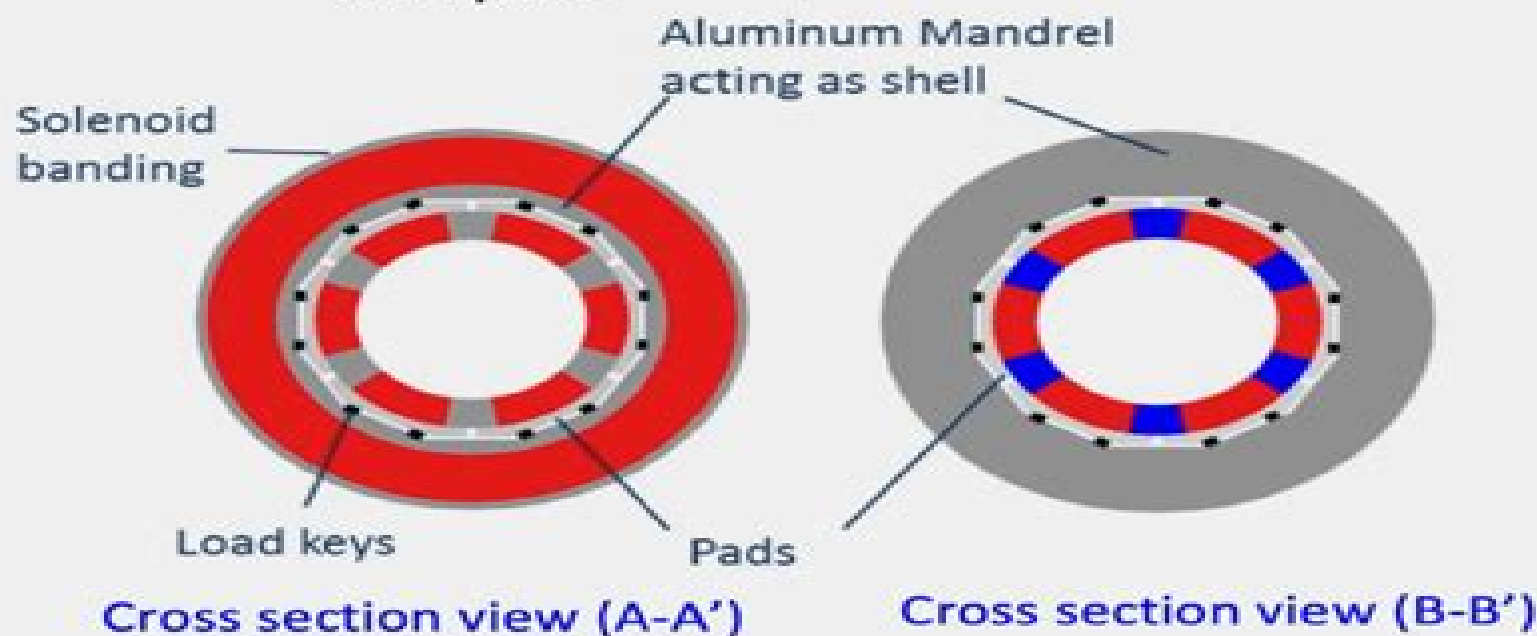
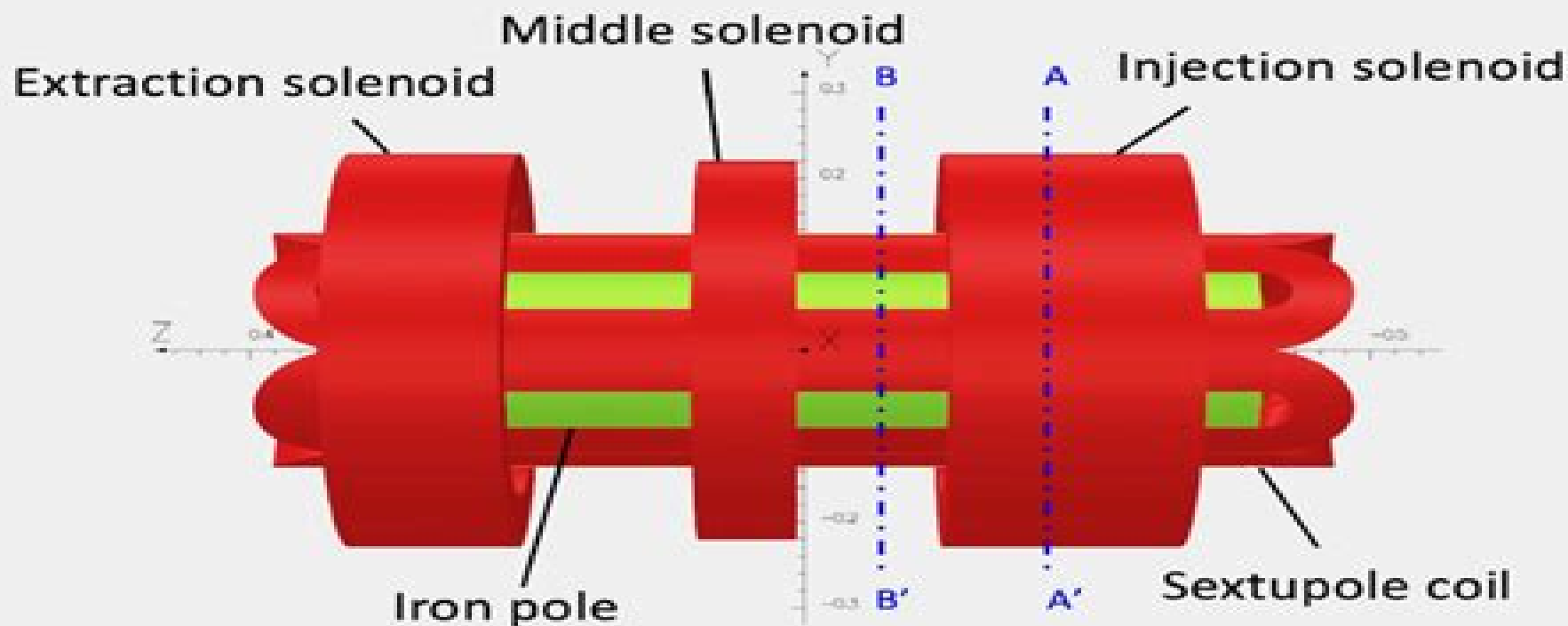




Superconducting Accelerator Magnets

A Gutmann



Superconducting Accelerator Magnets:

Superconducting Accelerator Magnets K.-H. Mess, Peter Schmüser, S. Wolff, 1996 The main topic of the book are the superconducting dipole and quadrupole magnets needed in high energy accelerators and storage rings for protons antiprotons or heavy ions The basic principles of low temperature superconductivity are outlined with special emphasis on the effects which are relevant for accelerator magnets Properties and fabrication methods of practical superconductors are described Analytical methods for field calculation and multipole expansion are presented for coils without and with iron yoke The effect of yoke saturation and geometric distortions on field quality is studied Persistent magnetization currents in the superconductor and eddy currents the copper part of the cable are analyzed in detail and their influence on field quality and magnet performance is investigated Superconductor stability quench origins and propagation and magnet protection are addressed Some important concepts of accelerator physics are introduced which are needed to appreciate the demanding requirements on field quality in large storage rings The operational experience with the superconducting HERA collider serves as an illustration Finally superconducting correction coils and practical construction and fabrication methods of accelerator magnets are discussed The physical and technical principles described in the book are substantiated with a wealth of experimental data on multipoles persistent and eddy current effects quench performance and much more

Nb3Sn Accelerator Magnets Daniel Schoerling, Alexander V. Zlobin, 2019-08-30 This open access book is written by world recognized experts in the fields of applied superconductivity and superconducting accelerator magnet technologies It provides a contemporary review and assessment of the experience in research and development of high field accelerator dipole magnets based on Nb3Sn superconductor over the past five decades The reader attains clear insight into the development and the main properties of Nb3Sn composite superconducting wires and Rutherford cables and details of accelerator dipole designs technologies and performance Special attention is given to innovative features of the developed Nb3Sn magnets The book concludes with a discussion of accelerator magnet needs for future circular colliders *High-field Superconducting Accelerator Magnets*, 1982 The next generation of accelerators for high energy physics will require high field small bore dipole magnets in the region of 10 T and 40 mm diam For such magnets there is a great incentive to attain high overall current density through increasing the current density within the superconductor and minimizing the copper stabilizer Both Nb Ti operating at 1.8 K and Nb3Sn at 4.2 are candidate superconductors Two programs in the US and one in Japan are directed toward the development of such magnets The program at LBL is described below *Magnetization Effects in Superconducting Accelerator Magnets*, 1978 Measurements of the effect of the superconductor magnetization on the field shape of dipole magnets are presented Such effects are most obvious at low fields where the current capability of the windings is very high and only a small fraction is used to support the transport current which produces the field In most dipoles the fundamental field component is reduced slightly when the field is increasing and enhanced by an almost equal

amount when the field is decreasing The effect on the higher allowed harmonics such as the sextupole and decapole components is much greater giving rise to considerable hysteretic behavior at the low field levels where the beam is injected into the accelerator The measurements summarized in this paper indicate that it is possible to accurately specify the field from current measurements if a standard energizing cycle is used and the previous history of the magnet is known **Final Report**, 2014 Our program consisted of the two components Strand Research and Cable Research with a focus on Nb3Sn Bi2212 and YBCO for accelerator magnet applications We demonstrated a method to refine the grains in Nb3Sn by a factor of two reaching 45 nm grain sizes and layer Jcs of 6 kA mm² at 12 T W also measured conductor magnetization for field quality This has been done both with Nb3Sn conductor as well as Bi 2212 strand Work in support of quench studies of YBCO coils was also performed Cable loss studies in Nb3Sn focused on connecting and comparing persistent magnetization and coupling magnetization for considering their relative impact on HEP machines In the area of HTS cables we have investigated both the quench in multistrand YBCO CORC cables as well as the magnetization of these cables for use in high field magnets In addition we examined the magnetic and thermal properties of large 50 T solenoids **Nb3Sn Accelerator Magnets** Alexander V Zlobin, Daniel Schoerling, 2020-10-08 This open access book is written by world recognized experts in the fields of applied superconductivity and superconducting accelerator magnet technologies It provides a contemporary review and assessment of the experience in research and development of high field accelerator dipole magnets based on Nb3Sn superconductor over the past five decades The reader attains clear insight into the development and the main properties of Nb3Sn composite superconducting wires and Rutherford cables and details of accelerator dipole designs technologies and performance Special attention is given to innovative features of the developed Nb3Sn magnets The book concludes with a discussion of accelerator magnet needs for future circular colliders Broadens our understanding of design and performance limits of high field Nb3Sn accelerator magnets for a future very high energy hadron collider Offers beginners a concise overview of the relevant design concepts for a new generation of superconducting accelerator magnets based on Nb3Sn superconductor Illustrates the complete process of accelerator magnet design and fabrication Provides a contemporary review and assessment of the past experience with Nb3Sn high field dipole accelerator magnets Identifies the main open R D issues for Nb3Sn high field dipole magnets This work was published by Saint Philip Street Press pursuant to a Creative Commons license permitting commercial use All rights not granted by the work s license are retained by the author or authors Thermo-magnetic Instabilities in Nb3Sn Superconducting Accelerator Magnets, 2006 The advance of High Energy Physics research using circulating accelerators strongly depends on increasing the magnetic bending field which accelerator magnets provide To achieve high fields the most powerful present day accelerator magnets employ NbTi superconducting technology however with the start up of Large Hadron Collider LHC in 2007 NbTi magnets will have reached the maximum field allowed by the intrinsic properties of this superconductor A further increase of the field strength

necessarily requires a change in superconductor material the best candidate is Nb₃Sn Several laboratories in the US and Europe are currently working on developing Nb₃Sn accelerator magnets and although these magnets have great potential it is suspected that their performance may be fundamentally limited by conductor thermo magnetic instabilities an idea first proposed by the Fermilab High Field Magnet group early in 2003 This thesis presents a study of thermo magnetic instability in high field Nb₃Sn accelerator magnets In this chapter the following topics are described the role of superconducting magnets in High Energy Physics the main characteristics of superconductors for accelerator magnets typical measurements of current capability in superconducting strands the properties of Nb₃Sn a description of the manufacturing process of Nb₃Sn strands superconducting cables a typical layout of superconducting accelerator magnets the current state of the art of Nb₃Sn accelerator magnets the High Field Magnet program at Fermilab and the scope of the thesis

Thermo-magnetic Instabilities in Nb₃Sn Superconducting Accelerator Magnets Bernardo Bordini, 2006 The advance of High Energy Physics research using circulating accelerators strongly depends on increasing the magnetic bending field which accelerator magnets provide To achieve high fields the most powerful present day accelerator magnets employ NbTi superconducting technology however with the start up of Large Hadron Collider LHC in 2007 NbTi magnets will have reached the maximum field allowed by the intrinsic properties of this superconductor A further increase of the field strength necessarily requires a change in superconductor material the best candidate is Nb sub 3 Sn Several laboratories in the US and Europe are currently working on developing Nb sub 3 Sn accelerator magnets and although these magnets have great potential it is suspected that their performance may be fundamentally limited by conductor thermo magnetic instabilities an idea first proposed by the Fermilab High Field Magnet group early in 2003 This thesis presents a study of thermo magnetic instability in high field Nb sub 3 Sn accelerator magnets In this chapter the following topics are described the role of superconducting magnets in High Energy Physics the main characteristics of superconductors for accelerator magnets typical measurements of current capability in superconducting strands the properties of Nb sub 3 Sn a description of the manufacturing process of Nb sub 3 Sn strands superconducting cables a typical layout of superconducting accelerator magnets the current state of the art of Nb sub 3 Sn accelerator magnets the High Field Magnet program at Fermilab and the scope of the thesis

Superconducting Accelerator Magnets, 1992 This paper reviews the basic mechanical designs of most of the superconducting magnets developed for high energy hadron accelerators The training performance of these magnets is compared with an instability factor defined by the square of the current density in the stabilizing copper divided by the surface to volume ratio of the strands A good correlation is observed

A Facility to Test Short Superconducting Accelerator Magnets at Fermilab, 1992 During the past four years the Superconducting Magnet R D facility at Fermilab Lab 2 has successfully tested superconducting dipole quadrupole and correction coil magnets less than 2 meters in length for the SSC project and the Tevatron D0 B0 Low beta Insertion During this time several improvements have been made to the facility that have greatly

enhanced its magnet testing capabilities Among the upgrades have been a new rotating coil and data acquisition system for measuring magnetic fields a controlled flow liquid helium transfer line using an electronically actuated cryo valve and stand alone systems for measuring AC loss and training low current Tevatron correction coil packages A description of the Lab 2 facilities is presented

Whispering the Secrets of Language: An Emotional Quest through **Superconducting Accelerator Magnets**

In a digitally-driven earth wherever screens reign great and immediate connection drowns out the subtleties of language, the profound techniques and emotional subtleties hidden within words usually get unheard. Yet, situated within the pages of **Superconducting Accelerator Magnets** a captivating literary treasure pulsating with raw thoughts, lies an extraordinary quest waiting to be undertaken. Published by an experienced wordsmith, that enchanting opus encourages visitors on an introspective trip, softly unraveling the veiled truths and profound influence resonating within the cloth of each word. Within the emotional depths of this emotional review, we will embark upon a sincere exploration of the book's core styles, dissect its charming writing style, and fail to the powerful resonance it evokes strong within the recesses of readers' hearts.

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