



Superconducting Undulators for hard X-ray Free-electron lasers

C. Calzolaio, M. Calvi, R. Kinjo, S. Hellmann, T. Schmidt, G. Montenero, and S. Sanfilippo

ABSTRACT

To produce hard X-rays with a wavelength down to 0.03nm, harmonic lasing and inter-undulator chicanes are proposed [1]. High K-value (K=2.4), low period (λ_u =10 mm) and small gap (g=4 mm) undulators are needed. To achieve these performance, high temperature superconductor bulk materials are a possible enabling technology. In this work we present a detailed FEM magnetic model which has been at first benchmarked against the experimental results produced by R. Kinjo et al. at Kyoto University and then used to analyze a larger diameter configuration working at higher field. An outlook for further experimental characterization of the superconducting materials is finally addressed.



HTS bulks magnetized to produce the undulator field







3D modeling:

3D Simulations Results on 8 periods

Screening currents induced by the external applied field





Conclusions

At Kyoto University GdBCO bulks have \bullet been tested showing the potentiality to reduce λ_{μ} keeping a reasonable gap size.

A FEM model based on the H-formulation has been developed to simulate the effect of the bulks magnetization including thermal and mechanical effects.

The model can be used to optimize the system.

HTS properties should be measured.

References

[1] T. Schmidt, M. Calvi & G. Ingold (2015) Undulators for the PSI Light Sources,

Synchrotron Radiation News, 28:3, 34-38, DOI: 10.1080/08940886.2015.1037681

[2] R.Kinjo et al., Applied Physics Express 6 (2013) 04270