Variable period undulator with tunable polarization

Pavel Vagin* and Markus Tischer

Deutsches Elektronen-Synchrotron, Germany

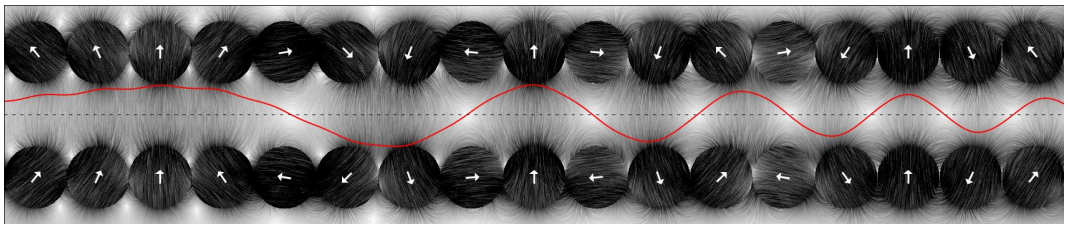
**pavel.vagin@desy.de*

The proposed magnetic structure allows to vary all three parameters of a permanent magnet undulator sinusoidal magnetic field $B(s) = B_0 \sin(2\pi s/\lambda_u + \phi)$: field amplitude B_0, period λ_u, and phase ϕ. The magnetic structure consists of diametrically magnetized cylindrical magnets. The field is adjusted by motorized rotation of each magnet. Individual adjustment of the magnets allows creating an arbitrary shaped magnetic field and also embed other elements like phase shifters [1], dipoles or quadrupoles into the undulator magnetic structure.

An adjustable phase ϕ (longitudinal shift) of the magnetic field allows not only for a planar but also a helical undulator with tunable polarization to be implemented. These devices show brilliance comparable to usual variable gap planar and helical insertion devices, and also have higher wavelength tuning range, especially towards lower photon energies.

Tuning the wavelength towards higher photon energy by adjusting the undulator period, instead of decreasing field amplitude in case of variable gap undulators, is much more efficient for the brilliance of the undulator. The required K value decrease is smaller for the same change of the wavelength and number of periods is increasing. This results in high photon flux despite of lower magnetic field amplitude. Besides, lower magnetic forces simplify the support structure.

For a free electron lasers an undulator with variable period also results in higher pulse energy and wider wavelength range, due to increasing number of periods while tuning the wavelength and thus decreasing saturation length. Such a device covers a wavelength range that otherwise would require several magnetic structures with different periods (e.g. revolver undulator) or adjustment of the electron beam energy, which is an additional constrain when several beamlines share the same accelerator.



Principle of creating variable period magnetic field and vertical field amplitude on-axis.

References

[1] M. Tischer, A. Schöps, P. Vagin, "An adaptive scheme for suppression of higher harmonics in an undulator", these proceedings