Superconducting Magnet R&D Overview

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Outline

- Magnet Program Goals and Priorities
- Base Program Support
  - Magnet Development
  - Facilities
  - Conductor R&D
- R&D Strategy

US LARP Magnet Program

- Improve long-term physics research opportunities of the LHC
  - Provide technology choices for luminosity upgrade
- Extend US expertise in high–field accelerator magnets
  - Represents the first opportunity to use Nb_3Sn in an accelerator
  - Ensure continued leadership in Nb_3Sn technology
  - Advances the enabling technology for the next generation of hadron colliders
- Extend collaborative environment between national lab programs
- Develop world-wide collaboration on high-performance magnets
  - CERN, ESGARD, KEK, EU, etc.
  - Archamps Workshop

LHC Accelerator Upgrades

- Luminosity (IR upgrade)
  - Options
    - **IR I**
      - **Largest aperture quad with maximum gradient ~250 T/m**
    - **IR II**
      - **Largest aperture 2/1 quad with maximum gradient ~ 250 T/m**
      - **Large bore separation dipole with a field > 15 T**
      - **2/1 dipole with a field > 15 T**
- Energy Upgrade
  - Addressed by base programs at the 3 labs
  - Benefits from technology developed for luminosity upgrade

Initial program target

LARP Magnet Program

- An ambitious program focusing on Nb_3Sn
  - Large-aperture quadrupoles
    - Required in all IR upgrade scenarios under consideration
  - Large-aperture, high-field, beam-separation dipoles
    - Required in most IR upgrade scenarios under consideration
- Builds on base program Nb_3Sn dipole R&D
- Initial program is to develop technologies, not specific designs
  - Technology Development includes model magnets
- Specific design choices will be made after several years of magnet R&D and related accelerator design studies

Base Program Support

- Integrate the three US laboratories
  - Leveraged by
    - **Existing technology base**
    - **Intellectual resources**
    - **Facilities**

Existing Programs are essential to the success of LARP

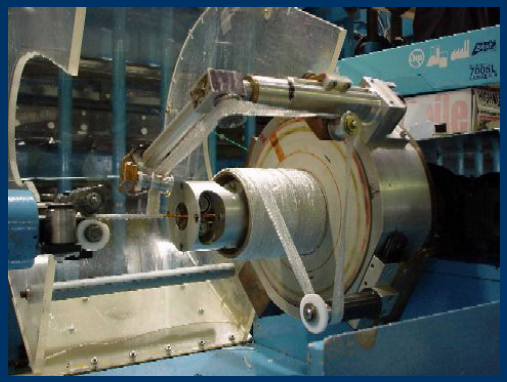
- BNL – React and wind Nb_3Sn and HTS studies
- FNAL – Wind and react Nb_3Sn cos-theta dipoles
- LBNL – High field, Nb_3Sn dipoles
- DOE/HEP Conductor Development Program

BNL Magnet R&D Facilities

- 5 Vertical Test Dewars (cold mass testing)
- 3 Horizontal test stations (full magnet testing)
- 2.5KW refrigerator complex (runs 365/24/7)
- Coil winding factory with 3 separate stations
- 2 Direct winding stations
- Coil and beam tube insulating station
- 3 magnet production lines (SNS, LHC, RHIC spares)
- 3 warm magnetic field measuring stations

FNAL Magnet R&D Facilities

- Cable insulating machine
- Winding tables: (2m,15m)
- Coil HT oven and retorts (1m)
- Epoxy impregnation facility (6m)
- Collaring/yoking presses (2m, 15m)
- Magnet test facilities (4m,15m)

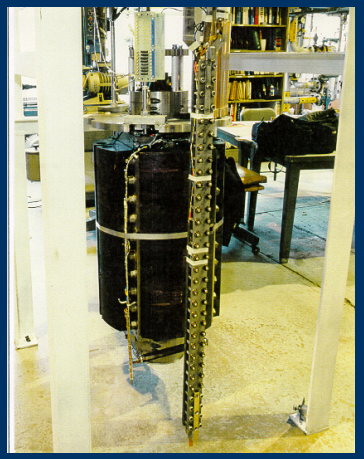


LBNL Magnet R&D Facilities

- SC Magnet Test Facility
  - Control system/DAQ
  - 15 kA PS, 12kA extraction
  - Superfluid capability
  - 1 meter models
- Magnet Fabrication Shop
  - Coil winding
  - Reaction furnace
  - Vacuum vessel
  - G-10 shop
  - Materials Test System
  - 100,000 lb. Press

Strand and Cable R&D Facilities

- BNL, FNAL, LBNL
  - Strand and cable heat treat ovens
  - 28 and 60-strand cabling machines
  - SEM
  - Short sample strand test facilities
    - 15 – 17 Tesla solenoids
    - Sample prep
    - 2 kA power supply
  - Cable test facility (7.5 T, 4.2K, 25 kA)



Base Program FTE Profiles

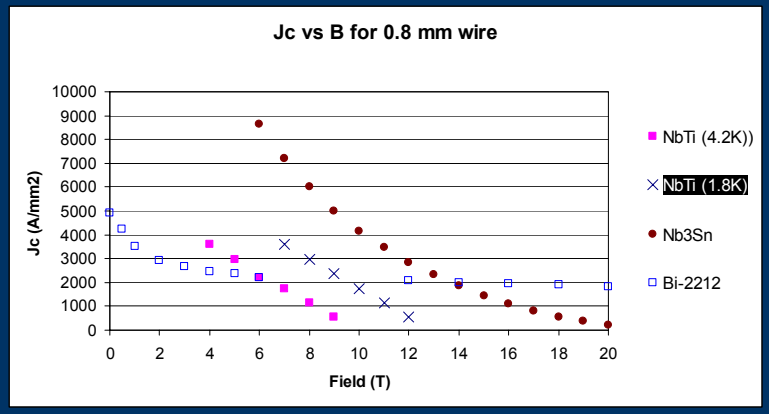
- BNL
  ~ 4 FTE's (2 Scientists, 1 Engineer, 1 Tech)
- FNAL
  ~ 13 FTE's (3 Scientists, 5 Engineers, 5 Techs)
- LBNL
  ~ 10 FTE's (3.5 Scientists, 2 Engineers, 4 Techs)

Plus designers, facilities support, etc.

R&D Strategy

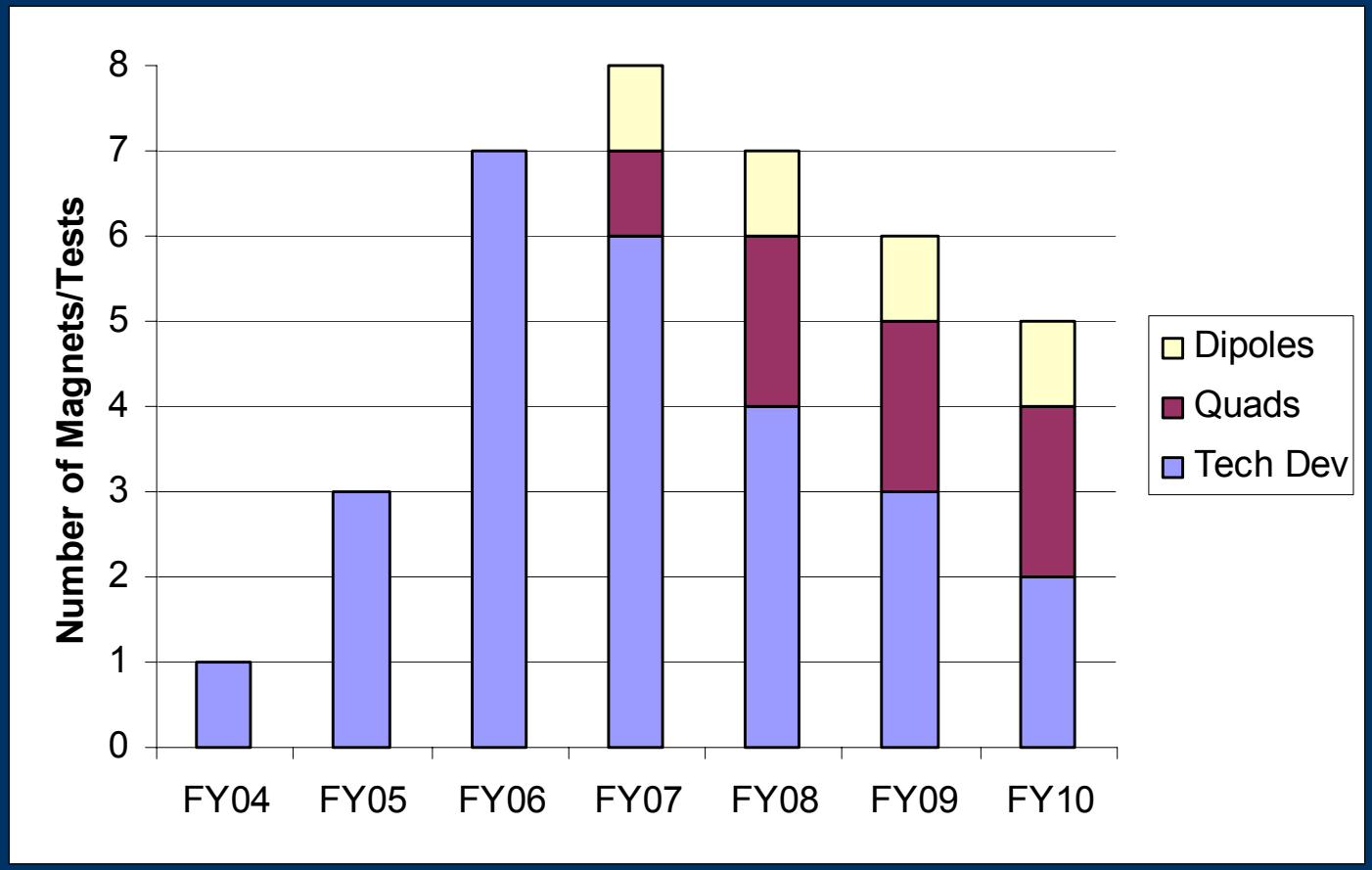
- Main Issues
  - High fields and gradients
  - Large beam-induced heat loads
- Extend and quantify limits on key performance parameters
- Issue-driven program designed to develop an enabling technology base for LHC upgrades

Nb_3Sn



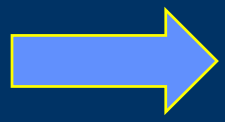
- 2003 – 05
  - Technology, simple models
- 2006 – 09
  - More complex models (~ 3/yr)
- 2010 – 12
  - Accelerator-ready prototype

Program Profile



Summary

- Delayed funding turn-on
- Need to establish basis for future planning



- Highly leveraged, cost effective start
  - Fundamental issues specific to LARP requirements
- Focus on technology development

Goal: Accelerator-ready design – production start ~ 2012

A Very Challenging Task