COMPASS PT- team introduces:

Microwave performances for the OD-magnet cavity

1) **Introduction: MW - FM - spectrum; Cavity modes**

2) ÓÉ ó-»² -±®º±®¬¸» -°»½¬®¿´³ »¿-«®»³ »²¬-

3) **Radial MW-field distribution and frequency modulation effect**

4) **Spectral structure of the conical and cylindrical cavities**

5) **Mode suppression by the Kevlar chamber and the PT- material**

7) !Ì¸» ¬¸®»» ½±²½´«-·±²-"æ¬¸» °±--·¾´» ·© ± ¿²¼ ¬¸®»»ó½»´´- ½¿ª·¬§ ¼»-·¹²-òÓÉ ¿¾-±®°¬·±² ¾§ ÒÓÎ ½¿¾´»-ò

Spectrum of Frequency Modulated Microwave Signal

if → ! & !$_0$ % $! $_{max}$ # Cos " t

$! $_{max}$ / 2" (5.0 MHz ! Ú®»¯«»²½§ ¼»ª·¿¬·±²

" / 2·· (500 Hz ! Ó±¼«´¿¬·±² º®»¯«»²½§

In our case

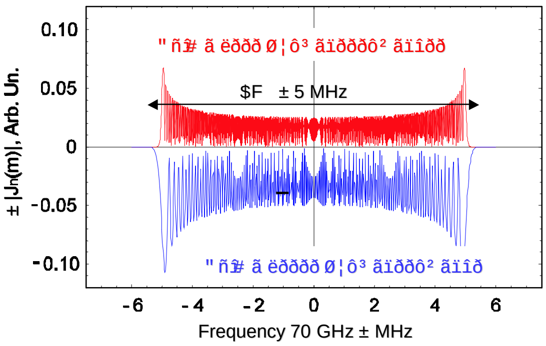
m & $! $_{max}$ / " (10000 is the modulation index

then

I & Sin[!$_0$t % m # Sin " t] & J$_0$(m) # Sin !$_0$t %
J$_1$(m) # [Sin(!$_0$ % ")t ' Sin(!$_0$ ' ")t] %
J$_2$(m) # [Sin(!$_0$ % 2")t % Sin(!$_0$ ' 2")t] %
!

For m > 3, the frequency bandwidth of FM spectrum equals to doubled frequency deviation

in our case it is 2 $F (10 MHz



The ideal case: cylindrical cavity

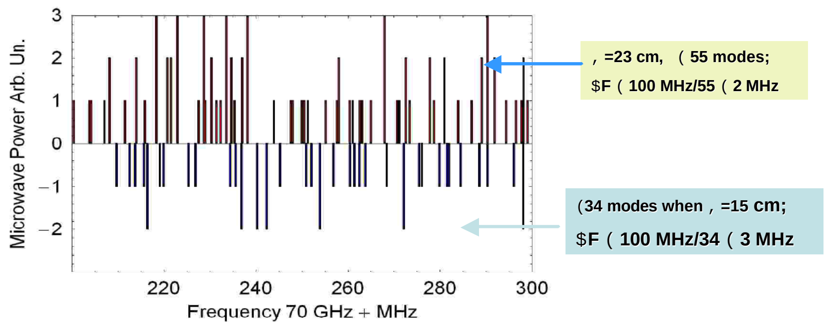
Electric modes

$$f_E \;\&\; \frac{3\cdot10^{10}}{2\#}\sqrt{\left(\frac{p\#}{l}\right)^2 \% \left(\frac{\$_{mn}}{R_0}\right)^2}$$

Magnetic modes

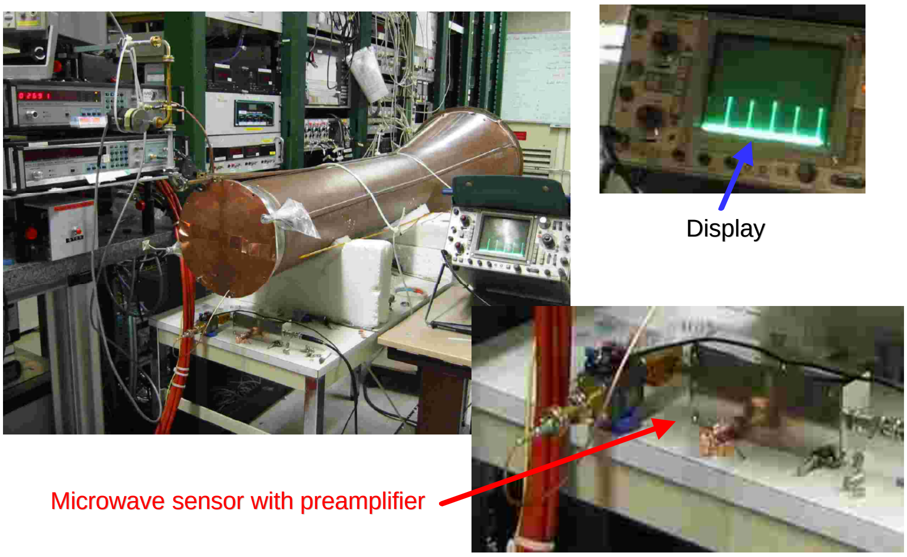
$$f_M \;\&\; \frac{3\cdot10^{10}}{2\#}\sqrt{\left(\frac{p\#}{l}\right)^2 \% \left(\frac{"_{mn}}{R_0}\right)^2}$$

COMPASS cavities have the fixed tuning. The pictures shows is modes:



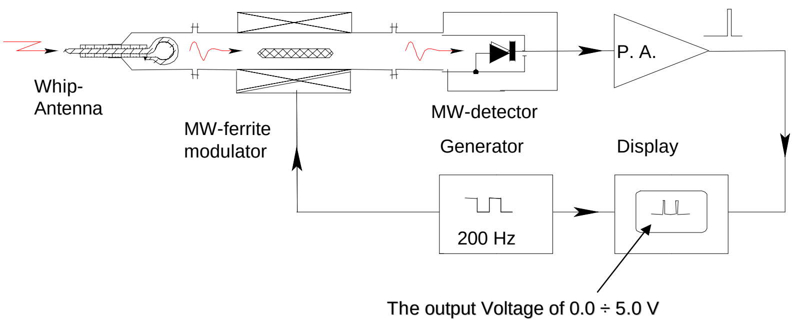
The amount of excited modes decreases with the cavity diameter

General view of the new microwave cavity in PT control room

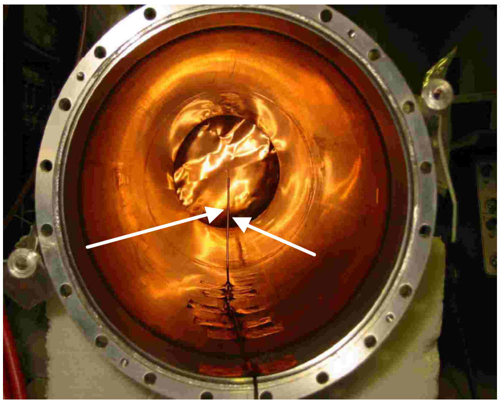


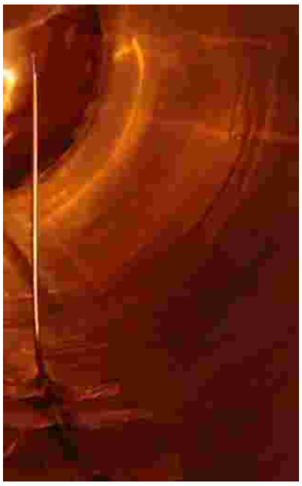
MW-sensor for the spectral measurements.

It has linear characteristic within 0.÷ 50 ! W region.

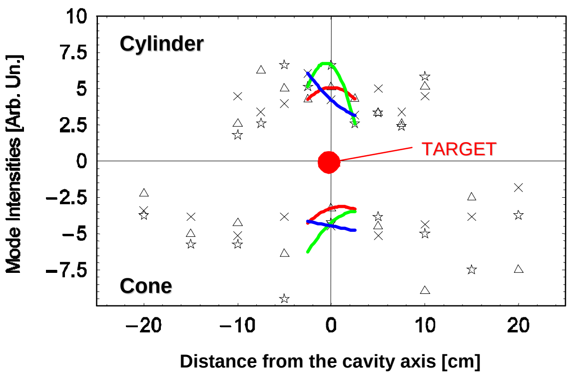


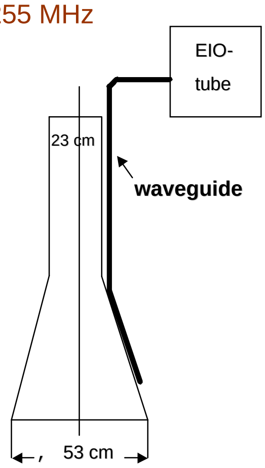
Position of the whip-antenna in the cavity

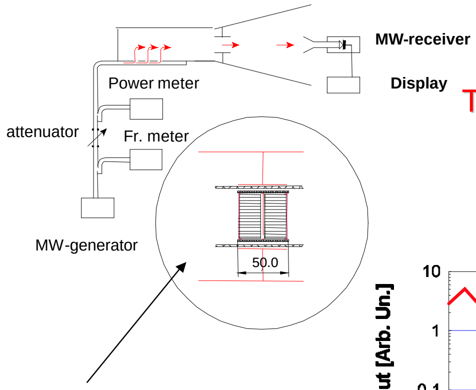




The Comparison of MW - radial distribution in the cylindrical and conical cavities for the three nearest-neighbor modes: 70250, 70246 and 70255 MHz

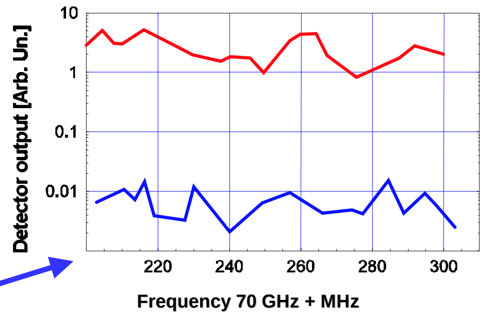




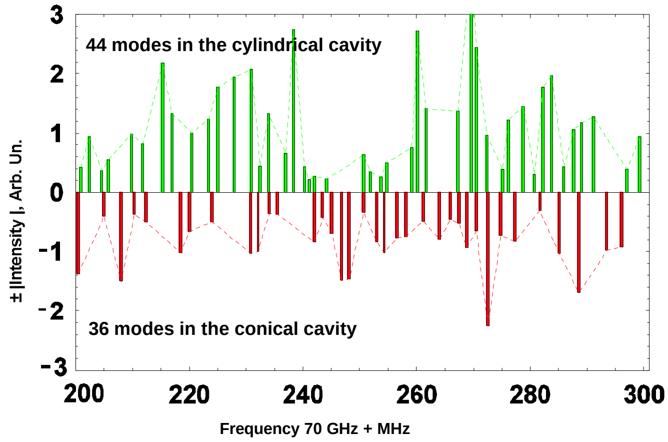


The next following results were obtained with the new of 5 cm length stopper

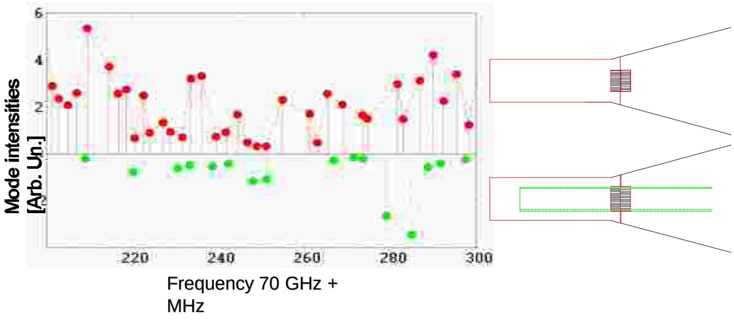
This stopper made of two plug-MW-cavities and it provides more then 20 dB power attenuation between the cavities



The measurements yield 44 and 36 modes per 100 MHz bandwidth for the empty cylindrical and conical cavities correspondingly.



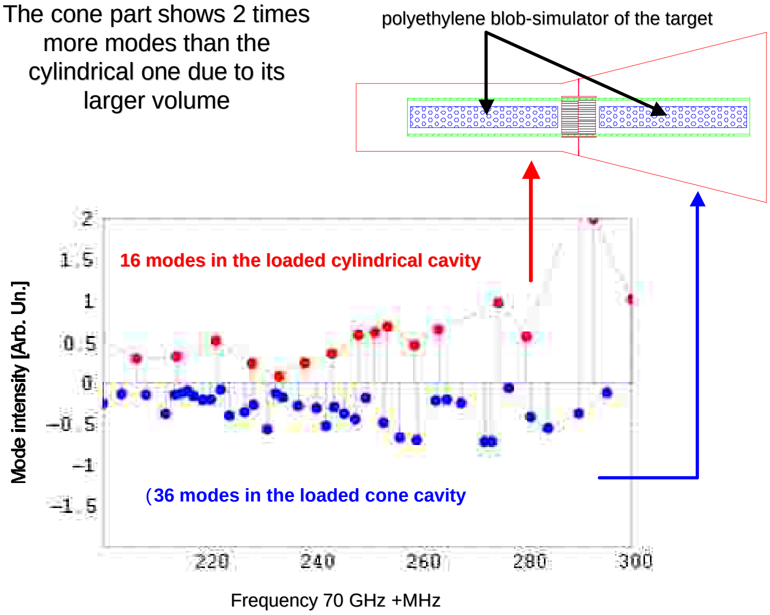
However, the mode amount depends strongly on the dielectric losses in the dilution chamber, made of the Kevlar plastic, and on the dielectric losses in the target material



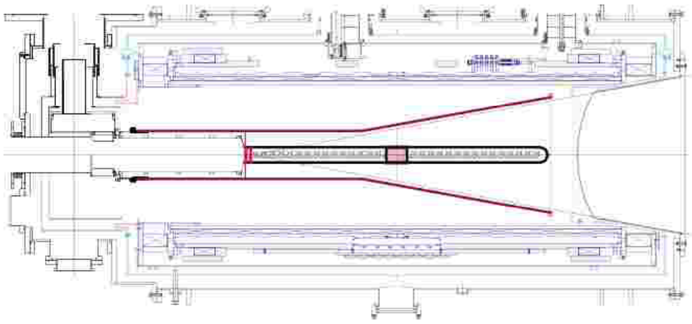
AND

35 mode in the empty Cu cavity → Only 16 modes when there is the Kevlar dilution chamber

The cone part shows 2 times more modes than the cylindrical one due to its larger volume



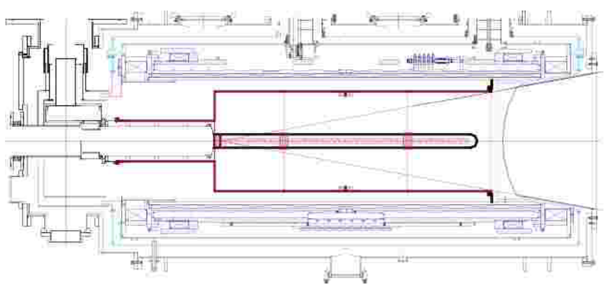
Conclusion 1:



In the case of the twin-target we recommend to use the conical cavity which has already been produced and investigated

Conclusion 2:

In the case of the three target cells I would prefer to use the simple cylindrical cavity of about 50 cm of diameter, divided in the three cells by 2 stoppers with 5 - 7 cm width



Conclusion 3:

The rigid coaxial cable has a considerable attenuation about 10 dB/m or even more. The MW energy induced in the NMR coils is dissipated inside the cables

BUT we do not know the amount of this parasitic absorption.

We should discuss and take a decision about MW protection chokes for NMR-cables.