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FABRICATION AND COLD TEST OF THE CORRECTION CAVITY CHAIN FOR KLYSTRON-BASED CLIC

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Abstract

A proposed RF scheme based on correction cavity chain and storage cavity (CC-SC scheme) for klystron-based CLIC has the ability to generate flat output pulses. In the scheme, the correction cavity chain modulates the amplitude of the input pulse, while the storage cavity compresses the amplitude-modulated pulse. Resonant cavities of the correction cavity chain are of a relatively low unloaded quality factor and of small size, which results in the compactness of the RF scheme. The first prototype of a correction cavity chain was fabricated and cold tested at Tsinghua University. The results of the cold test showed that the correction cavity chain is of good performance.

INTRODUCTION

The klystron-based Compact Linear Collider (CLIC) proposed a novel RF system based on correction cavity chain to generate flat pulse which is required for multi-beam acceleration. The prototype was designed for the output pulse length of 244 ns with power gain of 4.3[1]. The correction cavity chain consists of 4 RF polarizers and 8 small spherical cavities. They modulate the amplitude of the input pulse and generate RF pulse with shape of sawtooth. A SLED-type pulse compressor can compress the pulse with shape of sawtooth and generate RF pulse with flat top. In this note, the mechanical design and the cold test of the correction chain are described.

MECHANICAL DESIGN

Figure 1 shows the mechanical design of the correction chain with two vacuum pumping ports.

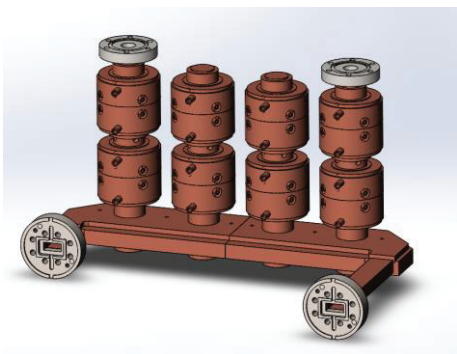

Figure 1: Mechanicl design with vacuum pumping port.

The geometrical parameters for the spherical coupled cavity chain with two different operation frequencies are shown in Fig.2. The parameter *rh1* determines the frequency of single spherical cell. The frequencies are modified by changing the value of *rh1* as is shown in Fig.3. The parameter *hmm* can modify the frequency difference of the two operation frequencies of the coupled cavity chain as is shown in Fig 4. There are 4 coupled cavity chain for the correction cavity chain. Due to these geometrical parameters, all the spherical cell have the same radii.

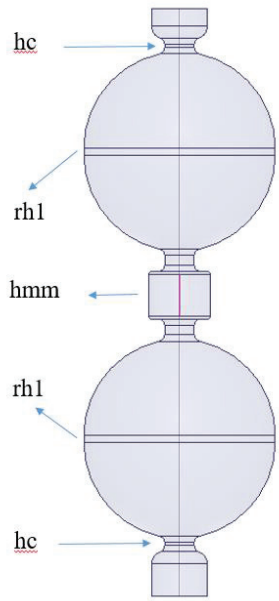

Figure 2: Geometrical parameters for different frequencies.

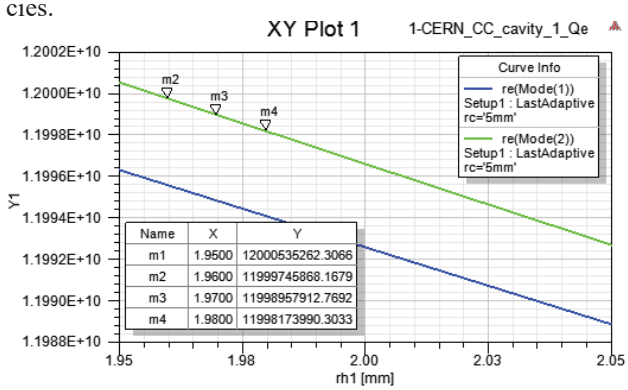

Figure 3: Tuning frequencies of the two operation frequencies.

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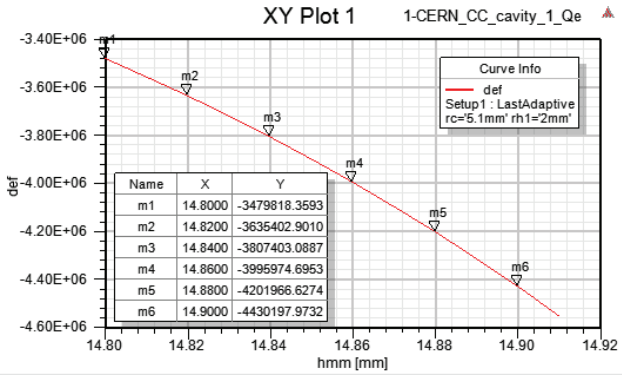

Figure 4: Tuning frequency difference of the two operation modes.

MODE LAUNCHER FOR COLD TEST

In the coupled cavity chain, there are two orthogonal polarized modes for each operation frequency. A mode launcher was designed to measure the frequency of the modes with different polarizations. The RF design is shown in Fig.5. The mode launchers under test are shown in Fig.6 and the results are shown in Fig.7. From the 11.9 GHz to 12.1 GHz, the S_{11} and S_{22} are below -20 dB as is shown in Fig.7.

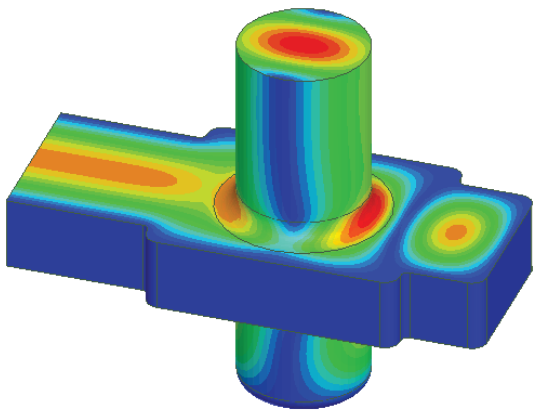

Figure 5: Electric field of the mode launcher for cold test of the correction cavity chain.

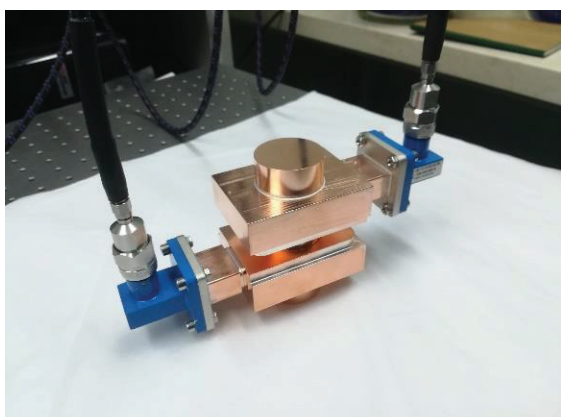

Figure 6: The mode launchers under test.

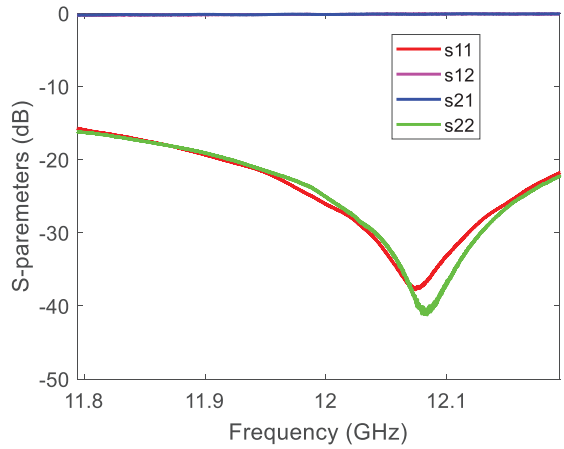

Figure 7: Measured S-parameters of the mode launcher.

COLD TEST

Figure 8 shows the coupled cavity chain under test. And the result of the measurement is shown in Fig.9. The shapes of the s-parameters of the coupled cavity is similar with the designed ones. However, before brazing the coupled cavity chain the unloaded quality factor is lower than the designed values. The frequencies of 4 different polarizations are measured as is shown in Fig.10. After tuning all the cells by cutting of a little bit of the spherical cell, the frequencies of different polarizations are tuned to the values which are very close to the designed ones as is shown in Fig.11. And the frequency difference after brazing the correction cavity chain will be compensated by the tuning holes on the surface of the coupled cavity chain.

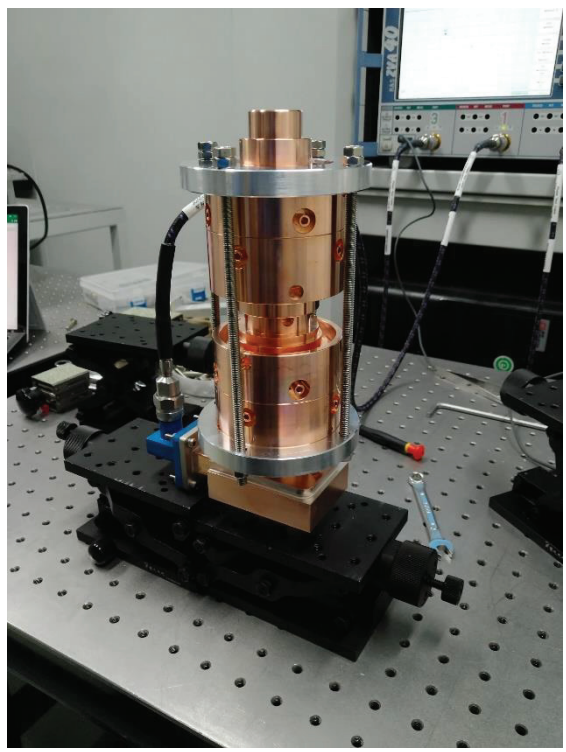

Figure 8: The coupled cavity chain under test.

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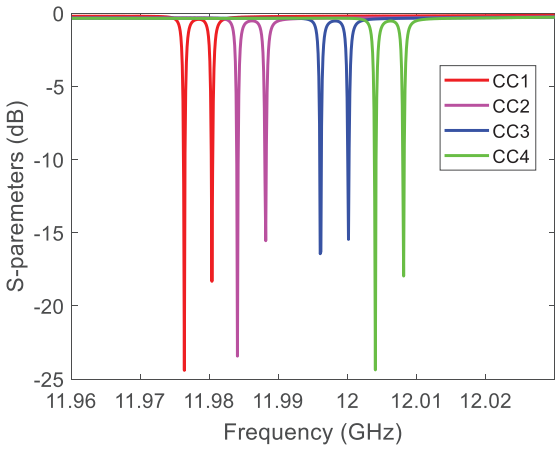

Figure 9: S-parameters of the coupled cavity chains.

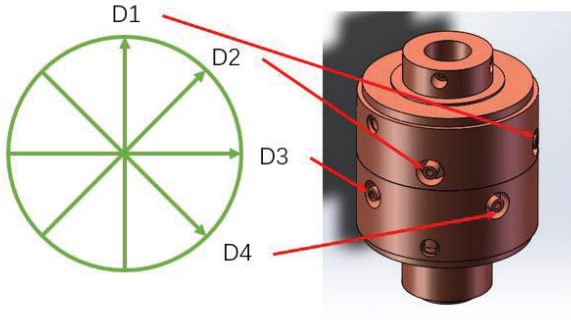

Figure 10: Tuning holes for different polarizations.

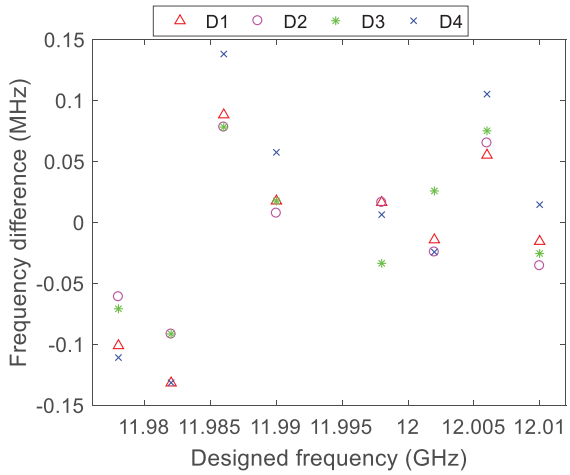

Figure 11: Results after tuning.

CONCLUSION

We fabricated a correction cavity chain for the klystron-based CLIC. A mode launcher was designed and fabricated for testing the correction chain. The results of the cold test shows that the correction cavity chain is of good performance at this stage. In the near future, it is will be tested with high power microwave at CERN.

REFERENCES

[1] P. Wang, H. Zha, I. V. Syratchev, *et al.*, "RF design of a pulse compressor with correction cavity chain for klystron-based compact linear collider", *Phys. Rev. Accel. Beams 20 (2017)* 112001.