Target Solenoid Issues

Neutrino Factory Feasibility Study II
Video Conference
9 October 2000
Target Solenoid System

- High fields (20 T combined)
- High radiation environment
  - heating
  - damage
- Remote maintenance requirement
Traditional 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
Options Overlaid
Field on-axis, two options

- Bitter-plate option
- Baseline hollow-Cu option
The D-Coil Pair, ORNL
cia. 1966

- 3-in-hand, double-pancake winding
- 8-T field on axis
- 10 MW
- \( J_{\text{pack}} \approx 20 \text{ A/mm}^2 \)

Note supply and return headers and connections
The Mineral-Insulated Conductor (MIC) options

Solid Core
- Cu sheath
- MgO insul.
- Cu core
- Cooling passage

Hollow Core

From “Development of Radiation-Resistant Magnets for the JHF Project,” K.R. Tanaka et al., presented at MT-16 (preprint provided by Bob Weggel). However, general concept dates back at least to Art Harvey, LLNL and Jim Luton, ORNL, early 1970s.
Limitations

- Conductor length
  - Present lengths in the 30 – 60-m range
- Operating voltage
  - Uncertain, limited by termination design
- Practical winding-pack current density
  - approx. 10 A/mm$^2$ or less for HC-MIC
  - maybe 60 A/mm$^2$ or higher for SC-MIC
Solid-core MIC, layer wound, with cross-flow cooling
Proposed approach

- Optimize two options for comparison
- Identify critical issues for each
- Define essential R&D