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F**inuda magnet for **L**ight **A**xion **S**earc**H

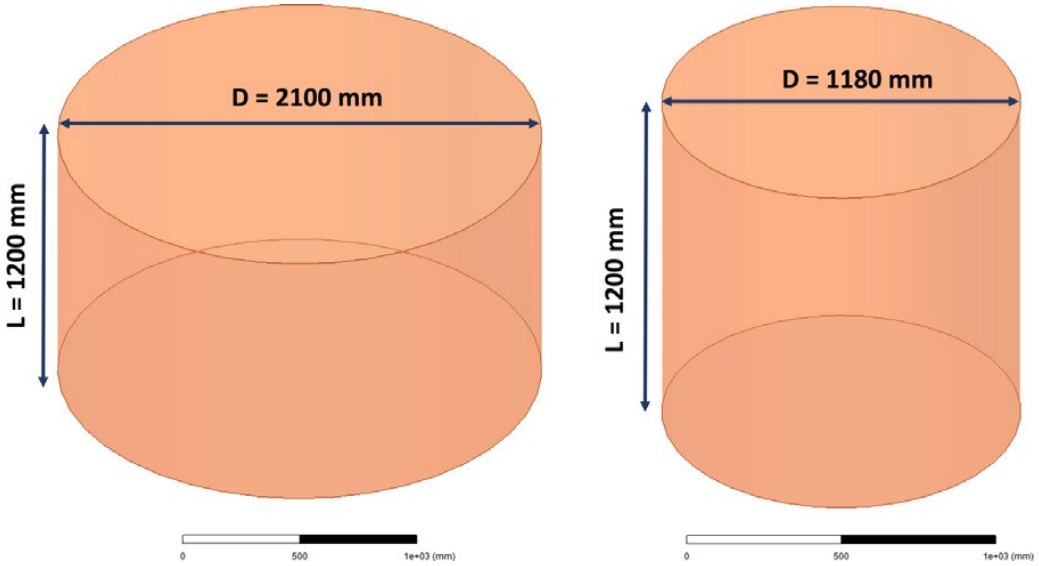
Status of RF cavity design

The future search for low-frequency axions and new physics with the FLASH resonant cavity experiment at Frascati National Laboratories
David Alesini et al. - https://doi.org/10.1016/j.dark.2023.101370

RF cavity size and EM mode

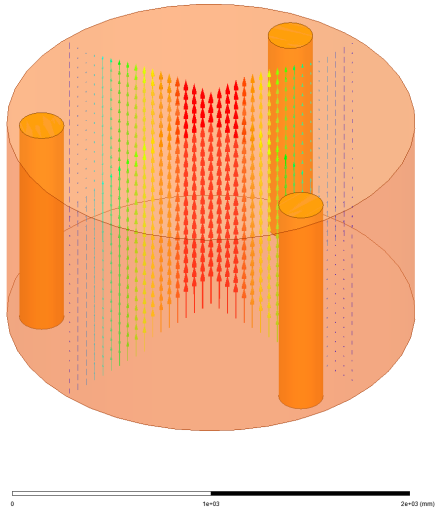
The goal of the FLASH experiment is to cover the frequency range about 117–360 MHz by tuning its resonant frequency that operates on the mode TM010 for the axion search.

FLASH Low Frequency or LF

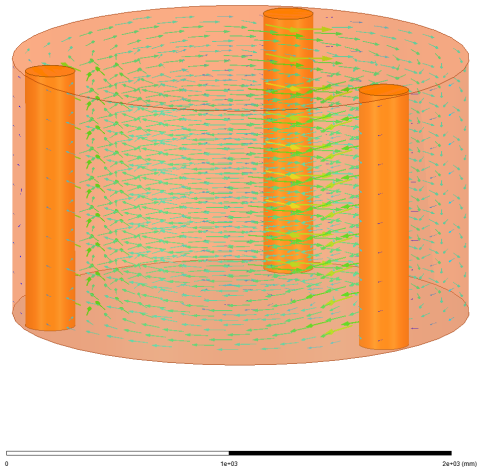


FLASH High Frequency or HF

TM010 - E field

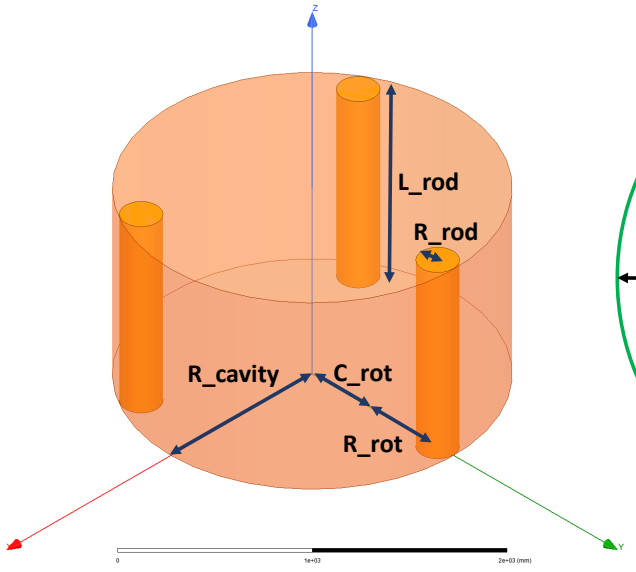


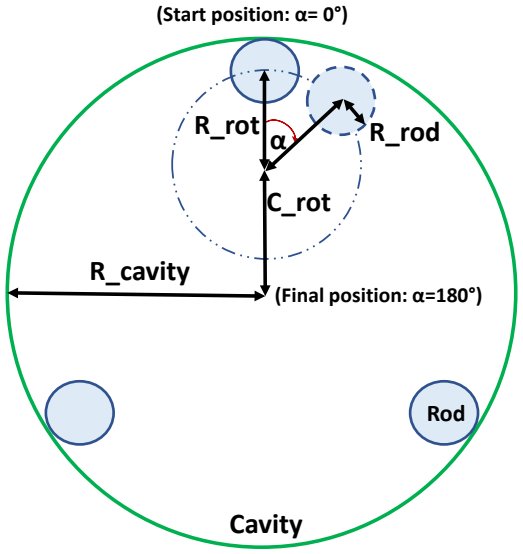
TM010 - H field



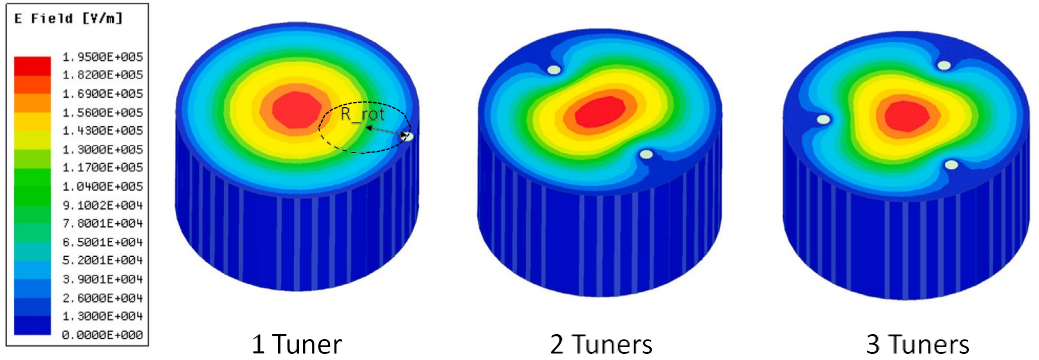
FLASH frequency tuning system

The tuning system is based on the use of metallic movable rods, similarly to what has been adopted by the ADMX collaboration.



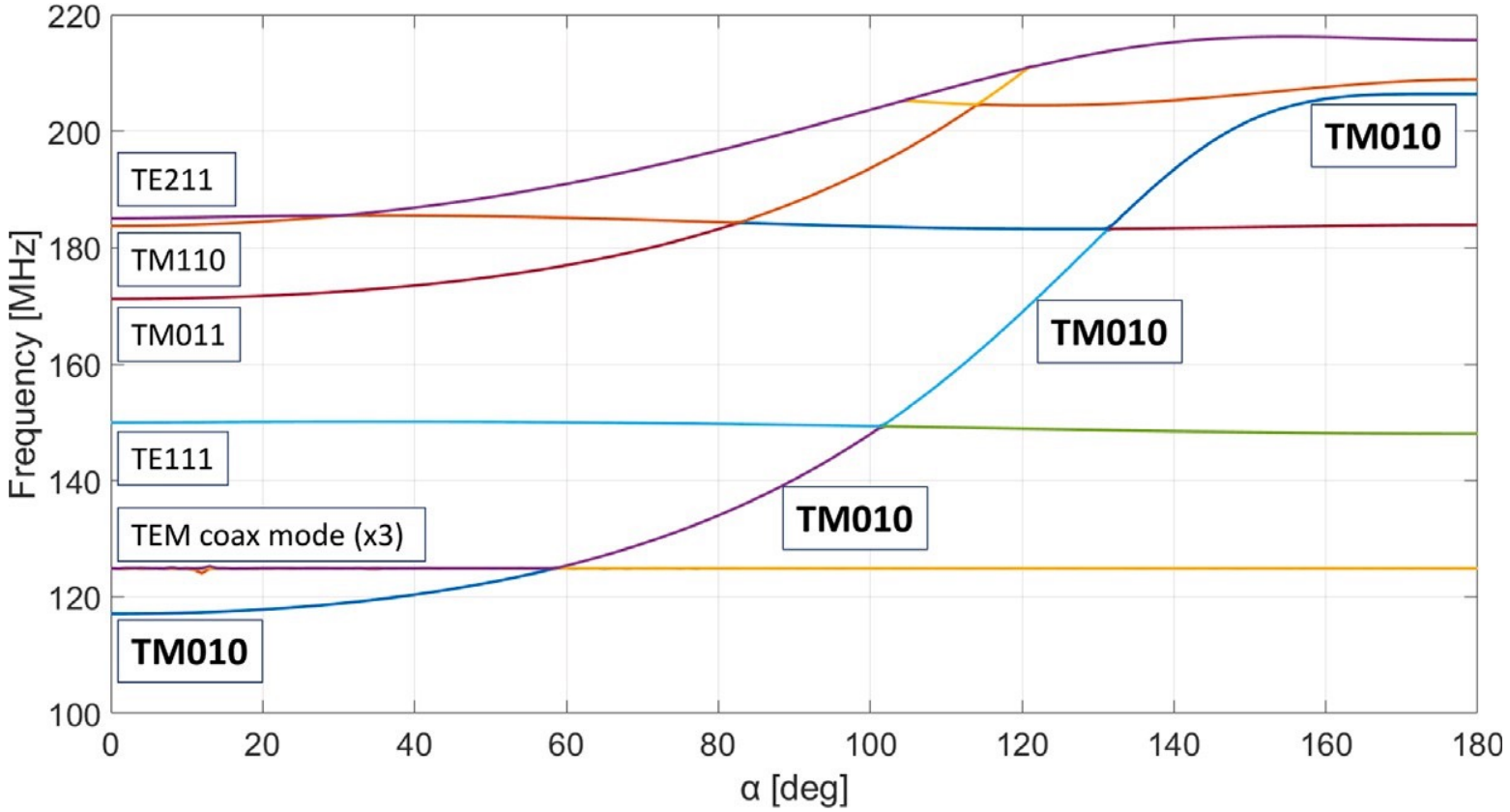


Parameter	FLASH LF	FLASH HF (S)
R cavity (mm)	1050	590
R_{rod} (mm)	115	60
R_{rot} (mm)	276	160
C_{rot} (mm)	654	367
L_{rod} (mm)	1200	1200
n. tuning rods	3	3
Frequency range (MHz)	117–206	206–360
$Q/1000$	570–450	524–380
Form factor	0.63–0.73	0.64–0.75
BW (Hz) @ β = 1	410–916	786–1895



FLASH mode mapping (LF)

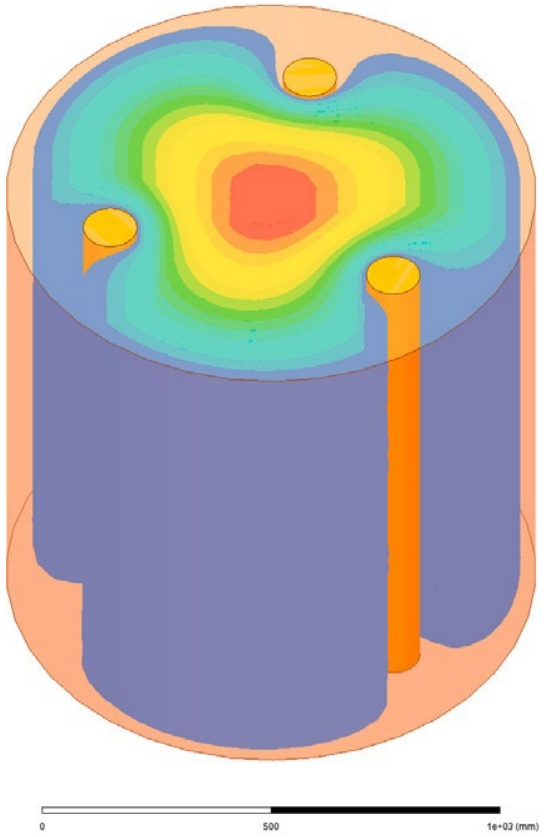
This tuning system does not affect the mode frequencies equally, leading, for some rod positions, to an overlap between different modes.

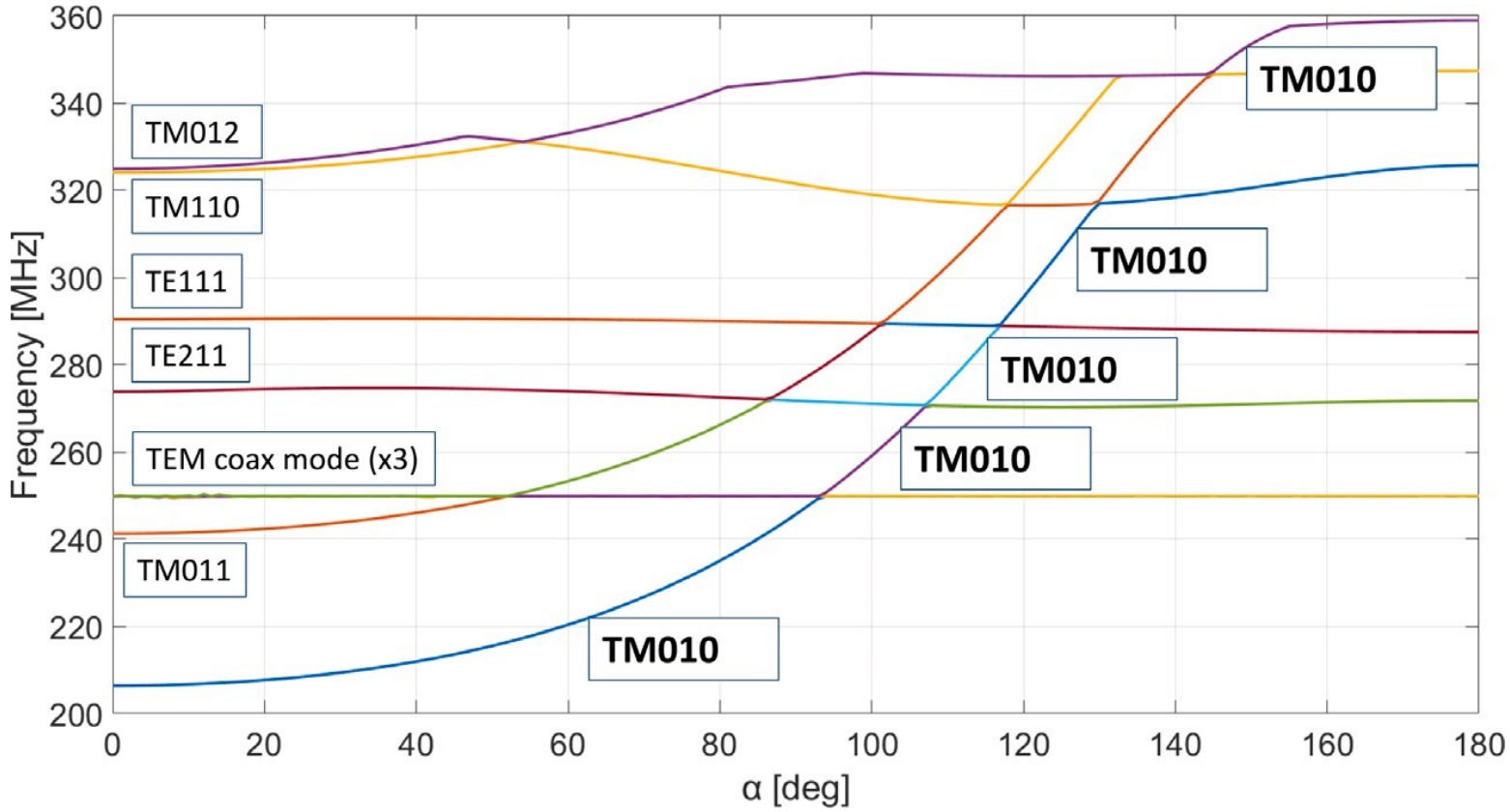


$$f_{TM_{010}|\alpha=0^\circ} \cong 117\ MHz$$

$$f_{TM_{010}|\alpha=180^\circ} \cong 206\ MHz$$

FLASH mode mapping (HF)

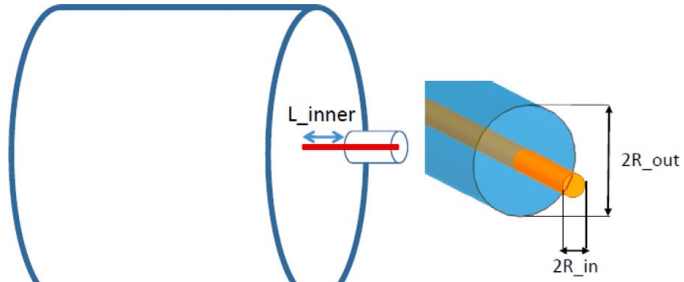




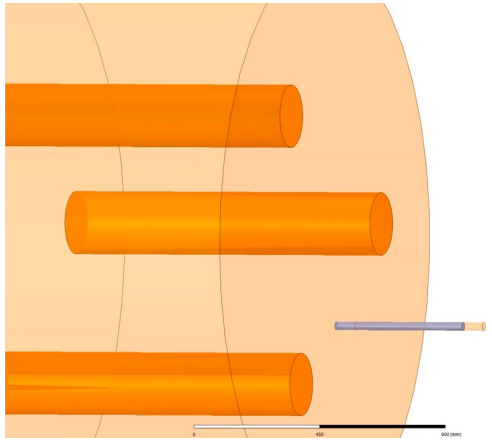
$$f_{TM_{010}|\alpha=0°} \cong 206\ MHz$$

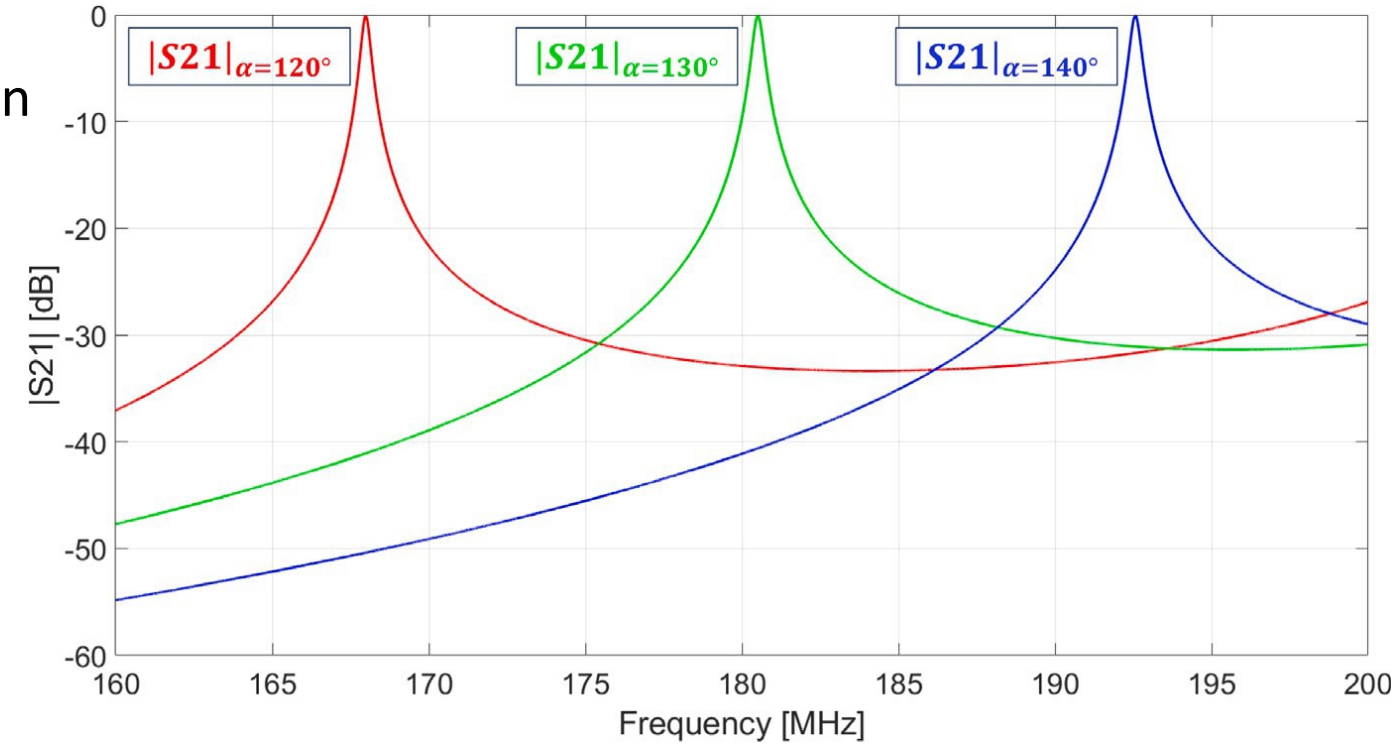
$$f_{TM_{010}|\alpha=180°} \cong 360\ MHz$$

TM_{010} pick-up and mode mixing



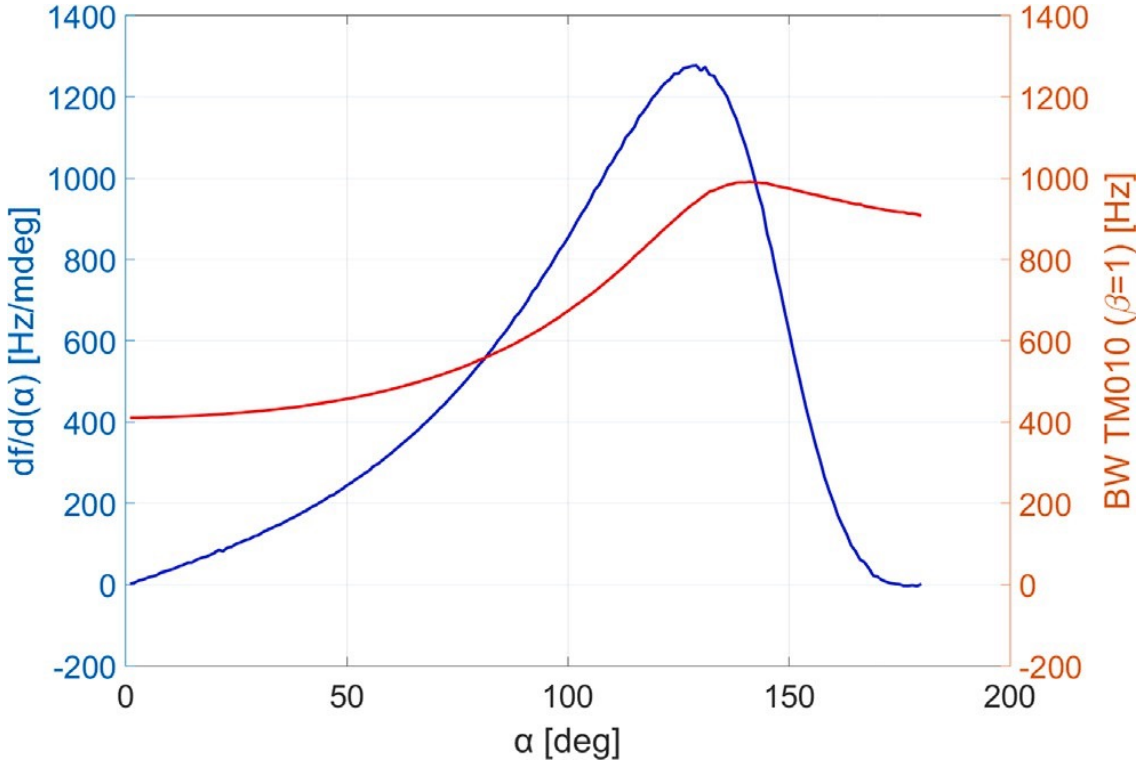
The signal from the TM010 mode is extracted through a coaxial probe inserted in the two end-caps of the cavity, parallel to the axis of the cavity itself.

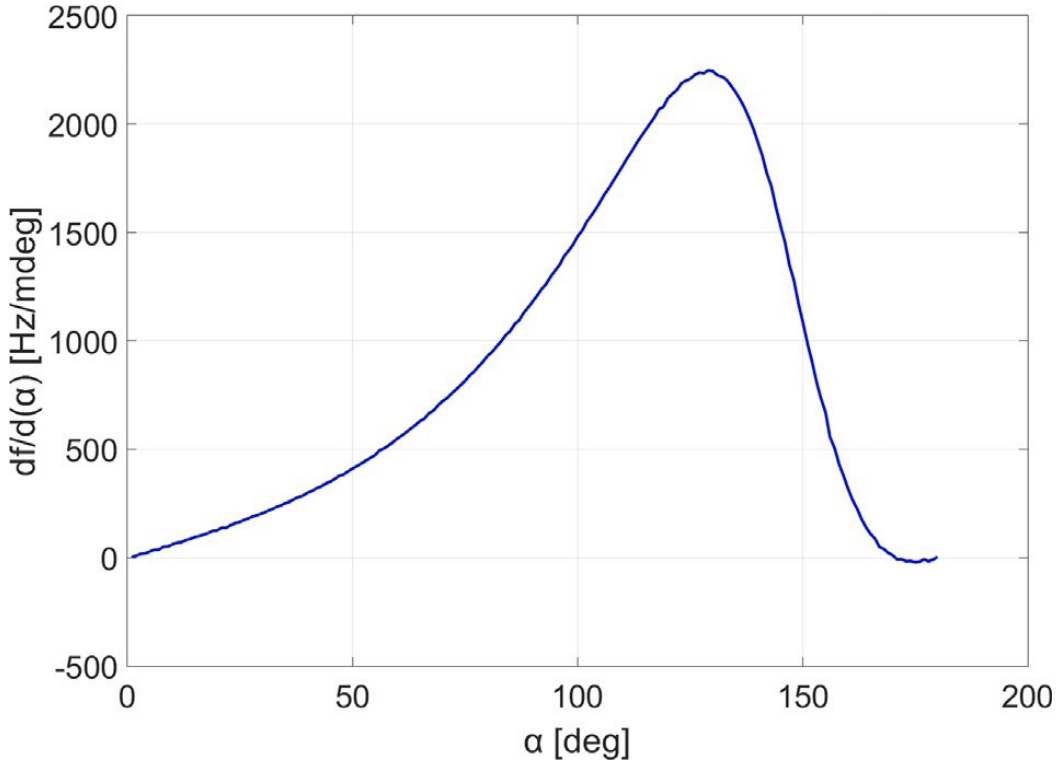




Sensitivity and Bandwidth

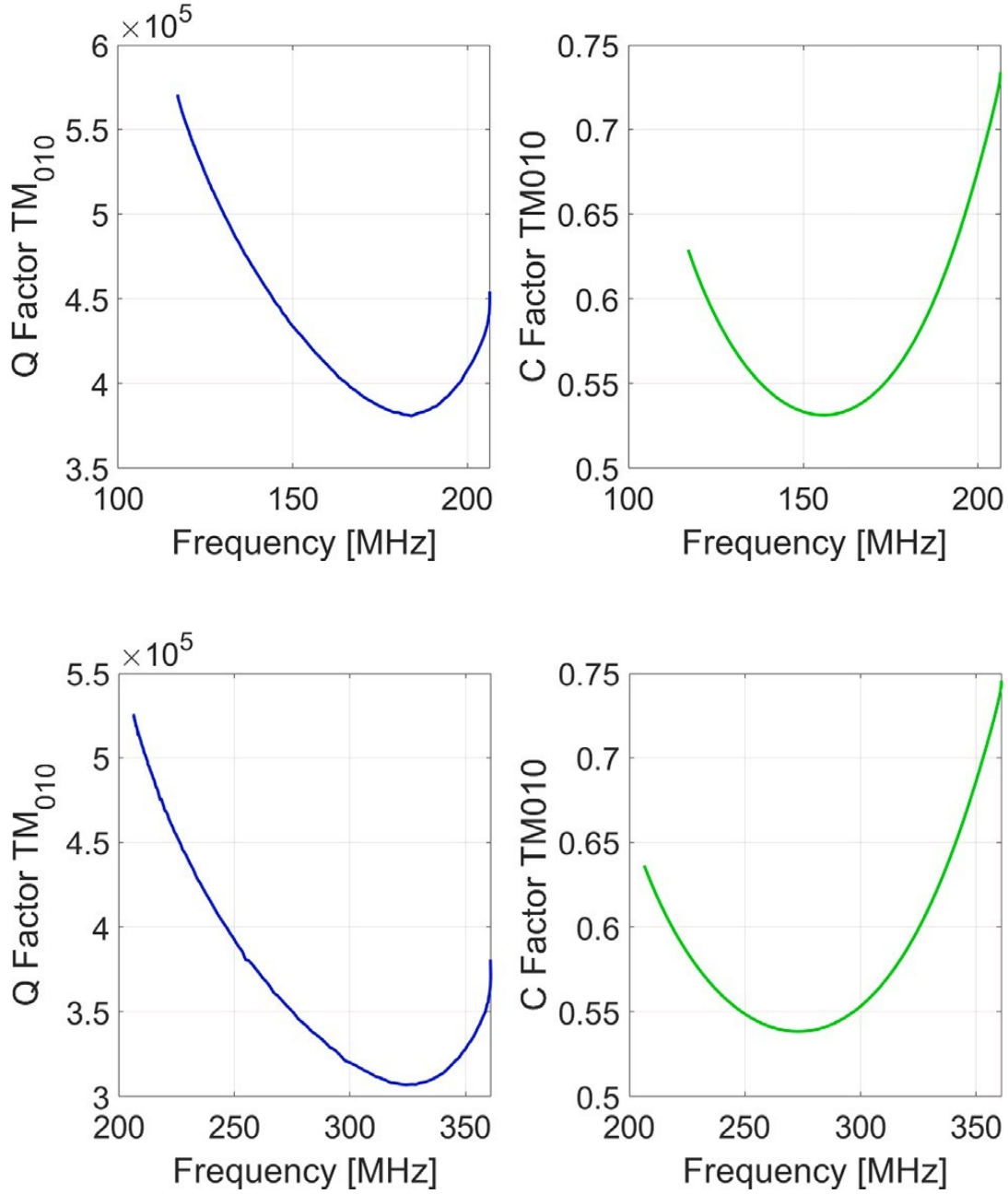
The minimum angle of rotation achievable with the FLASH tuning system must correspond to a frequency variation on the order of the cavity bandwidth.





FLASH main EM parameters

The resonant cavity will be made of oxygen-free high thermal conductivity copper (OFHC). We are assuming RRR = 50, we simulated the quality factor Q and the form factor C of the TM010 with the ANSYS- HFSS code.



Thank you