Effect of the Electron Beam Misalignments on a Continuously Frequency-Tunable Gyrotron

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***Abstract*—The effect of the electron beam misalignment on the operating frequency, the frequency-tunable range and the beam-wave interaction efficiency for a continuously frequency-tunable gyrotron has been investigated. It is found that the influence of the misaligned electron beam is significant, the electron beam misalignments should be taken into account and avoided in the design and fabrication of a continuously frequency-tunable gyrotron.**

I. INTRODUCTION

NUCLEAR magnetic resonance (NMR)has been applied in many fields such as physics, chemistry, biology, material science, medicine and geology. However, the low sensitivity and the spectral resolution of NMR limit its application. Dynamic nuclear polarization (DNP) driven by a THz continuously frequency-tunable gyrotron can enhance the sensitivity of NMR [1]-[2] However, the fabrication of a gyrotron is complex and there are some possibilities of magnetron injection gun misalignments, which will cause a misaligned electron beam, as shown in Fig. 1. The distance between the misaligned electron beam axis and the concentric electron beam axis is *d*.

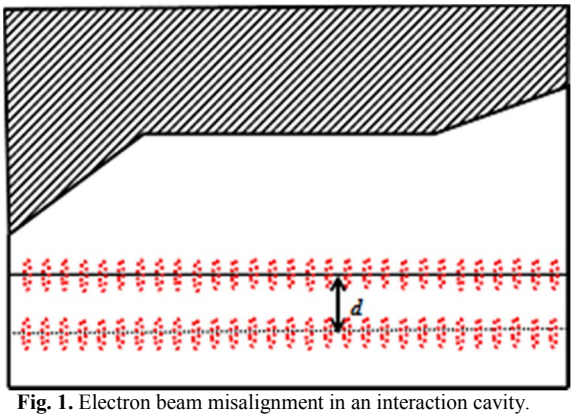

Fig. 1. Electron beam misalignment in an interaction cavity.

II. RESULTS

Fig. 2 and Fig. 3 present the effect of misaligned electron beam on the operating frequency and the beam-wave interaction efficiency. Fig. 2 shows that the operating frequency has a small change and the frequency-tunable range remains around 1.3 GHz when *d* is increased. Fig. 3 presents that the beam-wave interaction efficiency η is varied with *d* when it changes from 0mm to 7mm. Generally speaking, η decreases with the increase of the parallel shifted distance, and the decrease of η is more obvious for a higher order axial mode.

III. SUMMARY

The result present that the misaligned electron beam has a significant effect on the operation of the frequency-tunable gyrotron. In the fabrication and assembly of a frequency-tunable DNP/NMR terahertz gyrotron, the misaligned electron beam should be taken into account and avoided.

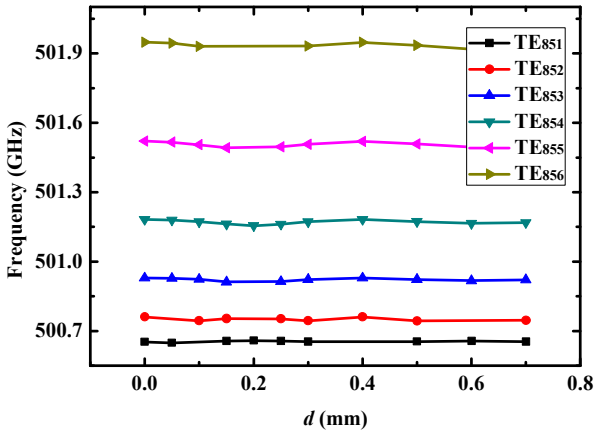

Fig. 2. The operating frequency versus *d*.

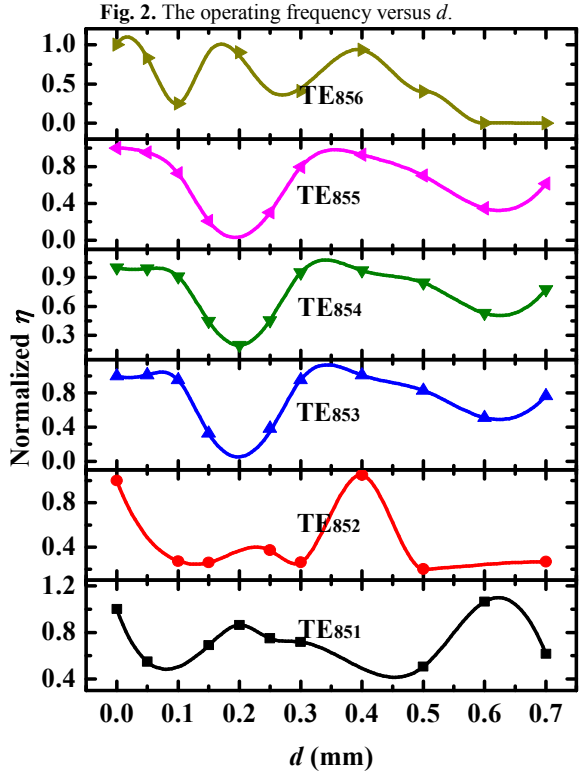

Fig. 3. The normalized beam-wave interaction efficiency η . versus *d*.

REFERENCES

[1]. E. A. Nanni, A. B. Barnes, R. G. Griffin and R. J. Temkin, "THz Dynamic Nuclear Polarization NMR," *IEEE Trans on Terahertz Science and Technology*, vol. 1, no. 1, pp. 145-163, Sep. 2011

[2]. S. Jawla, Q. Z. Ni, A. Barnes, W. Guss, E. Daviso, J. Herzfeld, R. Griffin and R. Temkin, "Continuously Tunable 250 GHz Gyrotron with a Double Disk Window for DNP-NMR Spectroscopy," *J Infrared Millim Terahertz Waves*, vol. 34, no.1, pp.42-52, 2013.