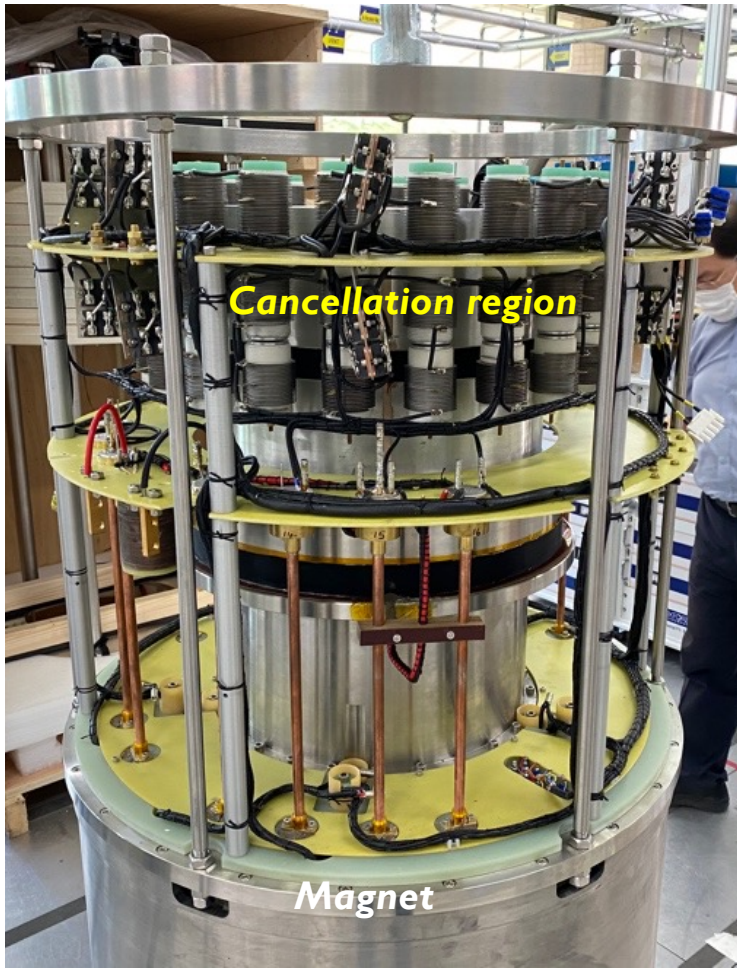
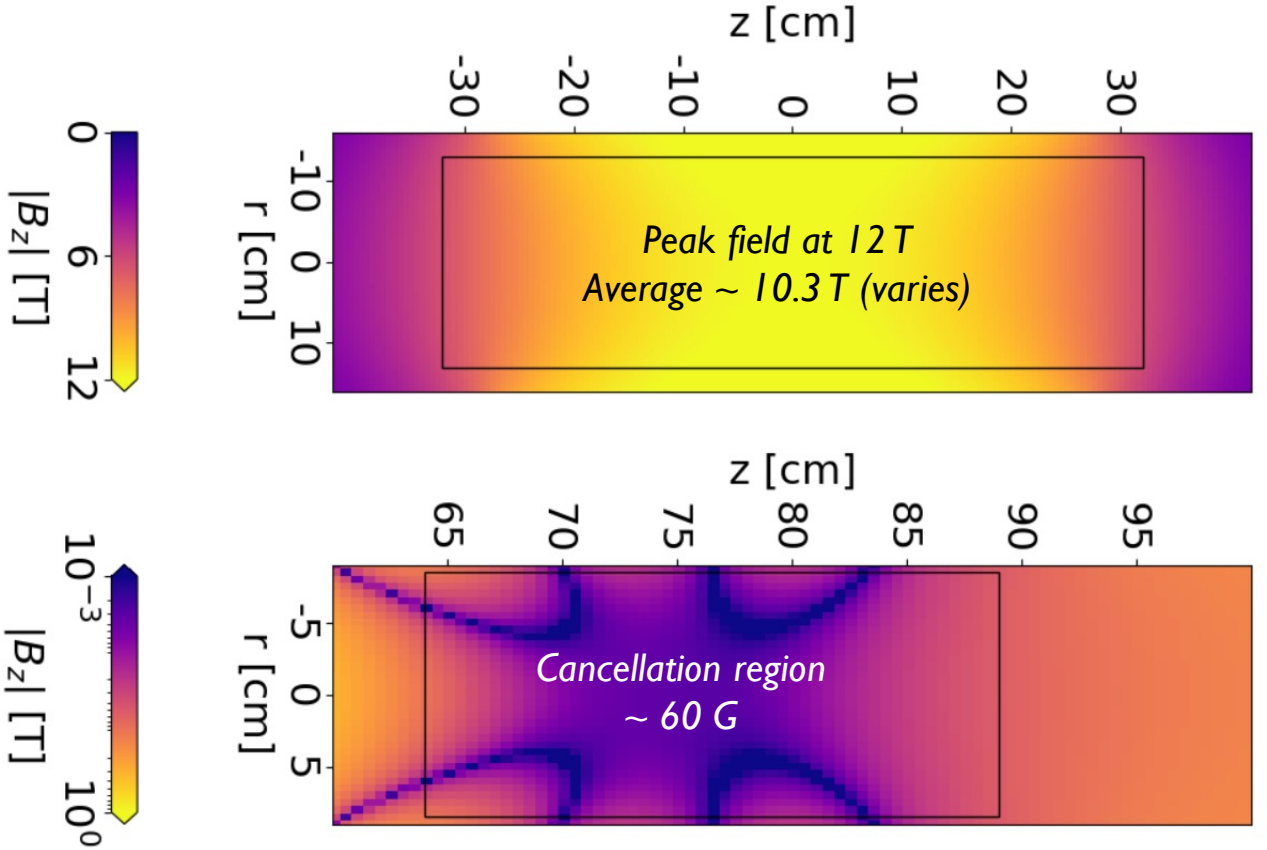
DMAG-12TB

DMAG-12TB Magnet

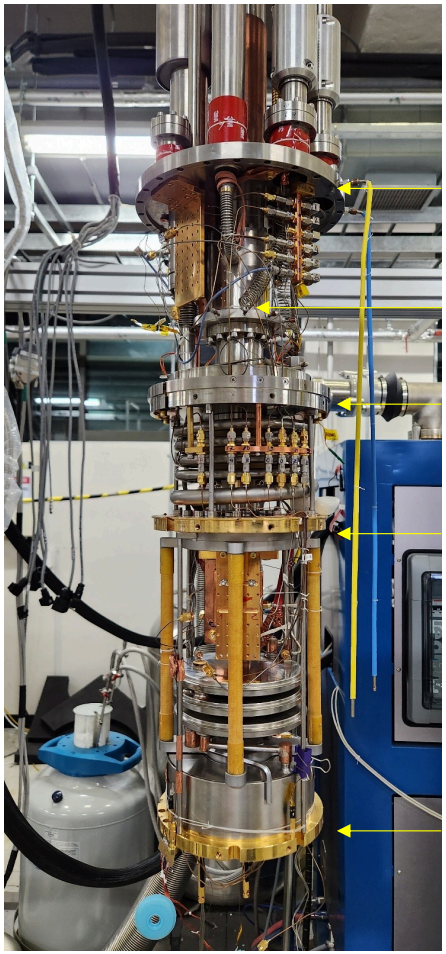
W Ma *et al*
2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **502** 012104



- Nb_3Sn *Superconducting coil*



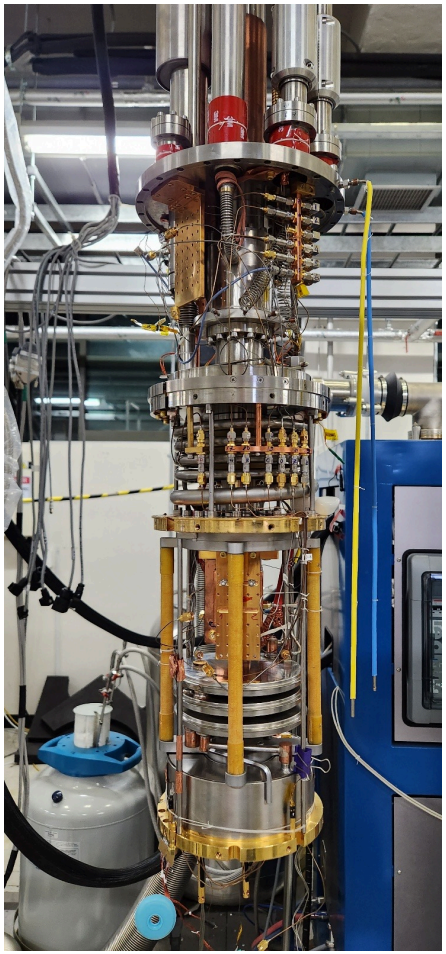
DMAG-12TB cryogenic system



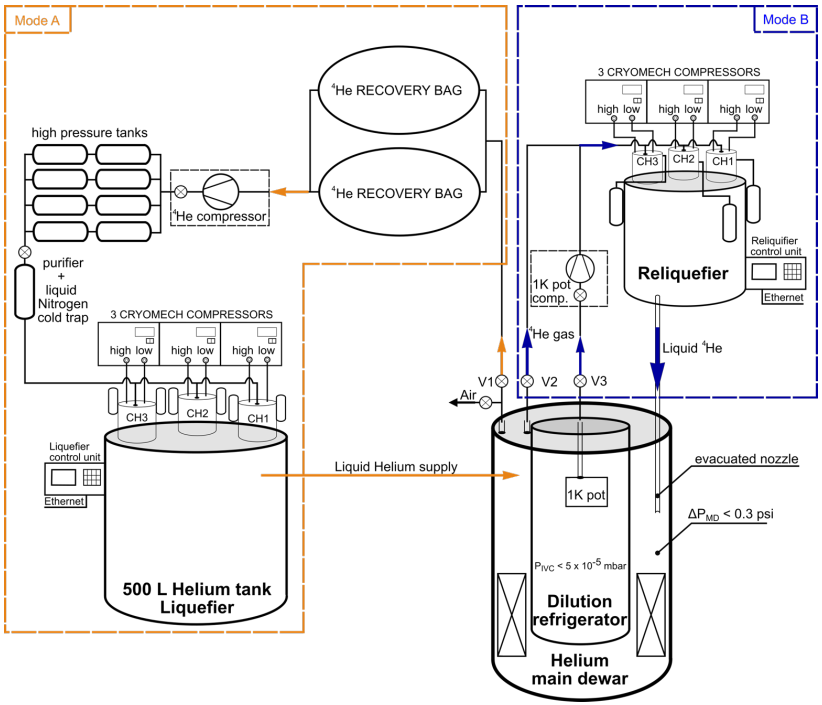
Wet type LEIDEN dilution refrigerator

- *5.6 mK of base temperature (bare fridge)*
- *Cavity temperature ~ 30 mK*

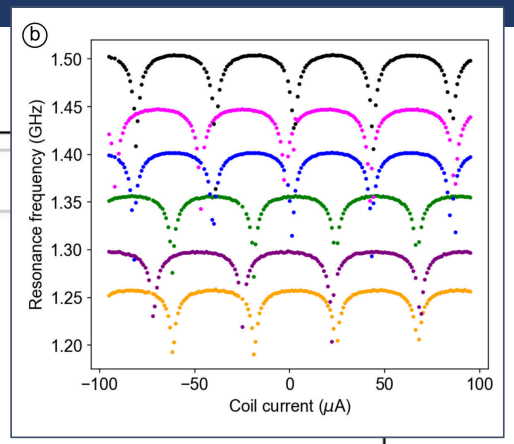
DMAG-12TB cryogenic system



- *He recovery system ~ 160 L capacity*
- *He liquefier with 60 L / day rate*
- *He Re-liquefier with 60 L / day rate*



DMAG-12TB Parallel JPAs

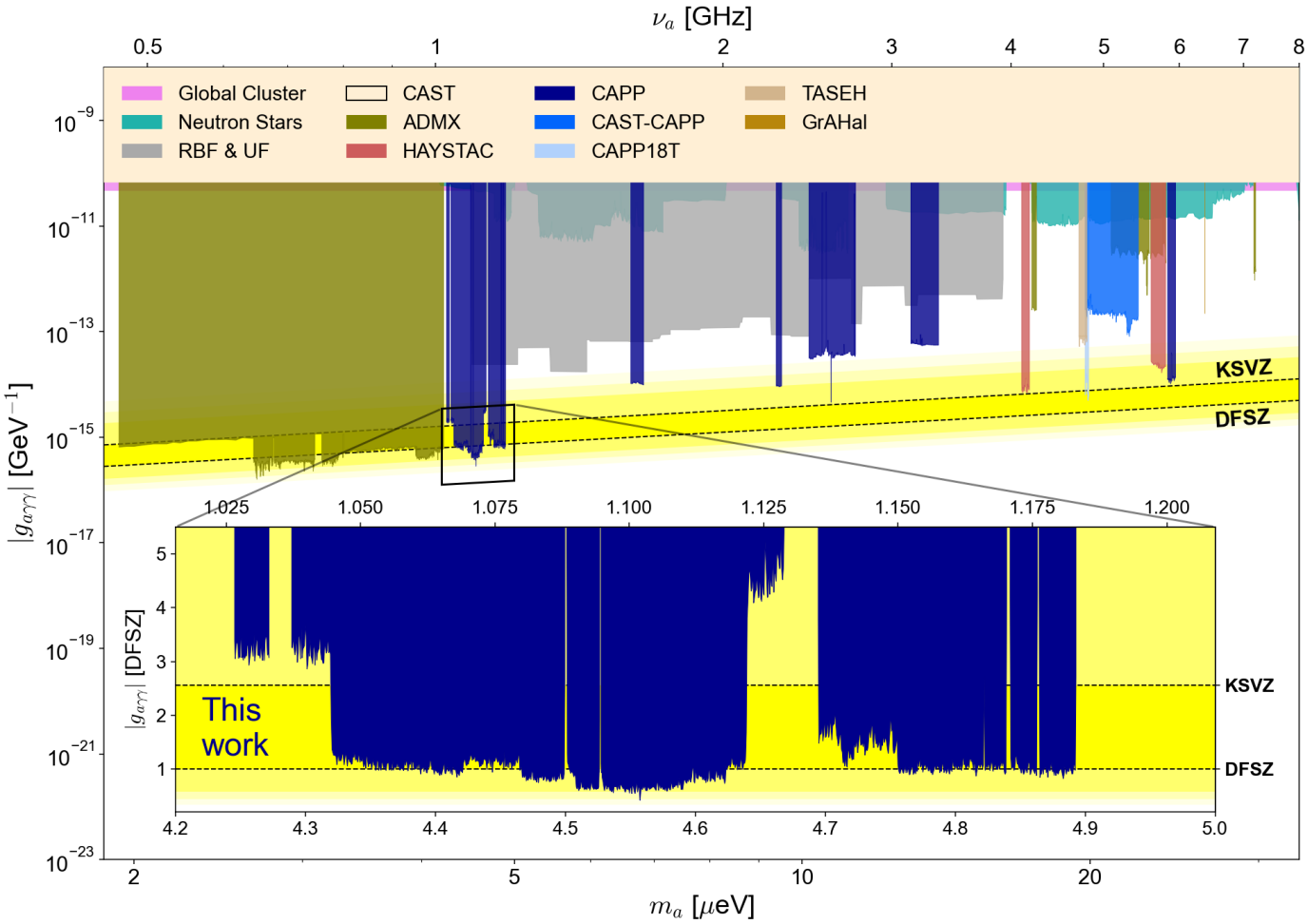


- *6 JPA assembly*
- *Tested in a dedicated dry fridge*
- *Added noise ~ 100 mK (T_{phy} ~ 30 mK)*
- *1.2 – 1.5 GHz total range*

Detection capability

- *Homemade ultralight cavity (37-liters)*
- *3 parallel JPAs readout*
- *Physical temperature ~ 30 mK*
- *$T_{syst.}$ ~ 230 mK (average)*

- *1.025 - 1.18 GHz scan finished*
  - *Published in PRX (Aug, 2024)*



Other experiments

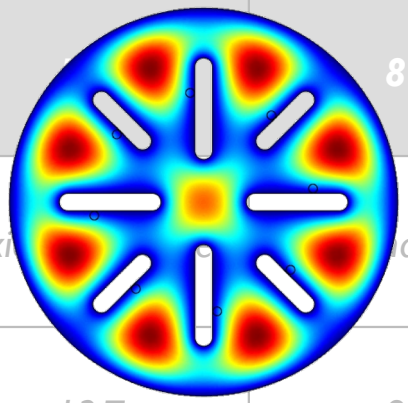
Experiments at DMAG

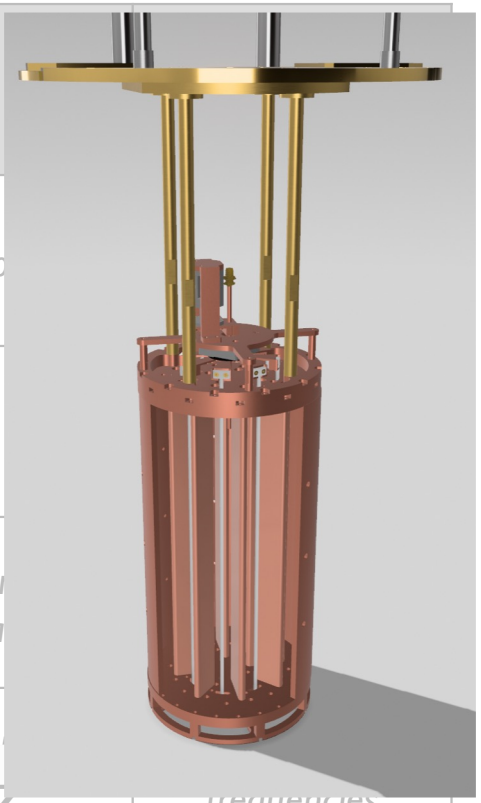
	12TB	8TB	12T	8T	QLNA
Experiment	*Large-cavity DFSZ haloscope*	*Axion haloscope*	*Axion haloscope*	*Axion haloscope*	*Testbed for quantum devices*
Magnet	*12 T*	*8 T*	*12 T*	*8 T*	-
Cavity	*In progress*	*8-cell pizza*	*Quad-TM_{020}*	*Single-rod HTS cavity*	-
Short-term goal	*1.3-1.5 GHz* ***DFSZ***	*Around 5.5 GHz* ***KSVZ***	*Around 5 GHz* ***KSVZ***	*Around 3.5 GHz* ***KSVZ***	*JPA for all frequencies*

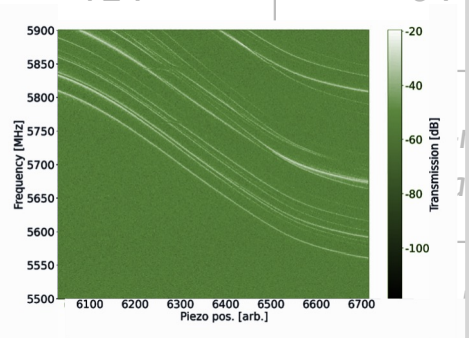
Experiments at DMAG

Saebyeok Ahn
Pallavi Parashar
Boris Ivanov

	12TB	8TB
Experiment	Large-cavity DFSZ haloscope	Axion haloscope
Magnet	12 T	8 T
Cavity	In progress	8-cell pizza
Short-term goal	1.3-1.5 GHz **DFSZ**	Around 5.5 GHz **KSVZ**

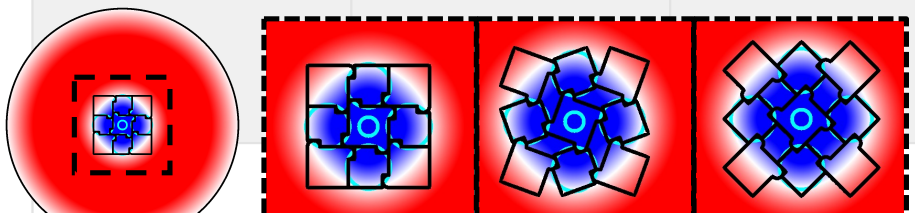




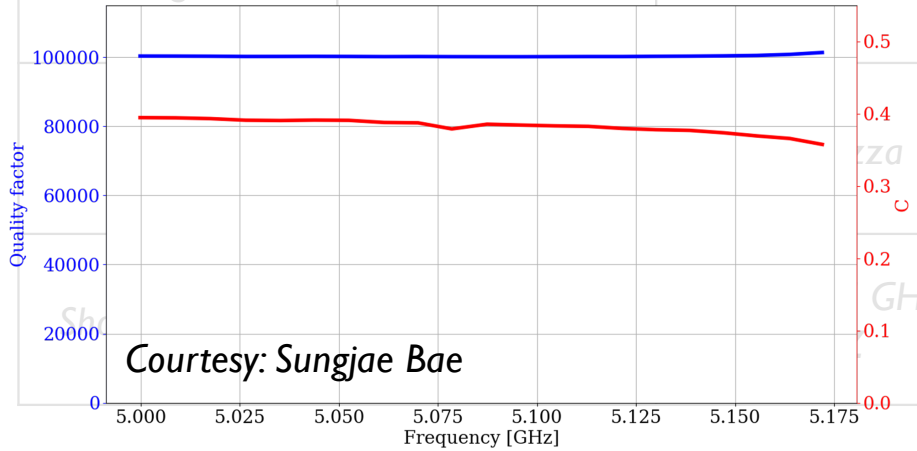


Cavity and chain ready, DAQ very soon

Experiments at DMAG



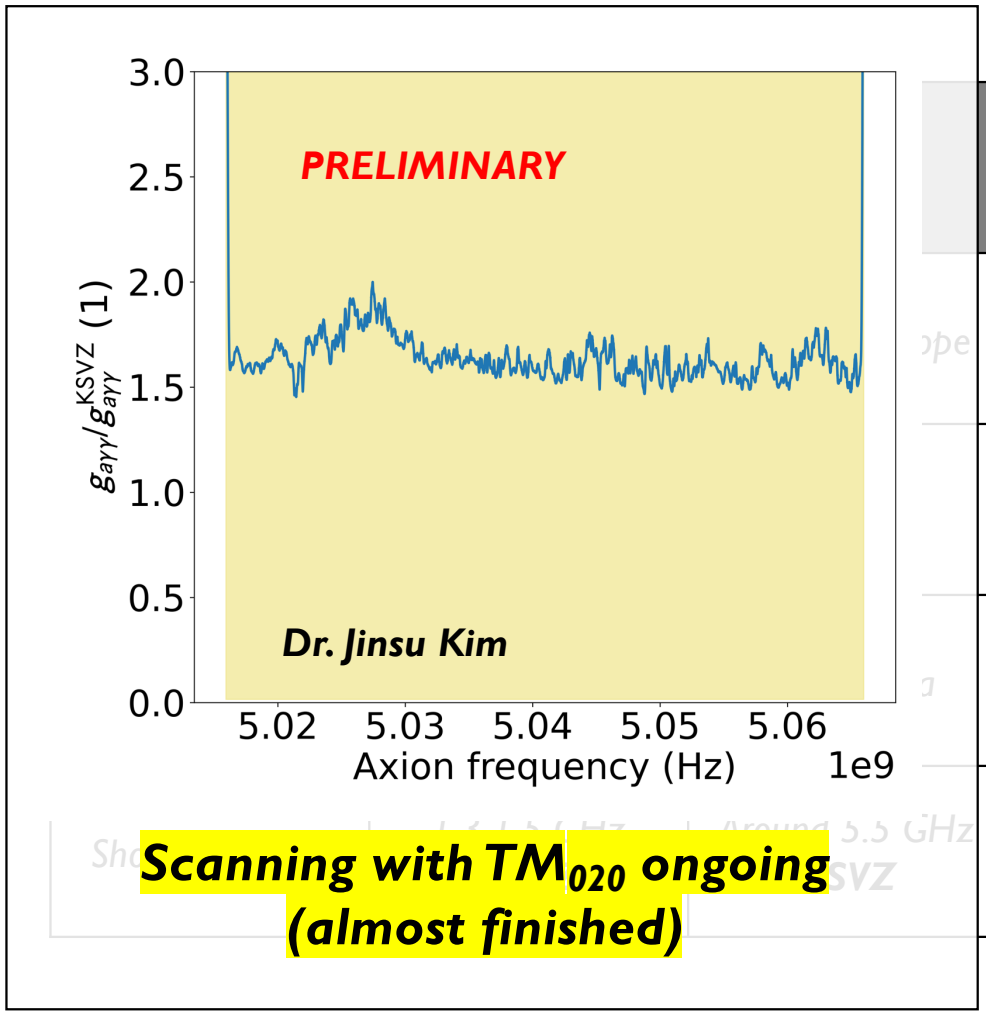
Utilizing TM_{020} (high frequency mode)
Rectangular rods with kirigamy tuning mechanism



Courtesy: Sungjae Bae

	12T **Jinsu Kim Jiwon Lee SungWoo Youn**	8T	QLNA
	Axion haloscope	*Axion haloscope*	*Testbed for quantum devices*
	12T	*8T*	-
	Quad-TM_{020}	*Single-rod HTS cavity*	-
	Around 5 GHz **KSVZ**	*Around 3.5 GHz* **KSVZ**	*JPA for all frequencies*

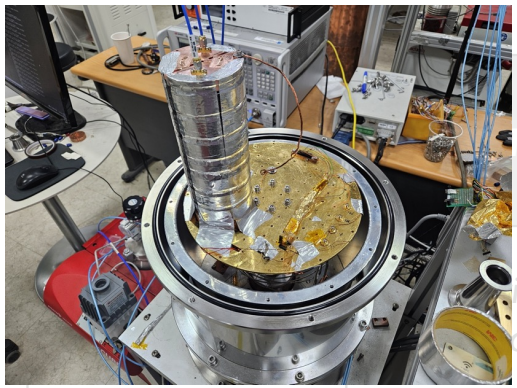
Experiments at DMAG

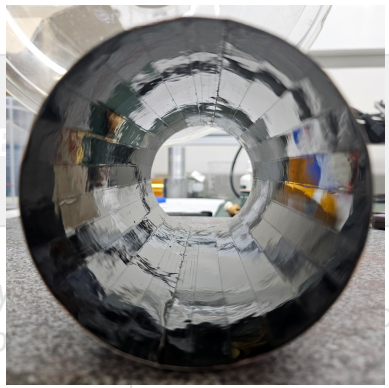


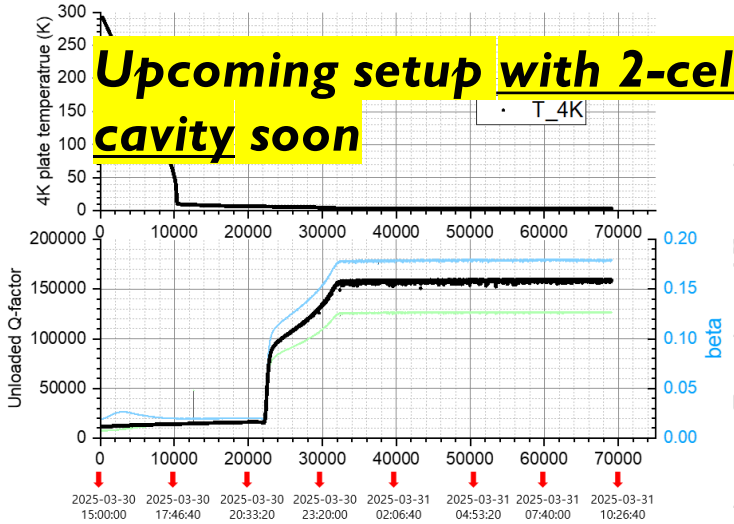
Scanning with TM_{020} ongoing (almost finished)

12T Jinsu Kim Jiwon Lee SungWoo Youn	8T	QLNA
Axion haloscope	Axion haloscope	Testbed for quantum devices
12T	8T	-
Quad-TM_{020}	Single-rod HTS cavity	-
Around 5 GHz **KSVZ**	Around 3.5 GHz **KSVZ**	JPA for all frequencies

Experiments at DMAG





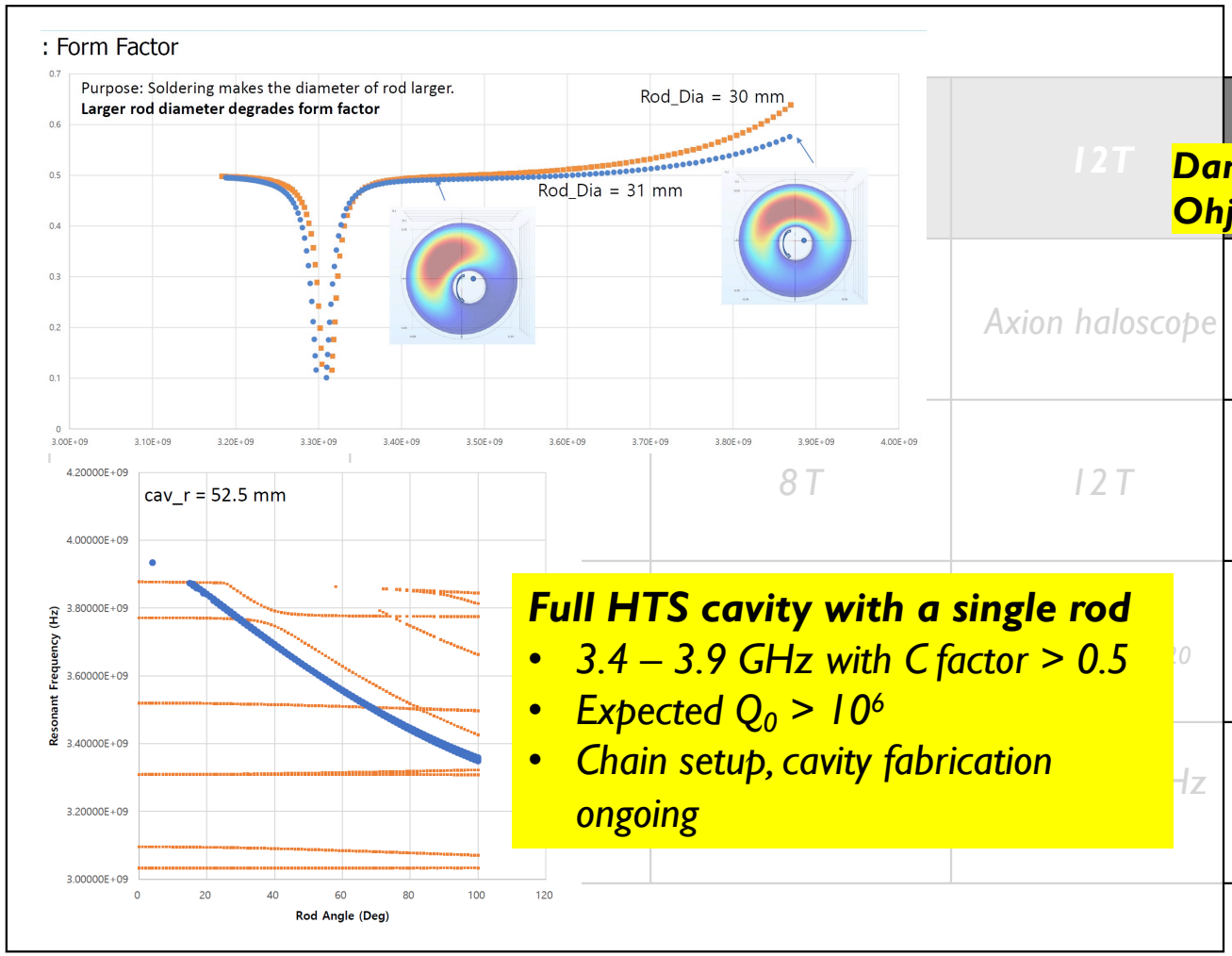


Upcoming setup with 2-cell HTS cavity soon

Jiwon Lee

	12T ***Jinsu Kim Jiwon Lee SungWoo Youn***	***8T***	***QLNA***
	Axion haloscope	*Axion haloscope*	*Testbed for quantum devices*
	12T	*8T*	-
	Quad-TM_{020}	*Single-rod HTS cavity*	-
	Around 5 GHz ***KSVZ***	*Around 3.5 GHz* ***KSVZ***	*JPA for all frequencies*

Experiments at DMAG



Full HTS cavity with a single rod

- *3.4 – 3.9 GHz with C factor > 0.5*
- *Expected $Q_0 > 10^6$*
- *Chain setup, cavity fabrication ongoing*

12 T	**Danho Ahn** 8T **Ohjoon Kwon**	QLNA
Axion haloscope	Axion haloscope	Testbed for quantum devices
8 T	12 T	8 T	-
		Single-rod HTS cavity	-
Hz		Around 3.5 GHz **KSVZ**	JPA for all frequencies

Experiments at DMAG

	12TB	8TB	12T	8T	QLNA
Experiment	*Large-cavity DFSZ haloscope*	*Axion haloscope*	*Axion haloscope*	*Axion haloscope*	*Testbed for quantum devices*
Magnet	*12 T*	*8 T*	*12 T*	*8 T*	***Sergey Uchaikin*** ***Boris Ivanov*** ***Saebyeok Ahn*** ***Pallavi Parashar*** -
Cavity	*In progress*	*8-cell pizza*	*Quad-TM_{020}*	*Single-rod HTS cavity*	
Short-term goal	*1.3-1.5 GHz* ***DFSZ***	*Around 5.5 GHz* ***KSVZ***	*Around 5 GHz* ***KSVZ***	*Around 3.5 GHz* ***KSVZ***	*JPA for all frequencies*

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Cavity	*In progress*	*8-cell pizza*	*Quad-TM_{020}*	*Single-rod HTS cavity*	
Short-term goal	*1.3-1.5 GHz* ***DFSZ***	*Around 5.5 GHz* ***KSVZ***	*Around 5 GHz* ***KSVZ***	*Around 3.5 GHz* ***KSVZ***	*JPA for all frequencies*

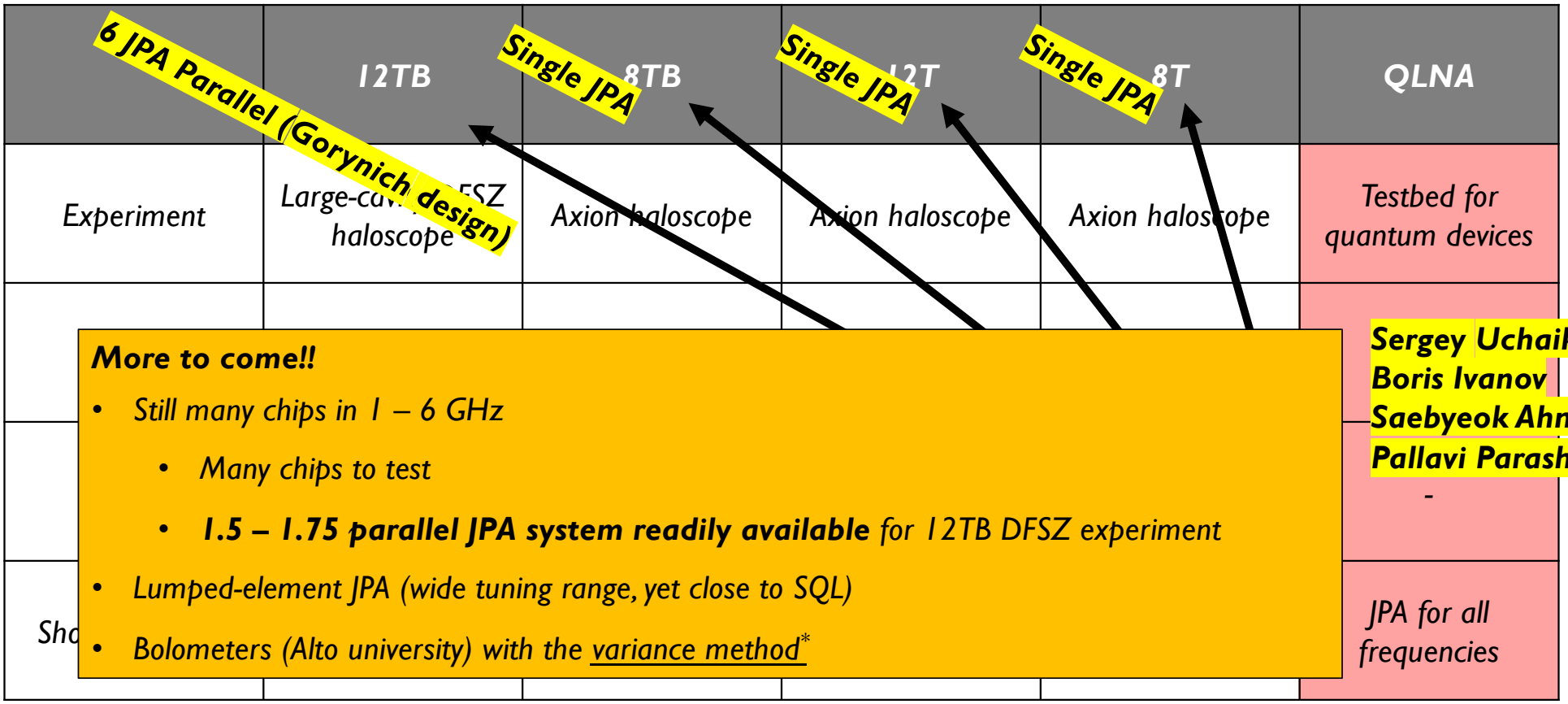
6 JPA Parallel (Gorynich design)

Single JPA

Single JPA

Single JPA

Experiments at DMAG



*Z. Omarov, J. Jeong, and Y. K. Semertzidis, Speeding axion haloscope experiments using heterodyne-variance-based detection with a power meter, Phys. Rev. D **107**, 103005 (2023).

Experiments at DMAG

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Experiment	Large-cavity DFSZ haloscope	Axion haloscope	Axion haloscope	Axion haloscope	Testbed for quantum devices
Magnet	12 T	8 T	12 T	8 T	-
Cavity					-
Short-term goal					for all uencies

Team Hero

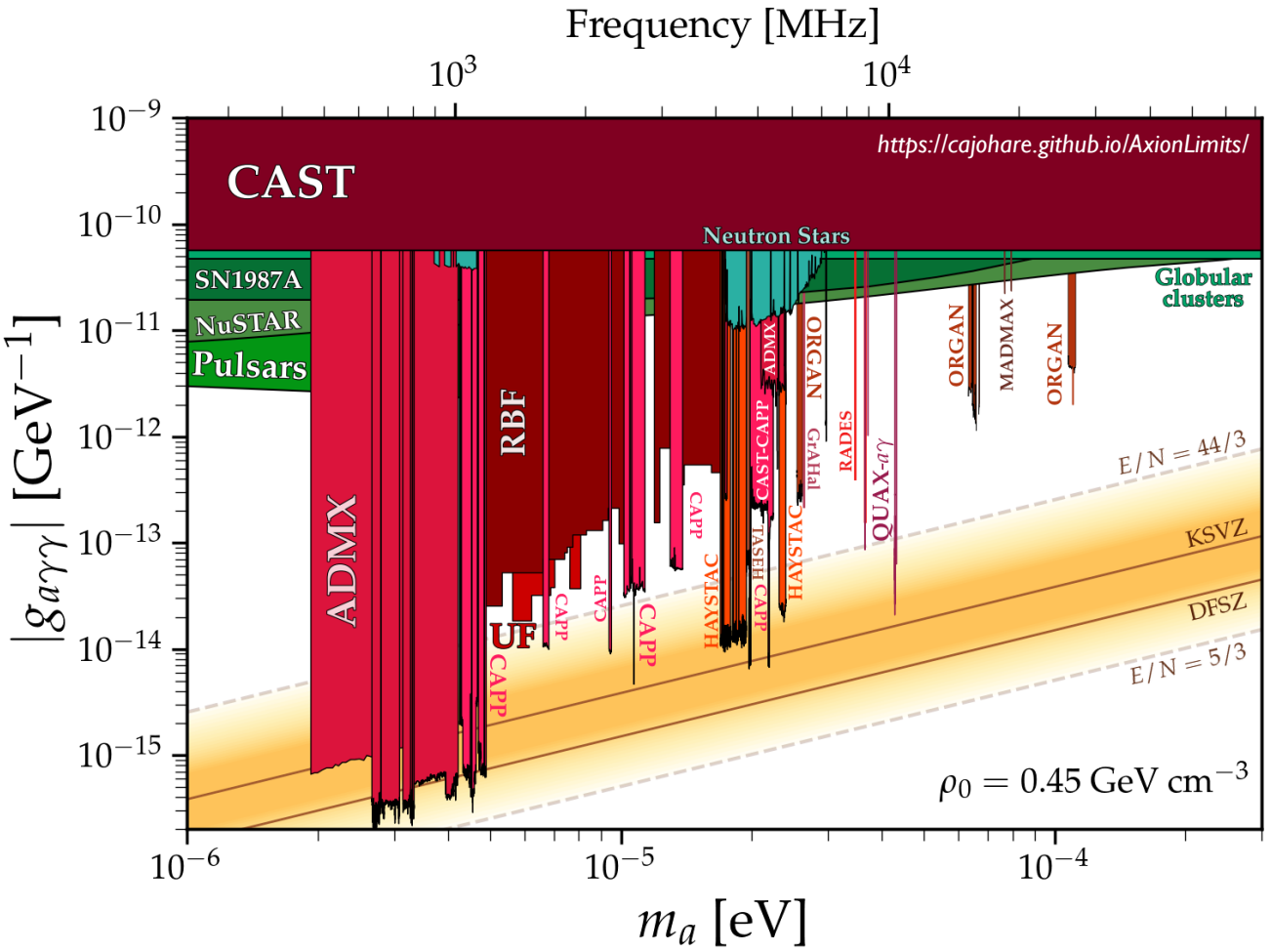
Sunjung Oh: QLNA team/purchase assistant

Taehyeon Seong: 2D/3D drawings, inspector/safety officer

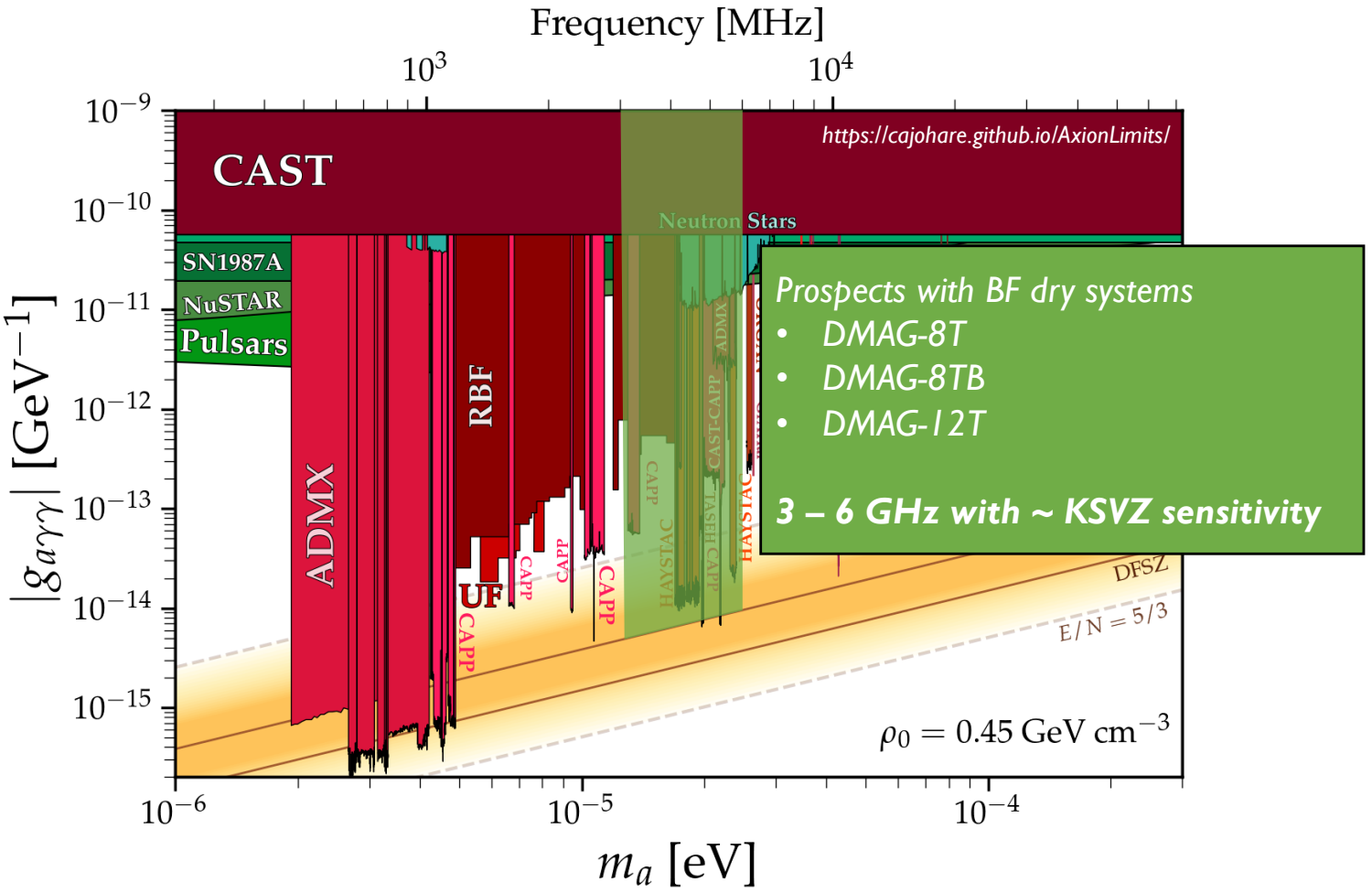
Heejun Park: Gas-handling/cryogenics/electricity expert, overall system maintenance

*Z. Omarov, J. Jeong, and Y. K. Semertzidis, Speeding axion haloscope experiments using heterodyne-variance-based detection with a power meter, Phys. Rev. D **107**, 103005 (2023).

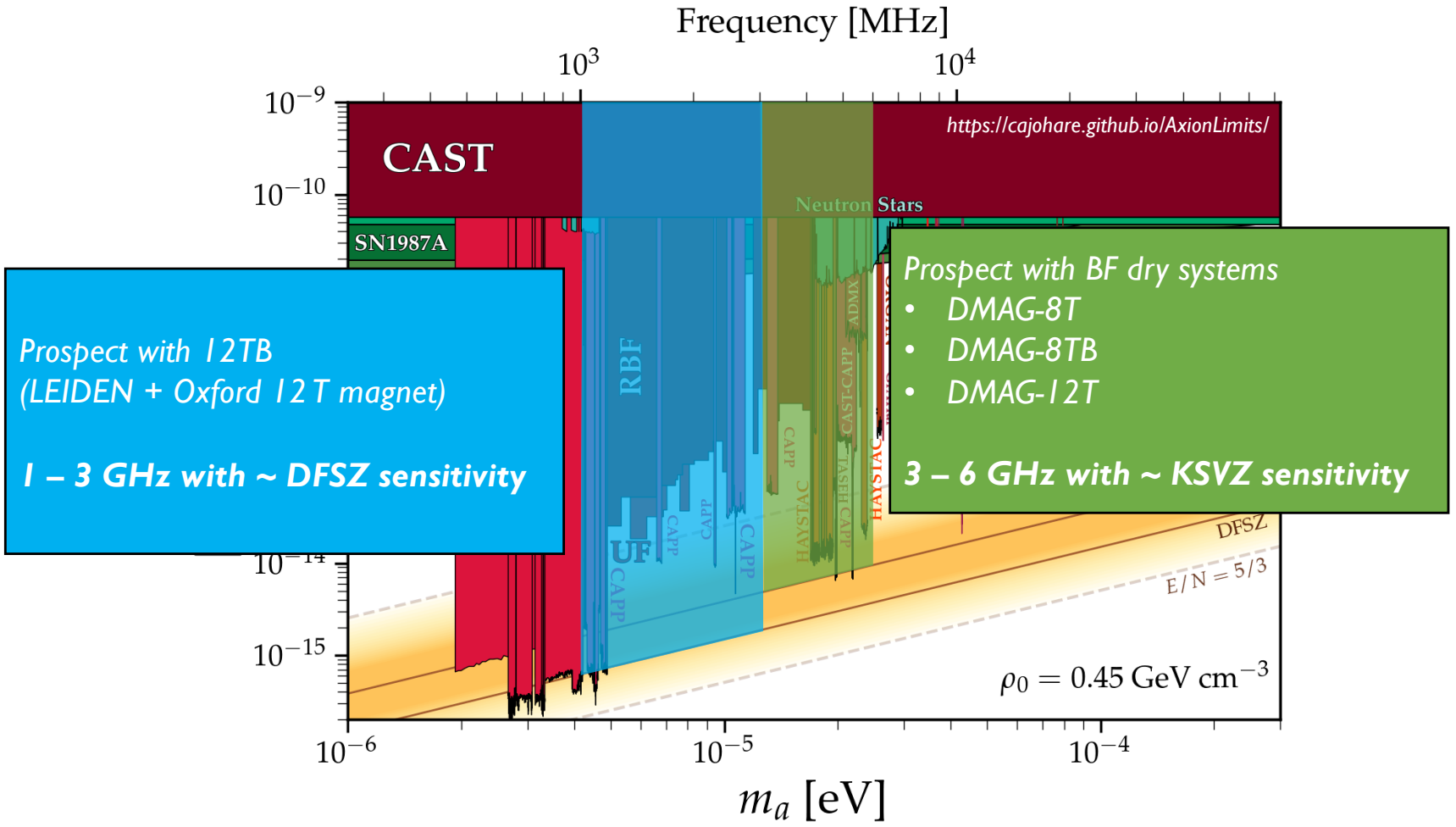
DMAG prospects



DMAG 4 years prospects



DMAG 4 years prospects



DMAG 4 years prospects