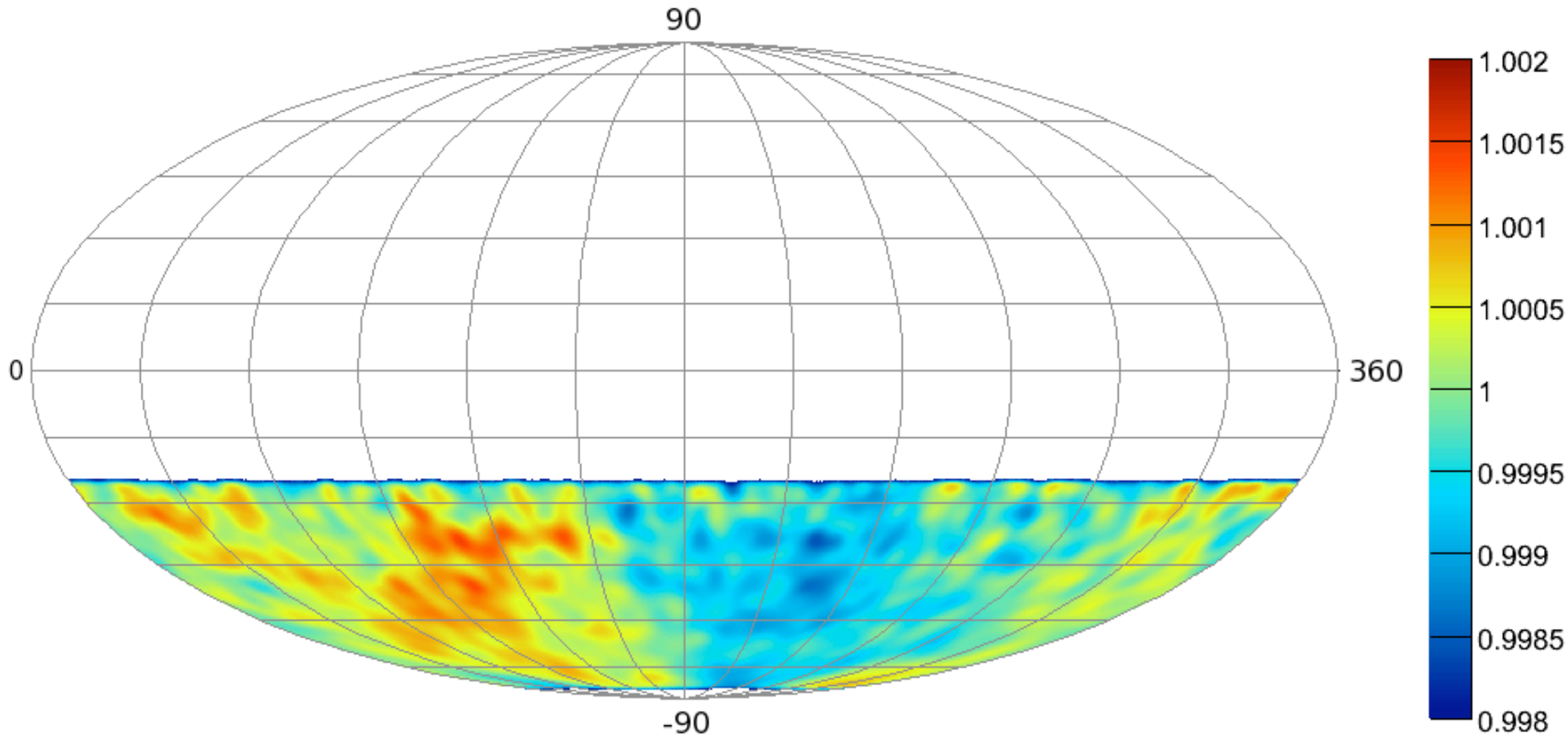


IceCube Science: Search for WIMP decay

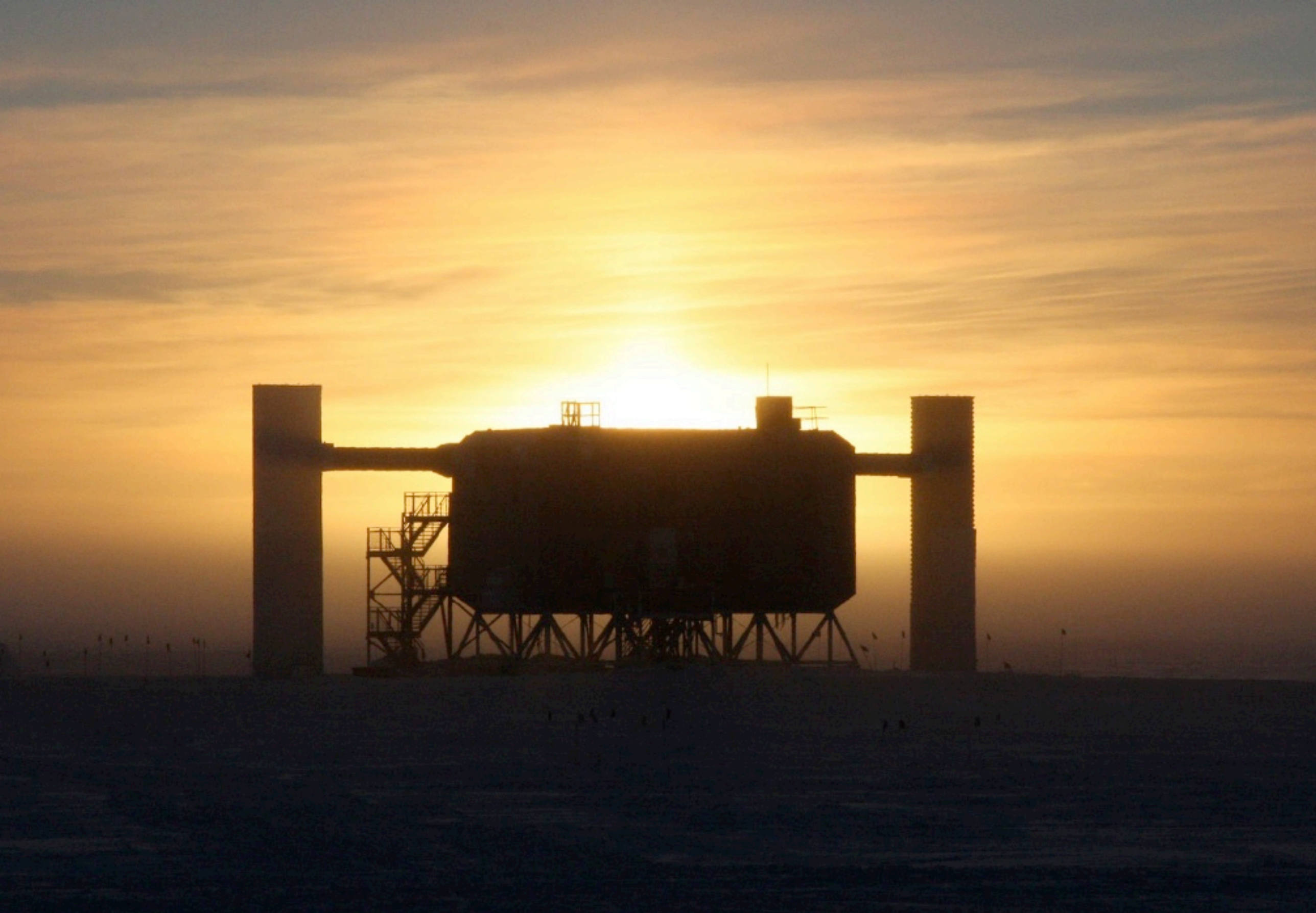


Rott et al., 2009

IceTop Science:
Anisotropy of cosmic rays



Halzen & Klein, 2010



National Science Foundation/Keith Vanderlinde