

WATCHMAN: WATER Cherenkov Monitor of ANtineutrinos

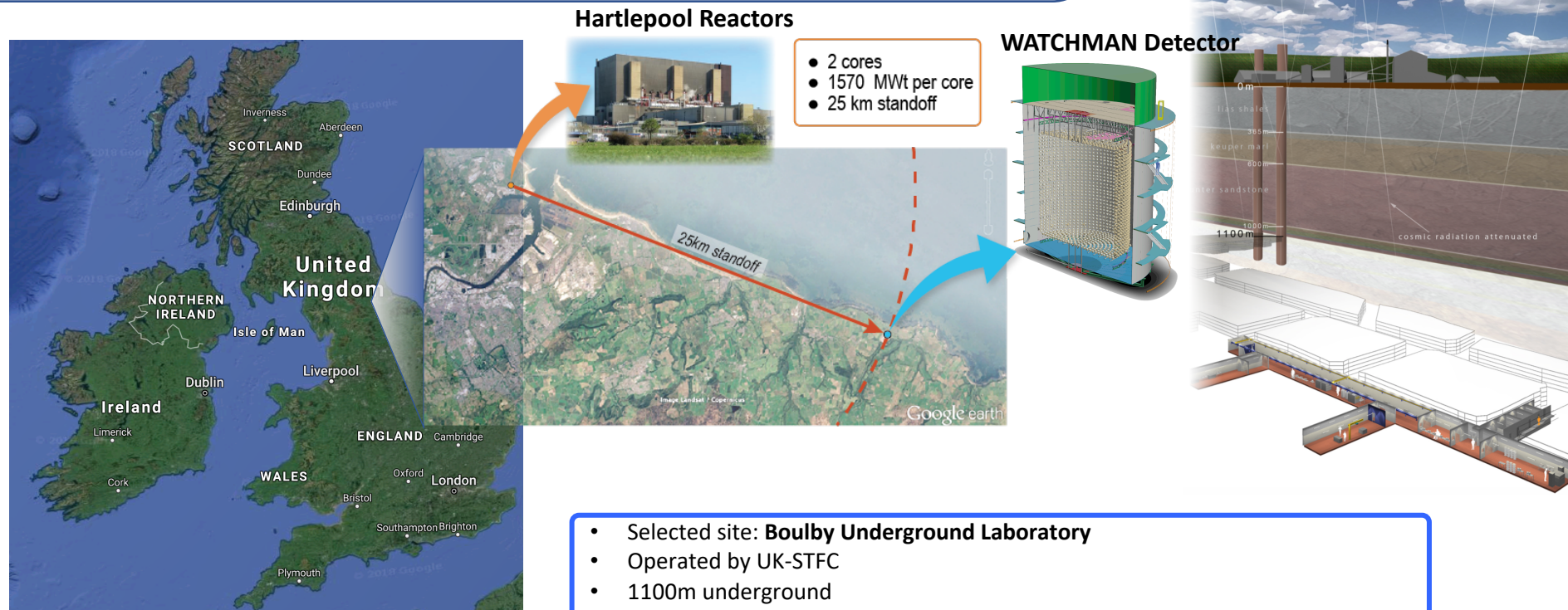
AIT-NEO project

AIT – Advanced Instrumentation Test-bed
a joint US-UK effort for studies of large-scale antineutrino detection methods, main site located at the Boulby Underground Laboratory

NEO Neutrino Experiment One
the first detector deployed at AIT

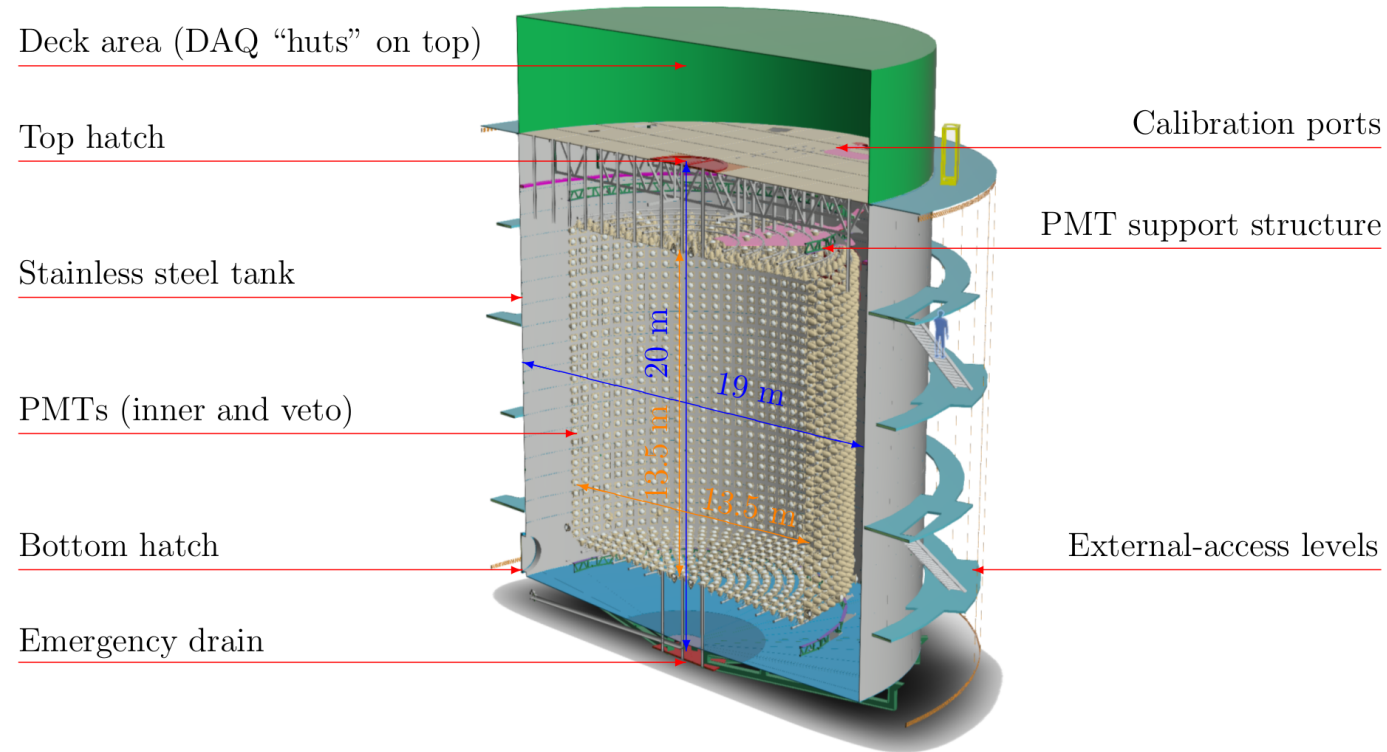
WATCHMAN scientific collaboration

WATCHMAN – a scientific collaboration and detector concepts under consideration for NEO



- Selected site: **Boulby Underground Laboratory**
- Operated by UK-STFC
- 1100m underground
- Part of an operating polyhalite mine
- Candidate for deployment in the **Advanced Instrumentation Testbed**,
- **Gd-H₂O** and **WbLS** under consideration for first fill (NEO)

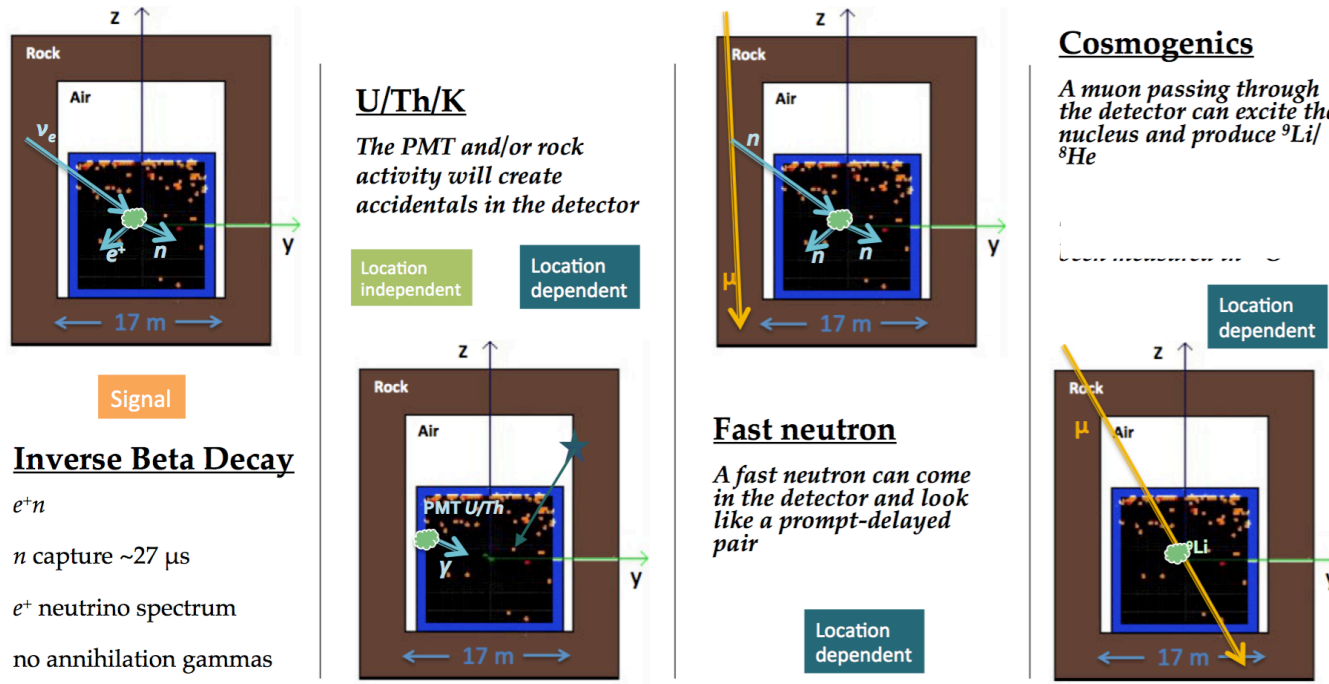
The WATCHMAN Gd—H₂O Conceptual Design – a first look



- 0.1% Gd doping
- Cylindrical tank: 19-20 m diameter, 20 m tall
- Target region: 3600-4400 photomultiplier tubes
- ~1.5 m active buffer region around the ~kiloton fiducial volume
- 2.5 m – 3.5 m veto region outside of target

Preliminary

Signal and Background Estimates (preliminary, Gd-H2O only)



neutron capture on gadolinium for enhanced sensitivity
short capture time, high energy (~ 8 MeV) gamma-ray cascade

WATCHMAN baseline design
20 m tank
kton fiducial, 20% photocoverage

	detect 1 reactor	detect both reactors
Signal (#/day)	0.5	1
Total Bkg	0.9	0.4
Accidental	0.15	0.15
World reactors	0.7	0.2
Fast neutrons	0.01	0.01
Radionuclides	0.04	0.04
Spontaneous Fission	$\ll 0.01$	$\ll 0.01$
days to 3 sigma sensitivity	~ 50	~ 12
$n\sigma = \frac{s\sqrt{t}}{\sqrt{s+b}}$		

Preliminary

Summary

- The Advanced Instrumentation Testbed is a joint United States and United Kingdom project that will test and demonstrate a range of antineutrino-based monitoring technologies for remotely detecting, excluding, and monitoring nuclear reactors
- The project goal is to perform a demonstration of remote reactor monitoring with potentially scalable water-based technologies
- The current schedule driver is preparation of the underground site
- The collaboration is developing possible use cases for a publication oriented to the nonproliferation community, in consultation with internal and external nonproliferation experts