The optimal declinations of a pair of SD arrays for full-sky studies

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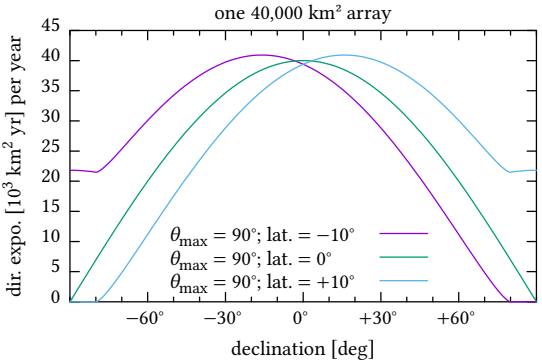
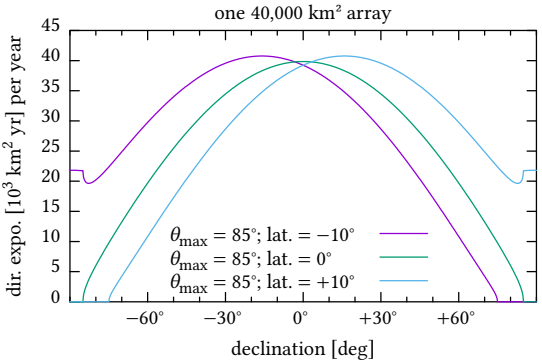
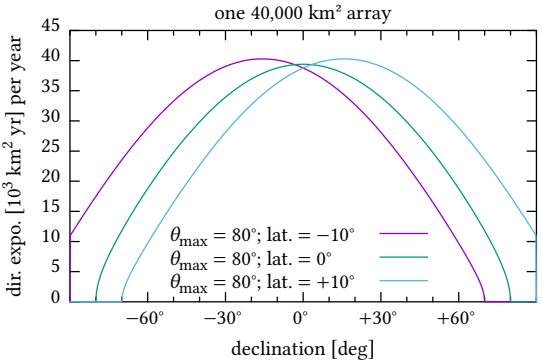


- A single array can have full-sky coverage only if it's *exactly* on the equator and has *exactly* 2π aperture.



- A single array with $<2\pi$ aperture can't have full-sky coverage no matter where it is.



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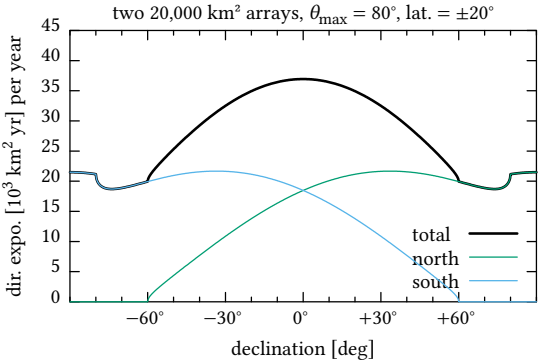
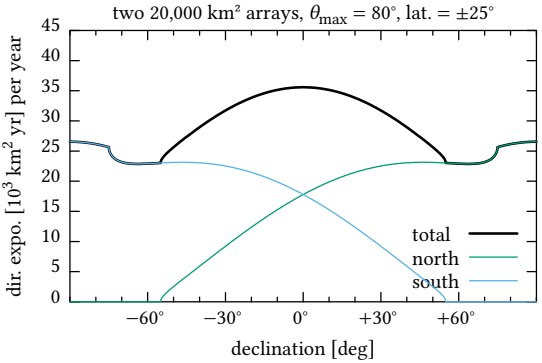


- Two arrays can cover the full sky, and the coverage seems to be most uniform for $\lambda \approx \pm 30°$.
  - That's why Auger was deployed at 35° S in the first place — "Auger north" had also been planned.



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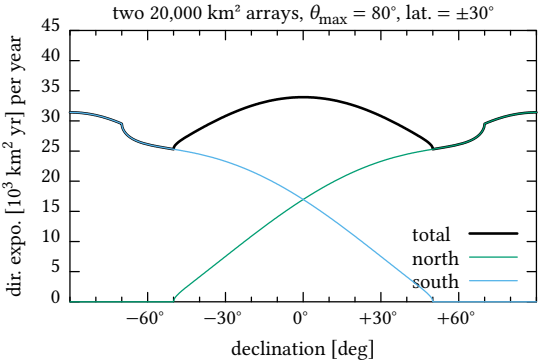

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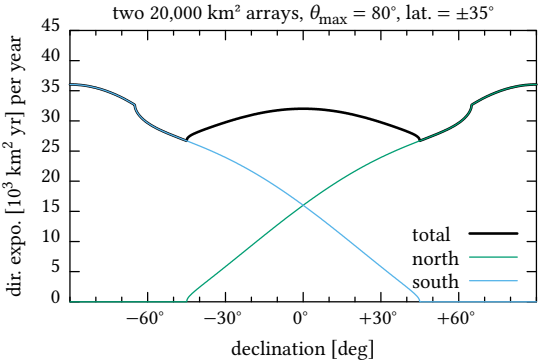

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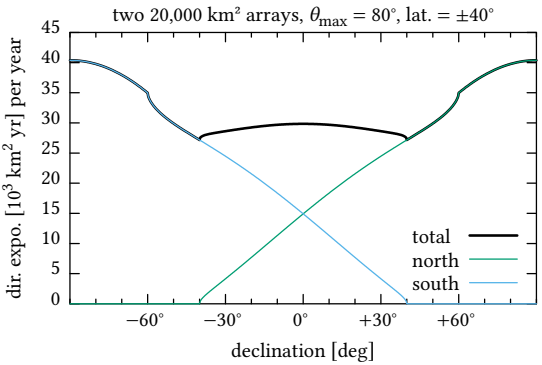

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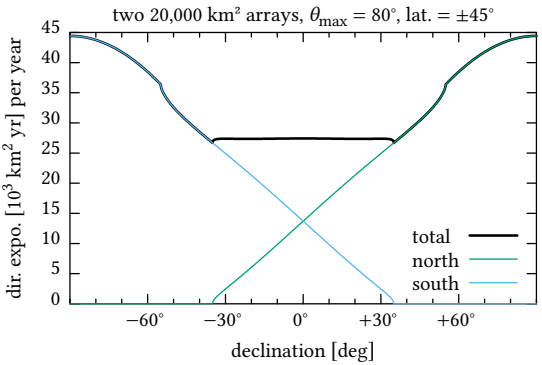

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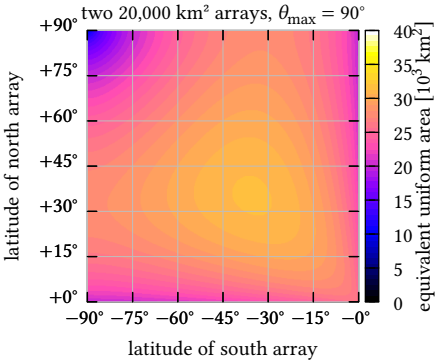
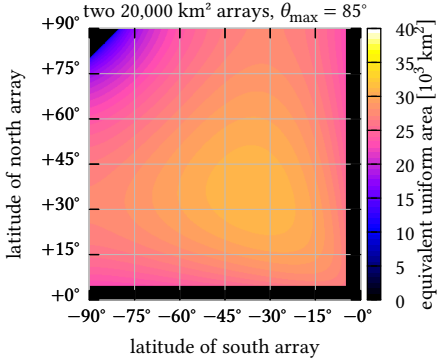
- Can we quantify this?



- It can be shown that the uncertainty in unbiased estimates of the full-sky flux depends on

$$\iint_{\text{sky}} \frac{1}{\omega(\delta)}\, \mathrm{d}\alpha\, \mathrm{d}\sin\delta.$$

- The best is $\lambda = \pm 35°$, but the precise values don't matter *that* much.



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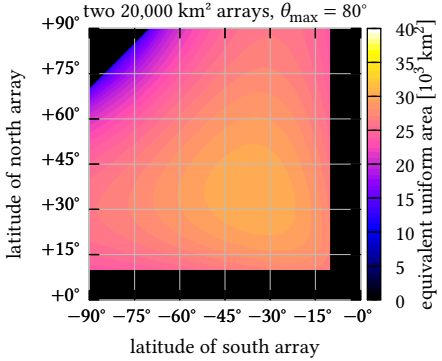

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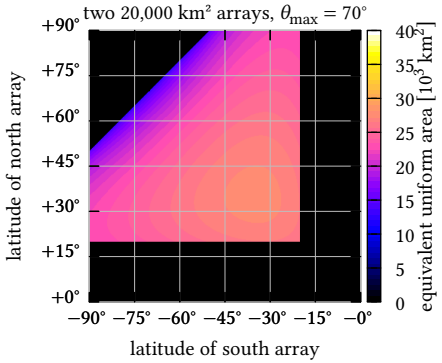

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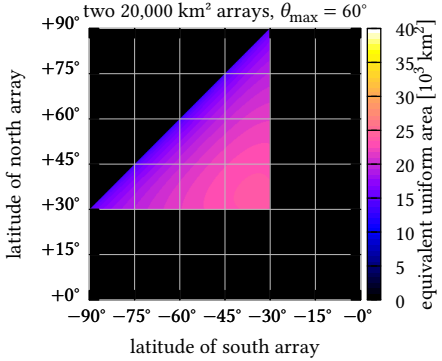
- The best is $\lambda = \pm 35°$, but the precise values don't matter *that* much.
- But if we have less than 2π aperture, we can't be too close to the equator.



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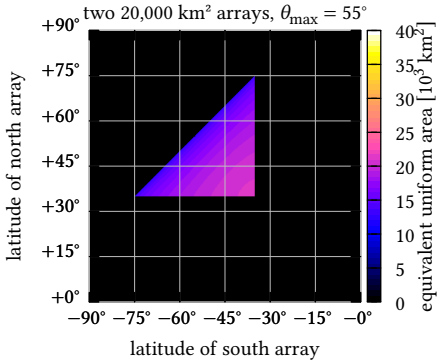

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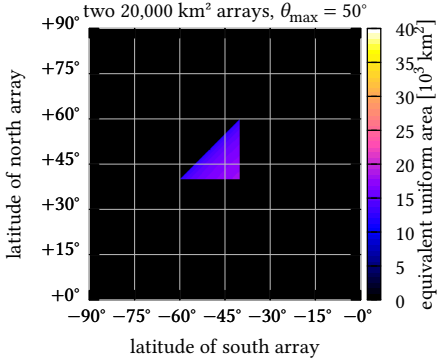
- The best is $\lambda = \pm 35°$, but the precise values don't matter *that* much.
- But if we have less than 2π aperture, we can't be too close to the equator.
- Highly recommended to have as large aperture as possible (WCDs and/or radio rather than plastic scintillators)



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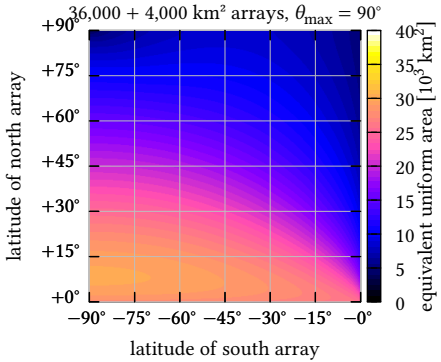
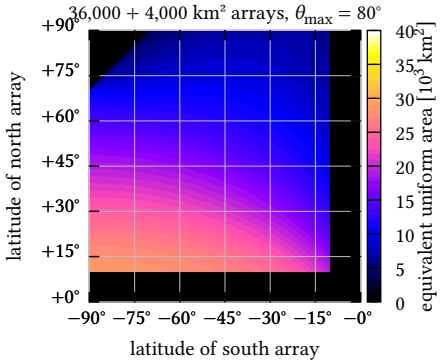
- The best is $\lambda = \pm 35°$, but the precise values don't matter *that* much.
- Highly recommended to have as large aperture as possible (WCDs and/or radio rather than plastic scintillators)
- With $\theta_{\text{max}} < 45°$ we can't have full-sky coverage no matter where we are!



- With “lopsided” arrays, we’d better put the larger one near to the equator and the smaller one near the pole.



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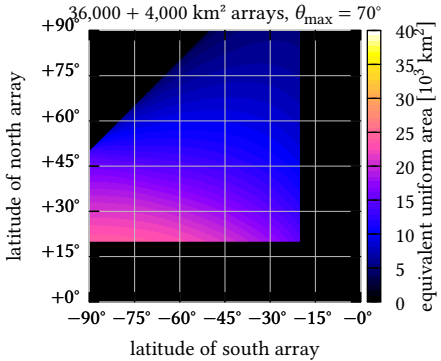

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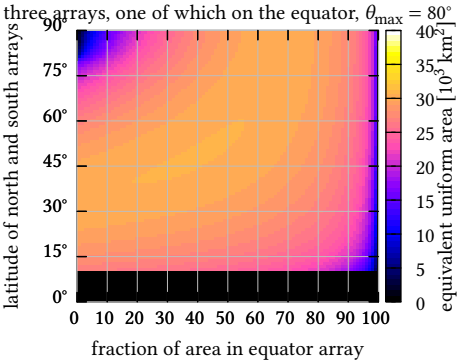

- Another possibility is to have
  ~ 16 000 km^2 on the equator,
  ~ 12 000 km^2 at ≈ 50° N and
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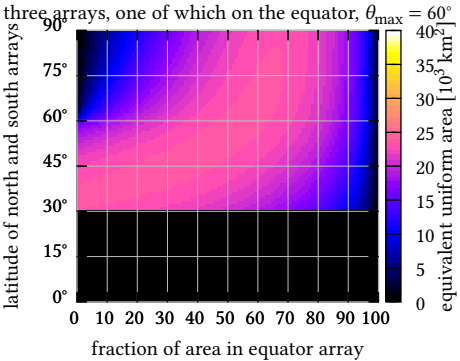
  (not that there's much land at ≈ 50° S).



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- Note: The same applies to estimates of the dipole components d_x and d_y.
- For estimating d_z, if we have two identical arrays, we want them to be as close to the poles as possible.
- For the quadrupole component Q_{zz}, the optimal declinations are $\approx \pm 47°$.

- I assumed identical detectors $\rightarrow$ perfect knowledge of the relative energy and exposure calibration.
- If two arrays use different techniques and a data-based cross-calibration is required, they had better be closer together, so their fields of view overlap more.

Thanks for your attention!