

# A new wiggler for the HARWI-II beamline

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The radiation characteristics of the HARWI-II wiggler has to cover the energy spectrum from 30 keV up to several hundred keV as required by the later experiments. The radiation output has been optimized for maximum flux through a  $1 \times 1 \text{ mm}^2$  aperture at a photon energy of  $E = 100 \text{ keV}$  according to the main applications.

A new magnet design has been developed to achieve the large peak field for the specified period length  $\lambda_U = 110 \text{ mm}$ . As it can be seen in Fig. 1, side magnets have been applied additionally to enhance the magnetic flux through the poles. Furthermore, the central magnets consist of two different magnet grades to cope with the necessary coercive field in the near-gap region close to the magnet surface and to maximize the remanent field in the main part of the magnet. All magnets have been characterized in a Helmholtz coil and showed remanence scatter and angular errors within specs. Although the average remanent magnetization exceeds specs by a few percent, the peak field increases only to some extent due to strong saturation of the Vacoflux poles. All magnets have been sorted before assembly to reduce the residual field errors, and field integral measurements with a stretched coil have been performed for all preassembled half period modules before mounting them finally onto the magnet girders.

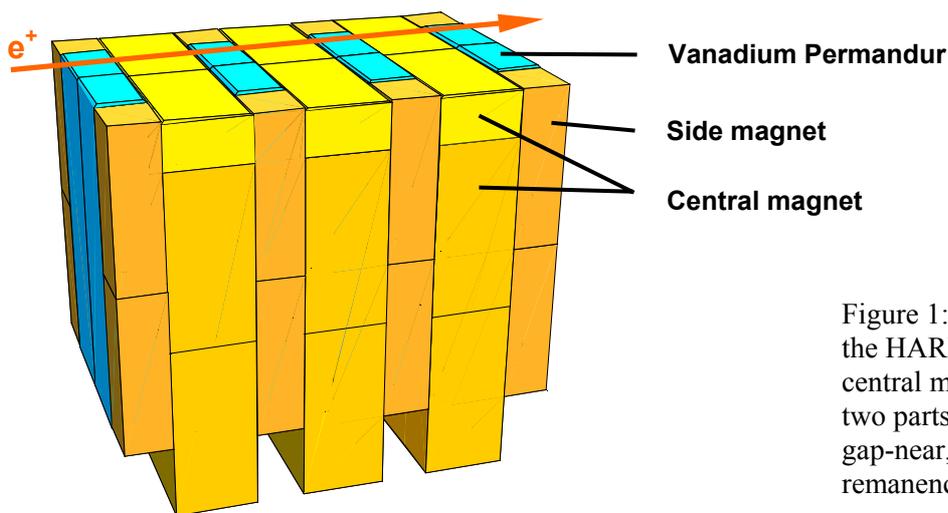


Figure 1: Magnet design of the HARWI-II wiggler. The central magnet consists of two parts, a high coercivity gap-near, and a high remanence volume part.

Due to similar magnetic strength and forces of this new magnet structure and the DORIS wiggler BW5, the same type of gap drive mechanics and magnet girders, as well proven for BW5, could be used.

After mounting and mechanical adjustment of the magnet structures, magnetic measurements have been performed by means of a newly developed Hall-probe/coil hybrid sensor and a moving wire stand. Peak field, field integrals and their gap dependence as well as the multipole content have been optimized in iterative steps. The longitudinal field dependence is shown in Fig. 2 for the minimum gap  $g = 14 \text{ mm}$ . Due to the small ratio of  $g/\lambda_U$  the field distribution is not purely sinusoidal anymore but contains higher order components. A maximum peak field of  $B_0 = 1.98 \text{ T}$  has been determined corresponding to an rms value of  $1.30 \text{ T}$ .

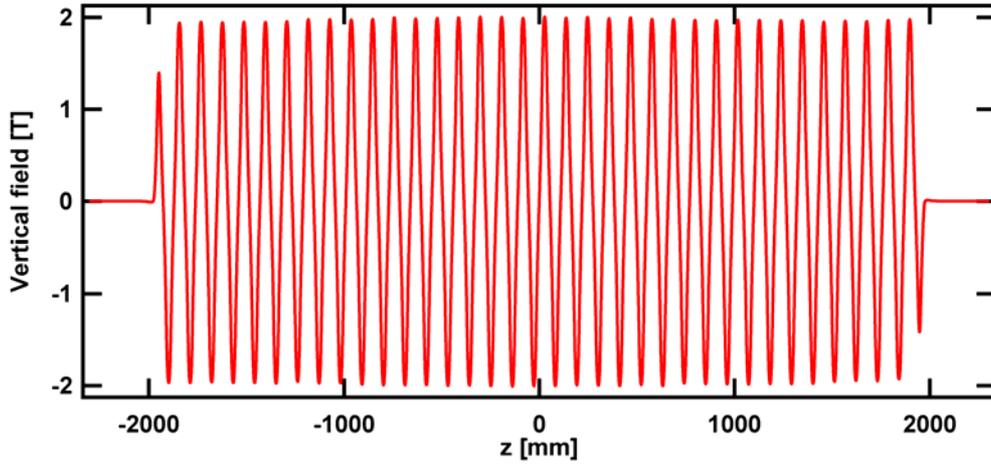


Figure 2: Longitudinal field dependence of the new HARWI-II wiggler for gap = 14 mm.

Several types of iron shims were used to reduce especially the gap dependent variation of the vertical and horizontal second field integrals which finally have been reduced to 2940 Tmm<sup>2</sup> and 469 Tmm<sup>2</sup> corresponding to about 6% and 16% of the horizontal and vertical beam size ( $1\sigma$ ), respectively. The resulting wiggler parameters are summarized in Tab. 1, the derived synchrotron radiation properties relate to the present machine parameters:  $I=150\text{mA}$ ,  $\varepsilon=450\text{nmrad}$ ,  $\beta_x=21\text{m}$ ,  $\beta_y=3\text{m}$ ,  $\eta_x=0.9\text{m}$ .

Period length $\lambda_U$	110 mm
Minimum magnetic gap $g$	14 mm
Peak field $B_0$	1.98 T
Number of periods	35
Deflection parameter $K_{\text{max}}$ (rms)	20.3 (13.4)
Critical energy $E_c$	26.7 keV
On-axis power density	31.9 kW/mrad <sup>2</sup>
Total power	29.0 kW

Table 1: Wiggler parameter and SR characteristics

The new wiggler has been installed in the DORIS tunnel during the summer shutdown this year. A larger modification of the machine had to be done as the new wiggler has not been installed at the previous wiggler location but was moved about 8 m upstream. This allowed to reduce the minimum magnetic wiggler gap to 14 mm. A rearrangement of several machine components was necessary [1]. Additionally, a photon beam absorber was installed behind the wiggler to protect the beam pipe down to the dipole exit chamber. A new design has been applied for the wiggler chamber: It has an elliptic cross section providing a maximum beam stay clear of 11 mm. According to the good experience at CERN and ESRF, the inner surface of the stainless steel chamber has been completely coated by a  $\sim\mu\text{m}$  thick NEG film serving as a pump after thermal activation. Fig. 4 shows the wiggler together with the vacuum chamber installed in the DORIS tunnel. It will go into operation as soon as the photon beamline is completed.

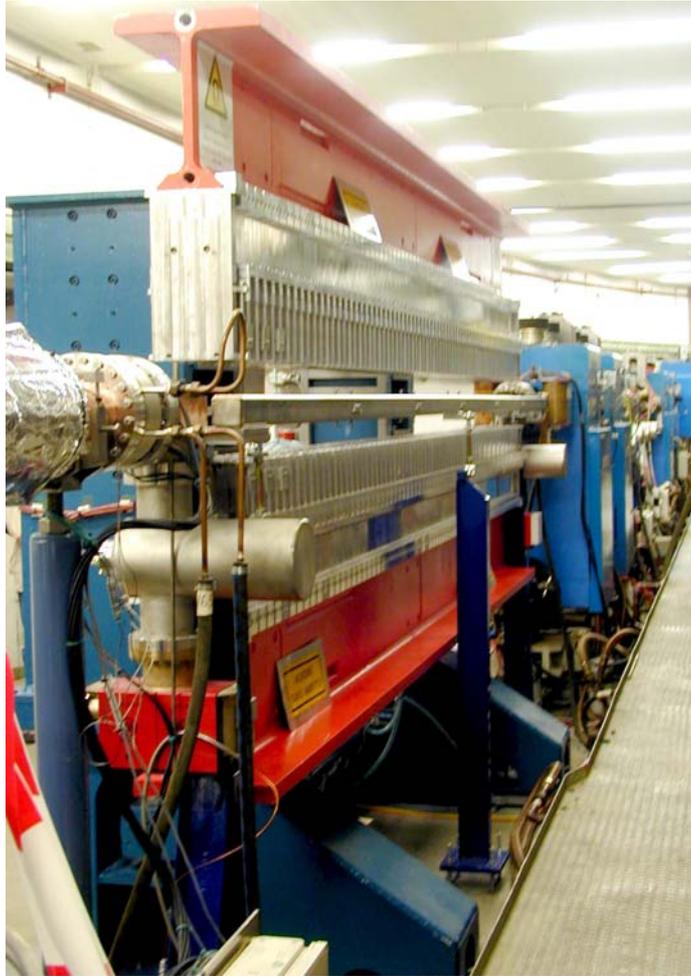


Figure 4: The new HARWI-II wiggler installed in the DORIS tunnel.

## References

- [1] O. Kaul, "DORIS III operation 2004", this volume.