IceCube and PATh Services

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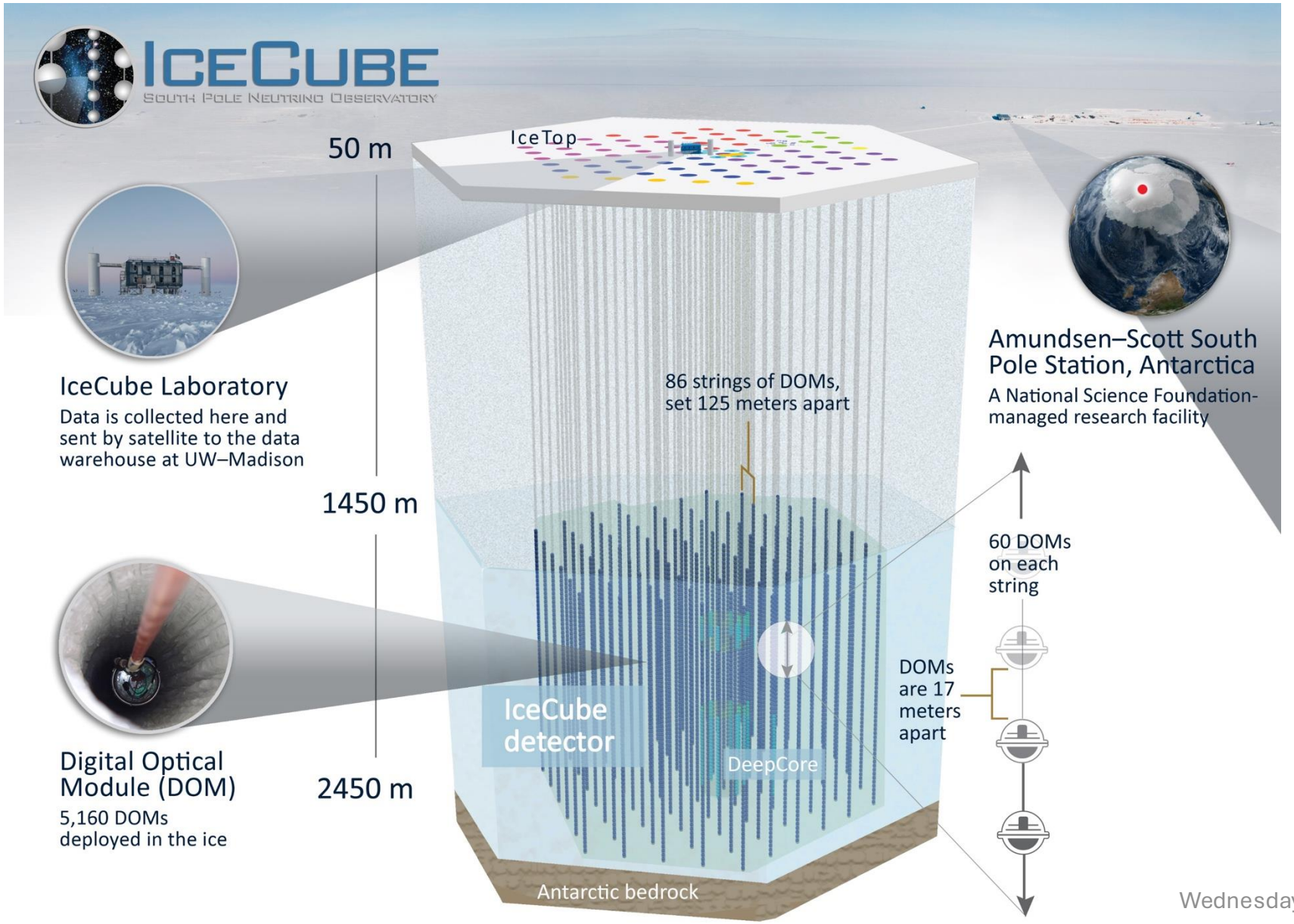
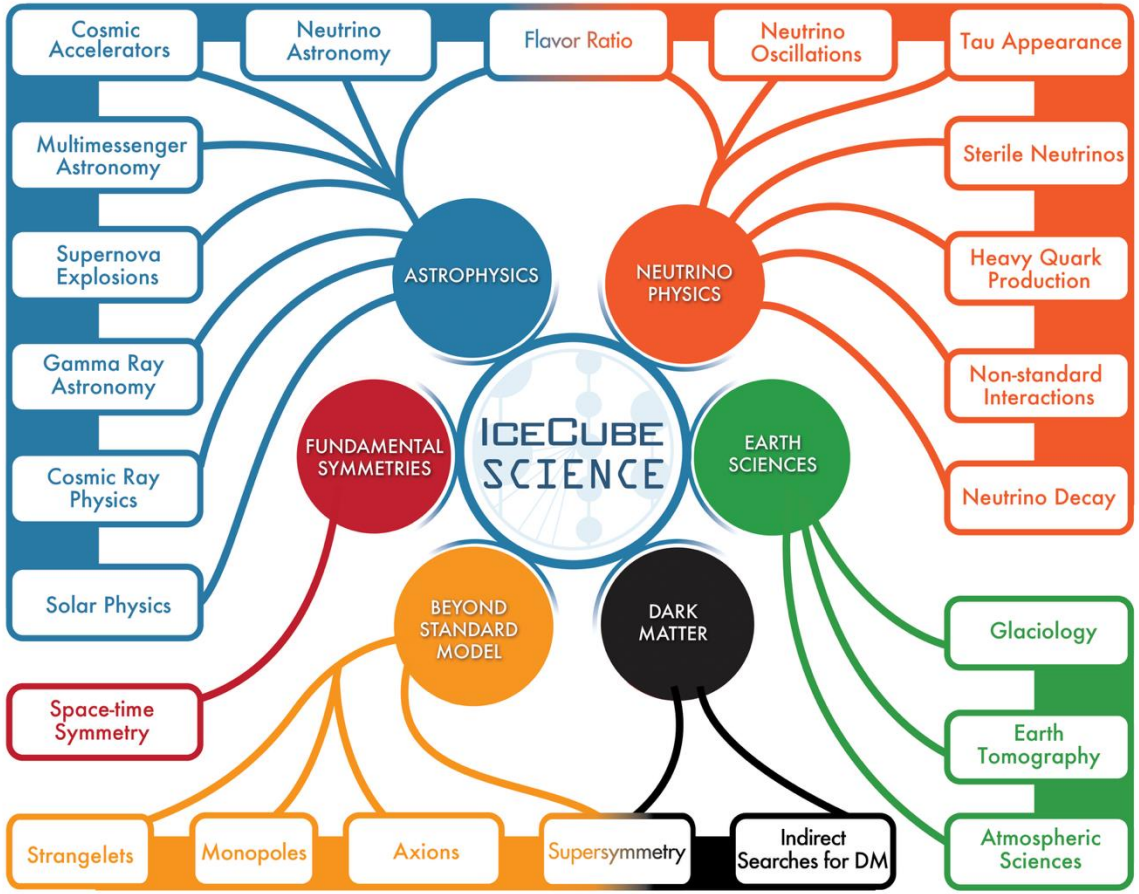
IceCube


IceCube
South Pole Neutrino Observatory
50 m
IceTop
IceCube Laboratory
Data is collected here and sent by satellite to the data warehouse at UW–Madison
1450 m
86 strings of DOMs, set 125 meters apart
Amundsen–Scott South Pole Station, Antarctica
A National Science Foundation-managed research facility
60 DOMs on each string
DOMs are 17 meters apart
IceCube detector
DeepCore
Digital Optical Module (DOM)
5,160 DOMs deployed in the ice
2450 m
Antarctic bedrock

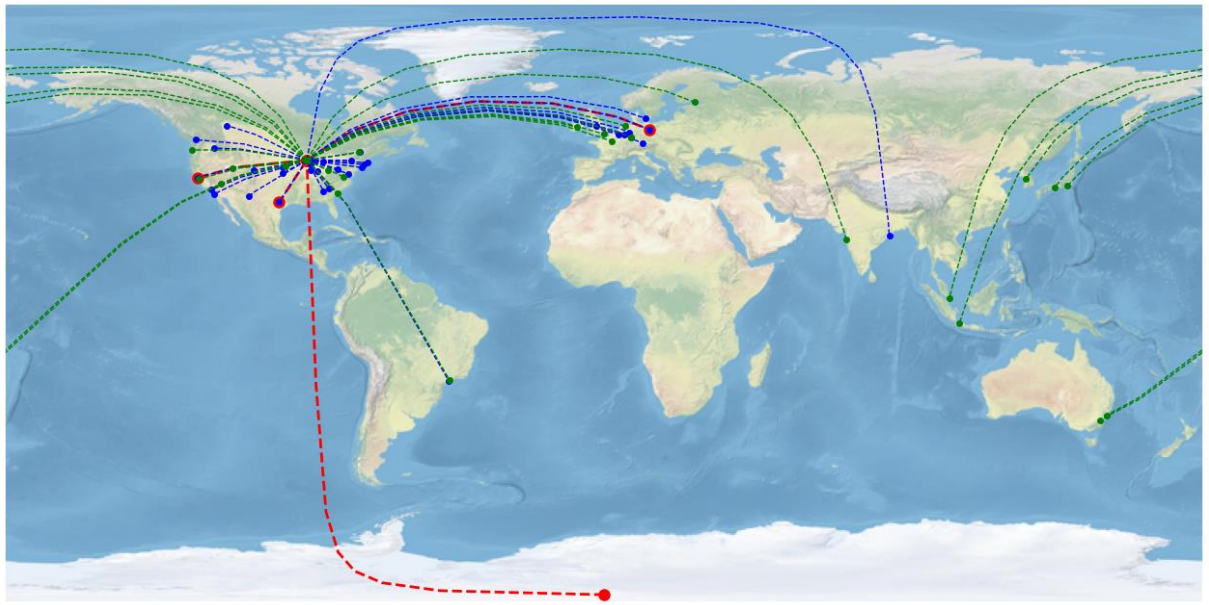
IceCube Science



- Novel instrument in multiple fields
- Broad science abilities, e.g. astrophysics, particle physics, and earth sciences
- Lots of data that needs to be processed in different ways
- Lots of simulation that needs to be generated

IceCube Computing – 10,000 Foot View

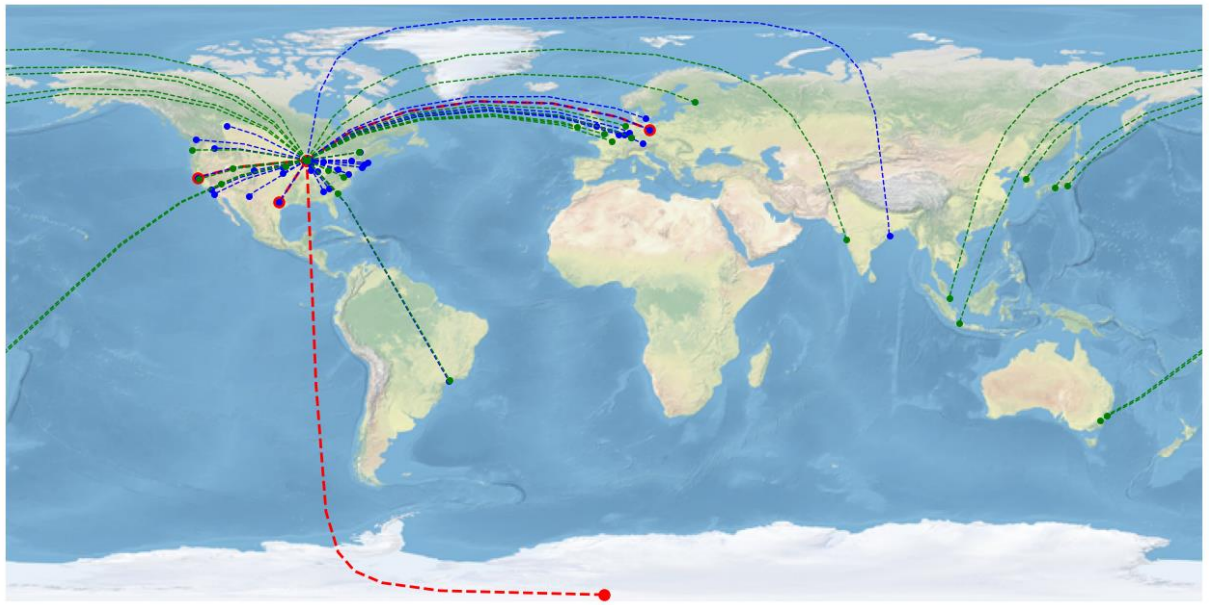
- Global heterogeneous resources pool – Powered by PATh services and products
- Mostly shared and opportunistic resources
- Atypical resources requirements and software stack
  - Accelerators (GPUs)
  - Broad physics reach with high uptime
  - Niche dependencies
- Significant changes of requirements over the course of experiment - Accelerators, Multi-messenger Astrophysics, alerting, etc.



Red – Data Blue – Dedicated Green - Opportunistic

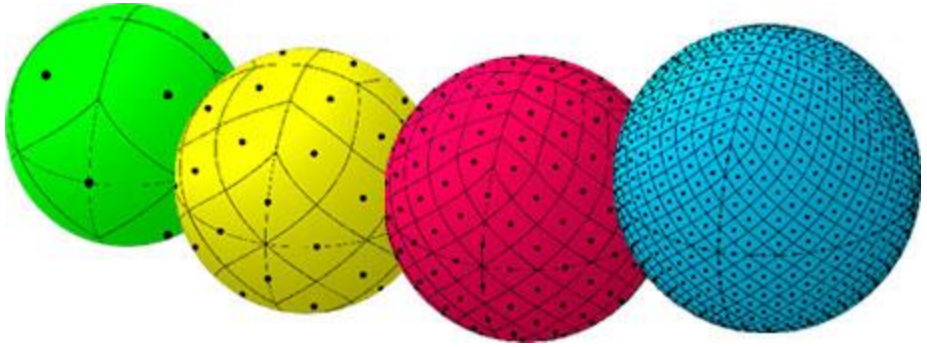
Global Resource Pool

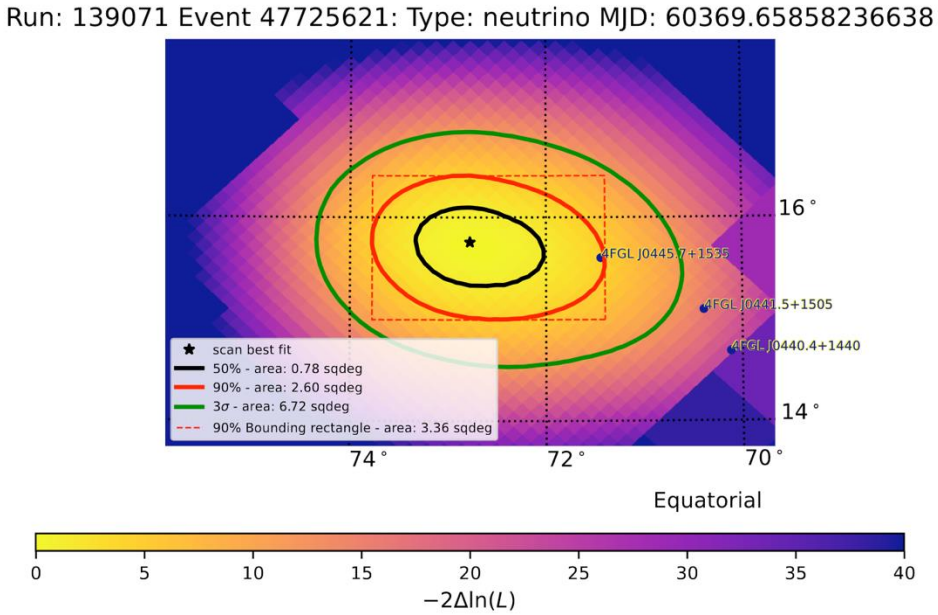
- Global heterogeneous resources pool – GPU and CPU
- Tied to together through HTCondor
  - Using PATh HTCondor pilot to start glideins at sites without endpoints
    - ACCESS Sites – Delta
    - Campus Clusters – Harvard
    - LCCF – Frontera, Vista
  - Use HostedCEs/CEs where available
    - ACCESS Sites – Anvil
    - DESY
  - Flocking to Open Science Pool



Red – Data Blue – Dedicated Green - Opportunistic

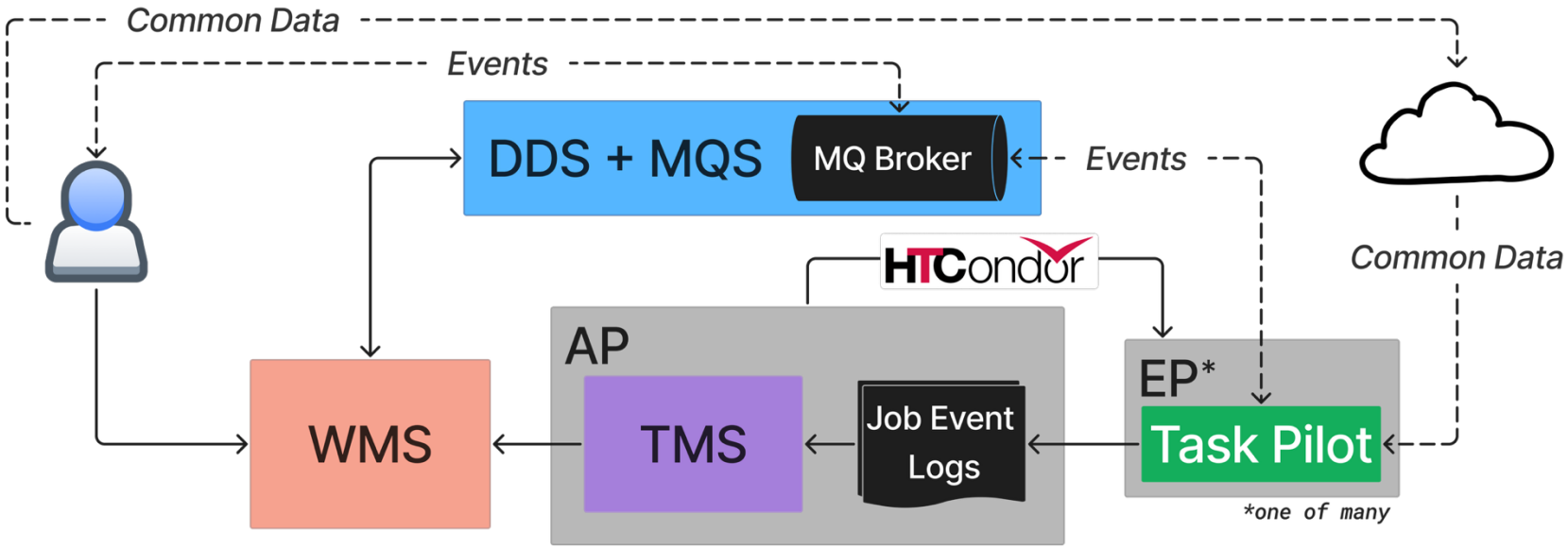
Multi-Messenger Astrophysics – Reconstruction





- Most accurate directional reconstruction comes by scanning across the sky
  - Split sky into constant surface area pieces
  - Test each directional hypothesis against likelihood
  - Create directional likelihood map
  - Gives most probable direction and error
- Each hypothesis calculation is independent – Easy to split up workload across O(1000[000]) cores

Event Workflow Management Service



- EWMS as a backend to distribute large number of O(second-minute) tasks
- Hosted backend infrastructure for EWMS on PATh facility
- Message Queue (RabbitMQ) is hosted on PATh facility

Current and Forthcoming Integration

- Current
  - Using /cvmfs distribution via OSDF for limited datasets
- Future
  - Switching to Pelican for data transfer to/from jobs
  - ML-Inference-as-a-Service on the PATh Facility
    - Work with A3D3 and SuperSONIC