Solenoid Issues and Design

Neutrino Factory Feasibility Study II
Editors Meeting, LBNL
2 October 2000
Target Solenoid System

• High fields (20 T combined)
• High radiation environment
  – heating
  – damage
• Remote maintenance requirement
Resistive Insert Options

• Bitter-plate technology chosen for Study I
  – high J
  – short-lived but low-cost & easily replaceable
  – co-mingled conductor, insulation, & water

• Hollow-copper technology proposed for Study II
  – low J
  – long-lived but higher cost & difficult to replace
  – insulation separated from cooling water
Study-II Target and Decay-Channel Solenoid System

5 m
Baseline
Hollow-Copper Option

59 MJ

9 MW
Alternative Bitter-Plate Option

23 MJ

5.4 MW
Field on-axis, two options

On-axis field (T)

- Bitter-plate option
- Baseline hollow-Cu option
Super FOFO Lattice

- RF 201 MHz Cavity
- Safety Vent
- Insulation to Low Vac
- Axial Field

Coil "A"
- I/A 2A/mm
- 6 53.48

Coil "B"
- I/A 2A/mm
- 2 53.48

Arad 0.33m [13.0°]
Brad 0.77m [30.3°]
Adr 0.33m [13.0°]
Bdr 0.11m [4.3°]

- Max "B" (t) 6.247248
- Amp turn 8.5 (MA)
- HIGH VACUUM
- 5.5m [216.5°]
- 2.75m [108.3°]
Issues for Cooling-Channel Solenoids

- Modest fields (6 - 7 T)
- Modest internal winding stresses
- High inter-coil forces
- Large numbers to amplify per-unit costs
Winding-Pack Options

• Impregnated windings
  – highest current density
  – least stable

• Porous or ventilated windings
  – high current density
  – more stable

• Either option may require active protection to preclude high inter-coil forces
Benefit of helium for stability

From "Accelerators and Superconductivity: a Marriage of Convenience," lecture delivered at the CERN Accelerator School, 27 November 1986, by Martin N. Wilson, CERN /87-06
General Approach

• Quantify options with regard to
  – Performance
  – Cost
  – Risk

• Identify R&D tasks that will reduce cost and risk

• Select a primary option and optimize it