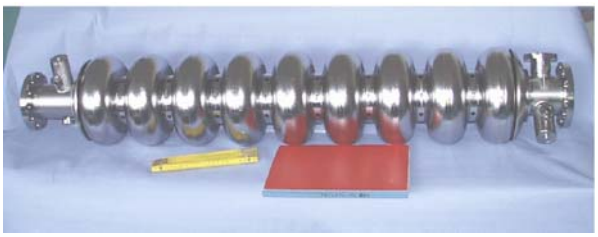
SRF 

Report on RF design of new prototypes

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LAL/Orsay

JRA 1
WP 7
Task 7.1

Report on RF design of new prototypes

In addition with the work on TTF 3 and 4 couplers, two new prototypes have been designed, they are called TTF5 and TW60.

1/TW 60 coupler:

This prototype has been designed using a window geometry that was already successfully tested for KEK B and SNS couplers.

1.1.Description :

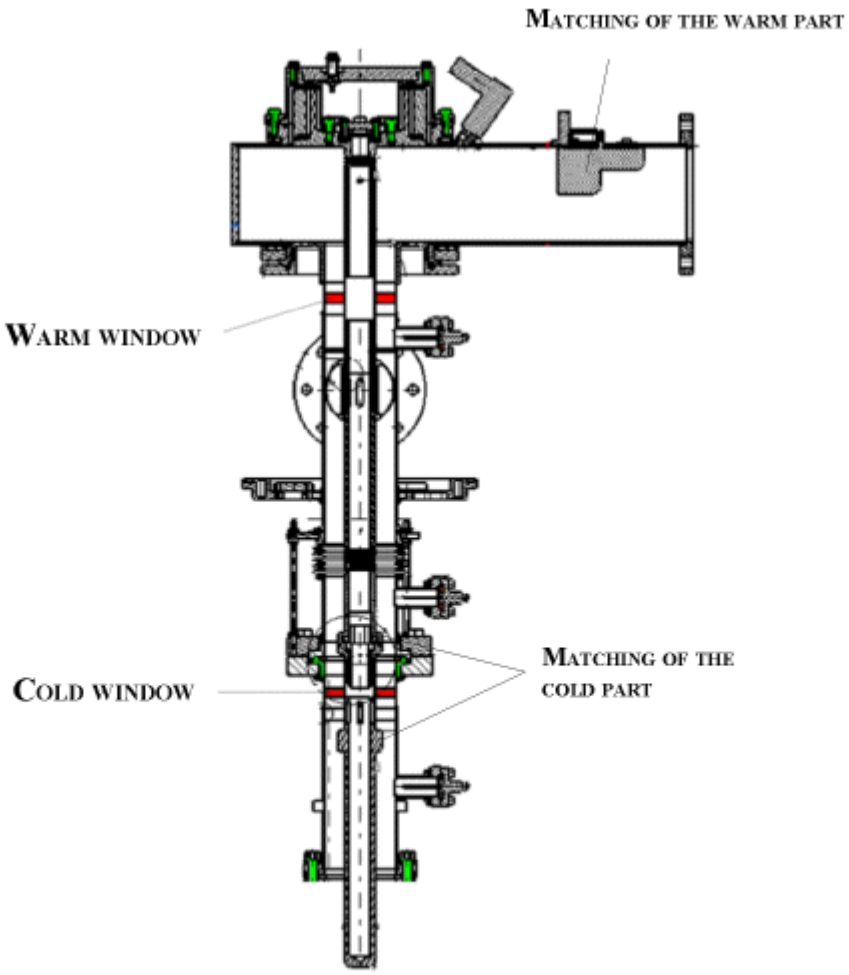

Figure 1 : Layout of the TW 60 coupler

The diameter of the coaxial and its characteristic impedance (61,6 mm, 50 Ohms) were chosen to reduce the RF losses and to limit the electric field maximum. The warm and cold windows are identical (8 mm alumina disks) and both are in the coaxial part of the coupler in order to reduce the electric field on the brasings. The matching is achieved with a reduced height waveguide in the warm transition. A DC bias can be applied to remove the multipactor. The electrical insulation is obtained using a dielectric ring and insulating screws (see figure 2). Also, a RF trap was designed

to prevent from RF leakage. The pumping port of the coaxial is large (60 mm diameter). As this layout is a first demonstrator, the antenna is fixed.

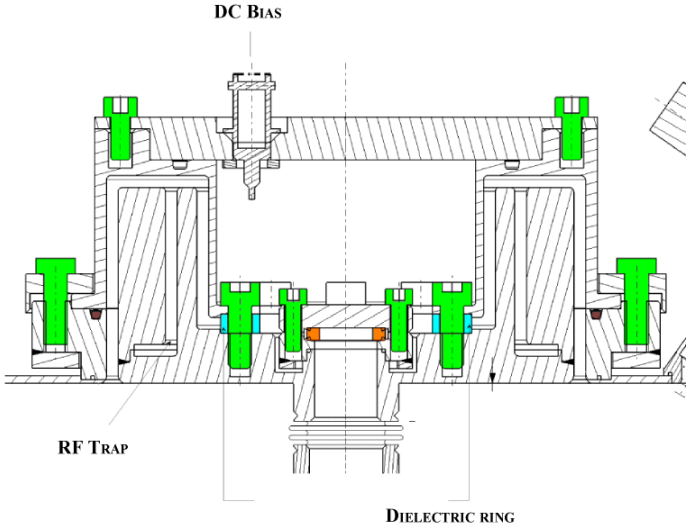

Figure 2 : Layout of the biasing insulation and of the RF trap.

1.2.RF calculations:

For the simulations, this coupler was decomposed in two parts (warm transition and window, cold window and antenna). Each part is matched at 1,3GHz so that there is no standing wave between the windows. Figure 3 gives the reflection and transmission coefficients for the complete structure.

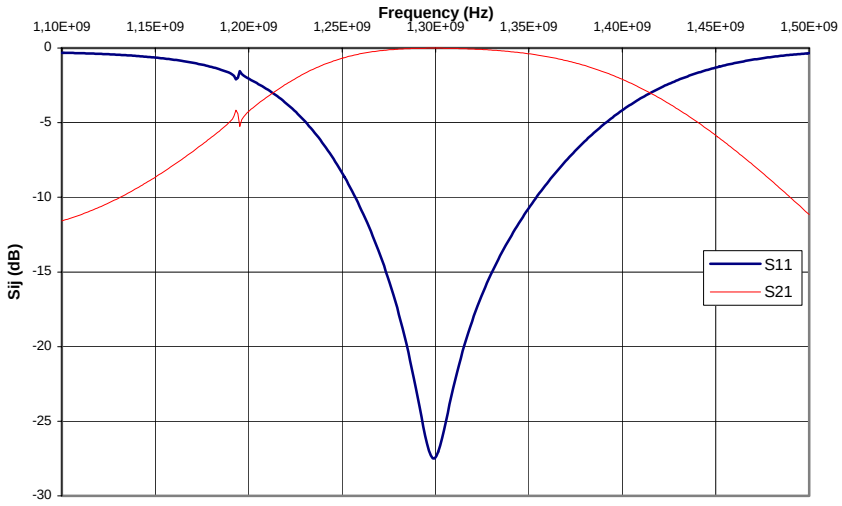

Figure 3 : RF response of the TW 60 coupler assuming
a permitivity of 9,4 and 9 for the warm and cold ceramic respectively

The sensibility of this coupler to the permittivity value is shown on figure 4 : maximum of the frequency shift is 15MHz, but the frequency can be easily adjusted with the reduced height waveguides.

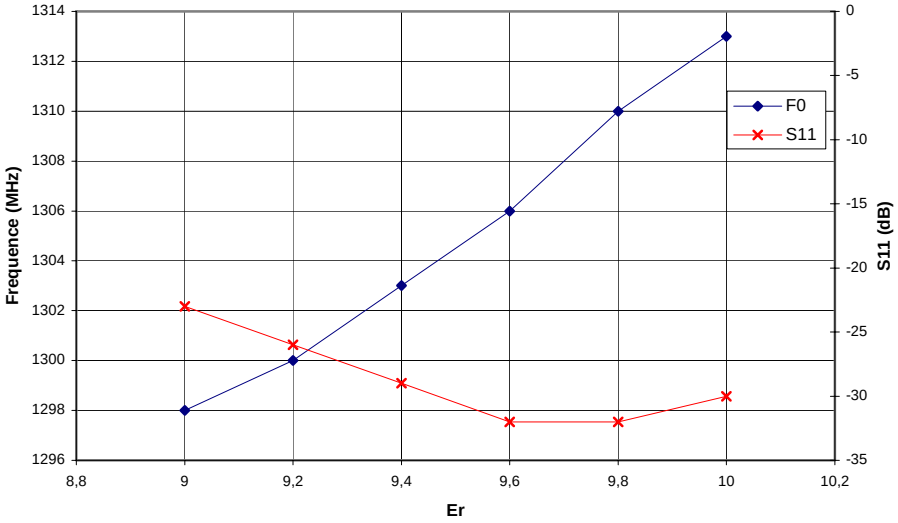

Figure 4 : Influence of the ceramic permittivity

The plot of the figure 5 confirms that the electric fields near the two windows are kept low.

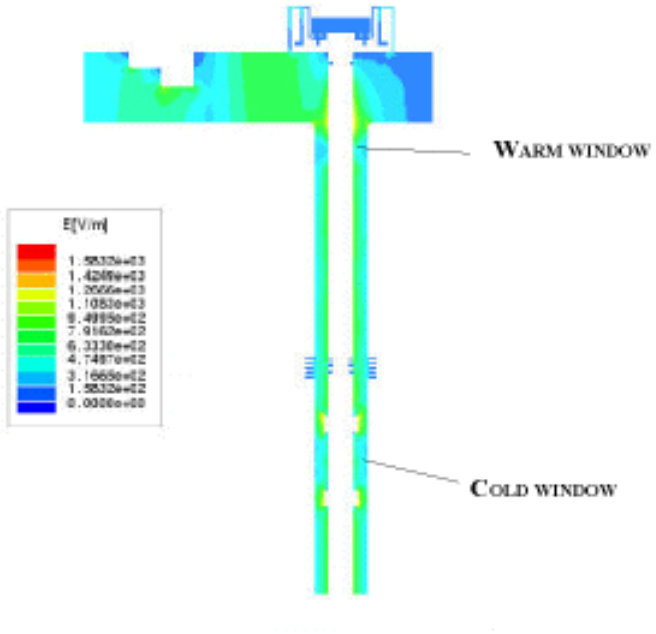

Figure 5 : Electric field for 1W of incident power.

Assuming the loss factor $tg\delta=3.10^{-4}$, the dielectric losses in the cold window are 0,8 W for 2kW of average power.

2/TTF 5 coupler:

This coupler is a TTF3 type with a 50 Ohms constant impedance along the coaxial (see figure 6).

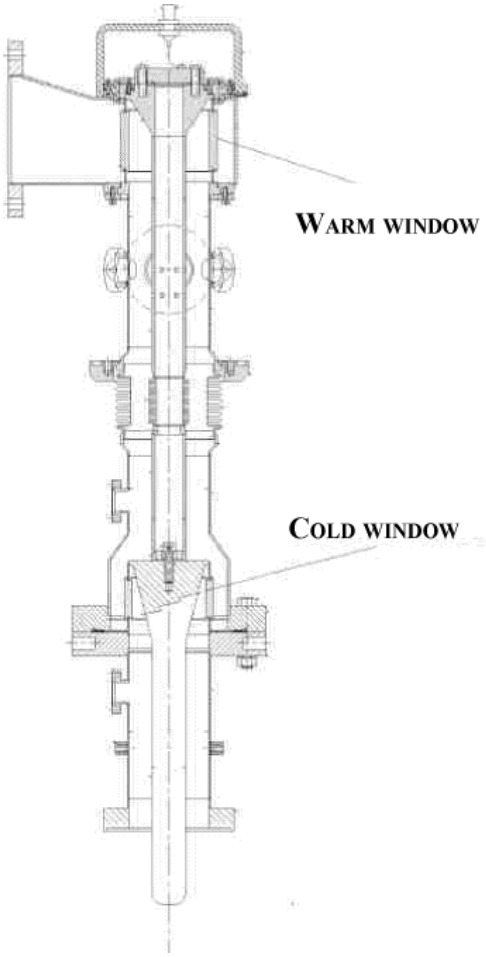

Figure 6 : layout of the TTF 5 coupler

The cold part was scaled to 60 mm diameter and matched at 1,3GHz. The warm part is identical to the TTF3 one. Here again, the tuning of the antenna is not possible. Figures 7 and 8 present the results of the RF simulations.

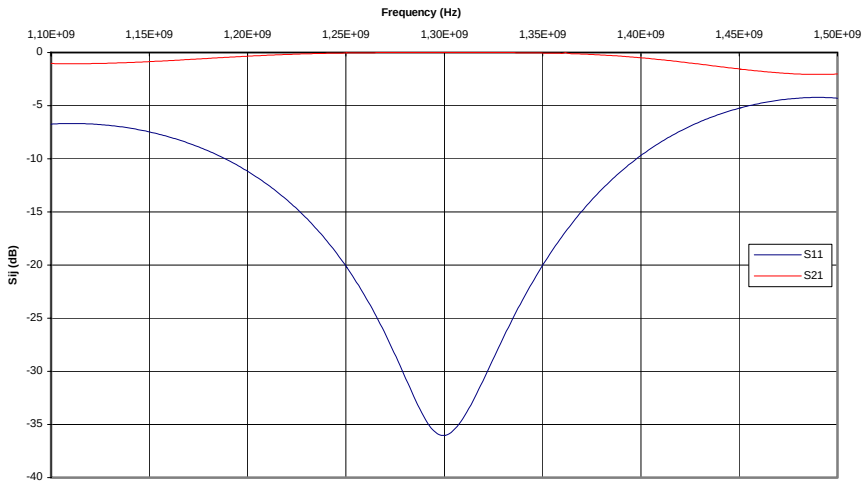

Figure 7 : RF response of the TTF 5 coupler

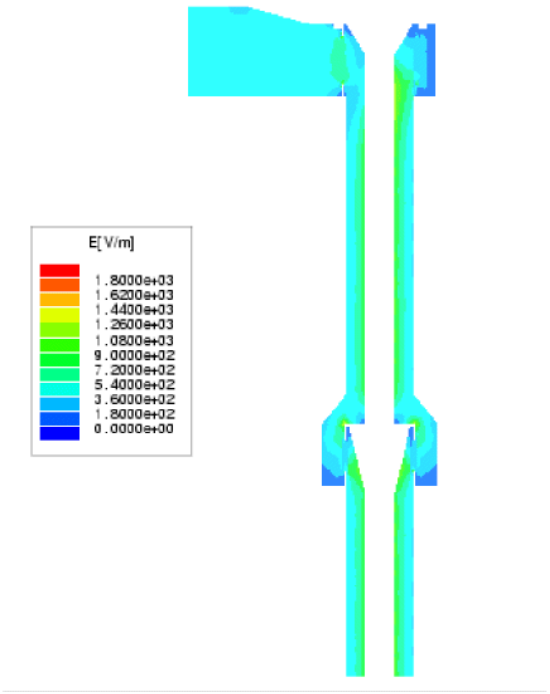

Figure 8 : electric field for 1W of incident power.

As for the TTF3, the maximum of the electric field are localized at the brasing of the windows. The dielectric losses are 0,55W for the cold window (assuming 2kW of average power).

3/Further developments :

At this step, a complete thermal study is needed. Tunable prototypes of these couplers can also be designed. Nevertheless, two couplers of each type will be built and tested up to 1MW. The results will be used to validate the design of these prototypes.