Judy Nicholls

Fermilab

I have reviewed and I approve the attached MOU.

Joel N. Butler 7/12/93

Vicky A. White 7/12/93

This is a small Varonline experiment.
I expect it to be a total load of between
0.5 an 1.0 FTEs including
- online liaison + questions
- system management + networking
- repairs
-

Fermilab

Directorate

# MEMORANDUM OF UNDERSTANDING

## T864

## MiniMax

June 29, 1993

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INTRODUCTION

T864 is a simple, staged test program of very modest scope, cost, and impact on the laboratory which responds to the suggestion of the Fermilab Physics Advisory Committee that it ``hopes that efforts will continue to develop possible methods for exploring the large rapidity regime.'' We propose initially to measure the background environment in the forward direction at the C0 collision area with a minimal ``maximum acceptance'' detector (MiniMax). This will be done initially in noncollider mode in the far forward direction using only MWPC tracking elements and a simple scintillator-based triggering system. Only minor and straightforward modifications to the beam pipe are requested. Pending successful completion of the initial test program, we will carry out studies of charged particles and gamma rays in the fiducial region defined by the MWPC telescope. Physics goals include both generic multiparticle production studies and a disoriented chiral condensate search. Both will proceed in non-collider mode initially, with a request for a very short collider run following the successful completion of the initial program.

This is a memorandum of understanding between the Fermi National Accelerator Laboratory and the experimenters of T864. 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 which will reflect such required adjustments.

## I. PERSONNEL AND INSTITUTIONS

Co-Spokesperson: J. D. Bjorken, Stanford Linear Accelerator Center
Co-Spokesperson: C. C. Taylor, Case Western Reserve University
Physicist in Charge: H. R. Gustafson, University of Michigan

T864 Computing On-line liaison: Jonathan Streets

T864 Accelerator Division liaison: (P. Colestock? )

1.1 Case Western Reserve University: K. Del Signore (grad student), W.J. Fickinger, T.L. Jenkins, K.L. Kowalski, C.C. Taylor

1.2 Duke University: S.H. Oh, W.D. Walker

1.3 Fermilab: P. Colestock, B. Hanna, M. Martens

1.4 Los Alamos National Laboratory: F. Cverna

1.5 Stanford Linear Accelerator Center: J. D. Bjorken

1.6 University of Michigan: H.R. Gustafson, L.W. Jones, M.J. Longo

1.16 Other obligations:
OSSE Analysis: T.L. Jenkins, K. Del Signore
Anti-Proton Lifetime (E868): H. R. Gustafson, L.W. Jones, M. Martens

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS

2.1 The test is to take place in the C0 experimental area.

2.2 Special Considerations for the utilization of the C0 experimental area:
2.2.1 The C0 E735 PortaKamps will be used for electronics and DAQ. The experimenters agree sharing the control room with E853 and to resolve all conflicts.
2.2.2 A labyrinthine channel of order 2' by 1' will be provided through the shielding wall separating the C0 collision area in the tunnel and the Spectrometer Room.

2.3 Initial running will be without proton-antiproton collision at C0.
2.3.1 Data taking will take place with separators turned off and before terminating stores.

2.4.1 Energy: available Tevatron energy
2.4.2 Luminosity: available Tevatron Collider luminosity

2.5 Schedule
2.5.1 Parasitic Beam-Gas running: approximately 1 run of 1 hour duration per day
2.5.2 Collider Running: short runs with separators off at the end of a fill to be coordinated by Fermilab's Program Planning Office.
2.5.3 In addition, concurrent running with E811 is contemplated.

III. RESPONSIBILITIES BY INSTITUTION - NON FERMILAB
([] denote replacement cost of existing hardware.)

**3.1 Case Western Reserve University**
(University Funds)
3.1.1 20 MWPC's **$50.0K**

**Total existing items [$0.0K]**
**Total new items $50.0K**

**3.2 Duke University**
(DOE funded)
3.2.1 10 (20 cm x 20 cm) paddles of scintillator + PMT's **[$3.0K]**

**Total existing items [$3.0K]**
**Total new items $.0K**

**3.3 Los Alamos National Laboratory**
(DOE Funded)
3.3.1 Contingency source of electronics and computing

**Total existing items [$.0K]**
**Total new items $.0K**

**3.4 Stanford Linear Accelerator Center**
(DOE Funded)
3.4.1 Contingency source of electronics and computing

| | |
|---|---|
| **Total existing items** | **[$.0K]** |
| **Total new items** | **$.0K** |

**3.4 University of Michigan**
(NSF Funded)

| | | |
|---|---|---|
| 3.4.1 | Contingency Readout Electronics for MWPC's (1536 channels) | [$29.0K] |
| 3.4.2 | Scintillation counters and PMT's | [$3.0K |
| 3.4.3 | Miscellaneous instrumentation | [$1.2K |
| | **Total existing items** | **[$33.2K]** |
| | **Total new items** | **$.0K** |

IV. RESPONSIBILITIES BY INSTITUTION - FERMILAB
([] denote replacement cost of existing hardware.)

**4.1 Fermilab Physics Section**

| | Type of Funds | Equipment | Operating |
|---|---|---|---|
| 4.1.1 | Design for chambers supports | 1 man-month | |
| 4.1.2 | Technician effort for chambers supports | 3 man-months | |
| 4.1.3 | Chambers supports | $6.0K | |
| 4.1.4 | Miscellaneous supplies | | $2.0K |
| 4.1.5 | Travel for Fermilab physicists | | $3.0K |

4.1.S Summary of Physics Section Costs:

| Type of Funds | Equipment | Operating | Plant | Manpower (man-years) |
|---|---|---|---|---|
| **Total existing items** | | | | |
| **Total new items** | **$6.0K** | **$5.0K** | | **0.3** |
| **Contingency** | | | | |
| **Totals** | **$6.0K** | **$5.0K** | **$0.0K** | **0.3** |

**4.2 Fermilab Research Division**

| | Type of Funds | Equipment | Operating | Plant |
|---|---|---|---|---|
| 4.2.1 | Surveying and alignment | | 4 man-days | |
| 4.2.2 | Gas system for MWPC's | $3.0K | | |
| 4.2.3 | Miscellaneous cables and connectors | $3.0K | | |

4.2.S Summary of Research Division costs:

| Type of Funds | Equipment | Operating | Plant | Manpower (man-years) |
|---|---|---|---|---|
| **Total existing items** | | | | |
| **Total new items** | **$6.0K** | | | |
| **Contingency** | | | | |
| **Totals** | **$6.0K** | **$.0K** | | **<0.1** |

**4.3 Fermilab Computing Division**

4.3.1 The Computing Division On-line liaison is J. Streets

4.3.2 Computing resources needed for data analysis are expected to be small. As a result, no off-line liason will be named. The Computing Division on-line liaison, listed in 4.3.1, will also track the needs of the experiment and help obtain facilities and services from the division. The co-spokespersons or representative should make sure that a review of computing status and needs occurs as needed.

4.3.3 T864 will use the Vaxonline DAQ system.

| | Type of Funds | Equipment | Operating |
|---|---|---|---|
| 4.3.4 | Software support for the on-line, data acquisition and other software products designated as supported by the Computing Division. | $0.0K | |
| 4.3.5 | Maintenance and update services for operating systems and packages at versions levels supported by the Computing Division. | | $6.0K |
| 4.3.6 | PREP and Data Acquisition equipment as specified in Appendix I and II.) | $219.0K | |
| 4.3.7 | Maintenance and repair of PREP and DAQ equipment. | | $33.0K |

4.3.S Summary of Computer Division Costs:

| Type of Funds | Equipment | Operating | Plant | Manpower (man-years) |
|---|---|---|---|---|
| **Total existing items** | | | | |
| **Total new items** | **$219.0K** | **$39.0K** | | |
| **Contingency** | **$37.0K** | | | |
| **Totals** | **$256.0K** | **$39.0K** | | |

## 4.4 Fermilab Accelerator Division

| | Type of Funds | Equipment | Operating | Plant |
|---|---|---|---|---|
| 4.4.1 | Replace 3" SS beampipe with 3" Al Beampipe | $5.0K | | |
| 4.4.2 | Enginnering for pipe | | 0.5man-months | |
| 4.4.3 | Draftsman for pipe | | 0.5man-months | |
| 4.4.4 | Technician support for beam pipe | | 2.5 man-months | |
| 4.4.5 | Unstacking of C0 wall for cable penetration | | Experiment's Personnel | |
| 4.4.6 | Gas lines | | Experiment's Personnel | |

4.4.S Summary of Accelerator Division costs:

| Type of Funds | Equipment | Operating | Plant | Manpower (man-years) |
|---|---|---|---|---|
| **Total existing items** | | | | |
| **Total new items** | **$5.0K** | | | **0.3** |
| **Contingency** | | | | |
| **Totals** | **$5.0K** | | | **0.3** |

V. SUMMARY OF COSTS

| **Type of Funds,** [] existing (with contingency) | **Equipment** | **Operating** | **Plant** | **Manpower** (man-years) |
|---|---|---|---|---|
| Fermilab Division/Section: | | | | |
| Accelerator Division | $5.0K | | | 0.3 |
| Physics Section | $6.0K | $5.0K | | 0.3 |
| Research Division | $6.0K | | | |
| Computer Division | $256.0K | $39.0K | | |
| **Totals Fermilab** | **$272.0** | **$44.0K** | | **0.6** |
| **Totals Non-Fermilab** | **$50.0K [$36.2K]** | | | |
| **Overall Totals** | **$358.2K** | **$39.0K** | | **0.6** |

VI. SPECIAL CONSIDERATIONS

6.1 The responsibilities of the Scientific Spokesperson and procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters" (PFX). The Scientific Spokesperson agrees to those responsibilities and to follow the described procedures.

6.2 To carry out the experiment a number of Environment, Safety and Health (ES&H) reviews are necessary. The procedures to carry out these various reviews are found in the Fermilab publication "Review Procedures for Experiments" (RPX). The spokesperson undertakes to follow those procedures in a timely manner.

6.3 The experiment spokesperson will undertake to ensure that no PREP equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the PREP management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the PREP management.

6.4 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.

6.5 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.

6.6 At the completion of the experiment:

6.6.1 The 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 Spokesperson will be required to furnish, in writing, an explanation for any non-return.

6.6.2 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 manpower for the removal will be borne by the experimenters.

6.6.3 The experimenters will assist Fermilab's Divisions and Sections with the disposition of any articles left in the offices they occupied, including computer printout and magnetic tapes. Costs for shipment of printout and/or tapes will be borne by the receiving university.

SIGNATURES:

_____

J. D. Bjorken, T-864 Co-Spokesperson

_____

C. C. Taylor, T-864 Co-Spokesperson

_____

J. Peoples, Fermilab

# APPENDIX I - T864 PREP REQUEST

** REQDB6 ** FERMI NATIONAL ACCELERATOR LABORATORY ** REQDB6 **
* A.W.N. *
OLESA/PREP REQUEST DATA BASE *06/16/1993*
**********

PREP UNFILLED REQUESTS SORTED BY TYPE CODE

| TP CD | MFGR | MODEL | DESCRIPTION | QTY | ITEM | UNIT COST$ | TOTAL COST$ | QTY DEL | QTY OWE |
|---|---|---|---|---|---|---|---|---|---|
| AA | MECHTRON | 3034 | NIM BIN | 5 | EML/01 | 550 | 2750 | 0 | 5 |
| AB | BLP | 1012 | NIM PS 6@5;12@2;24@1 | 5 | EML/02 | 815 | 4075 | 0 | 5 |
| AD | LECROY | 620 | OCTAL DISCRIMINATOR | 5 | EML/03 | 1045 | 5225 | 0 | 5 |
| AD | LECROY | 621 | QUAD DISCRIMINATOR | 4 | EML/39 | 1040 | 4160 | 0 | 4 |
| AE | LECROY | 364 | DUAL 4-FOLD LOGIC | 2 | EML/04 | 1130 | 2260 | 0 | 2 |
| AE | LECROY | 365 | DUAL 4-FOLD MAJ LOG | 5 | EML/05 | 1130 | 5650 | 0 | 5 |
| AF | LECROY | 429 | LOGIC FAN-IN/OUT | 4 | EML/40 | 890 | 3560 | 0 | 4 |
| AN | LECROY | 222 | DUAL GATE GENERATOR | 4 | EML/06 | 1130 | 4520 | 0 | 4 |
| AO | JORWAY | 1880 | DUAL VISUAL SCALER | 2 | EML/07 | 975 | 1950 | 0 | 2 |
| AR | LECROY | 688AL | NIM/TTL CONVERTER | 2 | EML/08 | 1150 | 2300 | 0 | 2 |
| CA | STD ENG | 850C | CAMAC CRATE | 3 | EML/09 | 895 | 2685 | 0 | 3 |
| CA | STD ENG | 850F | CRATE FAN ASSEMBLY | 3 | EML/10 | 291 | 873 | 0 | 3 |
| CB | STD ENG | 850P | CAM PS6@50;12@3;24@6 | 3 | EML/11 | 1000 | 3000 | 0 | 3 |
| CE | LECROY | 2551 | 12CH 100MHZ SCALER | 5 | EML/12 | 2430 | 12150 | 0 | 5 |
| CF | LECROY | 2341 | 16CH COINCIDENCE REG | 4 | EML/13 | 1100 | 4400 | 0 | 4 |
| CG | LECROY | 2249A | 12CH CHARGE ADC | 5 | EML/14 | 3405 | 17025 | 0 | 5 |
| CG | LECROY | 2259 | 12CH PK SENSING ADC | 1 | EML/15 | 3675 | 3675 | 0 | 1 |
| CH | LECROY | 2228 | 8CH, 10 BIT TDC | 2 | EML/41 | 2160 | 4320 | 0 | 2 |
| CI | JOERGER | CCA-1 | SER CRATE CONTROLLER | 3 | EML/16 | 1284 | 3852 | 0 | 3 |
| CL | FERMIRFD | RFD02 | LAM MODULE | 1 | EML/42 | 1000 | 1000 | 0 | 1 |
| EA | TEKTRONI | 2465 | OSCOPE, 350MHZ, 4CH | 1 | EML/17 | 7755 | 7755 | 0 | 1 |
| ED | TEKTRONI | 564 | OSCOPE, 10MHZ, STORE | 1 | EML/18 | 3200 | 3200 | 0 | 1 |
| EG | TEKTRONI | P6137 | PROBE X10 | 2 | EML/19 | 196 | 392 | 0 | 2 |
| EI | TEKTRONI | 3A74 | AMP 4T 20MV 2MHZ PI | 1 | EML/20 | 900 | 900 | 0 | 1 |
| EI | TEKTRONI | 3B3 | TIME BASE, DEL SWEEP | 1 | EML/21 | 680 | 680 | 0 | 1 |
| FB | FLUKE | 415B | HV PS 3KV @ 30MA | 3 | EML/22 | 609 | 1827 | 0 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FC | KIEBLER | 6900 | POS MWPC POWER SPLY | 6 | EML/35 | 725 | 4350 | 0 | 6 |
| FD | FERMILAB | ES-7092 | HV DISTR BOX | 3 | EML/23 | 1711 | 5133 | 0 | 3 |
| KJ | WYSE | 1575 | GRAPHIC TERMINAL | 2 | EML/24 | 2015 | 4030 | 0 | 2 |
| LC | FERMILAB | 2107-F | NIM COOLING FAN | 5 | EML/50 | 300 | 1500 | 0 | 5 |
| NA | FERMIRFD | RFD-VS | SCALER, VIS, TRIPLE | 2 | EML/25 | 800 | 1600 | 0 | 2 |
| PH | NANOMET | N-277C | 16-CHAN AMPL CARD | 96 | EML/26 | 199 | 19104 | 0 | 96 |
| PL | NANOMET | N-278 | 32-CHAN LATCH CARD | 48 | EML/27 | 825 | 39600 | 0 | 48 |
| PO | NANOMET | N-280 | CRATE CONTROLLER | 3 | EML/37 | 1700 | 5100 | 0 | 3 |
| PP | NANOMET | N-281 | SYSTEM CONTROLLER | 1 | EML/38 | 2000 | 2000 | 0 | 1 |

**TOTALS IS 243 ITEMS AT A TOTAL COST OF $186,601**

**20% PREP CONTINGENCY $37,320**

**TOTAL COST OF $223,921**

Note: MWPC electronics may be replaced by Michigan electronics

# APPENDIX II - T864 DATA ACQUISITION REQUEST

** REQDB7 ** FERMI NATIONAL ACCELERATOR LABORATORY ** REQDB7 **
* A.W.N. *
OLESA/COMP REQUEST DATA BASE *06/16/1993*
**********

COMPUTING EQUIPMENT-UNFILLED REQUEST SORTED BY TYPE CODE

| TP CD | MFGR | MODEL | DESCRIPTION | QTY | ITEM | UNIT COST$ | TOTAL COST$ |
|---|---|---|---|---|---|---|---|
| D3 | MICROPOL | 1924 | DISK DRIVE,1.2GB | 2 | EML/44 | 2000 | 4000 |
| D4 | DEC | VR260 | DISPLAY,17IN,MONO | 1 | EML/45 | 650 | 650 |
| I7 | JORWAY | JY411-Q | INTFAC,CAMAC,QBUS,S* | 1 | EML/36 | 7000 | 7000 |
| P7 | HP | HP33491A | PTR,LASERJET IIISI | 1 | EML/47 | 6000 | 6000 |
| T4 | EXABYTE | EXB-8200 | TAPE DRV,2.3GB | 2 | EML/48 | 2299 | 4598 |
| W7 | DEC | VS31V | WKSTN,120V,8MB,3200 | 1 | EML/49 | 10000 | 10000 |

**TOTALS IS 8 ITEMS AT A TOTAL COST OF $32,248**

COMPUTING ANALYSIS MODEL

## RESOURCE REQUIREMENTS AND CHARACTERISTICS

At this early stage in the T864 development it is appropriate only to give estimates of the computing needs as outlined in the Analysis Plan below. Current work on simulation and program development will allow us to refine these estimates during the course of the experiment.

### DATA PROJECTION

The following is a projection for the data we might accumulate during the 1993-94 data run. The estimates are based upon the run plan outlined below.

| | 1993-1994 |
|---|---|
| `Standard Run' | 1 hour |
| Standard Runs/day | 1 |
| Nominal Collision Rate | 1 kHz/1 m fiducial region |
| Trigger Rate (Multiplicity cut) | 30 Hz |
| Triggers/Standard Run | 100K |
| Readout Time per Event | 2 ms |
| Event Size | 0.3 KBytes |
| Data/Standard Run | 30 MBytes |
| Total Data (300 Standard Runs) | 10 GBytes |

T864 OFF-LINE ANALYSIS PLAN - 1993-4 RUN

FACTS Event size: 0.3 Kb
Event rate to tape: 30 Hz (DC)
30M events/1 yr. of std. runs

PRIMARY PROCESSING AND DATA ANALYSIS:

We are presently developing the analysis software based on the Hough transform approach outlined in the Appendix to the MiniMax proposal. We do not yet have final estimates of computing resources needed, but believe that with existing computing resources, a substantial fraction of the primary processing and data analysis can be done during the run using computing resources within the collaboration. Additional computing resources needed for data analysis are expected to be small. Accordingly, no off-line liason will be named. The Computer Division on-line liaison will also keep track of the needs of the experiment and help obtain facilities and services from the division. The co-spokespersons or representative will make sure that a review of computing status and needs occurs as needed.

MONTE CARLO's

Monte-Carlo simulations for apparatus, efficiency analysis and algorithm development are needed. Preliminary studies using EGS are under way, but GEANT-based studies will also be required. The bulk of this work will be done elsewhere; however, some small level of support from Computer Division will be very useful. The Computer Division on-line liaison will also assist in obtaining facilities and services from the division in this area. The co-spokespersons or representative will make sure that a review of computing status and needs occurs as needed.

ALTERNATIVE POWER

The VAXStation host computer is available for processing in periods between standard runs. We anticipate using this computer power for analysis as the experiment progresses during the 1993-94 run. We anticipate that much of the additional computer power needed will be provided elsewhere (SLAC, LANL, CWRU).

T864 1993-94 RUN PLAN

Assumptions:

6 month collider run, followed by 2 month shutdown (April-May '94) followed by collider run of 6 months duration
1 standard run (1 hr. duration) of data taking/day
$t_o$ = 1 October 1993
limited access during short shutdowns during commissioning
Note that we can begin taking data once the p beam is circulating

| | |
|---|---|
| $t_o$ - 3.5 months | Basic design frozen |
| $t_o$ - 3 months | MOU completed; beneficial occupancy of portakamp/service building |
| $t_o$ - 2 months | MWPC prototyping completed; chambers tested with readout electronics at CWRU test stand<br>2 planes of scintillator ready<br>Chamber mounts constructed<br>Gas system and cables in place and ready<br>Readout Electronics in place<br>DAQ equipment in place<br>Survey completed |
| $t_o$ - 1 month | SS Beam Pipe Replaced with Al Beam Pipe<br>8 MWPC's installed<br>checkout of all detector subsystems completed |
| $t_o$ - 2 weeks | Installation complete, including DAQ and computing systems |
| $t_o$ + (3 +/-2) months | Complete initial trigger, tracking and multiplicity studies (beam-gas)<br>Request short collider run with separators turned off at end of a few fills |
| $t_o$ + 7 months | Make necessary modifications/replacements during shutdown |
| $t_o$ + 9 months | Resume running as above after shutdown completed |
| $t_o$ + ? months | Additional run with collisions parasitic to E811. |

T864 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 | | high voltage (> 5 kV ) | experimental enclosure: |
| | bubble chamber | | exposed equipment over 50 V | Pb Converter Plates |
| **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: | $Str^{90}$ | Lithium (Li) |
| | window material | strength: | 200 μC | Mercury (Hg) |
| | window thickness | **Hazardous Chemicals** | | Lead (Pb) |
| **Lasers** | | | Cyanide plating materials | Tungsten (W) |
| | permanent installation | | Scintillation Oil | Uranium (U) |
| | temporary installation | | PCBs | other |
| | calibration | | Methane | **Mechanical Structures** |
| | alignment | | TMAE | lifting devices |
| type: | Nitrogen | | TEA | motion controllers |
| wattage: | | | photographic developers | scaffolding/elevated platforms |
| class: | | | other | others |

FERMILAB FUNDING PROFILE

No profile as all expenses are immediate.