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Tue-Af-Po2.24-02 [101]: 30 T pulsed magnet designed for an 800 GHz gyrotron

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Gyrotron is a promising source of high-frequency, high-power RF radiation for plasma heating, ESR spectroscopy, new medical technology and so on. The magnetic field system, which controls the trajectory of the electron beam and the cyclotron frequency of electrons at the resonator cavity, is one of the key parts of the gyrotron. According to the theory of electron cyclotron masers, an 800 GHz gyrotron requires magnetic fields of up to 30 T to operate at fundamental harmonic. The prohibitively expensive commercial superconducting magnet can just allow magnetic field of up to 12-15 T. But fortunately, Pulsed magnets with a maximum magnetic field up to 100 T have a relatively lower cost and simpler geometry.
In this paper, the design of a compact 30 T pulsed magnet for an 800GHz gyrotron will be proposed. The magnet has a large bore with a diameter of 80 mm for the installation of resonator tube. The magnetic field profile is given by the design of electron optics. So the magnet geometry was optimized by genetic algorithm. Then a simple one coil magnet system has been obtained. The inner radius, outer radius, and the height of the coil are R1=44.26 mm, R2=172.61 mm, and H= 352 mm respectively. A small filling factor of 28% was adopted to reduce the resistance of the magnet. Six coil layers were winded separately, and then connected by special designed copper joints. Each layer of conductor was also been reinforced by glass fiber. The magnet is powered by 5 modules of 25kV/1MJ capacitor backs. The 800GHz gyrotron can work at fundamental harmonic with the magnetic field of 29.6 T, and also at second harmonic with the magnetic field of 14.8 T.

Primary author: Dr WANG, Pengbo (Huazhong University of Science and Technology)

Co-authors: Mr LI, Xiaofeng (Huazhong University of Science and Technology); Prof. XIAO, Houxiu (Huazhong University of Science and Technology); Prof. LI, Liang (Huazhong University of Science and Technology); Mr CHEN, Xianfei (Huazhong University of Science and Technology,)

Presenter: Dr WANG, Pengbo (Huazhong University of Science and Technology)

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