# FLASH 2<sup>nd</sup> meeting

# WP3: RF Cavity

UPCT, LNF, IFIC (CSIC-UV)

FLASH 2<sup>nd</sup> Meeting

March 10th, 2025

- TM<sub>010</sub>:
  - Calculation of optimal  $\beta$  for maximizing the scanning rate. Study of electrical and magnetic coupling (comparison). Output: coupling geometry as input to mechanical eng.
  - Methodology for avoiding mode crossing (blind regions). Combination of coarse and fine tuning.
  - Effect of leakage from moving parts on  $Q_0$ . Input from mechanical eng.
- Analysis of other modes for HFGWs

## **RESULTS OF LARGE FLASH CAVITY (3 rods, with gap)**

Quasi - TM Modes	<i>Q</i> <sub>0</sub> (x10 <sup>5</sup> )	Q <sub>0rad</sub> (x10 <sup>11</sup> )	$f_r$ (MHz)
TM <sub>010</sub>	5.78	2.65	116.95
TM <sub>011</sub>	4.92	1.07	171.11
TM <sub>110</sub>	7.41	0.00896	183.62
TM <sub>111</sub>	5.69	0.011	222.07
TM <sub>210</sub>	8.33	0.0169	247.38
TM <sub>020</sub>	9.1	1.08	258.38
TM <sub>211</sub>	6.15	0.46	275.84
TM <sub>012</sub>	6.24	0.15	277.13
TM <sub>021</sub>	6.65	0.8	287.00
TM <sub>310</sub>	9.41	0.011	293.79

Quasi - TE Modes	Q <sub>0</sub> (x10 <sup>5</sup> )	<i>Q</i> <sub>0<i>rad</i></sub> (x10 <sup>9</sup> )	<i>f</i> <sub>r</sub> (MHz)
TE <sub>111</sub>	5.31	2.85	149.94
TE <sub>211</sub>	4.73	1.39	184.97
TE <sub>011</sub>	10.9	0.881	214.75
TE <sub>311</sub>	4.92	0.563	238.66
TE <sub>112</sub>	5.34	0.00681	263.23











#### FLASH: 3 RODS vs 4 RODS

3 RODS: Rcav = 1050 (TBD) mm Lcav = 1200 (TBD)mm Rrod = 115 mm

3 RODS: Freq. TM010 = 117 MHz Tuning Range = 90 MHz Tuning % = 43.5%



4 RODS: Rcav = 1050 (TBD)mm Lcav = 1200 (TBD) mm Rrod = 100 mm

4 RODS: Freq. TM010 = 117 MHz Tuning Range = 110 MHz Tuning % = 48.5%





Es. Copper Rod: Weight single Rod R100: 15 kg (60 kg – 4 rods) Weight single Rod R115: 18 kg (54 kg – 3 rods)



2e+03 (mm)

e+03 (mm)

## HFGW EM Mode $\rightarrow$ TE211 mode – 3 rods vs 4 rods

## HFGW EM Mode $\rightarrow$ TM210 mode – 3 rods vs 4 rods





#### HFGW EM Mode $\rightarrow$ TM211 mode – 3 rods vs 4 rods



## TM010 – 4 Rods $\rightarrow$ EM Axion parmeters





117 MHz  $\rightarrow$  227 MHZ

## Coupling - Loop Antenna



#### Coupling - Loop Antenna



## **Conclusions & Next tasks**

- TM<sub>010</sub>:
  - Three or four rods from now?
  - Calculation of optimal  $\beta$  for maximizing the scanning rate. Study of electrical and magnetic coupling (comparison).
  - Methodology for avoiding mode crossing (blind regions). Combination of coarse and fine tuning.
  - Effect of leakage from moving parts on  $Q_0$ . Input from mechanical eng.
- GWs:
  - Question: simultaneous or independent search for axions & GWs? Type of GW signal?
    - Tuning rods needed for GWs?
  - Identification of GWs operating modes:
    - Not clear at this moment.
    - Complete incidence analysis ( $\theta$ ,  $\varphi$  plots).
    - Selection of modes for avoiding blind spots or allow modulation analysis
  - Design of ports for desired modes.