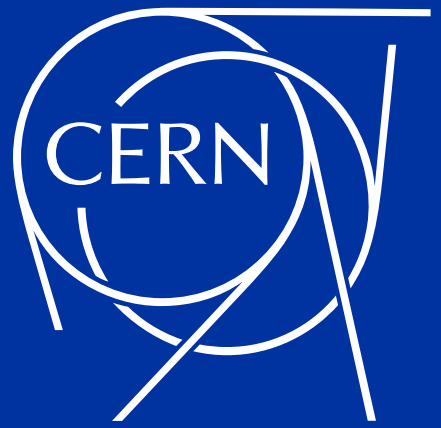

Novel open cavity for rotating mode SLED type rf pulse compressors

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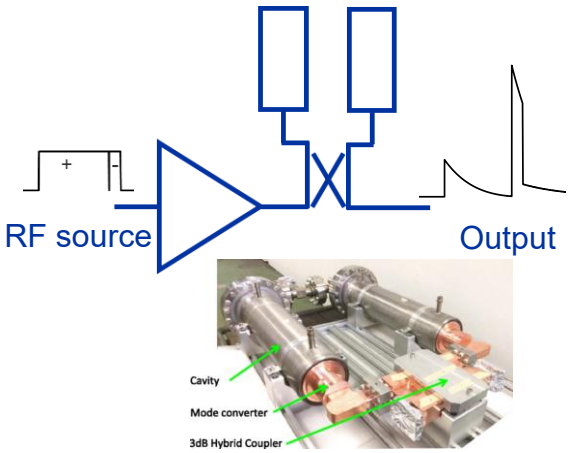
Alexej Grudiev

25-MAY-2021

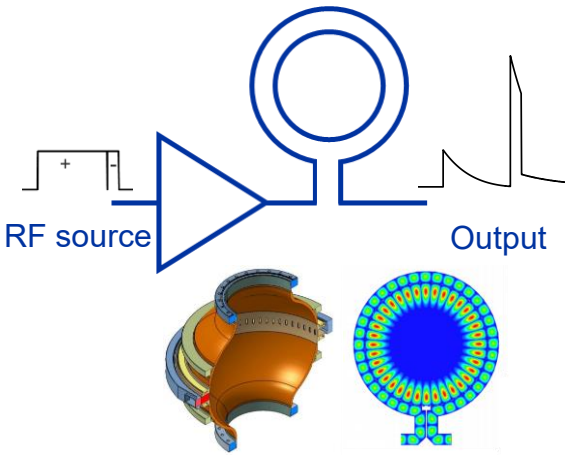
Overview of X-band passive pulse compressors

SLED type pulse compressors with resonant cavity

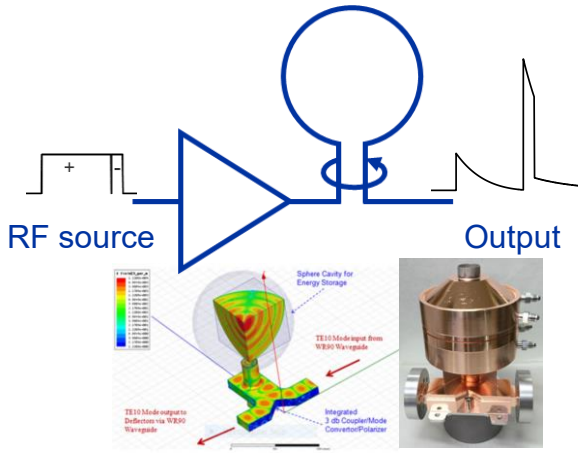
Cylinder cavities



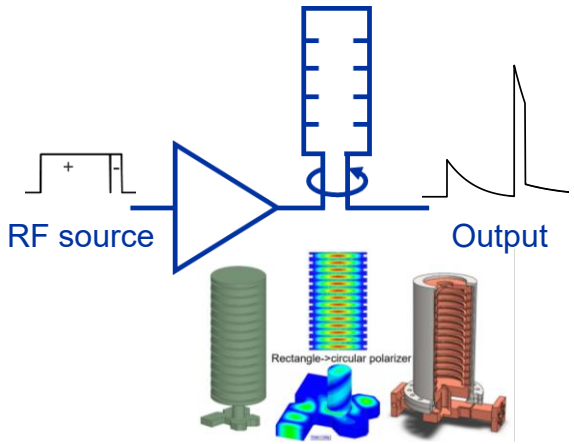
Barrel open cavity



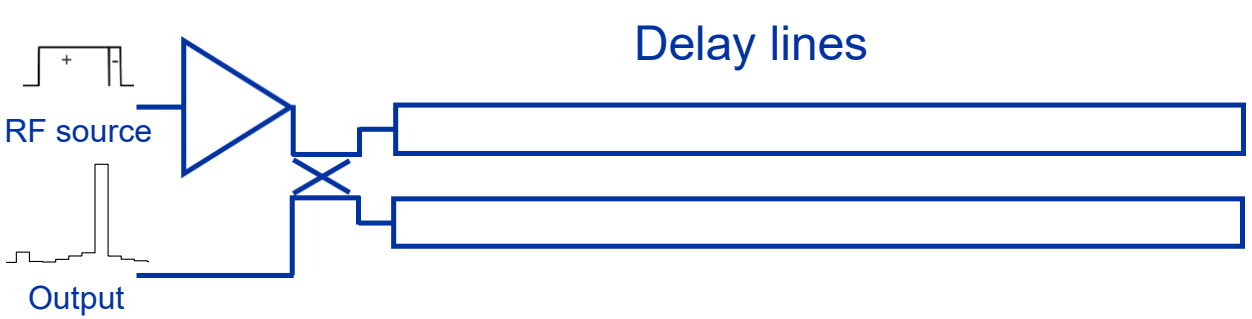
Spherical cavity



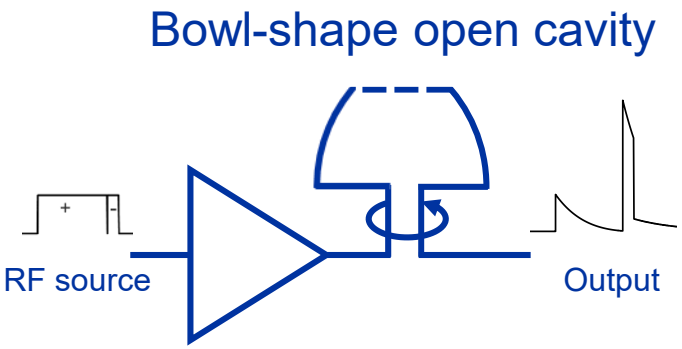
Corrugated cavity



SLEDII type pulse compressor with delay lines



Novel bowl-shape open cavity



SLED type resonant cavity working at $\mathrm{TE}_{1,2,i}$ rotating quasi-spherical mode

index i depends on the radius of the cavity (R_{cav})

High quality factor with compact size

Q_0 ~ 240000 in $\mathrm{TE}_{1,2,13}$ mode with R_{cav}=16.3 cm

Open boundary at the top the cavity

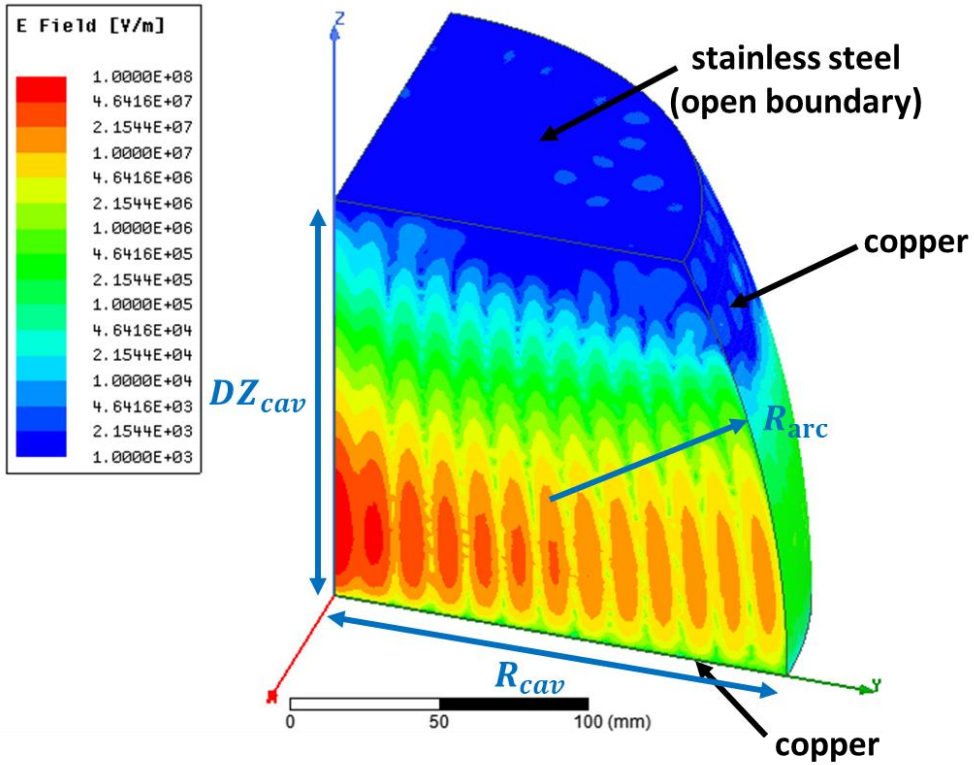
low field at the top area, connect to stainless steel flange (open boundary) and used for vacuum pumping

suppress many parasitic modes

Bowl shape symmetric geometry

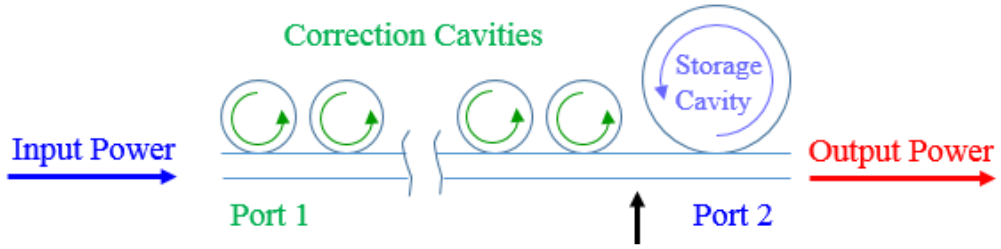
machining by lathe with high accuracy and low cost

no brazing needed for the cavity fabrication

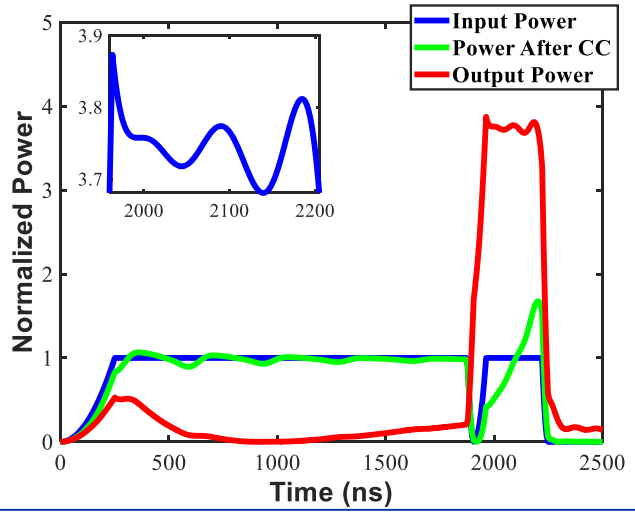


Requirement from CLIC rf pulse compression system

Firstly studied for CLIC rf pulse compression system
Can also be applied to other pulse compression systems

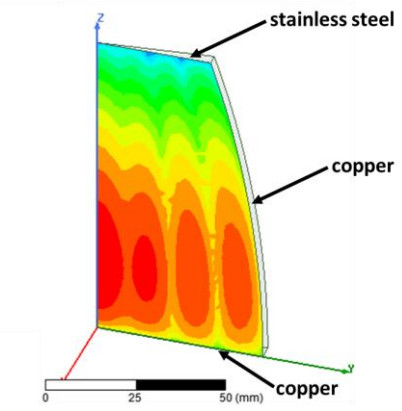


Power after correction cavities (CC)

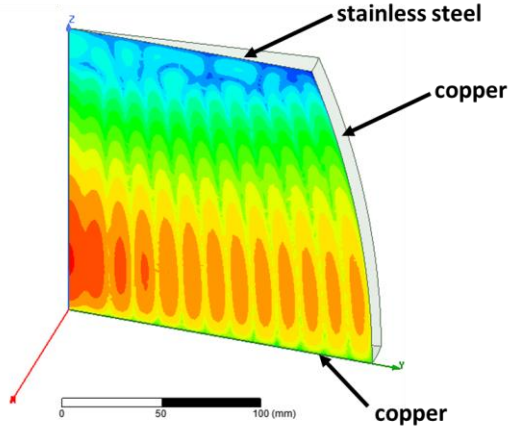


	Correction cavity	Storage cavity
Required Q_0	60000	240000
Mode selection	$TE_{1,2,4}$	$TE_{1,2,13}$
Mode Q_0	~74000	~240000

Correction cavity



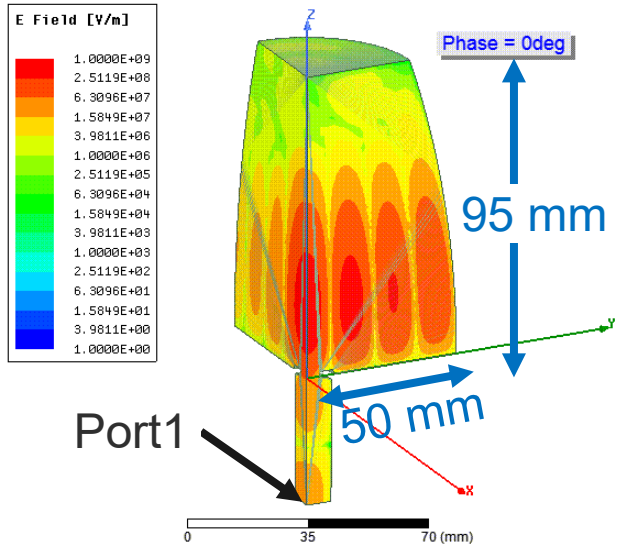
Storage cavity



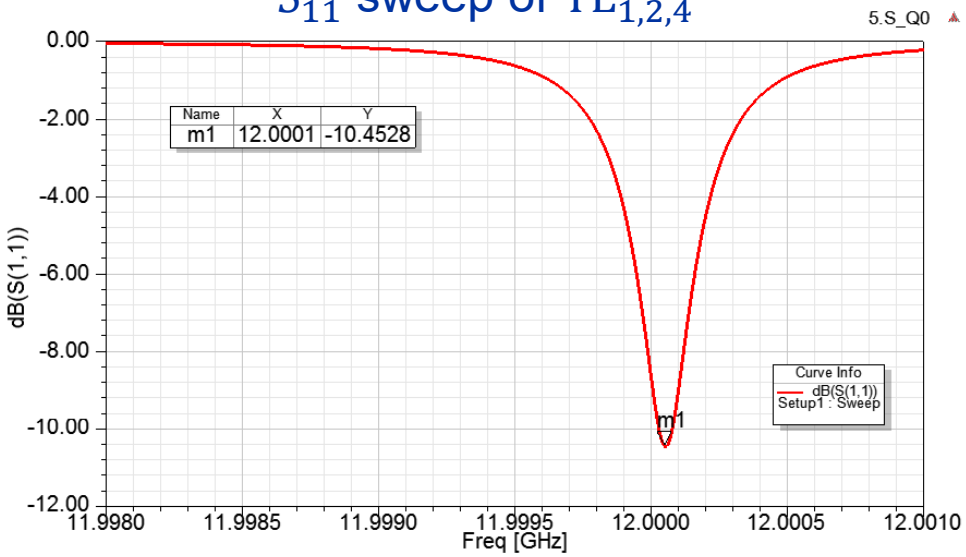
Correction cavity design

	Frequency [GHz]	Q_0
Working mode	12.0001	74649
Parasitic mode1	11.7295	16449
Parasitic mode2	12.2930	14990

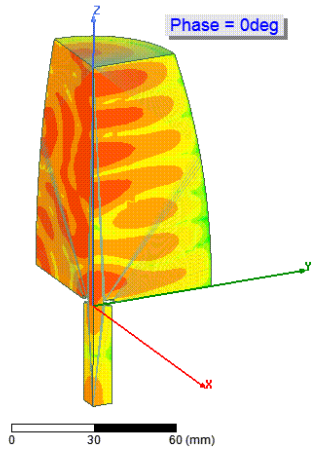
$TE_{1,2,4}$ rotating mode



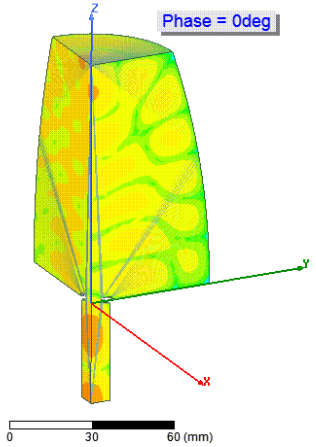
S_{11} sweep of $TE_{1,2,4}$



Parasitic mode1

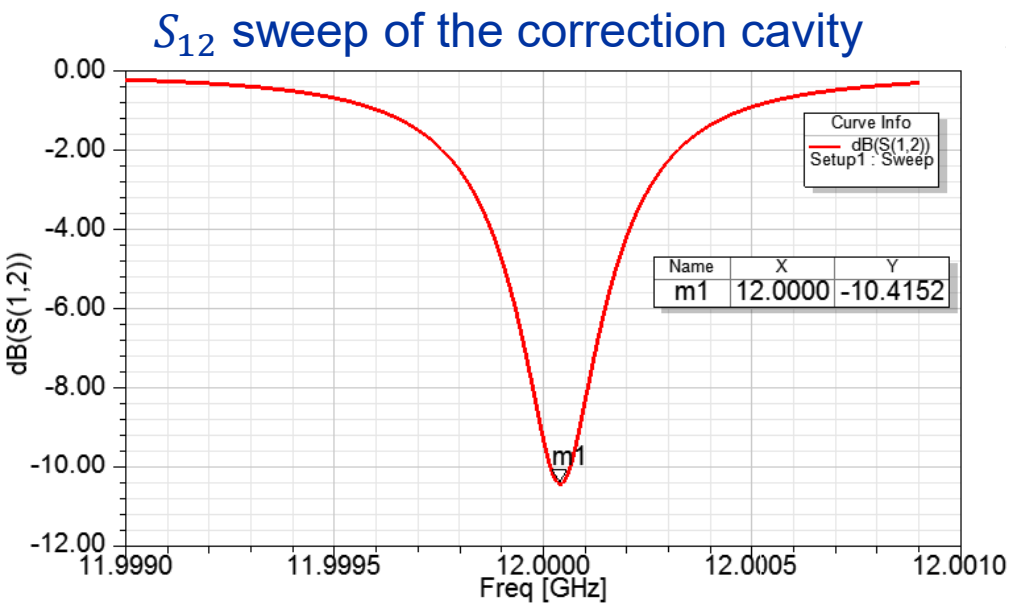


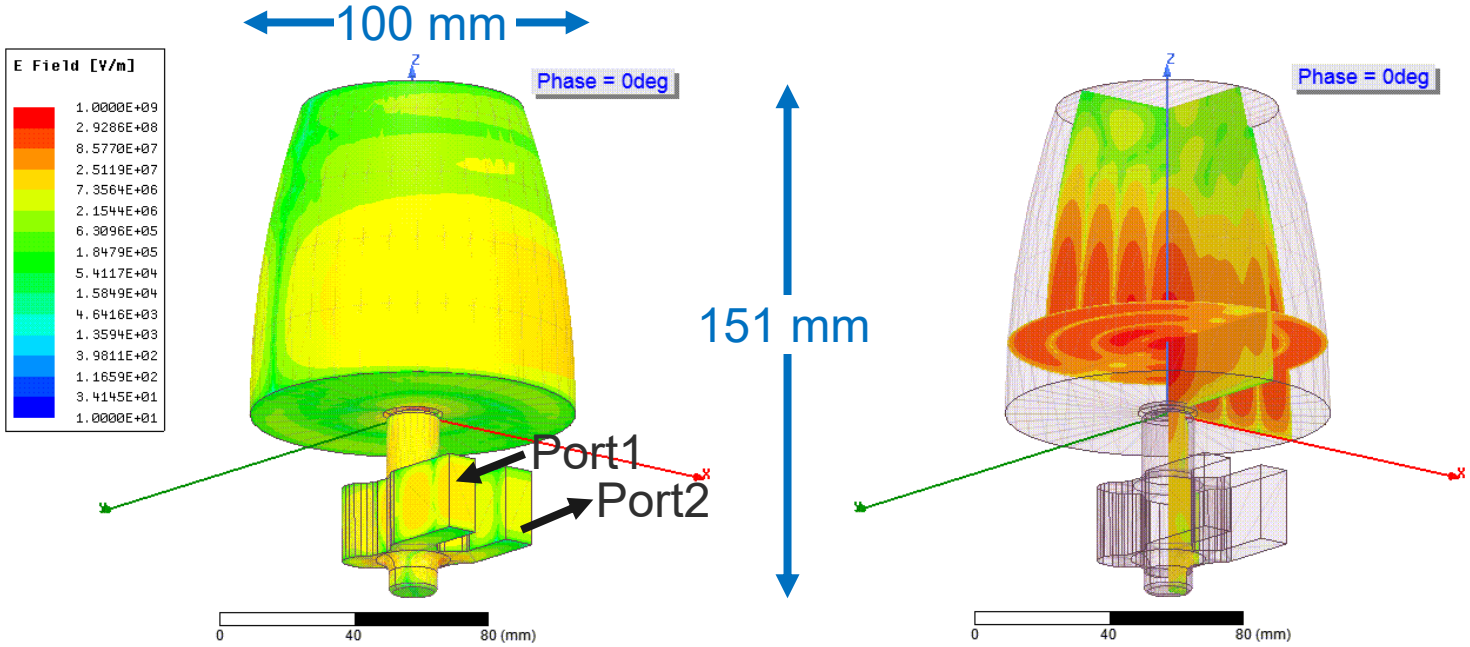
Parasitic mode2



Correction cavity with E-rotator

E-rotator converts $\mathrm{TE}_{1,0}$ rectangular waveguide mode to $\mathrm{TE}_{1,1}$ circular waveguide mode and excites $\mathrm{TE}_{1,2,4}$ rotating mode in the open cavity

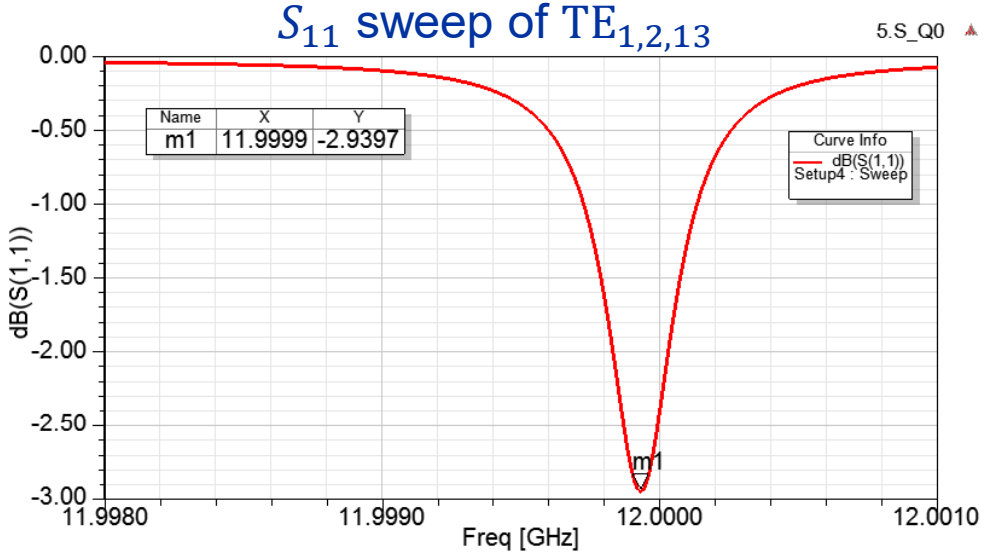




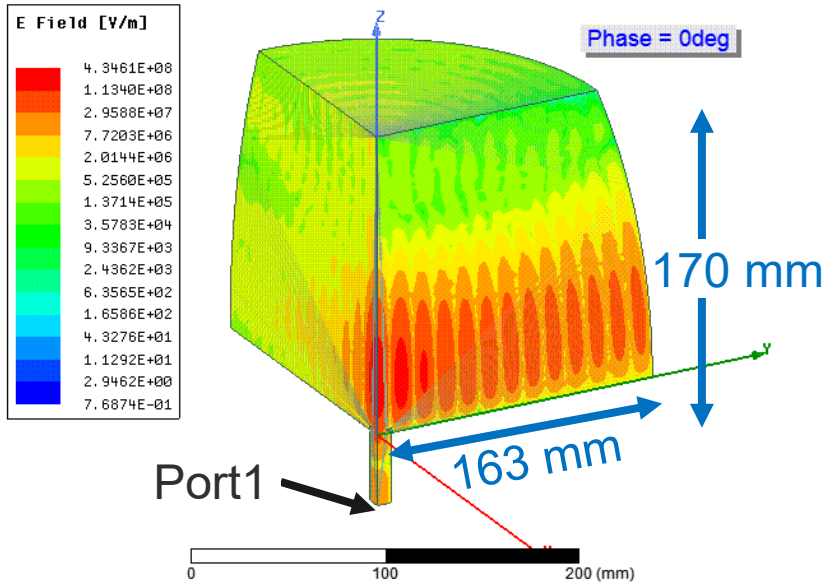
Storage cavity design

	Frequency [GHz]	Q_0
Working mode	11.9999	244799
Parasitic mode1	11.9686	50949
Parasitic mode2	12.0458	61082

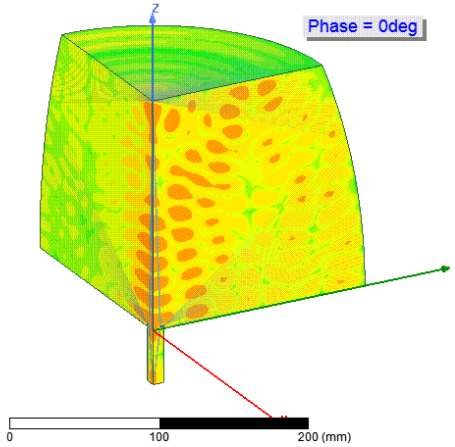
S_{11} sweep of $TE_{1,2,13}$



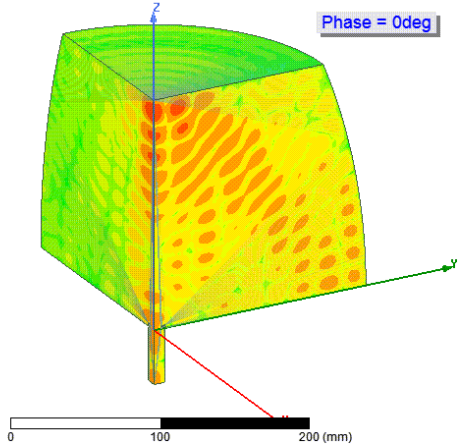
$TE_{1,2,13}$ rotating mode



Parasitic mode1



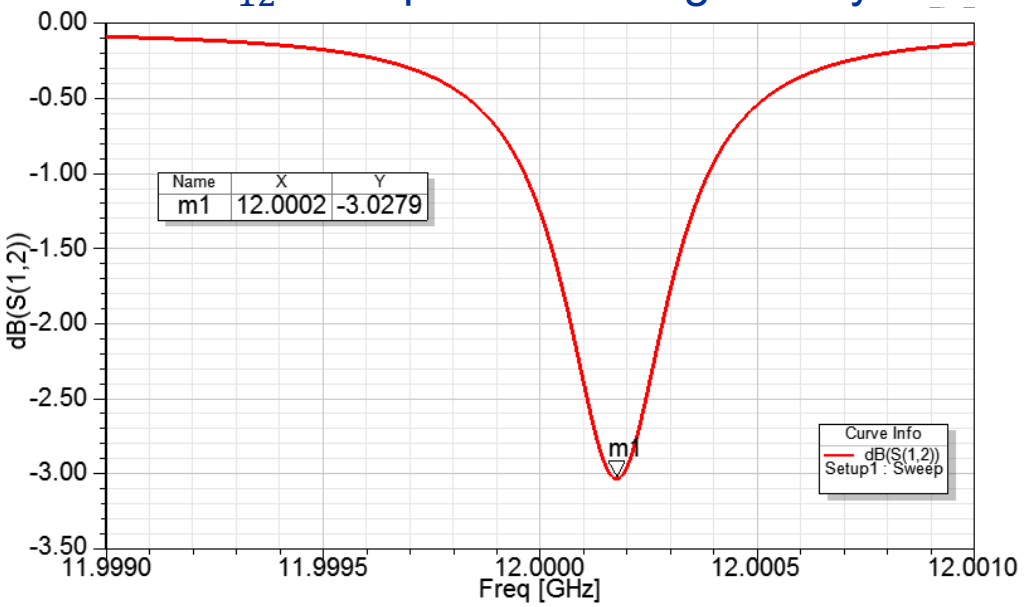
Parasitic mode2

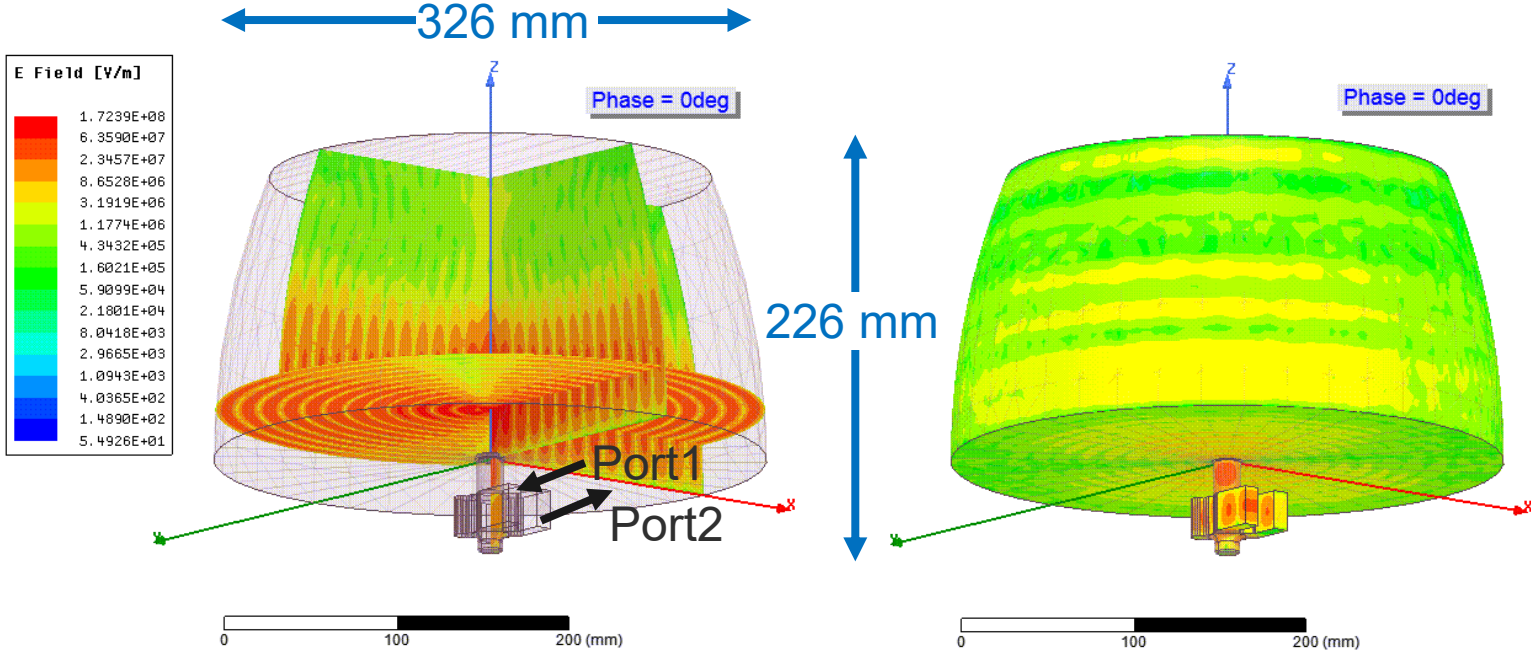


Storage cavity with E-rotator

E-rotator converts $\mathrm{TE}_{1,0}$ rectangular waveguide mode to $\mathrm{TE}_{1,1}$ circular waveguide mode and excites $\mathrm{TE}_{1,2,13}$ rotating mode in the open cavity

S_{12} sweep of the storage cavity





Future work

Parasitic modes suppression for storage cavity

Add absorption material such silicon carbide at the top of the cavity

Use $\mathrm{TE}_{1,2,12}$ mode to get larger mode frequency separation

Couple iris optimization to reduce maximum surface field/pulse heating/…

Finalize the mechanical design and fabrication

Lower-power rf measurement and high-power test of the bowl-shape open cavity

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