Demagnetizing fields

This is also an important point to be taken into account. The big fields involved in the device can also cause some demagnetization of permanent magnets. The simulations done so far (see Figure 6) indicate that a high coercitivity of at least 1010kA/m is required.

This is also an important point to be taken into account. The big fields involved in the device can also cause some demagnetization of permanent magnets. The simulations done so far (see Figure 6) indicate that a high coercitivity of at least 1010kA/m is required.

Figure 6. Demagnetizing field at Central block. Maximum demagnetizing is -1007 kA/m.

DESIGN OF A SHORT MULTIPOLE WIGGLER AND THE FRONT END FOR THE NEW ALBA BEAMLINE FAXTOR

J. Campmany†, J. Marcos, V. Massana
ALBA-CELLS, Barcelona, Catalonia, Spain

IPAC21
MOPAB085

INTRODUCTION

FAXTOR is a new hard XR tomography beamline that is being built at ALBA to fulfil the needs that cannot be currently covered by the MISTRAL VUV and soft XR beamline.

This new beamline needs a source size smaller than 310 μm horizontal and 25 μm vertical, as well as a high flux, larger than 1012 Photons per second through an aperture of 4x1 mm2 in the energy range 5 - 60 keV, for an electron beam current of 250 mA. The contract for the manufacturing of the ID has been awarded to AVS-US Company. In this paper we present the conceptual model for the insertion device developed at ALBA and the implementation proposed by the manufacturing company.

ID REQUIREMENTS

FAXTOR beamline is aimed at performing fast X-ray microcomputed tomography at high resolution. The beamline is foreseen to operate in both absorption and phase-contrast regimes. The scientific requirements include a small source size in order to attain a high spatial resolution, better than 0.7 μm, a large divergence, and a high photon flux in the range between 30 and 50 keV. In particular, at an energy of 30keV the specification is to obtain a flux of at least 4×10^{13} Ph/s/0.1%BW through an angular opening of $1\times0.4\text{mrad}^2$ for an electron beam current of 400mA. In order to fulfil these scientific requirements the initially proposed source was a wavelength shifter with a central pole achieving 3 T and two satellite poles to compensate the field integral. However, upon further development the proposal was changed into a short multipole wiggler in order to enhance the photon flux while keeping the source size small enough. The resulting device was an in-vacuum wiggler of hybrid type with only 5 periods and a period length of 50 mm. The peak field achieved in that model using RADIA simulation was 2.5 T, enough to fulfil the requirements.

Device type	wiggler
Magnetic configuration	Planar hybrid
Technology	In-vacuum
Period length	50±0.02 mm
Number of periods	5.5
Maximum magnetic length	362.5 m
Magnetic minimum gap	5.2 mm
Minimum physical gap	5.0 mm
Gap range (magnetic)	5.2 mm to 30 mm
B_0 value at minimum gap	2.5 T
K value at minimum gap	11.5

The manufacturing of this device was tendered and the winner was the AVS-US company as published on September 22nd of 2020 and the contract was signed on October 10th of the same year This company proposed a different design, changing the period from 50 to 54 mm and lowering the peak field from 2.5 to 2.45 T. The change was justified, as they said, to avoid the demagnetization forces during assembly, leading to a new design as presented in Figure 1

Magnet blocks are box-type with chamfers in edges allowing clamp fixations to prevent demagnetization. Mechanical tolerances have been assumed to give changes in the peak field smaller than 0.1%. Selected magnetic material is NdFeB with remanence Br = 1.34 T and coercivity μ0HCJ ≥ 1.5 T. Poles will be made of high permeability Vanadium Permendur.

The AVS-ALS model of central and side blocs, and pole dimensions are specified in Tables shown below

AVS-US MAGNETIC DESIGN

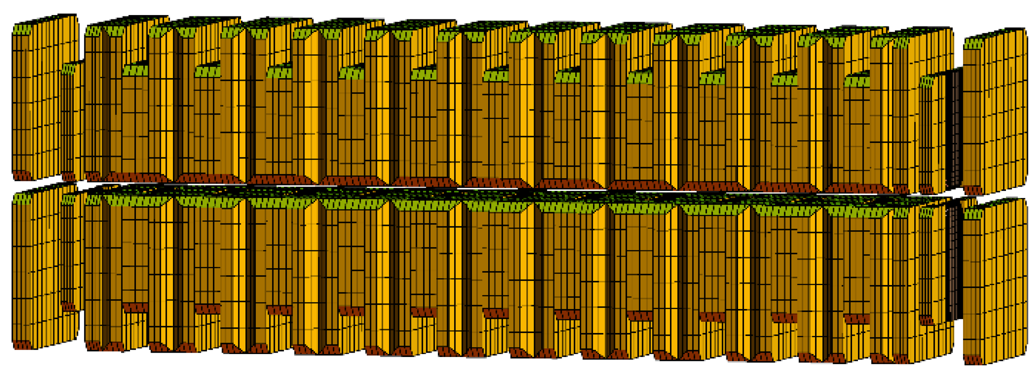

Figure 1. AVS-US Magnetic model generated by RADIA. Yellow parts are NdFeB magnets. Overall length is 0.3625 m, total width is 72 mm, overall height is 125.2 mm (including gap) and minimum gap is 5.2 mm.

Main block	
Width	72.0 ± 0.05 mm
Height	60.0 ± 0.05 mm
Length	8.5± 0.02 mm
Transverse chamfer angle	45.00º
Side block	
Width	17,521 ± 0.02 mm
Height	245.0 ± 0.02 mm
Length	170 ± 0.02 mm
Transverse chamfer side	3.0 ± 0.02 mm
Magnet characteristics	VACODYM 974 DTP
Remanent field	1.25 T
Permeability on axis	1.06
Transversal axis permeability	1.17

Width	30.0 ± 0.05 mm
Height	45.0 ± 0.05 mm
Length	9.9 ± 0.02 mm
Iron type	Vanadium permendur
Transverse chamfer angle	45.00º
Transverse chamfer side	3.0 ± 0.02 mm
Longitudinal chamfer angle	45.00º

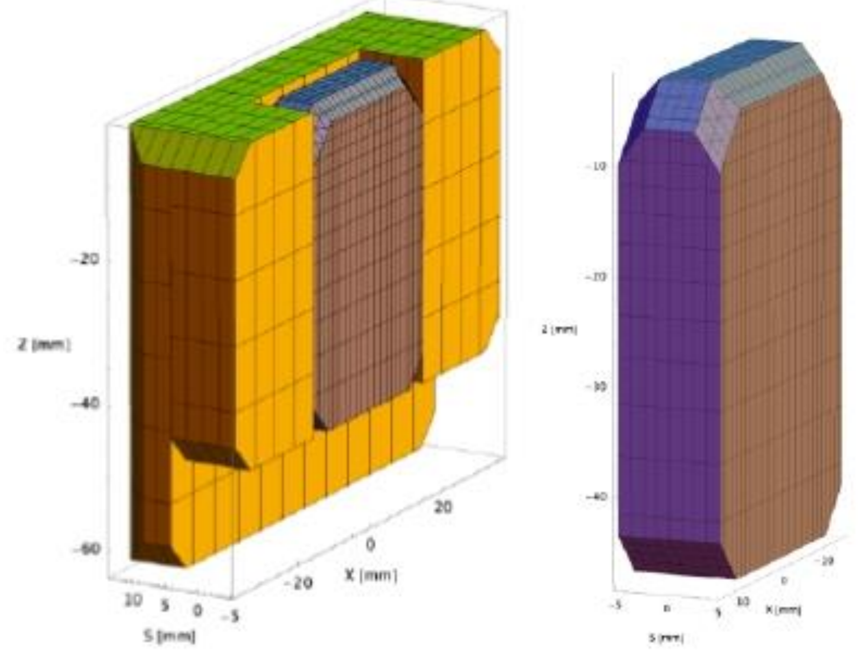

Figure 2. Block and pole shapes

With this magnetic structure, the requirements in terms of flux at high energies can be achieved, as shown in Figure 3, calculated with SPECTRA code

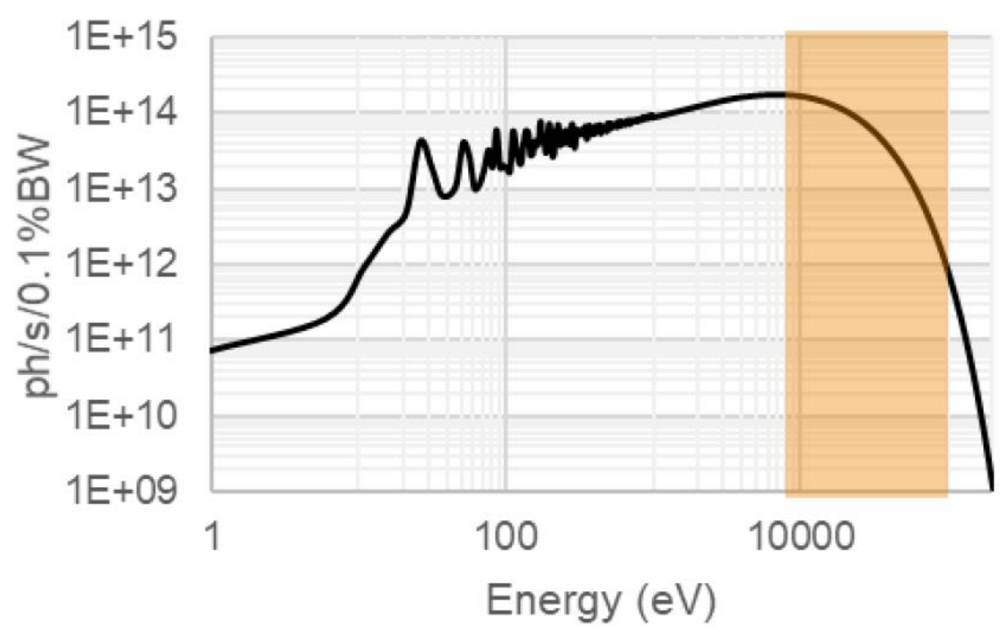

Figure 3: Photon flux density at 5.2 mm gap.

FRONT END (FE)

For the structure of the Front End (FE) the standard configuration used at existing ALBA beamlines [3] has been adapted to the aperture and power requirements of the wiggler source. The limiting aperture of the FE has an entrance acceptance of 3.56×1mrad2, and delivers to the beamline a photon beam with a maximum divergence of 1×0.4mrad2, as requested. As for the power load, the FE masks and shutters are designed to withstand a total power of 3.4kW and a peak power density of 5.0kW/mrad2 (calculated for an electron beam current of 400 mA). An innovation with respect to previously installed FEs at ALBA is that it will be equipped with two X-ray Beam Position Monitors (XBPMs), thus providing information not only on the photon beam position but also on its steering angle. The distance between the 2 XBPMs has been maximized taking into account the geometrical constraints inside the FE, and it will be equal to 2 m. A layout of the FE is shown in Figure below. The FE is currently being manufactured by company FMB-Berlin GmbH (Germany) and will be delivered on June 2022..