• Mechanical Components
• Software and Analysis
• Documentation and Schedule
MICE Tracker Hardware

- Tracker Mechanical
- Cryostats
- Fiber Production and Tests
- Station 5
Tracker Mechanical

• Ken Long gave update talk for Geoff Barber.

• Work and modification proceeding on many components:
  – Space frame, solenoid cryocooler, light guide map, connector QA, ...

• Discussion in parallel session about placements of VLPC cryostat/buffer volumes/compressors.
  – Main issue is ensuring that VLPC cryocooler is far enough away from strong magnetic fields to ensure proper operation.

• One of main conclusions was that there have been difficulties manufacturing components in house. Outsourcing has helped with this problem.
Tracker Cryostats

- Russ Rucinski talked about status of prototype cryostat and progress of four MICE cryostats.

- Prototype has been running well, but new cassette has been running with higher temperature and heat load than previous cassette.
  - Construction of new cassette is suspected and will be checked.

- Almost all parts for four MICE cryostats at Fermilab.

- Assembly and testing should be done by April, 2007 which is well ahead of schedule.
Fiber Production and Tests

• Alan Bross gave an update about fiber mirroring at Fermilab.
  – All the preparation work is done.
  – About $\frac{1}{2}$ of the fibers have been mirrored.
  – Expected finish time of mid November, but could be sooner with arrival of new sputtering gun.

• Expected full production of ribbons week of October 17.
  – Goal of 1 ribbon/day.

• Takatomi Yano reported on measurement of 3HF light yield
  – Check for differences between Kuraray and Fermilab samples.
  – Kuraray sample has about 10% higher light yield than Fermilab's samples.
  – Results not surprising and fine for MICE tracker.
Station 5 QA

• Work in Japan reported by Makoto Yoshida.
  – Waveguide Production and QA

• Work in UK reported by Takashi Matsushita.
  – Mechanical components
  – QA
    • Bundling/connectorization
    • Fiber counting
    • Sequence check
  – Station Acceptance Test Set-up
Station 5 QA at UK

QA image for one connector worth of bundles

QA image for one connector

CCD image is analysed by software.

The software notifies an operator if there is any failure/suspicious bundles
Station acceptance test set-up

- Scanning system being prepared at IC
- Readout components and firmware being tested/developed (US)
- Estimated time needed for the test per station ~ 5 days
- Plan to be ready by the time the assembly of station 5 completes
  (station 4 used at the KEK testbeam will be tested first)
  - Plan is to do a cosmic ray test for station 5 at FNAL if possible in December
Tracker Data Readout Software and KEK Data Analysis

- Tracker Data Readout with Analog Front End II t (AFE II t) Boards – Terry Hart

- KEK Data Analysis
  - Imperial College Analysis - Aron Fish
  - Osaka University Analysis – Hideyuki Sakamoto
MICE Requirements for Tracker Readout

- **Data Rate**: MICE has established goal of reading out 600 muons/ms.
  - D0 tracker readout optimized for TeVatron beam.
  - For MICE, current coding allows ~225 muons/ms.

- **Data Readout**: MICE tracker data will be read out to VLSB banks.
  - D0 data read out to digital boards and SVX sequencers.

MICE IIT group is modifying AFE II t firmware to realize these MICE requirements.
Tracker Data Rate

• What's done:
  – Modified analog FPGA (AFPGA) firmware generating signals appropriate for data rate scheme. (Bill, Terry)
    • Signals to ADC
    • Signals to Trip-T chips
  – Signal simulations verifying that code logic is correct. (Bill, Terry)

• What needs to be done:
  – Firmware providing bitmap to the AFPGA to implement data rate scheme. (Senerath, Bill, Terry)
  – Verification of digitization with input signals. (Craig, Bill, Terry)
Tracker Data Readout

• What's done:
  – Firmware written which transfers data to VLSB banks in an added test mode. Signal simulations verify that the code logic is correct.
  – Repeated transfer of data word to VLSB banks successfully tested on an AFE II t board.
  – Firmware written which
    • Transfers bytes of test data into AFE II t RAM blocks
    • Read out data to VLSB banks via LVDS

• What needs to be done:
  – Implement block data transfer and characterize how it breaks down.
  – Work with D0 VLSB experts to fix block data transfer problem.
  – Test AFE II t readout to VLSB with LED/cryostat/VLPC system.
Anticipated Tracker Readout Schedule

• Mid October: 25 AFE II t boards reserved for MICE

• Early – mid November: Firmware development should be done or nearly done
  – Most progress on code for data rate increase
  – Data readout is well underway.

• Late November: Firmware testing
  – Full data readout LVDS test mode being developed, and will be tested.
  – Data rate scheme testing with input signals to board on test stand.

• Later
  – Test AFE II t readout to VLSB with cryostat/LED/VLPCs.
Imperial KEK Data Analysis

- Tracker Channel Decoding Schemes
- Track Fitting
  - Seed Generation
  - Propagation Through Kalman Filter
- Data/MC Comparison for KEK data
Tracker Channel Decoding

- Slight discrepancies between Osaka (software check) and Imperial (hardware check) schemes.

- A few tasks left for Imperial
  - Both schemes implemented in G4MICE
  - Can be used in track analysis so that discrepancies can be checked
Track Fitting Procedure

• Form initial estimate (seed) of track momentum from first 3 points.

• Refine this momentum value by propagation through Kalman filter using remaining downstream hits.
  – non-uniform magnetic field
  – other effects
Momentum Seed

Initial $p_z$ momentum determination now fixed!

Aron Fish, Imperial College
Kalman Filter Track Reconstruction

Track reconstruction needs to be debugged.

Aron Fish, Imperial College
Plans for Imperial KEK Data Analysis

- Implement tests of SciFi track reconstruction.
- Implement Imperial and Osaka channel decoding schemes into G4MICE.
- Debug Kalman filter track fit.
- Migrate to new Data Reader so that data and simulated events are treated the same.
- Analyze KEK data.

Aron Fish, Imperial College
Contents

• Comparing MC fit ⇔ Data fit
  – Chi2 distribution
  – Residual distribution
  – Reconstructed Pt & Pz distribution

• Pz resolution

• Pt resolution

• Summary
Track Reconstruction

- Assuming “Uniform B-Field” and “NO scattering”
- Chi2 to be minimized
  - Input: xi,yi, i=1,4
  - Output: x0,y0,p0,R,L
  - Degree of freedom: 8-5=3

\[ \chi^2 = \sum_i \frac{(x_i - x_{fit})^2}{\sigma^2} + \frac{(y_i - y_{fit})^2}{\sigma^2} \]

\[ x_{fit} = x_0 + R \cos \left( \frac{z_i}{L} + \phi_0 \right) \]
\[ y_{fit} = y_0 + R \sin \left( \frac{z_i}{L} + \phi_0 \right) \]

\[ R = \frac{p_T}{(0.3B)} \]
\[ L = \frac{p_L}{(0.3B)} \]
Chi-squared distribution

D.o.f. = 3 chi2 distribution

Hideyuki Sakamoto, Osaka University
Pz error  – DATA –

250MeV/c, 6 degree, TOF#2

Chain P250B1R6S-1 -- /home/sakamoto/t585/ana/src_mod/hbk_new/n00013

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\( \sigma_{\text{fit}} = 8\% \)

Hideyuki Sakamoto, Osaka University
Pt distribution with TOF cut

Data_fit

400MeV/c, 3degree

MC_fit

Hideyuki Sakamoto, Osaka University
Tracker Documentation and Review

• NIM Paper - Makoto Yoshida went through a rough outline for a tracker paper.

• Tracker Review – Ken Long led a discussion about responses to the Tracker Review.
Tracker Schedule

- October, 2006
  - AFE II t boards ready for MICE
  - Ribbon production complete

- November, 2006
  - Fiber mirroring done
  - Station 5 QA done
  - Tracker firmware done
  - Firmware testing well underway

- Late 2006
  - KEK analyses (Imperial and Osaka) done

- Early 2007
  - Four cryostats built and tested
  - Full data readout of tracker data tested