

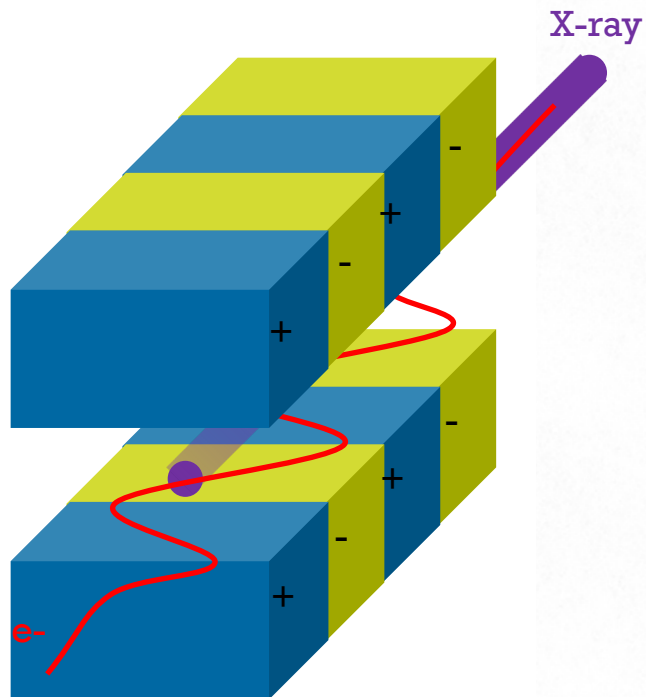


Introduction to Superconducting Undulators

Snowmass CPM

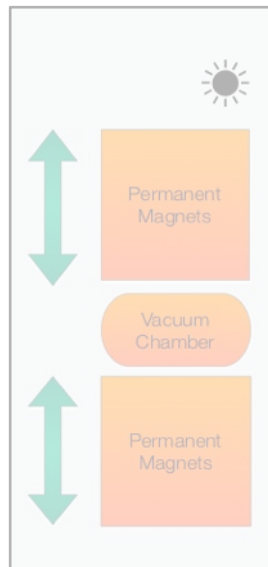
C. Boffo, 2020.10.06

Concept



KARA Ring at KIT,
Karlsruhe, Germany

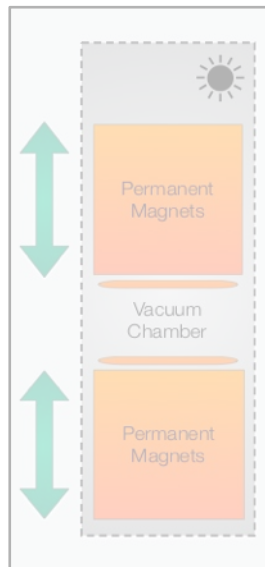
Undulators



Permanent Magnet Undulator

Traditional design
Controlled env.
Cheaper design

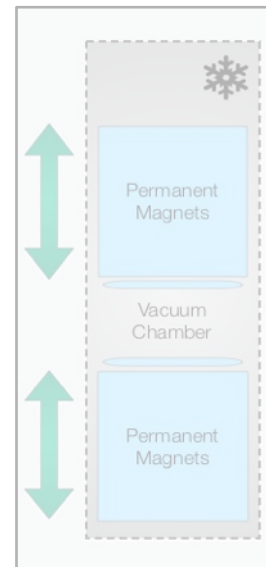
Low performance



In Vacuum Undulator

UHV vacuum pipe
Reduced distance of
magnets

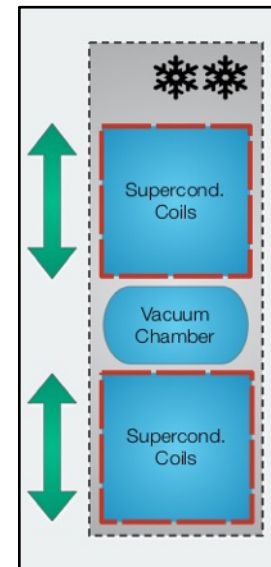
Good performance



Cryogenic Undulator

Improved B field
Increased complexity

Better performance



Superconducting Undulator

Highest B field
4 K design
Electromagnet

Best performance

SC Undulators Status

Planar and helical NbTi devices operate in rings (ANL APS, KIT KARA)

Nb₃Sn and 2G HTS demonstrators have been built

Most active institutions

US: ANL, LBNL, FNAL
EU: STFC, KIT, XFEL, PSI
China: SHINE
Russia: INP-Budker

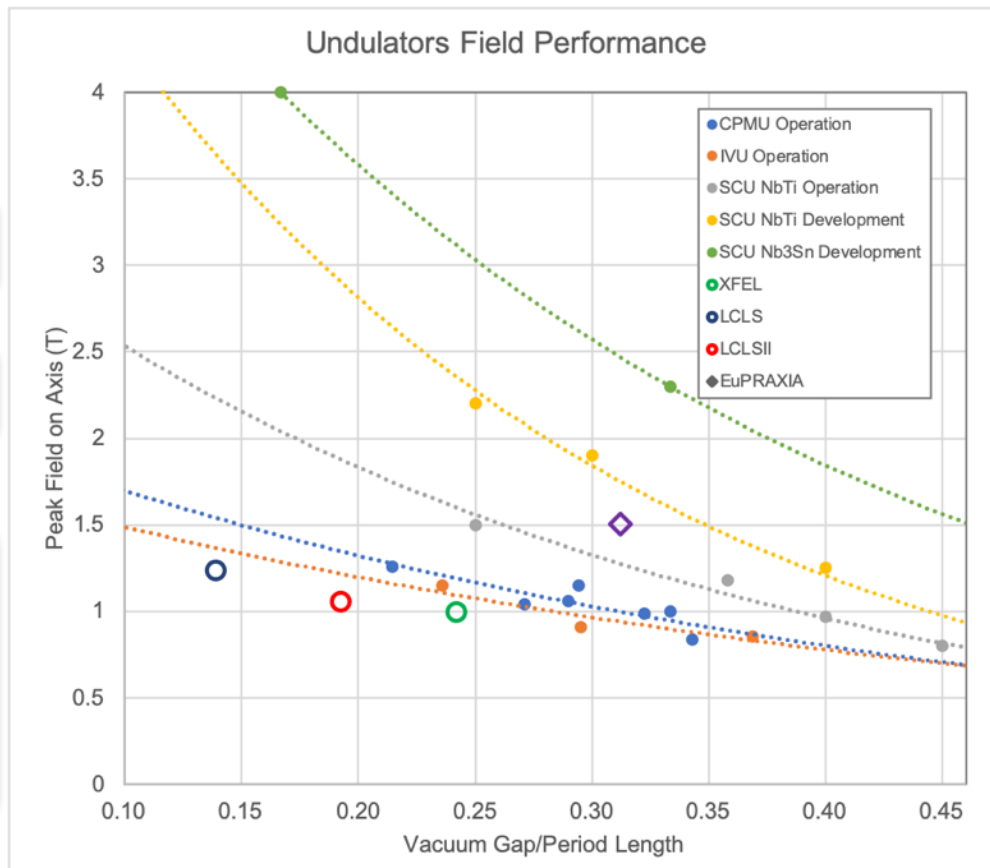


Chart based on: <https://doi.org/10.1016/j.nima.2018.03.069>

SCUs for: ILC, HEP and FELs

- **Helical SCUs for the ILC polarized positron source:** potential for higher field on axis, shorter length, larger aperture.
- **HTS wigglers for the ILC damping rings:** potential for improved radiation tolerance and machine reliability
- **EuPRAXIA undulator line:** considerably increases operation flexibility
- **Gamma-Gamma colliders:** potential to improve machine performance
- **New FELs and SRs:** allow reaching higher beam energies and harder x-ray ranges
- **Existing FELs and SRs:** significant machine upgrade with minimal investment

