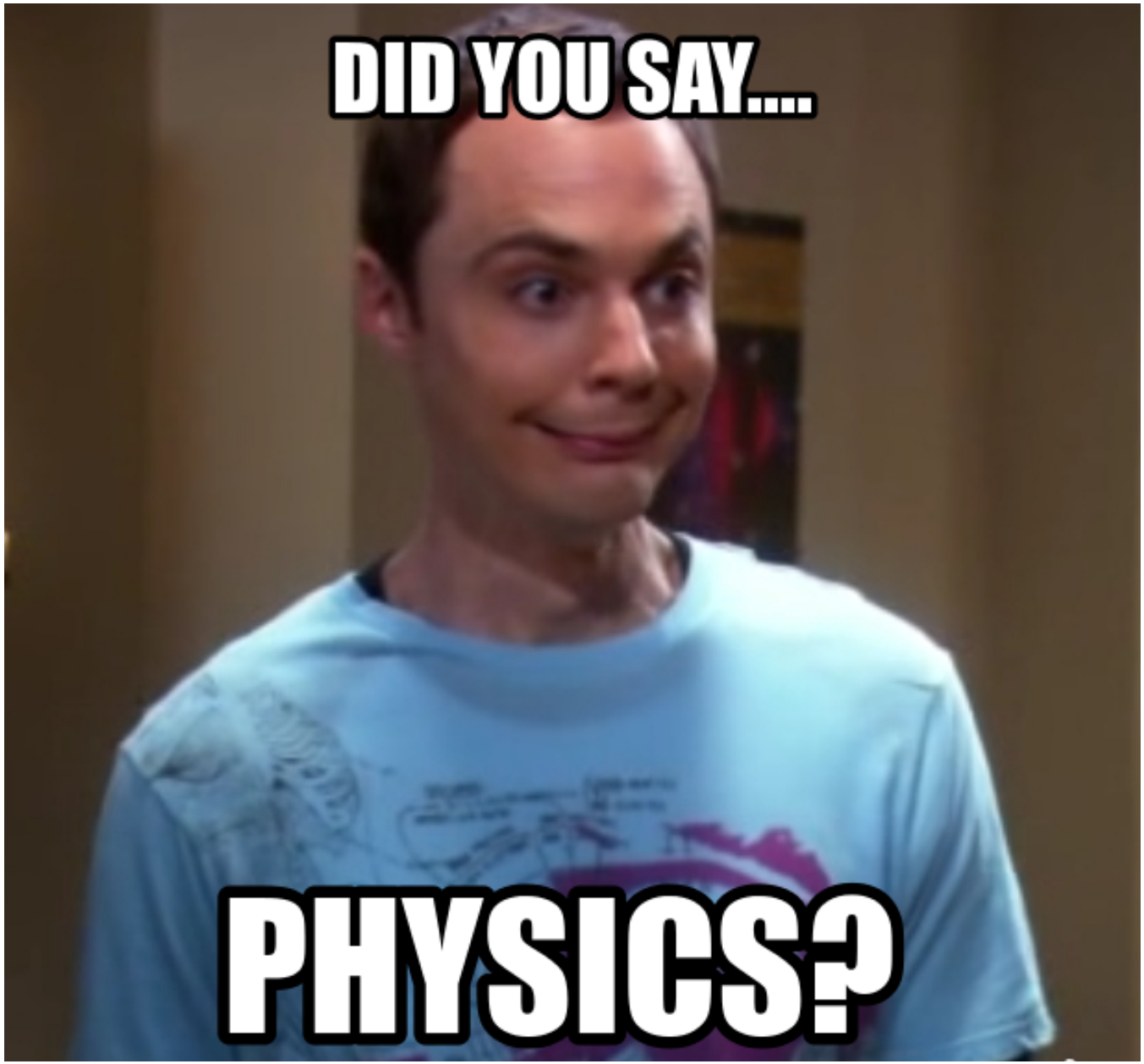
DUNE in 10 minutes

Laura Gómez Bermeo

New Perspectives 2018

19/06/2018

UNIVERSIDAD SERGIO ARBOLEDA

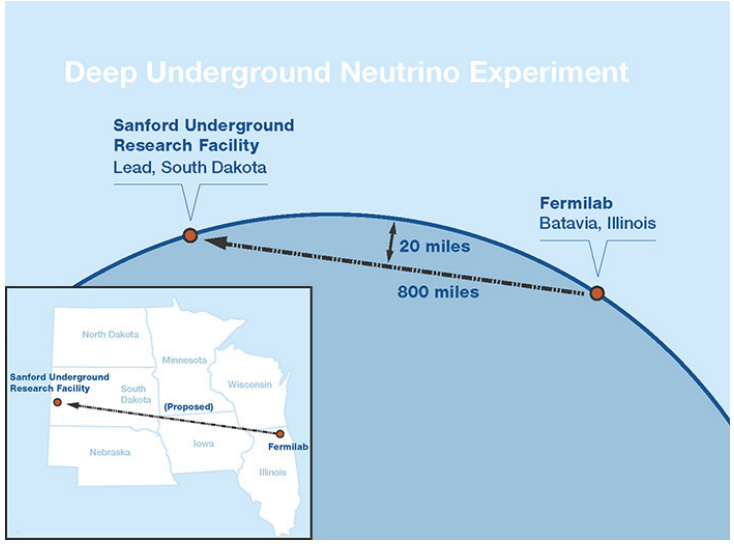

DID YOU SAY....
PHYSICS?

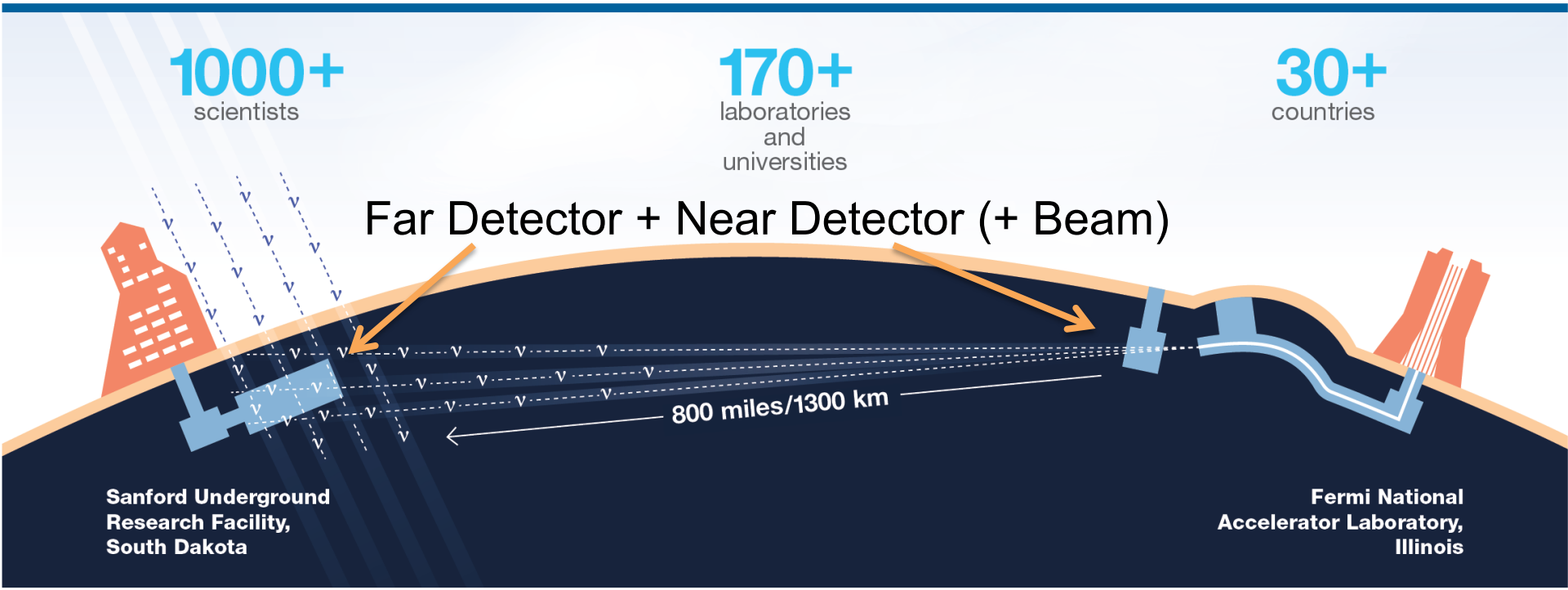
ME

DUNE

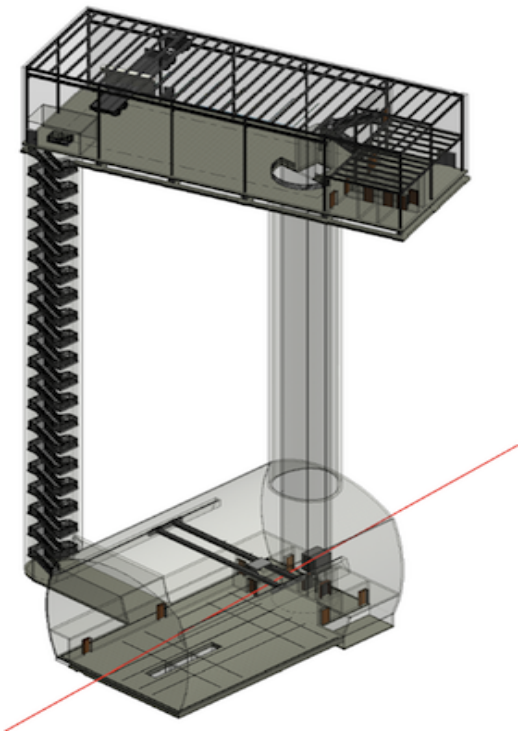
DEEP UNDERGROUND NEUTRINO EXPERIMENT

UNIVERSIDAD SERGIO ARBOLEDA


Deep Underground Neutrino Experiment
Sanford Underground Research Facility
Lead, South Dakota
Fermilab
Batavia, Illinois
20 miles
800 miles
North Dakota
Minnesota
Wisconsin
South Dakota
(Proposed)
Nebraska
Iowa
Illinois
Sanford Underground Research Facility
Fermilab

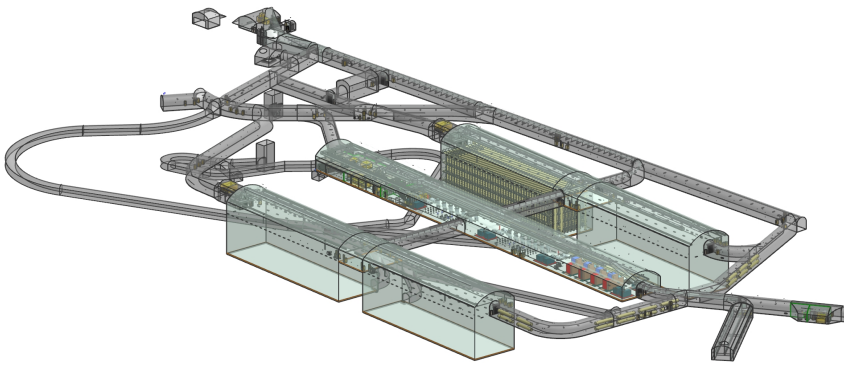

1000+
scientists
170+
laboratories and universities
30+
countries
Far Detector + Near Detector (+ Beam)
800 miles/1300 km
Sanford Underground Research Facility, South Dakota
Fermi National Accelerator Laboratory, Illinois

Near Detector



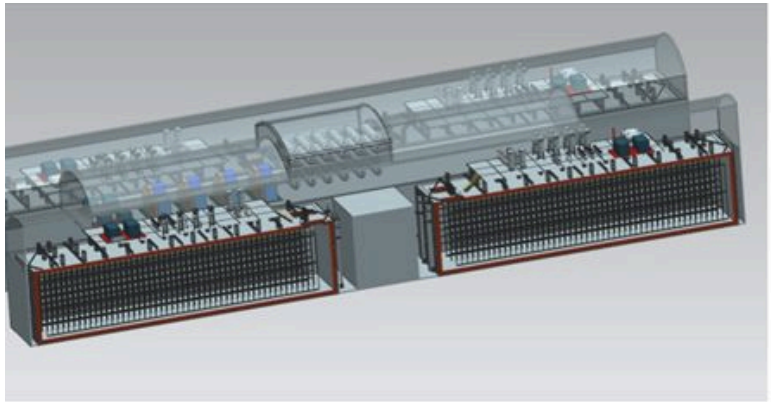
- Located 575 m from beam source at Fermilab
- Determine neutrino sources: $\nu_\mu, \bar{\nu}_\mu, \nu_e, \bar{\nu}_e$.
- Neutrino/Anti- neutrino energy scale
- Precision neutrino interaction physics.
- Modular liquid argon design (ArgonCube) to provide identical near/far target
- Mobile detector for different off-axis positions

Far Detector

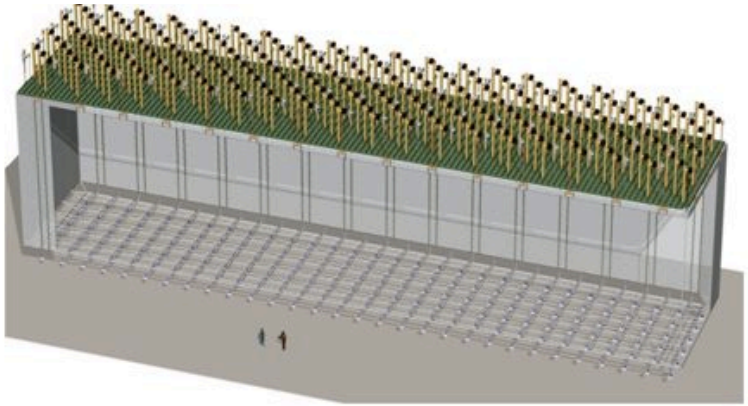


- 4 -10-kt liquid argon TPC modules
- **Single-** and dual-phase detector designs (1st module will be single phase)
- Modules will not be identical

Single-Phase FD modules

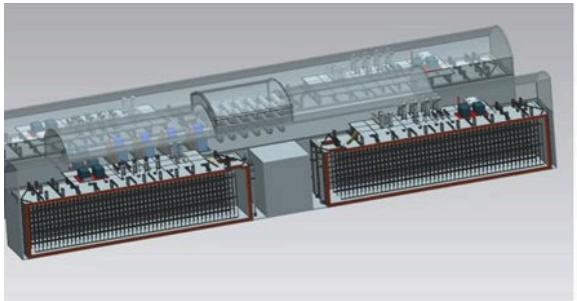


Dual-Phase FD module



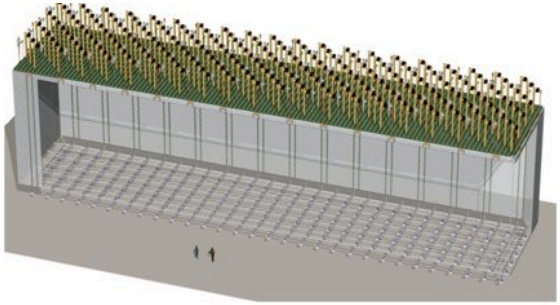
Two LAr-TPC technologies

Single-Phase FD modules



- Multiple drift volumes
- Mature Technology
- Detection and electronics in liquid

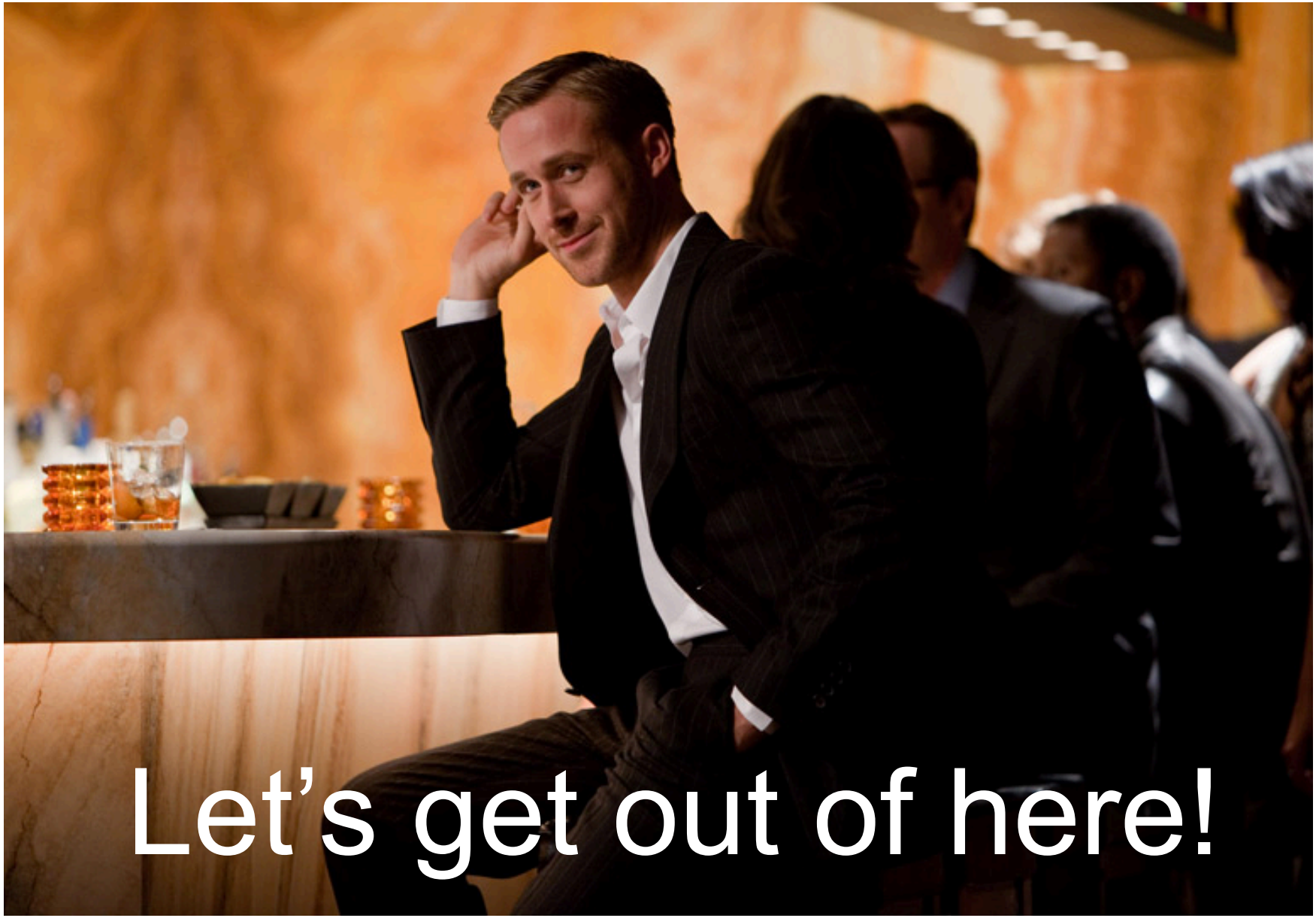
Dual-Phase FD module



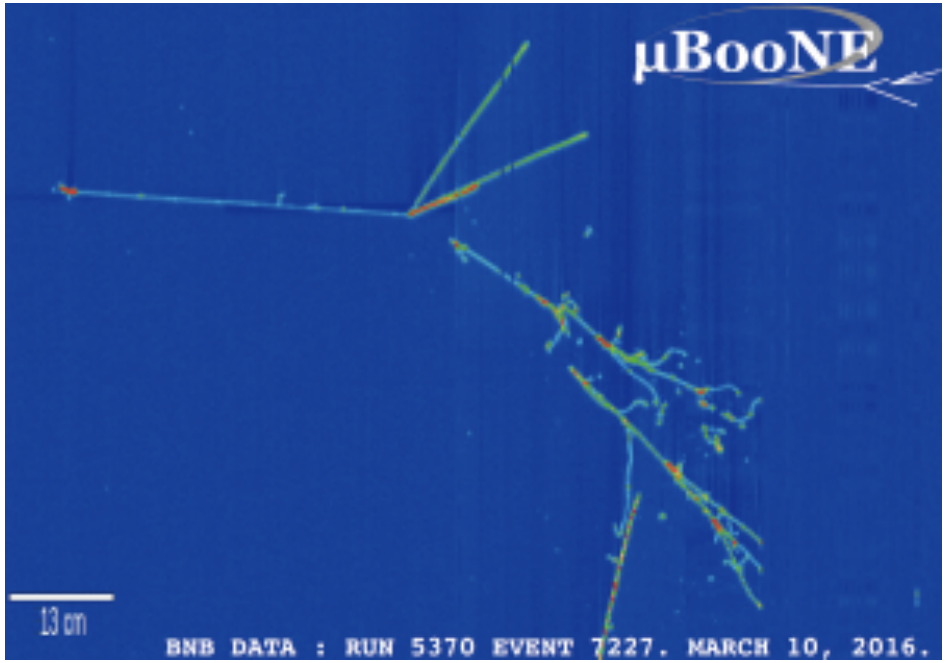
- Fully homogeneous LAr volume with a much longer drift length.
- New Technology
- Detection and electronics in gas above the liquid surface
- Amplification of the ionization signal in an avalanche process.

Single Phase Beam (protoDUNE) : August-November 2018

Dual Phase Installation Complete (protoDUNE) : Fall 2018


Let’s get out of here!

Why Liquid Argon?

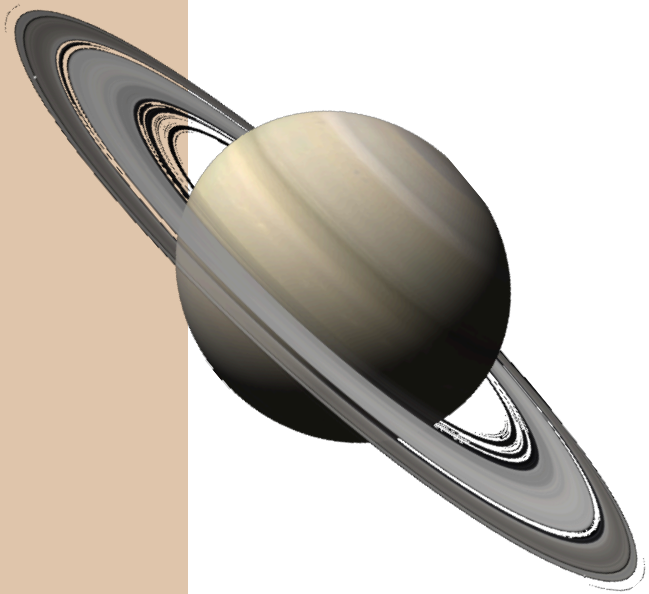


- Charged particles ionize Ar atoms.
- 3D image of particles
- Clear detection of neutrino flavour
- High resolution data
- Calorimetric information
- Excellent event selection
- Efficiency and background rejection.

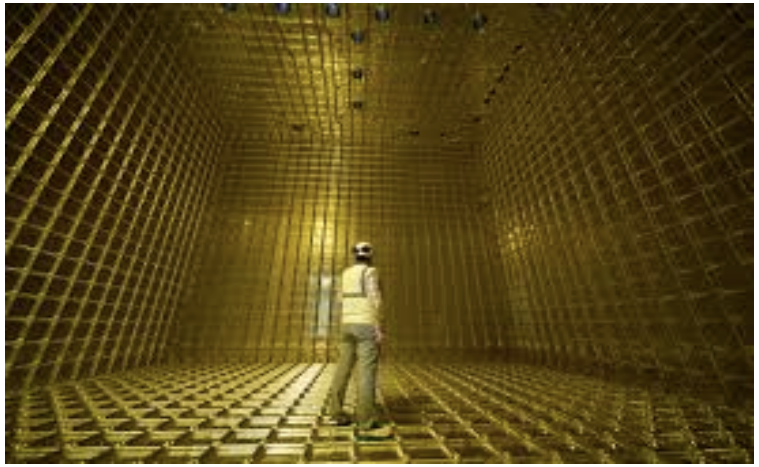
X 5000

X 280 million

KEEP CALM ITS FUN FACTS TIME



ProtoDUNEs



protoDUNE-DP Field Cage

Field cage fully installed

DUNE is moving forward rapidly

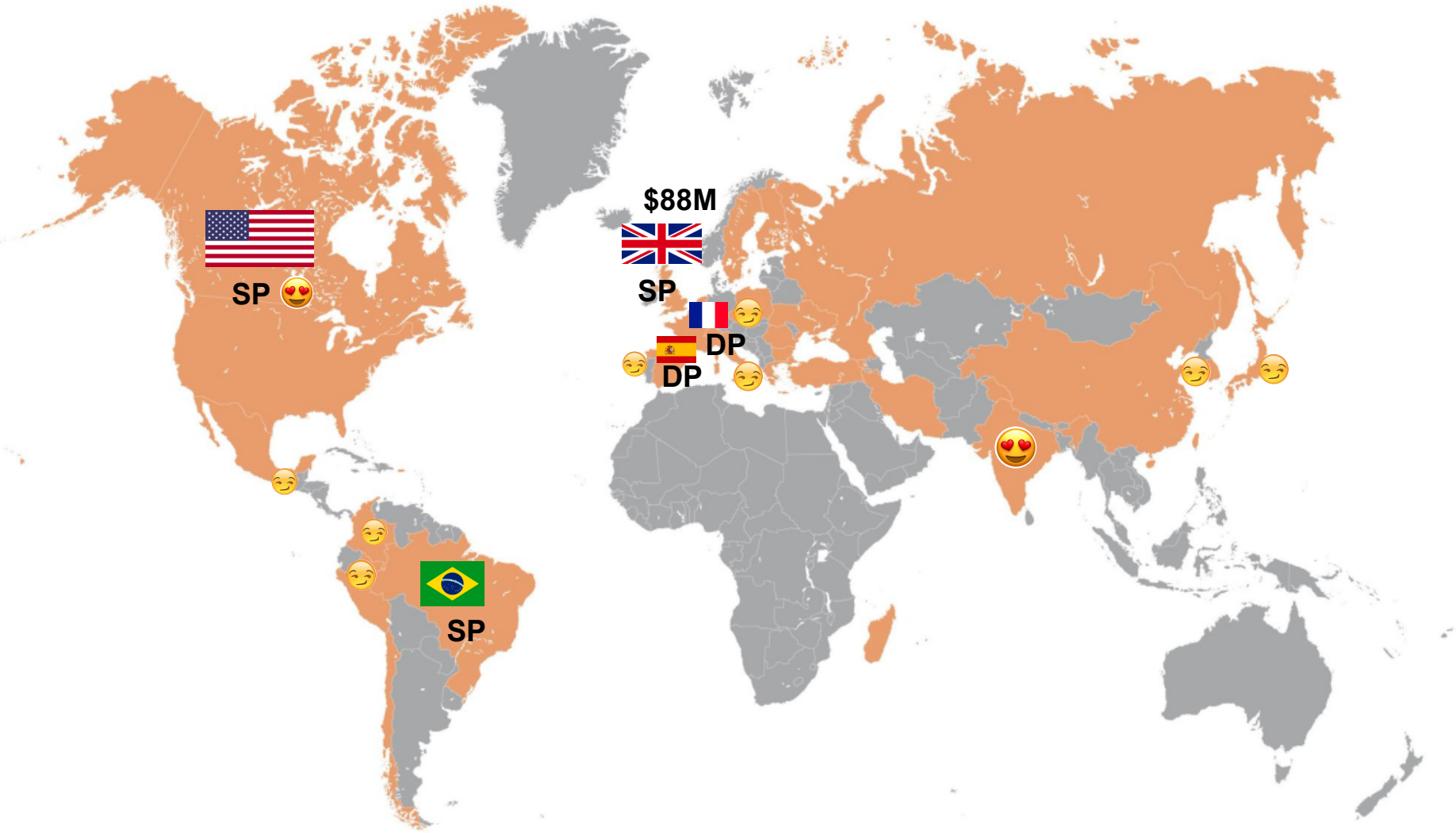
2018:
ProtoDUNEs at CERN

2019:
- Technical DesignReport
- Far Site Primary Excavations begins

2022:
First Module Installation Begins

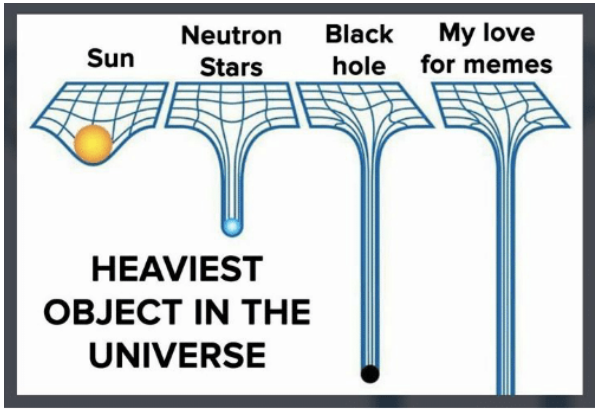
2026:
Neutrino Beam available

DUNE CONSORTIA



DUNE aims to
“do for neutrinos what the LHC did for the Higgs”

Origin of matter



Black holes formation

Matter and antimatter

Unification of forces

DUNE Physics

1.Neutrino Oscillation Physics

- Discover CP Violation in the leptonic sector
- Mass Hierarchy

2. Nucleon Decay

- Proton decays mode

3. Supernova burst physics & astrophysics

NEUTRINO OSCILLATION

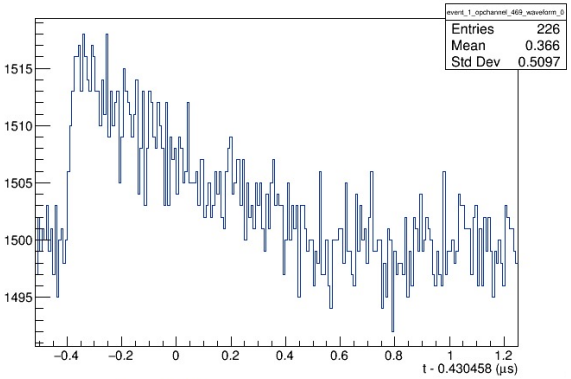
- **CP violation**—the difference in oscillatory behaviour between neutrinos and antineutrinos

- Muon Neutrino Disappearance and Electron Neutrino Appearance **in a single experiment.**

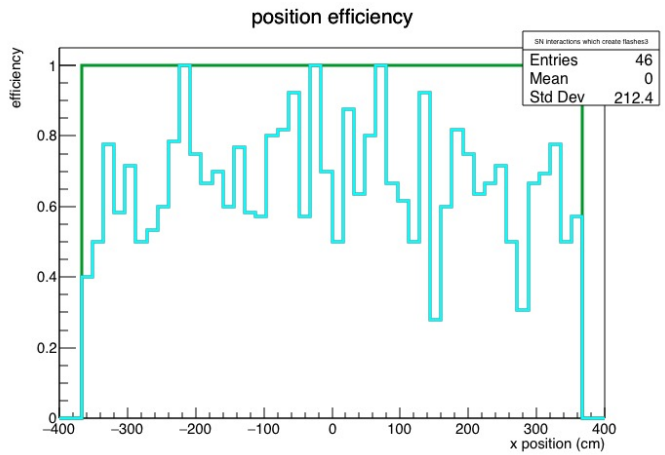
1061 scientists

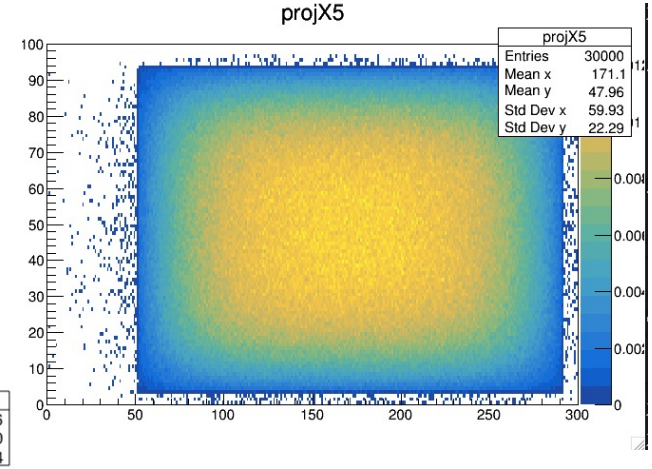
- 32 countries + CERN
- 175 institutions (60% non-US)

“The DUNE collaboration is growing at a rate of about 100 people per year,” Stefan Soldner-Rembold

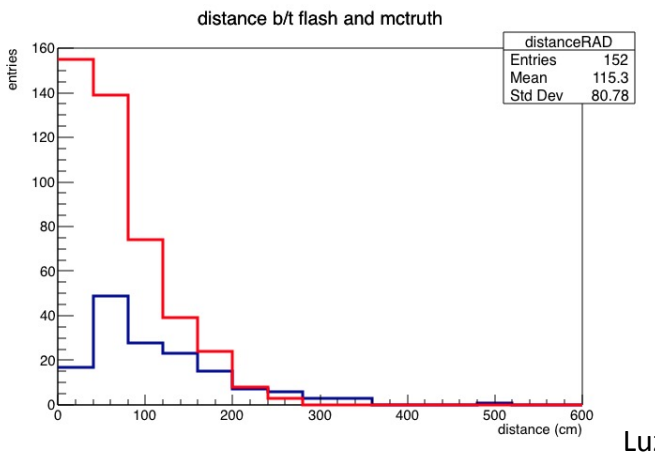


Alex Himmel-Photon Simulation Tutorial

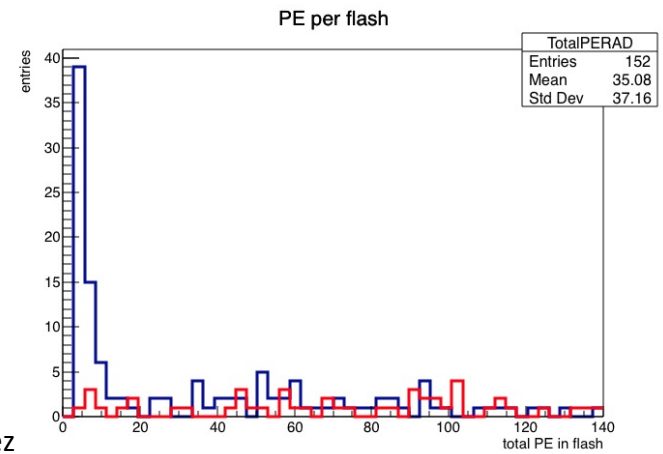


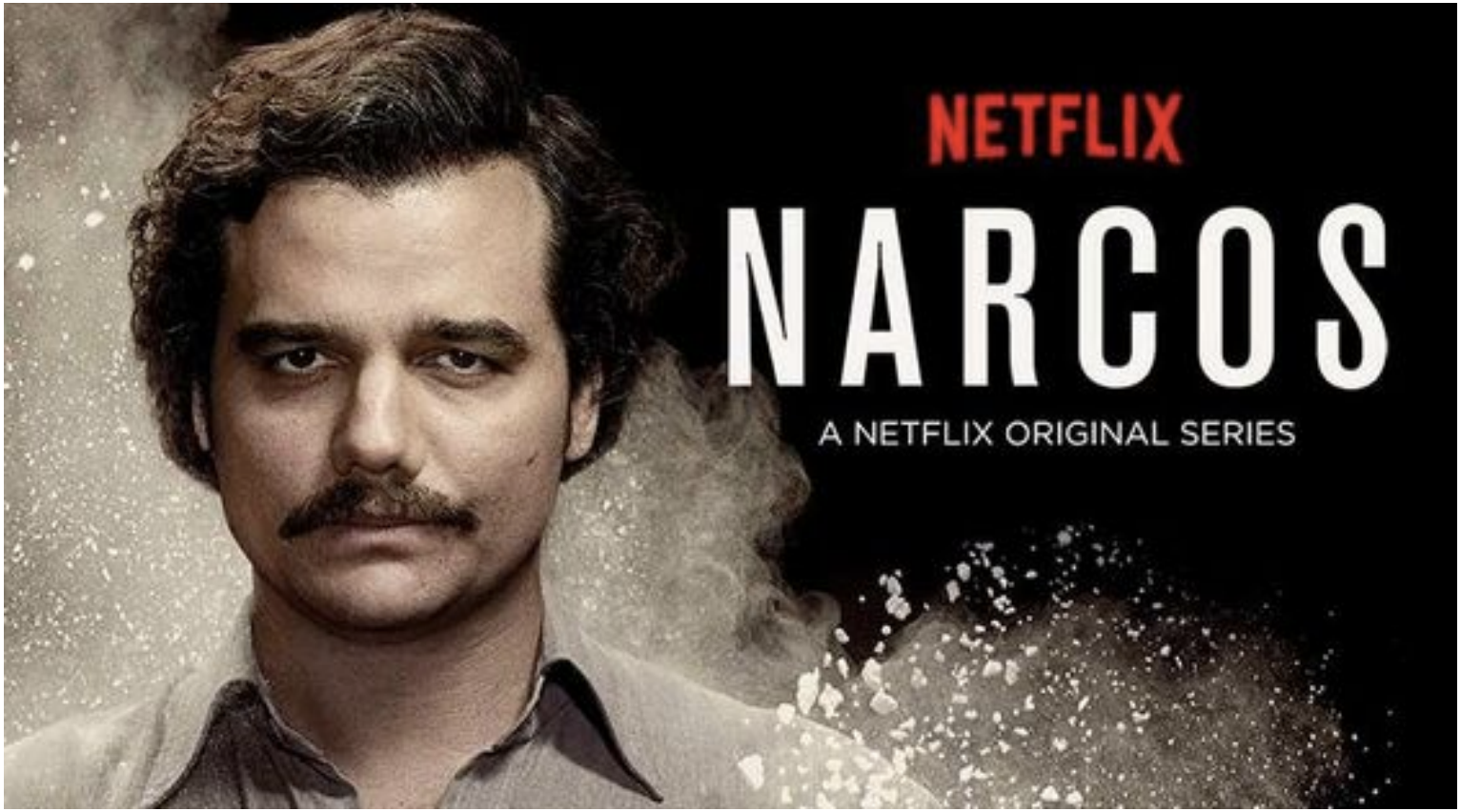


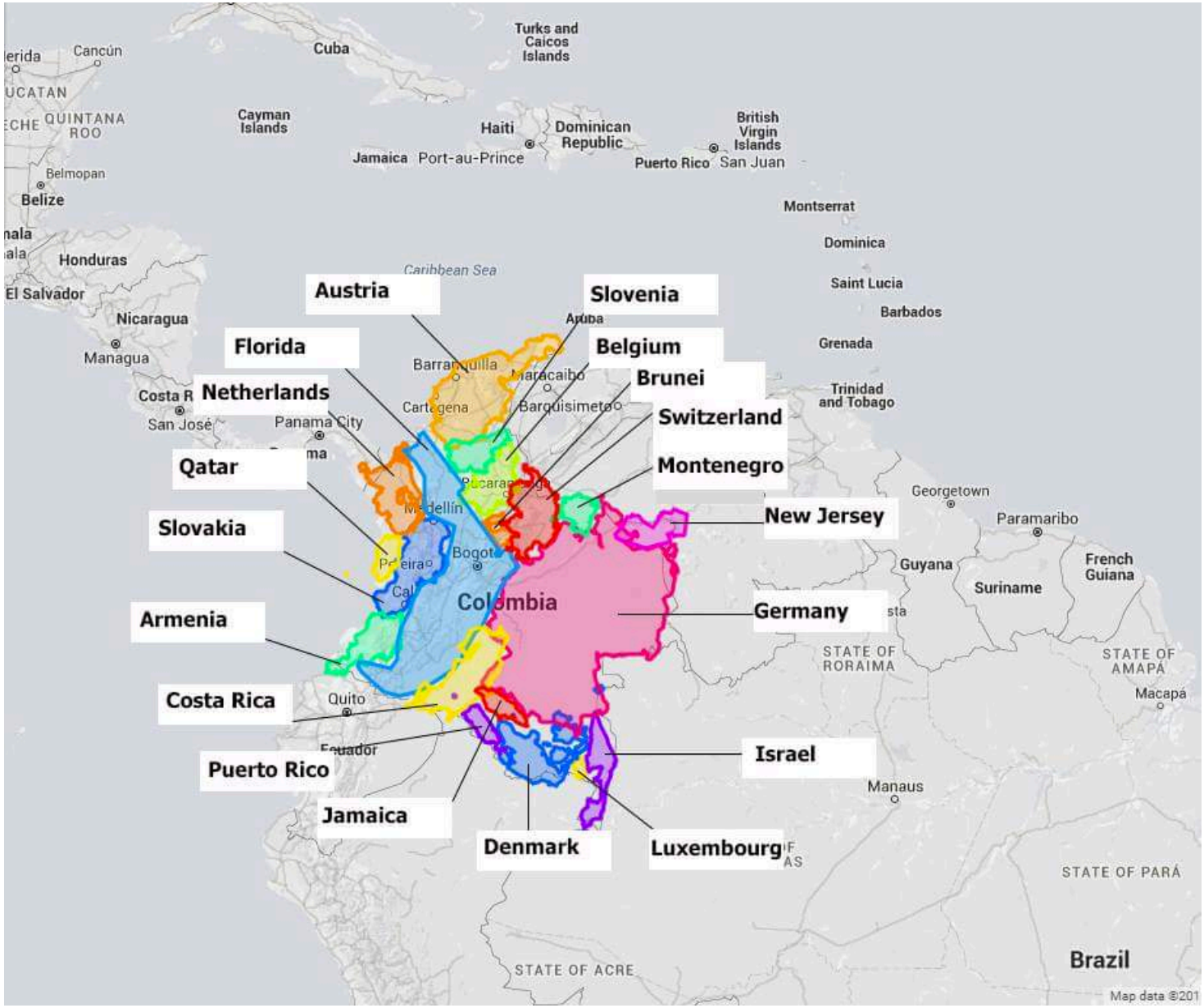
Alex Himmel-Photon Simulation Tutorial



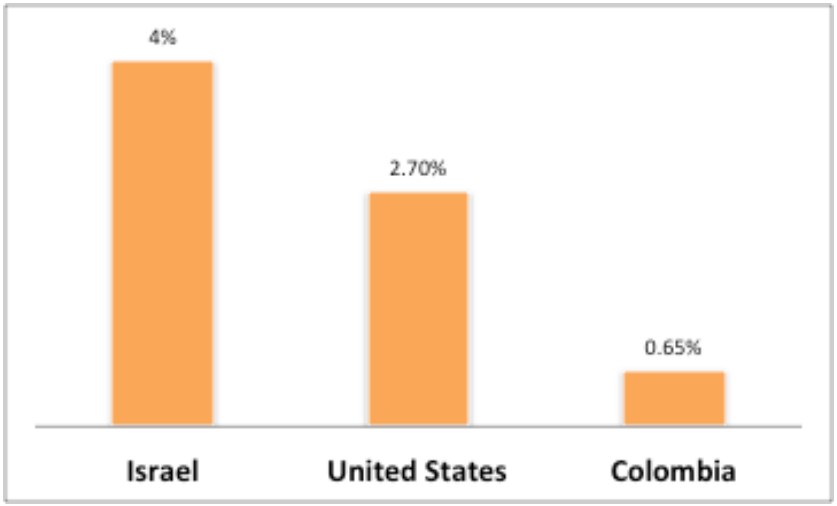
Luz Stella Gómez and Hermes Martinez

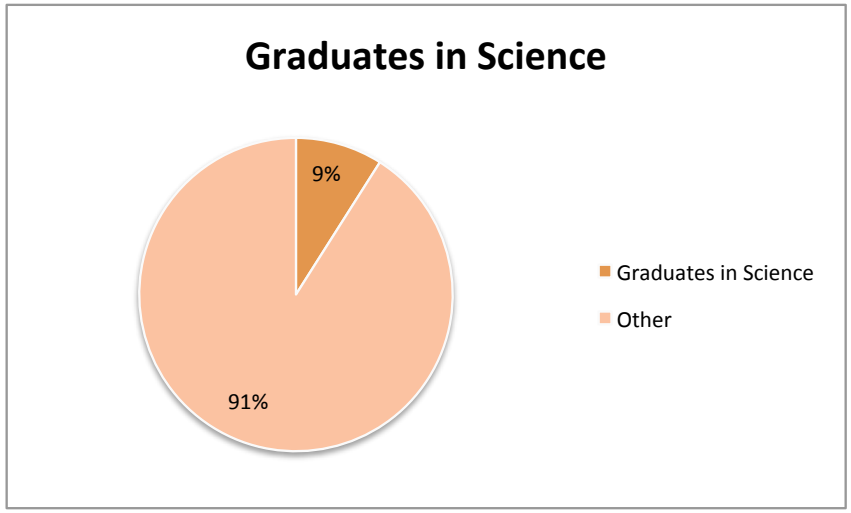



NETFLIX
NARCOS
A NETFLIX ORIGINAL SERIES


Austria
Slovenia
Florida
Belgium
Brunei
Netherlands
Switzerland
Qatar
Montenegro
New Jersey
Slovakia
Germany
Armenia
Costa Rica
Israel
Puerto Rico
Jamaica
Denmark
Luxembourg
Colombia
Cuba
Turks and Caicos Islands
Cancún
Cayman Islands
Haiti
Dominican Republic
British Virgin Islands
Jamaica
Port-au-Prince
Puerto Rico
San Juan
Belmopan
Belize
Montserrat
Dominica
Honduras
Caribbean Sea
Saint Lucia
El Salvador
Barbados
Nicaragua
Aruba
Grenada
Managua
Barranquilla
Maracaibo
Trinidad and Tobago
Cartagena
Barquisimeto
San José
Panama City
Georgetown
Paramaribo
Medellín
Bogotá
Guyana
French Guiana
Suriname
STATE OF RORAIMA
STATE OF AMAPÁ
Macapá
Quito
Manaus
STATE OF PARÁ
STATE OF ACRE
Brazil
Map data ©201

NOT FUN FACTS ☹





SHAKIRA.

17

Conclusions

- DUNE is progressing on facility construction, detector design, and physics analysis.
- DUNE Technical Design Report and protoDUNE SP and DP results in next year (2019)
- Scientific goals of the DUNE project has a primary focus on neutrino oscillation but also a large range of non-accelerator physics topics.
- Expect first DUNE FD data in ~2024
- It's Colombia not Columbia

THANK YOU

GRACIAS