

Science and Specs

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Outline

- Specifications in a research environment
- A quick case study
- Conclude

The Spec “Speedbump”

- Engineers: “I can’t design/build anything until I have the specs” (They are too fuzzy to even start).
- Scientist: “I can’t provide the specs until I’ve done the research”(I don’t want to commit to an actual **number**. How much does **better** cost?)

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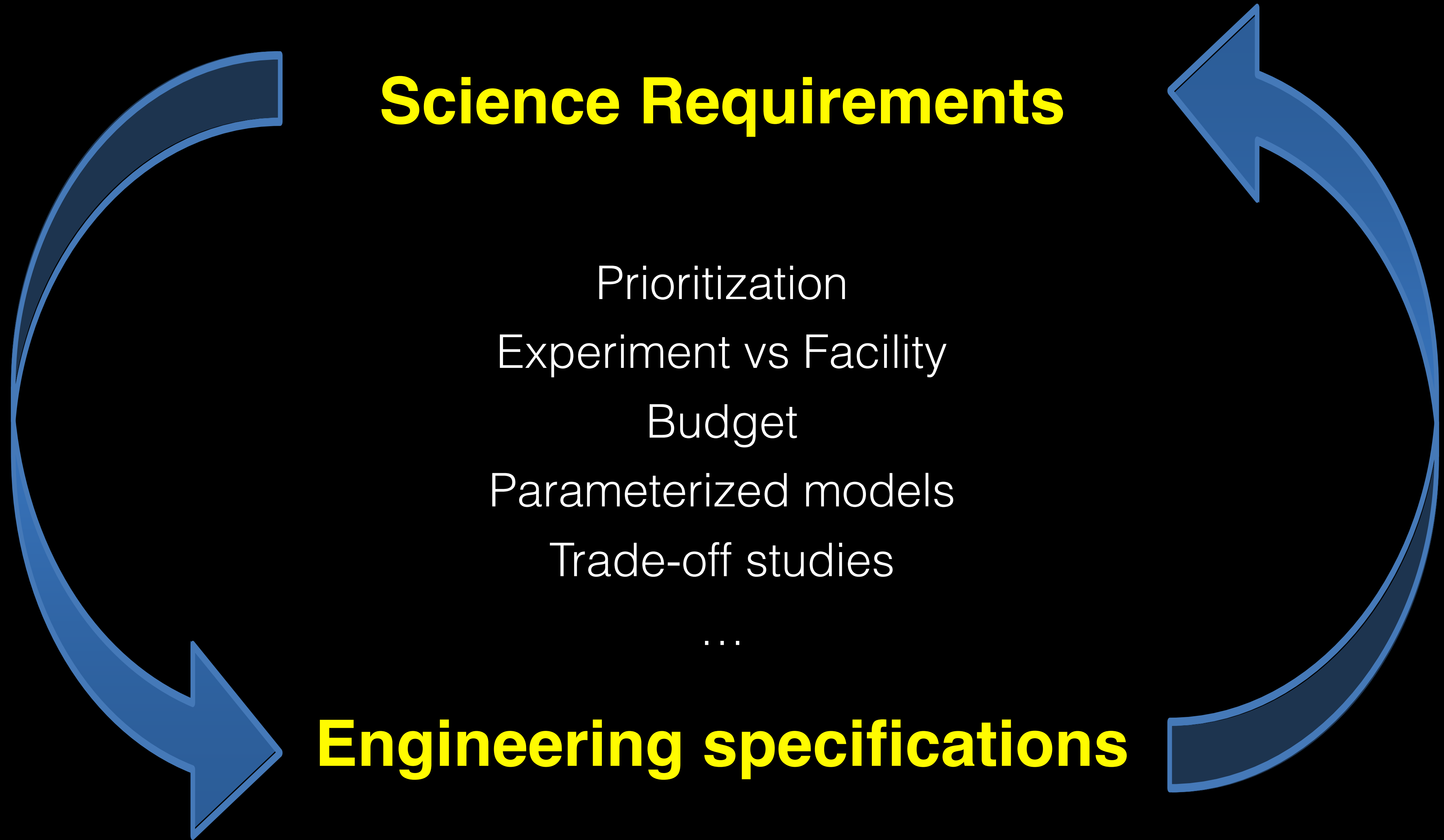
...should be more of a rumble-strip

- Wake you up and stop a wreck
- Back-and-forth on-going **dialogue**

Science Requirements

Prioritization
Experiment vs Facility
Budget
Parameterized models
Trade-off studies
...

Engineering specifications



Science Requirements

Figures-of-merit

$$\xi = \frac{\int_{-\pi}^{\pi} \left[\sqrt{G(\theta, \phi = 0)} - \sqrt{G(\theta, \phi = 90)} \right]^2 \sin \theta d\theta}{\int_{-\pi}^{\pi} \left[\sqrt{G(\theta, \phi = 0)} + \sqrt{G(\theta, \phi = 90)} \right]^2 \sin \theta d\theta}$$

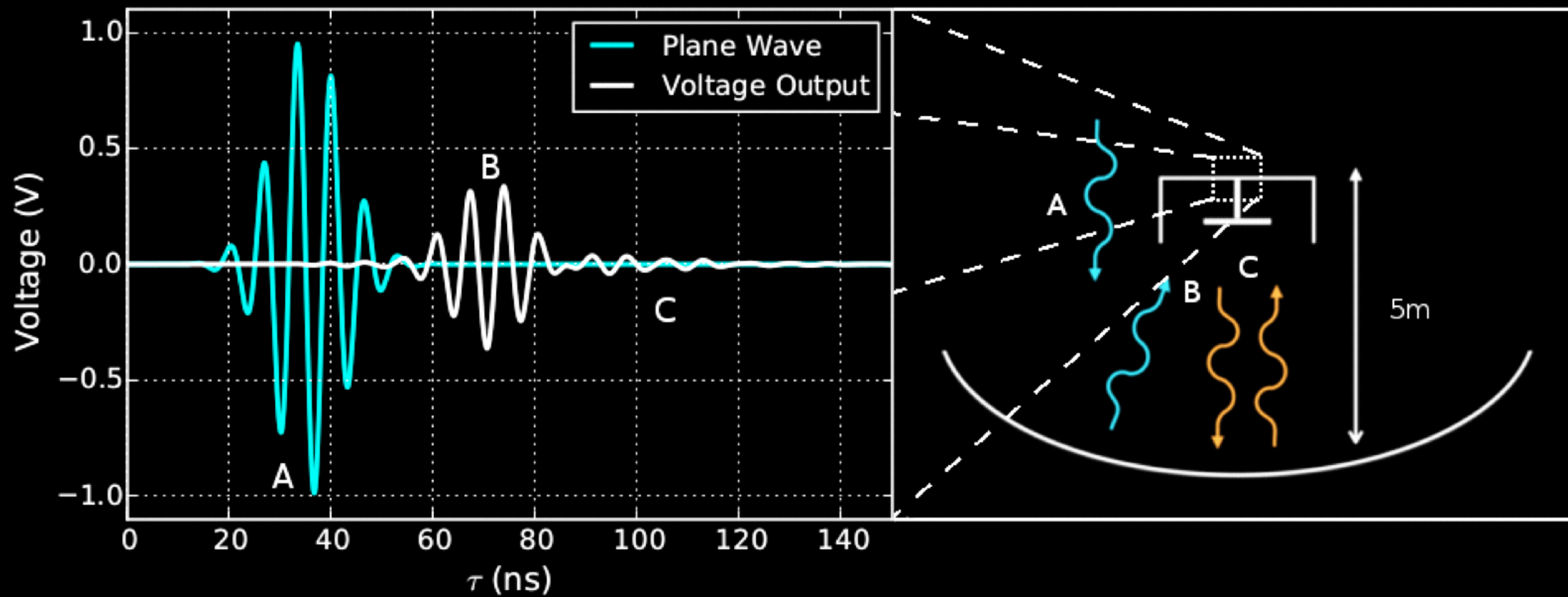
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Engineering specifications

Case Study: Delay spec for HERA

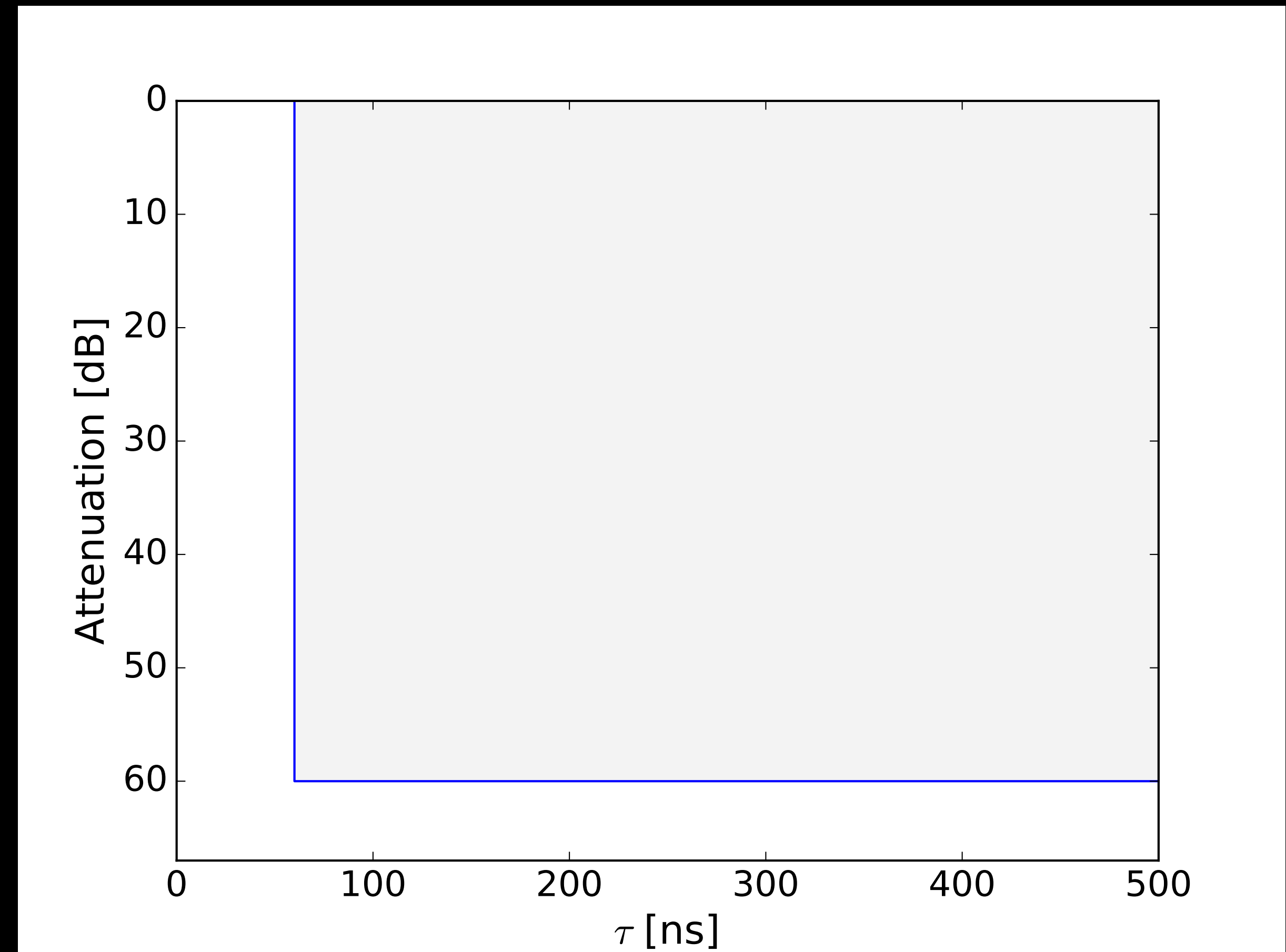
- HERA uses the delay-spectrum approach to measure the EOR power spectrum.
- Care about sky signals rattling around in the structure/cables.

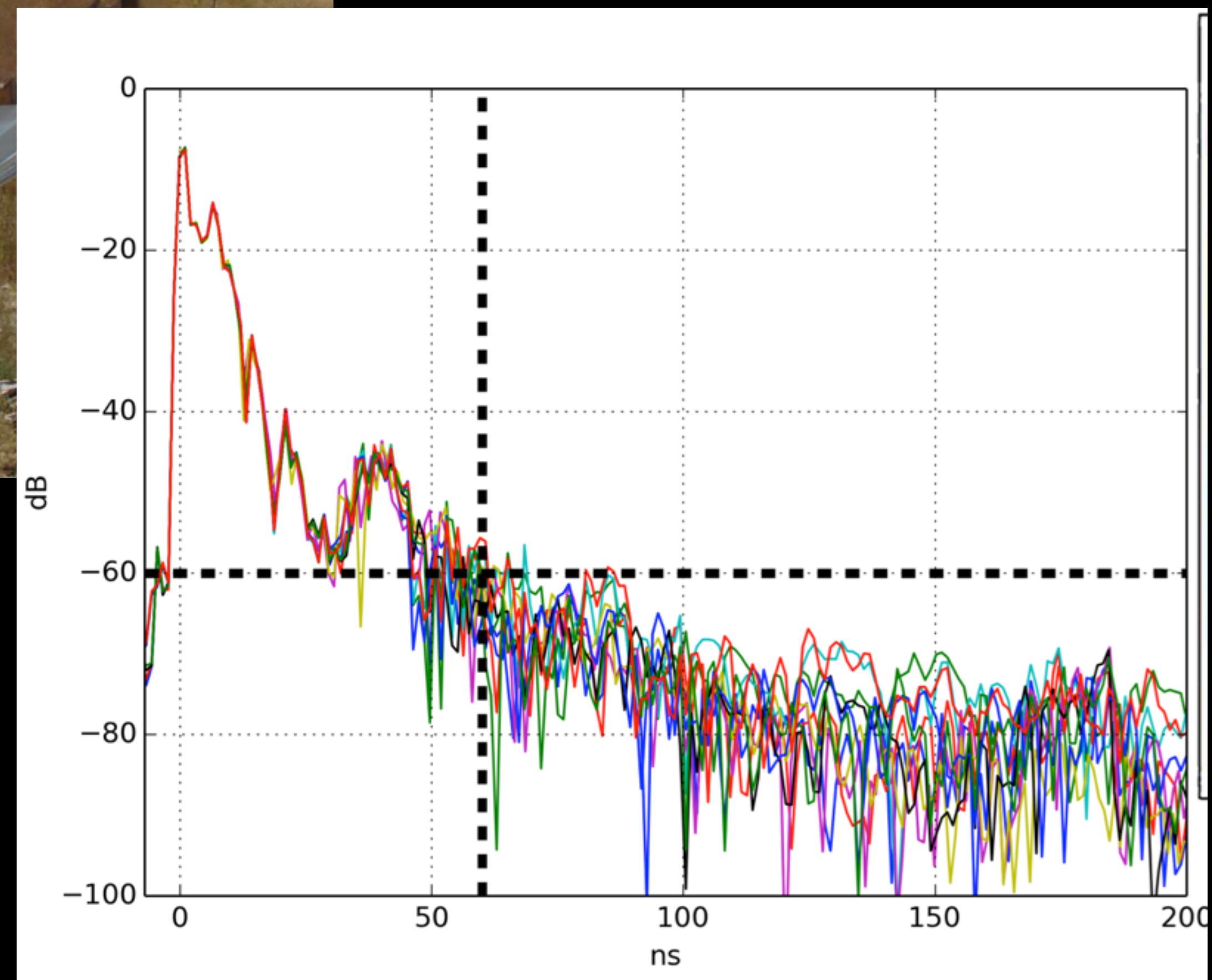
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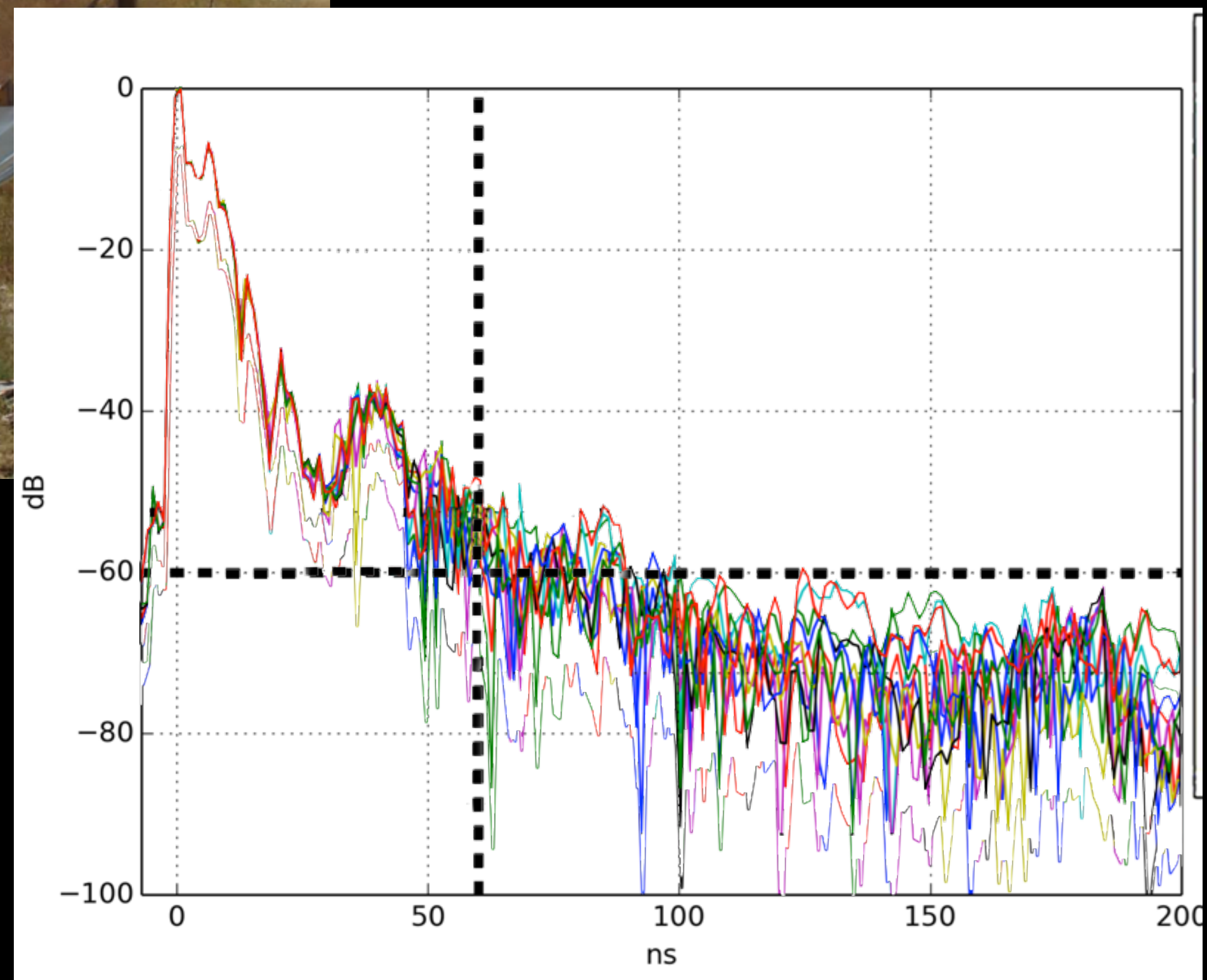


60 dB @ 60 ns

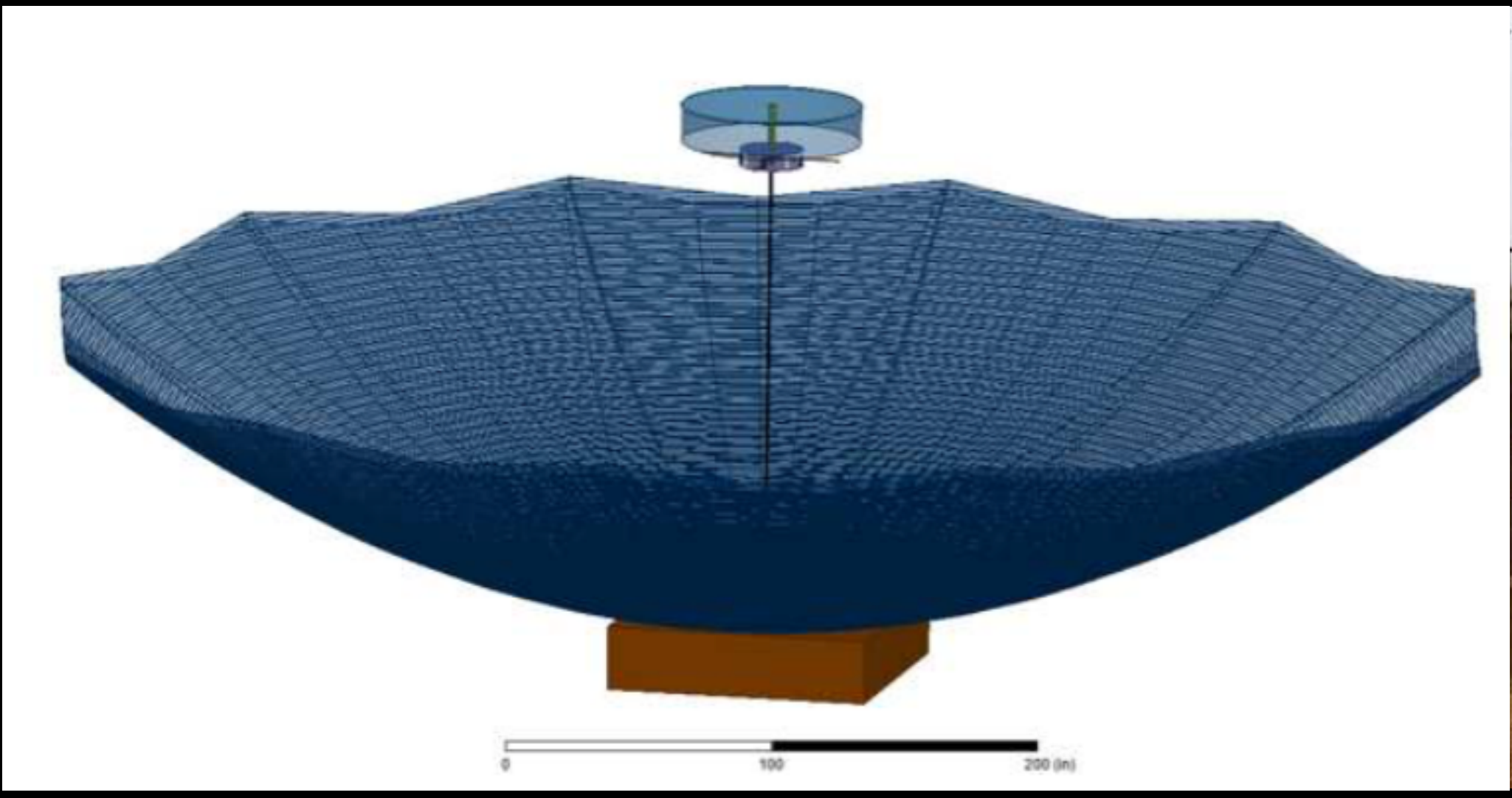
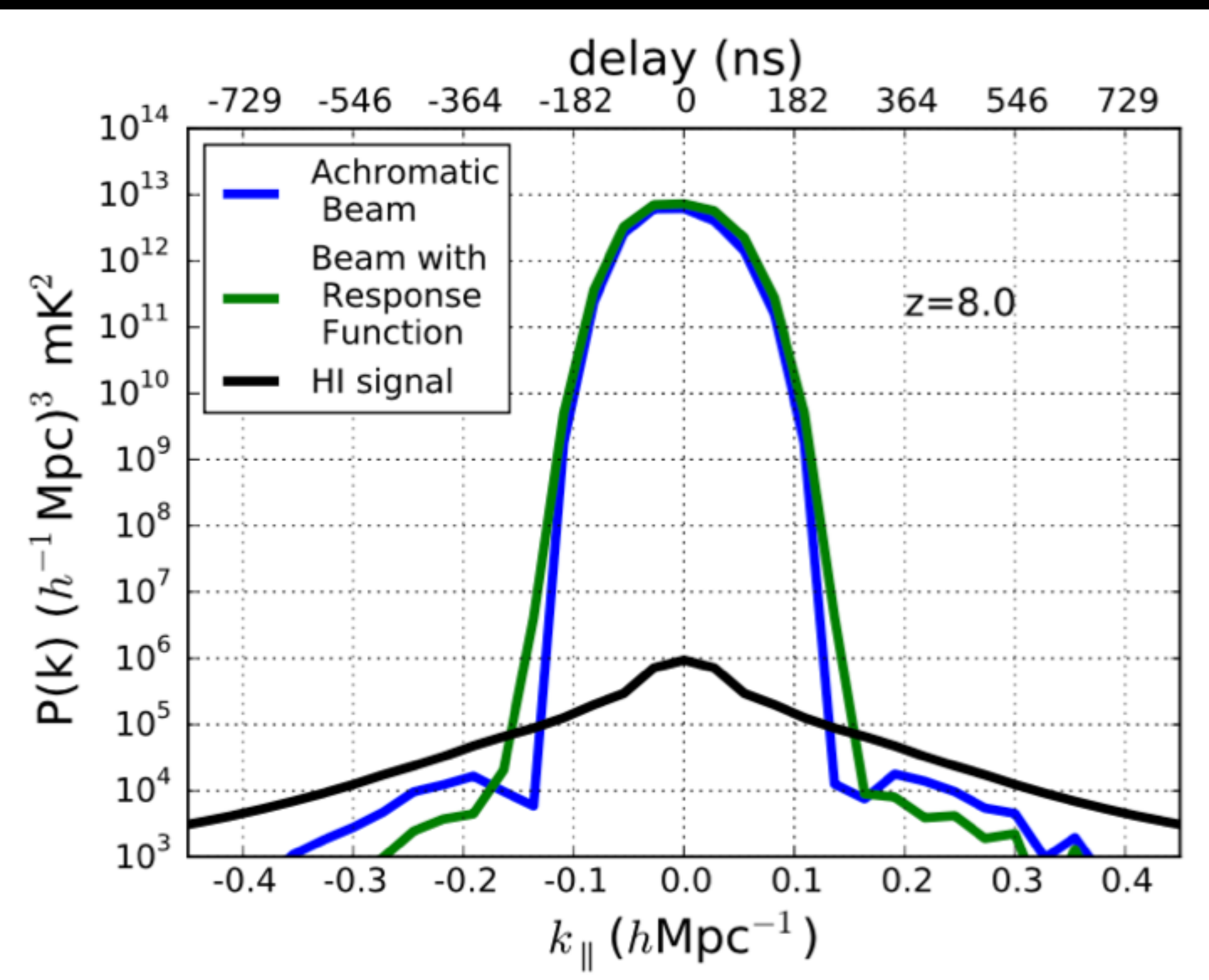
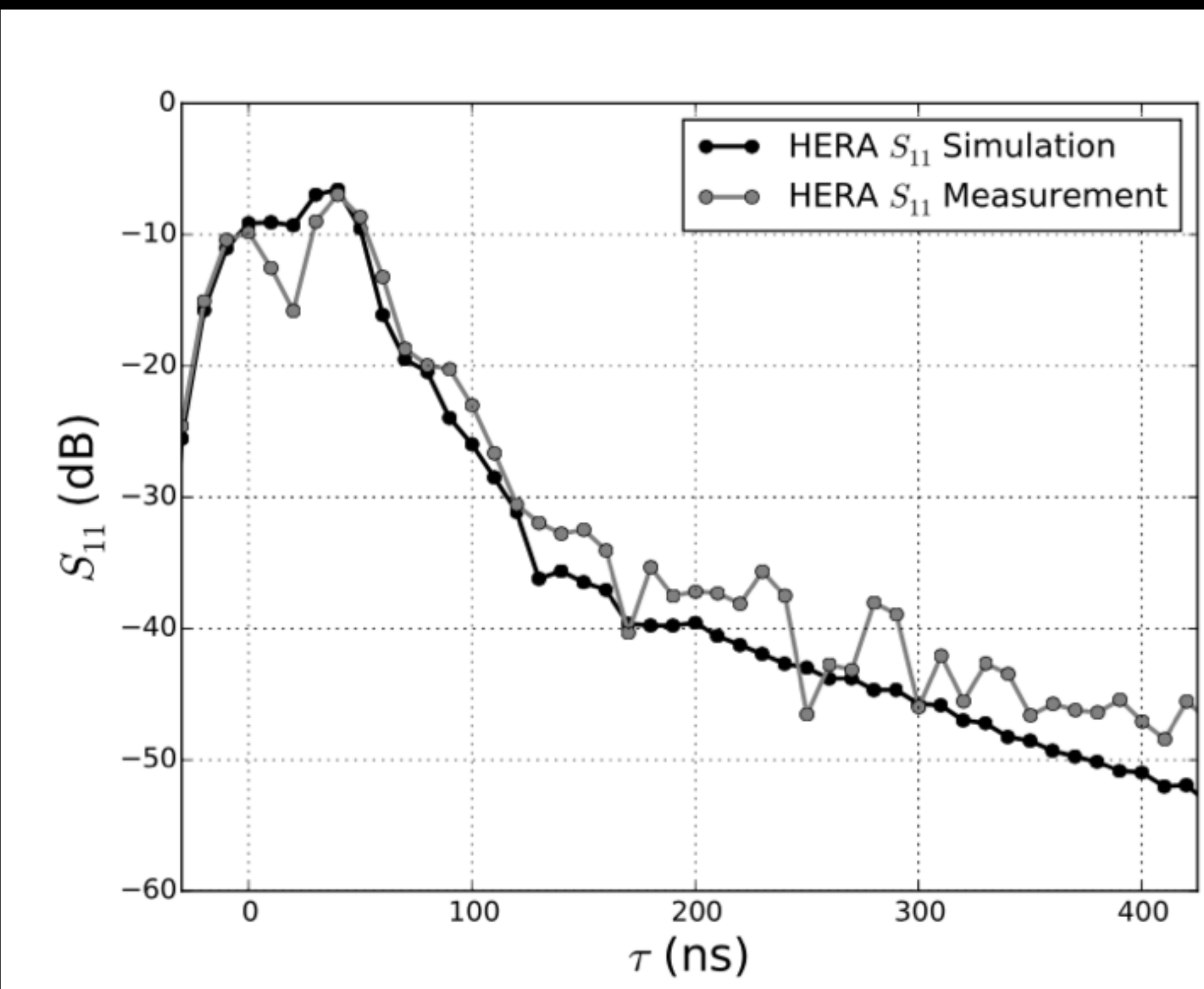
- 60 dB - strength of foregrounds
- 60 ns - 0.03 h/Mpc
- $VSWR < 1.001$ $f < 17$ MHz
- HERA Memo 5
<http://reionization.org>

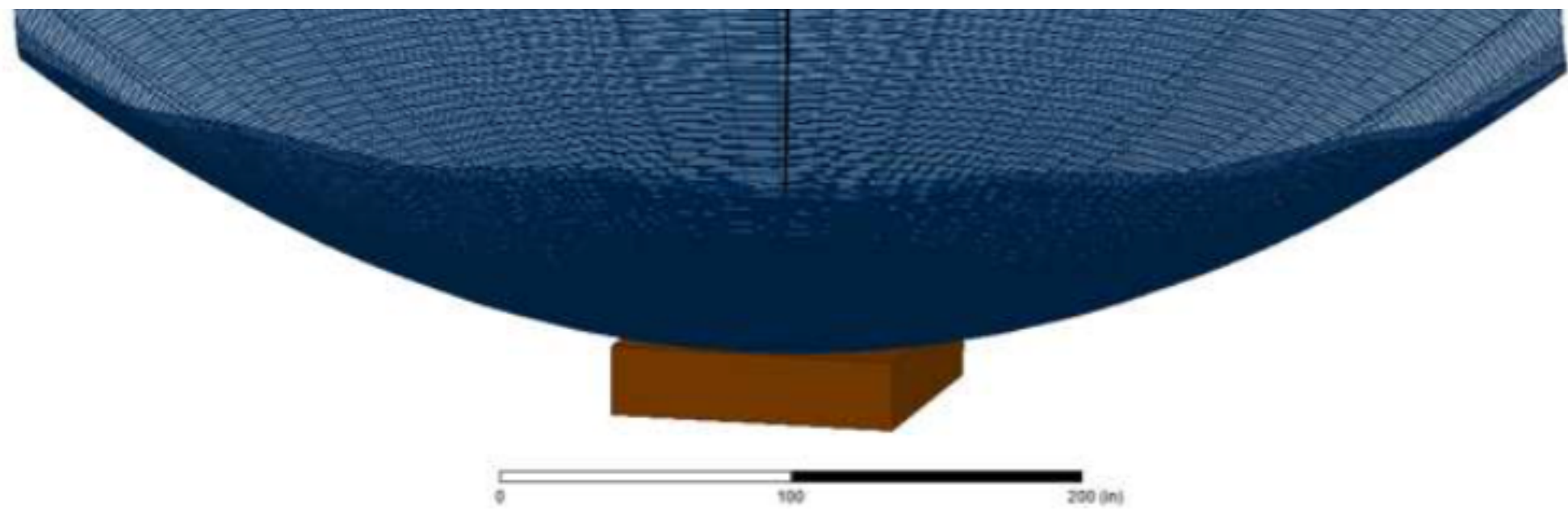
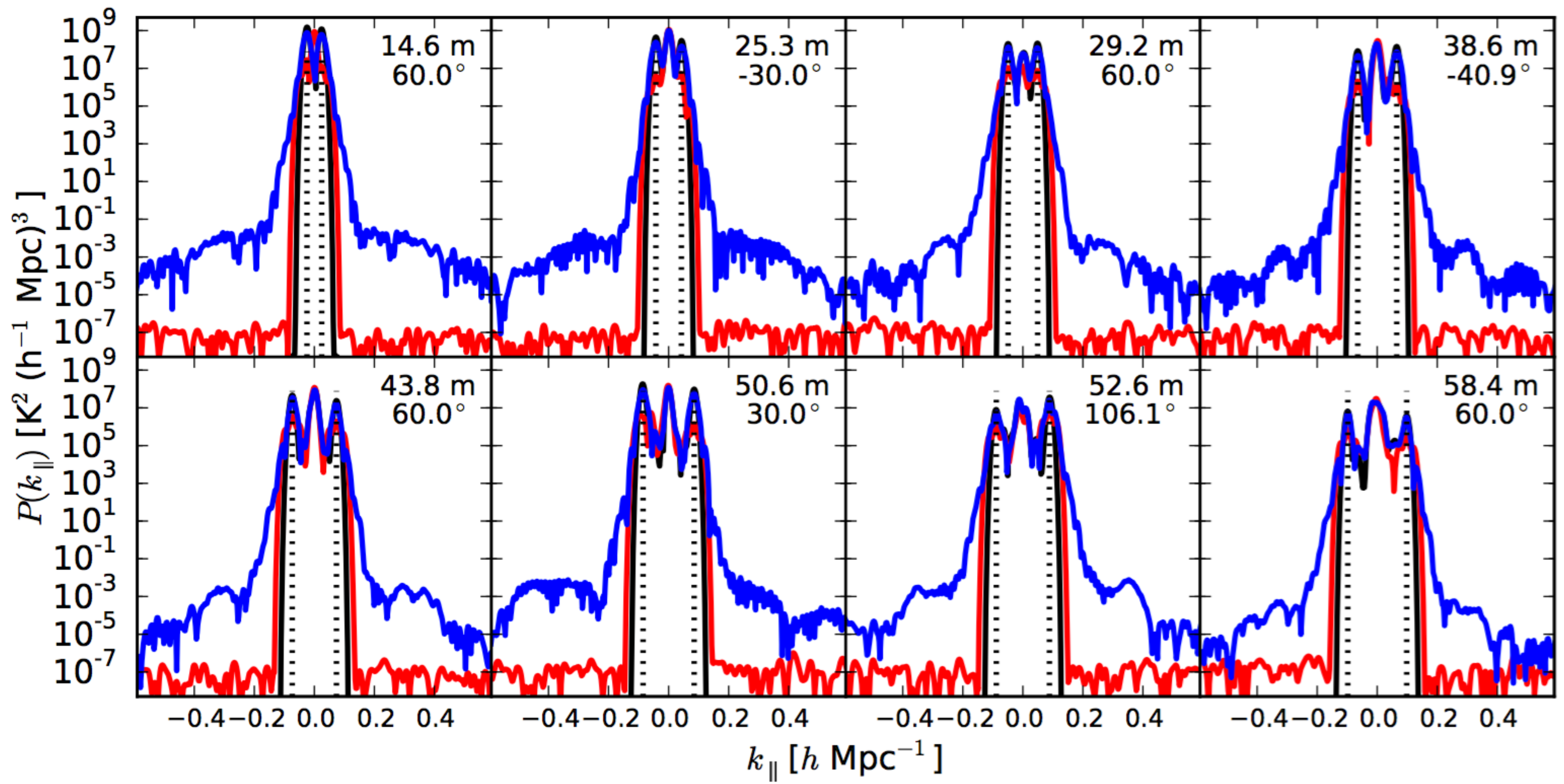


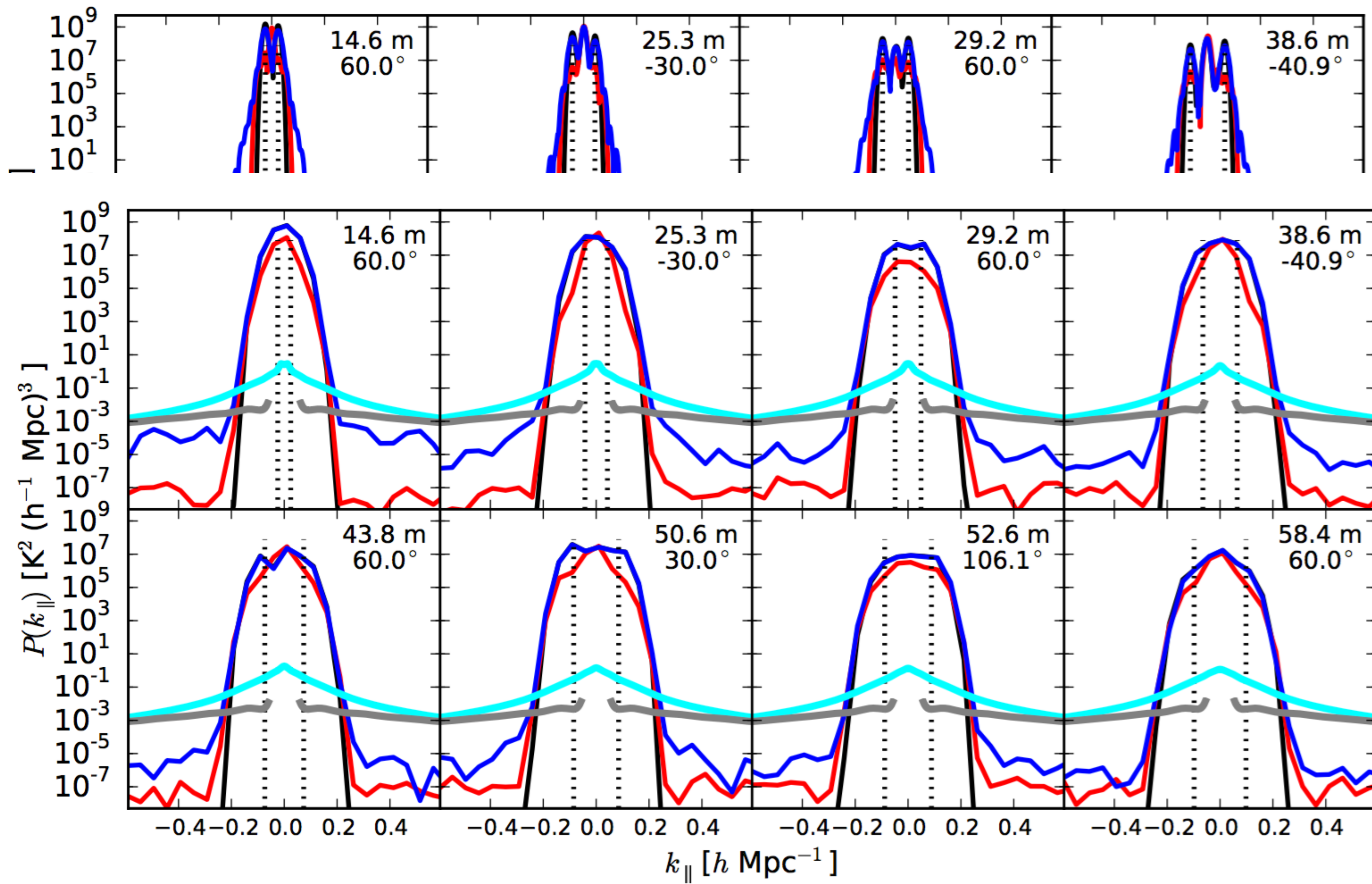




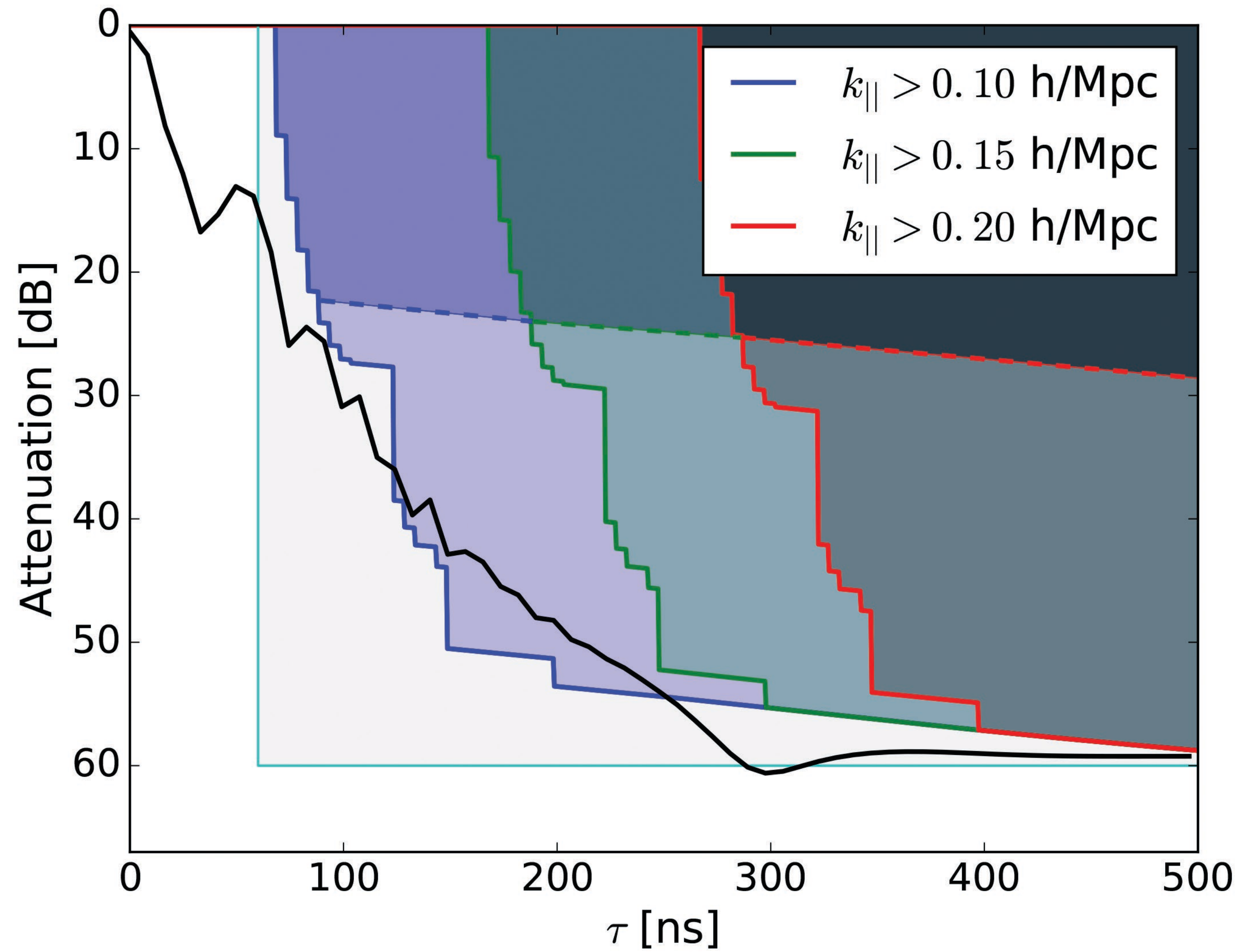
$$|\Sigma_n|^2 = P_n(\theta, \phi) \left[|\eta_f|^2 + 2 \operatorname{Re} \left(\frac{\Gamma_f}{\eta_f} (S_{11} - \Gamma_f) \right) + \left(\frac{|\Gamma_f|^2}{|\eta_f|^2} |S_{11} - \Gamma_f|^2 \right) \right]$$







(a) 150 MHz subband ($z \approx 8.47$)



Random Thoughts

- Acknowledge the need for actual specs
- Don't self-limit (at least to start)
- Don't let "perfect" lead to "nothing"
- Write it down and be able to find it again (and look at it again)
- Know how it affects full design (or have a way to find out, even approximately)
- Build/measure properly scoped prototypes
- Be ready to be disappointed at least a little bit
- Probably need the cranky engineer AND the unreasonable astronomer to succeed