**Fermilab** Directorate

# MEMORANDUM OF UNDERSTANDING FOR THE 2003-4 MESON TEST BEAM PROGRAM

## T933

## BTeV – EMCal Detector Test Beam Run

## November 4, 2003

## BTeV Document 1361

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## INTRODUCTION

E918 (BTeV) is an approved experiment. It requires detector research and development in tracking, triggering, data acquisition, charged hadron identification, electromagnetic calorimetry and muon detection, as well as an extensive effort in simulation and software development. The goal of the present R&D project is to develop the final devices for use in the BTeV experiment. This MOU relates to EM calorimeter radiation sensitivity and its monitoring studies that will be carried out using the MTEST beam of the Meson Area during the 2003-2004 run period.

This is a memorandum of understanding between the Fermi National Accelerator Laboratory and those experimenters of E918 who have committed to participate in EM calorimeter beam tests to be carried out during the 2003-2004 period. The memorandum is intended solely for the purpose of providing a budget estimate and a work allocation for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to negotiate amendments to this memorandum that will reflect such required adjustments.

## I. PERSONNEL AND INSTITUTIONS

| | |
|---|---|
| BTeV EMCAL Test Beam Spokespersons: | Yuichi Kubota, University of Minnesota;<br>Alexander Vasiliev, IHEP |
| Physicist in Charge: | Pavel Semenov, IHEP |
| BTeV Test beam Liaison: | Charles Newsom, University of Iowa |
| E918 Computing Off-line liaison: | Julia Yarba, Fermilab |
| E918 Computing On-line liaison: | Pavel Semenov, IHEP |
| Fermilab liaison physicist: | Erik Ramberg, Fermilab |
| Beamline physicist: | From Beams Div./External Beams Dept. Currently, Tom Kobilarcik |
| Particle Physics Division Liaison: | Erik Ramberg, Fermilab |
| Computing Division Liaison: | Dave Slimmer, Farmilab |

**The Collaboration members at present are**

Fermilab: J.N. Butler, H. Cheung, D. Christian, L. Garren, R.Kutschke, M. Votava, J.Yarba
University of Minnesota: J. Hietala, Y. Kubota, B. Lang
Institute for High Energy Physics: A.Derevschikov, V.Katchanov, V.Kravtsov, Y.Matulenko, V.Mochalov, D.Morozov, L.Nogach, P.Semenov, K.Shestermanov, A. Uzunian, A.Vasiliev
Syracuse University: S. Stone

Other commitments:

CLEO: Y. Kubota, S. Stone
FNAL E831/FOCUS analysis: J. Butler, H. Cheung, L. Garren, R. Kutschke
FNAL E690 analysis: D. Christian

BNL STAR : A. Derevschikov, V. Kravtsov, Y. Matulenko, V. Mochalov, D. Morozov, L. Nogach, K. Shestermanov, A. Vasiliev
CERN CMS: V. Katchanov, A. Uzunian

## II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS

### *2.1 LOCATION AND FACILITIES*

2.1.1 The EM Calorimeter prototype is to be located in the downstream area in the MT6 test beam line known as MT6-B4.

2.1.2 The test-beam Control/Counting Room to the west of the MT6 test beam will be used for electronics.

2.1.3 An array of crystals and monitoring system will be placed in a temperature and humidity regulated light-tight box. The box will be placed on the mechanical support table located in MT6-B4, which is remotely movable in the vertical and horizontal directions perpendicular to the beam direction. We also expect the mechanical support can be rotated manually in the horizontal plane up to $\pm 90^{o}$. PPD mechanical engineering will assist in the construction of this table.

2.1.4 The temperature regulation system uses a chiller and it will use chilled water for a primary means of cooling. The temperature will be in the range from $10^{o}$ to $25^{o}$ C. The water flow is up to 10 *l/min*

2.1.5 Dry air (or possibly dry nitrogen) must flow through the crystal box. We will need about 2*l*/min of flow.

2.1.6 We will need the existing 1 mm beam wire chambers as well as the existing Cerenkov identification system to tag the beam electrons at the EM Calorimeter.

2.1.7 A "gateway" computer with Internet access should be provided. Powered racks for electronics and NIM bins should also be made generally available.

2.1.8 Space in cable trays for approximately 110 cables (50 with BNC, 60 with SHV, and other misc. termination cables) connecting the light-tight box to the Counting Room are required.

2.1.9 Electronics Racks are needed near the light-tight box (1) and the Counting Room (2).

2.1.10 One standard-size table will be required in the test-beam Counting Room. Computer networking to the gateway computer will be required.

2.1.11 The power requirements are 2.5 kW of clean power for preamplifiers and remotely controllable HV near the detector power supplies as well as CAMAC and NIM in the counting room. An additional 25 kW is required for cooling, moving of the support and other uses. HV power supply requires power line of 208-240 VAC.

### *2.2 BEAM*

2.2.1 The tests require a beam of tagged electrons of 10 GeV (or higher). We would like an intensity of about 1-10 kHz for detector calibration, if it is achievable.

For Irradiation studies we will need a beam of pions/protons of energies 40 GeV or higher and an intensity of 0.2 – 0.7 MHz and total beam size of as large a size as possible, up to about 10 $in^2$.

### *2.3 SCHEDULE*

The goal is to deliver charged particles at the rate stated above for data taking as required by the R&D program over a significant period beginning early fall 2003. The group expects to collect data with different crystals at the center of the array for short bursts of shifts and to repeat some of the tests several times. We need to expose each set of crystals for few days at a constant intensity, and repeat this at 3 different intensities and for 3 - 5 different sets of crystals.

At least one long term test is needed to study stability. This would be at least 1 month as a background measurement with some other detector in place before the calorimeter, whose total depth with respect to the beam is less than 3 interaction lengths.

The group expects to share beam time with other R&D efforts. Further details are given in Appendix IV below.

## III. RESPONSIBILITIES BY COLLABORATING PHYSICS GROUP

([ ] denotes replacement cost of existing hardware.)

### 3.1 Fermilab

Fermilab physicists will be responsible for the trigger, the beam tracking telescope, beam ID and beam position detectors and will share responsibilities for EMCal monitoring system, data acquisition and monitoring, software and web support, and data analysis.

| | | **Equipment** | **Operating** |
|---|---|---|---|
| 3.1.1 | PMT's | [$ 10 K ] | |
| 3.1.2 | PWO crystals | [$ 27 K ] + $ 5 K | |
| 3.1.3 | DAQ computers | $ 5 K | |
| 3.1.4 | EMCal Monitoring system (fibers, light sources, photodetectors ) | $ 2 K | |
| 3.1.5 | Misc. cables (from previous experiment use) | [ $ 4 K] | |
| 3.1.6 | Misc. expendables and services | | |
| | **Total existing items** | **[$ 41 K]** | |
| | **Total new items** | **$ 12 K** | |
| | **Total operating cost** | | **$ 0 K** |

### 3.2 Institute of High Energy Physics (IHEP)

IHEP physicist will share responsibilities for the DAQ, HV, EMCal monitoring system, the software and data analysis.

| | | |
|---|---|---|
| 3.2.1 | EMCal Monitoring system (LED driver) | $ 2 K |
| 3.2.2 | Travel for personnel | $ 10 K |
| 3.2.3 | Misc. expendables and services (tools, facilities) | [$ 2 K] |
| | **Total existing items** | **[$ 2 K]** |
| | **Total new equipment items** | **$ 2 K** |
| | **Total operating cost** | **$ 10 K** |

### 3.3 University of Minnesota

Minnesota physicist will be responsible for the construction of the light-tight box and associated temperature and humidity control system, and share responsibilities for the software and data analysis.

| | | |
|---|---|---|
| 3.3.1 | Light –tight box | $ 5 K |
| 3.3.2 | Travel for personnel | $ 5 K |
| | **Total existing items** | **[ 0 ]** |
| | **Total new equipment items** | **$ 5 K** |
| | **Total operating cost** | **$ 5 K** |

### 3.S Summaries of Section 3

#### 3.S.1 Summary of Collaboration Responsibilities

Test beam coordination (hut, environment, cable tray, racks, crates, and coordination with other groups) – IHEP, Minnesota
Mechanical support and cooling – FNAL and Minnesota
Trigger - Fermilab
Data Acquisition – Fermilab and IHEP
Monitoring and Event Display – IHEP and Minnesota
EMCal Monitoring system – Fermilab and IHEP
Devices Under Test (detectors, boards, assembly, testing, maintenance) – IHEP and Fermilab
Offline Software (including databases, run log, and web: development, maintenance) – Fermilab, IHEP

#### 3.S.2 Summary of Non-Fermilab Costs

| | Equipment | Operating |
|---|---|---|
| **Total existing items** | **[$ 43 K]** | |
| **Total new items** | **$ 19 K** | **$ 15 K** |

# IV. RESPONSIBILITIES BY FERMILAB DIVISION

([] denotes replacement cost of existing hardware.)

## 4.1 Fermilab Beams Division

4.1.1 Use of MT6 test beam line.

4.1.2 Maintenance of all existing standard beam-line elements (such as SWICs, loss monitors, remotely-controlled finger counters, at least two threshold Cerenkov counters, etc) instrumentation, controls, clock distribution and power supplies.

4.1.3 Beam controls console and remote data logging capability (ACNET)

4.1.4 Reasonably rapid access to our equipment in the test beam. This will mitigate any interference with experiments running in adjacent beam lines. Such access is anticipated to be less than once per hour, typically more like once per shift.

4.1.5 Logic signal at experimenter electronics racks that has a constant phase (within 1-2 ns in a given hour) with respect to the arrival of beam buckets at the test apparatus.

4.1.6 No experiment-owned devices need interfacing to the Beams Division control system, other than the possible readout of beam-line variables of 4.1.3.

4.1.7 The test-beam energy and the rest of the beam-line elements will be under the control of the Main Control Room

4.1.8 Position and focus of the beam on the experimental devices under test will be under control of the BD Operations Department (MCR). Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.

4.1.9 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning

### 4.1.S Summary of Beams Division costs:

| | **Equipment** | **Operating** | **Personnel (person-weeks)** |
|---|---|---|---|
| Total new items | $ 0 K | $ 0 K | 0 |
| Total | $ 0 K | $ 0 K | 0 |

## 4.2 Fermilab Particle Physics Division

The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section 2. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MT6 test beam-line, including use of the user beam-line controls, readout of the beam-line detectors, and MT6 test gateway computer. Funding under this section will be handled through the BTeV R&D budget.

4.2.1 Tools and supplies for MT6 test [$ 1 K]
4.2.2 Beam Tracking Telescope (operation only; hardware Vanderbilt contribution)
4.2.3 Cerenkov particle identification [0.0]
4.2.4 Crystal positioning stage [$ 5 K ] + $ 2 K
4.2.5 Chiller and temperature sensors to maintain 20 C light-tight box operation [ $ 10 K]
4.2.6 Three Unistrut stands for trigger counters 0
4.2.7 Assistance in constructing 3 trigger [$ 2 K]
counters. Tubes, light guides, and bases will come from existing counters. Existing plastic needs to be cut to the proper dimensions and the counter will need to be glued and wrapped.
4.2.8 Use of the gateway UNIX computer for interfacing and isolation of DA computers.
4.2.9 Survey of detectors on beam line (trigger counters, EMCal with the box and EMCal monitoring system).
4.2.10 Installation and wiring of two relay racks in counting room.
4.2.11 Cable tray installation as needed
4.2.12 Installation of gas lines for N2 flushing.
4.2.13 Installation of quiet power to detector enclosure is required to reduce noise in electronics. Provision of adequate air-conditioning and cooling for detectors and electronics in the beam area, the electronics alcove, and the counting room. [$ 1 K]
4.2.14 Provision of adequate moisture protection for equipment and personnel in MT6 test beam area, Alcove, and counting room.
4.2.15 Support from Electrical Engineering Department in testing QIE chip and implementing preamplifiers may be needed. $ 2 K

**4.2.S Summary of Particle Physics Division costs:**

| | **Equipment** | **Operating** | **Personnel (person-weeks)** |
|---|---|---|---|
| **Total existing items** | **[$ 19 K]** | | |
| **Total new items** | **$ 4 K** | **$ 0 K** | **5** |

## 4.3 Fermilab Computing Division

4.3.1 The Liaison from the Computing Division is Dave Slimmer.
4.3.2 The attached off-line analysis plan contains the experiment's present understanding of its analysis model from code development, through production, stripping, final data analysis and Monte Carlo. A more detailed quantitative description is given in Appendix II. The Computing Division cannot guarantee, at this time, that these resources can be made available. The Computing Division, guided by priorities set by management, will attempt to allocate on a quarterly basis, the available resources. The present request and

amendments will be used in attempting to plan the laboratory's computing acquisition strategies.

4.3.3 Support from the Computing & Engineering for Physics Applications Department (particularly *Electronic Systems Engineering* and *Online and Analysis Applications* groups) in developing and implementing the DAQ/Online system for the EMCal detector tests. Some mentoring from a CD computing professional familiar with the system might be necessary. This might involve 10% of an FTE for a short period of time. Some off-hour support may be required for efficient use of beam-time. Details of the support will be worked out among CD, PPD and the experiments.

4.3.4 Computer security for the EMCal system in MT6 test will be organized by having wide-area networking for the DA computers through the Meson Test Facility gateway computer and via kerberized systems more directly attached to the networking backbone.

4.3.5 Support of the networking in MT6 test, including access to a gateway computer and local networking between the gateway and DA computer(s), which may not have network access. The support level for the gateway computer and support mechanisms are not specified in this MOU. Ethernet access in the test beam area to the Internet backbone will be provided. This may require more than running a cable to an existing bridge.

4.3.6 Maintenance and update services for operating systems and packages to versions & levels supported by the Computing Division. [$ 2.0 K]

4.3.7 Appendix I contains the list of the main part of the required PREP equipment. The estimated value of this equipment is [$ 80 K]

4.3.8 Maintenance and repair of PREP and DA equipment. $ 1.0 K

**4.3.S Summary of Computing Division Costs:**

| **Type of Funds** | **Supplies** | **Operating** | **Personnel (person-weeks)** |
|---|---|---|---|
| Total existing items | [$ 82 K] | | |
| Total new items | $ 1 K | $0.0K | 1 |

4.S Summary of New Fermilab costs

| **Type of Funds** […] denotes existing | **Equipment** | **Operating** | **Personnel** (person-weeks) |
|---|---|---|---|
| Beams Division | $ 0 K | $ 0 K | 0 |
| Particle Physics Division | $ 4 K | 0 | 5 |
| Computing Division | $ 1 K | 0 | 1 |
| **Totals Fermilab** | **$ 5 K** | **$ 0 K** | **6** |

## V. SPECIAL CONSIDERATIONS

5.1 The responsibilities of the BTeV EMCAL Test Beam Spokesperson and procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters" (PFX). The Physicist in charge agrees to those responsibilities and to follow the described procedures.

5.2 To carry out the experiment a number of Environmental, Safety and Health (ES&H) reviews are necessary. This includes creating a Partial Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The BTeV EMCAL Test Beam Spokesperson will follow those procedures in a timely manner, as well as any other requirements put forth by the division's safety officer.

5.3 The BTeV EMCAL Test Beam Spokesperson will ensure that at least one person is present at the Meson Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.

5.4 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.

5.5 All items in the Fermilab Policy on Computing will be followed by experimenters.

5.6 The BTeV EMCAL Test Beam Spokesperson will undertake to ensure that no PREP and computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.

5.7 Each institution will be responsible for maintaining and repairing both the electronics and the computing hardware supplied by them for the experiment. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

5.8 If the experiment brings to Fermilab on-line data acquisition or data communications equipment to be integrated with Fermilab owned equipment, early consultation with the Computing Division is advised.

5.9 At the completion of the experiment:

5.9.1 The BTeV EMCAL Test Beam Spokesperson is responsible for the return of all PREP equipment, Computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the BTEV EMCAL Test Beam Spokesperson will be required to furnish, in writing, an explanation for any non-return.

5.9.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters.

5.9.3 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied, including computer printout and magnetic tapes.

5.9.4 An experimenter will report on the test beam effort at a Fermilab All Experimenter Meeting.

**SIGNATURES:**

_____ / / 2003
Alexander Vasiliev, BTeV EMCal Test Beam co-Spokesperson

_____ / / 2003
Yuichi Kubota, BTeV EMCal Test Beam co-Spokesperson

_____ / / 2003
John Cooper, Particle Physics Division

_____ / / 2003
Roger Dixon, Beams Division

_____ / / 2003
Vicky White, Computing Division

_____ / / 2003
William Griffing, ES&H Section

_____ / /2003
Hugh Montgomery, Associate Director for Research, Fermilab

_____ / /2003
Steven Holmes, Associate Director for Accelerators, Fermilab

_____ / / 2003
Michael Witherell, Director, Fermilab

_____ / / 2003
Joel Butler, BTeV Co-spokesperson

_____ / / 2003
Sheldon Stone, BTeV Co-spokesperson

APPENDIX I - PREP AND DAQ EQUIPMENT

MISCOMP

| TC PROVCLASS | DESCRIPTION | QREQ | COST | TOTCOST |
|---|---|---|---|---|
| AA MECHTRON: 3034 | BIN,NIM | 2 | 381 | 762 |
| AB PD: AEC-320-9 | POWER SUPPLY,6@10A,12@3A,24@1.5A, | 2 | 621 | 1242 |
| AD LRS: 621L | DISCRIMINATOR,4CH,NIM | 3 | 706 | 2118 |
| AE LRS: 365 | LOGIC,2CH,4-FOLD,MAJORITY,NIM | 6 | 740 | 4440 |
| AG LRS: 428 | FAN-IN/OUT,4CH,LIN,NIM | 1 | 435 | 435 |
| AG LRS: 628 | FAN-IN/OUT,8CH,NIM | 1 | 1399 | 1399 |
| AH LRS: 612A | AMP,12CH,X10,PHOTOMULT,NIM | 1 | 966 | 966 |
| AN LRS: 222 | GENERATOR,GATE,2CH,NIM | 2 | 1001 | 2002 |
| AO JORWAY: 1880B | SCALER,2CH,VISUAL,NIM | 2 | 848 | 1696 |
| FERMI: RFDVS | 3-ch VISUAL SCALER,PRESET,8 DIGIT,100MHz | 4 | 750 | 2250 |
| EA TEK: 2465B | OSCILLOSCOPE,4CH,400MHZ | 1 | 5979 | 5979 |
| LRS: 1440 | HV power system frame | 1 | | |
| LRS: 1443NF | HV cards, 16-ch, negative | 4 | 1157 | 4628 |
| GA GENRAD: 1340 | GENERATOR,PULSE,0.2HZ TO 20MHZ | 2 | 484 | 968 |
| DSP:860C | BIN, CAMAC | 3 | 600 | 1800 |
| DSP:860P | CAMAC POWER SUPLY | 3 | 1000 | 3000 |
| LRS:4222 | Programmable delay generator | 1 | 3613 | 3613 |
| Kinetic Systems:3290 | Dataway Display | 3 | 460 | 1380 |
| JORWAY:71B | Type A1 Crate Controller | 3 | 1512 | 4536 |
| JORWAY:51 | Branch terminator | 1 | 640 | 640 |
| LRS:2551 | 12-ch scaler | 2 | 1170 | 2340 |
| LRS:2132 | RS232 interface to LRS 1440 | 1 | 450 | 450 |
| JORWAY:65 | interrupt register | 1 | 335 | 335 |
| JORWAY:41 | output register | 2 | 300 | 600 |
| SEC: PR-612 | output register | 1 | 425 | 425 |
| LRS:2285A | ADC, 15 option | 4 | 1585 | 6346 |
| LRS:2280 | ADC system processor, 15 bit option | 2 | 2500 | 5000 |
| FERMI: 156 | Power supply controller | 2 | 490 | 980 |
| VMECRATE | | 1 | 1350 | 1350 |
| CES:CBD8210 | CAMAC Branch driver | 1 | 3095 | 3095 |
| SBSBIT3: 617 | VME-to-PCI interface | 1 | 2850 | 2850 |
| LAMBDA:LCS-2-02 | LV power supply | 3 | 177 | 531 |

Total Req QTY is 67

## APPENDIX II – E918 OFF-LINE ANALYSIS PLAN FOR THE 2004-2004 EMCAL BEAM TESTS

### DATA PROJECTION

Based on the run plan outlined on page 16, we expect at most a few hundred gigabytes of data total which will be archived to disk and tape library for analysis.

Anticipated data sample:

| | |
|---|---|
| Total number of triggers on tape | less than $2 \cdot 10^9$ |
| Size of data sample | less than 250 Gbytes |
| Number of 5 GB 8mm tape equivalents | less than 50 |

### ANALYSIS PLAN

All analysis at Fermilab will be done on FNALU under normal priority, the EPP department cluster FNPPD, the BTeV LINUX cluster, and desktops and the substantial facilities available at several of the collaborating institutions. Analysis computing will not be a problem.

(i) Raw data processing:

| | |
|---|---|
| Reconstruction time per event | negligible |
| Total computing power needed | negligible |

(ii) Physics analysis:

| | |
|---|---|
| Total number of events | 2 billions |
| Analysis time per event | tiny |
| | Total computing power is at the level of a few workstations |

(ii) Monte Carlo studies:

Total requirements are at the levels of a few tens of hours on a workstation system.

### REQUEST

While our CPU requests can be handled from Fermilab general resources and university resources, we would like to have about 100 Gbytes of disk and about 200 Gbytes of storage in the Enstore system to be able to conveniently access key raw and derived datasets. .

## APPENDIX III COMPUTING DIVISION ANALYSIS MODEL

The analysis of the data from these tests will be carried out on Fermilab general purpose computing facilities, on the machines in the EPP cluster, and on computing at collaborating institutions. Given the scale of this activity, no additional formal plan is required at this time. The experimenters will inform the Computing Division if it appears that the scale of the computing will increase significantly from what was stated above.

## APPENDIX IV - E918 BTEV EMCAL TEST BEAM 2003-4 RUN PLAN

Assumptions:

16-weeks of running – can be divided into up to 8 runs of 2-week running.

Let $t_0$ be the start date of the 2003-4 EMCAL test beam program.

| | |
|---|---|
| $t_0$ - 4 months | begin assembling DAQ, Crystal array and monitoring system in the light-tight box. |
| $t_0$ - 4 months | begin work on trigger counters and design of stands |
| $t_0$ - 4 months | begin to establish presence in MT6 test , establish necessary infrastructure, and determine final layout of apparatus, cable runs, etc. |
| $t_0$ - 1 month | complete installation of trigger system, electronics, beam-tracking telescope, beam particle ID and DAQ in MT6 test |
| $t_0$ | Begin to commission beam and apparatus |
| $t_0$ + 2 weeks | start investigation of properties of devices under test |

Run Plans:

1. Goals:
   The primary goal is to measure the effects of irradiation arising from the beam on the light output of PWO crystals. It will be measured with an electron component of the beam and with a LED based monitoring system. Variation of the effect among crystals from the same vendors and variation among different vendors is one of the most important quantities we need to measure. Correlation between the beam and LED-based monitoring system measurements is a crucial outcome to estimate how well we can calibrate these crystals in BTeV. The variation in the correlation among different crystals is also very important quantity we need to know. Besides, we need to test QIE based EMCal electronics in the beam environment.
2. Run plan:
   a. We will need two weeks for the installation and alignment of the beam counters and the EMCal test devices. This can be done well before beam.
   b. We will need two weeks of beam time to tune the trigger, tracking telescope, beam particle ID and positioning and the crystal matrix under test.
   c. We will need up to 16 weeks for data taking for few crystal matrices. These 16 weeks can be broken into up to 8 pieces with some no-beam time between them for reassembling the matrix.

d. During the "no-beam" time, other experiment(s) may run in front of our apparatus as long as we have some access time to the crystal array to make modification to it.

# APPENDIX V - E918 BTEV EMCAL TESTS HAZARD IDENTIFICATION CHECKLIST

Items for which there is anticipated need have been checked

| **Cryogenics** | | **Electrical Equipment** | | **Hazardous/Toxic Materials** | |
|---|---|---|---|---|---|
| | Beam line magnets | | Cryo/Electrical devices | | List hazardous/toxic materials |
| | Analysis magnets | | capacitor banks | | planned for use in a beam line or |
| | Target (Si pixel detector under test) | | high voltage (> 5 kV ) | | experimental enclosure: |
| | Bubble chamber | X | exposed equipment over 50 V | X | Oxygen depletion if dry nitrogen is used instead of dry air |
| **Pressure Vessels** | | **Flammable Gasses or Liquids** | | | |
| | inside diameter | type: | | | |
| | operating pressure | flow rate: | | | |
| | window material | capacity: | | | |
| | window thickness | **Radioactive Sources** | | | |
| **Vacuum Vessels** | | | permanent installation | **Target Materials** | |
| | inside diameter | X | temporary use | | Beryllium (Be) |
| | operating pressure | type: | Co60,Cs137 | | Lithium (Li) |
| | window material | strength: | Up to $10^8$ rad.dec/min | | Mercury (Hg) |
| | window thickness | **Hazardous Chemicals** | | | Lead (Pb) |
| **Lasers** | | | Cyanide plating materials | | Tungsten (W) |
| | Permanent installation | | Scintillation Oil | | Uranium (U) |
| | Temporary installation | | PCBs | | Other : $PbWO_4$ crystals |
| | Calibration | | Methane | **Mechanical Structures** | |
| | Alignment | | TMAE | X | lifting devices |
| type: | | | TEA | X | motion controllers |
| Wattage: | | | photographic developers | | scaffolding/elevated platforms |
| class: | | | Other: | | Others |