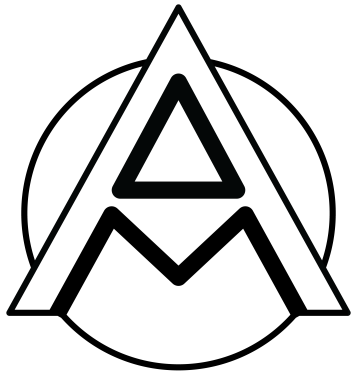
Stockholms universitet

alpha



Introducing The ALPHA Consortium

Matthew Lawson, on behalf of the ALPHA Consortium

Stockholm University

June 18, 2021

Axion Dispersion Matching: A Primer

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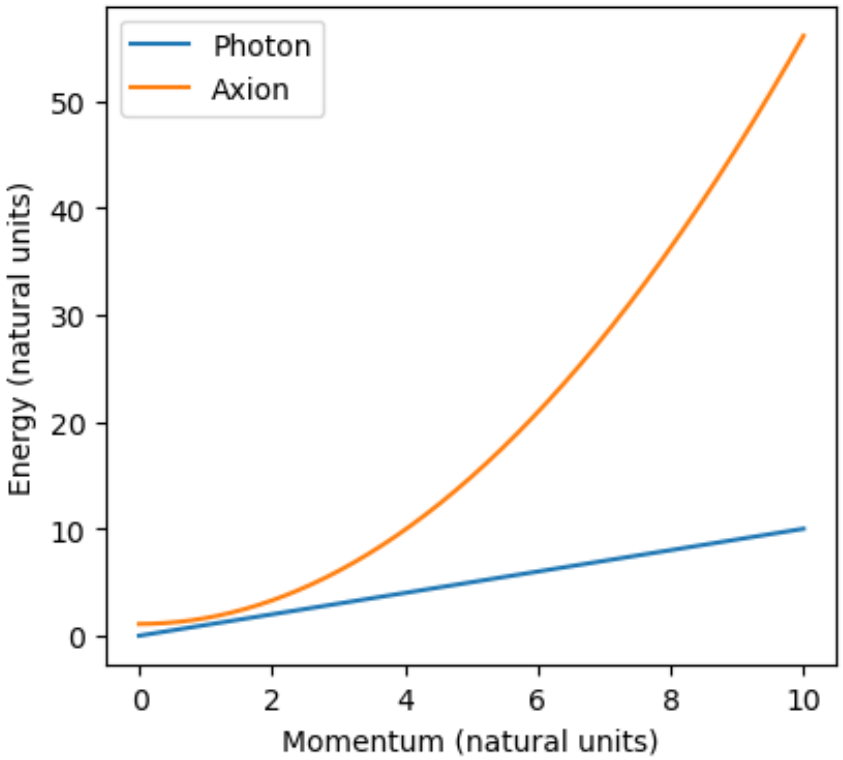
- Must fix this mismatch for resonant conversion



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- Give photon effective mass (ALPHA (That's us!), TOORAD)

Big Idea

Breaks the Tyrrany of the $V \sim 1/\omega^3$ Scaling!

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- Axion couples to E&M as $a\vec{E} \cdot \vec{B}$
- In presence of DC B-field axion can induce longitudinal plasmon excitations
- Require $\omega_a = \omega_p$ (Photon mass is w_p)
- Axion oscillation coherent for 10^6 cycles, long plasmon lifetime beneficial

Wire Metamaterials

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$$\omega_p^2 = \frac{n_e e^2}{m_{eff}} = \frac{2pi}{a^2 \log(a/r)} \tag{1}$$

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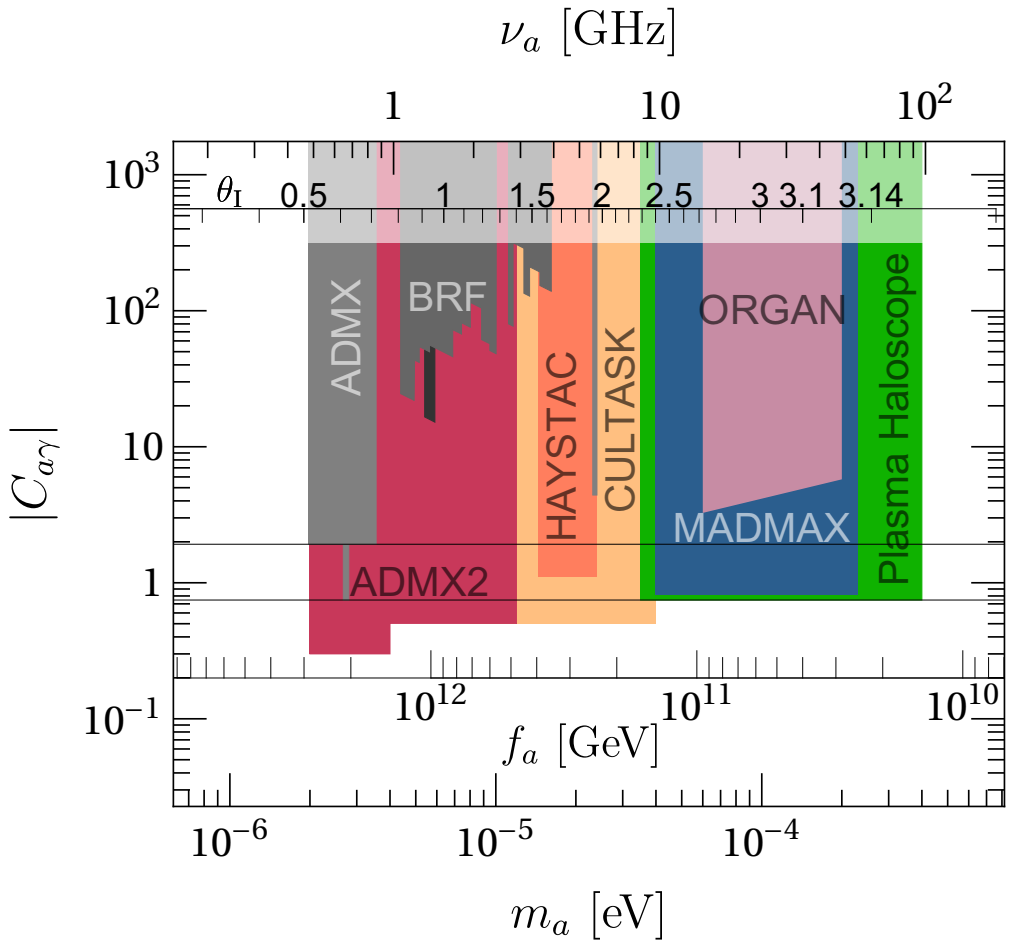
- Volume limited by axion de Broglie Wavelength

Projected Exclusion



Assumptions: $T = 4K$, $B = 10T$, $V = 2m^3$, $Q = 100$, Three years live time

Problems

What could make this not work?

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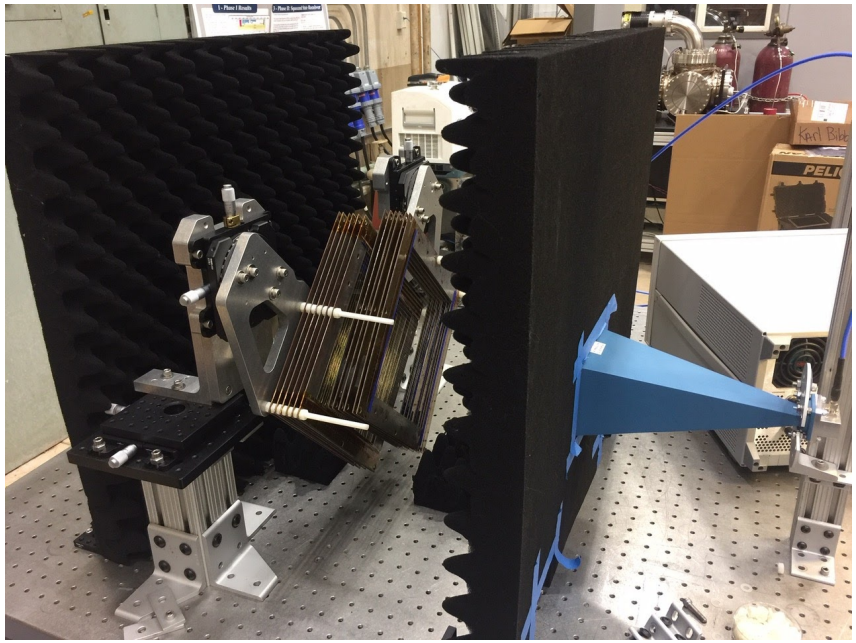
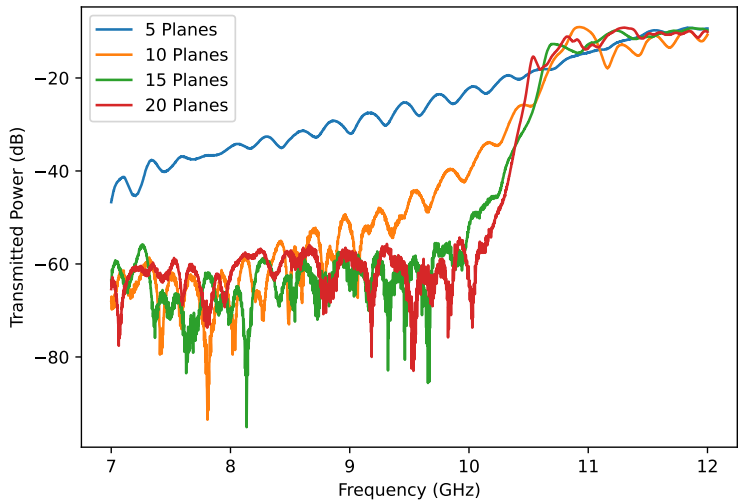
- Maybe it isn't tunable?
- Maybe we can't couple it to an antenna?

Q Factor

Our industrious collaborators at UCB have built a prototype!



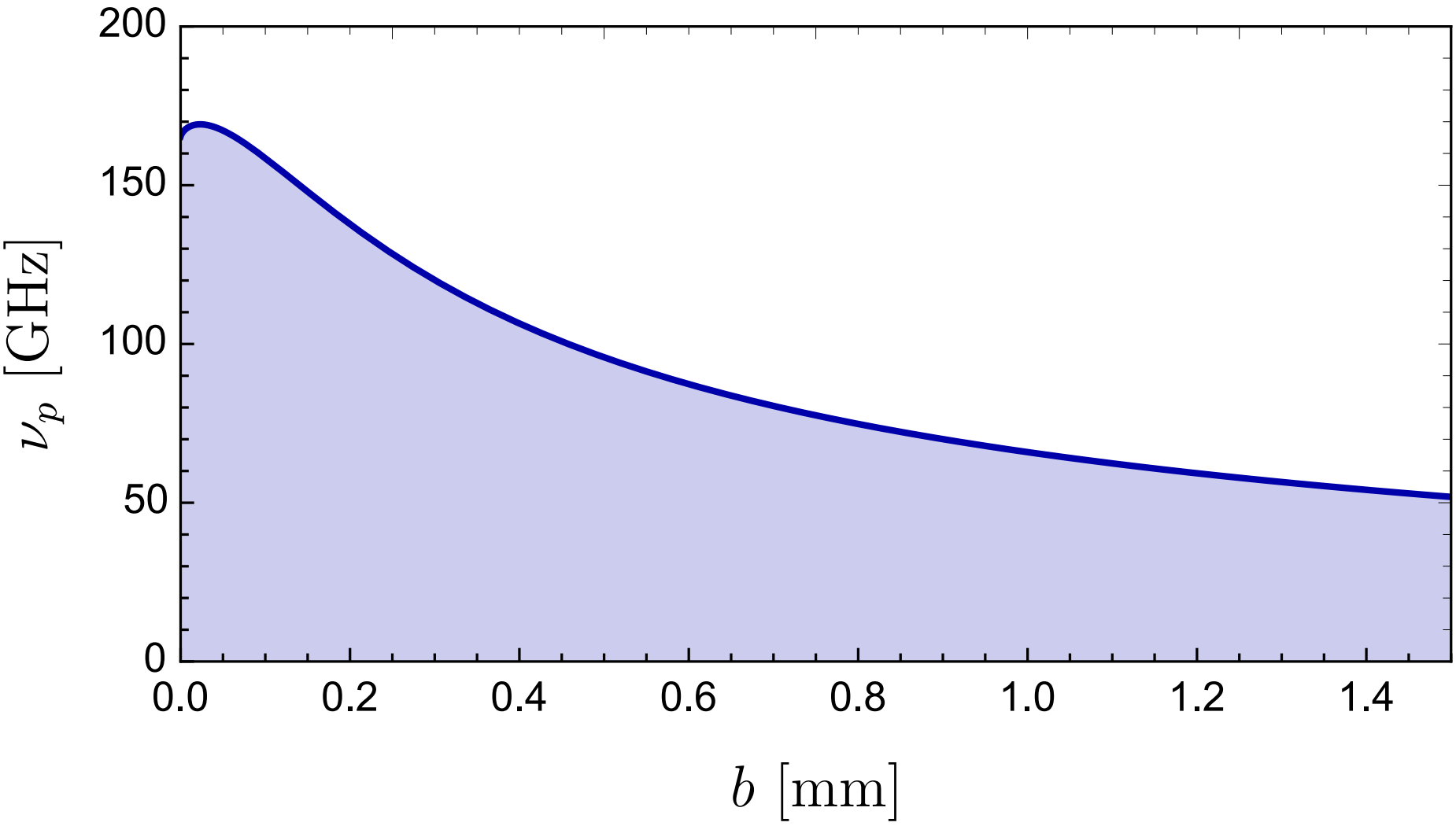


Al Kenany, Alex Droster, Karl Van Bibber

Fits indicate a $Q \sim 200$ at room temperature with 20 frames
Simulations suggest higher Qs with more frames!

Tuning - Asymmetric Lattice

$a \neq b$: each wire feels same mutual inductance!



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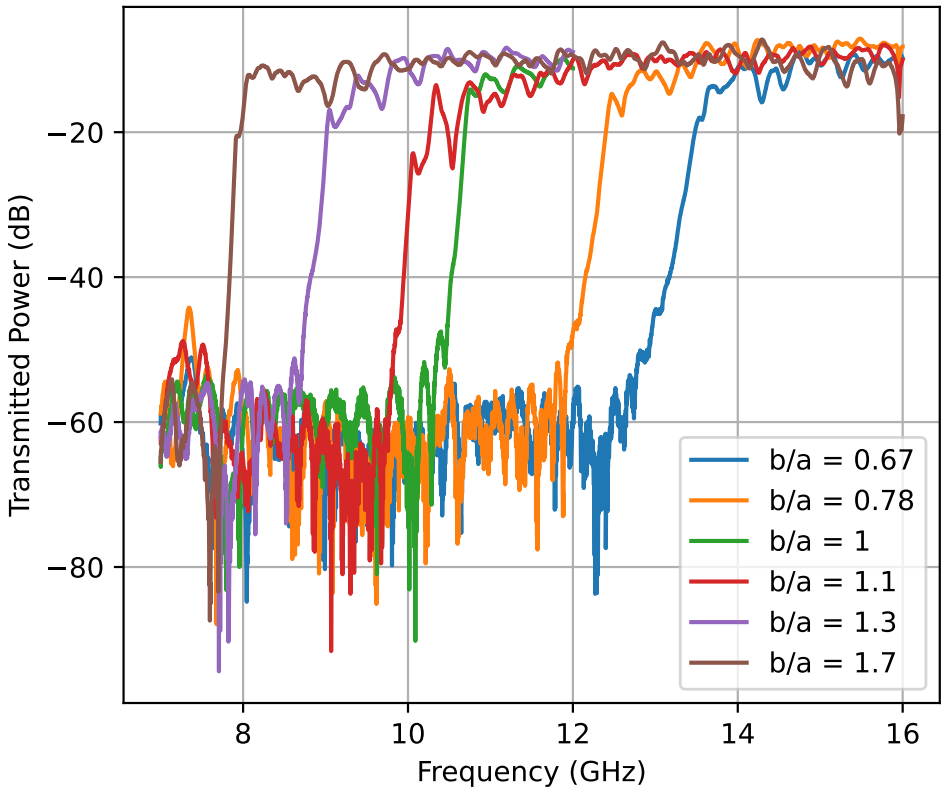
Experimental results from UCB Axion Works!



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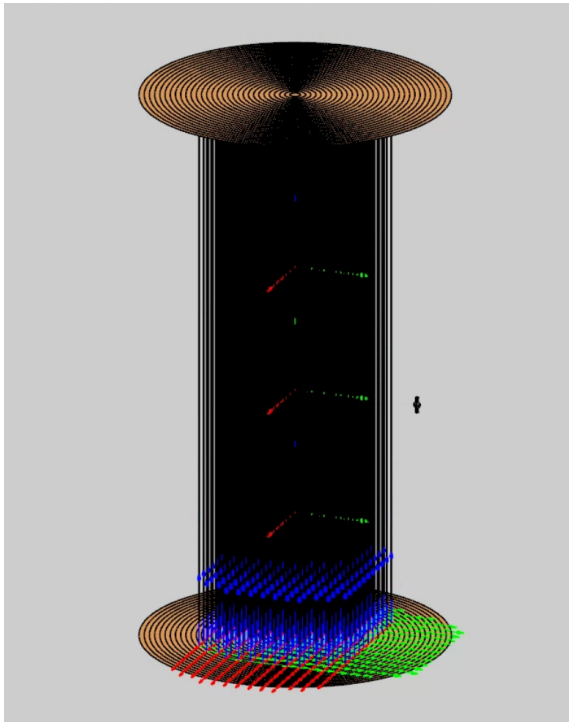
Antenna Simulations: GRASP

Due to Jon Gudmundsson



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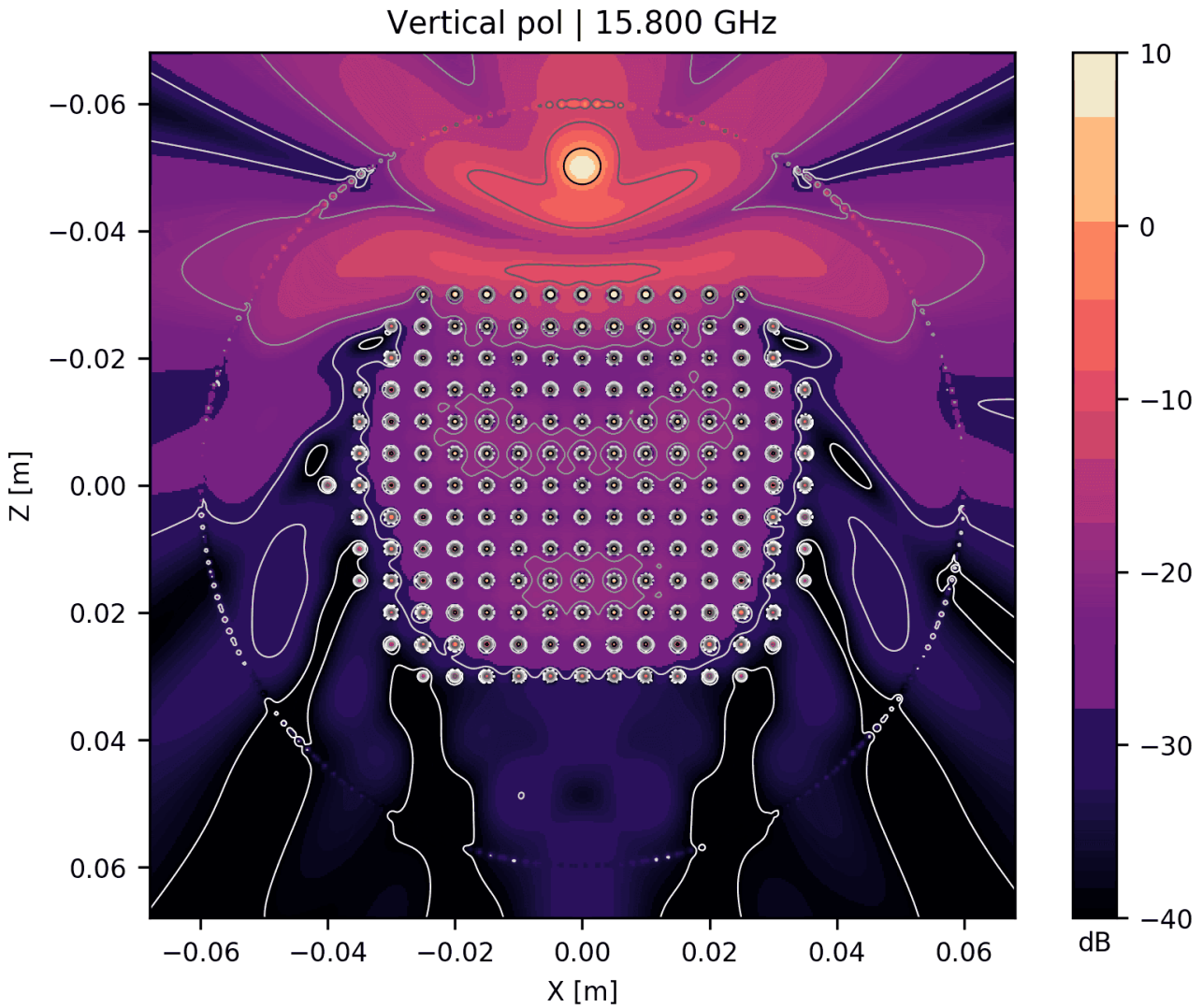

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- Now getting organized, breaking into working groups
- Inquire Within!

Conclusions, and Acknowledgments

What I talked about:

- Plasma Haloscopes are a new way to get to higher mass axions
- Deal-breakers have not yet broken any deals
- Open to collaborations!
- Questions?

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