

Ice as a scientific observatory

Updates on South Pole in-ice physics & astrophysics

- *Precision IceCube Next Generation Upgrade (PINGU)*
- *Askaryan Radio Array (ARA)*

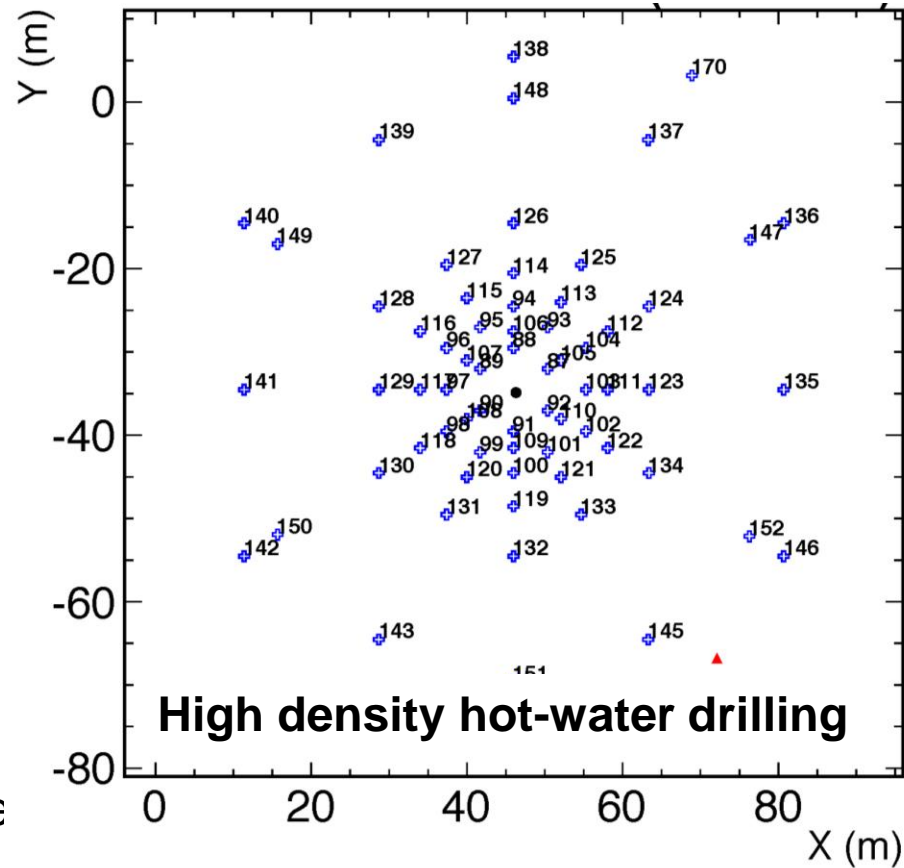
PINGU

(Precision IceCube Next Generation Upgrade)



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- IceCube reported detection of cosmic neutrinos (2013)
- PINGU is a denser, lower energy ~\$100M proposed in-fill IceCube expansion
- Neutrino mass hierarchy, oscillations, dark matter, supernovae, tomography of Earth
- Close-packed HW drilling, degassed water
- P5 (Particle Physics Project Prioritization Panel)
- P5 report May 2014 will strongly influence NSF and DOE funding decisions
- PINGU Letter of Intent January 2014 (arXiv 1401.2046)



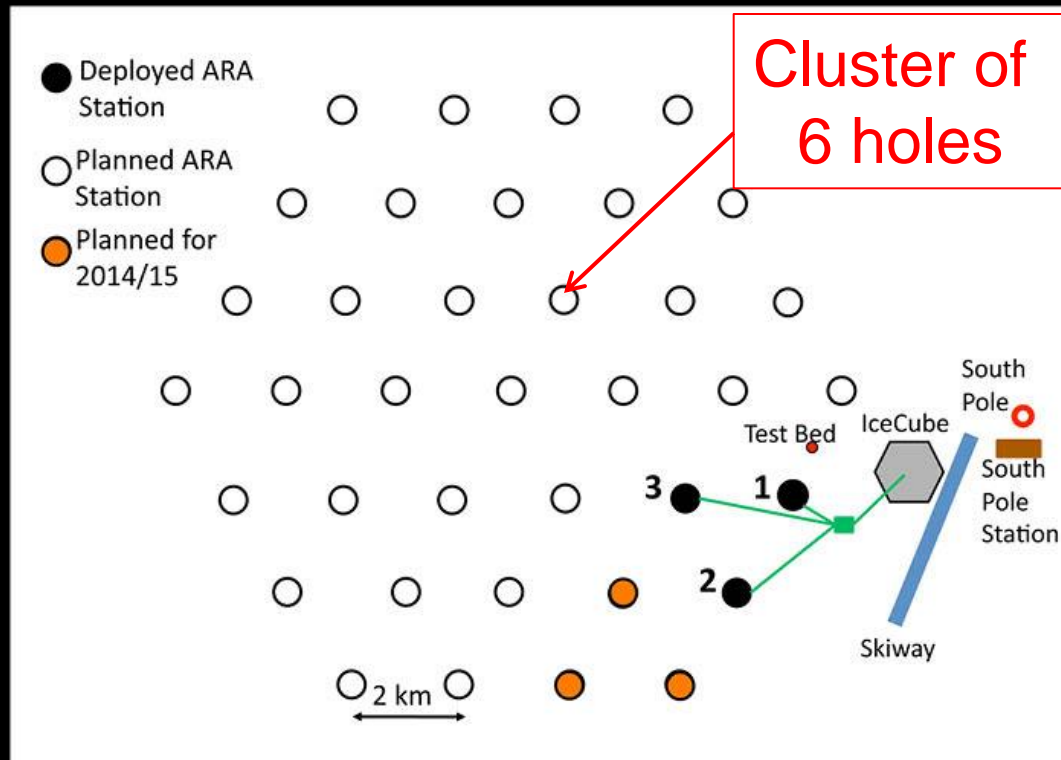
Askaryan Radio Array (ARA)

Ultra-HE ν detection w\ radio Cherenkov (Askaryan) radiation

- **80 km²** area, strings spaced ~ few 100s m

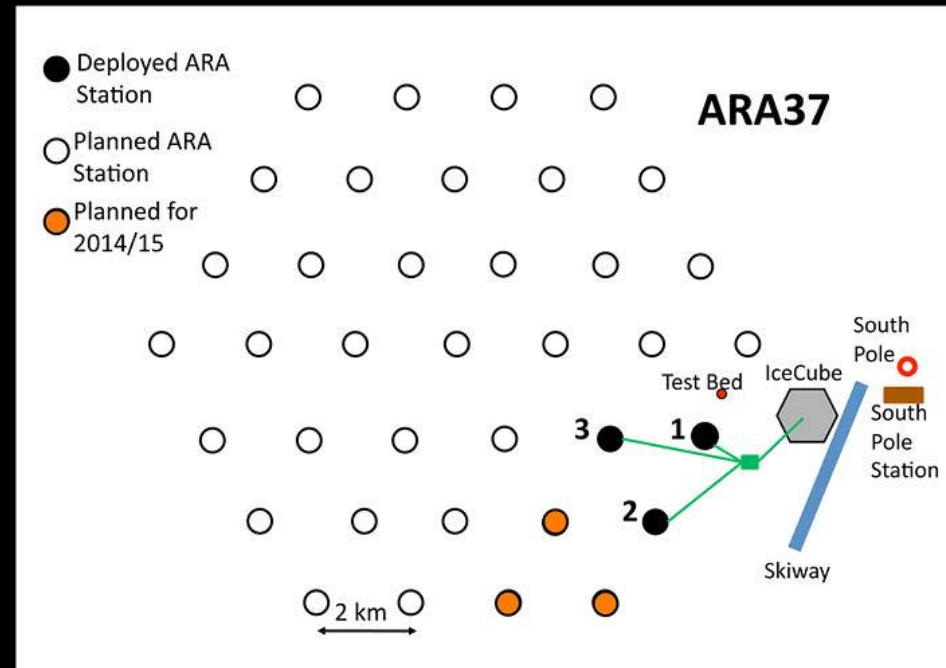
⇒ 222 holes, dry, minimum 6" \varnothing , 200 m deep

⇒ Drill with hot water and pump dry while drilling

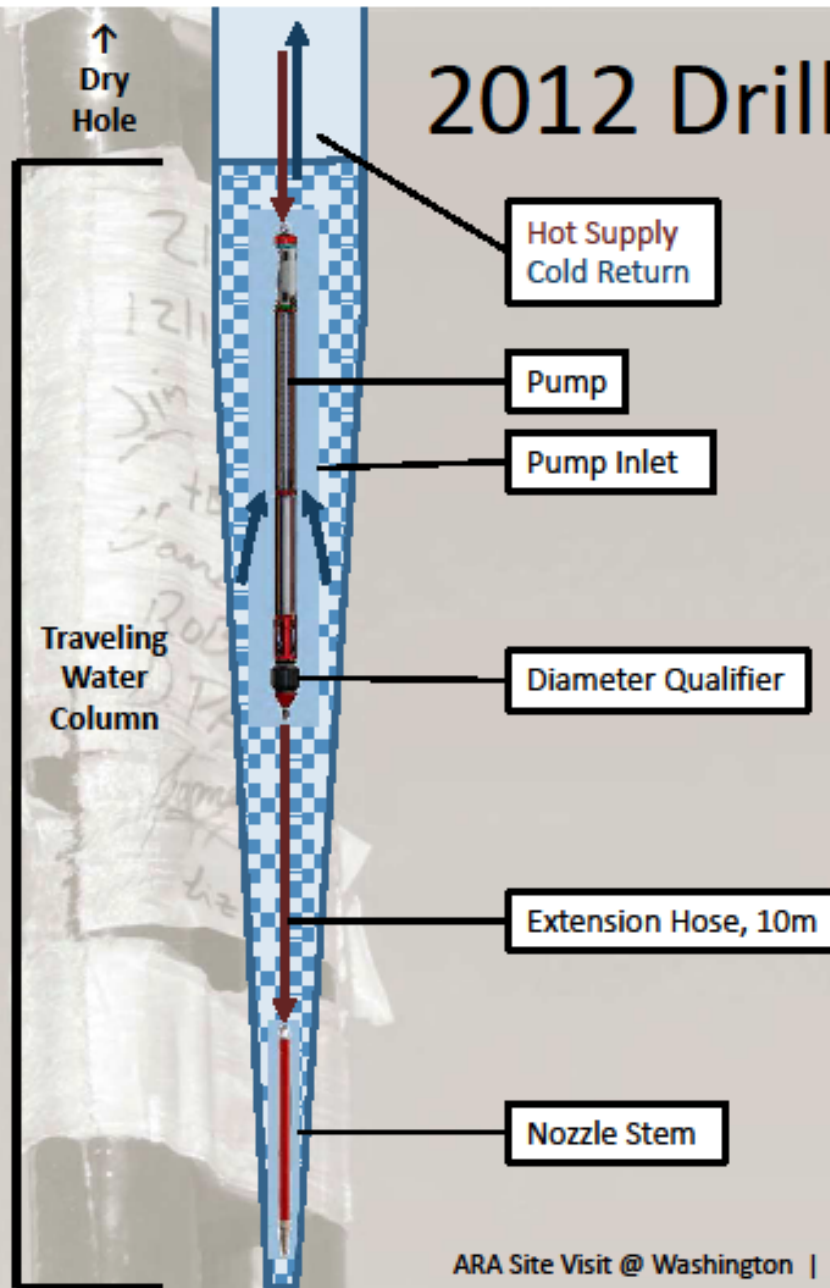


Askaryan Radio Array (ARA)

- No funded ARA work in 2013-14, but contract work for ASC
Terry Benson, Jeff Cherwinka, Darrell Hamilton
Rodwell access shaft, new emergency outfall
ASC electric hot-point technique was not converging
- Buried SP debris (lumber, sawdust, metal conduit)
Traverse GPR was helpful here
- Closed-loop glycol firn drilling with ARA system
- Simple camera for hole qualifying was very useful
- 2014-15 field work
awaiting NSF approval



2012 Drill System Upgrades



New Drilling Method:

PUMP/DRILL AT SAME TIME

Recirculated water column travels down with drillhead. Hot water sprays out nozzle and travels some distance back up the hole to the pump, where the water is pumped back to the surface. Hole diameter is developed between nozzle and pump.

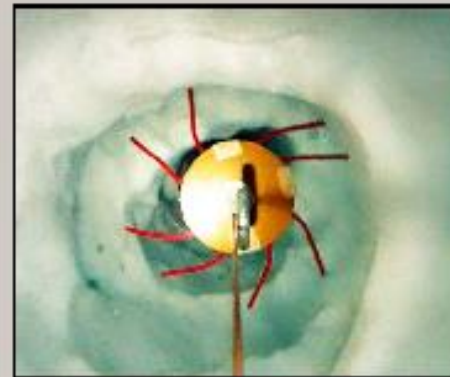
- Closes loop and returns water during drilling
 - No snow melting, net water production
 - System capacity effectively doubled
- Leaves dry hole above
 - No freezeback!
 - 1 step = faster production rate

Hole Quality

FIRN

0-40m

Oversized, ragged, offshoots



TRANSITION ZONE

40-120m

Frosty, post-drill ice structures



DEEP ICE

120-200m

Smooth and uniform

