MASSLESS SEPTUM WITH HYBRID MAGNET

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Abstract

A massless septum magnet with shorter transition length is calculated. Electromagnets and electro-permanent hybrid magnets, which produce 8kG at extraction region with a gap height of 40mm, are compared. The transition region is less than 40mm with the minimum gap height of 30mm, which is achieved by extra poles at the gap. Because no magnetic field is produced in the circulating beam region, it does not disturb the circulating beam.

1 INTRODUCTION

For high energy and high intensity synchrotrons, even a small fraction of beam losses would make serious radio activities in its components and peripherals. Such beam losses should be kept as small as possible for many aspects such as the maintenance problem. Among the components, a septum for slow extraction may be the most serious one. This paper describes a possible massless septum magnet[1] with a short transition region compared with the conventional one that is an extension of a Q magnet structure[2].

The gap heights at the circulating beam region, transition region and extracted beam region are assumed as 80 mm 30 mm and 40 mm, respectively. The magnetic field at the extracted beam region is targeted at 8 kG, and thus the required coil current is 25600 AT (Bl/μ_0). Allowable current density in a coil region is assumed less than 50A/mm^2 (60A/mm^2 in Cu).

2 ELECTRO-SEPTUM MAGNET

Figure 1 shows a septum magnet only with electro-magnet and the magnetic field plots at Y=0., 5., and 10. mm. The extra pole at the left suppresses the long tail and minimizes the interference in the circulating beam region, which can be recognized as a field clamp. Because the transition length cannot be much smaller than the half gap height *g*(=15mm) at the transition region, the minimum distance between the inner pole and the outer pole is chosen as 15 mm. The current density is 43.3 A/mm^2. The right pole has saturated region at the pole tip. The transition length is less than 40mm. The magnetic field distribution plots are magnified in fig. 2.

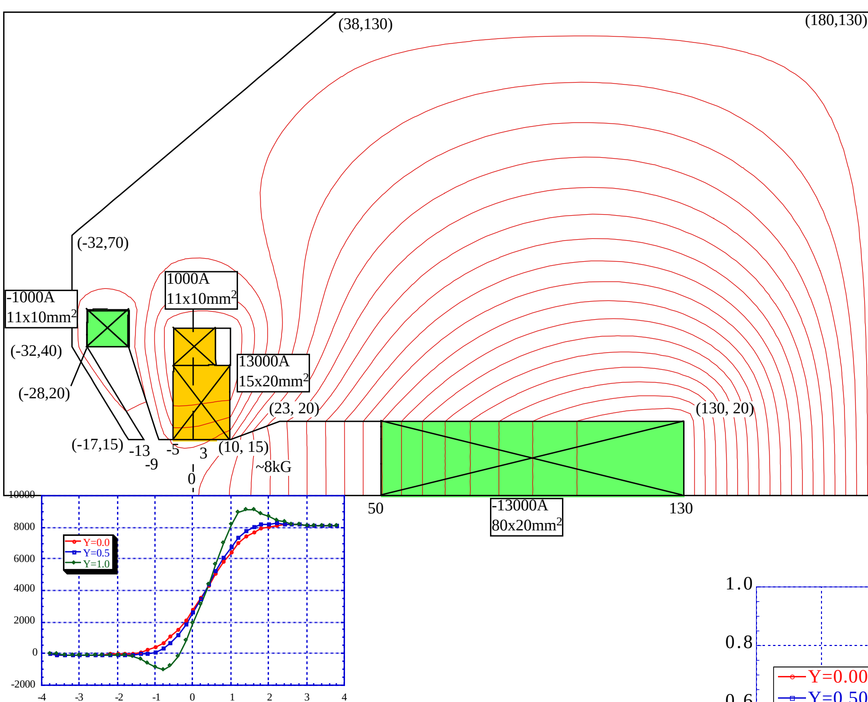

Figure 1: Electro-Massless Septum Magnet. (without permanent magnet)

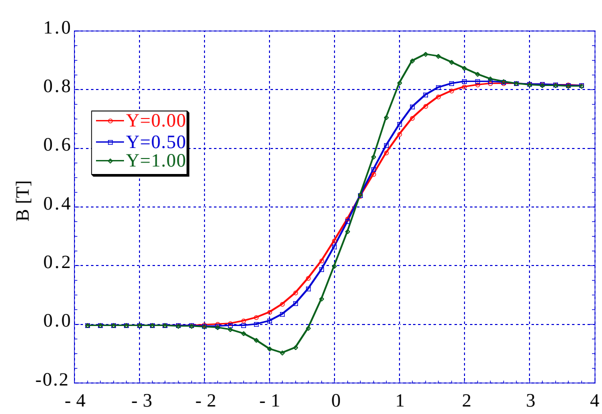

Figure 2: Magnified Magnetic field distribution of Fig.1.

3 HYBRID SEPTUM MAGNET

Figure 3 shows the hybrid massless septum magnet and its flux plot calculated by PANDIRA. The magnetic field distributions at Y=0., 5., and 10. mm are also shown. The circulating beam region (left side) has small magnetic field so as to keep the closed orbit. The magnetic field distribution plots are magnified in fig. 3.

In order to decrease the total flux between the poles, the distance is increased at the outer region and the space is filled with permanent magnet (NEOMAX 35H). The permanent magnets are vertically oriented so that the demagnetization would be prevented.

The transition length is slightly shorter than the electro-magnet version. The advantage of the hybrid version is also the small current density of the coil conductors (8.125A/mm^2), which reduces the power dissipation and requirements for the power supply.

4 DISCUSSION

The demagnetization of the permanent magnets in high radiation field should be investigated. The coil windings may have to be modified for practical fabrication.

REFERENCES

[1] Y. Iwashita, "A possible Massless Septum Magnet for High Intensity Synchrotrons", Beam Science and Technology, Activity report published by NSRF, Inst. for Chem. Res., Kyoto university, Japan, ISSN 1342-033X, p.14.

[2] T. Watanabe, et al., "Calculation of Field Configurations of the Electric Septum and Massless Septum Magnet for the Slow Extraction System of the JHF Main Ring", Proc. of the 11th Symposium on Accelerator Science and Technology, Oct. 21-23, 1997, SPring-8, Harima Science Garden City, Hyogo, Japan, pp.374-376.

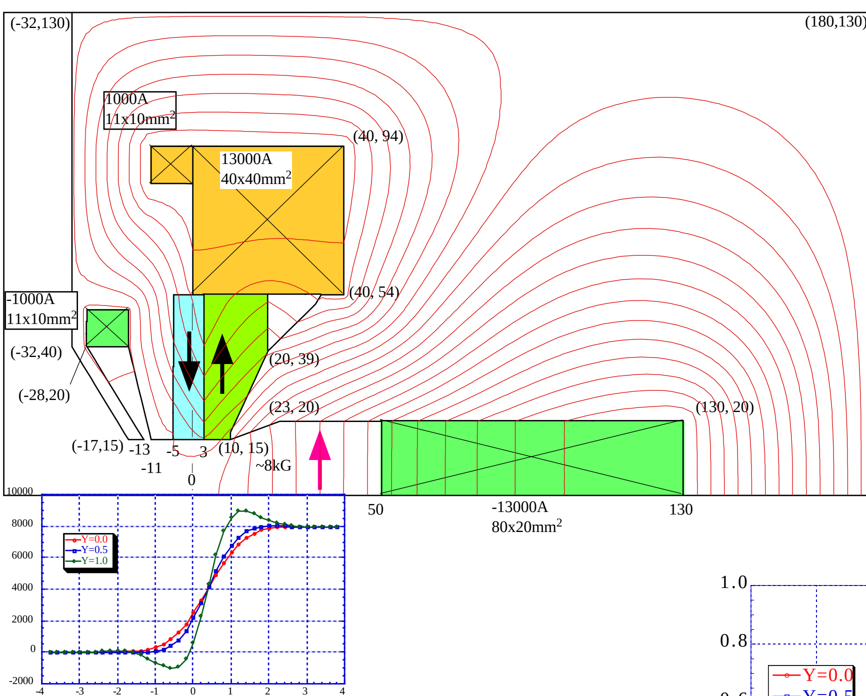

Figure 3: Hybrid Massless Septum Magnet

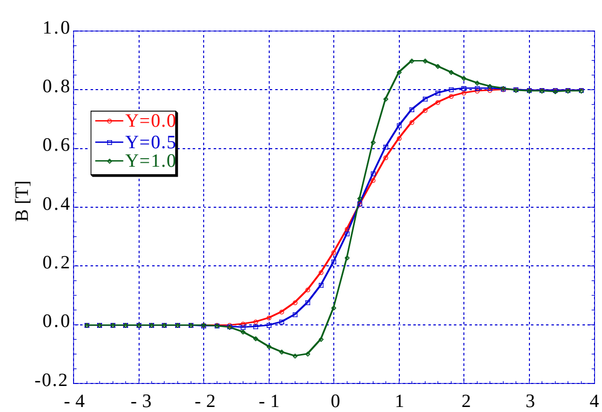

Figure 4: Magnified Magnetic field distribution of Fig.3.