APPENDIX C

BACK IRONS: THICKNESS

The thickness of each back iron, shown in Fig. 4.3b, has to be determined carefully. Indeed, decreasing their thickness reduces the section crossed by the flux, leading to a higher magnetic flux density. It has thus a considerable impact on the magnetic saturation in the material. Let us determine the minimal thickness allowing to avoid the saturation. To this end, the magnetic flux density in the back irons due to the permanent magnets is calculated for thicknesses ranging from 2 to 3.5 [mm] by step of 0.5 [mm], through finite elements simulations with COMSOL. The norm of the magnetic field in the back irons reaches its maximal value in the radial sections comprising the boundary between two consecutive PMs. Indeed, the flux enters axially the back irons through a large surface and is then concentrated as it goes through these small radial sections. More precisely, the magnetic field attains its maximum along the internal edges of the back irons in these radial sections, as can be seen in Fig. C.2. Fig. C.1 shows the resulting norm of the magnetic field along these edges for different thicknesses. Given that high permeability iron alloys start saturating around a value of 1.2 [T], it can be remarked that the minimal required thickness is 3.5 [mm], while maintaining a safety factor.

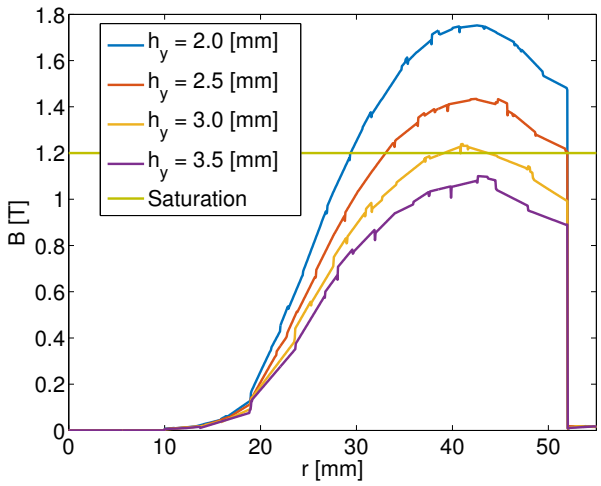

Fig. C.1: Norm of the magnetic flux density along the internal edges of the radial section.

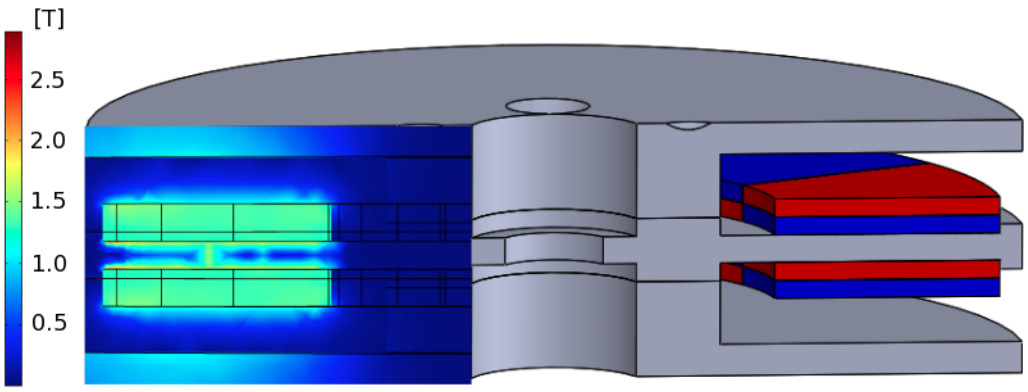

Fig. C.2: Norm of the magnetic flux density in a radial section comprising the boundary between two consecutive PMs.