Permanent Dipole Magnets for Future Accelerators

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Cost estimation of permanent magnet material (PM) for dipoles. Used SmCo5 permanent magnets because of higher than NdFeB thermal stability, much higher radiation and corrosion resistances. The magnet model is shown in Fig. 1 having the ferromagnetic pole flux concentrator and gap 10 mm.

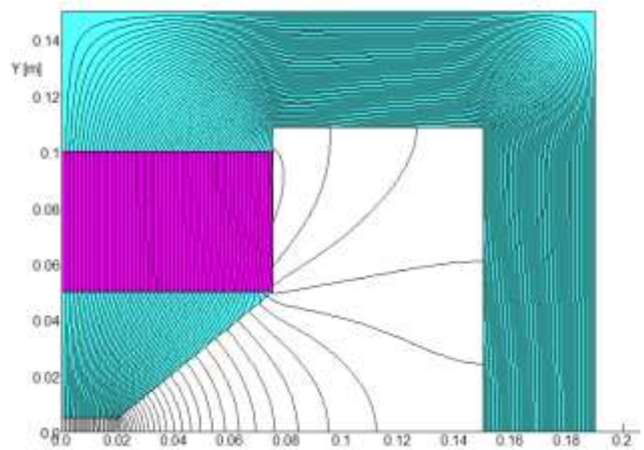

Fig. 1. Magnet flux lines for the 1/4th area.

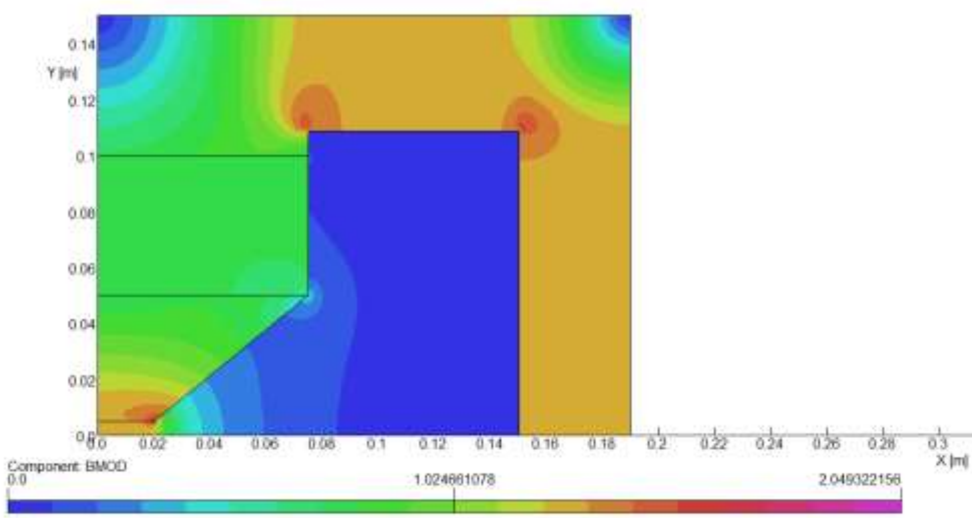

Fig. 2. Magnet flux density. The magnet gap peak flux density Bmax=1.31 T.

In Table 1 shown 3 variants of magnets for the gap 10 mm, 10 mm width of good field area but different volume of PM for 1 m magnet length. The PM height was 50 mm. The cost of SmCo5 for NOVA magnets was 58.8 $/inch^3 or 3.6 M$/m^3.

Table 1

PM width, mm	**Gap field, T**	**PM volume/m, m^3**	**PM Cost/m, k$/m**
25	0.6	0.005	18
50	1.02	0.01	36
75	1.31	0.015	54

The magnet other parts, including the complicated assembly and calibration might double the cost.

For the room temperature magnet the copper cost now is 3.7 $/lb or 8.2$/kg. For the air cooled magnet with current density 1 A/mm^2 and 1 T gap field needed 150 kg/m of copper. If we even suppose the cost of coil 20$/kg, the coil cost will be 3000 $/m.

For the superconducting magnet the NbTi cost will be only 200 $/m.

Total rather small accelerator magnet costs usually in the range of 10-30 k$/m.