Preliminary Magnetic Design of Room Temperature NSLS2 Dipoles
Overview

Preliminary 2d design for
(a) Curved 60 mm good field aperture magnet
(b) Straight 90 mm good field aperture magnet

Preliminary 3d design calculations
• Iron cap to cut field fall off beyond magnet ends
• A possible design concept to significantly reduce loss in space due to magnet ends

Basic design assumptions
(a) Copper current density : 2 Amp/mm²
(b) Vertical iron gap 34 mm
Magnetic Models of 3 kG Magnet Designs for Light Source 2 (LS2)

Water-cooled copper magnet
60 mm good field aperture (curved)
Current Density = 2 A/mm²

Water-cooled copper magnet
90 mm good field aperture (straight)
Current Density = 2 A/mm²
Field Quality in Preliminary Design

Good field quality in 60 mm aperture in curved magnet

Good field quality in 90 mm aperture in straight magnet

These are preliminary conceptual designs. Nevertheless the field quality requirements of a few parts in $10^{-4}$ have been obtained by shaping the pole (5 mm max, vertically).

Pole profile is shaped for field quality

Pole profile is shaped for field shaping (maximum 5 mm used in half height)
**Guidance on Coil Design**

Coil dimensions in design 1:
80 mm X 28 mm

Coil dimensions in design 2:
40 mm X 56 mm

- What is the preferred direction for coil cross-section?
- Should coil be further above the pole tip?
- Should they be lifted/tilted on one side (left side)? In the ends?
Field in Iron With Fe Cover in the Ends
Field Away From The Magnet
With and Without Fe Cover

With Fe cover

Without Fe cover

Component: -BY, Integral = 7.3267067833926
Component: -BY, Integral = 6.7520374387569
An investigation to see if magnetic length can be determined by pole only and loss in length due to coil ends can be freed-up for other purpose.
Magnet Ends Optimized For Machine

Saddle coils without extended pole

Iron pole extended to extend the field region

Shield to trim fringe field

Freeing Up Loss in Space Due to Magnet Ends By Extending Pole

With some adjustments, one can get similar gains in racetrack coils too.

Space freed-up (made available for other purpose) is ~15 cm between two magnet ends. (Note, we are taking advantage of low field in poles).

Anyone interested? Is it useful? Is it worth some small complications?
Summary

• Preliminary investigation of water-cooled dipole magnet design has been made.

• Some interesting variations in the design have also been examined.

• We can move forward to finish this design study with some guidance.