

Photo Credit: McGill University

GIGANTIC TELESCOPES FOR TINY COSMIC MESSENGERS

BRIAN CLARK
THE OHIO STATE UNIVERSITY

SCIENCE PUB
MAY 3, 2018

Original plan was to be a lawyer...

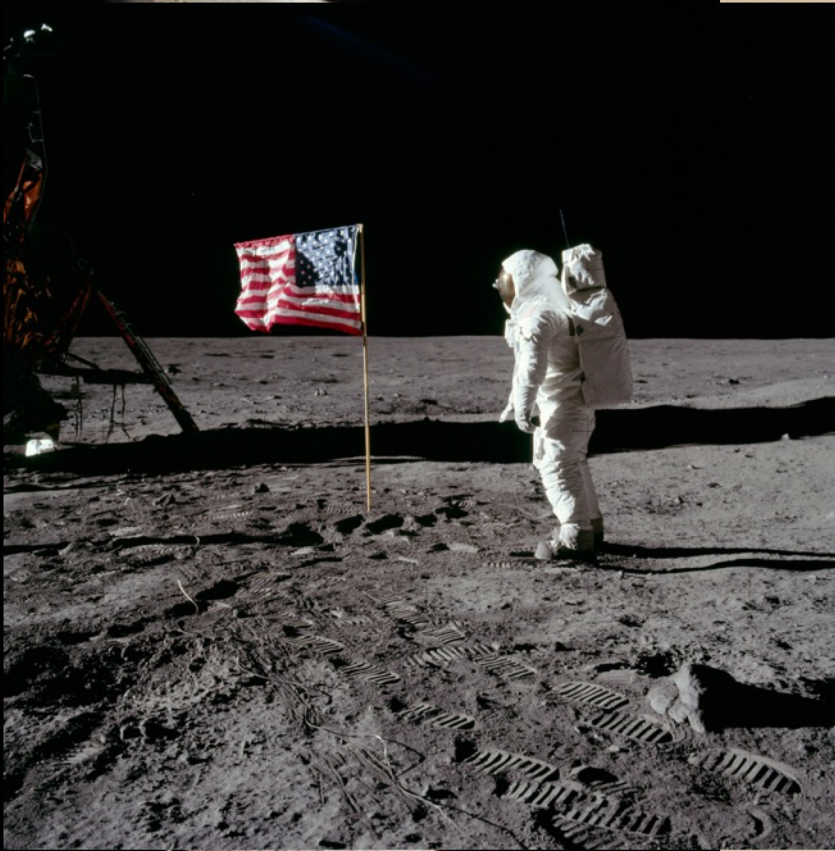


...Now I build telescopes in Antarctica!

TELESCOPES



IC: Gary Seronik

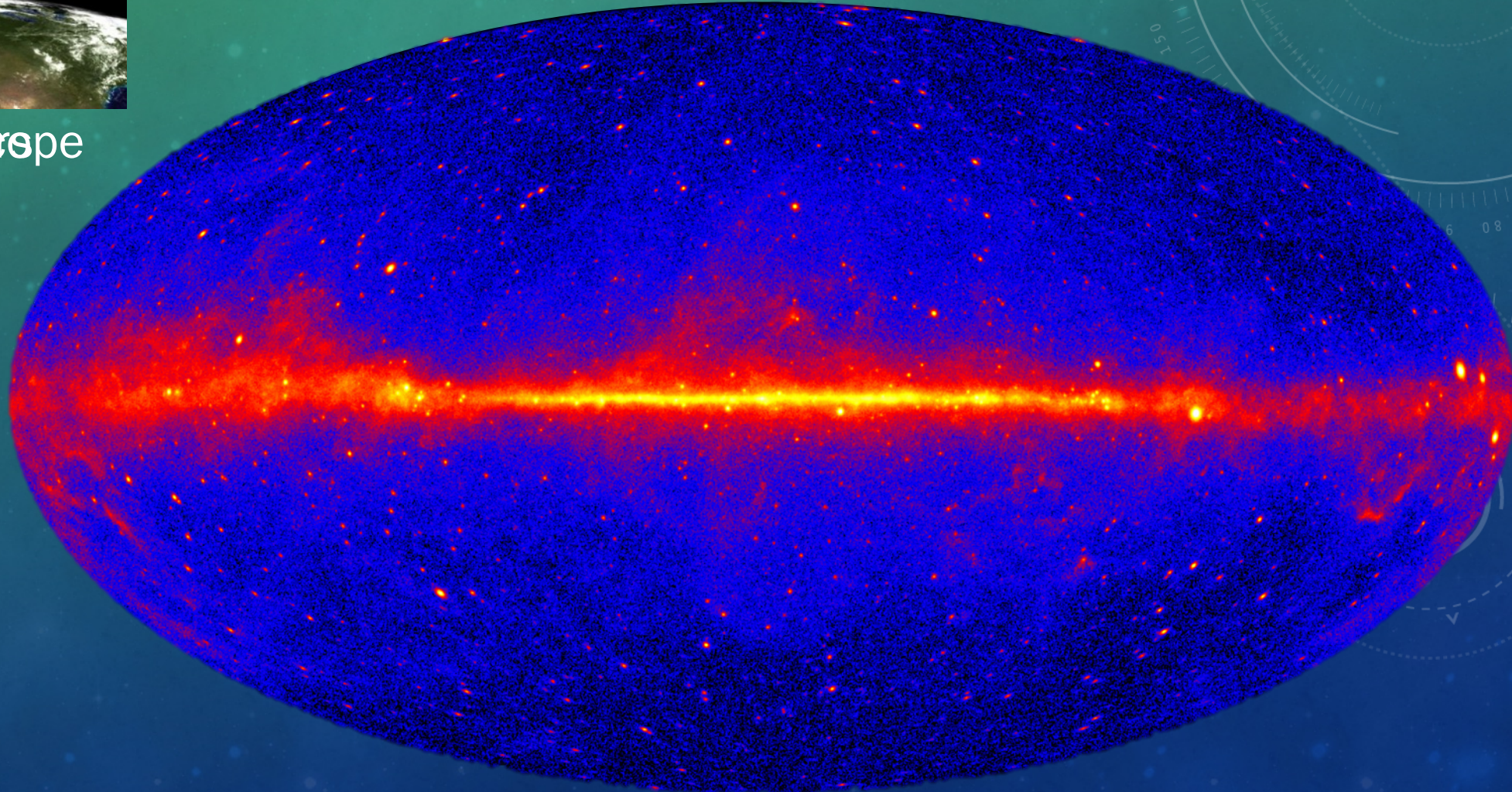


1609: Galileo observes the “rough and unequal” surface of the moon in *visible* light.

THE NIGHT SKY



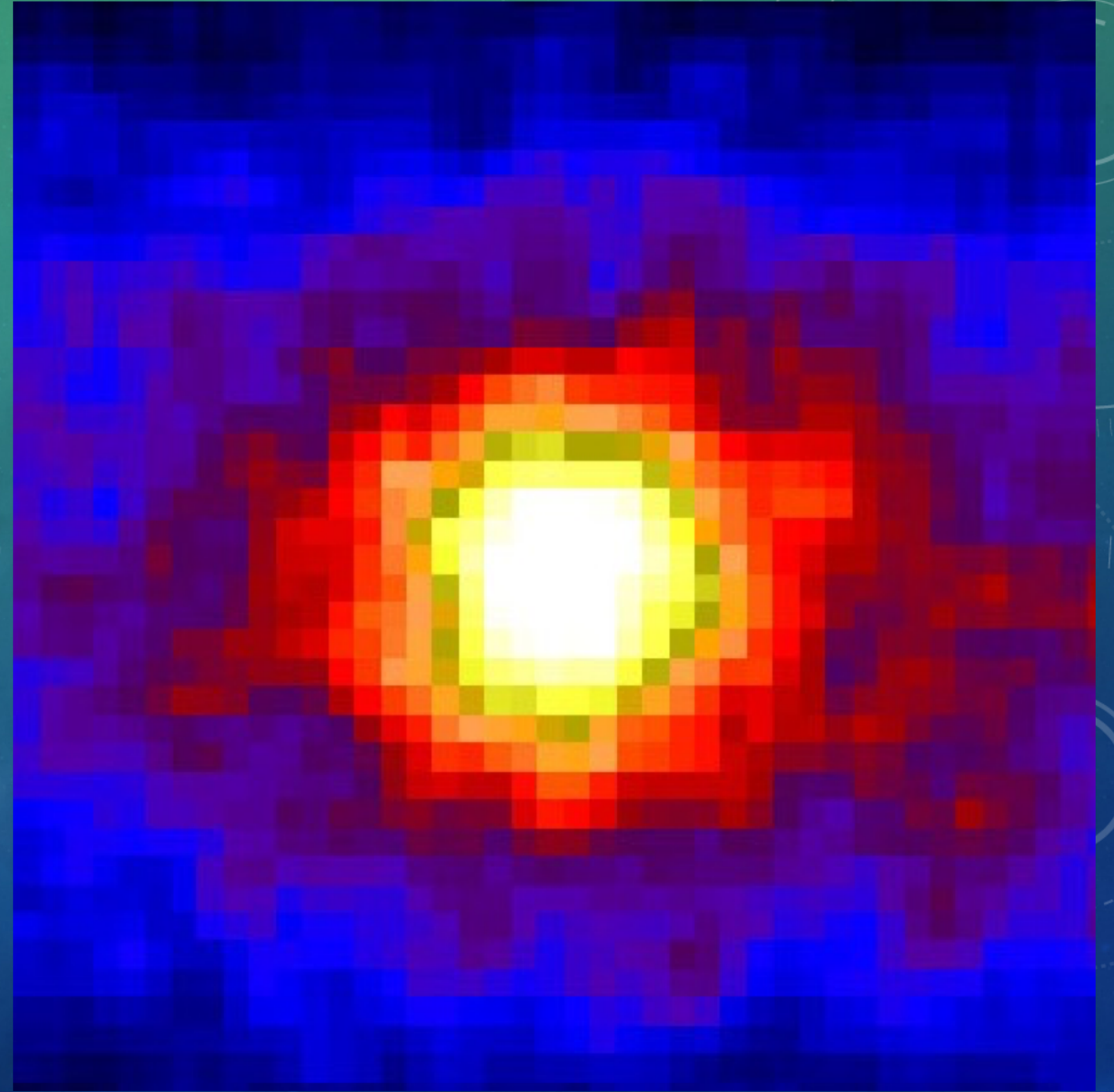
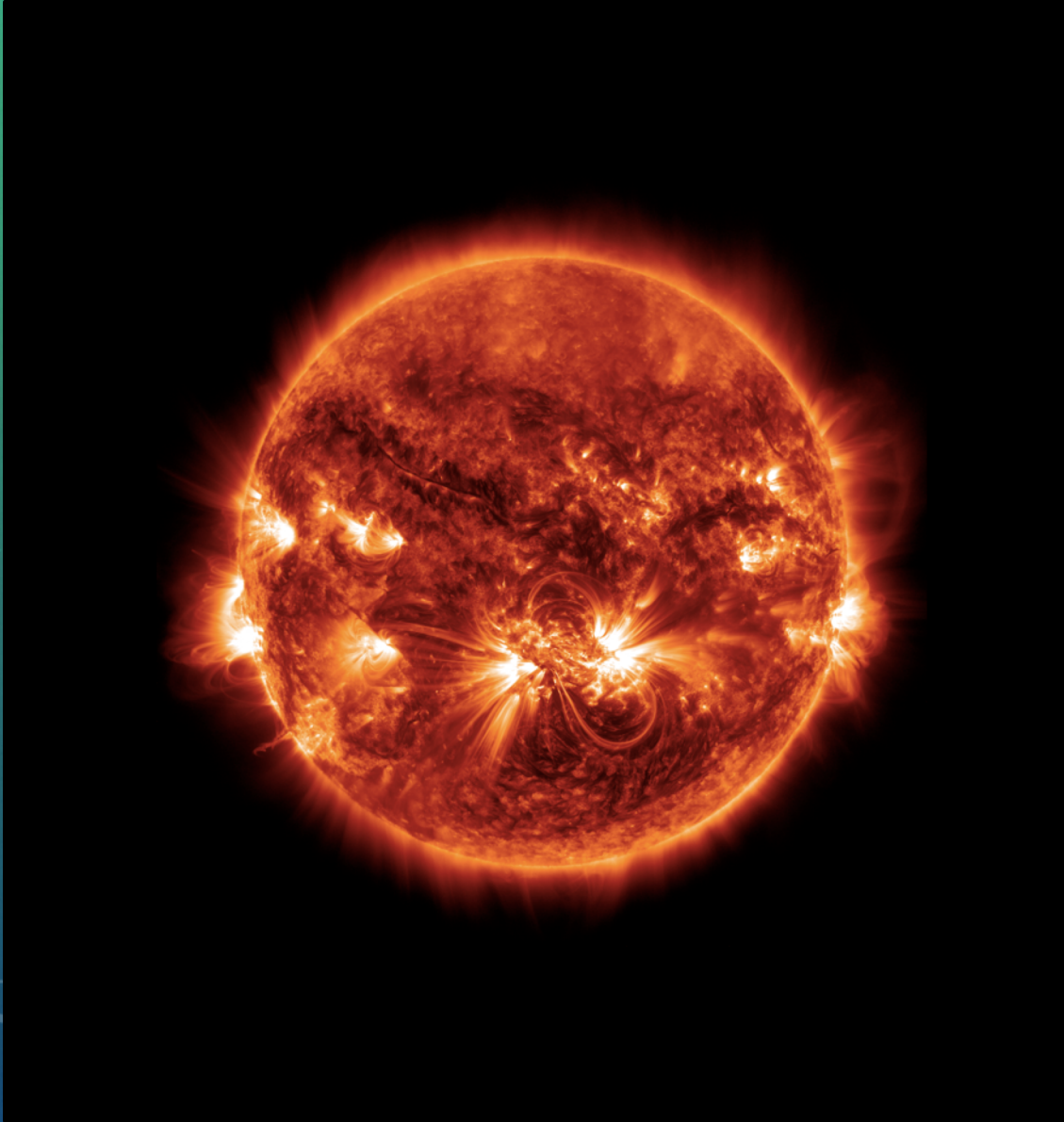
Particle Astrophysics
Gamma Rays



SO FAR, JUST *LIGHT*...

...ANYTHING ELSE?

Yes! Neutrinos



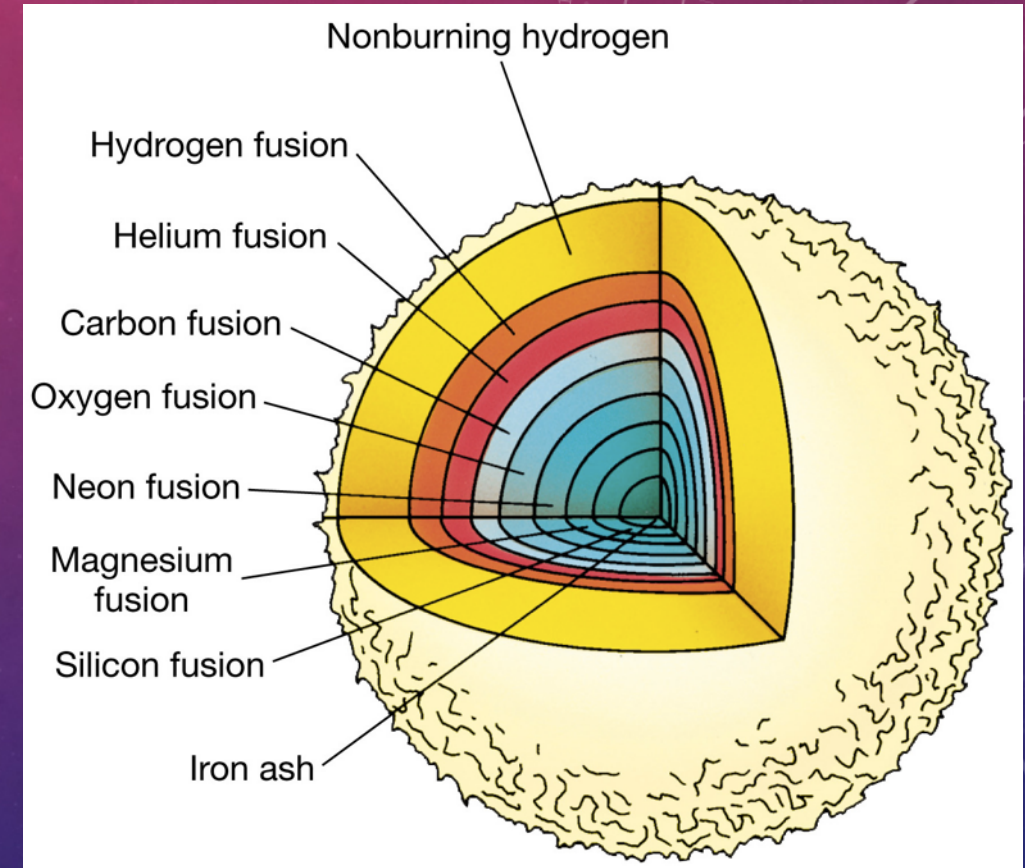


NEUTRINOS: THE GHOST MESSENGER

BORN IN ANY NUCLEAR REACTION



Fission in Nuclear Reactors

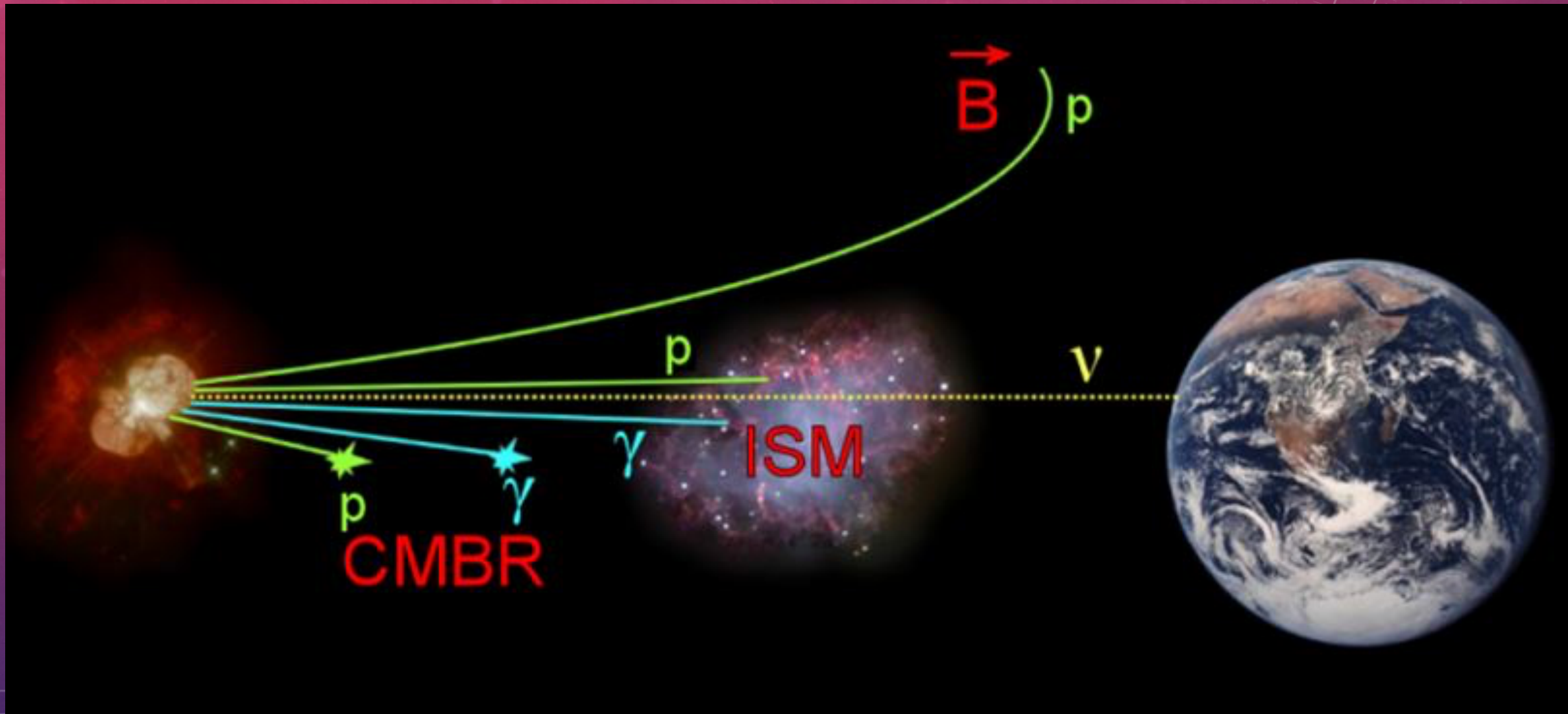


Fusion Inside stars

LIGHT AND WEAKLY INTERACTING

100 trillion neutrinos pass through your body **every second!!!**

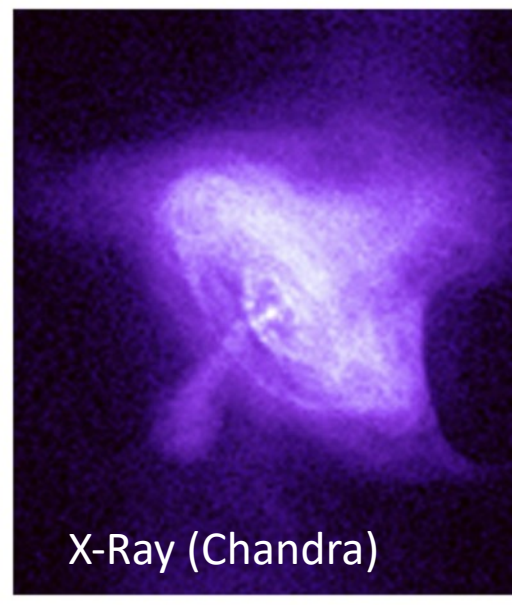






**DREAM FOR ME:
SEE THE UNIVERSE
THROUGH NEUTRINO EYES**

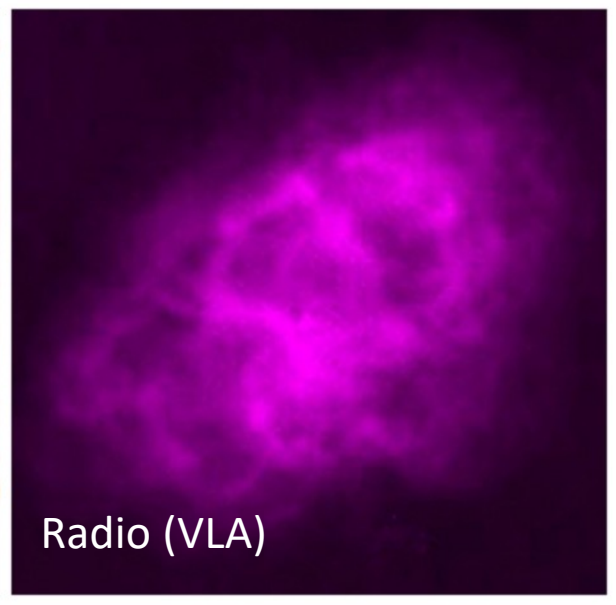
In Neutrinos?



X-Ray (Chandra)



Radio (VLA)



Crab Pulsar (HAWC)

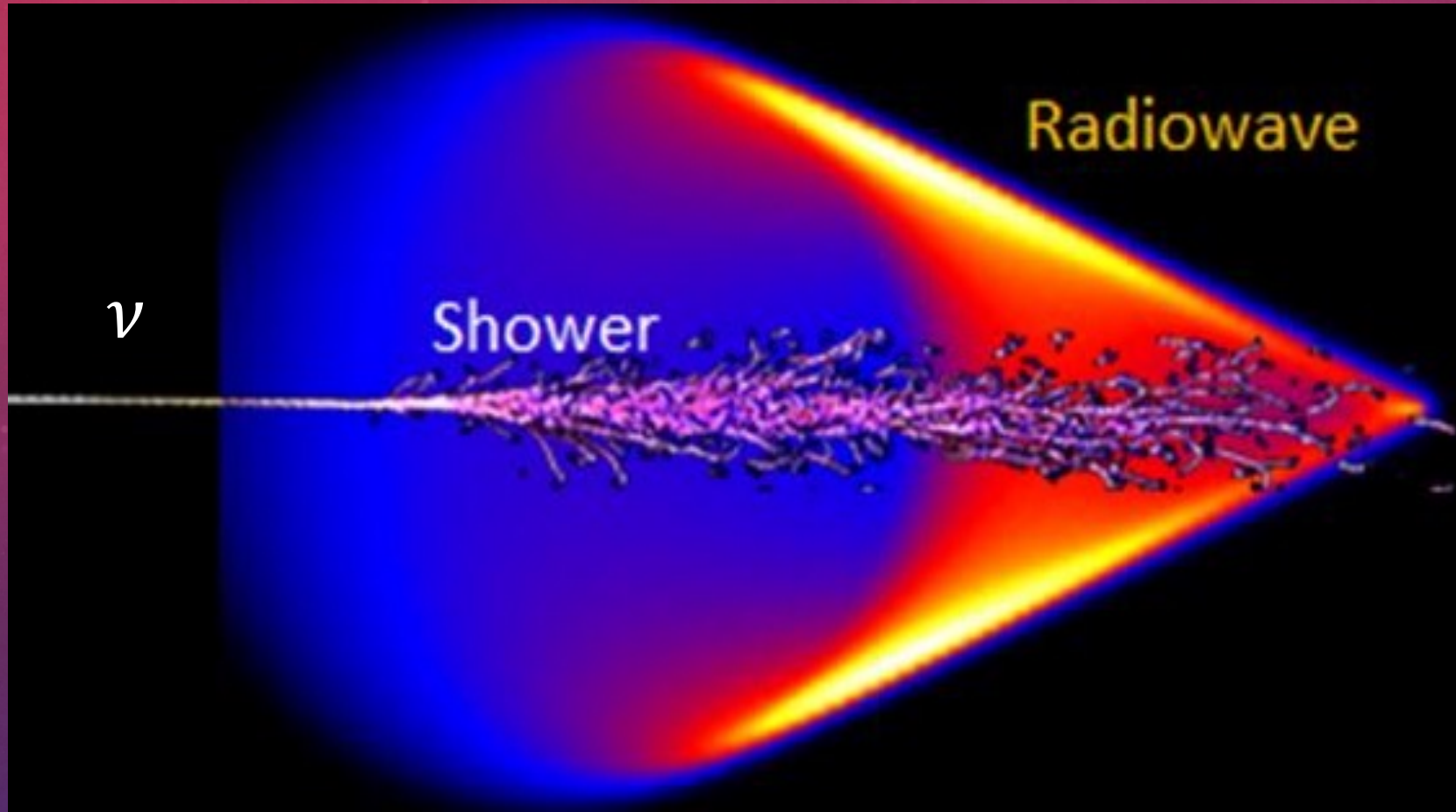
WHAT DOES A NEUTRINO INTERACTION LOOK LIKE?

The background features a gradient from red to blue with faint, semi-transparent scientific diagrams. On the right side, there are circular gauges with numerical scales (e.g., 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200) and arrows. At the bottom, there are dashed circular paths with arrows indicating direction.

F-18 going Supersonic



Sonic boom...



...but in light!
Puff of Blue Light + Puff of Radio Waves

SWEET! THIS ALL SOUND SWELL.

...SO WHY DO I HAVE A JOB?

BECAUSE LIFE IS HARD

Neutrino energy

$\sim 10^{18}$ eV

1,000,000,
000,000,
000,000



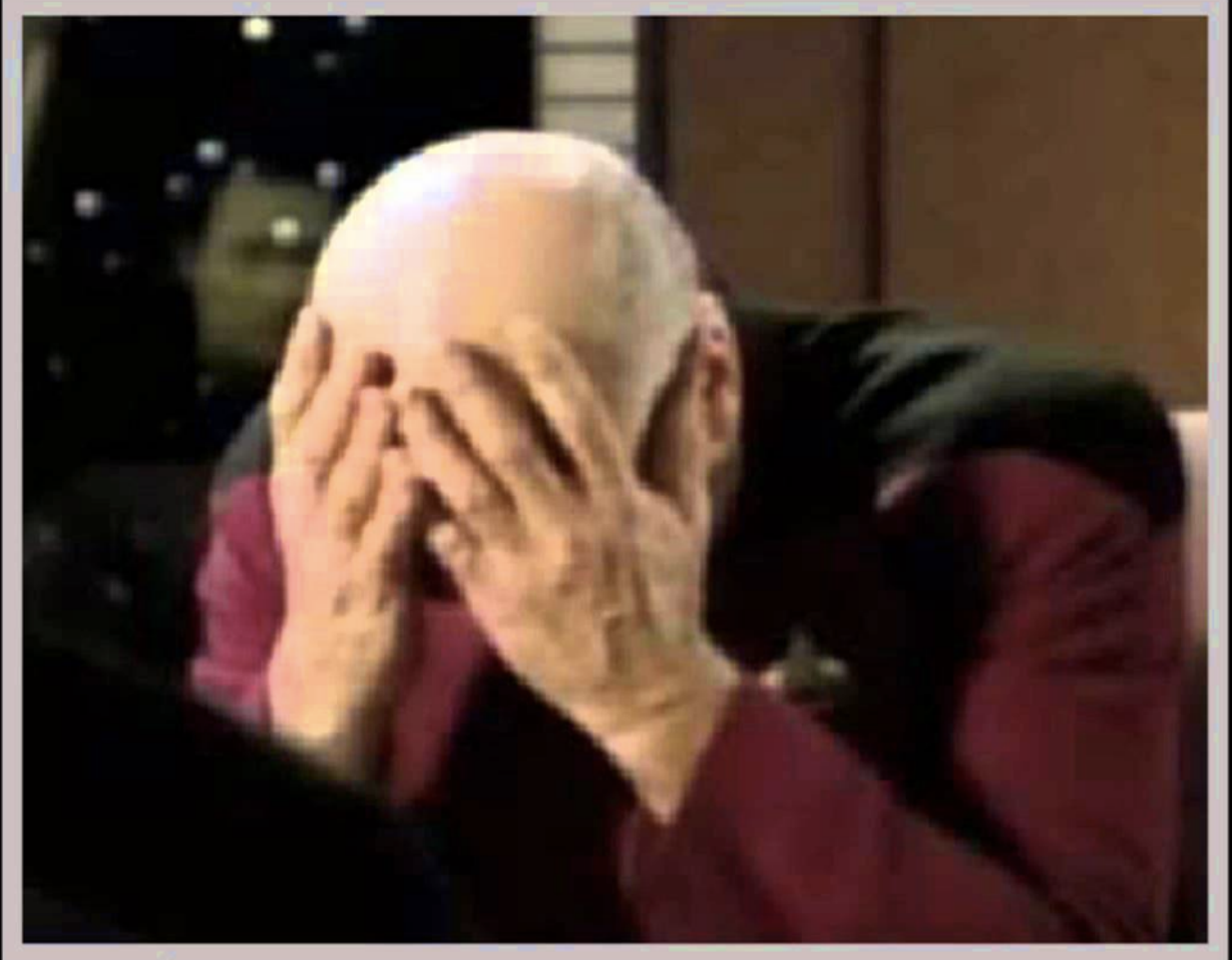


IC: Jack Westerheide, *The Lantern*



Passes through 'shoe ~1/year
Interacts ~1/decade

A *rare*
particle
that also
interacts
rarely.



DOUBLE FACEPALM

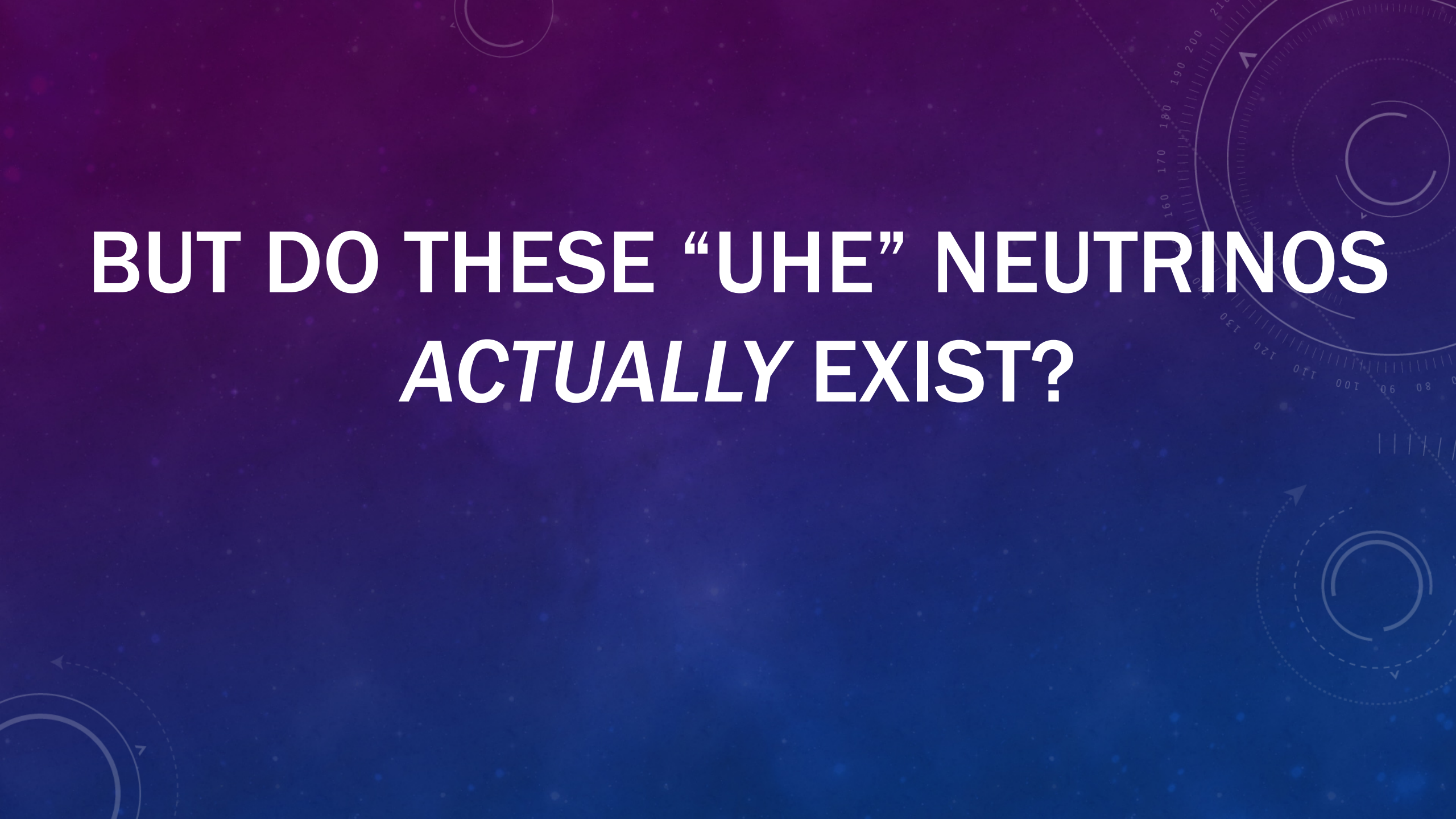
When the Fail is so strong, one Facepalm is not enough.

QUESTION:

**WHERE DO YOU FIND A
GIGANTIC AMOUNT OF RADIO
CLEAR ICE?**

ANTARCTICA



The background features a dark blue gradient with a subtle pattern of white stars and technical diagrams. On the right side, there are several circular diagrams with concentric lines and arrows, resembling a control panel or a scientific instrument. The text is centered and reads:

**BUT DO THESE “UHE” NEUTRINOS
ACTUALLY EXIST?**



THEY DO EXIST

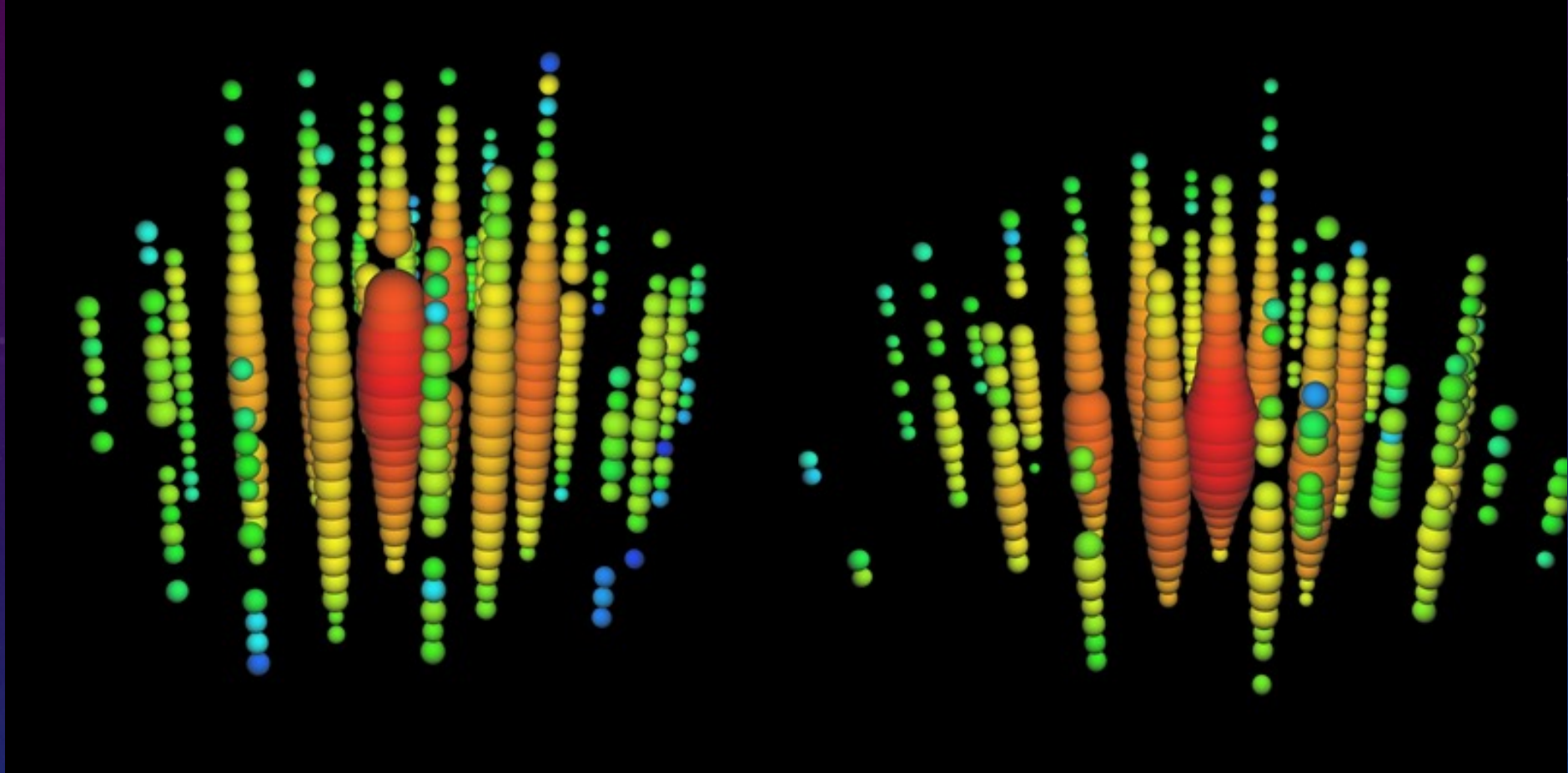
TV Commercials

memegenerator.net

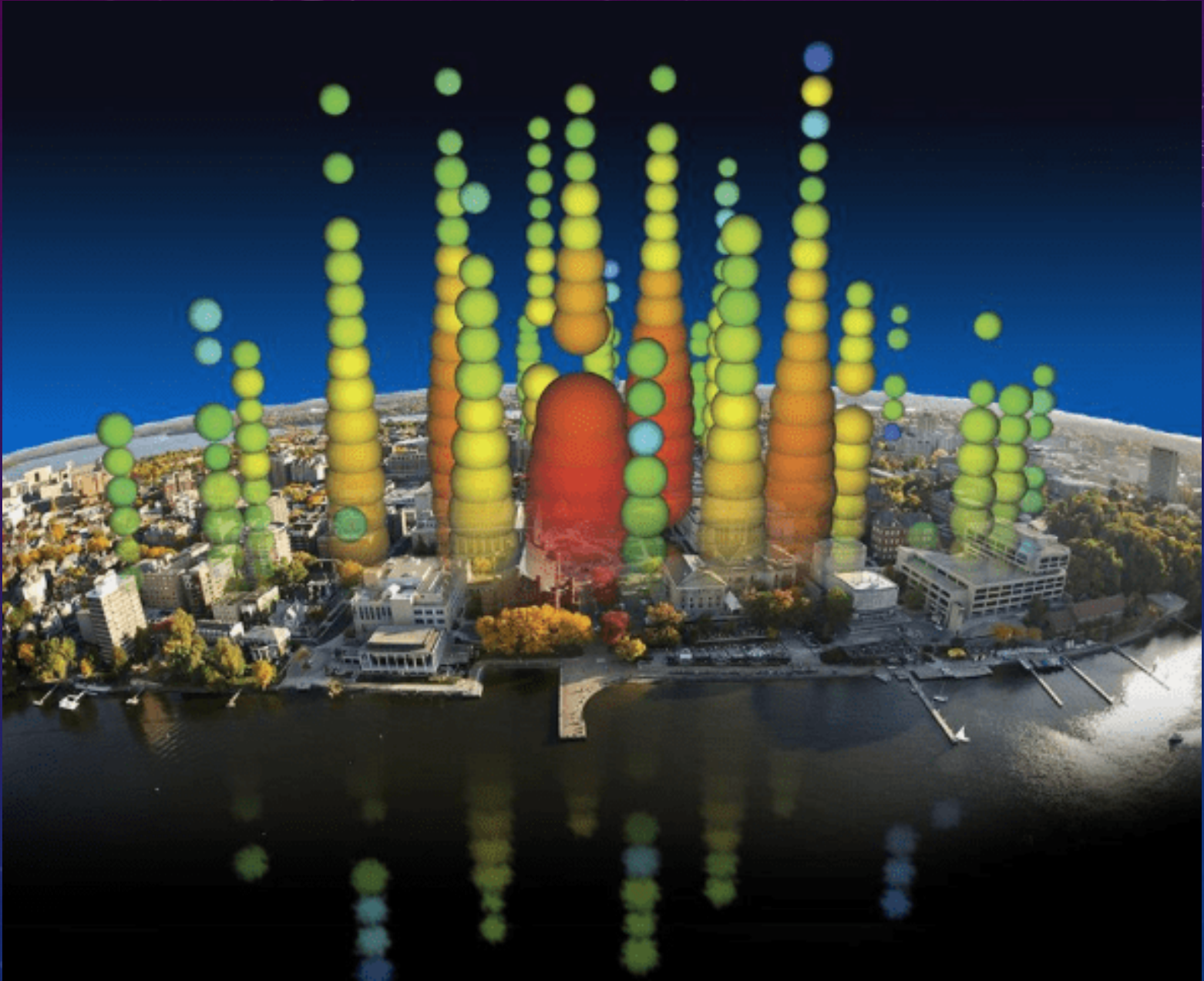


HE DOES EXIST!

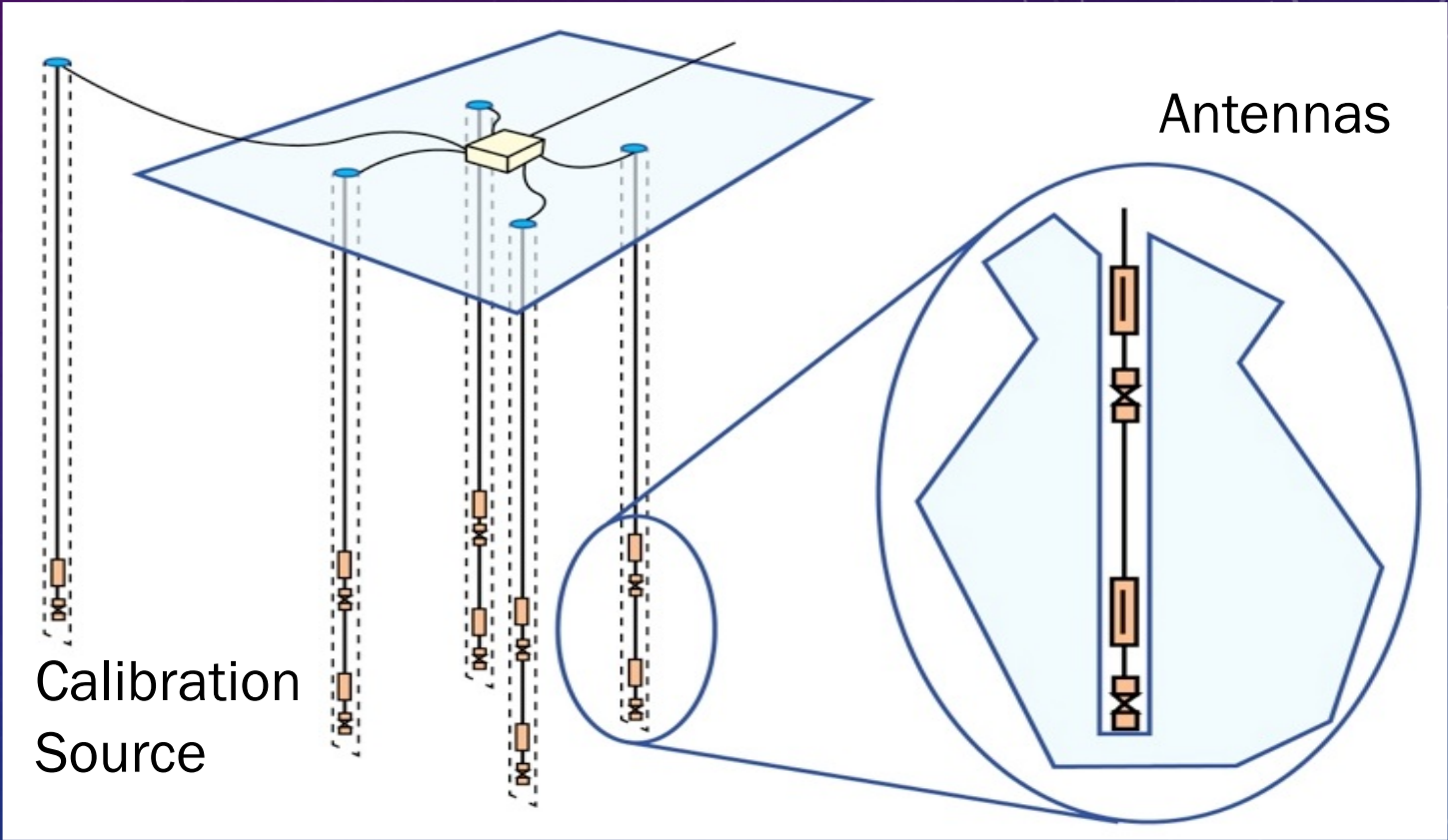
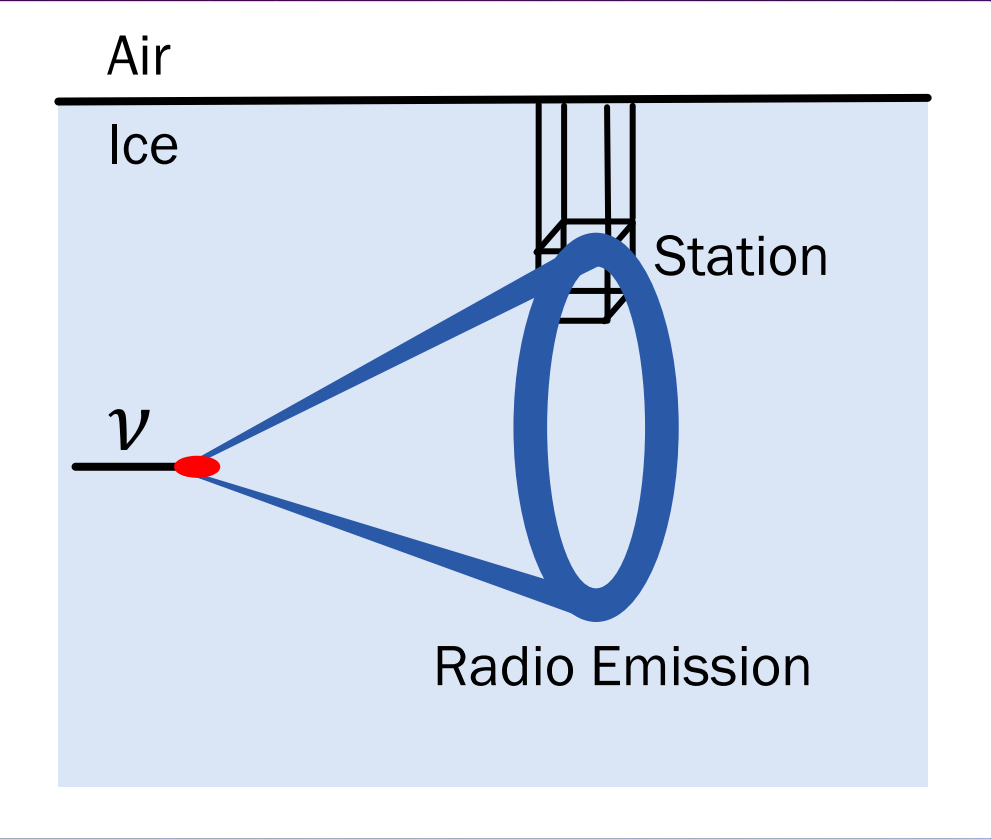
2012: IceCube reveals "Bert and Ernie"



First cosmic neutrinos



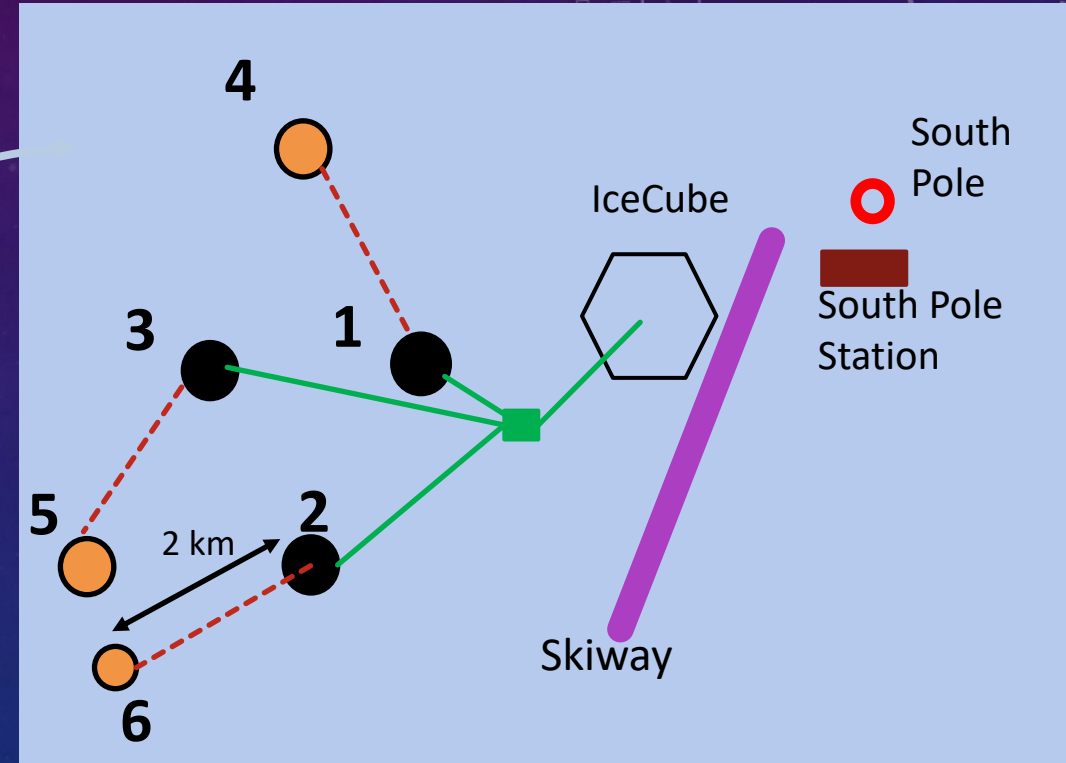
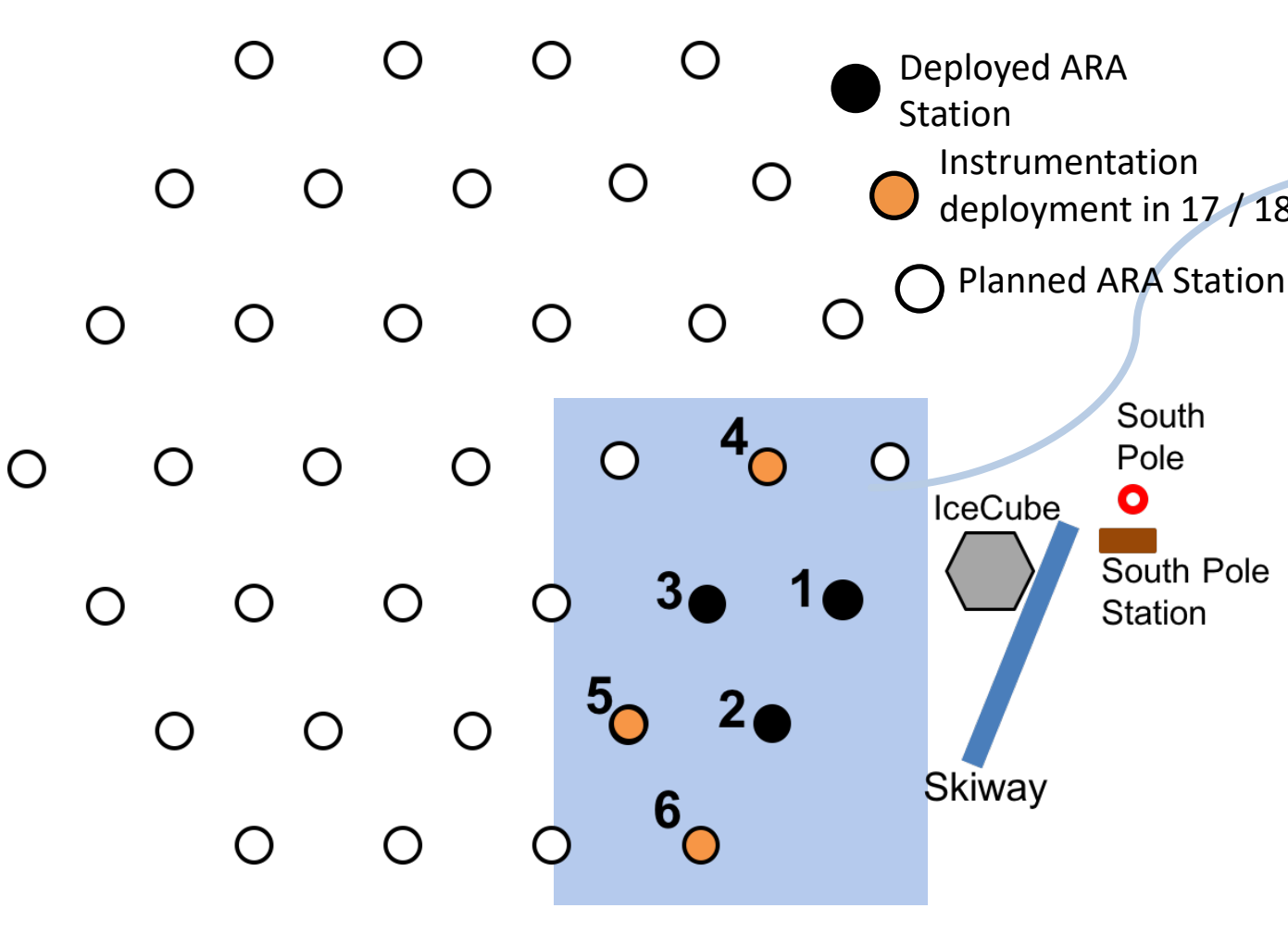
ASKARYAN RADIO ARRAY



Detection Concept

Station Design

STATUS OF ARA



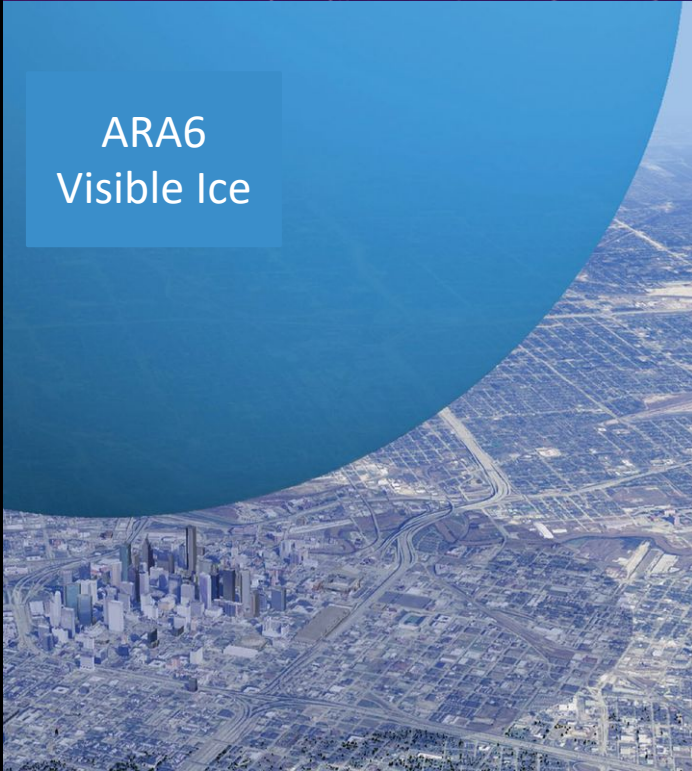
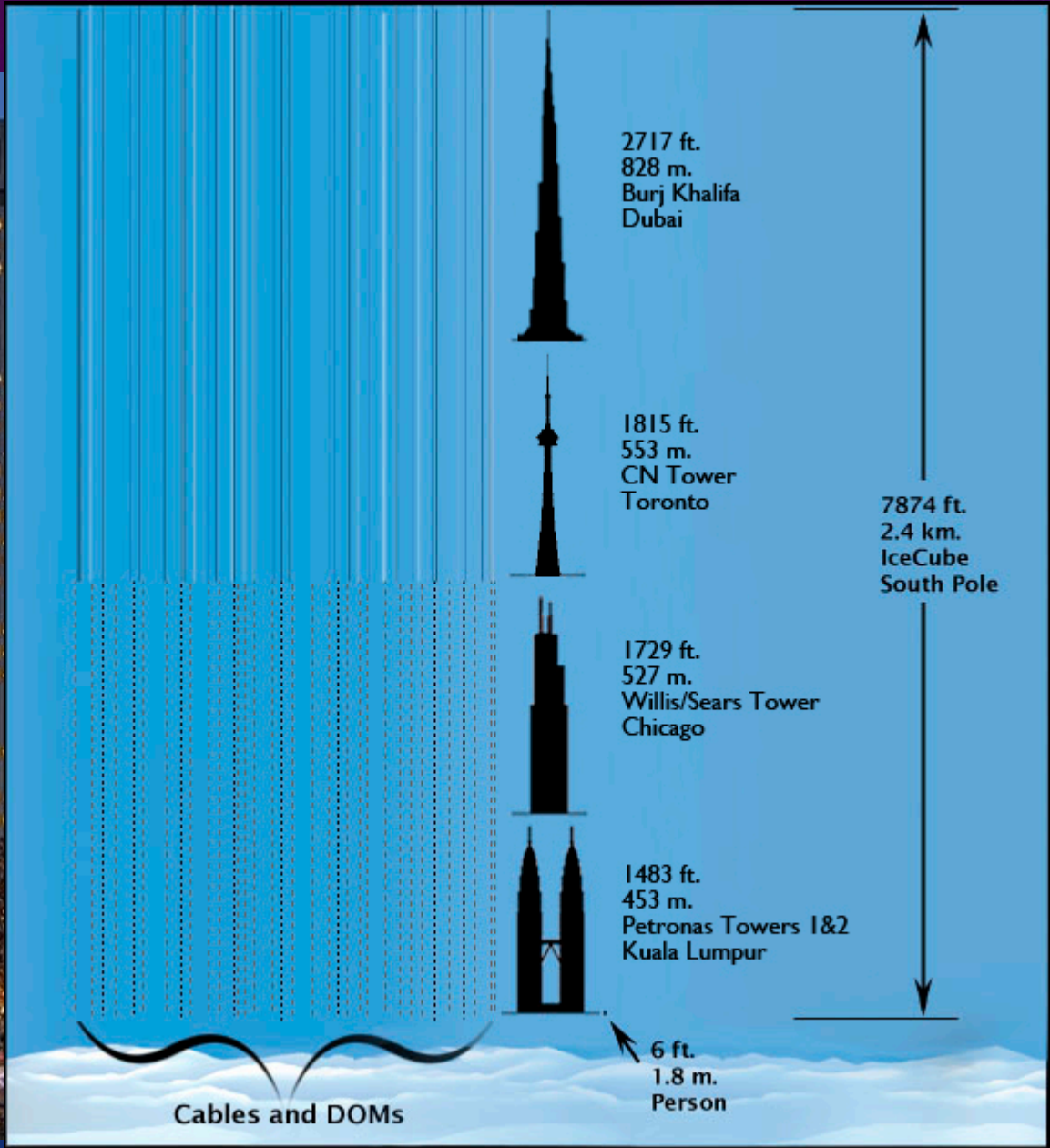
Amundsen-Scott South Pole Station

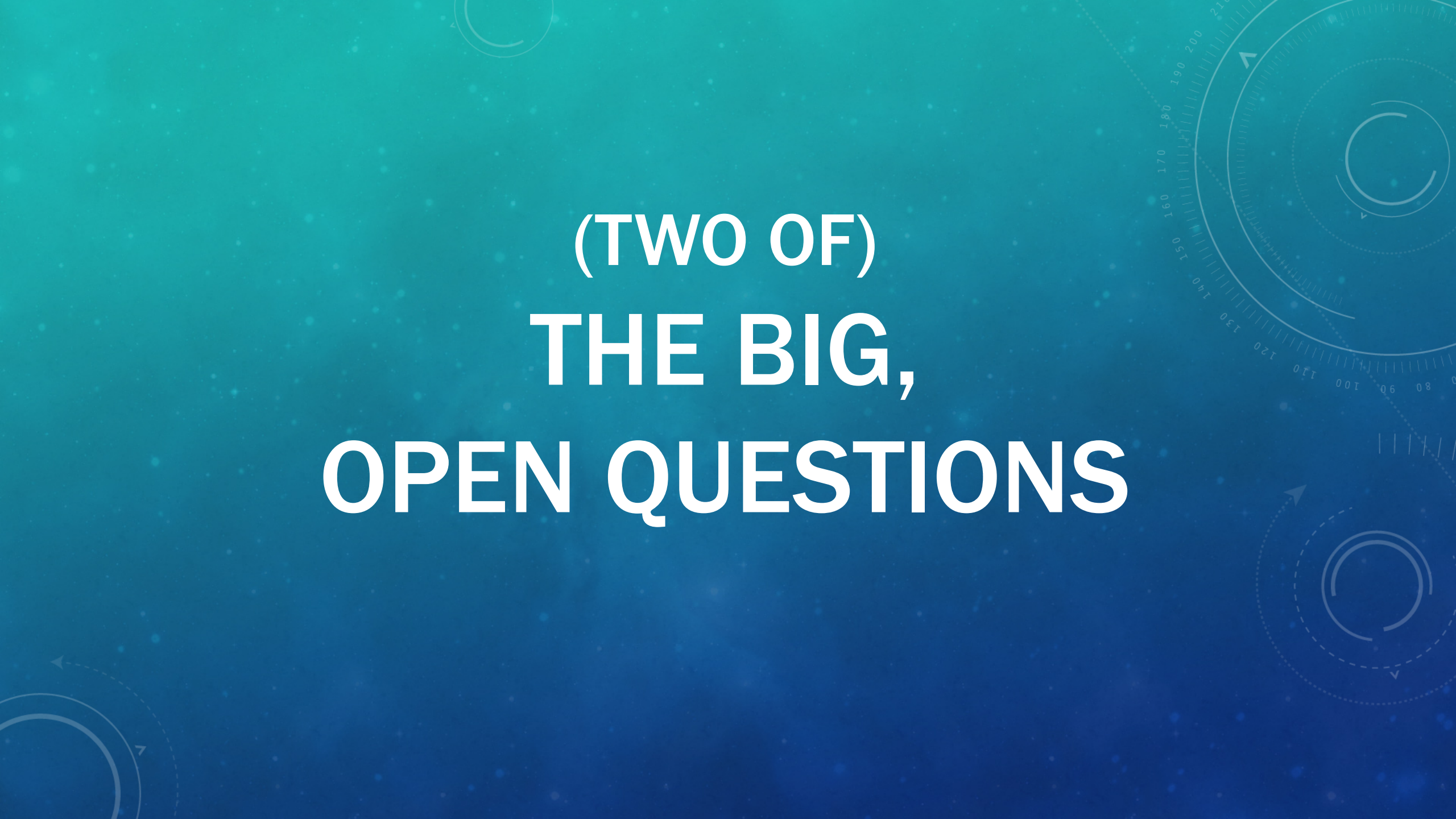
COSMO Sky-Med RADAR image

July 6, 2012



GARGANTUAN INSTRUMENTS



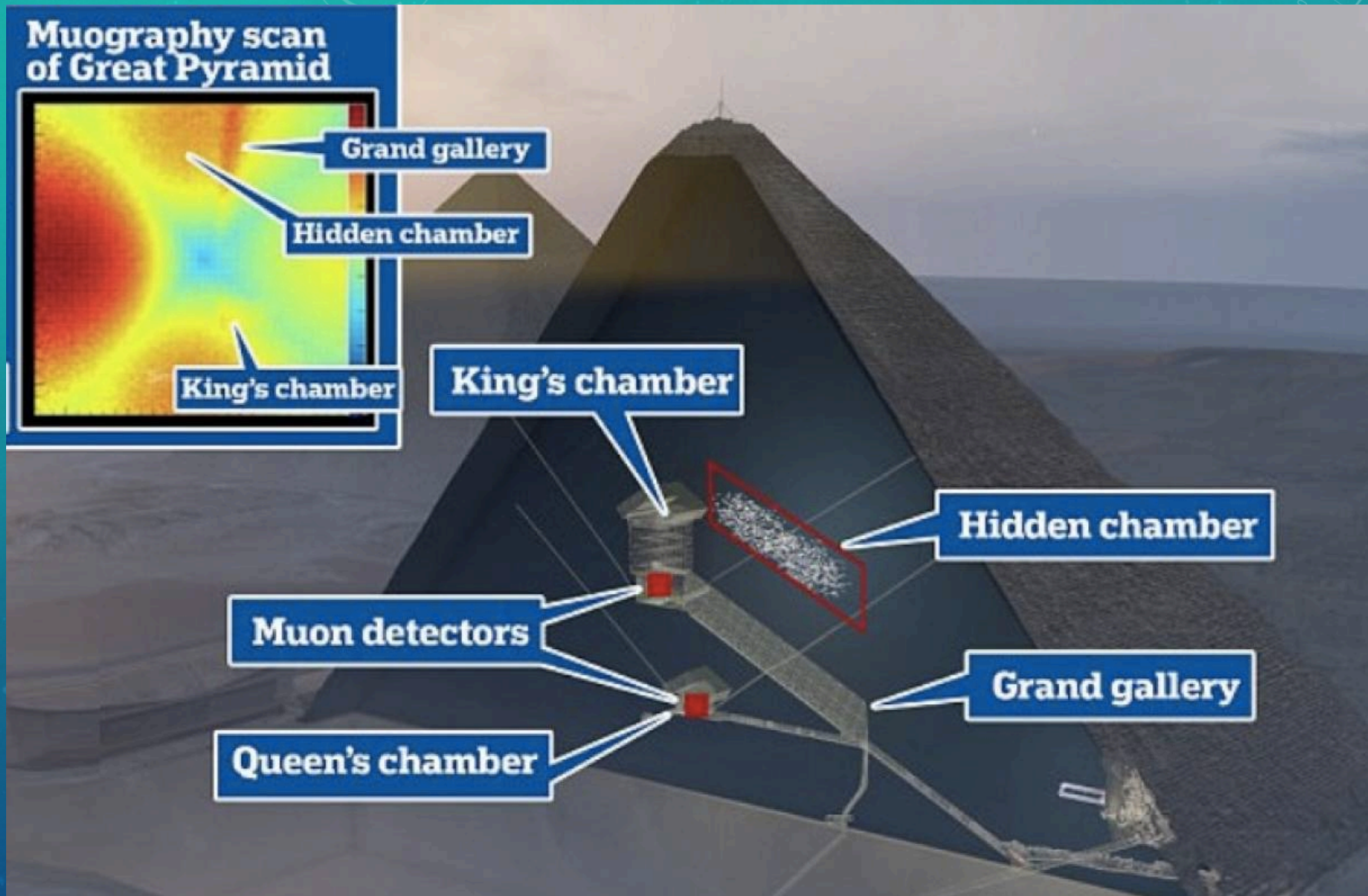


**(TWO OF)
THE BIG,
OPEN QUESTIONS**



Active Galactic Nucleus Centaurus A.
(ESO public image release)

What are the neutrino “engines”?



What can we do with them?

THANK YOU!
QUESTIONS?

