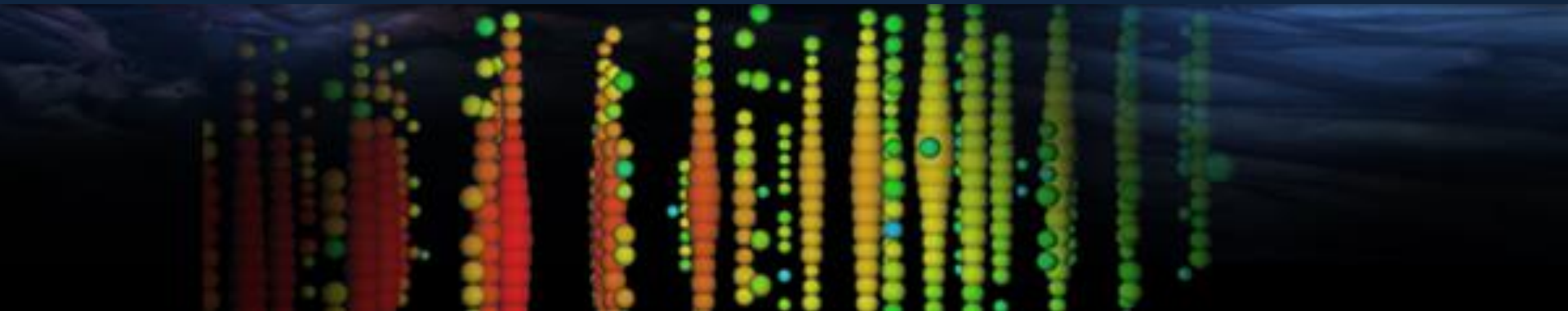




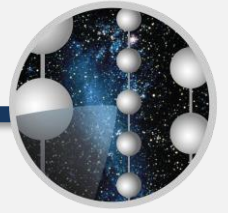
Science Advisory Committee • Madison, WI • Oct. 20, 2015

# ICECUBE EDUCATION & OUTREACH



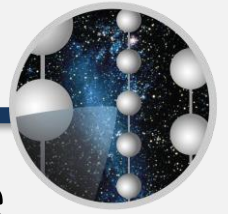
# Outline

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- Introduction
- M&O goals and focus areas
  - K–12 students and teachers
  - Undergraduate research and STEM
  - Web and print resources, graphics and displays
  - Building internal E&O capacity
  - Assessment
- Summary

# Introduction

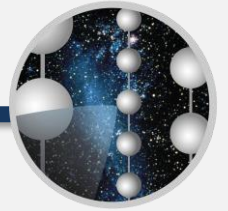


- Small core team at Madison led by IceCube Associate Director for E&O works together with IceCube researchers and external partners
- Examples of current extensive, successful E&O program
  - 4 Teacher South Pole deployments with IceCube/[PolarTREC](#)
  - UWRF Upward Bound Math-Science, 8-day summer enrichment classes (400 students over last decade)
  - [Chasing the Ghost Particle](#) full-dome video (~40 sites)
  - TED-Ed [Why Neutrinos Matter](#) animation (~80,000 views)
  - Collaboration-wide opportunities for undergraduate research
  - Multiple [South Pole webcasts](#) annually, some with international partners
  - [IceCube Masterclasses](#) preparing for third year (~275 students to date)



# 2016-2020 E&O goals

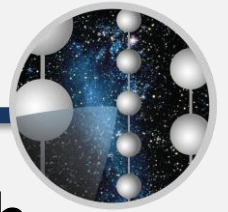
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- Increase collaboration-wide programs to leverage resources at 45 institutions in 12 countries
- Integrate research and education with an emphasis on reaching underrepresented groups and communities
- Improve assessment of E&O programs

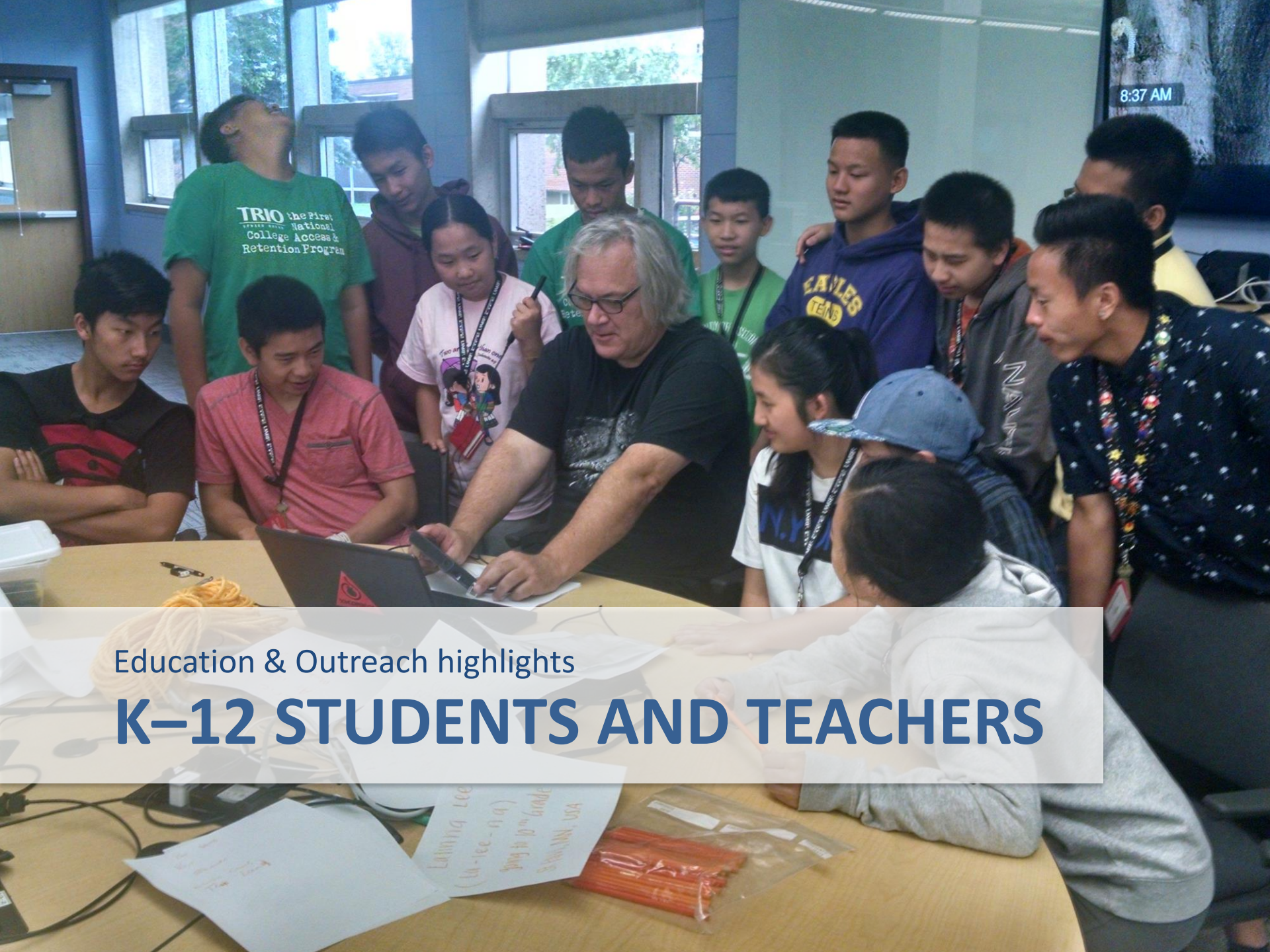
# 2016-2022 E&O focus areas

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- Reaching HS students and teachers through IceCube Masterclasses
- Connecting with K-12 classrooms through webcasts from the South Pole
- Increasing STEM awareness/participation with
  - REU and IRES programs
  - South Pole deployments for HS teachers
  - UWRF Upward Bound (UB) program
- Producing captivating web and print resources, graphic designs, and displays
- Building internal E&O capacity via semiannual communication skills workshops





8:37 AM

TRIO the First National College Access & Retention Program

LAVLES TEND

Education & Outreach highlights

# K-12 STUDENTS AND TEACHERS

Latimig Lee  
(44-lee-119)  
going to 10th grade  
8th, NY, USA



# IceCube Masterclasses

*“become a scientist for one day”*

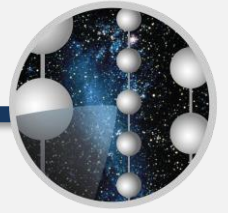
- Intensive day-long activity for select HS students
  - Bring students to campus
  - Experience science with those who make it happen
  - Replicate important IceCube results
- 2015 was program’s second year
  - Doubled # of sites to 10 locations in the US & Europe
  - Almost doubled # of students to 175
  - Added second analysis
- Support from WIPAC, but local organization
  - Resources shared online and used beyond the masterclass
- Both students and teachers greatly value this program
  - Challenging research activities one of the best rated activities.



[icecube.wisc.edu/masterclass](http://icecube.wisc.edu/masterclass)

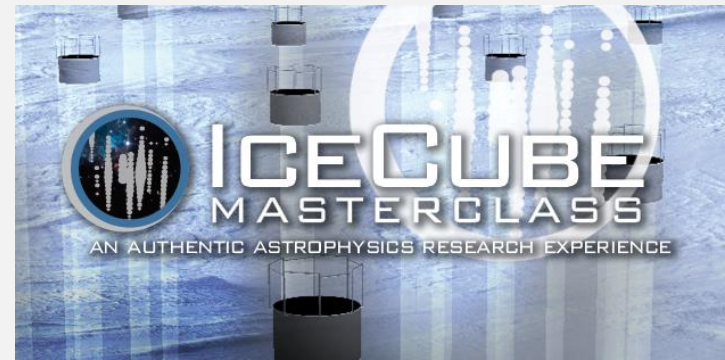
# IceCube Masterclasses

*“become a scientist for one day”*



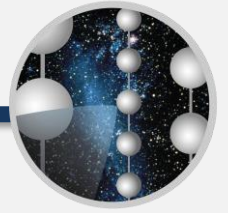
- 2016 masterclass
  - HESE and CR flux analyses
  - Website in 3 languages (English, German, Spanish)
  - Offer masterclass in Spanish
- 5-year goals:
  - Increase participation to 250 students annually
  - Increase diversity, offer Spanish masterclass
  - Annually review and revamp resources based on user evaluations

[icecube.wisc.edu/masterclass](http://icecube.wisc.edu/masterclass)





# Upward Bound, UWRF

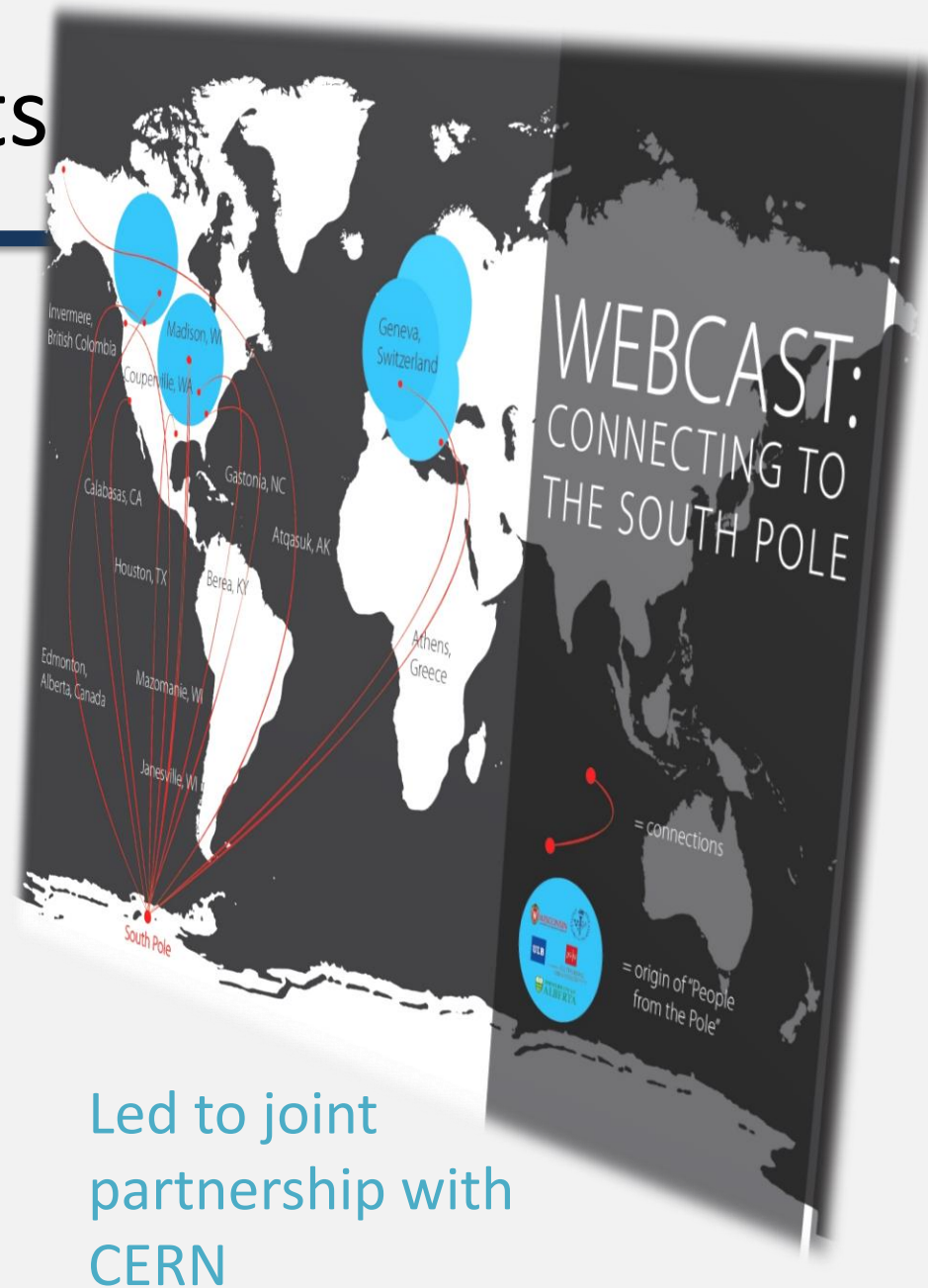


- 8 day residential Math/Science summer program at UWRF
  - Engages low-income, first-generation 9-12<sup>th</sup> grade students in science and math
  - Work with master teachers (PolarTREC) and pre-service teachers
  - Test innovative, hands-on lesson plans
- 5-year goal: continue successful program



# South Pole Webcasts

- Video connection to the Pole
  - Led by IceCube winterovers with off-ice host
  - Typically six times/year, but increasing activity for 2015–16
  - For 2014-15,
    - 1600 participants overall
    - More than 12 schools in the US
    - Germany, India, Italy, US and Puerto Rico
  - Over 25 collaborators have participated in four years
- 5-year goals:
  - 10 webcasts per year
  - At least one in Spanish
  - Average 100 participants, attract diverse audiences



Led to joint  
partnership with  
CERN

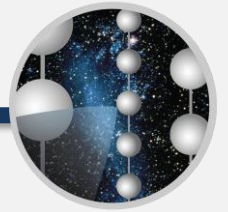
A woman and a man are working on laptops in a dimly lit laboratory. The woman in the foreground is looking at a laptop screen displaying a colorful heatmap. The man in the background is also working on a laptop. The scene is filled with various pieces of laboratory equipment, including a large glass dome and various cables.

Education & Outreach highlights

# STEM & RESEARCH EXPERIENCES



# Undergraduate(UG) research

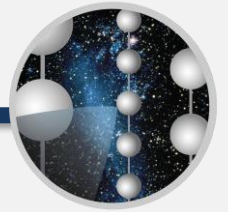


- Many IceCube collaborators have UGs making real contributions
- UWRF has NSF funding for USA UGs
  - Target students from two-year colleges and underrepresented groups
  - Scaffold approach to build confidence and increase sophistication
- Research Experience for UGs (REU)
  - 10-week summer internships at UWRF
- International Research Experiences for Students (IRES)
  - 10-week summer internships in Europe
  - Brussels, Bochum, Mainz to date
  - Stockholm summer 2016



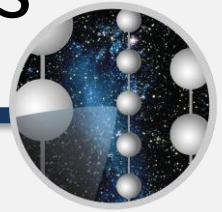
# UG research 5-year goals

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- Improve UG research experiences by
  - Holding dedicated virtual meetings connecting UGs across collaboration
  - Enhancing visibility by introducing UG poster prizes at IceCube Collaboration meetings
- Increase diversity of UG researchers and commit to having a majority of UWRF REU and IRES UGs from underrepresented groups and/or two-year colleges

# South Pole deployments for HS teachers



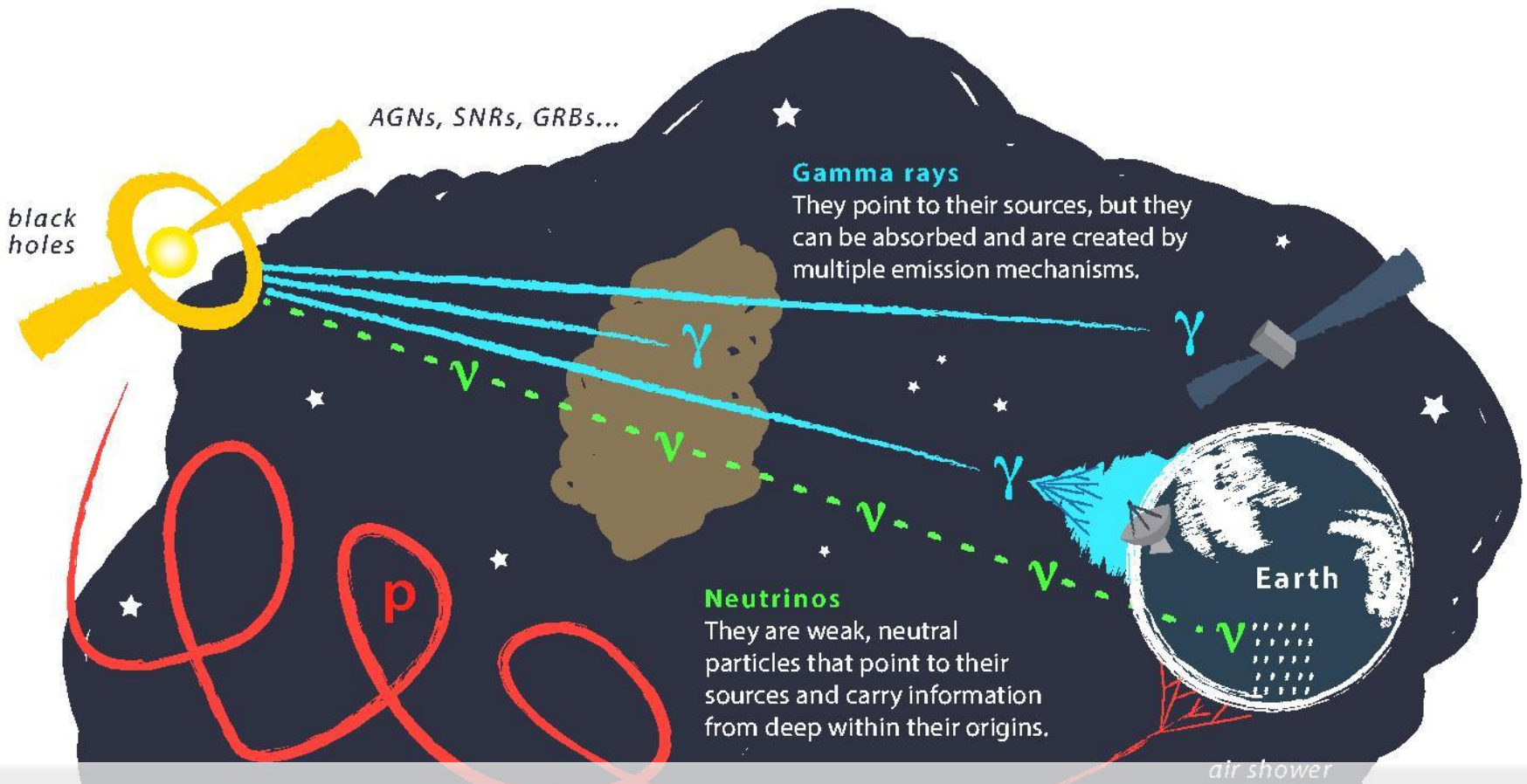
Work with NSF-supported PolarTREC project to provide South Pole IceCube research experiences

- 4 high school teachers hosted by IceCube, most recent Armando Caussade, a native Spanish speaker from Puerto Rico
  - Participate in webcasts
  - Blog about experience
  - Bring new audiences to IceCube
- Following deployment,
  - Encourage participation in Upward Bound
  - Create classroom resources
- 5-year Goals
  - Host at least one teacher at the South Pole annually
  - Recruit at least teacher from an underrepresented group
  - Continue collaborating with past IceCube PolarTREC teachers to bring ICNO science to the classroom



The screenshot shows the PolarTREC website interface. At the top, there is a navigation bar with links for 'About', 'Virtual Base Camp', 'PolarConnect', 'Newsroom', 'For Teachers', 'For Researchers', 'Resources', and 'En Español'. Below the navigation bar is a search bar. The main content area features a profile for Armando Caussade. The profile includes a 'Details' section with a small photo of Armando, his name, occupation (Teacher), organization (G Works Inc. for the Puerto Rico Department of Education), location (Juncos, Puerto Rico, United States), and expeditions (Ice Cube Neutrino Observatory 2014). To the right of the details is a 'Featured Photos' section showing a photo of Armando standing in a classroom with other people.





AGNs, SNRs, GRBs...

black holes

**Gamma rays**  
They point to their sources, but they can be absorbed and are created by multiple emission mechanisms.

**Neutrinos**  
They are weak, neutral particles that point to their sources and carry information from deep within their origins.

Earth

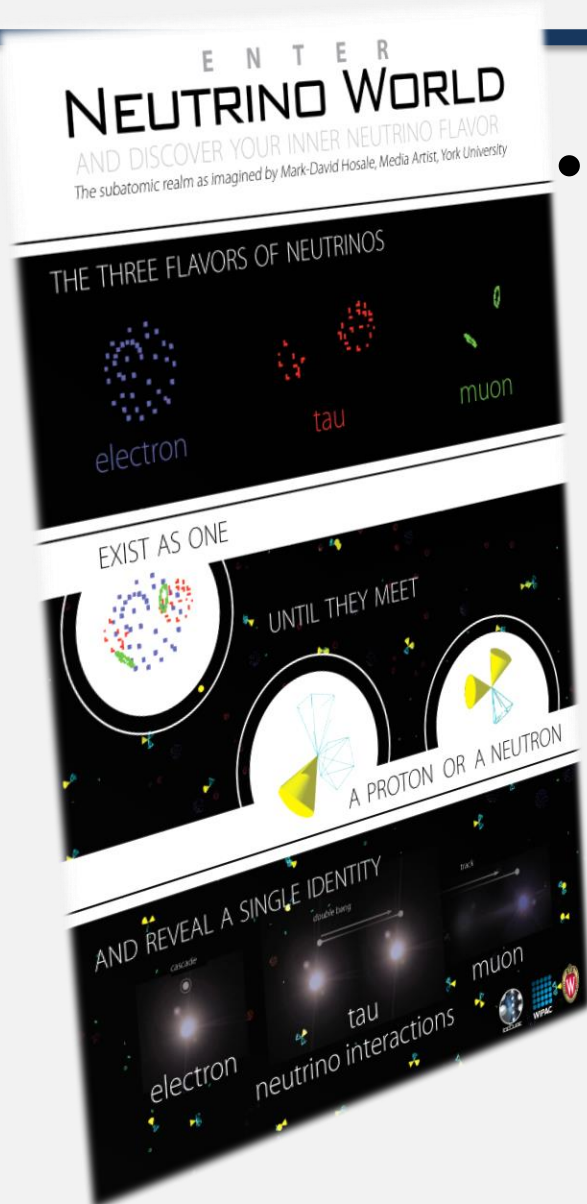
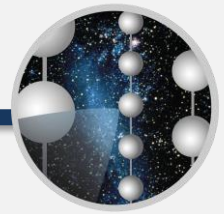
air shower

Education & Outreach highlights

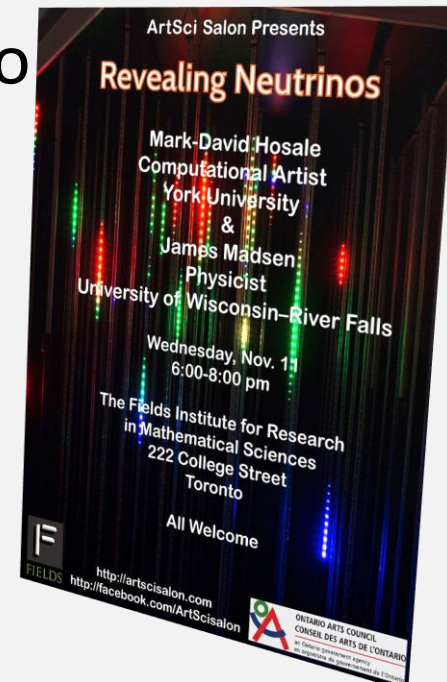
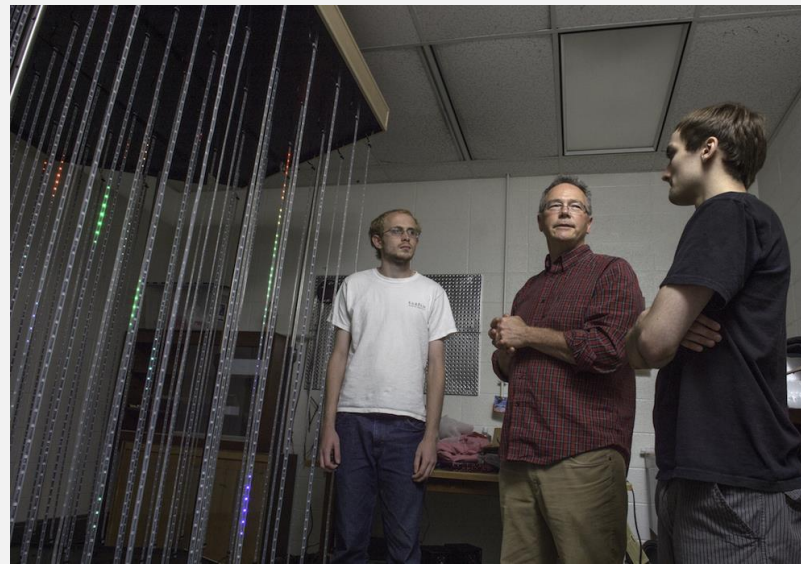
They are charged particles and are produced by magnetic fields.

# WEB, PRINT RESOURCES AND DISPLAYS

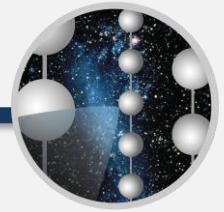
# Exploring ArtScience world



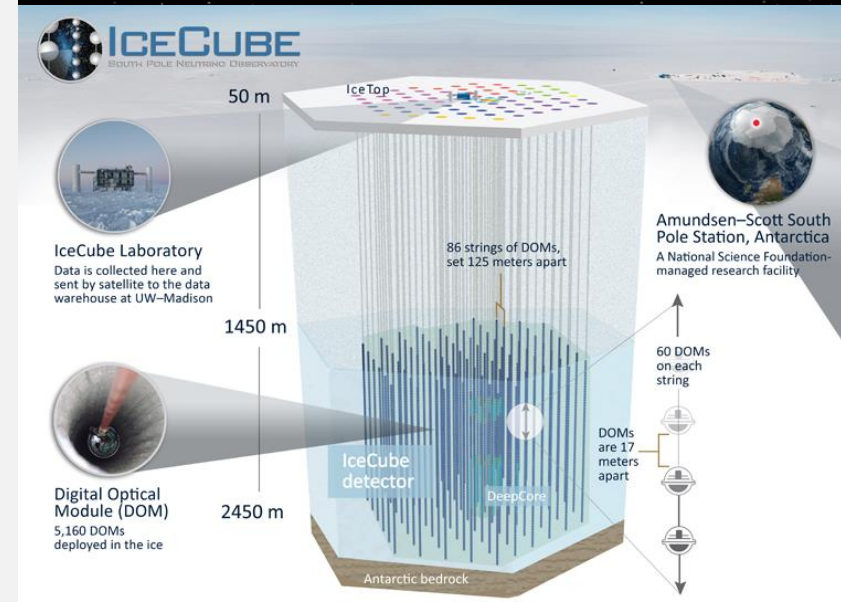
- Ongoing 3-year collaboration with Mark-David Hosale, York University
  - Interactive LED model of in-ice array
  - An engaging video interpretation of the world of the neutrino



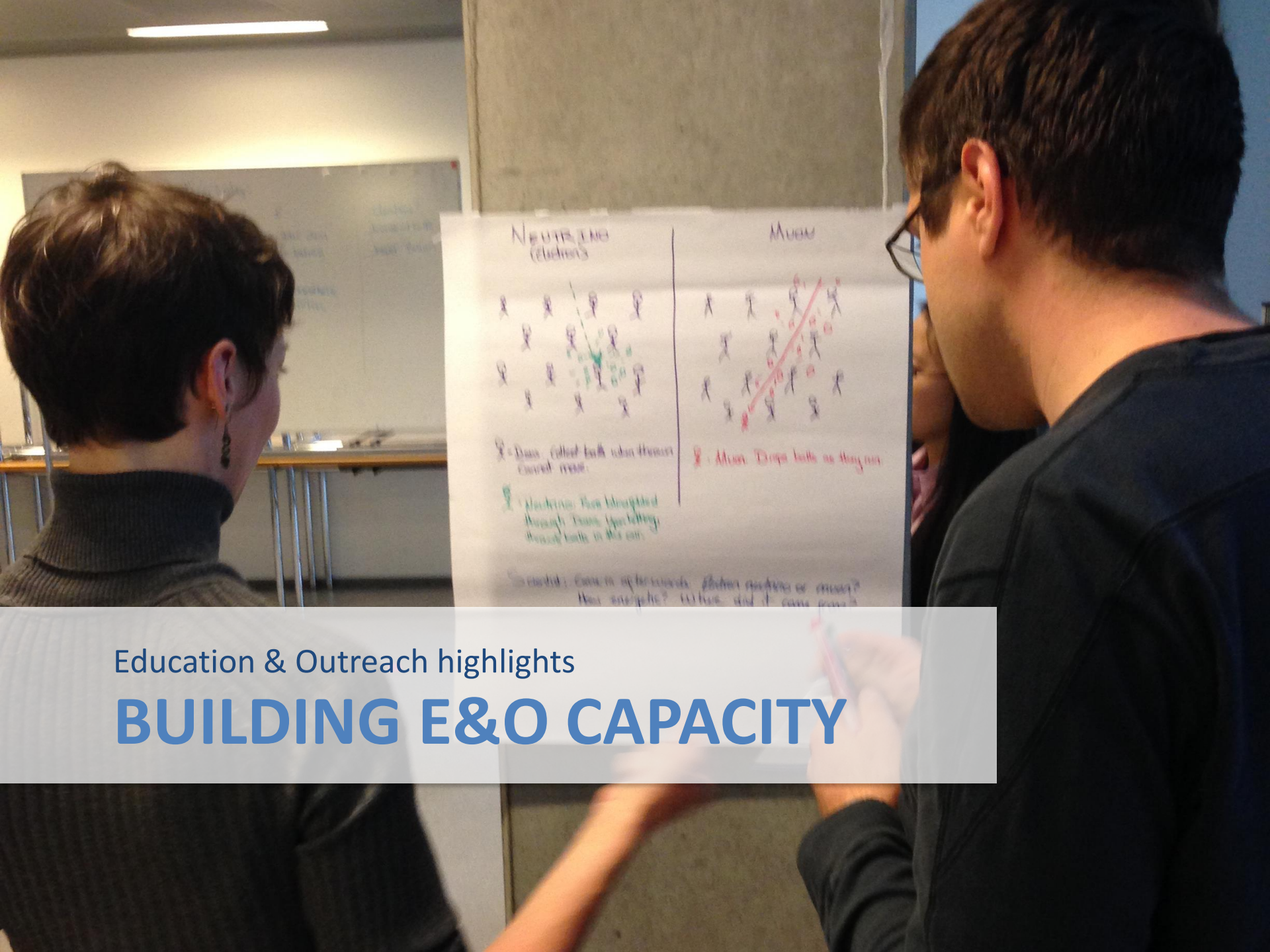
# Web, print, and other resources



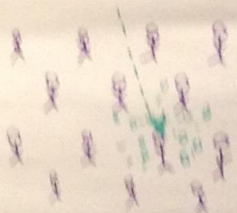
- Craft multimedia resources to describe IceCube science and technology
- 5-year goals
  - Continue successful partnership with Hosale
  - Add sound to LED model and assess its impact on engagement and understanding
  - Annually assess effectiveness of learning web resources with user experience groups attending IceCube outreach events







NEUTRONS  
(electrons)

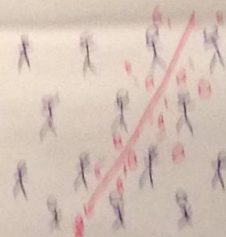


♀ - Dues, collect both when Hueser  
cannot move.

♂ - Neutrons: Not brought  
through Dues (partially)  
through both in the car.

So-called: come in afterwards. Electron numbers or energy?  
How energetic? Where did it come from?

MUSEU

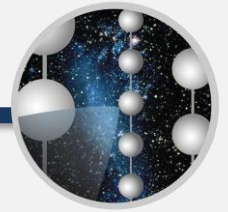


♂ - Museu: Drops both as they run.

Education & Outreach highlights

# BUILDING E&O CAPACITY

# Communication workshop

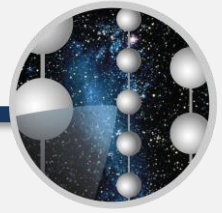


- Training program to develop communication and education & outreach skills, with different topic for each workshop
- 2<sup>nd</sup> workshop held at fall collaboration meeting: “Engage students through kinesthetic learning,” Jesper Bruun
- 43 participants in the program so far
  - 9 completed both workshops
- 5-year goals:
  - Increase capacity to reach 50% of young researchers
  - Offer workshops for mid-and late-career scientists





# E&O activity examples



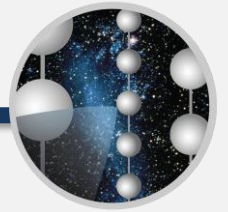
- Fysik i Kungsträdgården ice drilling at the “open house” for Stockholm University and Royal Institute of Technology
- *Faculty Voice* essay and video profile for Michigan State U.
- Nuclear Science Day at LBNL drew 180 middle & HS girl and boy scouts
- *Chasing the Ghost Particle* at U. of Alaska Anchorage with after show presentation





# Assessment of E&O programs

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- 5-year goal: develop outcomes assessment program
  - Working with an expert to develop tools to share within the collaboration for the assessment of individual programs
  - Develop a framework to integrate results from individual programs toward the assessment of the M&O, E&O program

# Summary

- Lots of activity
- Rewarding on multiple levels
- Moving from opportunistic to strategic program
- Everybody has something to contribute

