Improvements on Operation and Analysis for ADMX-G2 Run 1C

(& New Preliminary Results!!)

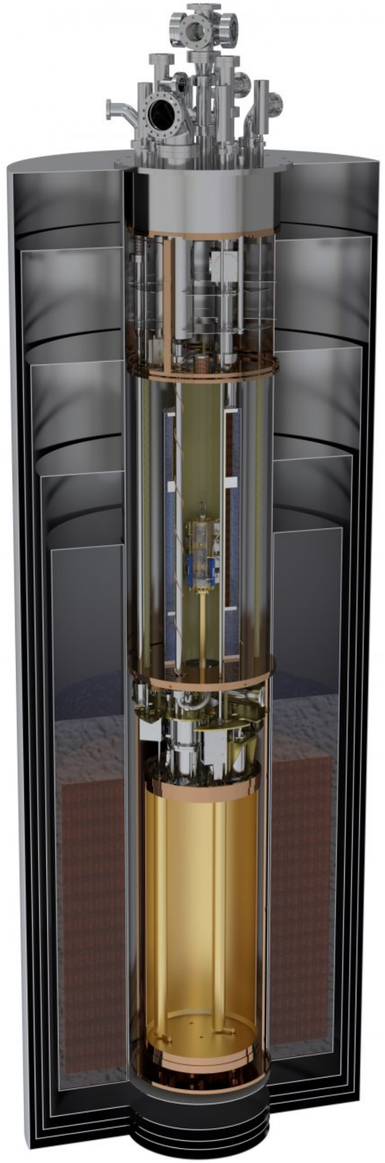
June 14, 2021

16th Patras Workshop @ online

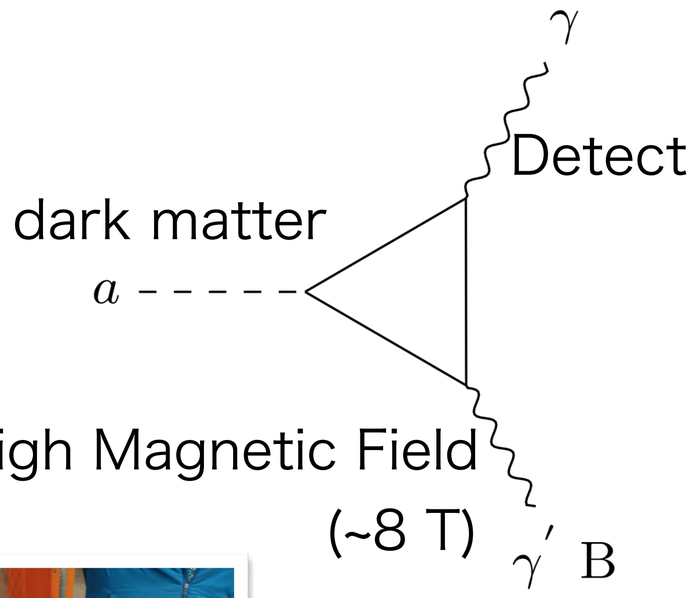
Tatsumi Nitta, University of Washington

& JSPS Overseas Research Fellow

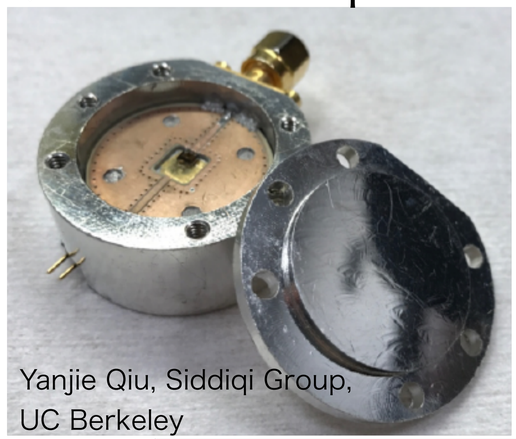
ADMX Experiment

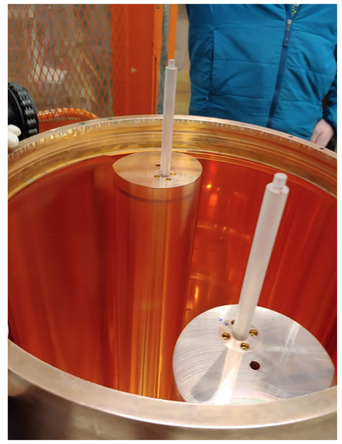


Higher P_a ⊕ Low Noise = High SNR



Quantum Amplifier

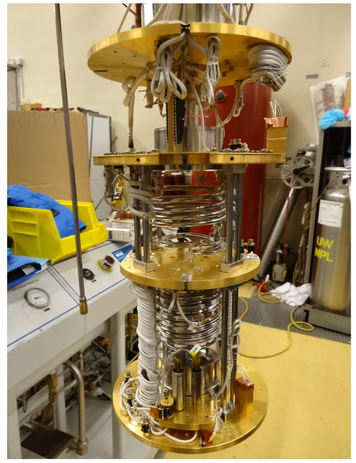




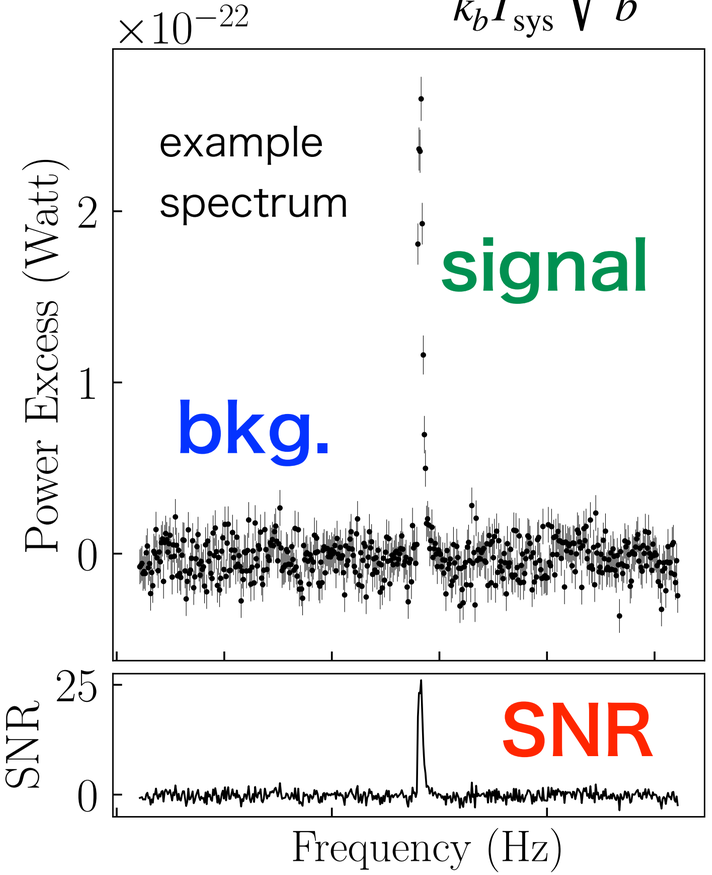
High Q_o (160k)

Large V (136 L)

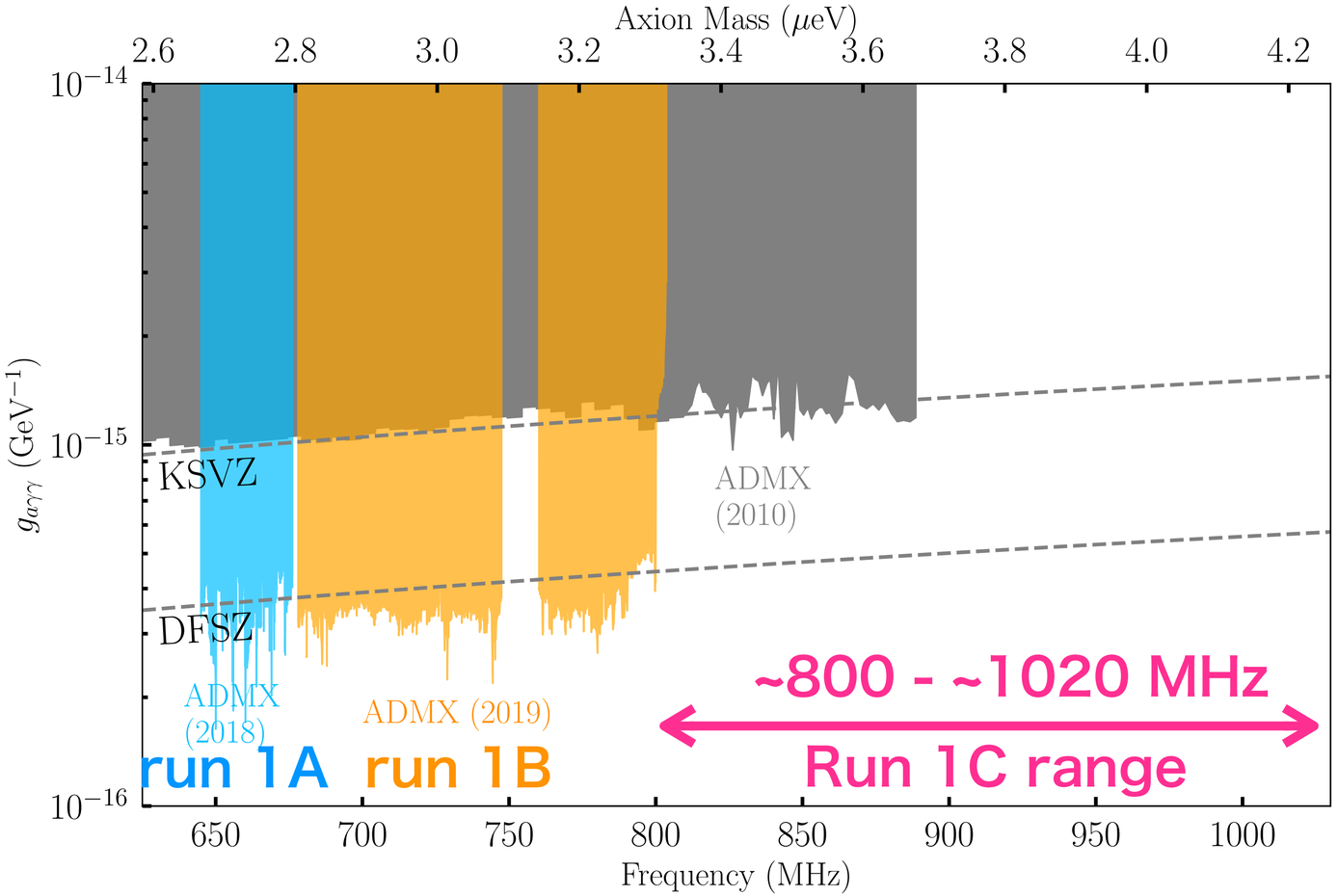
Dill fridge
~ 100 mK



$$\mathrm{SNR} = \frac{P_{\mathrm{sig}}}{k_b T_{\mathrm{sys}}} \sqrt{\frac{t}{b}}$$



ADMX-G2 Run 1C



Period:

October 2019 - May 2021→ 2x $g_{a\gamma\gamma}^{\mathrm{DFSZ}}$

Fall 2021 - → 1x $g_{a\gamma\gamma}^{\mathrm{DFSZ}}$

Frequency range:

~800 - ~1020 MHz

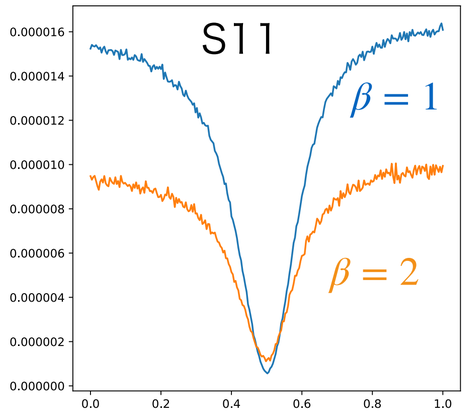
→ **The widest run period**
(for DFSZ search)

Typical System Noise:

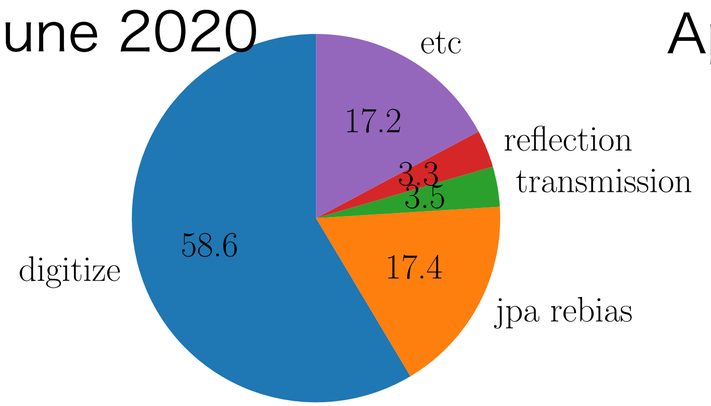
600 mK (incl. Cavity→JPA atten.)

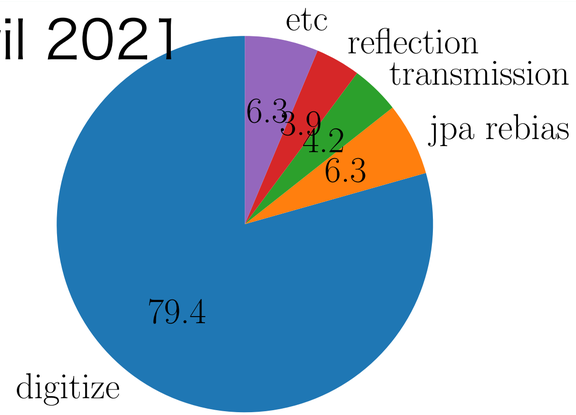
We will improve it during summer maintenance.

Improvements on Operation

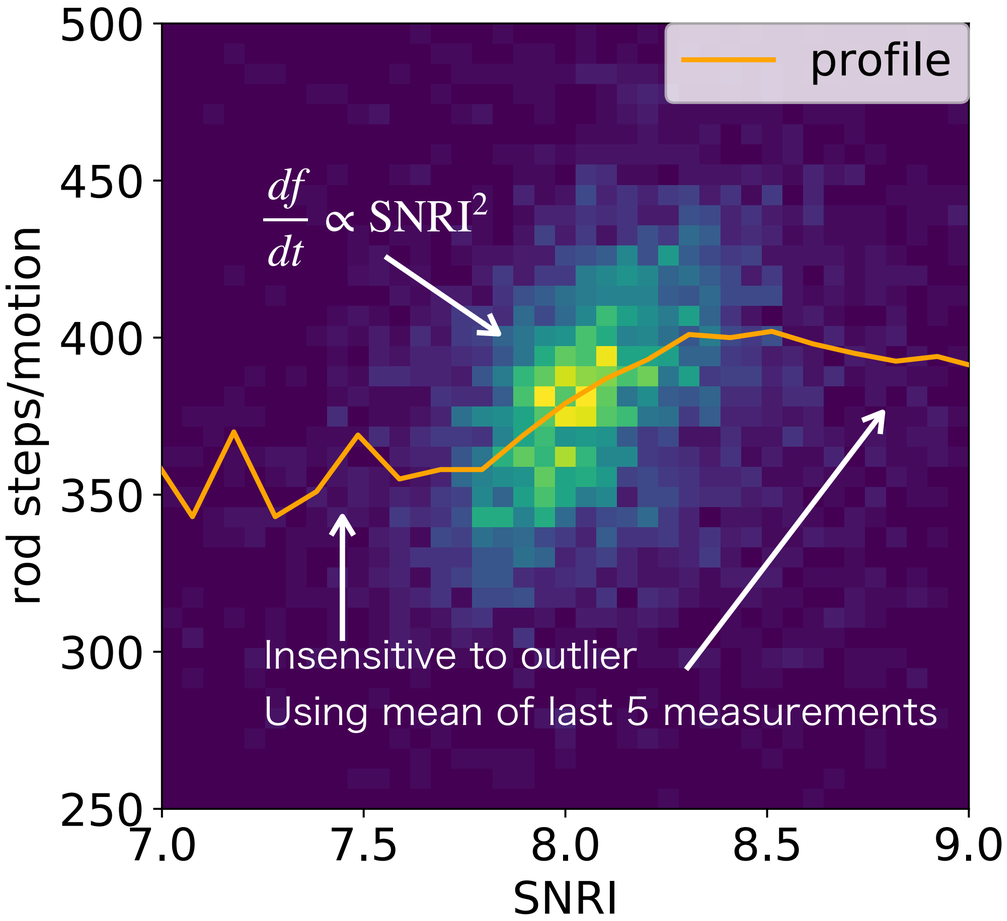


Utilizing $\beta = 2$ (S. Al Kenany, 2017)
→ **~20% speed up**





Optimize JPA rebias algorithm
→ 3 times efficient
→ **30% increase of digitization time**

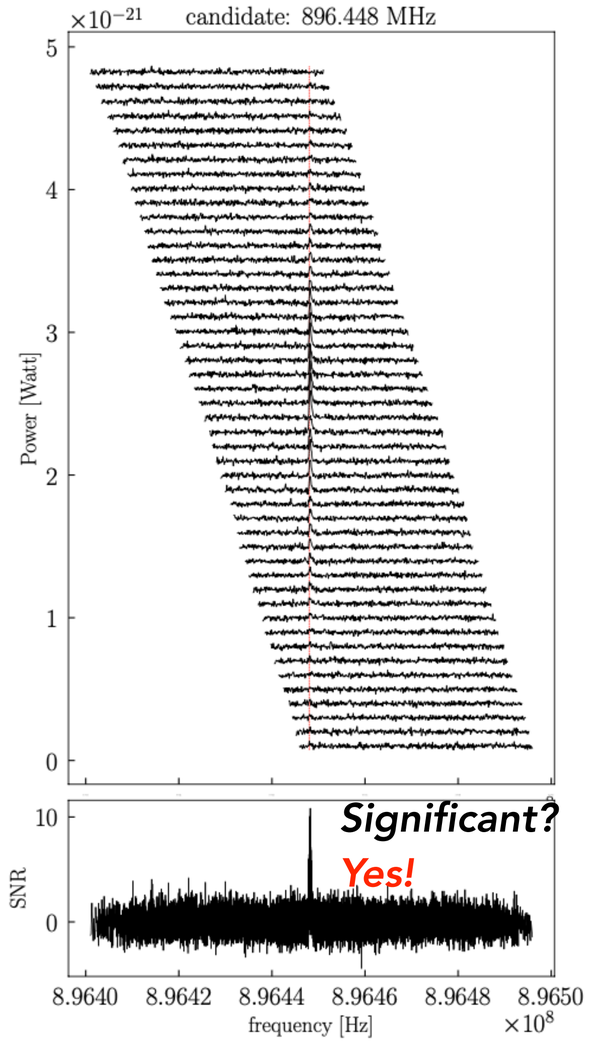


Rod speed calculation is automated

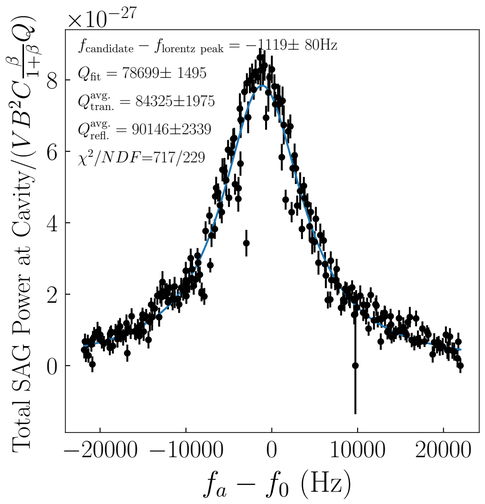
Axion?

we found suspicious candidate at ~896 MHz

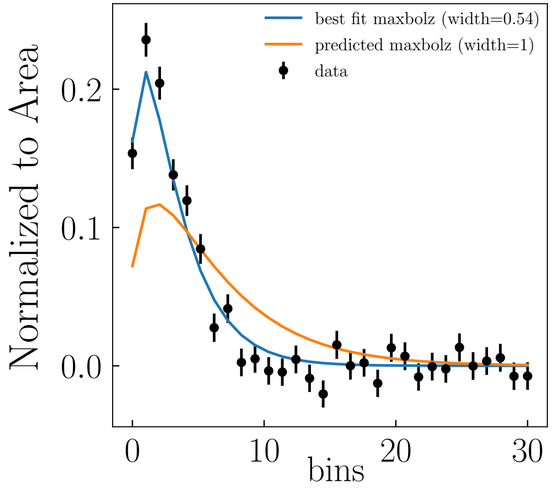
Permanent? Yes!



Lorentzian? Yes!

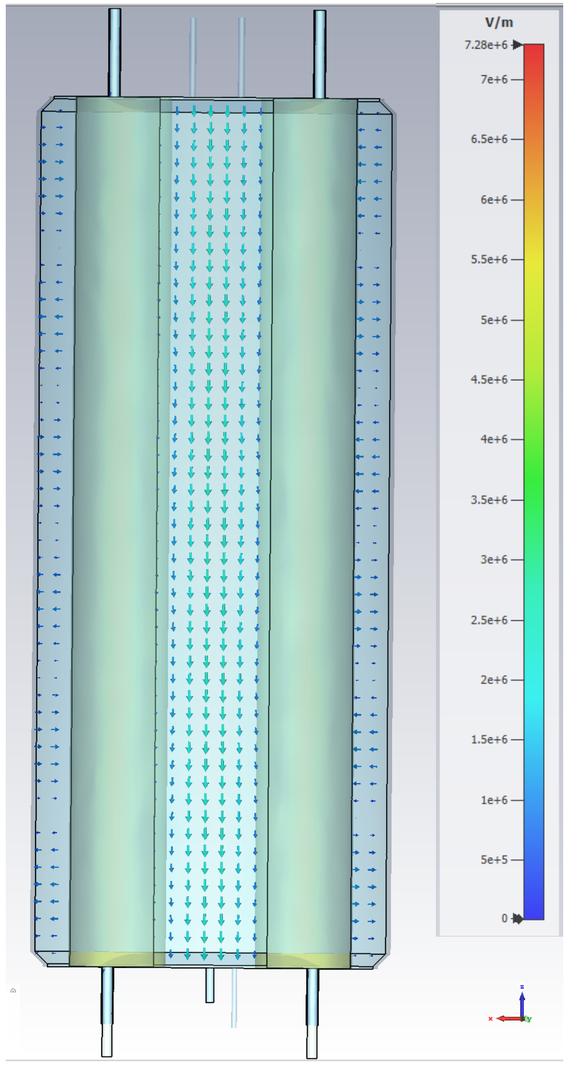


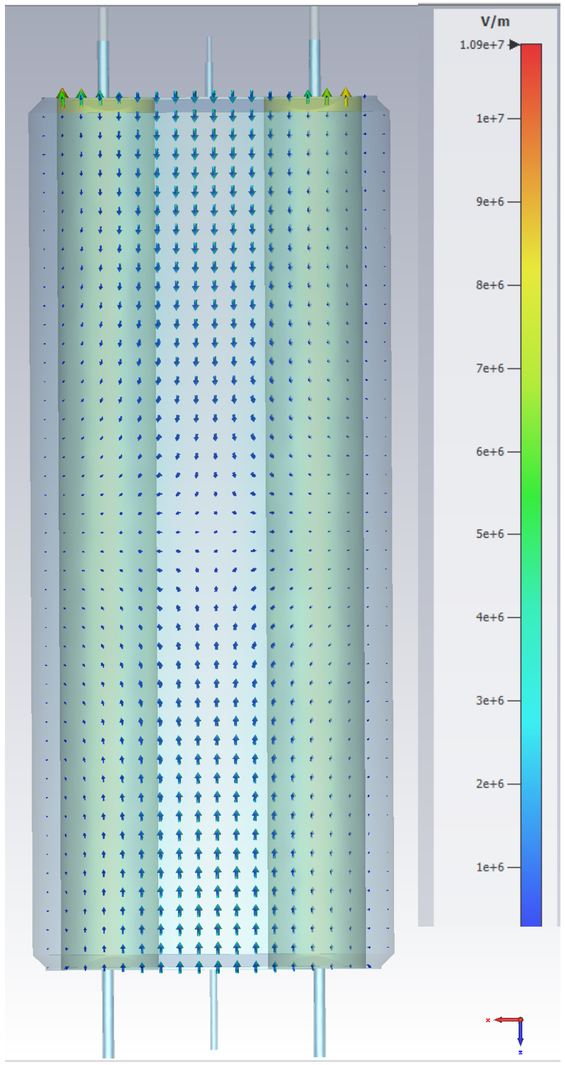
DM-like shape? Yes!



Vanishing in TM011?

TM010	TM011
$C_{010} \sim 0.455$	$C_{011} \sim 0.00097$





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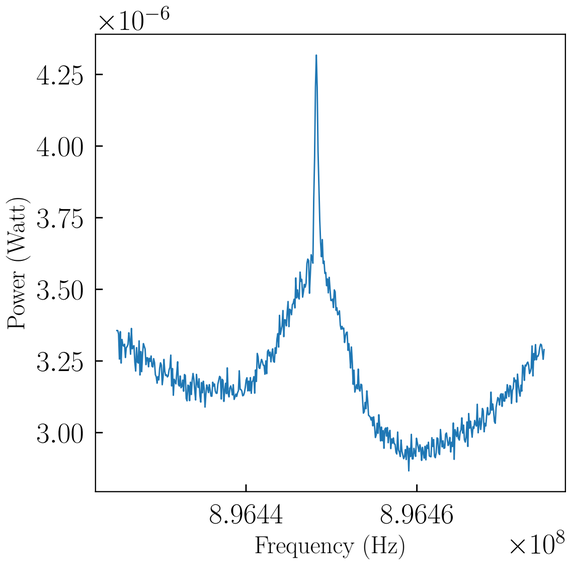
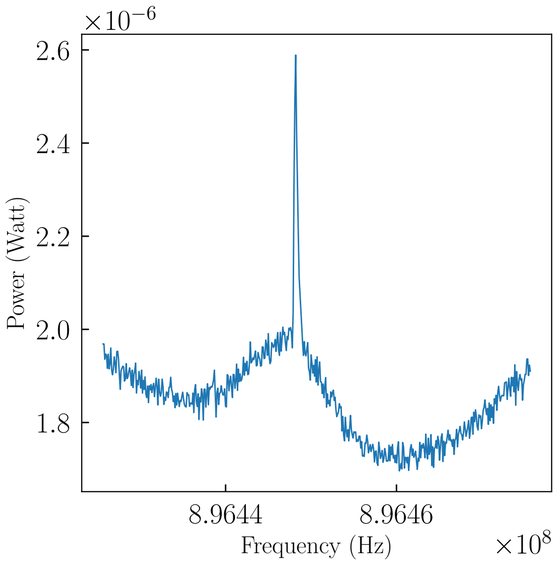


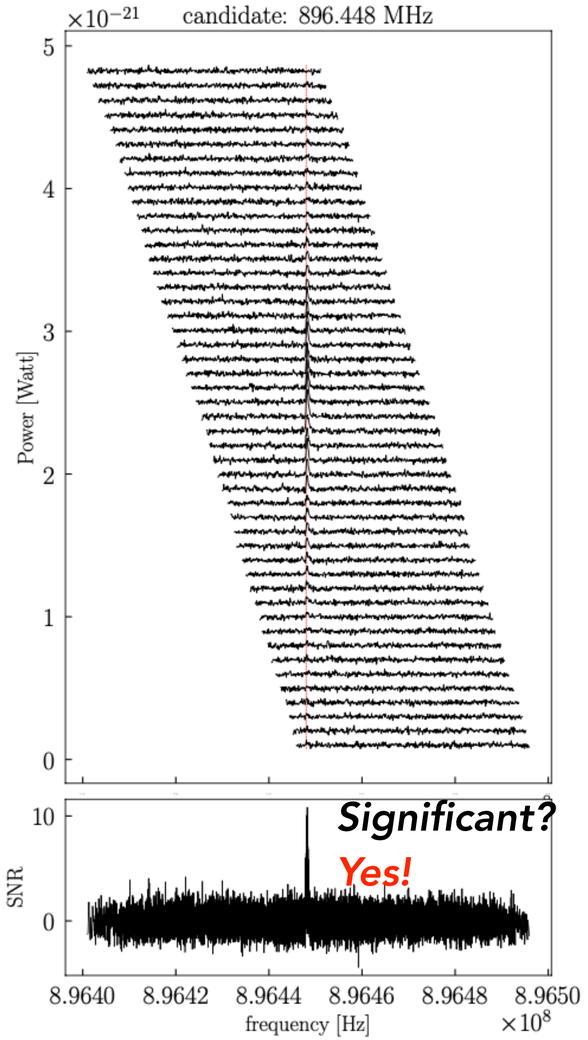


Not the real axions!

It turns out to be synthetic injection.

→ We verify our procedure to detect axions with blind synthetic signals.

Permanent? Yes!



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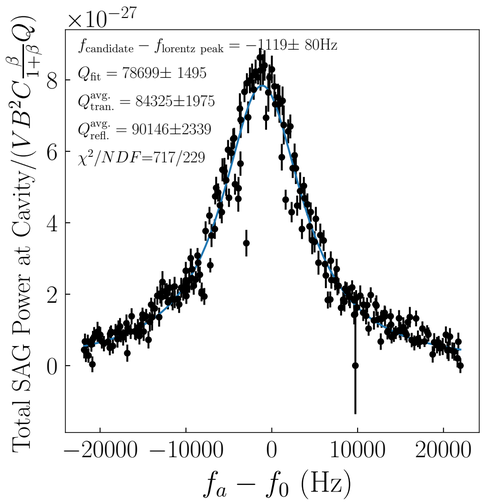

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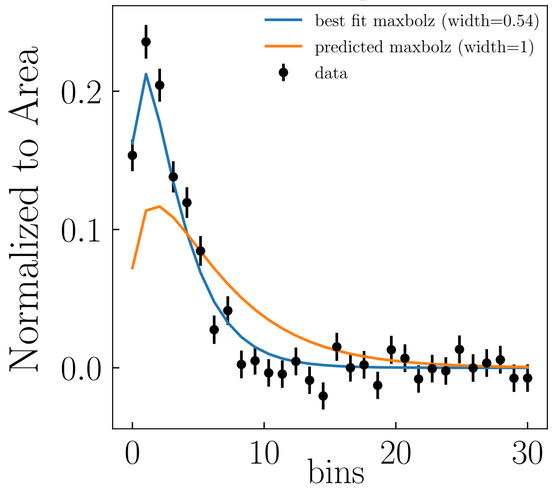


New Results! (Preliminary)

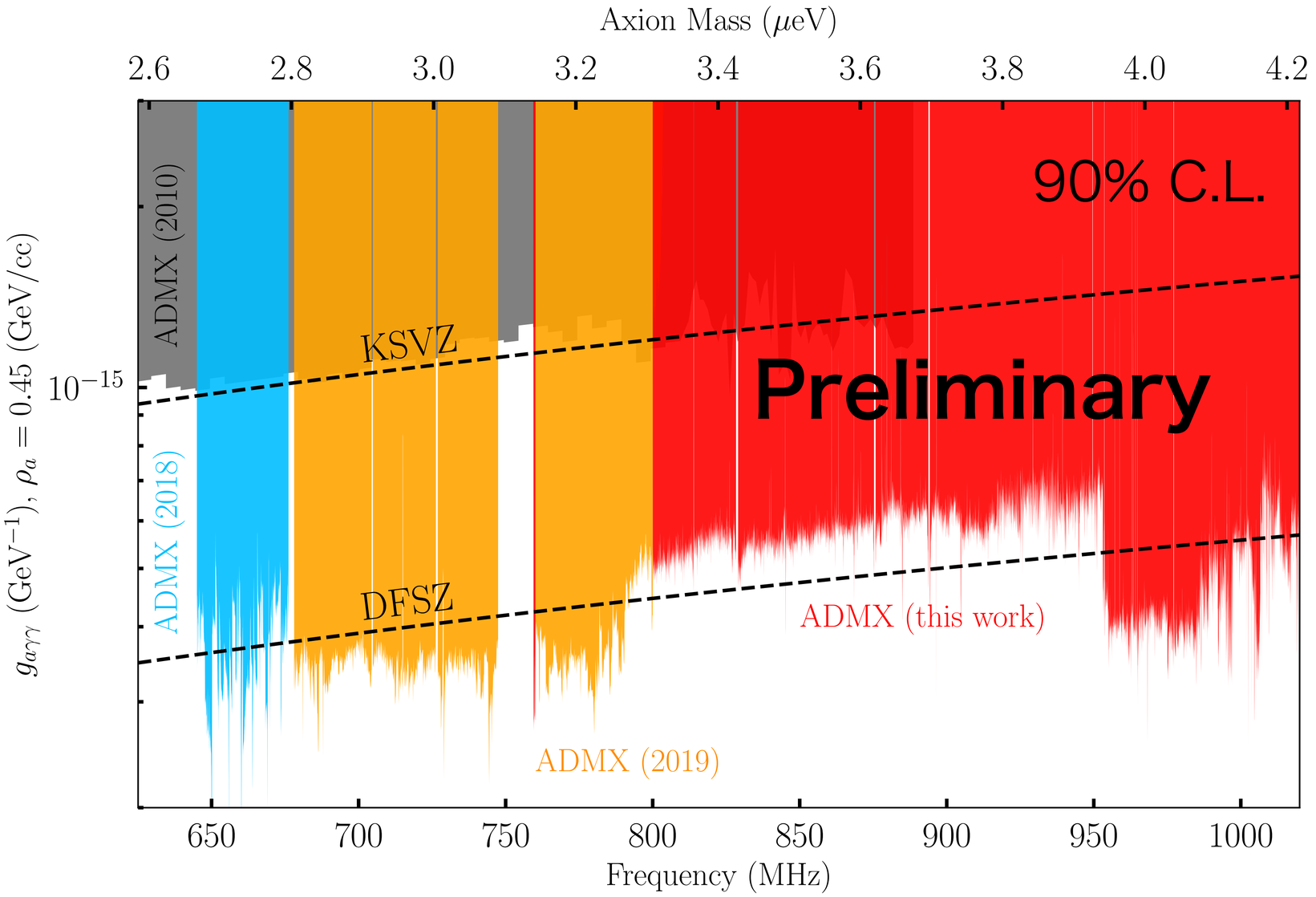
Sensitivity:

KSVZ axions

800 – 1020 MHz

DFSZ axions

~ 970 MHz



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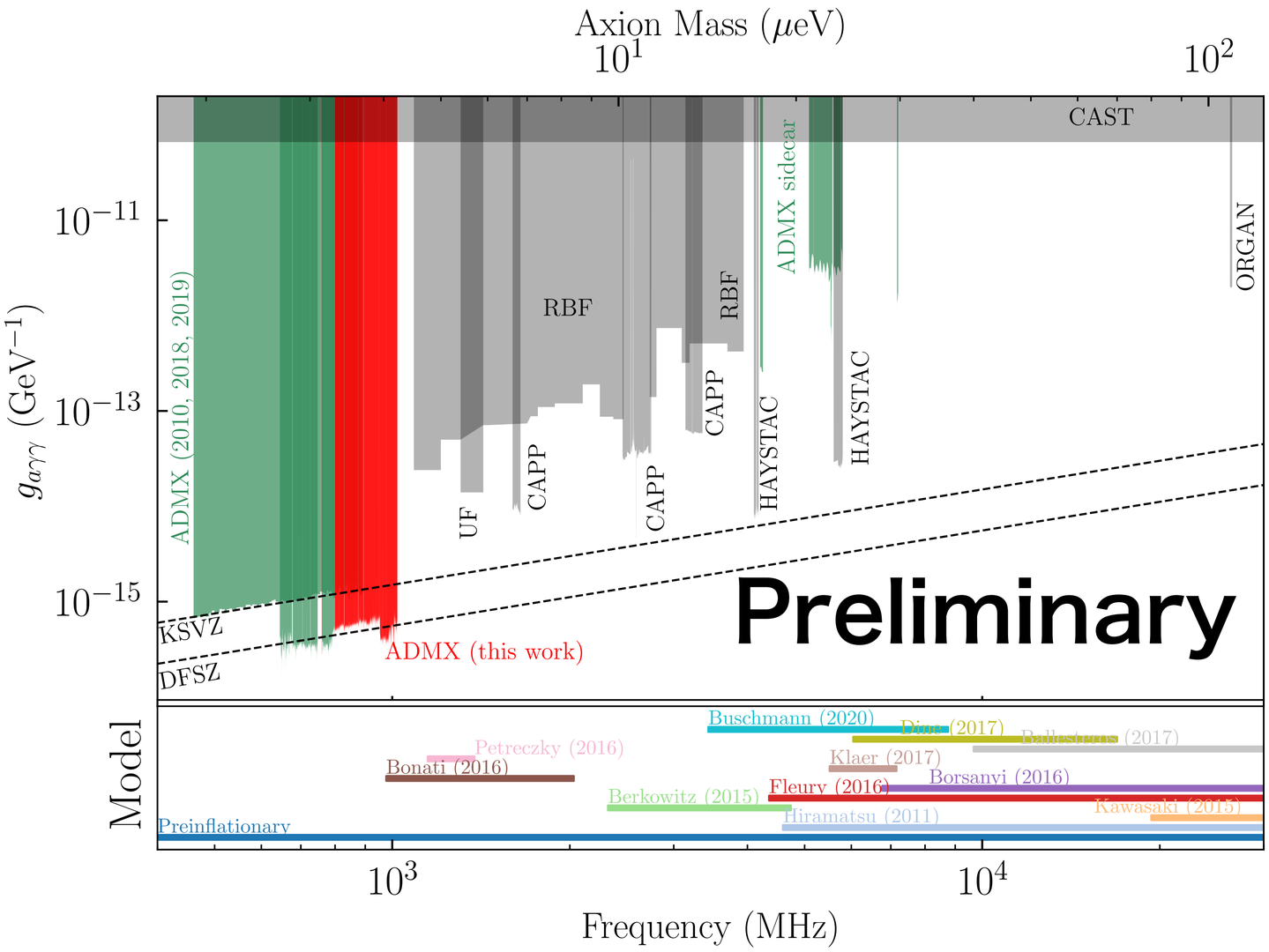
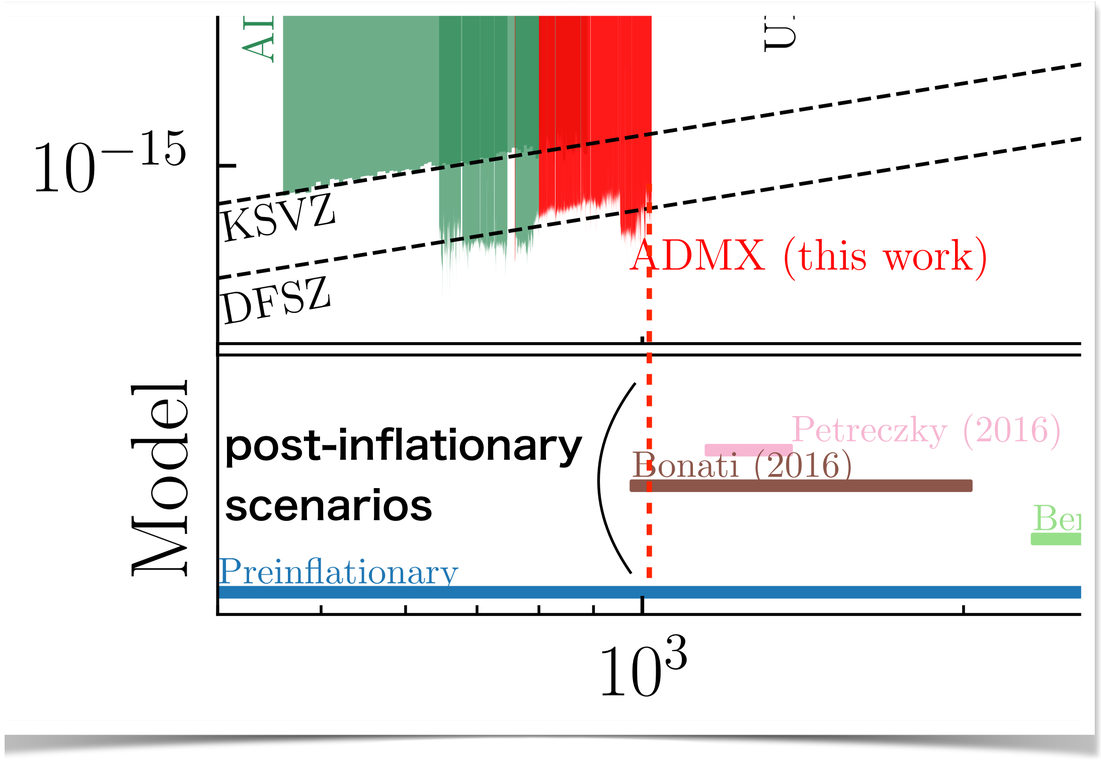


Now we are getting into post-inflationary frontier!



(Let me know if your prediction isn't here)

ADMX Collaboration

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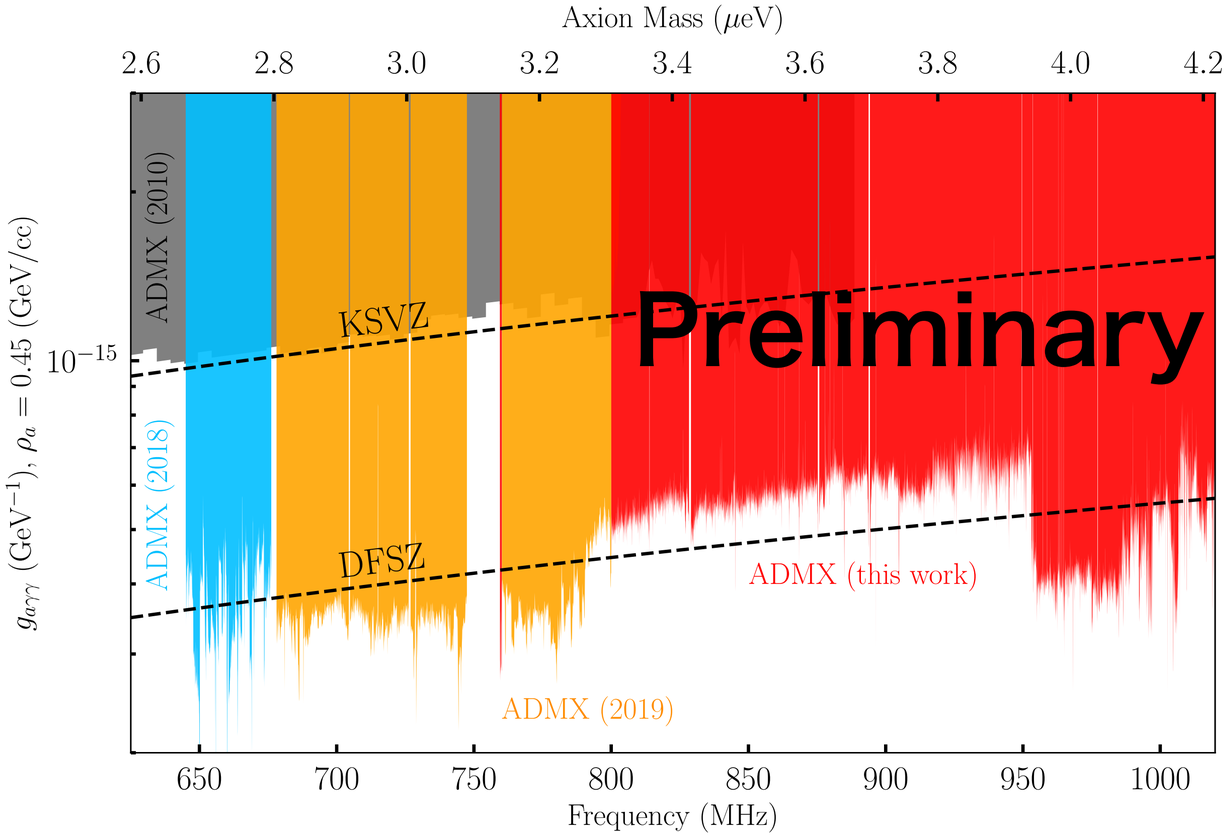
Summary

Reported the first Run 1C results!
We'll resume data-taking from Fall 2021.

- Sensitivity to KSVZ (DFSZ) axions $800 - 1020$ MHz (~ 970 MHz).
- Getting into post-inflationary frontier.
- Achieved several improvements on the operation.
- Candidate inspection method is quite solid.



Further details can be seen in Chelsea Bartram's talk on Friday