

***Seismically-cued antineutrino detectors  
have limited potential to monitor  
nuclear explosions***

**Rachel Carr (MIT)**

**Ferenc Dalnoki-Veress (MIIS)**

**Adam Bernstein (LLNL)**

CTBTO SnT2019  
June 2019 – Vienna

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*Seismically-cued antineutrino detectors*

②

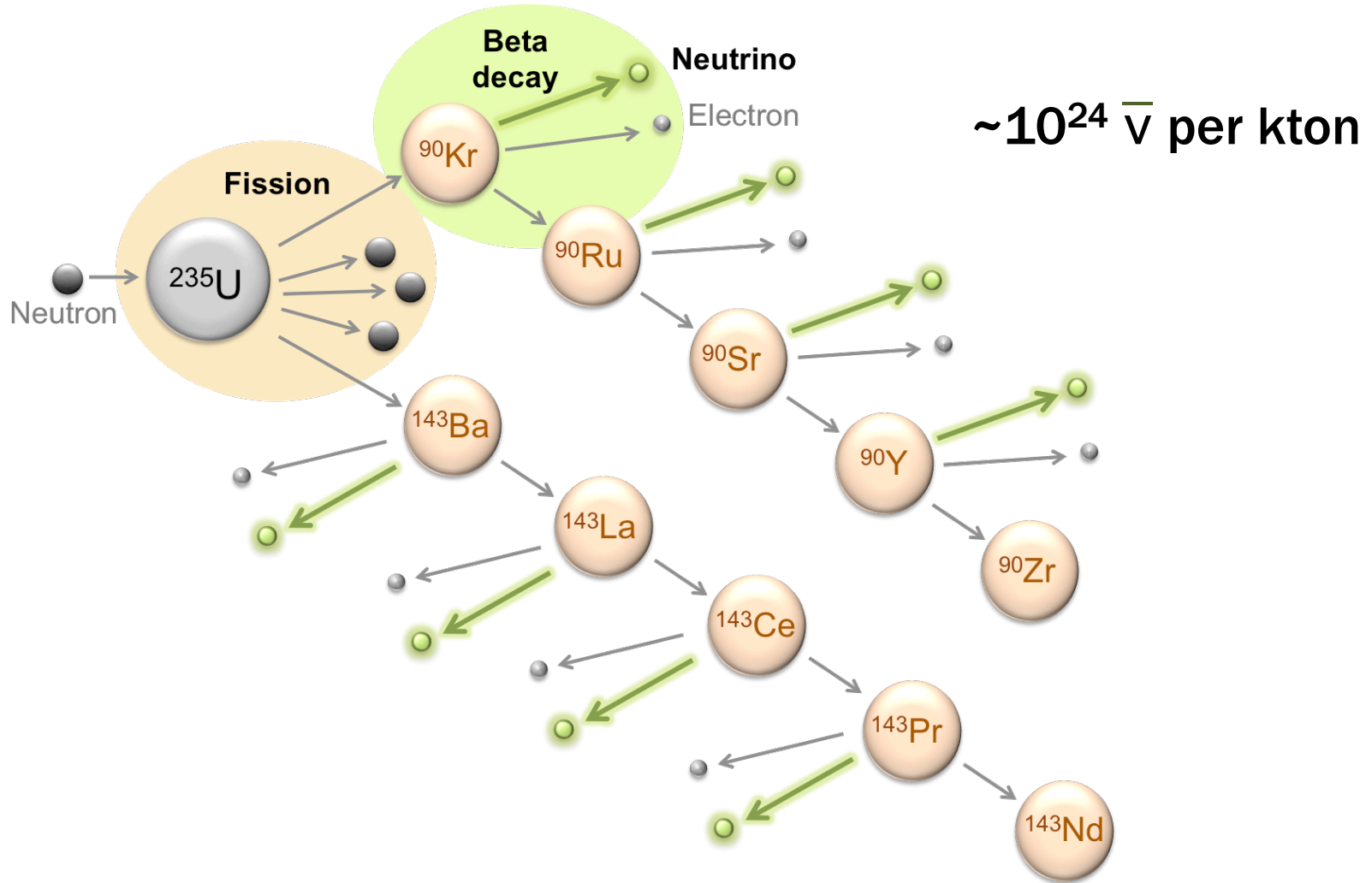
*have limited potential to monitor*

③

*nuclear explosions*

1

# Antineutrinos from fission explosions



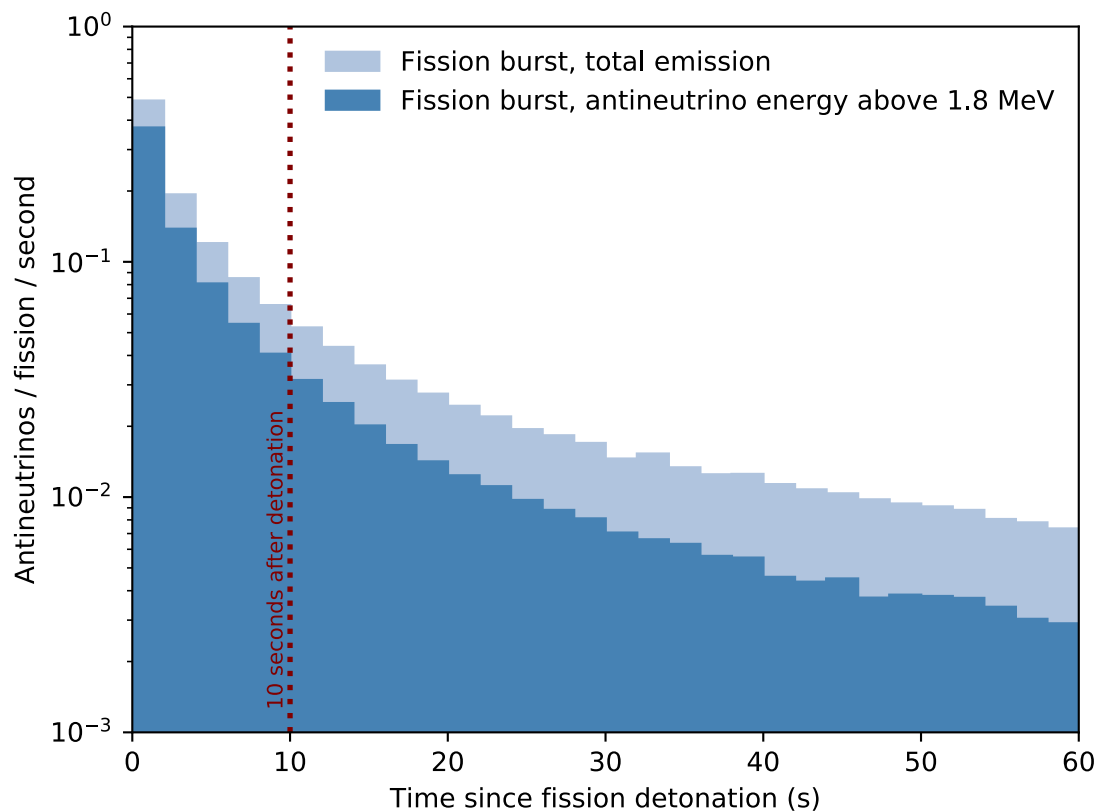
# 1

## *Antineutrinos from fission explosions*

Few-second “burst”

Isotropic

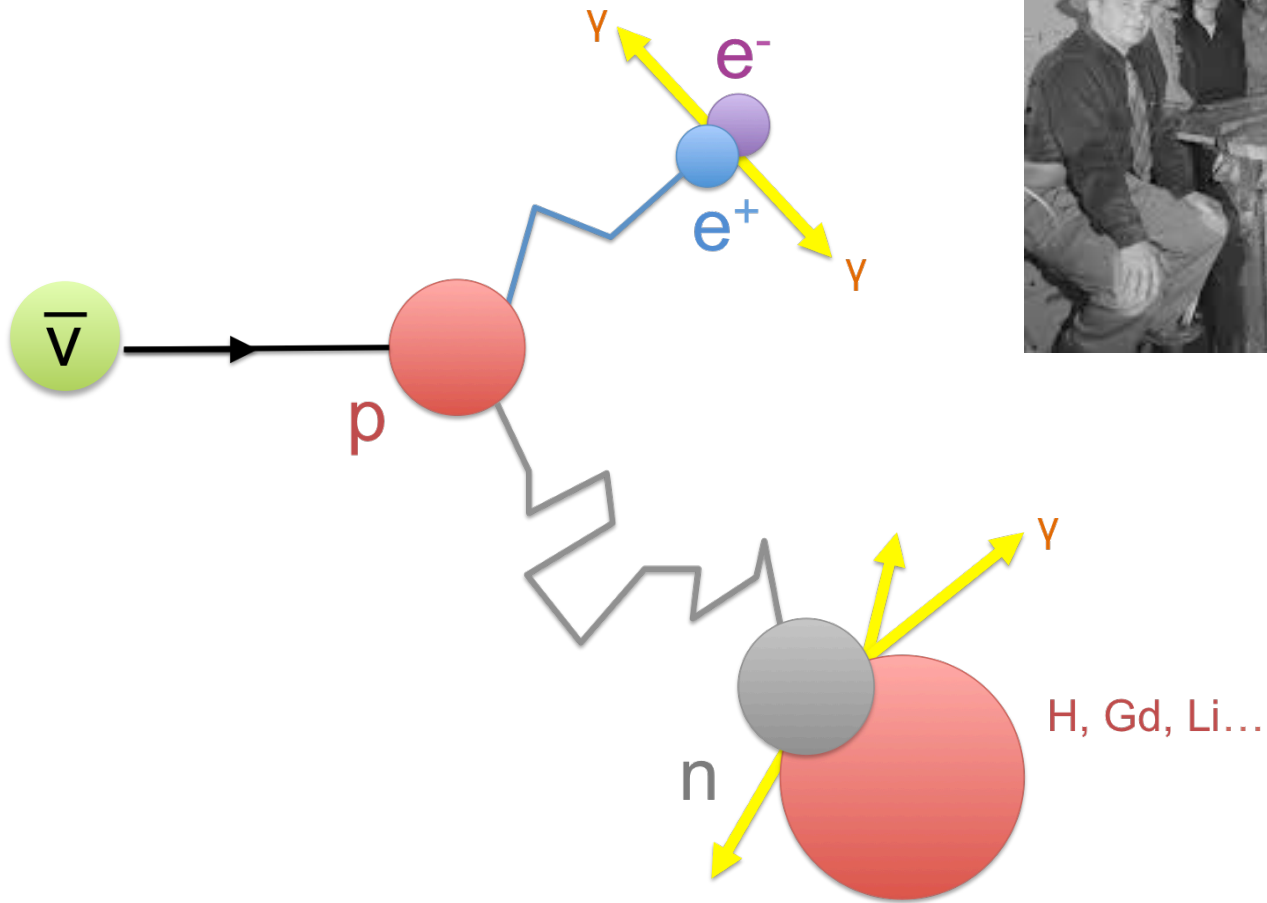
Weakly interacting



***Simulation of antineutrino emission from  $^{235}\text{U}$  explosion***

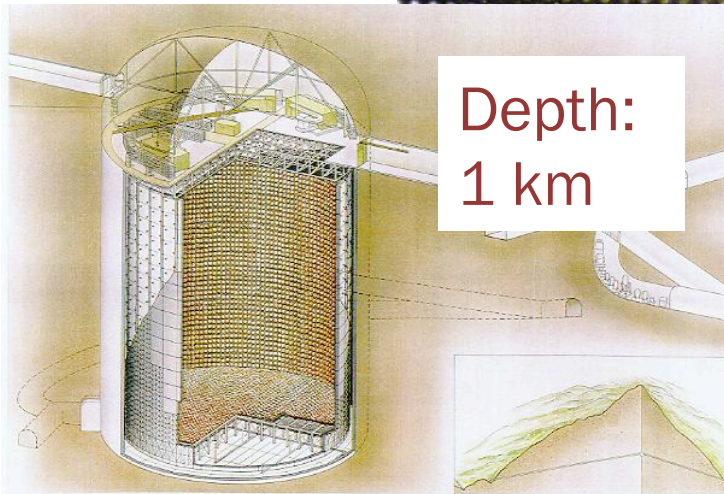
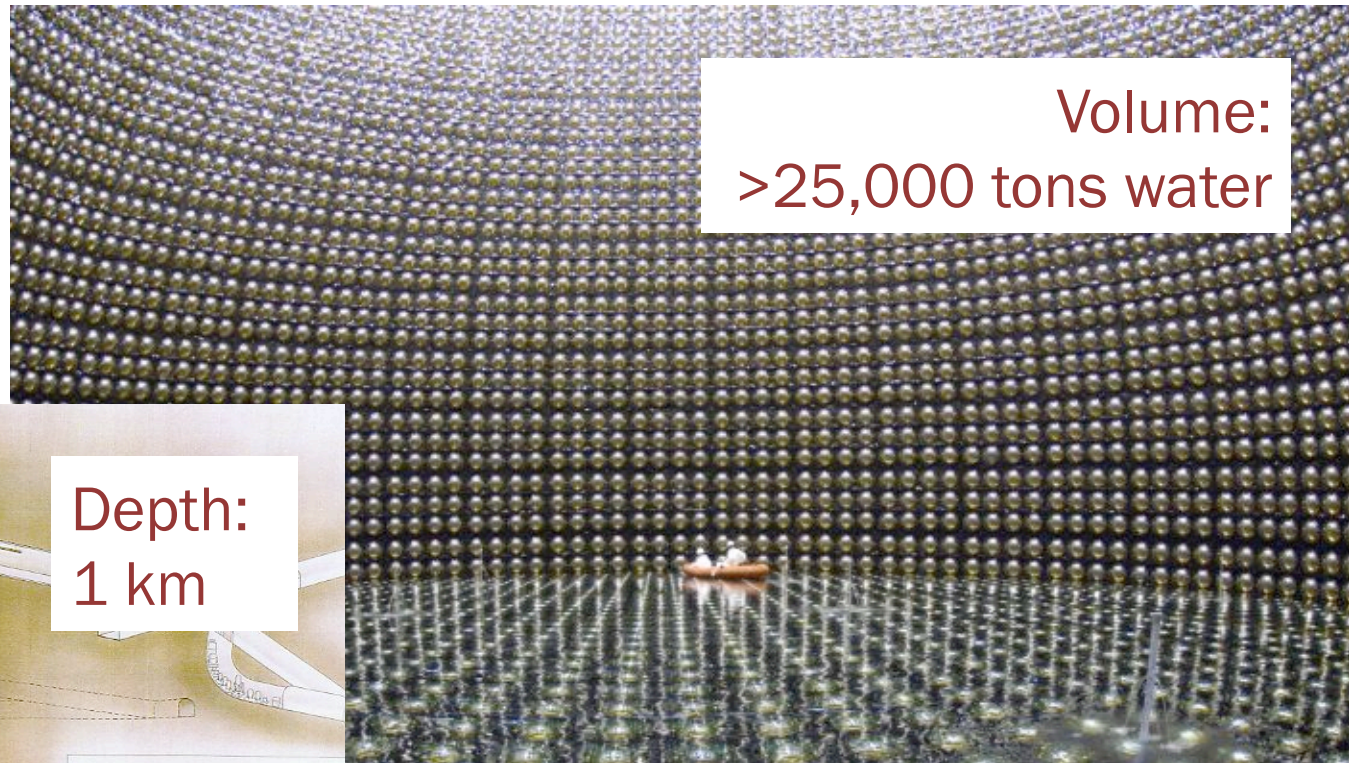
*R. Carr, F. Dalnoki-Veress, A. Bernstein, Phys. Rev. Applied 10 (2018).*

# Antineutrino detection



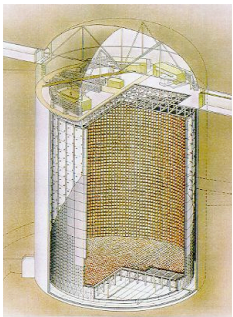
# *Antineutrino detection, on a large scale*

**Super Kamiokande (>\$100M)**

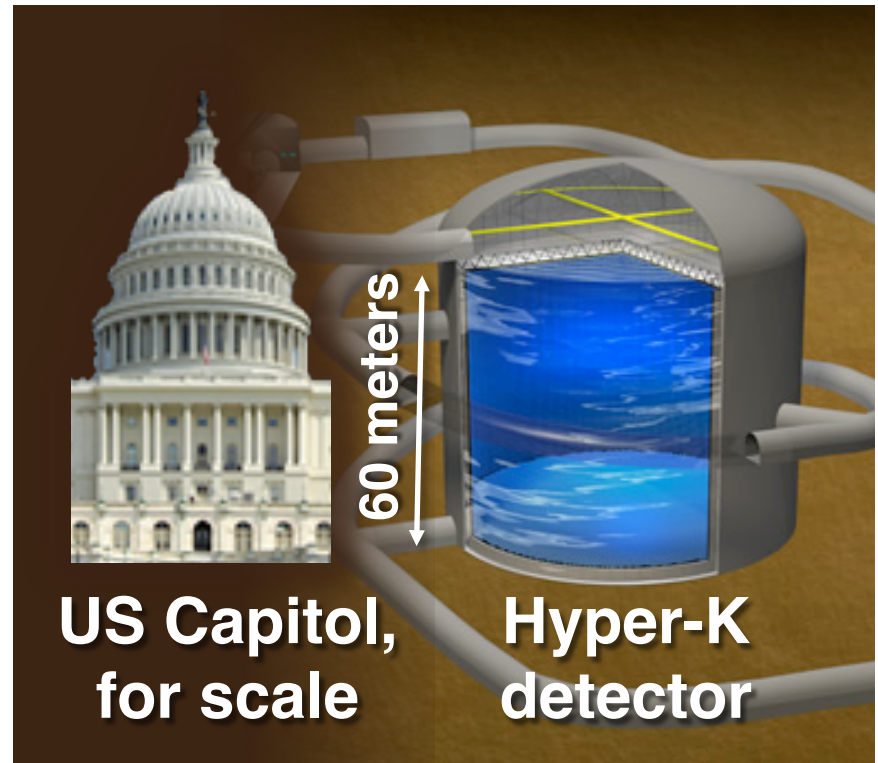


# *Antineutrino detection, on a <sup>very</sup> large scale*

Hyper Kamiokande (~\$2B)

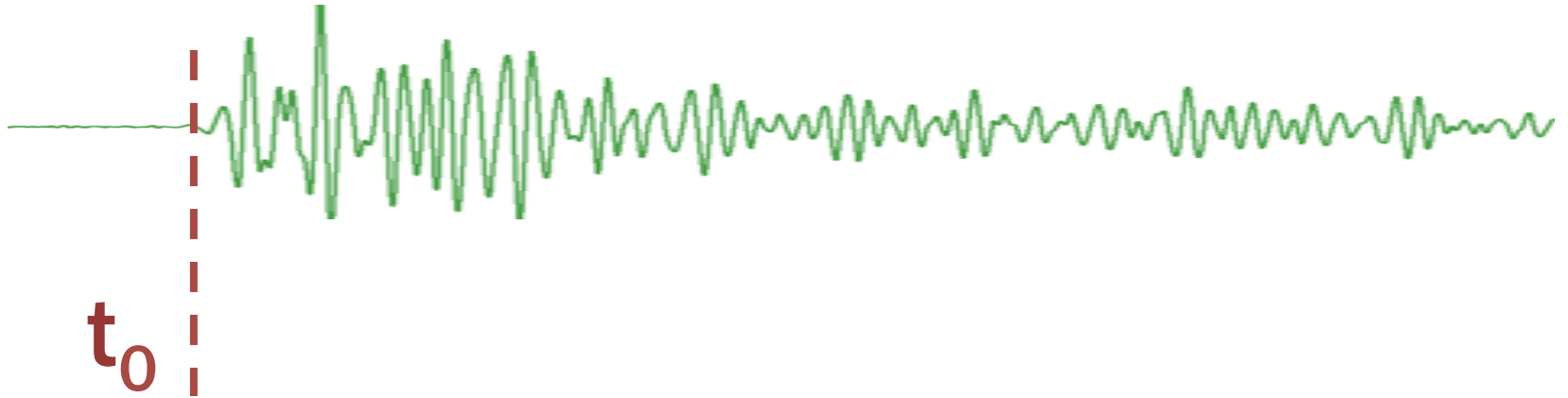


$\times 10 =$

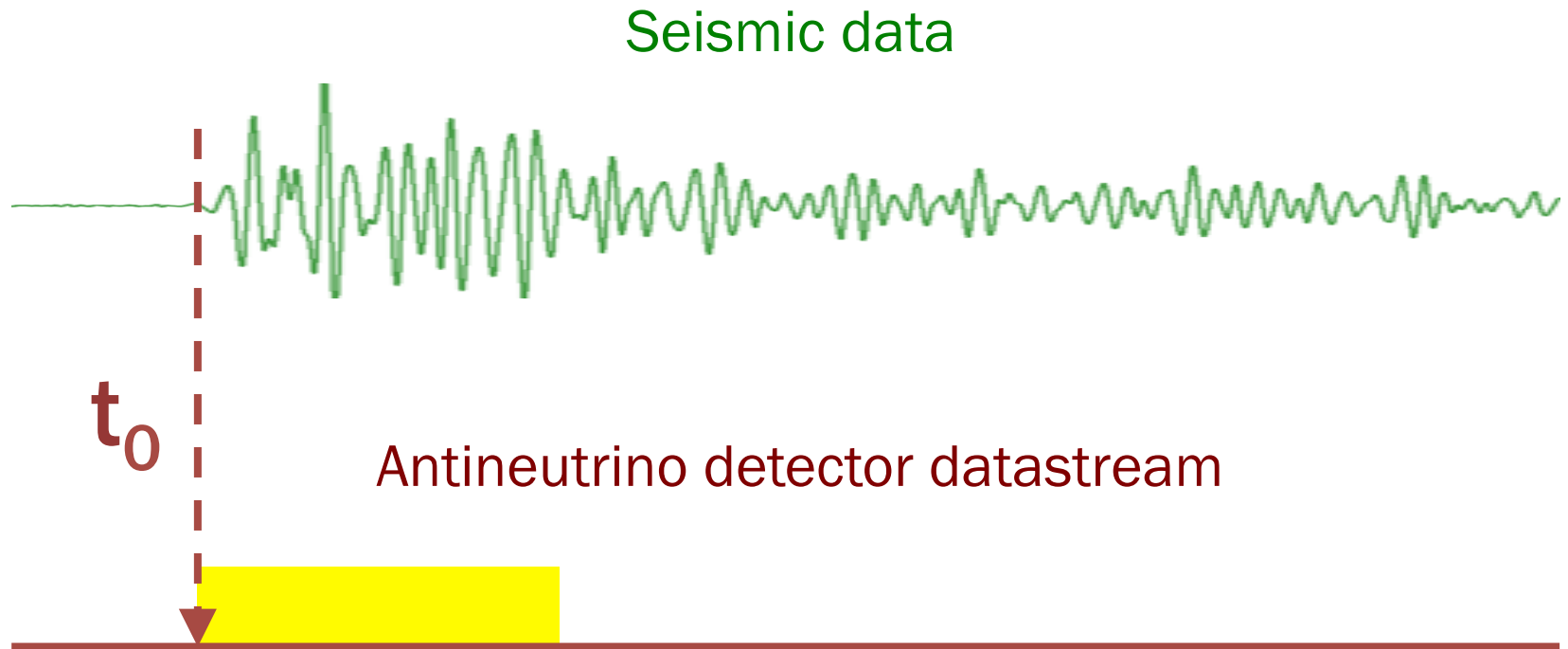


## ② *Seismic cueing*

Seismic data



## ② *Seismic cueing*



**Concept: Look for antineutrinos in seismically cued 10 s window to confirm fission event**

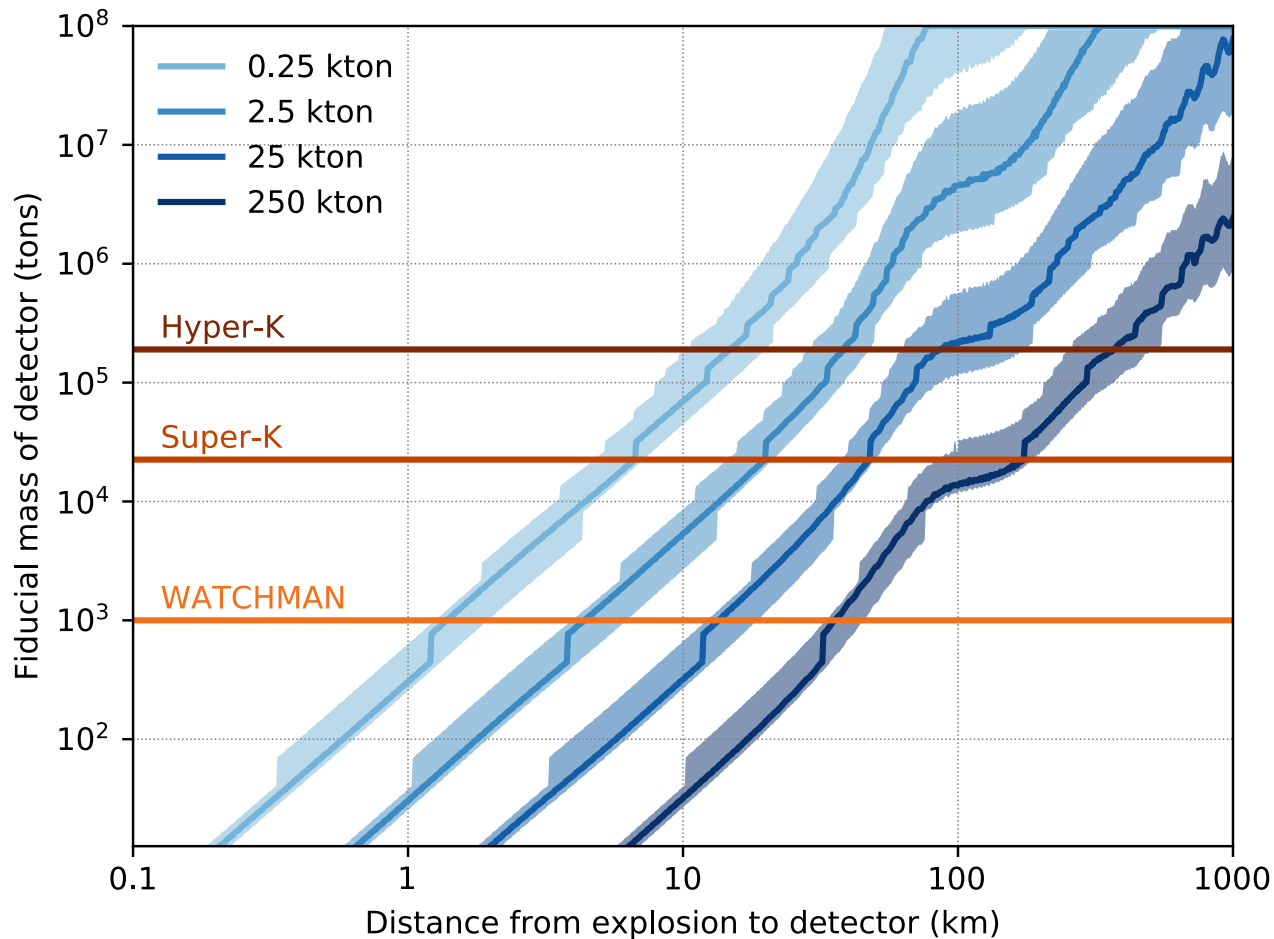
## ***To assess practicality, we asked:***

For a given fission yield...  
observed from a given distance...

**How large would a water-based antineutrino detector need to be in order to (in 90% of cases) **confirm that the suspect seismic event involved nuclear fission** (at 99% confidence level)?**

# Result:

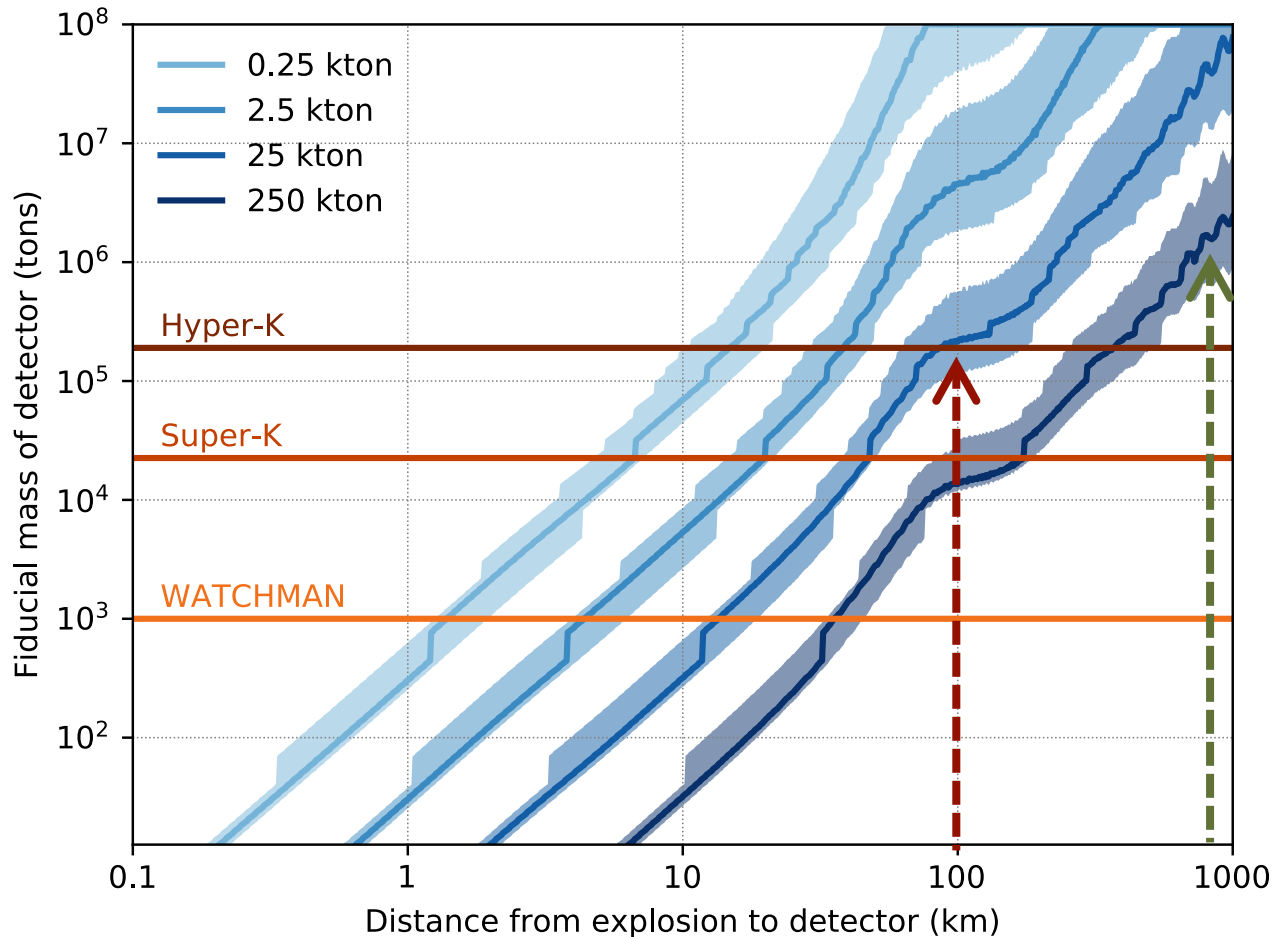
Size of antineutrino detector required to give 90% probability of **confirming nuclear fission** at 99% CL



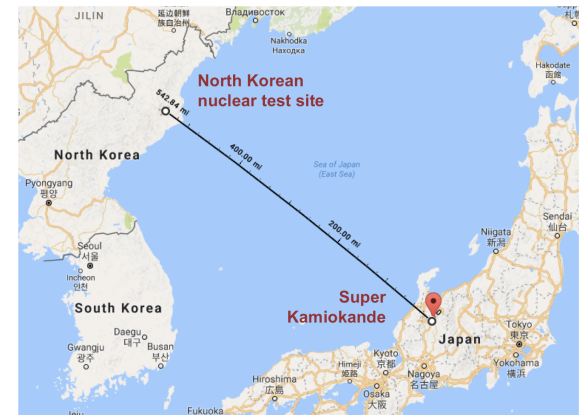
R. Carr,  
F. Dalnoki-Veress, A. Bernstein,  
*Phys. Rev. Applied* 10 (2018)

# Result:

Size of antineutrino detector required to give 90% probability of **confirming nuclear fission** at 99% CL



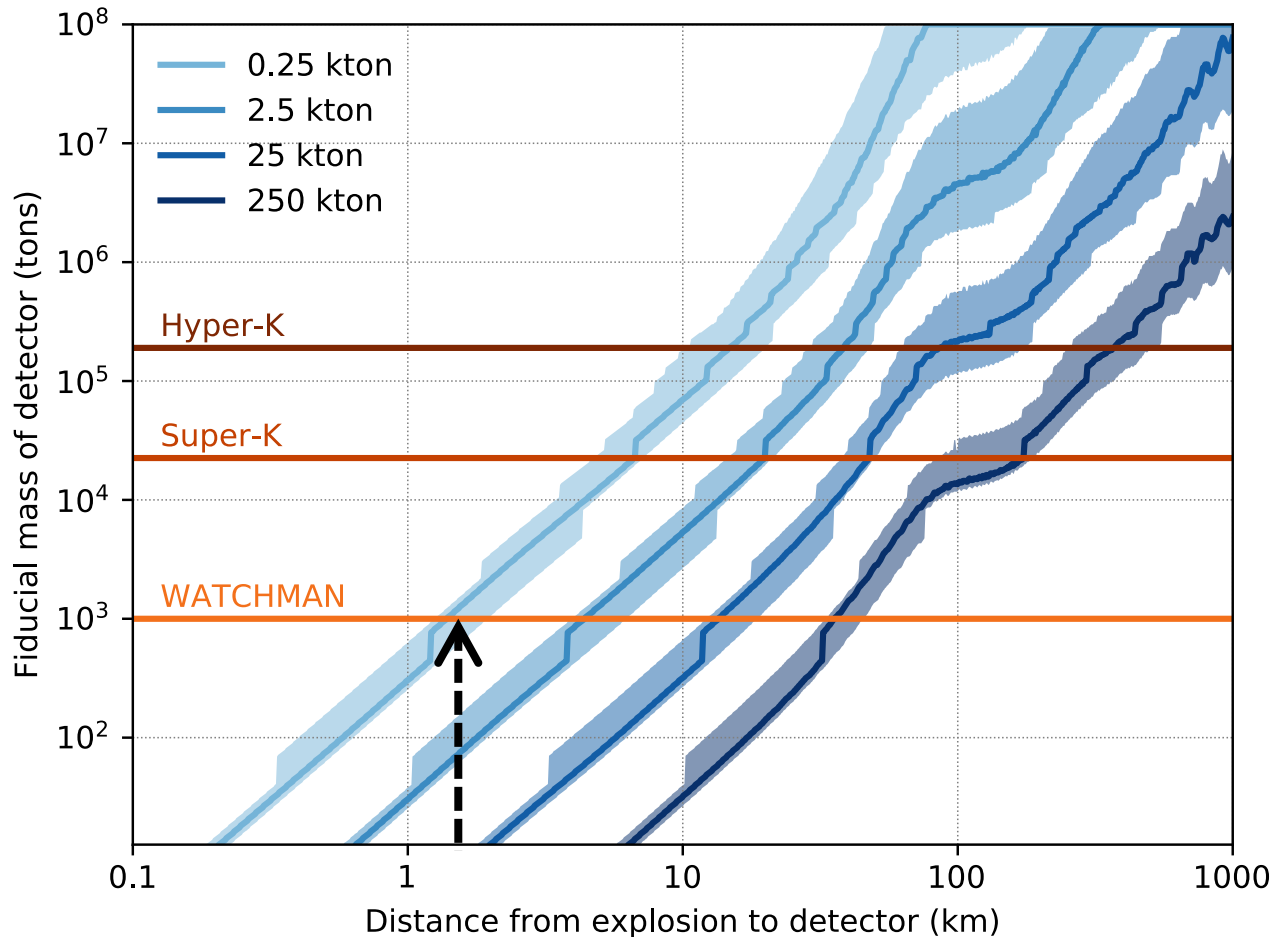
For 25 kton explosion @ 100 km, need Hyper-K size (~\$1B scale)



For 250 kton explosion @ 900 km, need ~10× Hyper-K (~\$10B scale?)

# Result:

Size of antineutrino detector required to give 90% probability of **confirming nuclear fission** at 99% CL



For 0.25 kton explosion @ few km, need WATCHMAN size (~\$10 M scale)

### 3 ***Conclusion: Potential is limited***

**While detection of antineutrinos from fission explosions is conceivable, the potential for applying this technology to nuclear explosion monitoring is strongly limited by detector size and cost.**

For more on detector cost estimates, see **poster T3.1-P5:**

M. Foxe et al. *Antineutrino Detectors: An Evaluation of their Use for Monitoring Nuclear Explosions*.

For details of this study, see:

R. Carr et al. *Sensitivity of Seismically Cued Antineutrino Detectors to Nuclear Explosions*. *Phys. Rev. Applied* **10** (2018).