Run II ICD status to date
Univerisity of Texas - Arlington, Texas
September 1997

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October 13, 1997

Abstract

Participants in the meetings: Kaushik De, Paul Draper, Ted Eltzroth, Elizabeth Gallas, Jia Li, Victor Reece, Lee Sawyer (by phone), Mark Sosebee, Ransom Stevens. and Andy White.

PLEASE read the sections which apply to you and send me corrections/comments ASAP !!!

This is basically a status report on each of the ICD subsystems as I currently understand them. Please send corrections to me asap. The basic format is ordered by subparts, summarizing current status and immediate future plans. Please pay particular attention to the tasks with your name on them.

Regular ICD phone meetings will be held thursday's at 11 am between UTA/LT/FNAL.

Contents

1 General issues

1.1 ICD COVERAGE EXTENSION(all)

ICD covers 1.1 to 1.4 in eta (η). The FPD (forward preshower detector) covers a region of $\eta > 1.5$. This leaves a gap in coverage in eta from 1.4 to 1.5. This gap will be used for ICD tile module mechanical support and FPD support and fiber routing.

Some months ago, Jon Kotcher (FPD) raised the issue of extending coverage of either detector to the region between 1.4 and 1.5 in eta. Since the coverage sampling should be hadronic calorimetry, this addition should be an extension of the ICD.

EXTENDING THE ICD WOULD REQUIRE ICD changes:

1. increase in scintillator quantity purchased,
2. change tile design - extend smallest tile toward smaller radius
3. change in aluminum boxes

QUESTIONS FOR KOTCHER:

- though we know that additional sampling would help. as of now, there is no simulation to demonstrate need,
- how far should we extend coverage (ie how much space does he need to get his cabling out)
- has he gotten Jia Li's current drawings

QUESTION FOR FNAL:

- verify that we have 1" of space at the extended radius

CONCLUSION:

We met with Kotcher 3-oct-1997 and we decided that the ICD will stay as is, extending from 1.1 to 1.4 in eta. Jon does not have a new FPS fiber layout plan but it is obvious that he will need some or all of the space between 1.4 and 1.5. One option he suggested is to run his fiber under the ICD. This seems ridiculous to me, because it would require redesign of the boxes (tile locations), the specifications for which would not be settled upon for a long time. We need to buy and cut our scintillator sometime this century.

2 Tiles

2.1 TILE MODULE CR TESTSTAND (Mark S, Victor R, Elizabeth, Kaushik)

The 5mm thick prototype tile has been cut/epoxied and is currently on the tile module teststand at UTA. The .5 inch tile is currently in Lab 8 with special bits on order to cut this deeper tile. Bits have been shipped by the manufacturer, so cutting should begin in less than 1 week.

Three sets of fiber pigtails were assembled by Mark and Elizabeth at Fermilab. A pigtail is an assembly of WLS fiber epoxied into connectors which brings the light signal from the fiber grooves to the connector. The three sets of pigtail configurations :

1. 1σ with 1.0 mm fiber and one mirrored end (due to lack of fiber length, all fibers were about 24 inches long).
2. 1σ with 0.9 mm fiber and one mirrored end (length of fibers varied)
3. 2σ with 0.9 mm fiber, each fiber having one mirrored end (length of fibers varied)

will be tested using the thicker half inch tile. The 1α pigtail configuration has proved to be difficult to construct, which is suggestive of a design which is difficult to produce consistantly in any quantity. The 2σ pigtails will not fit in the thin (5mm) tile because the fiber groove is not deep enough. The 1.0 mm 1σ fibers will not fit because the fiber groove is too narrow.

Mark and Victor have tested 3 tiles of the 5 mm thick prototype tile module (0.9 mm 1σ). These 3 channels span the three eta divisions in one phi bin. Channels 1 and 2 (etas 12 and 13) gave consistent > 50 mV cosmic signals, while the gain on channel 3 was a bit lower. Very approximately, these numbers are smaller by a factor of 2-4 compared to the same 3 PMTs running in an old ICD box. The thickness of the Run I ICD tile was 1 cm (twice as thick as this tile). So, with the thicker tile and two fibers/groove, we should be in good shape.

The width of the fiber groove in the tiles should be increased slightly near the location of the mirrored end, since Mark said the mirroed/epoxied end of the 0.9 mm fiber was too large to fit easily into the groove without damage.

Mark and Victor will now hook up all 12 channels and work our some noise problems with the tile teststand. With hope, this will be up and able to collect statistics when the thicker (half inch) tile is shipped to UTA.

3 Fibers

3.1 Fiber Cabling (Lee, Elizabeth, Andy, Jia Li)

Four prototype fiber cables have been ordered from Mitsubishi by Lee Sawyer at $200.00 each. Each cable will contain 6 fibers, provided by Mitsubishi.

Lee provided them with eight the DDK (CDF) connectors which can accommodate 10 fibers. Only 6 of the 10 holes will be used. The six fibers should be grouped in pairs, leaving connector holes 1, 4, 7 and 10 blank. Mitsubishi will epoxy the fibers into the connectors and optically polish the connector end.

Louisiana Tech will set up a cursory test for the prototype cables which may be adapted to test cables as well as fiber connections in the fiber backplane. After testing, cables should be shipped to UTA Novemberish to include them in the full prototype test to take place before the end of the year.

Lee should be sure to remind/tell Mitsubishi that the connectors are keyed, just in case they don't notice. Otherwise, roughly half the connectors will be backwards on the cables. Elizabeth's convention is that the beveled end is called the top.

Jia Li should design something to mechanically support the fiber cables at the connectors on the fiber backplane. We may want to increase the number of fibers to 8 or 10 (2 to 4 dummy fibers) to increase mechanical stability of the unit, particularly at the ends.

Lee should order more fiber connectors, and include some of the screw in design for testing. Lee reports that the order for connectors last time took 9 weeks (too long!).

4 Crates

4.1 FIBER BACKPLANE (Jia Li, Andy, Victor, Mark, Paul)

A mechanical prototype of the fiber backplane has been built at UTA. It includes an all aluminum walls and frame with an aluminum plate with 96 holes simulating the location of the cookies leading to the PMTs.

Over half the signal fibers were routed from connectors afixed to slots in the crate side (6 fibers/connector) to the individual pmt cookies (2 fibers/cookie). The calibration signal routing from the opposite crate side to the PMT cookies still needs to be designed and implemented.

The procedure for assembling the backplane seems to be:

1. produce a mock fully assembled backplane with all fibers epoxied into cookies/connectors/calibration distribution can. The fibers must be the correct length to be used in the final design.

2. Dis-assemble the mock backplane. Reproduce one of each of the fiber/connector/cookie/can assemblies, taking into account that two of the backplanes will be identical with the other 2 being mirror images of each other (fibers routed to connectors at opposite side). Calibration fibers must be polished before potting into distribution can. Calibration fibers then can be epoxied into the cookies and connectors. Some method of color coding fibers would help insure that the routing of fibers is correct.

3. Connector polish the connector and cookie ends.

4. Assemble backplane with fiber/connector/cookie/can assemblies.

This is a long detailed procedure, which requires alot of planning through all the steps ! Some method of color coding fibers would help insure that the routing of fibers is correct after the backplane is assembled.

A prototype of the backplane must be assembled for the full prototype test to take place by the end of november 1997, when the fiber cables will be available. Any possiblity that calibration can be included in the test ?

4.2 Iron Block (Ransom, Jia Li)

For cost savings, we are obligated to reuse the 1/2 inch diameter Hamamatsu phototubes used in the Run I ICD. Ransom (and students) established that the iron block is necessary to sheild the PMTs from the magnetic field expected in the Run II detector.

We have more than enough tubes in our Run I inventory. Should we find some do not satisfy our requirements, Hamamatsu assures us that these tubes will continue to be available because they are very popular.

Both the size of the tubes and the need for the sheilding will not change, nor will the width or height of the PMT crate. Therefore, Jia Li should go ahead with the manufacture of the four iron blocks from the shop in Fort Worth. Include the four holes at the sides for mechanical support of the block under the pig troughs.

4.3 PMT Crate (Jia Li, Lee, Andy)

There are 3 sections of the PMT crates, namely

- fiber backplane
- iron block enclosing the PMT array and
- drawer system including the electronics motherboards

The width or height of the PMT crate is not expected to change because it has proven to be a good size for the iron sheilding the PMTs and the routing of fiber in the backplane.

We therefore can go forward with the iron block manufacture, but not the crate manufacture since the the depth of the crate will certainly change since the size of the electronics section is in flux. A few factors must be considered in the final decision here:

- The electronics motherboard length is currently 11" long, but it looks like only 5 to 6" will be required. The number of HV supplies and the location of the trim resistor circuitry deteremines the final board size, both of which remain undetermined.
- The extent of electronics cooling required in the crates depends on the size of the board and the crate design. In an open design (parts of electronics not light tight), less cooling is required. In a closed, completely light tight system, more cooling is required.
- A shorter crate is bound to be easier to mount under the pig troughs and leaves more space for cable connections at the drawer face.

Jia Li should go to Ruston to work with Lee and students to negotiate the best design. Lee/Elizabeth should talk to Marvin Johnson at FNAL to discuss the HV, trim and fanout options. Motherboard manufacture was included in the 1997 LT MOU, so this design needs to be finalized.

5 Photo Multiplier Tubes

5.1 RUN I BOX TESTER (Mark S, Kaushik D, Victor R)

The Run I cosmic ray teststand has been reassembled at UTA and is running using the same scintillator paddles and in principle the same amplification/preamps/electronics settings as the fnal cosmic ray teststand for Run I. As of September, 1997 3 boxes have been tested:

1. One box had not been tested since Run I. It showed a normal mip peak with a drop in gain of over a factor of 2. The expected drop was no more than $20-30\%$. this was one of the first boxes tested and electronics has been tweeked somewhat, so another test is pending.

2. The next box was a more recently tested box (tested between Run Ib and Ic). This box showed a drop in gain of 20%, where a minimal drop in gain was expected.

3. Box was an outer Hamamatsu box more recently tested box (like box in 2). This box showed a drop in gain in channels 1 and 3, and channel 2 showed results identical to the previous test. After electronics tweeked, it was retested and found that all channel gains were down by $10-20\%$.

The test stand electronics tweeking stage is over, Mark and Kaushik think that the timing is okay now so tests will go from here. If boxes are found to have a drop in gain larger than expected, then there are 2 consequences that may be VERY serious:

- The Run Ic ICD data could require a different energy correction than what is currently used. The current version of the energy scale paper does not look at time dependence. Anna Goussiou reports that the run IC 630 GeV run required a different eta dependent correction in the ICR. I have written to Daniel to see if we can settle the Run Ic data issue.

- The gain of many of the used ICD phototubes may on have dropped too much to be used in the Run II detector. This has serious budget consequences. Mark suggests that maybe a dedicated test stand can be set up with a few tubes running long term (months/years) to see if we are in for disaster in Run II if we use these used tubes.

5.2 PMT STATUS (Elizabeth, Kaushik, Jia Li, Lee)

Need to establish that new Hamamatsu R647 phototubes (1/2" diameter, 3" length including pin out) will still be available through 1999. The design of our system hinges on these tubes, so if we need to buy more, we must make sure they will be available.

EG : just talked to our Hamamatsu tube representative and he reports that the Hamamatsu R647 phototubes are currently very popular and he expects them to be available for years. (Don Lowell 847 825-6046)

Therefore, we can go ahead with the current design with the assumption that the phototubes design/specs will not change:

1. Kaushik/Andy can order the PMT sockets (on FY97 UTA MOU) immediately. After they arrive, they should be shipped to Lee at LT.

2. Jia Li can go ahead with the iron block manufacture.

Current cost per phototube (for between 10 and 100 tubes) is somewhere between $325.00 to $375.00 depending on off-the-shelf .vs. special order. May be slightly cheaper for 100 or more.

5.3 PMT TESTSTAND (Kaushik De, Ted Eltzroth)

The PMT teststand has not been run for a few years (Xia Yu's thesis). Kaushik estimates it will take 1-2 months of dedicated time to set it up again. Is anyone working on it now?

Kaushik needs to decide on the criteria which will be used to separate acceptible tubes from those which do not meet our performance requirements.

We need to develop a database to store PMT test results for all the PMTs. It was suggested that Ted might do this and that it should be a Microsoft access database. Is this a relational database ?

Every PMT has a unique number to identify it (PMT_TUBE_NUMBER). Here is a breakdown of the 'relations' in the PMT database (please correct me where I am missing stuff - this is a rough pass through).

- **RUN_I_BOXES**
  key field - Run I box number (R_I_BOX)
  PMT_TUBE_NUMBER 1
  PMT_TUBE_NUMBER 2
  PMT_TUBE_NUMBER 3
- **RUN_I_BOX_TESTS** is a relation containing the run 1 box test results obtained at the UTA Run I box teststand. This relation has 2 key fields (R_I_BOX and a version number) (combination of Run I box number and test version number). Other fields are just like in the box test notebook:
  trim R values
  pigtail
  date
  voltage
  preamp (5 or 22 pF)
  gain mulitiplier (8.7)
  channel 1 peak fit
  channel 2 peak fit
  channel 3 peak fit
  we might also add some width measure to the fit.
- **PMT_TESTS** key field - PMT_TUBE_NUMBER
  voltage

peak
width

- **PMT_DRAWER** is a relation containing which Run II PMT drawers contain which PMTs (PMT_TUBE_NUMBER)
  key field - PMT_DRAWER_NUMBER
  PMT_TUBE_NUMBER 1
  PMT_TUBE_NUMBER 2
  PMT_TUBE_NUMBER 3
  PMT_TUBE_NUMBER 4
  PMT_TUBE_NUMBER 5
  PMT_TUBE_NUMBER 6

There are many things that need to be considered in designing the database including the criteria for good or bad tubes. It is not straightforward, we need to consider things like the tubes in the pmt drawers may change over time, so how do you keep track of this ? We should sit down and think about what we need to record and put it in some system that will make access easy over time (Kaushik, Andy, Mark, Lee, Elizabeth ... should all contribute from past experience).

6 Electronics

6.1 Bases (Lee, Derek, Mark, Kaushik, Ted)

Kaushik wasn't lying when he said all the surface mount components for the bases were there. The values of some of the components has changed slightly due to the differences in values available in surface mount components. Kaushik was able to log into his old Michigan account and get all the required information, including the last changes in the base design (added filtering circuit of HV line and increased value of one resistor near the diodes).

Also, Mark and E found a surface mount base card and shipped it to Lee. All seems to be in order, except that Lee needs a few more daughter cards made from Ann Arbor Circuits and this company needs Kaushik's signature to release the design. You guys work it out.

The order to Ann Arbor Circuits should also request that they remove some of the writing on the cards (a silk screen?), which may interfere with HV distribution.

Lee's preliminary base tests show

- ability to hold High Voltage and
- low noise characteristics.

Next tests include adding some PMTs (see below) and a light tight box, maybe some calibration source?

The PMT's E shipped to Lee have been numbered and tested previously. Lee should send the numbers to Mark. Mark should check the master PMT database to get HV characteristics for these tubes.

6.2 Fanout Electronics (Lee, Jia Li, Elizabeth, Andy)

Last word from Dean was that the Run II calorimeter pulsers have not hit the drawing board yet, so it may to prudent to wait on the design for the pulser fanout yet. Run I pulse had : ????

Lee and company are designing the low voltage fanouts, expected to sit underneath the PMT crates. Lee should be in contact with Rich Hance to make sure these LV lines supplying the fanouts satisfy safety requirements.

Lee and E measured 15 inches as the total distance from the bottom of the pig trough to the top edge of the cable winder. The crate will occupy 11 inches. We think we can safely assume an additional 2 inches for the fanout, but E must confirm this with someone at FNAL.

When Lee has a design, he should send it to

- Elizabeth so that she can verify that the space it occupies is okay,
- Jia Li so he can include it in the mechanical design drawings, and
- Rich Hance so he can check the safety issue.

6.3 Preamplifiers (Lee, Elizabeth)

E has sent Lee 12 upgrade hybrid preamps from Lynn Bagby at FNAL. He plans to set up a test for them soon, evolving into building a complete motherboard.

Ashutosh/Lynn/Tuts have sent out an order for prototype preamps which includes about 12? for ICD. These may be the final design, so it will be very useful to test these and ultimately use them in the full prototype test.

Derek is expected to finish up around March 1998. Lee has a new EE student (Jonathan Morris) starting up who should be around for a couple of years.

7 Calibration

7.1 Calibration (Paul D., Brandon, ?, Elizabeth, Jia Li)

The calibration subsystem is currently the critical path item in the ICD project. This means that the time line of the design-prototyping-testing-assembly-testing of the calibration system is the subtask currently most behind in getting the whole system finished. This is somewhat of an exaggeration since the real task is not expected to have a large impact on the progress of most of the other subtasks and the time allowed to build the system is very conservative. None-the-less, we need to decide on the technology by the end of the year and include a test of the calibration in the solenoid test in the spring of 1998.

Currently, there remains 2 options for calibration based on LED's or LASER's. The laser disk distribution can is currently being drilled by Brandon (student at UTA) using an NC (numerically controlled) mill which drills holes at regular intervals around a scintillator disk.

If the LASER option is chosen, we will buy new fiber cables since the expense and trouble of polishing the quartz trunklines would be comparable to new cable purchase. The quartz cables could be problematic.

For the LED system, the rectangular block for distributing the light of (currently 4) LED"s to the 96 fibers in a fiber backplane is also being cut (roughtly 10x10 array of holes).

Elizabeth will send Paul some PMTs so that light yield and LED intensity variation can be studied. The PMT's E shipped to Paul have been numbered and tested previously. Paul should tell Mark so he can check the master PMT database to get HV characteristics for these tubes.

In either case, fibers ends must be polished before insertion/epoxy into the holes, so it is important that the connector polisher be able to polish fibers (bundles or single) in addition to connectors (Jia Li).

Also, in either case, color coding optical cables in the fiber backplane to distinguish calibration and tile fibers as well as distinguish individual channels would be very useful. Elizabeth will follow up on this.

A full mock up of the fiber backplane including the calibration fibers must be assembled. See the fiber backplane section (Jia Li).

A prototype fiber backplane must be assembled for the full prototype test by the end of November. Is it possible to include some kind of calibration here ?

8 Tools

8.1 CONNECTOR POLISHER (Jia Li)

The connector polisher must have 3 capabilities:

1. connector polishing
2. pmt cookie polishing
3. bulk single fiber polishing in frozen PVC pipe.

Jia Li has assembled nearly all the components for the polisher in the Swift center at UTA with the exception of the diamond bit. Jia Li has also built a holder for the fiber connectors which firmly holds 2 connectors at a time during polishing. It all looks great but we won't know if it works till we get the diamond bit (order it asap !) As soon as an acceptable bit manufacturer is found, a number of these bits should be ordered ASAP since they are in the current year UTA MOU (the fiberglas in the connectors is known to wear down the bits).

Jia Li: Additional holders need to be designed to polish the fiber backplane cookies, frozen PVC pipe assembly and possibly a single fiber polisher.

9 Software

9.1 Software (Lee, Elizabeth, Andy, Dick)

There is a large effort here to rewrite all calorimeter software in C++ and ICD should be included in this effort.

Elizabeth has recently signed on to rewrite the MTC package to be compatable with the new system. This will help me get familiar with the new storage and access for calorimeter related quantities.

Things unique to ICD software within the calorimeter framework are geometry, survey and calibration constants. There is currently a great need for someone to think about how we are really going to calibrate this detector without a test beam (monte carlo is our standard response, which seemed to make people content at the last collaboration meeting).

Lots to do here, but needs dedicated efforts. Most of us very busy with the hardware. It may be advantageous to wait for the cal software group to make some decisions but certainly many issues should be addressed independent of this.