General considerations for a SGSO

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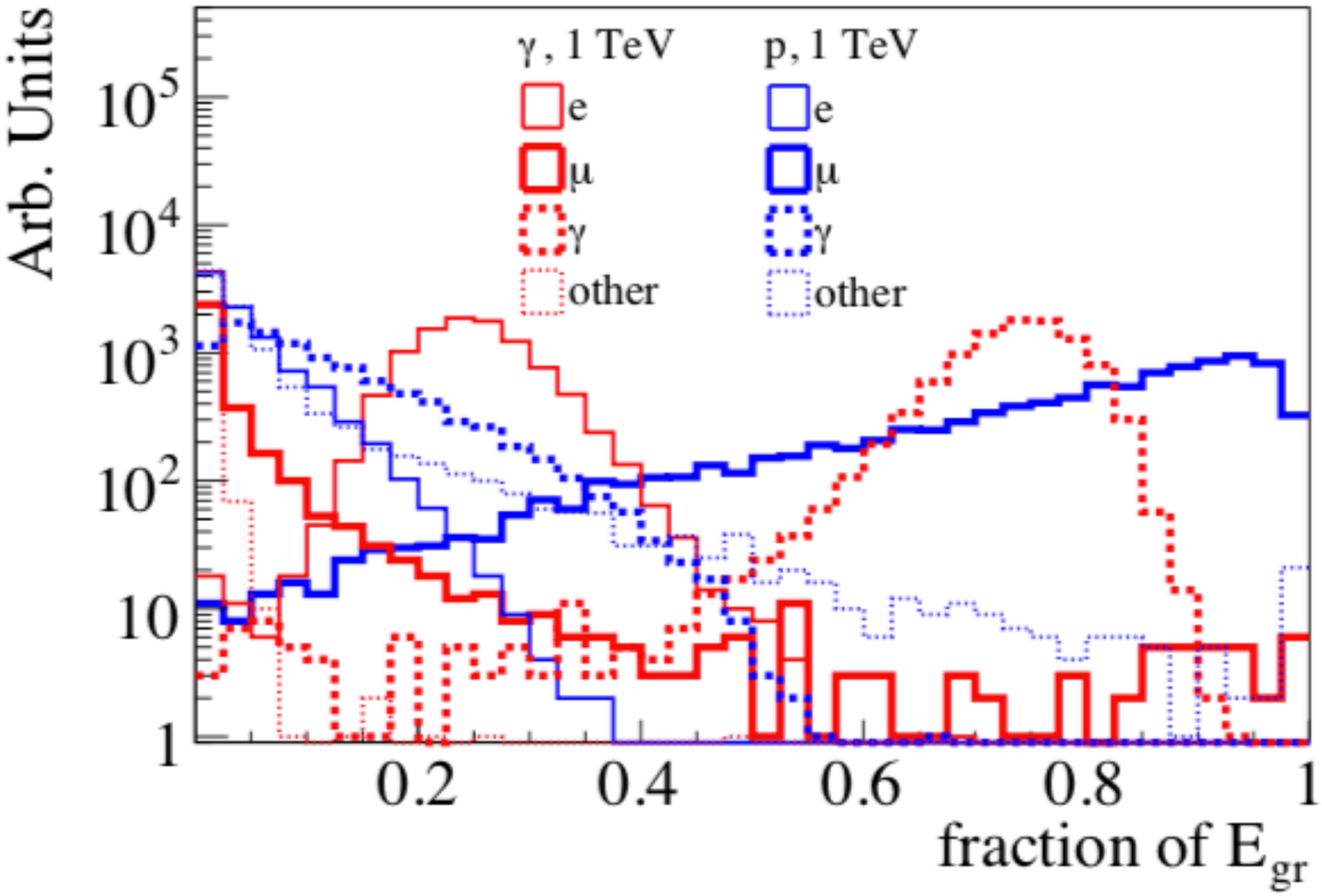
What should a unit detect?

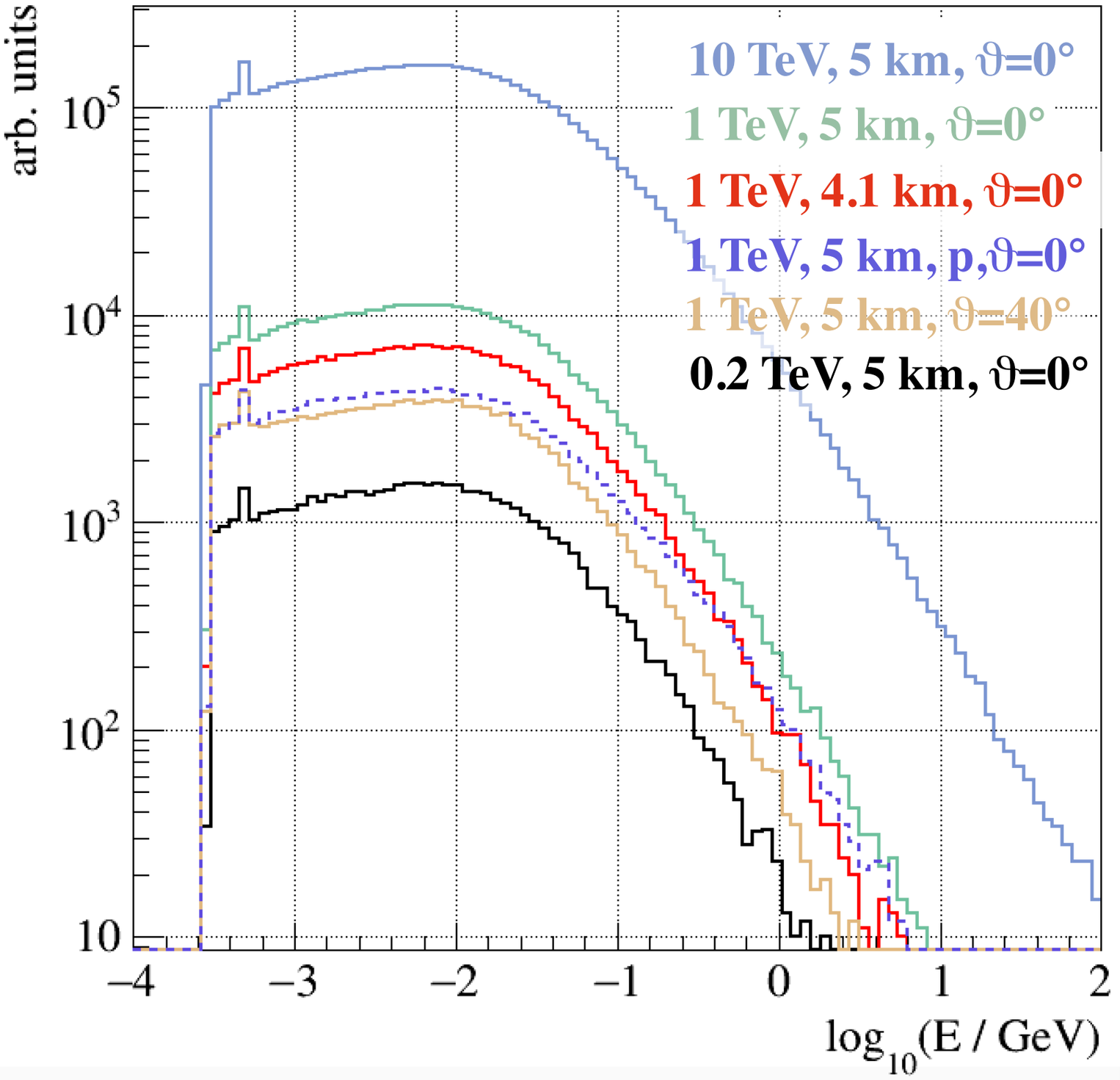
gammas, electrons, muons



What should be the threshold for a unit?

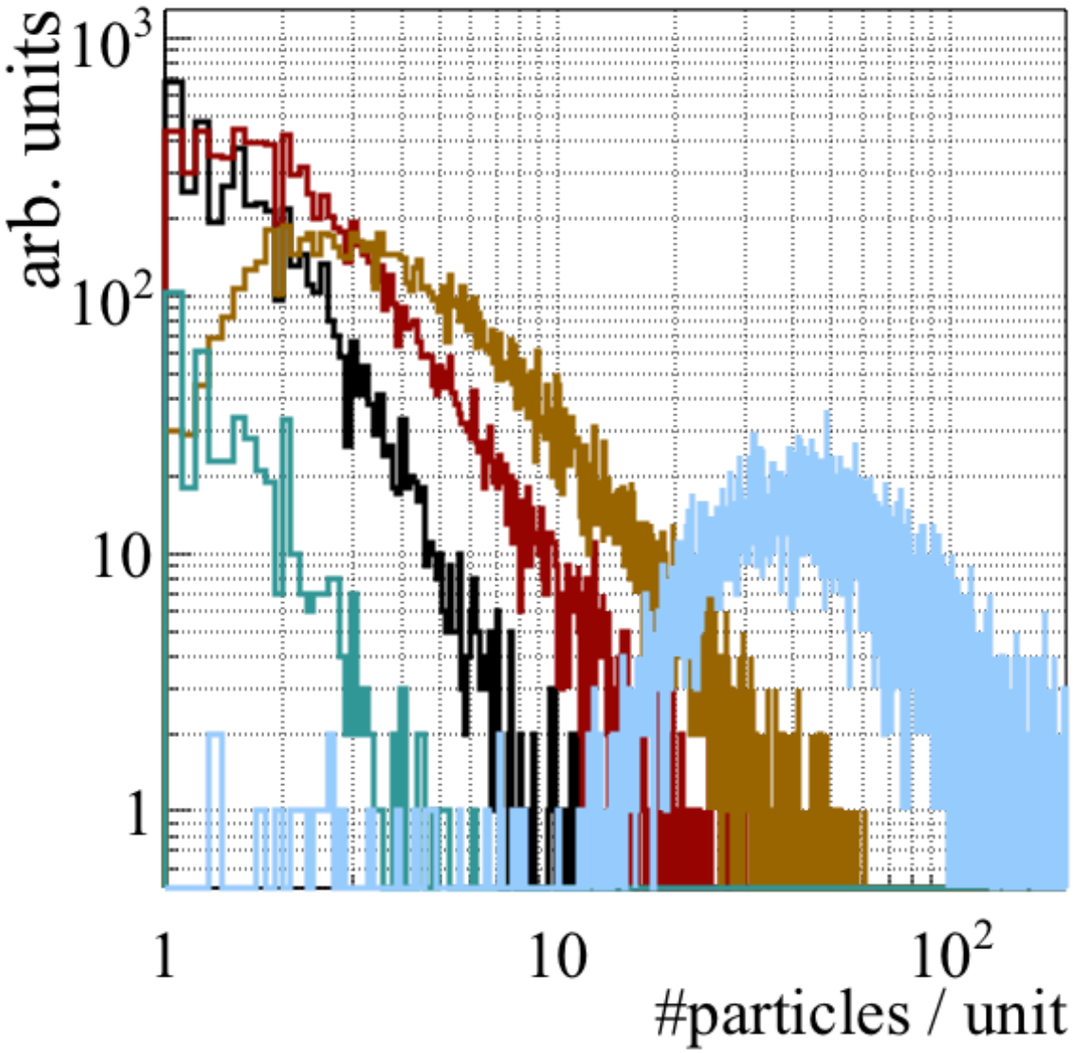
Mode of distribution peaks around 10 MeV, independent of:

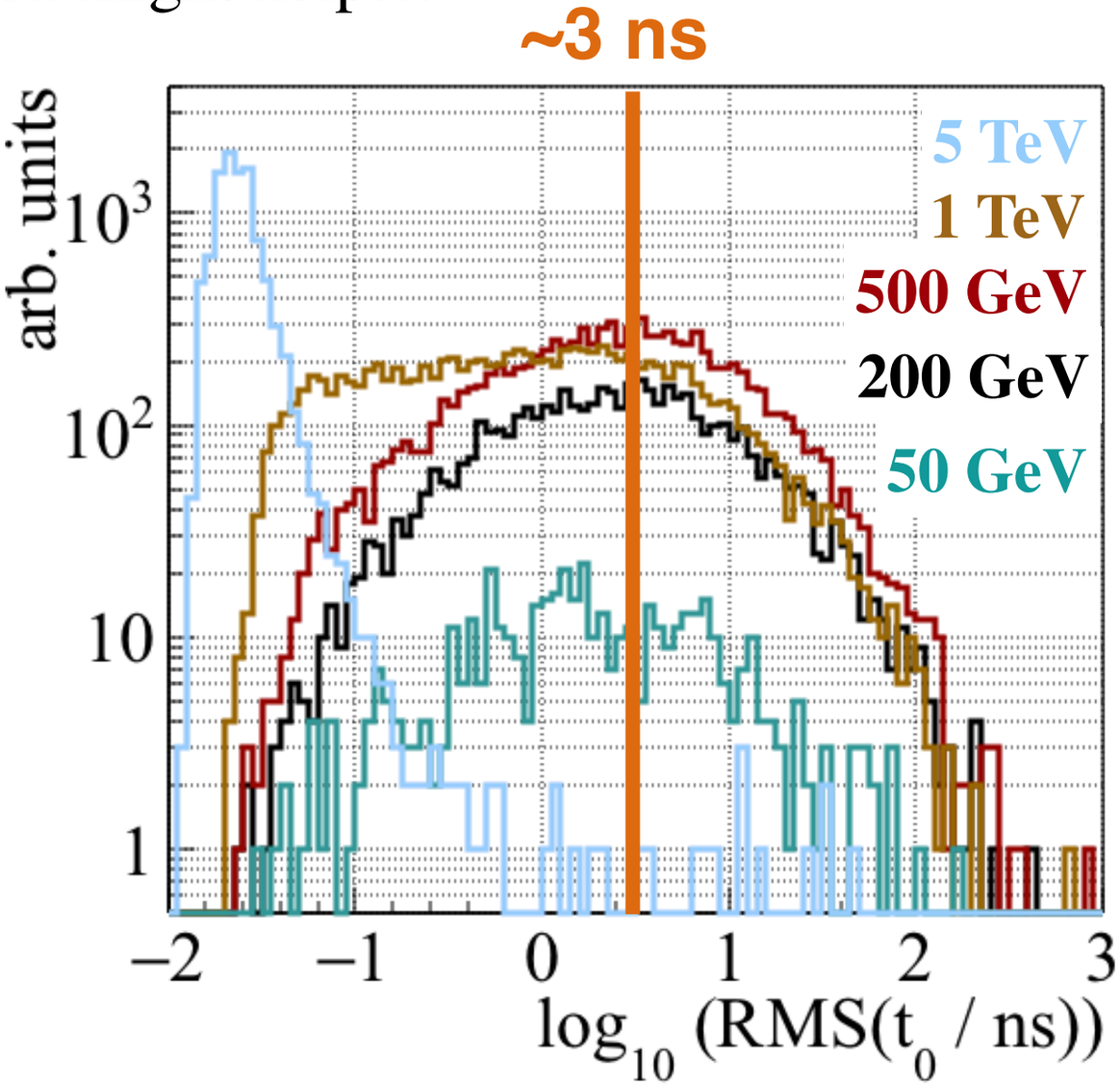
1. Primary Energy
2. Zenith angle
3. Detection Altitude
4. Primary Particle



What should the time resolution be of a unit?

- **At the end only angular resolution is what matters.**
- Ideal case: spread of first particles hitting a detector (3m x 3m) near the core (<10m)
- When under-sampling the particle distribution (< 2 particles/unit), about 3 ns resolution seems fine: <500 GeV at 5 km
- When over-sampling better resolution might help…





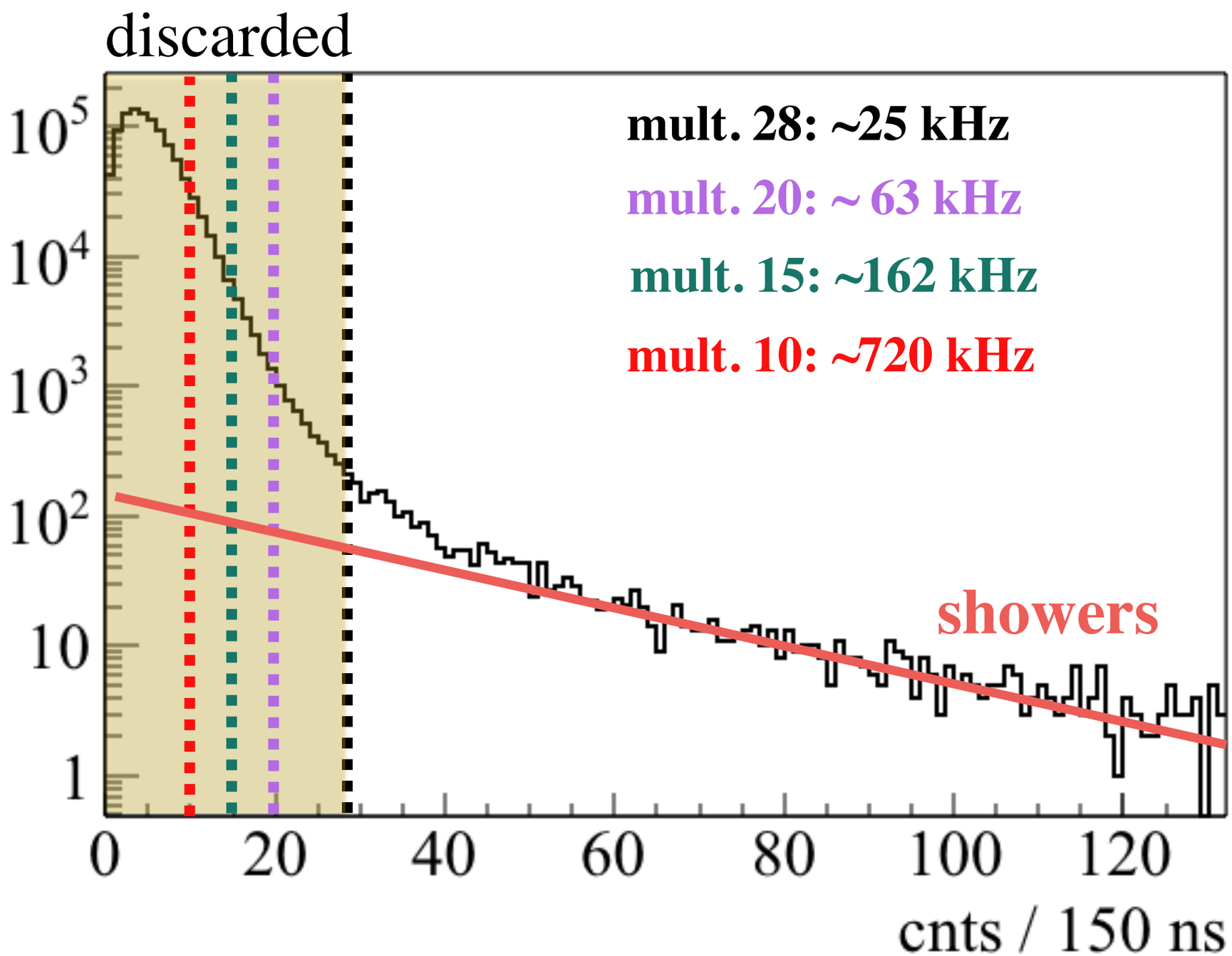
What trigger or data-rate to allow for?

You don't get to pick!

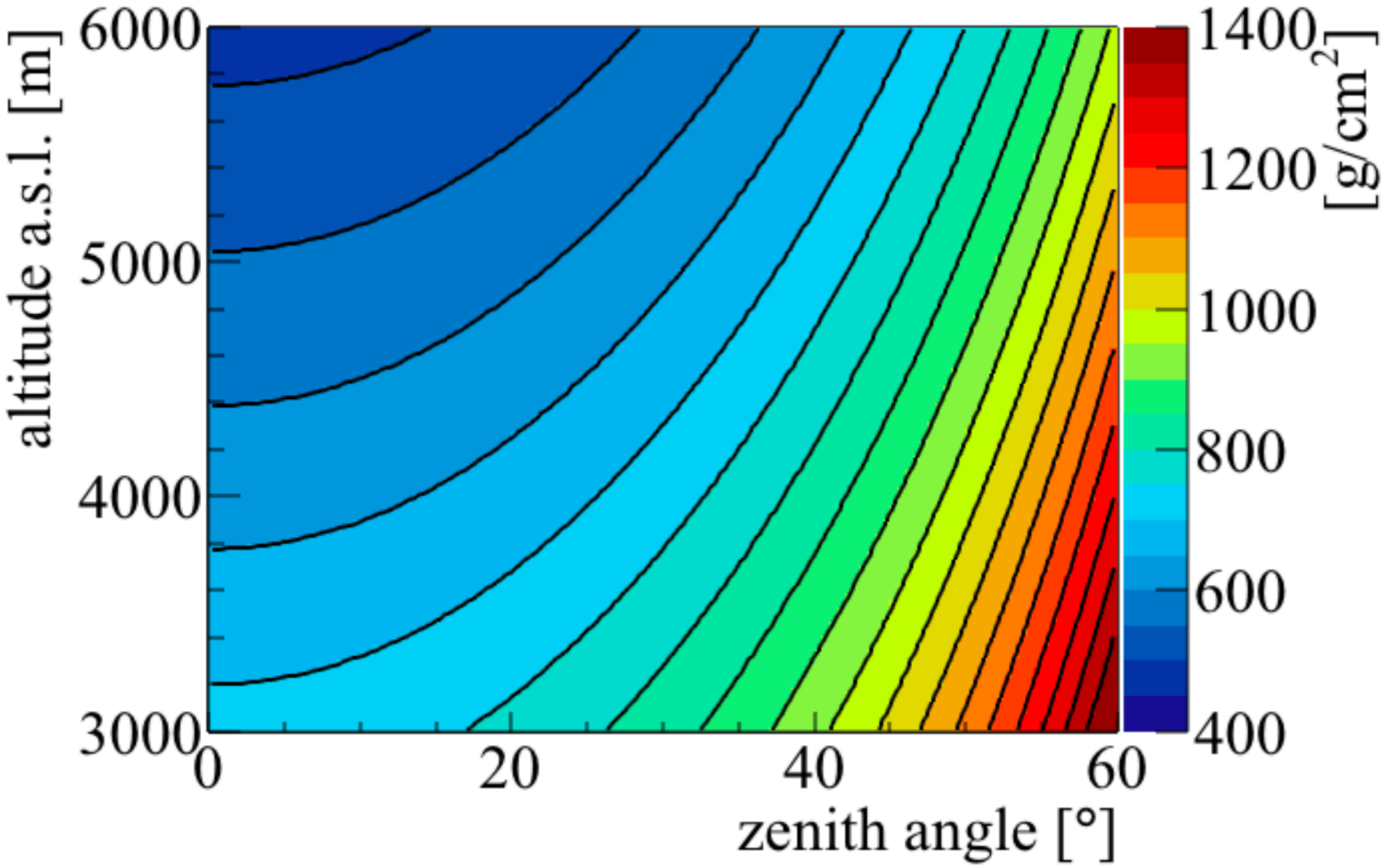
Multiplicity will depend unit design + **noise!**

Noise is:
- Single particles
- Dark rate
- Radio activity
- Light leaking
- Electronic noise

Example HAWC:
Channel multiplicity in 150 ns coincidence window



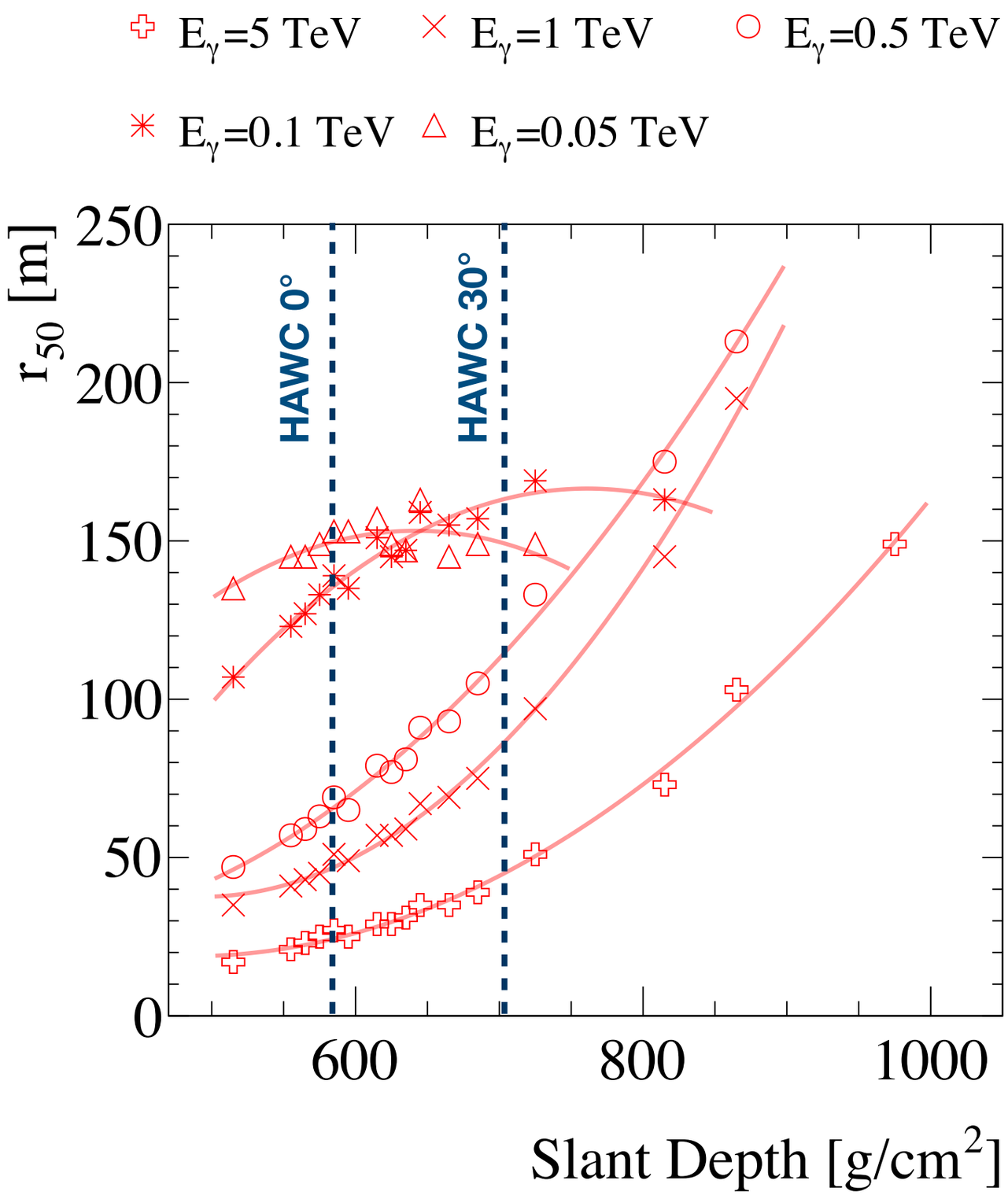
Atmospheric density, Slant depth



What size should the array be?

Shower size:
radius that contains 50% of electromagnetic energy that reaches the ground.

r_{50} is determined to contain the 68% of the smallest sized showers



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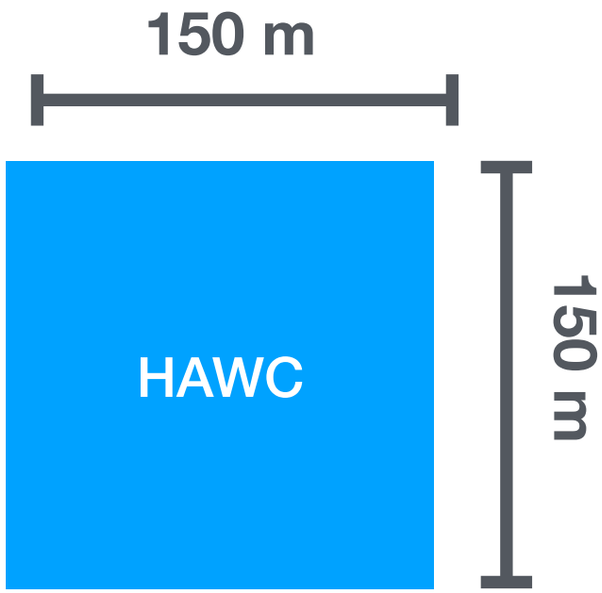
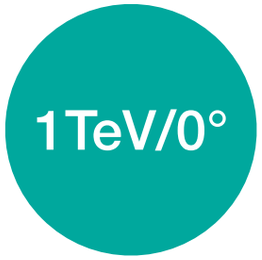
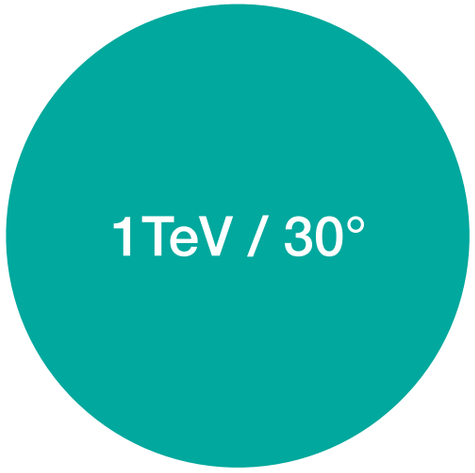
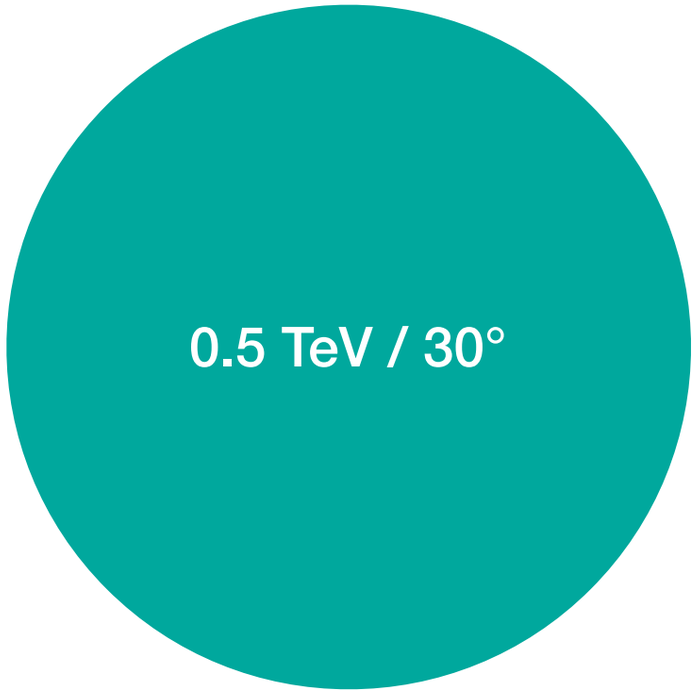


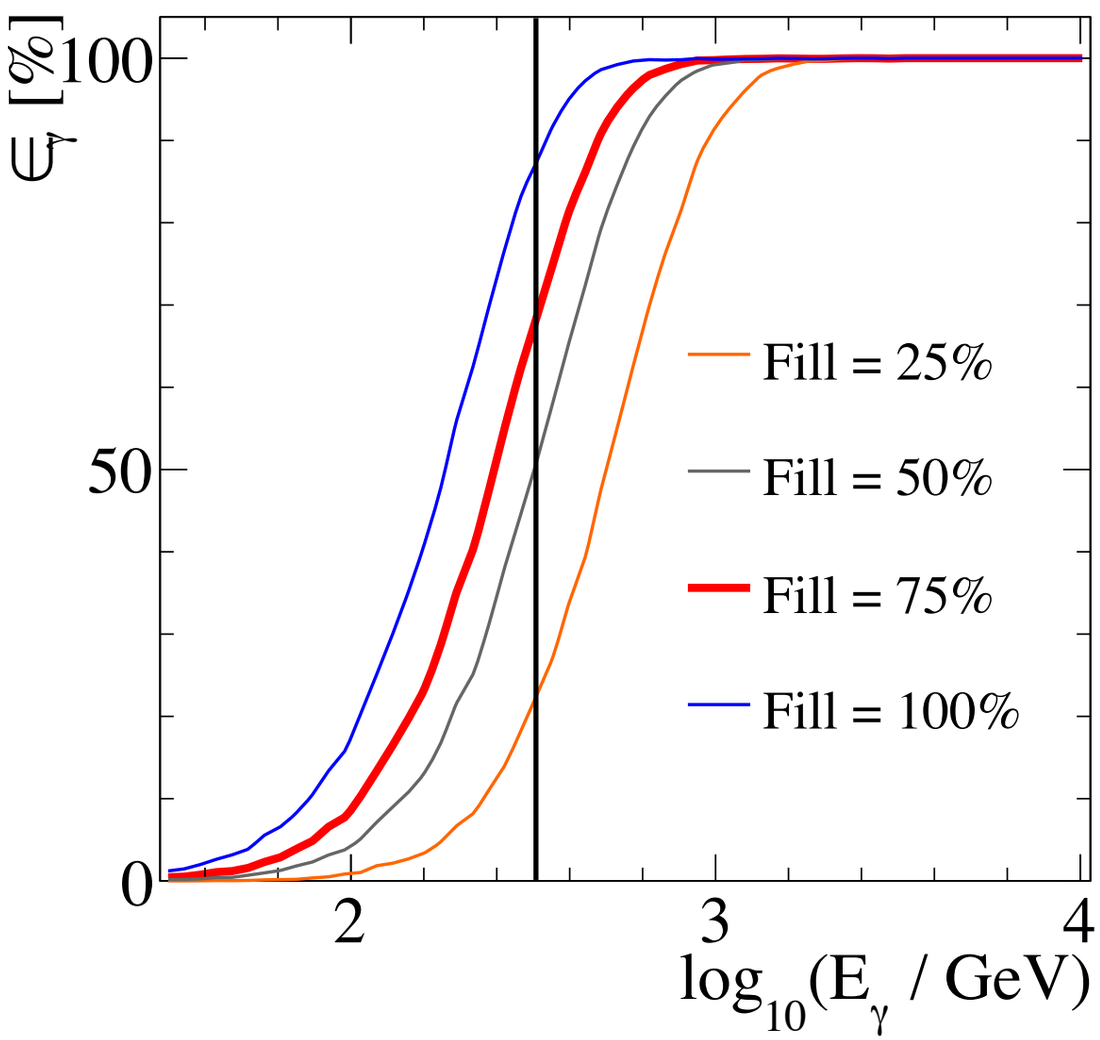


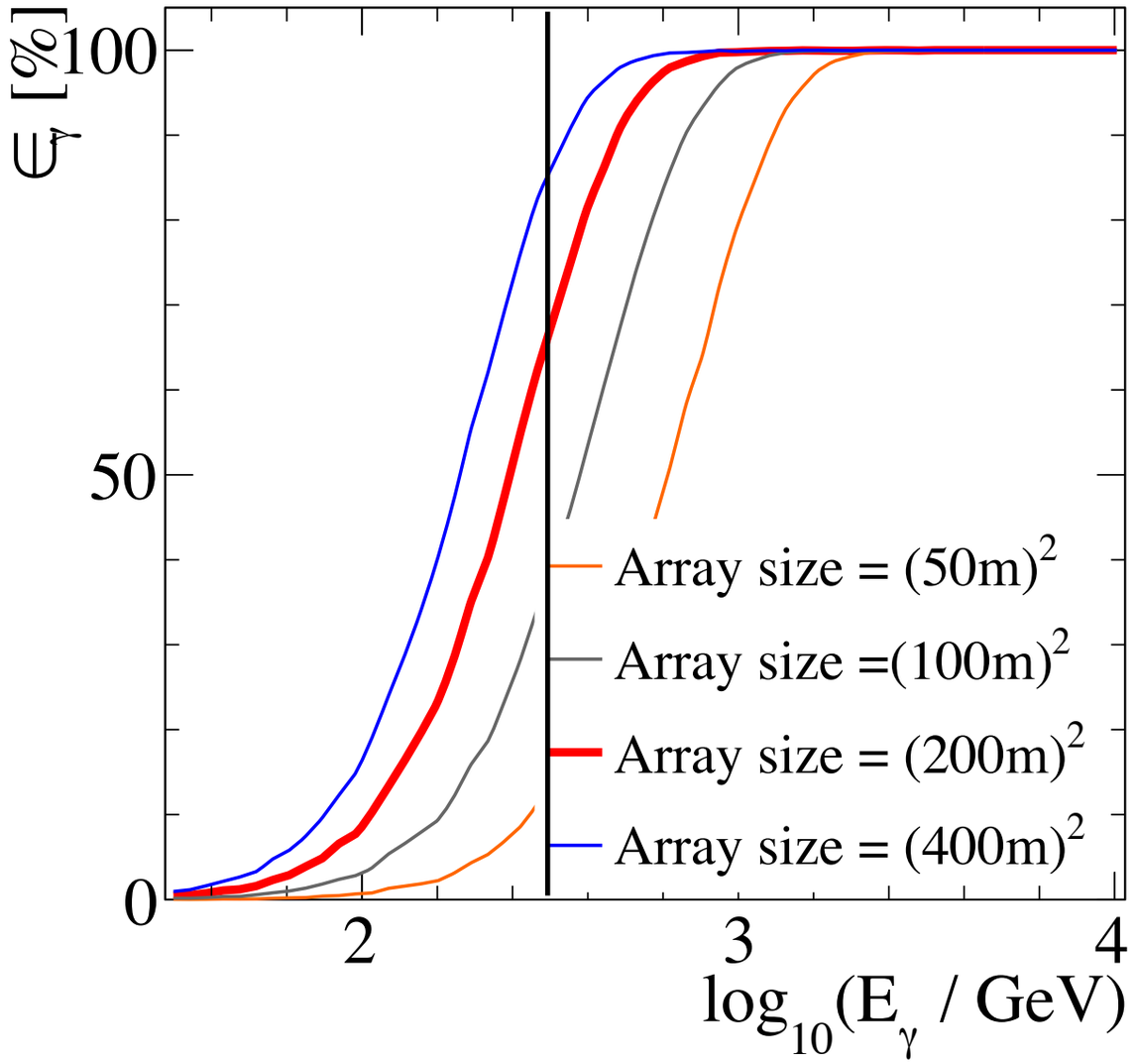




What size should the array be?

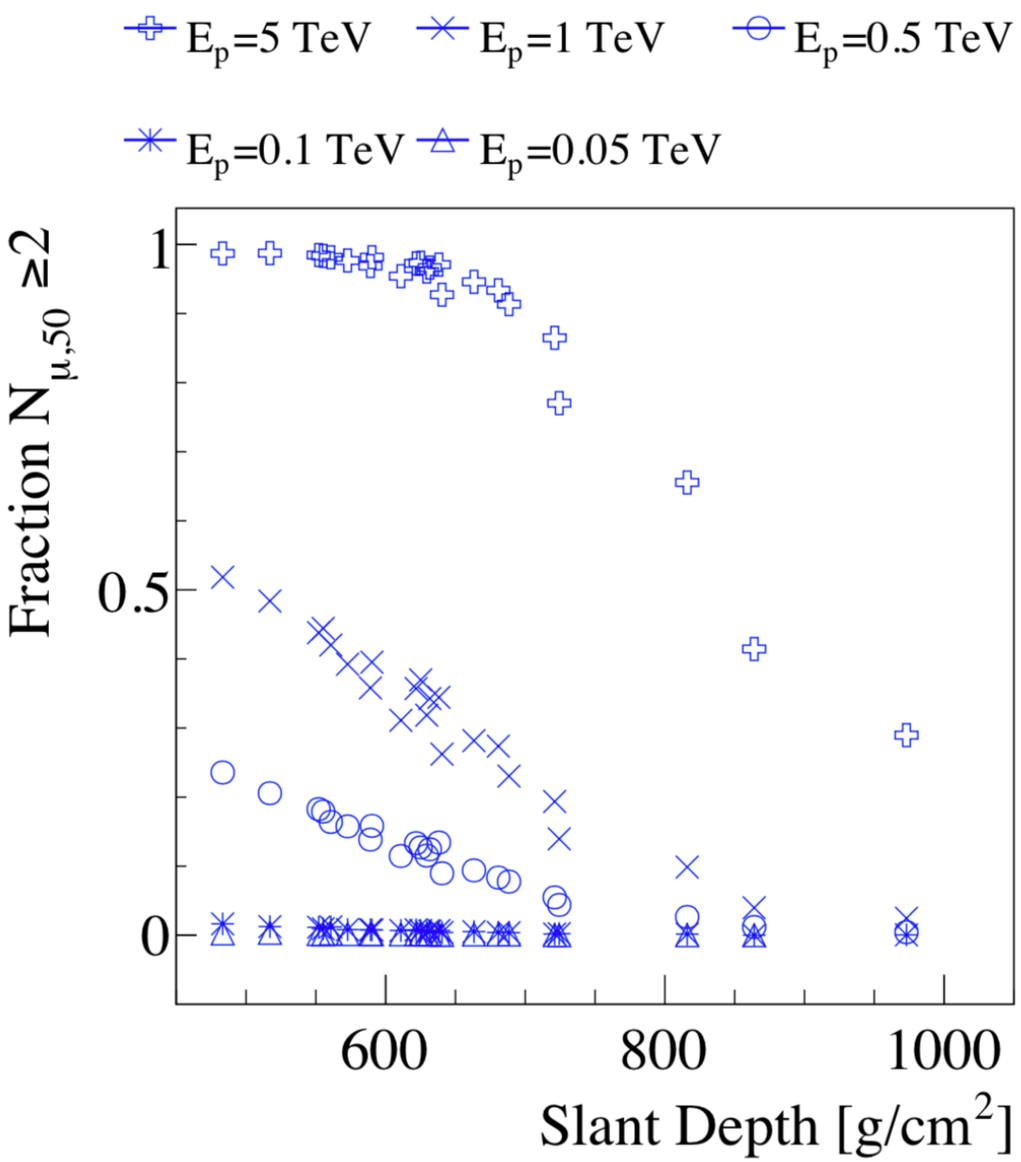
Trigger efficiency for gamma's: Scales harder than ∝ Area, since it lowers the detection threshold

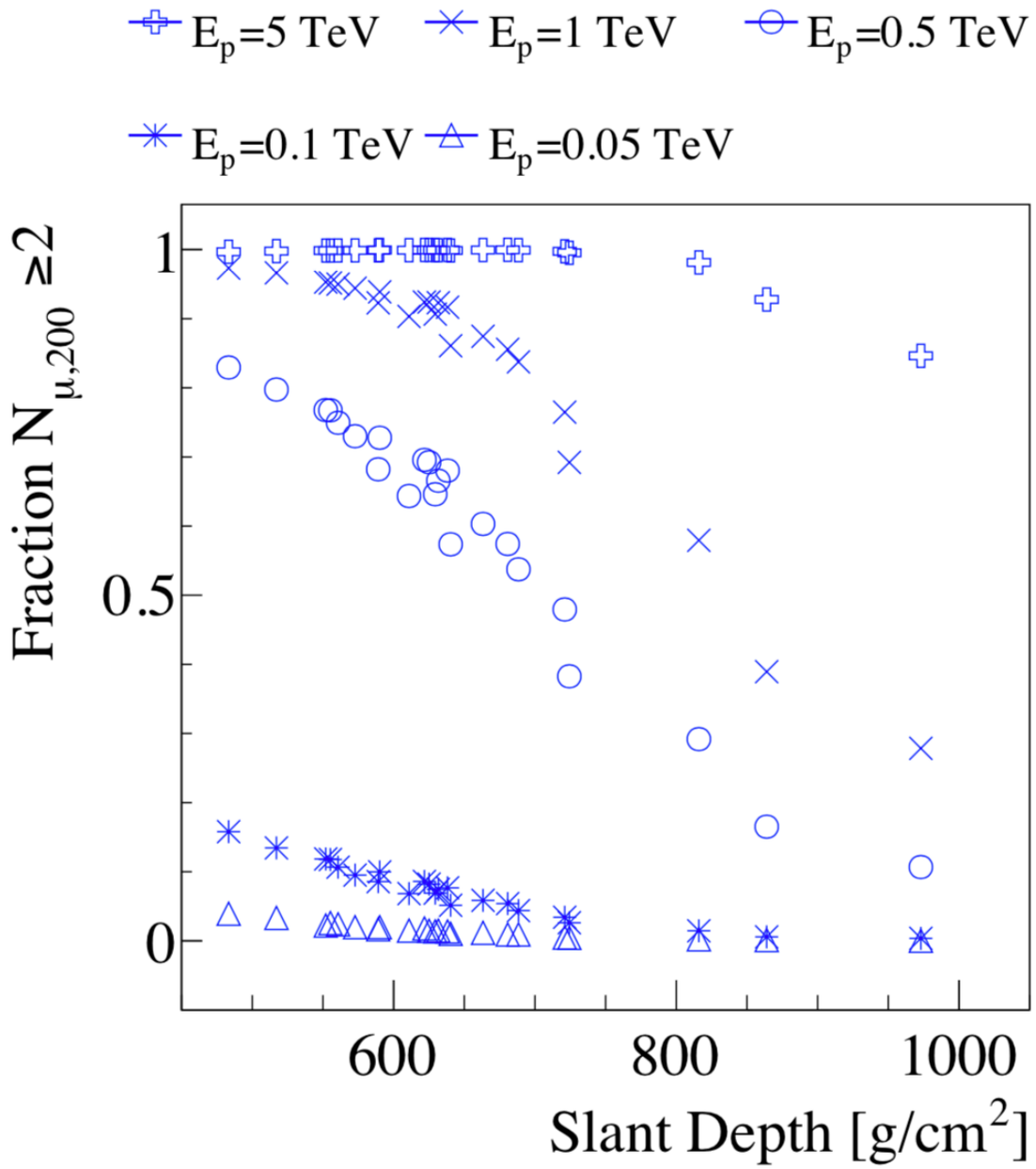




What size should the array be?

Muons, travel far from axis





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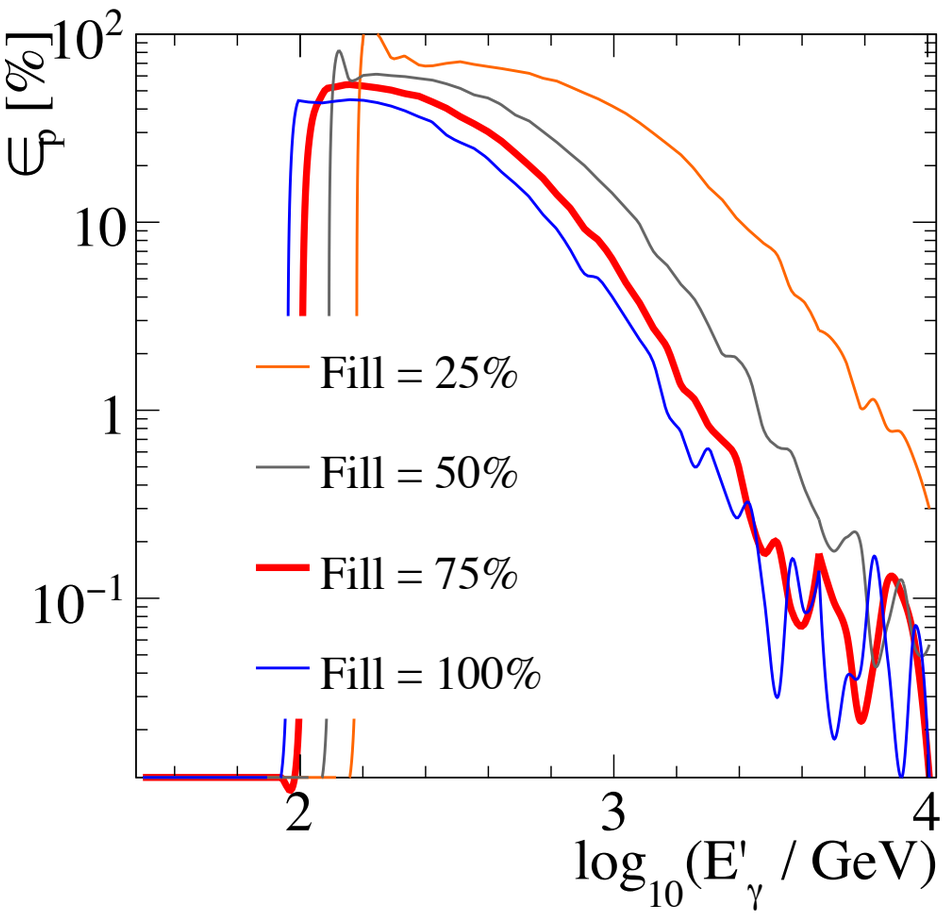
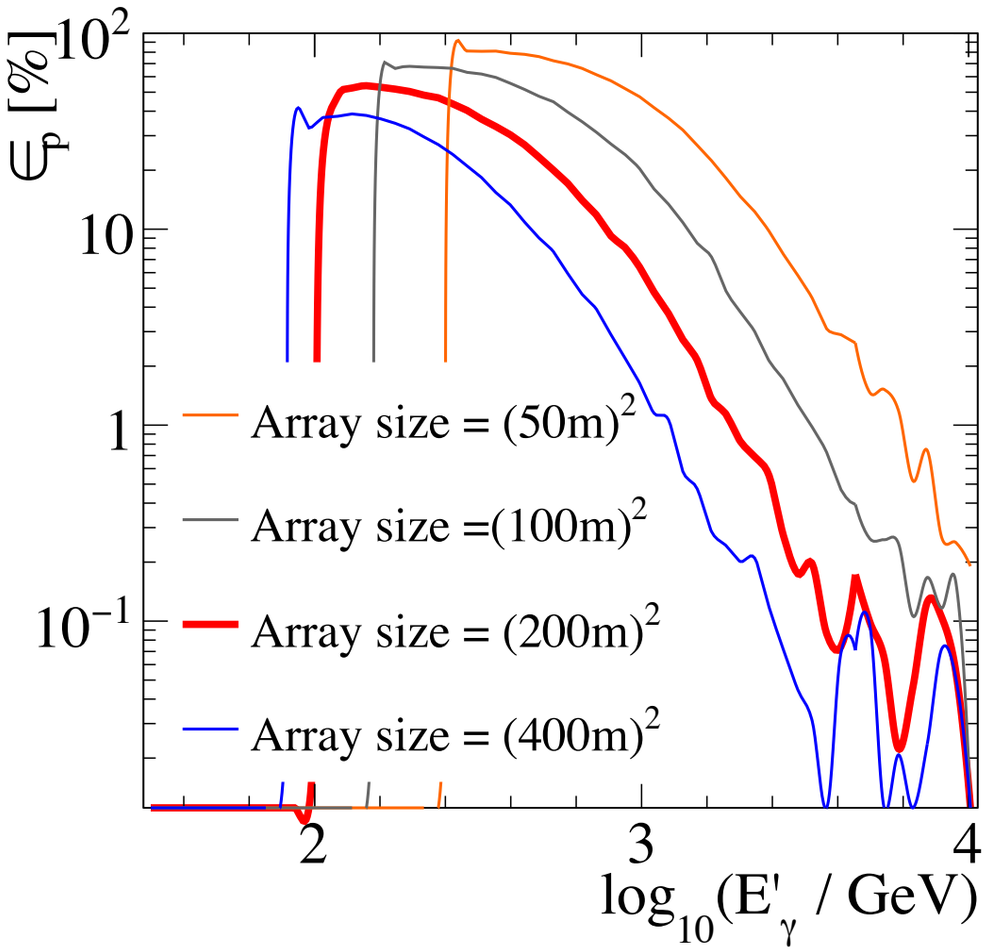




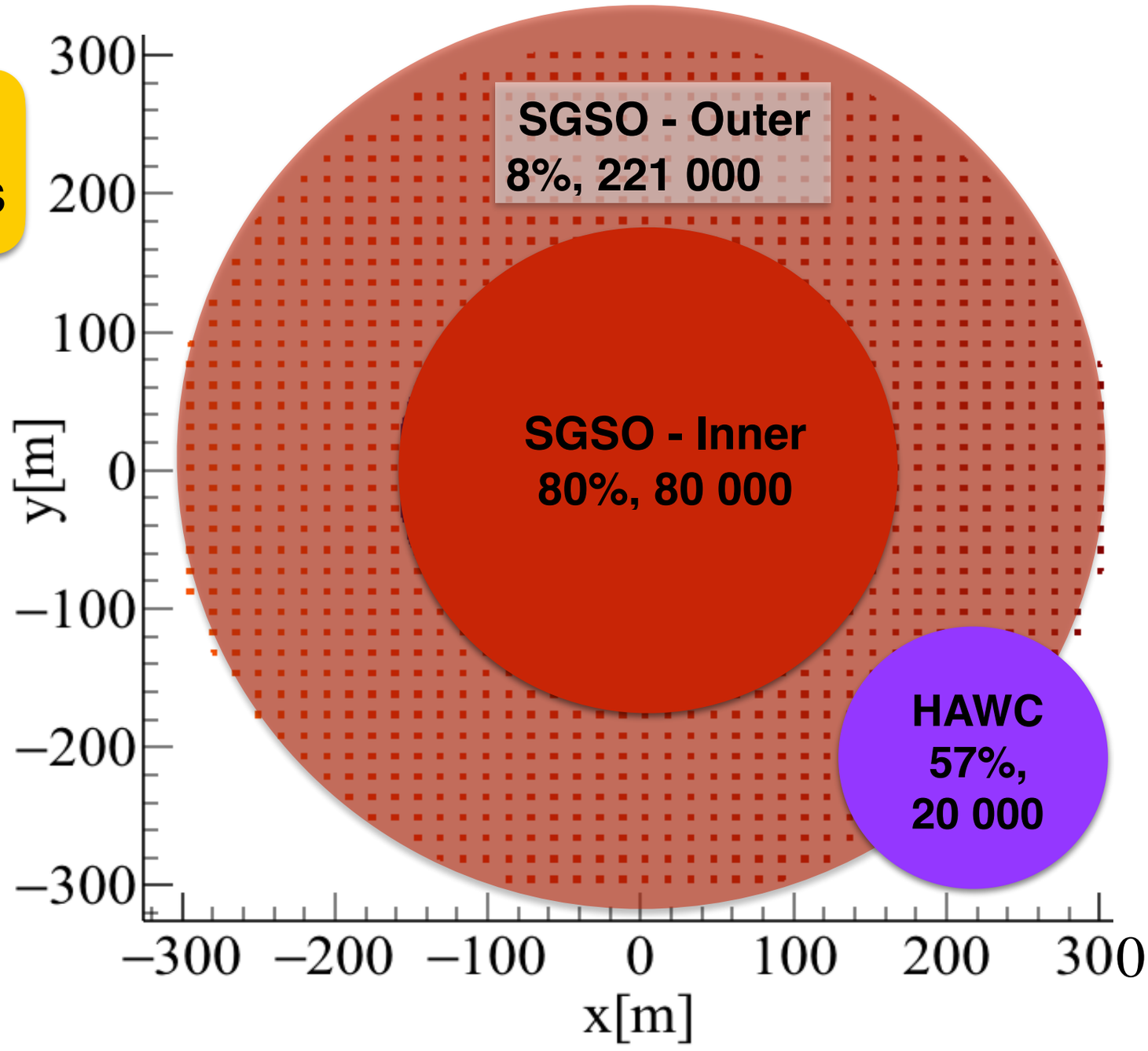
SGSO Sensitivity calculation

HAWC performance

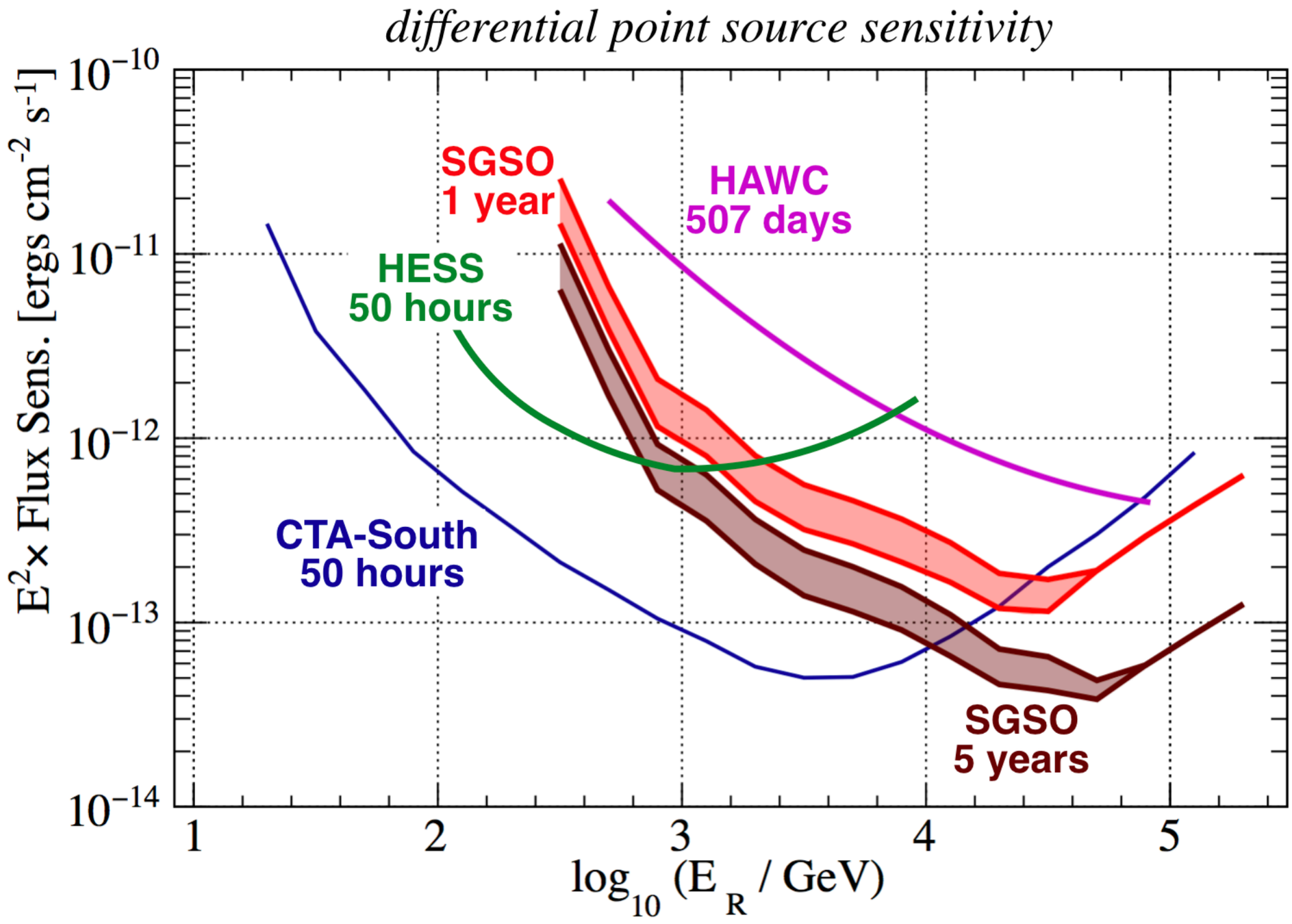
CORSIKA & Simple Detectors

E_{det}

SGSO Detector Response at 5km above sea-level

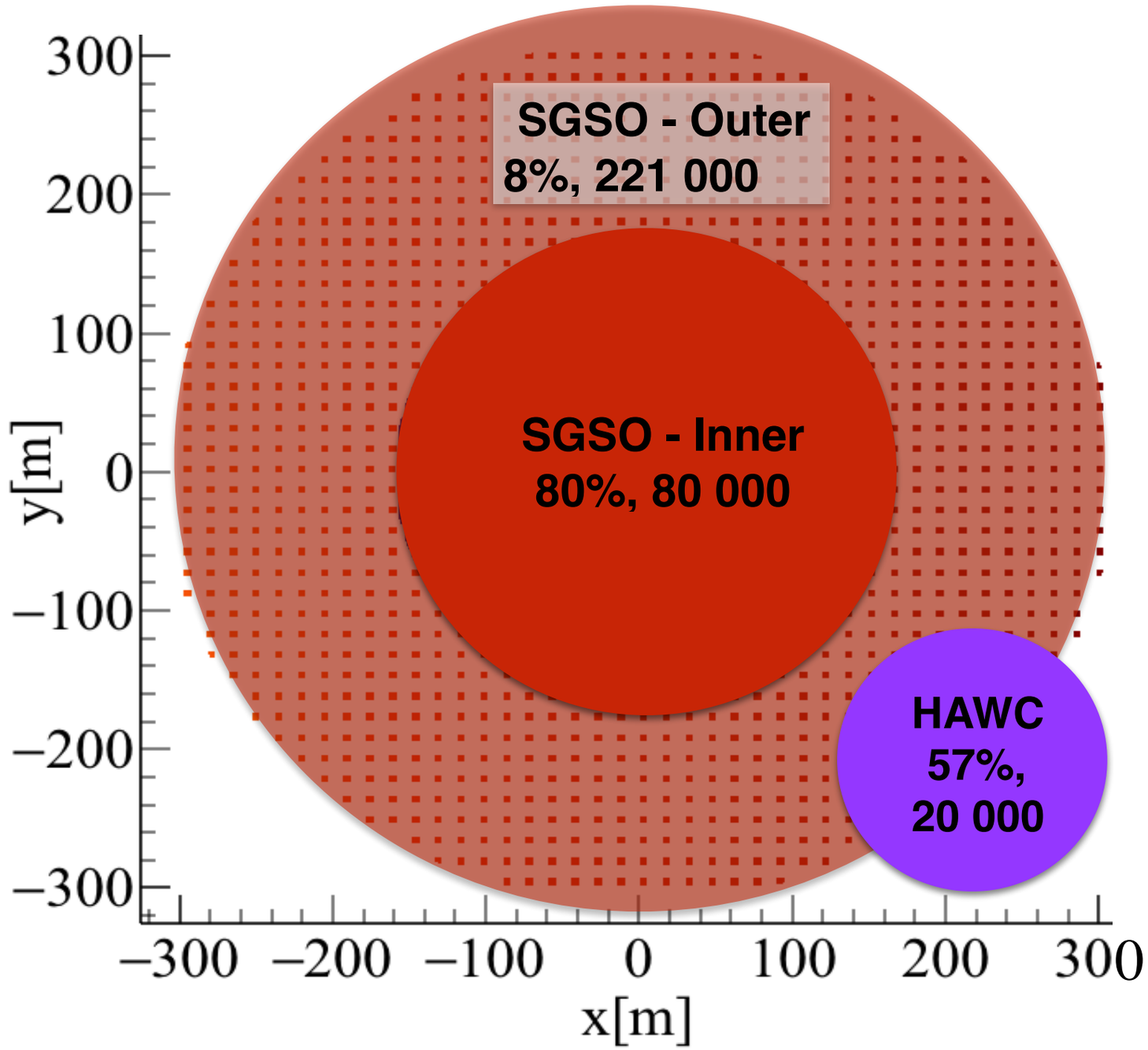


SGSO Sensitivity calculation: Why are we about a factor of 7 better than HAWC at 1 TeV



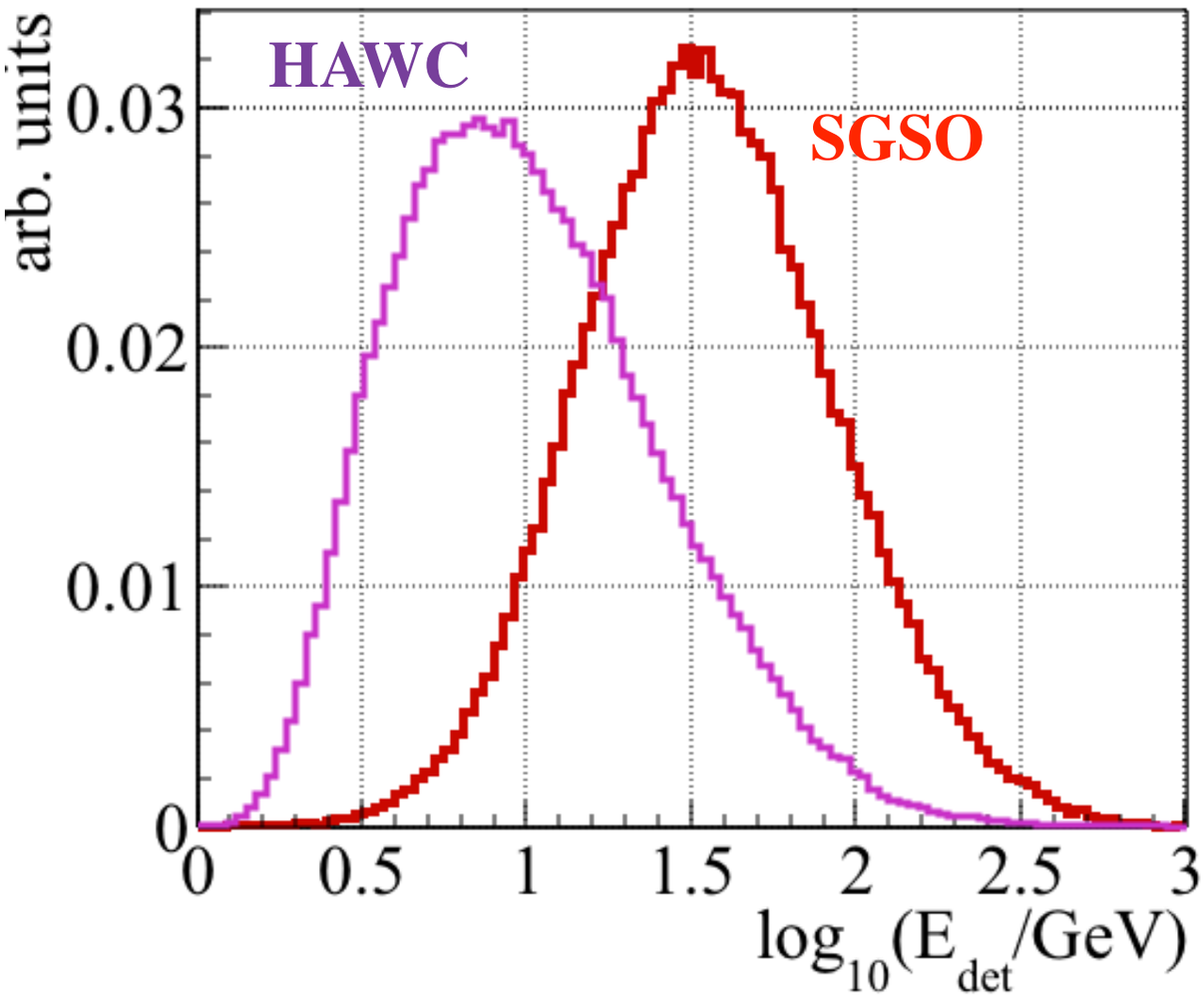
SGSO Sensitivity calculation

$$\sigma = \frac{S}{\sqrt{B}} \propto \sqrt{A} \approx 2$$

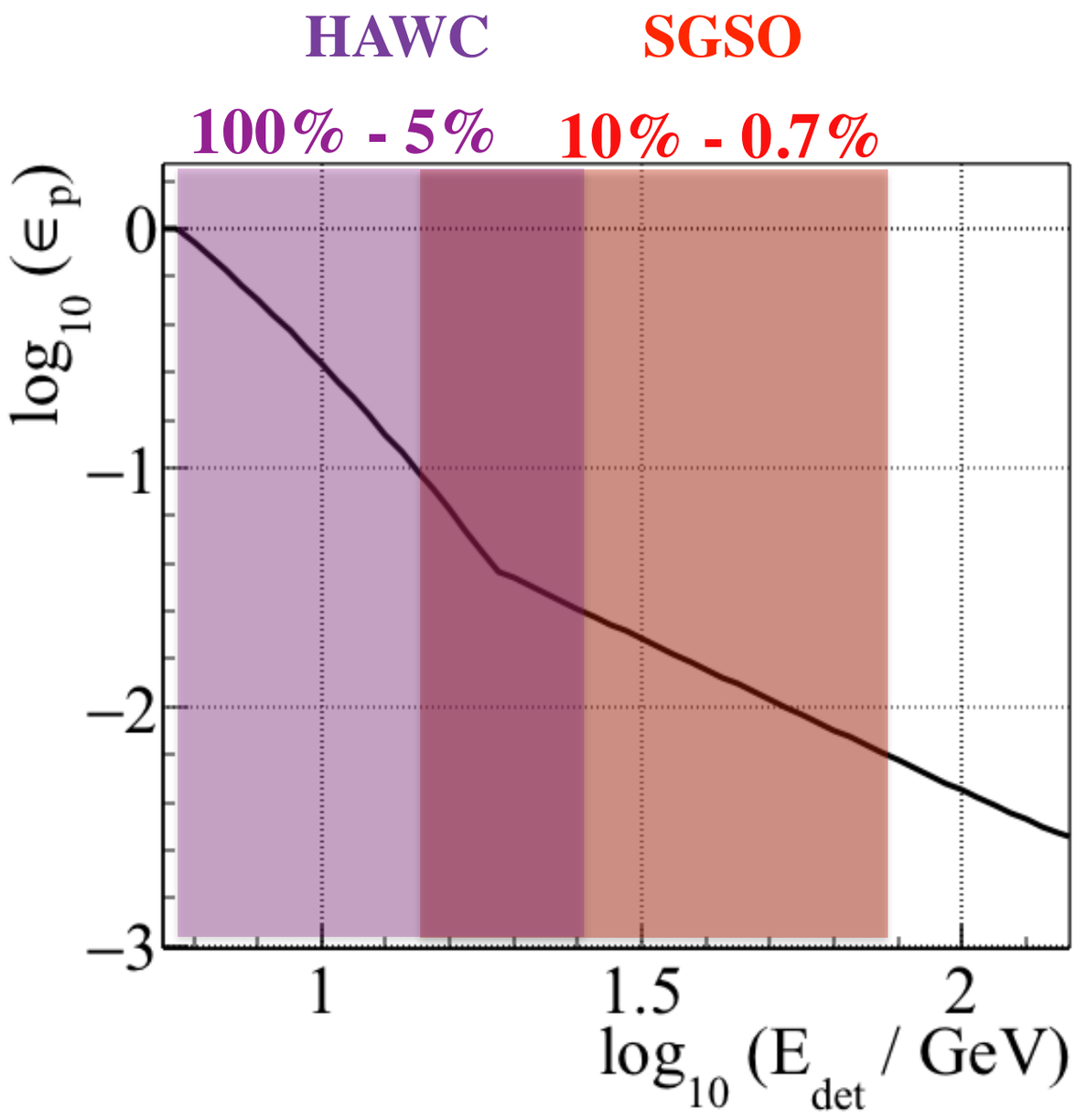


SGSO Sensitivity calculation

$$\sigma = \frac{S}{\sqrt{B}} \propto \sqrt{\epsilon_p^{-1}} \approx 2 - 3$$



Detected energy 1 TeV gamma's

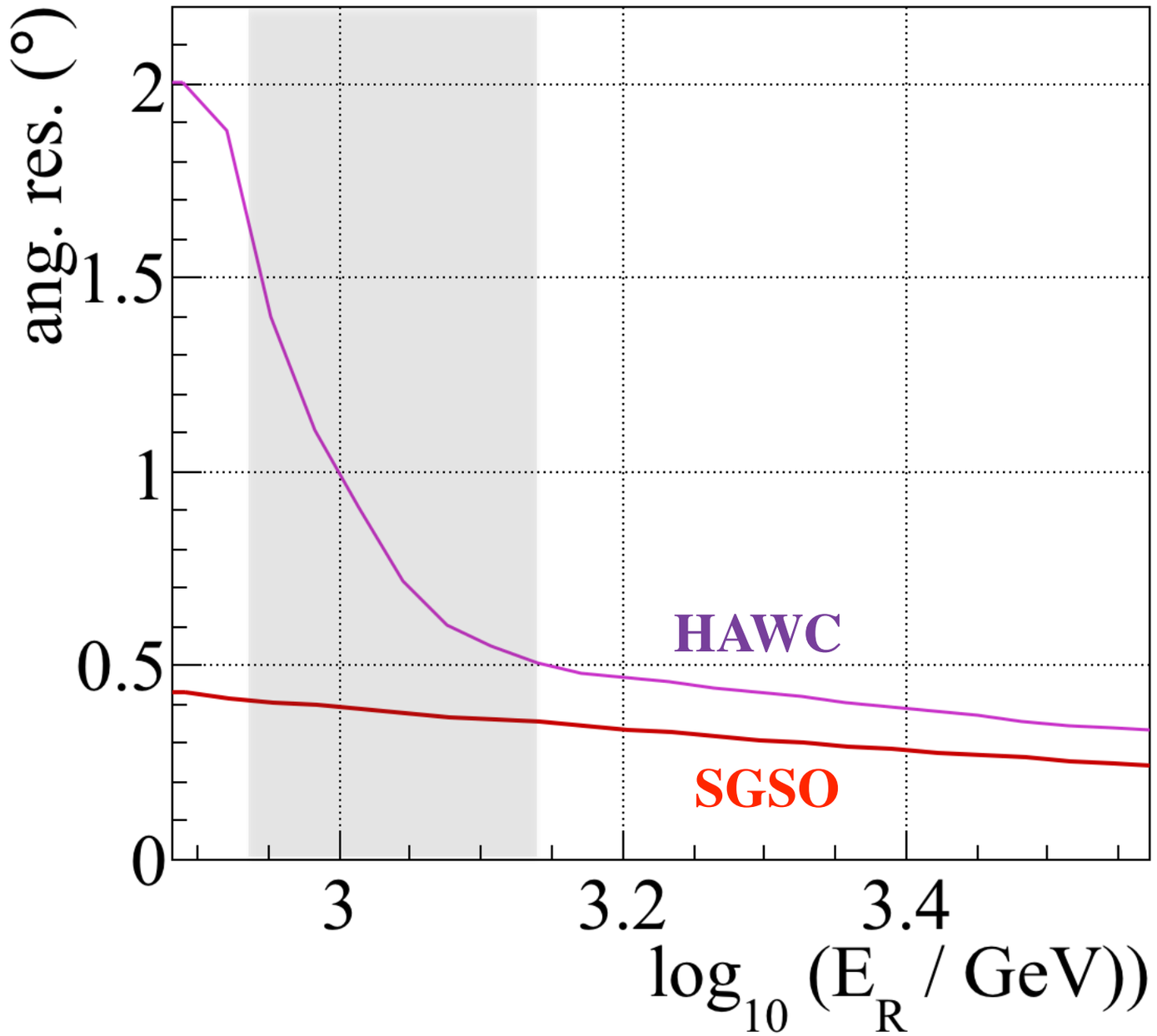


Background rejection

Increase due to: Fill factor (0.1), Altitude (0.3 -0.4), Array Size (0.1)

SGSO Sensitivity calculation

$$\sigma = \frac{S}{\sqrt{B}} \propto \theta^{-1} \approx 1.5 - 2.5$$



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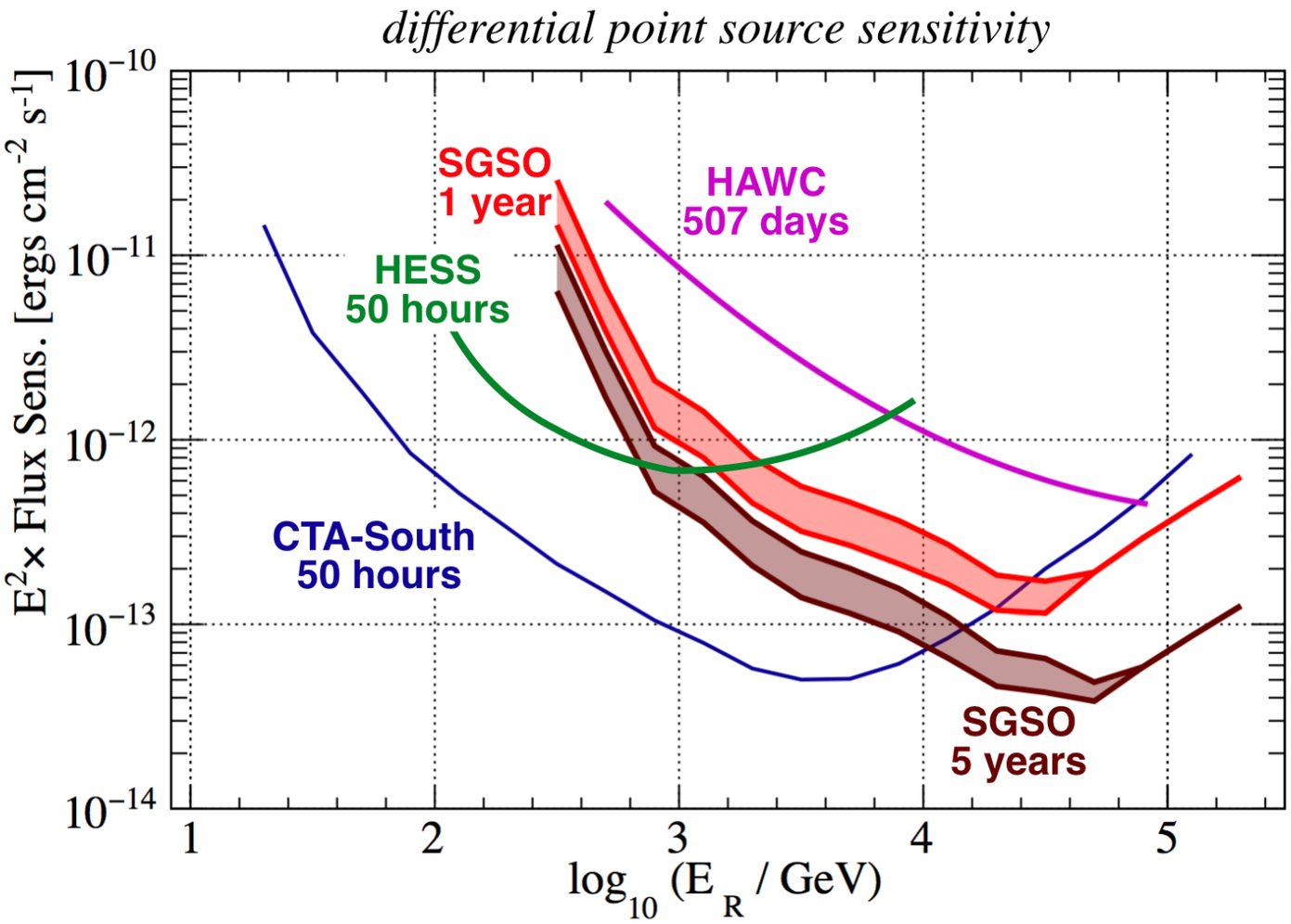
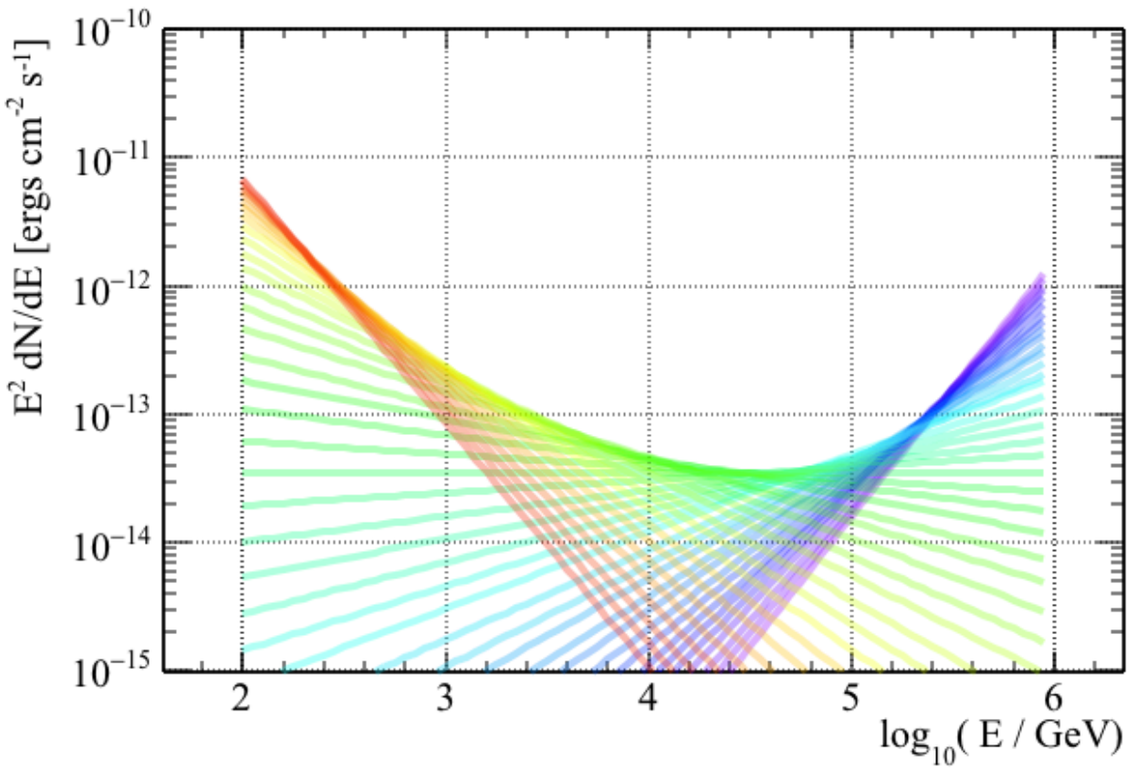
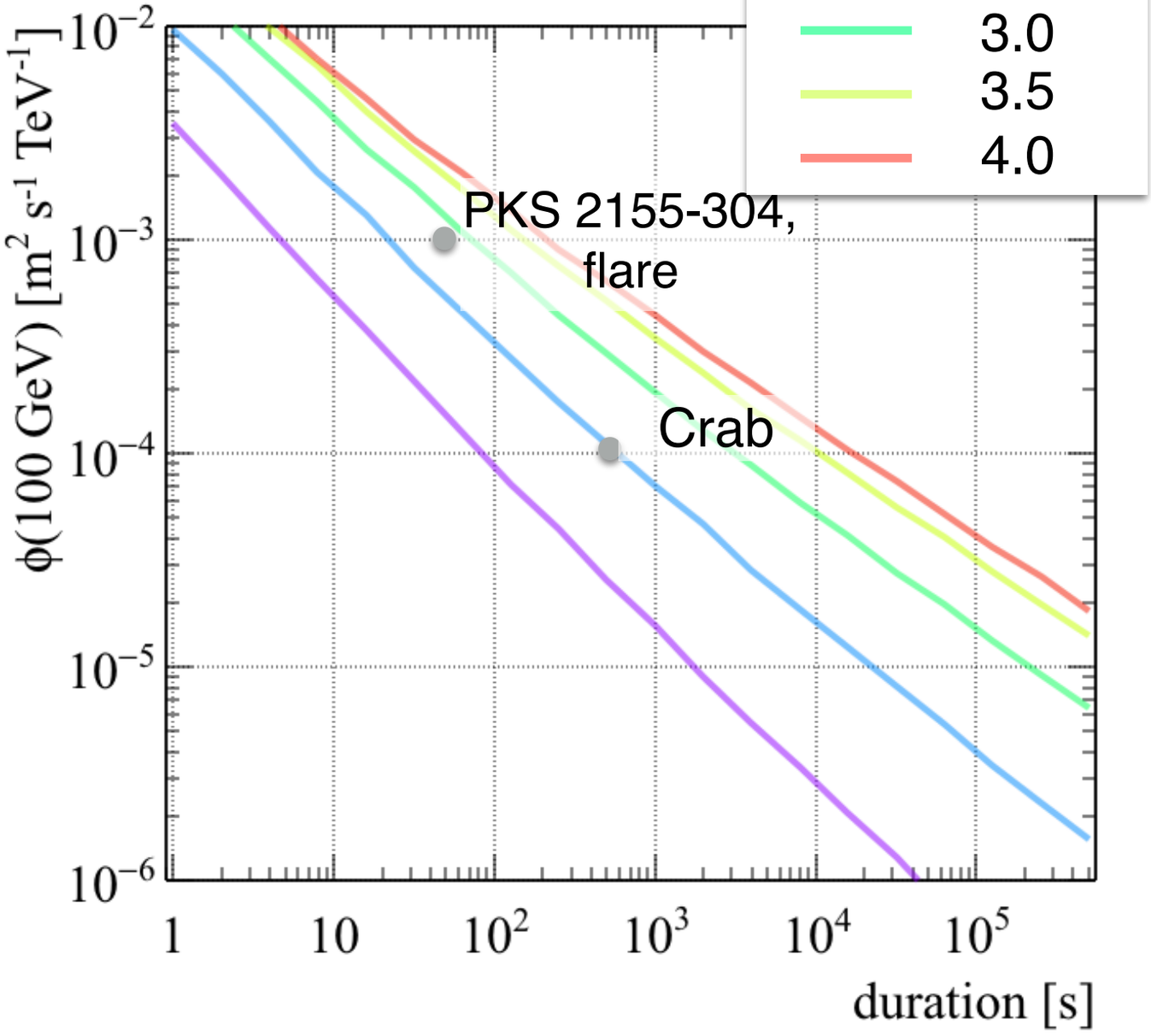
Total:

$$\sigma_T \approx [6 - 15]$$



SGSO Integral sensitivity





What to figure out?

- How to generated realistic noise simulations?
  ➡ What is a realistic trigger? Is it intrinsic to the design?
- How to compare designs? (See Sam's talk tomorrow)
- Reconstruction:
  ➡ Test same or similar reconstructions on different designs