CICompass

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IceCube in the Clouds

By Benedikt Riedel

The March Toward the Clouds: MF Perspectives

March 2, 2022
CI Compass Cyberinfrastructure for NSF Major Facilities Workshop

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IceCube in the Clouds

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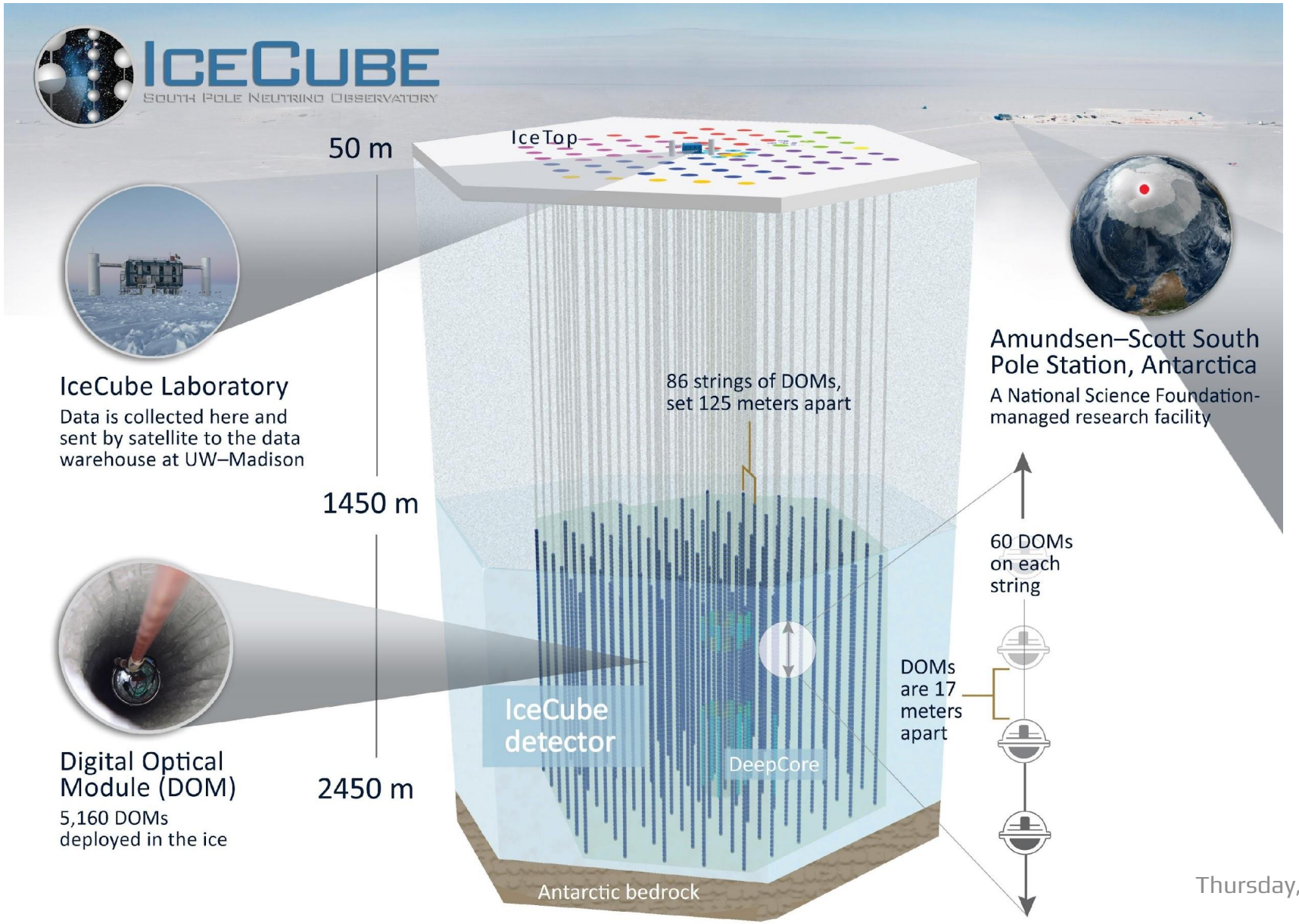
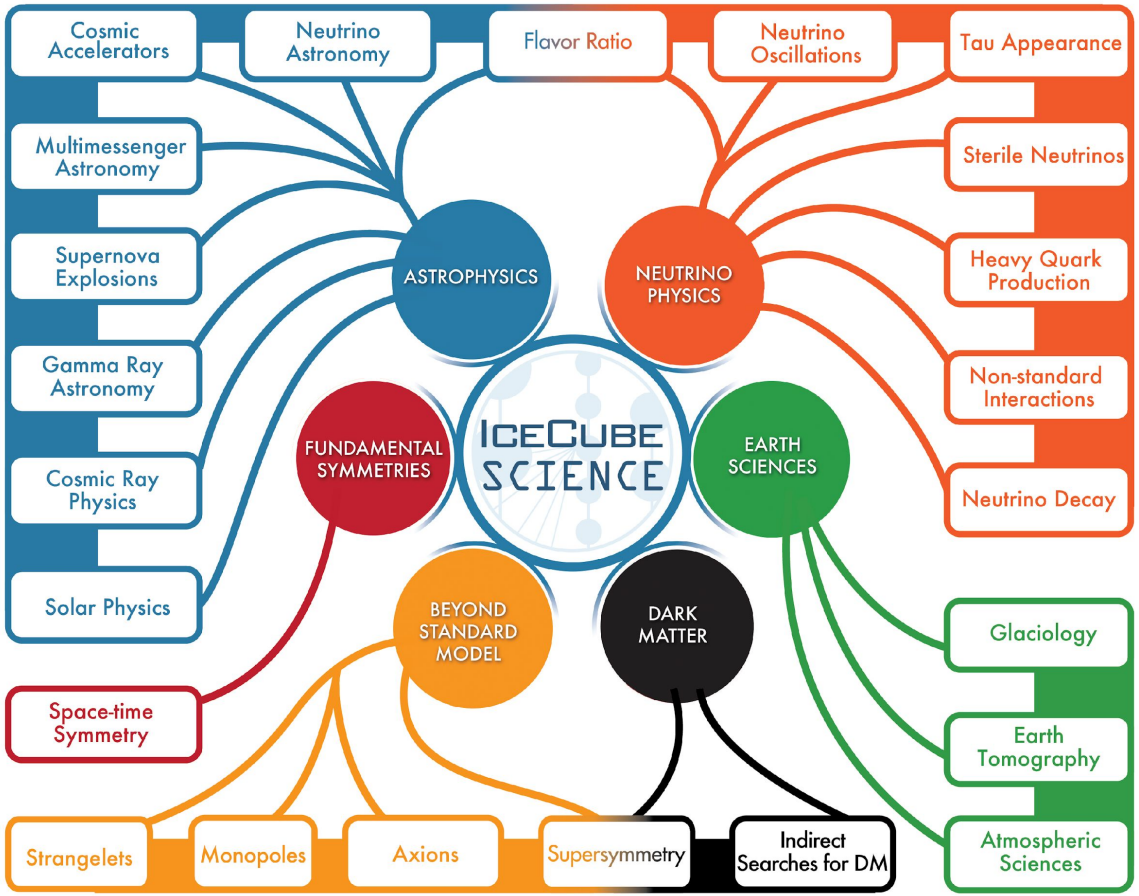
IceCube
South Pole Neutrino Observatory

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

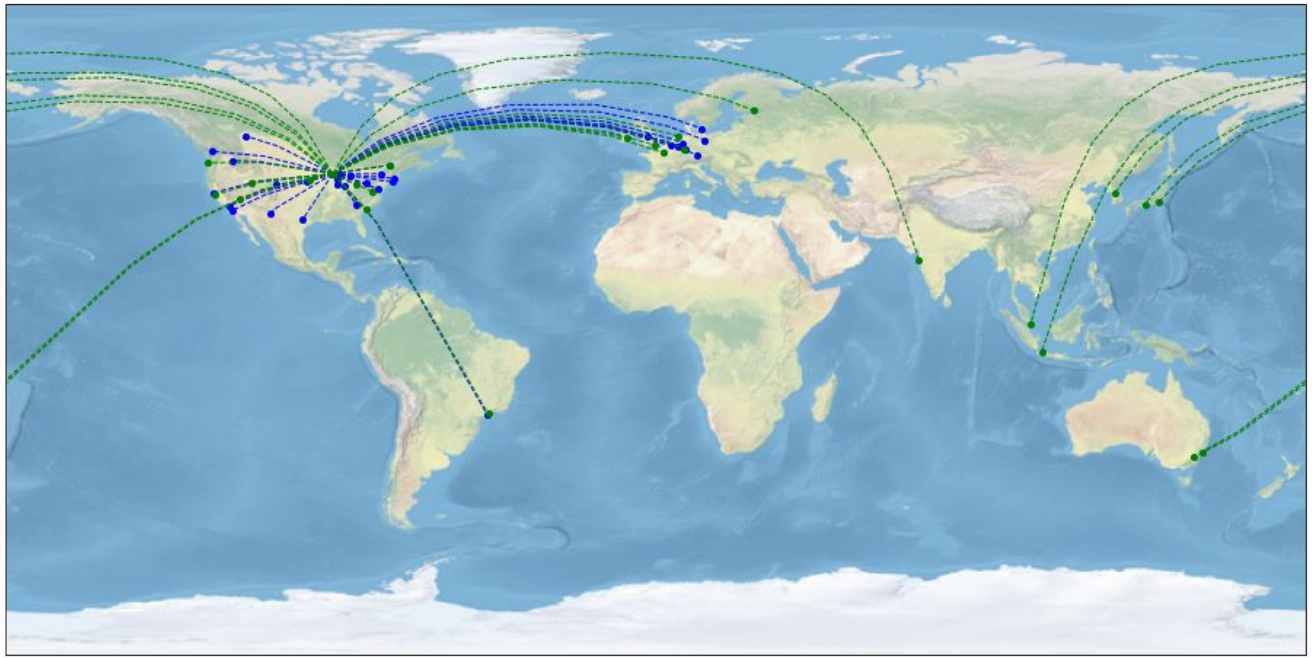
IceCube Science



- 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

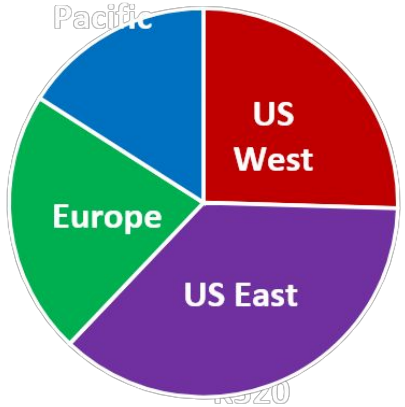
IceCube Computing

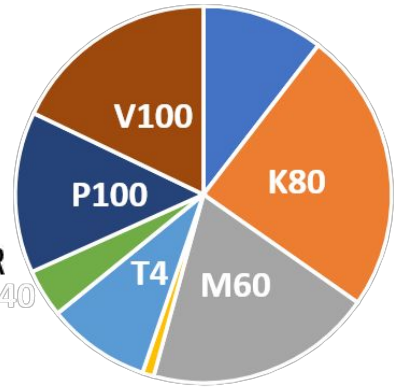
- Particle Physics Computing
  - Ingeniously Parallel!
  - Globally distributed computing
- Full Stack IT services for 400+ people across 53 institutions in 13 countries
- Basic business IT (email, document management) to large-scale distributed computing
- Cloud touches IceCube in multiple ways
  - Transitioning business services from on-prem to cloud services
  - Already using cloud-based services – Zoom
- Cloud resources could easily compensate for lack of resources – But can we "pay" for them? (Answer: No)



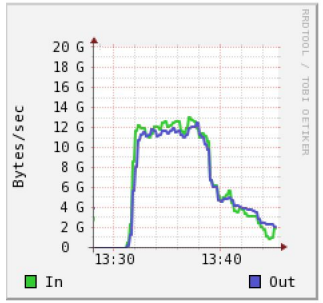
GPU Cloudburst Experiments

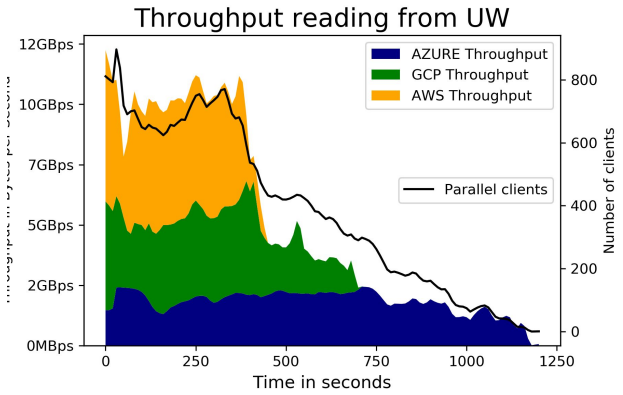
- Original Goal: Create an ExaFLOP compute pool in the cloud (80,000 NVIDIA V100) and address review panel recommendations
- First Experiment – On Nov 16 2019 we bought all GPU capacity that was for sale in Amazon Web Services, Microsoft Azure, and Google Cloud Platform worldwide - **Creating The Largest GPU Cloud Pool in History**
  - 51k NVIDIA GPUs in the Cloud
  - 380 Petaflops for 2 hours (90% of DOE's Summit, No. 1 in Top 500)
  - Distributed across, US, EU, and Asia-Pacific
  - Cost: $50-150k (under NDA)
- Second Experiment – More realistic test
  - Most cost-efficient GPUs for 8 hours
  - Achieve 1 ExaFLOP-hour of compute
  - Distributed across, US, EU, and Asia-Pacific
  - Cost: ~$60k
- Third Experiment – Network Peering between clouds and UW
  - 100 Gbps between UW and clouds with the right setup – Multiple clients on both sides, Internet2 peering

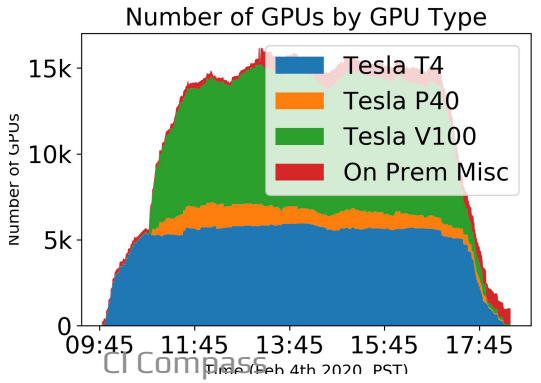


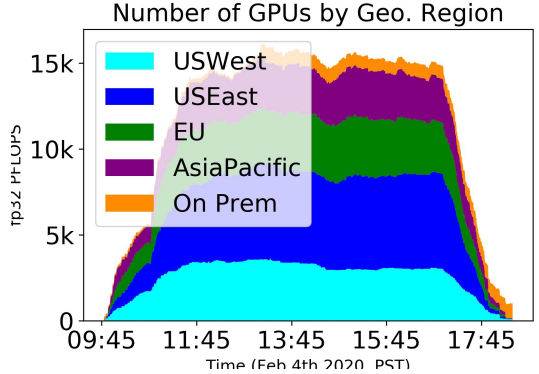


IceCube Server Monitoring









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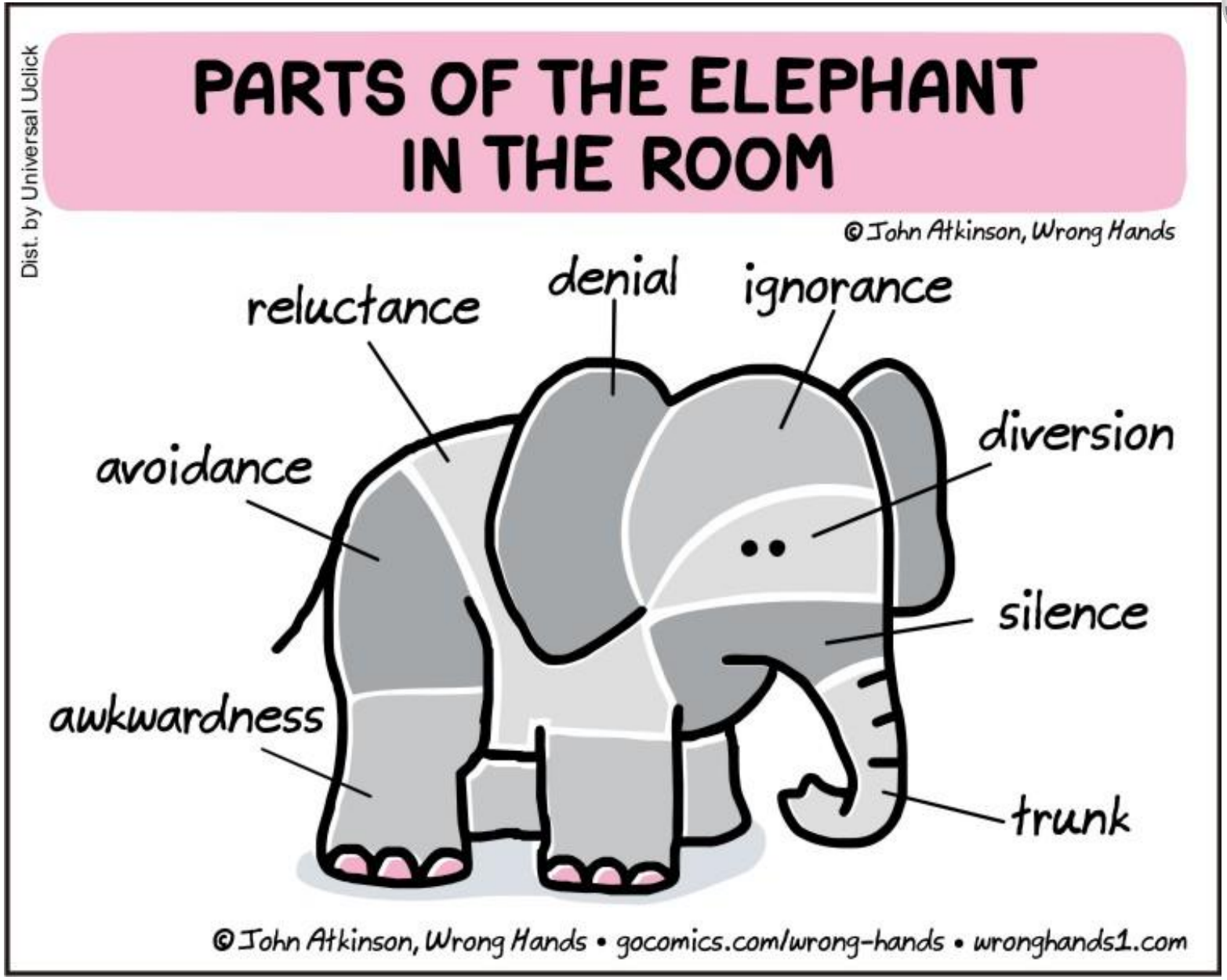
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avoidance
diversion
silence
awkwardness
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Institutional Hesitance/Social Engineering

- UWisc took 18 months to negotiate a contract a contract with GCP
  - 4 years after contract with AWS
  - Standard NSF grant is 3 years
  - How would a smaller school or program do this? – Something like NSF's Cloudbank looks like the solution
  - What about vendors like Oracle? DigitalOcean? Linode?
  - Need to make sure we don't spend over budget
- Inconsistent overhead policy among instructions
  - 50+% potential price swing
- Internet2-UW direct connections needed to make cloud viable for large scale science

Institutional Hesitance/Social Engineering

- Campus-wide SaaS – Between a rock and a hard place
  - Campus-based SaaS is not negotiated for collaborative cross-institutional science
  - Typically limited to affiliated people (students, staff, faculty) – Collaborators excluded
  - Science is becoming more collaborative – IceCube is no longer an outlier
  - Providing business services to non-UW collaborators can be expensive – Example: Groups are paying more per user than UW
- Billing – Unknown cost can have issues with funding agencies and campus administration
- Push towards “free” existing resources – On campus, NSF/DOE HPC, etc.