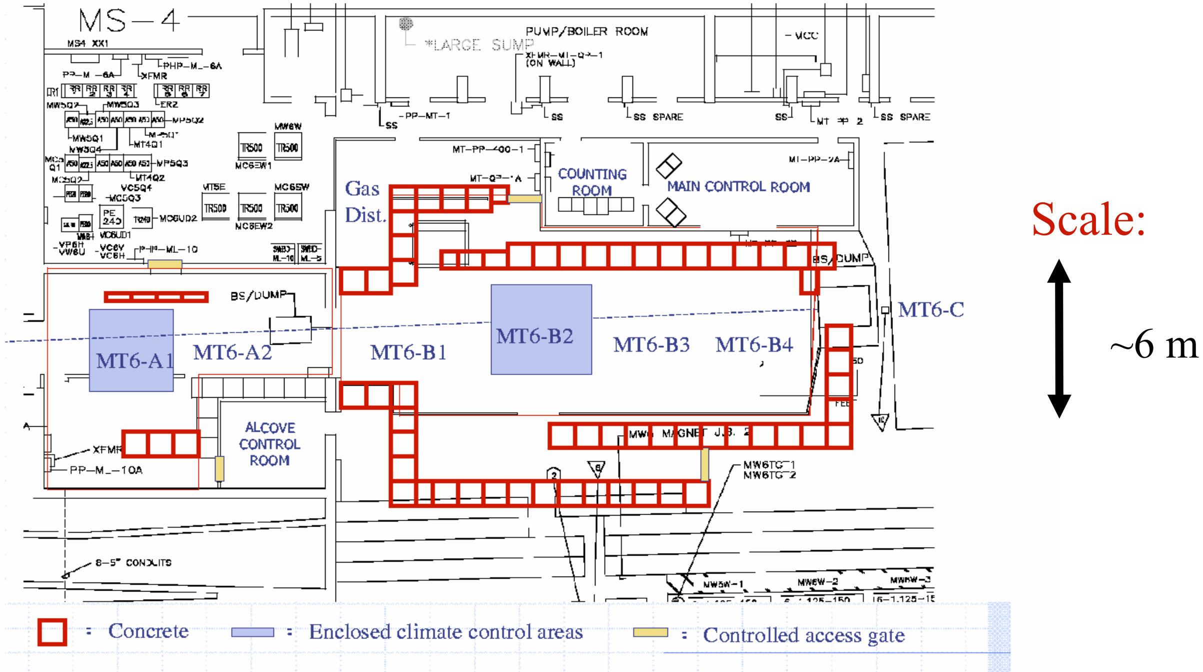
Status of the Fermilab Meson Test Beam Facility

Erik Ramberg
12 Nov. 2004

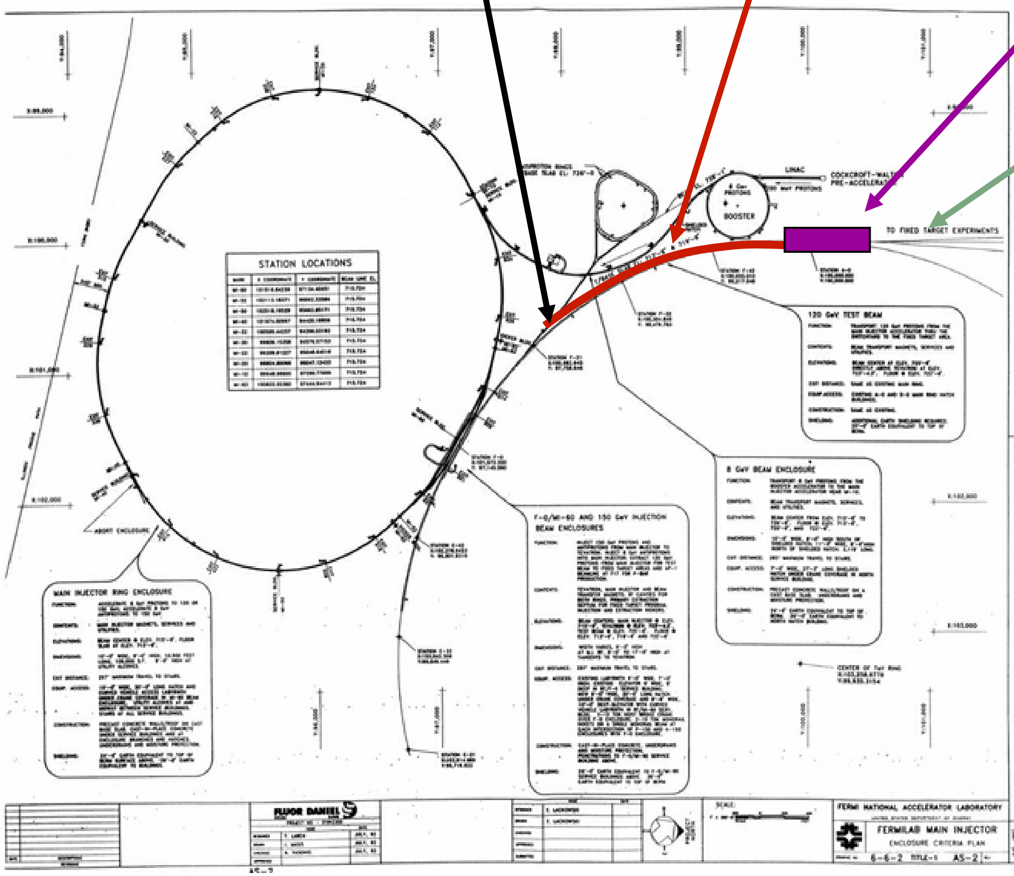
- Test area layout
- Extraction cycle
- Beam composition
- Schedule and new proposal

MT6 Test Beam User Areas



- 2 beam enclosures. Eventually, downstream enclosure will be operated independently of upstream.
- 6 user stations, with a 7th downstream of the beam dump. An experiment can take up more than one station.
- 2 climate stabilized huts with air conditioning.
- 2 separate control rooms.
- Signal and HV cables at each user station
- Outside gas shed + inside gas delivery system can bring any 2 gases (and exhaust lines) to any of the user stations
- Lockable work area for small scale staging or repairs.

Split between pbar production and SwitchYard

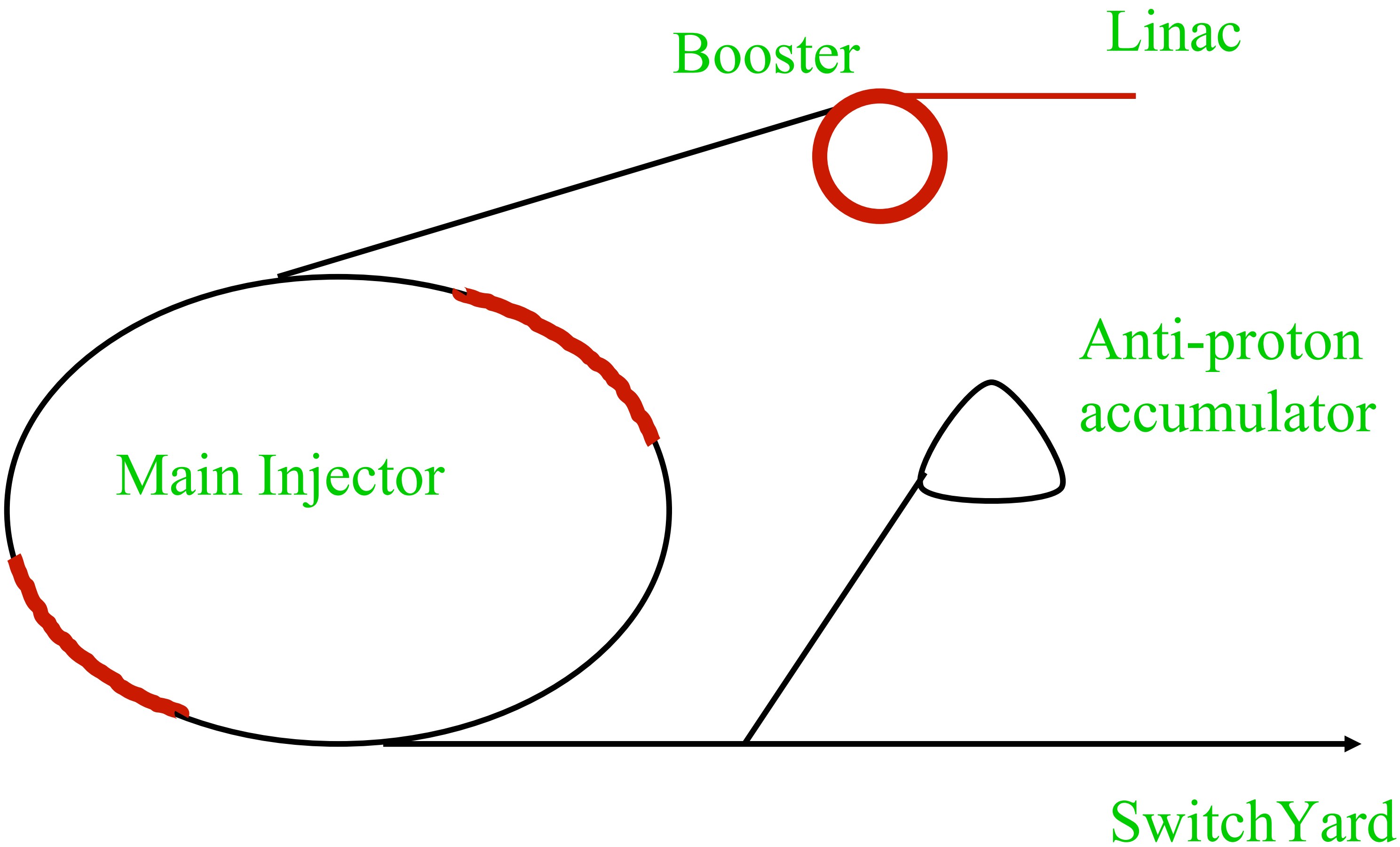


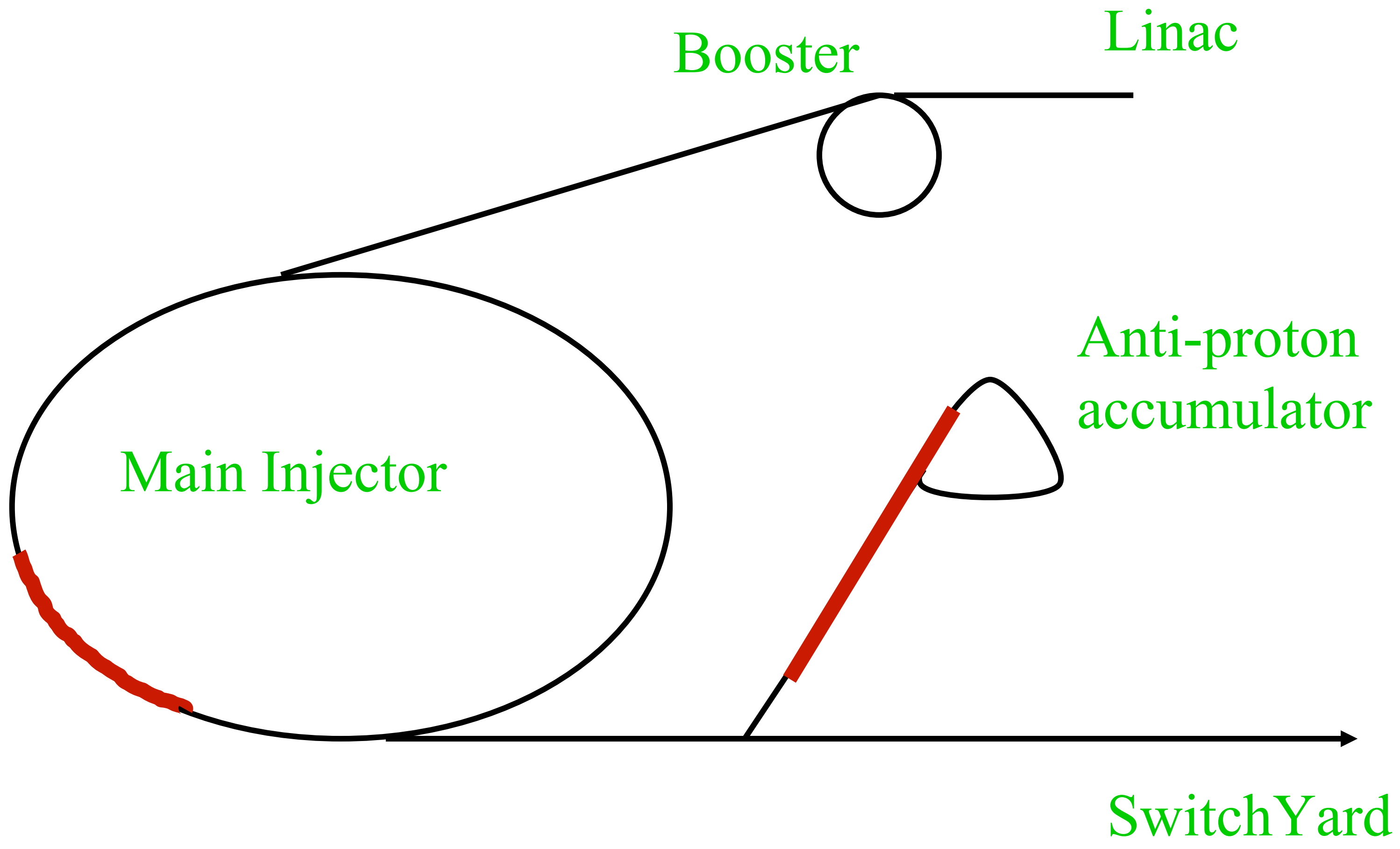
First consistent operation of SY120 occurred in January, 2004

Concurrent operation with pbar stacking occurred in Summer, 2004

'SwitchYard 120' Project:

- Delivers Main Injector beam to Meson Detector Building
- Runs in conjunction with protons delivered to pbar source
- Spills to SY120 should impact 'program' by no more than 5%


Booster
Linac
Anti-proton
accumulator
Main Injector
SwitchYard


Booster
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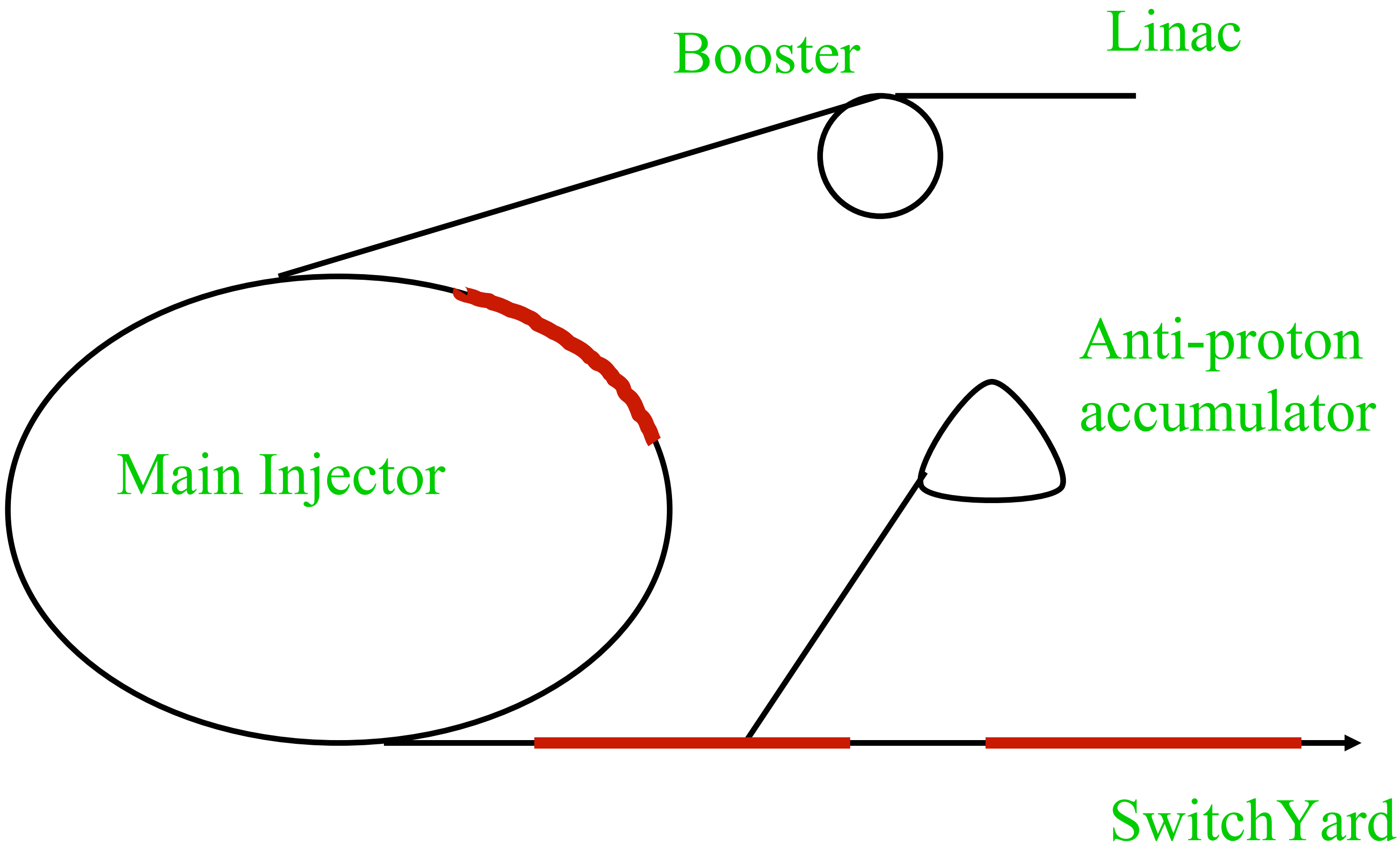
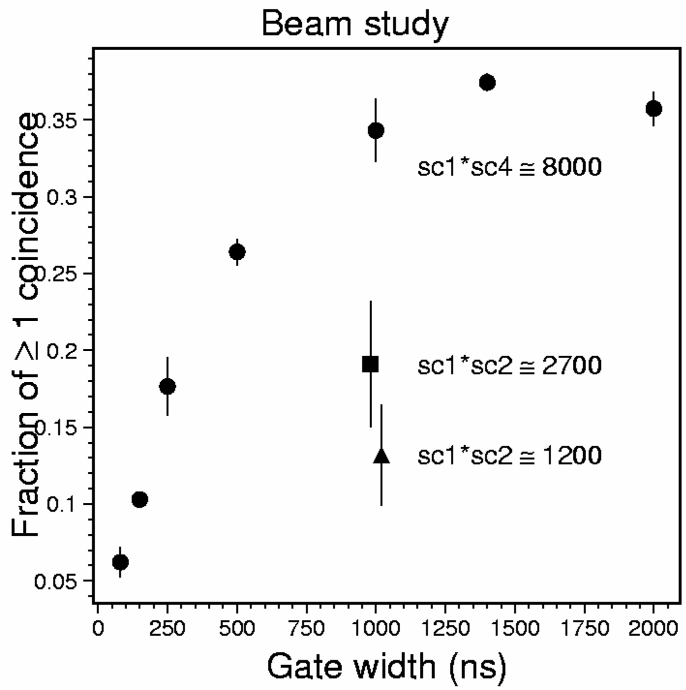

Booster
Linac
Anti-proton
accumulator
Main Injector
SwitchYard

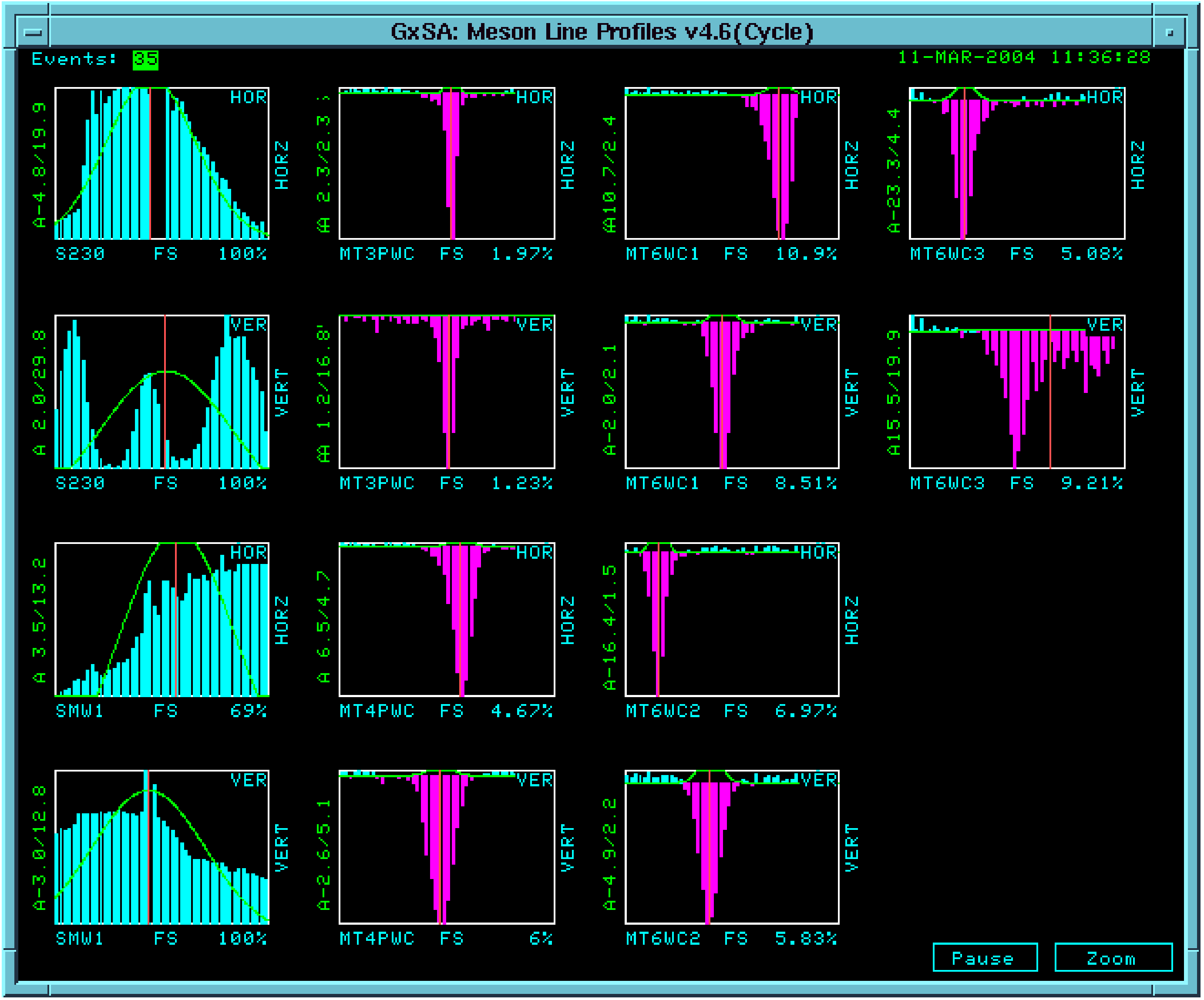
Multiple tracks

The Main Injector batch circulates at 100 kHz. So, up to that rate at MTBF, there should be no multiple tracks (if the extraction process is smooth).

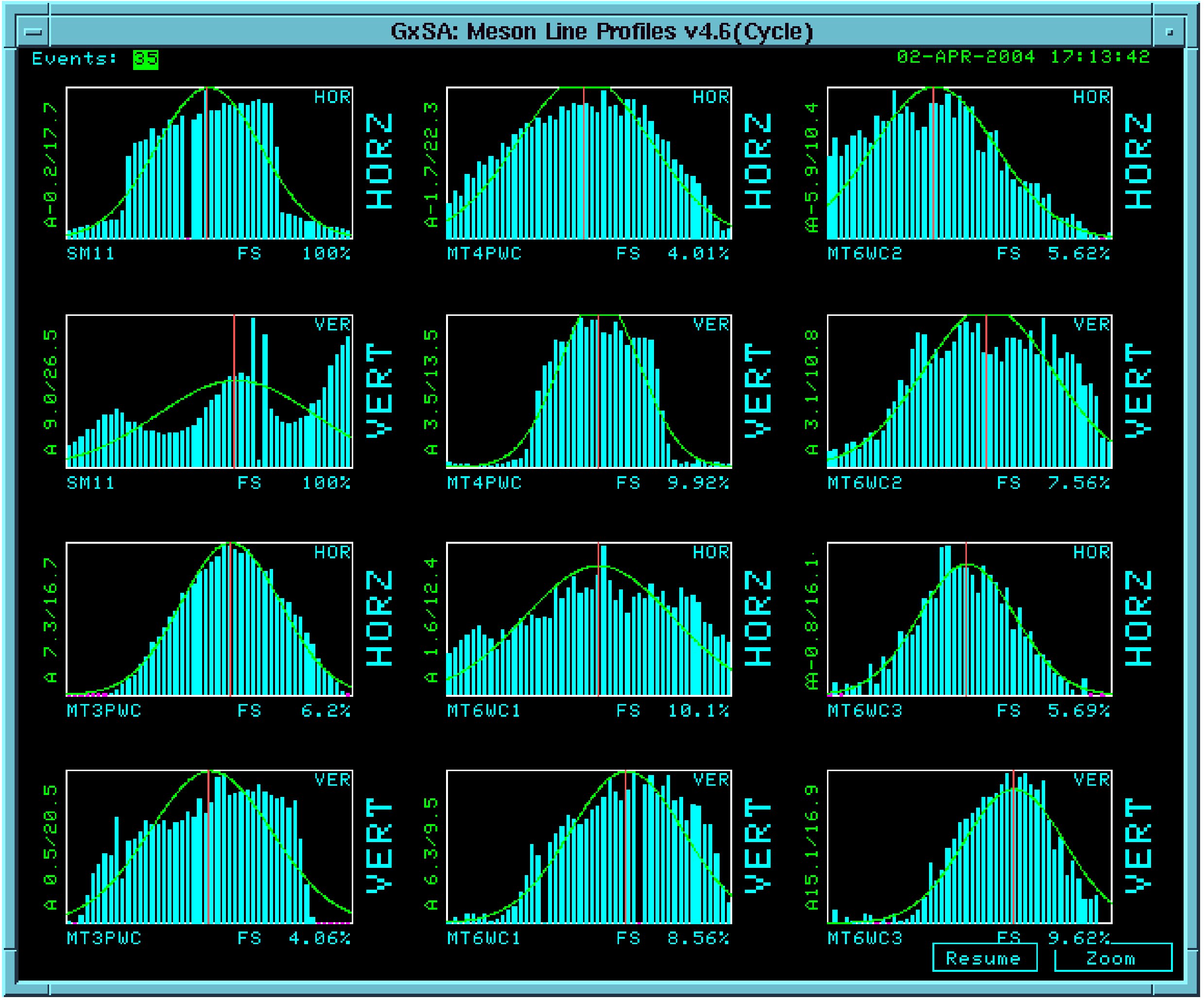


Operational Characteristics

- There are several operational modes:
  - Proton Mode: Tune beamline for 120 GeV protons that get transmitted through the target. Rates at the user area are administratively limited to 1 Mhz. Maximum rates so far are 200 KHz.
  - Secondary, or 'Pion' Mode: Vary the tune of the beamline according to the momentum desired. Maximum momentum is currently 66 GeV, with rates on the order of 20 kHz. Lowest momentum tune is on the order of 3-5 GeV. (See graph of calculated rates)
  - Muons: Muons are a component of the beam at lower momenta. By inserting a beam stop upstream, muons of tagged momentum less than 66 GeV can be delivered to both areas. By inserting the beam stop between the two user areas, muons of indeterminate momentum can be delivered to the downstream area. Rates are on the order of 100 Hz.
  - Electrons: At low momentum (< 5 GeV), the beamline delivers an enhanced electron fraction, at very low rates. There are intermediate target wheels and sweepers to attempt production of an electron beam at higher momentum. These modes have not been tested yet.
- Resonant extraction delivers 'smooth' beam over .6 sec spill. Spill can be made longer, with a limit of about 5 seconds due to MI magnet heating.
- Without NUMI running, we can coexist with pbar production with ~5-10 spills/minute.
- With NUMI running, it will probaby be best to run with 1 longer spill per 2 minute supercycle
- Spot sizes can be made as small as 3-5 mm square (with 120 GeV protons) and as large as 5 cm square.

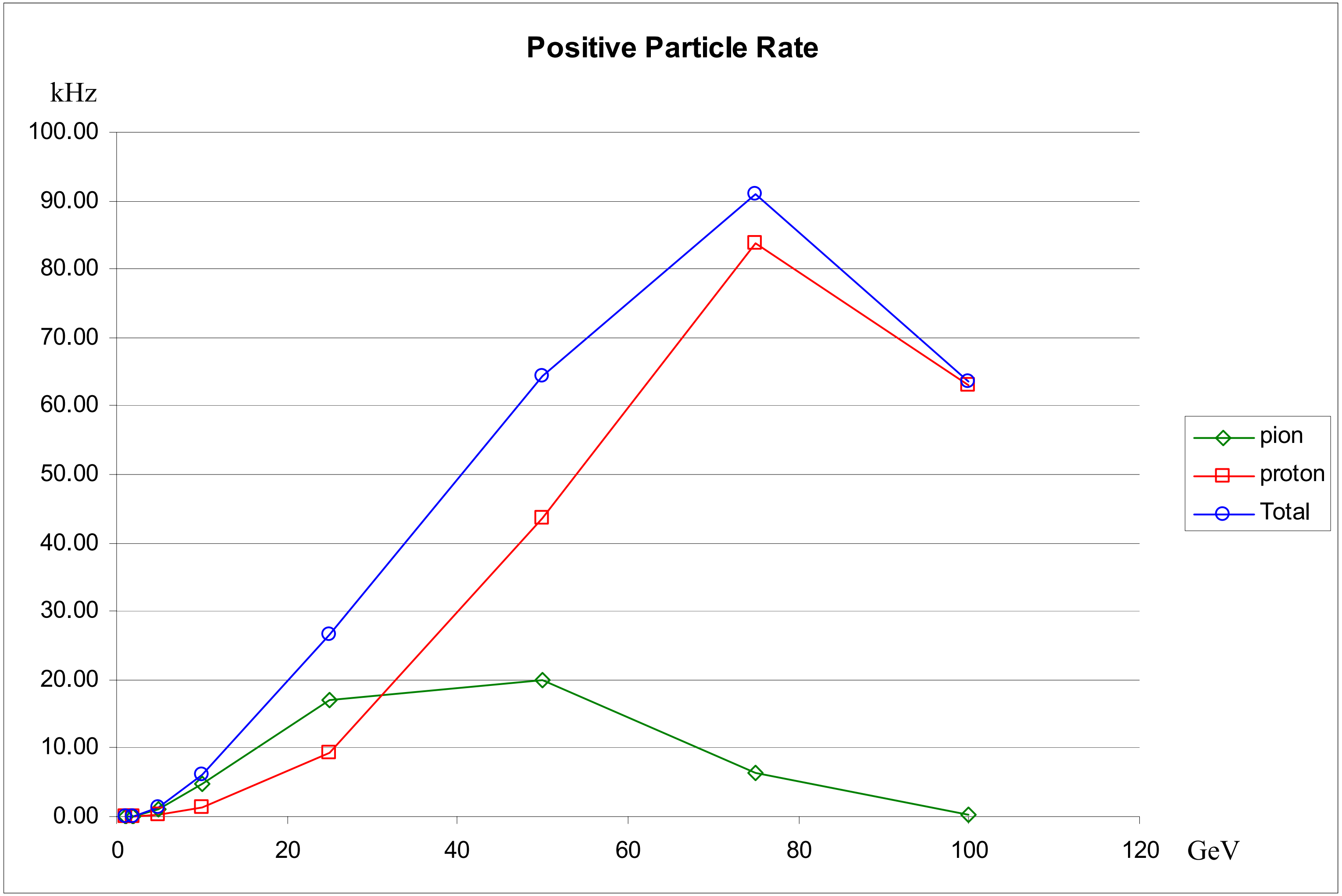


SWIC profiles while delivering 120 GeV beam (1 mm wire spacing)



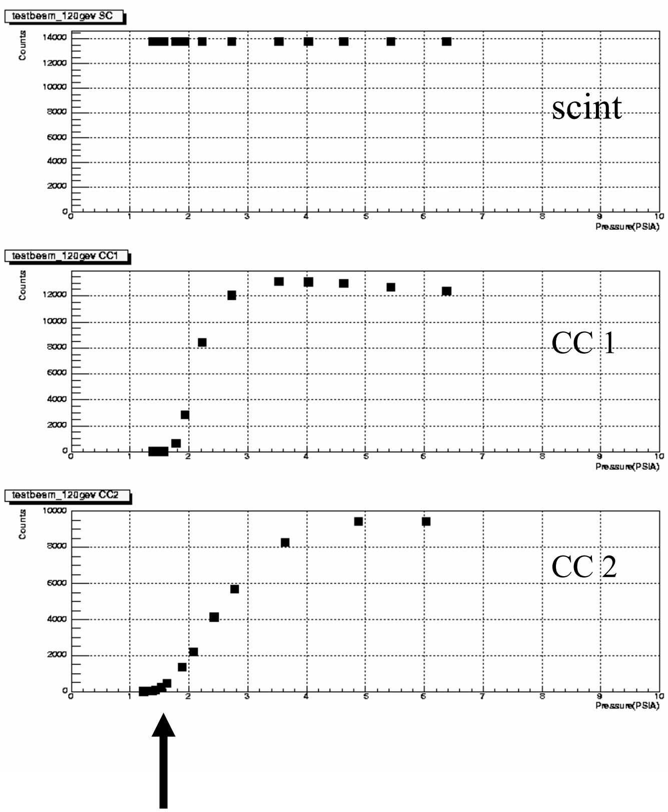
SWIC profiles while delivering 66 GeV beam

Predicted maximum rates in MT6 as a function of momentum for pions and protons

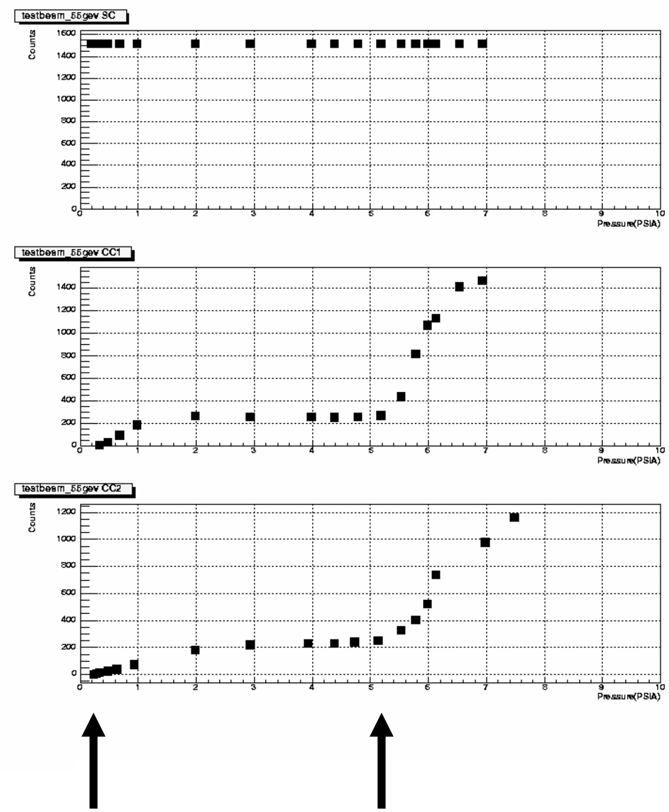


Cerenkov results

120 GeV – 23 kHz



66 GeV – 2.5 kHz



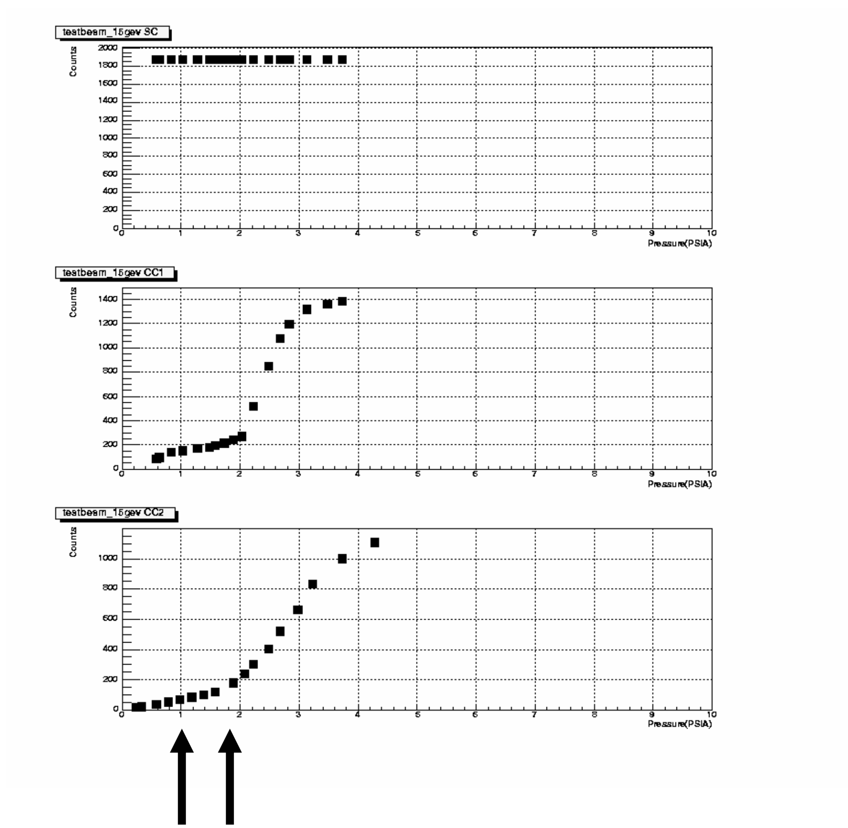
p threshold

π threshold

p threshold

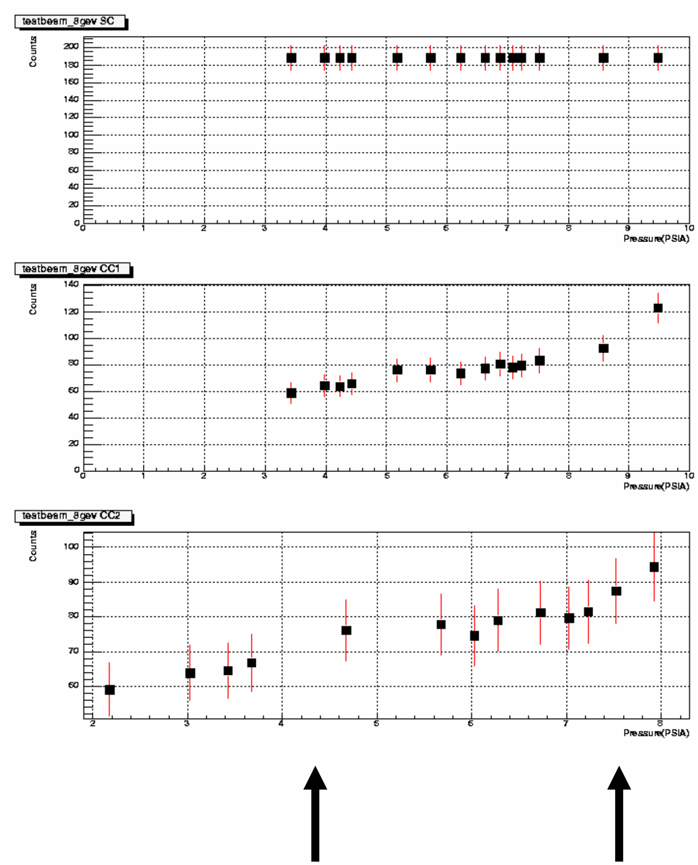
Cerenkov results (cont)

16 GeV – 3 kHz



μ,π threshold

8 GeV – 300 Hz



μ threshold

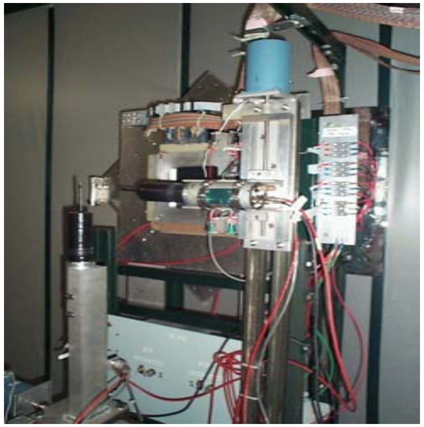
π threshold

Facility Detectors

- Two beamline threshold Cerenkov counters can be operated independently for good particle i.d. (50' and 80' long)
- Two stations of X,Y silicon strip detectors are installed.
- Three 0.5 mm pitch MWPC into DAQ Three 1.0 mm pitch MWPC into the accelerator ACNET control system.
- DAQ will be minimum bias triggered during the spill. The data from scintillators, Cerenkov counters, silicon and MWPC go into event buffers. Buffers are read out during and after the spill and this data will be accessible to experimenters.
- Have obtained beam profiles from 3 PWC stations. Still working on silicon readout.

One of the two beamline Cerenkov counters

One of three MWPC stations



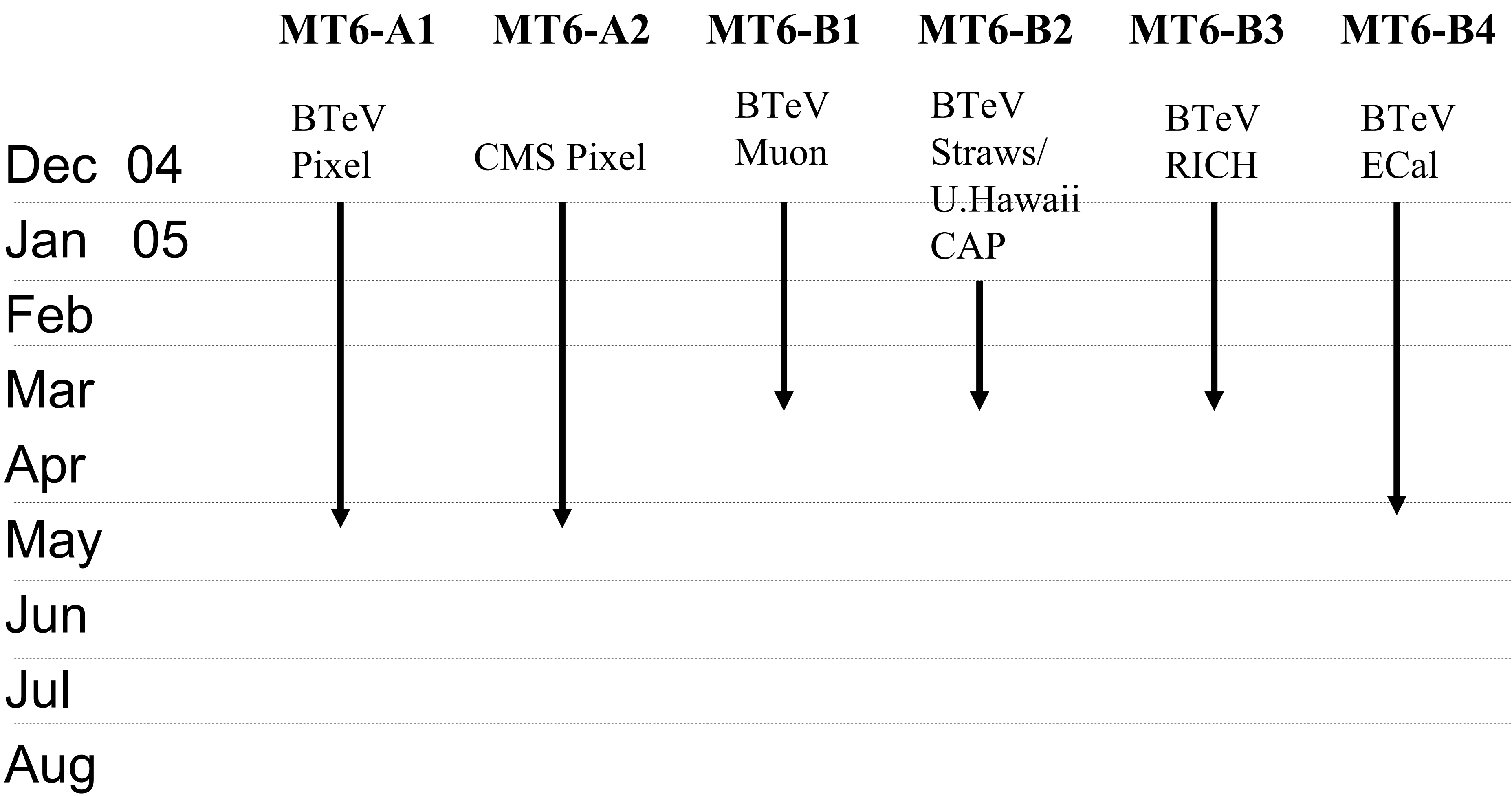
Remote controlled scintillator finger counters

Silicon tracker

List of MTBF Memoranda of Understanding (MOU):

T926: RICE   **Signed / Experiment completed**
T927: BTeV Pixel   **Signed / Taking data**
T930: BTeV Straw   **Signed / Taking data**
T931: BTeV Muon   **Signed / Taking data**
T932: Diamond Detector   **Signed**
T933: BTeV ECAL   **Signed / Taking data**
T935: BTeV RICH   **Signed / Taking data**
T936: US/CMS Forward Pixel **Signed / Taking data**
T941: UIowa PPAC Test **Signed / Experiment completed**
T943: U. Hawaii Monolithic Active Pixel Detector **Signed**

Meson Test Beam Schedule



Schedule of test beam activities after beam resumes:

Week	Activity
Dec. 6	Facility tests / installation
Dec. 13	U. Hawaii + BTeV + CMS
Dec. 20	Facility tests / installation
Dec. 27	
Jan. 3	U. Iowa / PPAC
Jan. 10	BTeV pixel + muon
Jan. 17	BTeV RICH
Jan. 24	BTeV RICH
Jan. 31	BTeV EMCAL
Feb. 7	BTeV Straw
Feb. 14	BTeV Muon
Feb. 21	Facility tests
Feb. 28	BTeV EMCAL

An ILC test beam proposal – 34 institutions, ~160 names

IV. Personnel and Institutions

The following Tables 2.a and 2.b list all participating institutions and the names of the physicists involved in the test beam program at Fermilab in this proposal. **CALICE** collaboration is by far the largest single-organization in this test beam program.

Table 2.a Part one of the list of institutions and personnel participating in ILC calorimeter program.

Institutions/Collaborations		Personnel Names
CALICE	Argonne National Laboratory	S.Chekanov, G.Drake, S.Kuhlmann, S.R.Magill, B.Musgrave, J.Repond, D. Underwood, B Wicklund, L Xia
	University of Texas at Arlington	A.Brandt, K.De, V.Kaushik, J.Li, M.Sosebee, A.White, J.Yu
	Nothern Illinois University/ NiCADD	G. Blazey , D. Chakraborty, A. Dychkant, A. Maciel, M. Martin , R. McIntosh, V. Rykalin, V. Zutshi
	University of Birmingham, UK	C.M.Hawkes, S.J.Hillier, R.J.Staley, N.K.Watson
	Cavendish Laboratory Cambridge University, UK	C.G.Ainsley, G.Mavromanolakis , M.A.Thomson, D.R.Ward
	Laboratoire de Physique Corpusculaire – Clermont	F.Badaud, G.Bohner, F.Chandez, P.Gay, J. Lecoq, S.Manen, S.Monteil
	Joint Institute for Nuclear Research – Dubna, Russia	V.Astakhov, S.Golovatyuk, I.Golutvin, A.Malakhov, I.Tyapkin, Y.Zanevski, A.Zintchenko , S.Bazylev, N.Gorbunov, S.Slepnev
	DESY – Hamburg, Germany	G.Eigen, E.Garutti, V.Korbel, R.Poeschl, A.Raspereza, F.Sefkow
	Hamburg University, Germany	M.Groll, R.-D. Heuer, S.Reiche
	Kangnung National University – Kangnung, Korea	G.Kim, D-W. Kim, K.Lee, S.Lee
	Imperial College London, UK	D. Bowerman, B. Cameron, P. Dauncey, D.Price, O. Zorba
	University College London, UK	S. Bogeert, J.M.Butterworth, D.J.Miller, M.Postranecky ,M.Warren, M.Wing
	University of Manchester, UK	R.J.Barlow, I.P.Duerdoth, N.M.Malden ,D. Mercer, R.J.Thompson
	University of Minsk, Russia	N.Shumeiko, A.Litomin, P.Starovoitov, V.Rumiantsev, O.Dvornikov, V.Tchekhovsky, A.Solin, A.Tikhonov
	Institute of Theoretical and Experimental Physics – Moscow, Russia	M.Danilov, V.Kochetkov, I.Matchikhilian, V.Morgunov, S.Shuvalov
	Lebedev Physics Institute – Moscow, Russia	V. Andreev, E. Devitsin, V. Kozlov, P. Smirnov, Y. Soloviev, A. Terkulov
	Moscow Engineering and Physics Institute- Moscow, Russia	P.Buzhan, B.Dolgoshein, A.Ilyin, V.Kantserov, V.Kaplin, A.Karakash, E.Popova, S.Smirnov
	Moscow State University Moscow, Russia	P.Ermolov, D.Karmanov, M.Merkin, A.Savin, A.Voronin, V.Volkov

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Table 2.b Part 2 of the list of the participating institutions and personnel in ILC test beam program.

Institutions/Collaborations		Personnel Names
CALICE	Laboratoire de l'Accélérateur Linéaire – Orsay, France	B.Bouquet, J.Fleury, G.Martin, F.Richard, Ch. de la Taille, Z.Zhang
	LPNHE - Université de Paris 6 et 7, France	A. Savoy-Navarro
	Charles University – Prague, Czech	S.Valkar, J.Zacek
	Institute of Physics, Academy of Sciences of the Czech Republic – Prague, Czech	J.Cvach, M.Janata, M.Lokajicek, S.Nemecek, I.Polak, J.Popule, M.Tomasek, P.Sicho, V.Vrba, J.Weichert
	Institute of High Energy Physics – Protvino, Russia	V. Ammosov, Yu.Arestov, B.Chuiko, V.Ermolaev,V.Gapienko, A.Gerasimov, Y.Gilitski,V.Koreshev, V.Lishin, V.Medvedev, A.Semak, V.Shelekhov, Yu.Sviridov, E.Usenko, V.Zaets, A.Zakharov
	School of Electric Engineering and Computing Science, Seoul National University	Ilgoo Kim, Taeyun Lee, Jaehong Park, Jinho Sung
University of Chicago		M. Oreglia
University of Oregon		R. Frey, D. Strom,
Stanford Linear Accelerator Laboratory		M Breidenbach
University of Kansas		G. Wilson, P. Baringer, A. Bean,
University of Colorado		U. Nauenberg
University of Iowa		Y. Onel
University of Washington		Tienchi
Fermilab		E. Ramberg, R. Yarema, H.E. Fisk,
University of Oklahoma		P. Skubic
Frascati, Italy		M. Piccolo, P. Checchia
Asian Collaborators should be in here!!		

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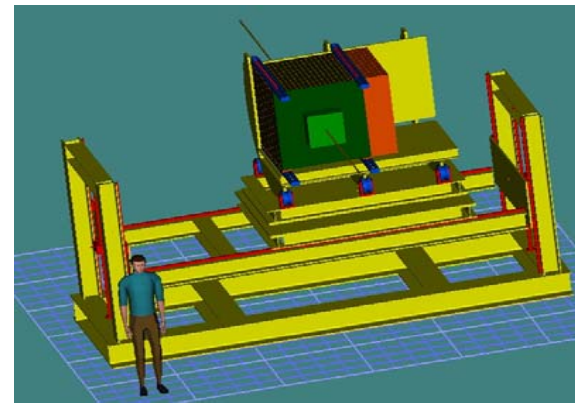

- This proposal requests 2.5 years occupation in MTBF.
- They need a broad range of particle types (e,π,μ,p)
- Requests for high energy electrons (25 GeV) and low energy pions (1 GeV) probably can't be met by current facility.

Recommendations to the PAC

- Fermilab should continue to support an active test beam program for the foreseeable future, and should encourage users around the world to use our facility.
- The Accelerator Division should develop a way to deliver more duty cycle to SY120 in the NUMI era. This could include:
  - Dedicated runs, when this fits into the program
  - Increasing the spill length
  - Attempting a combined Pbar/NUMI/SY120 cycle
- Significant support for the ILC calorimeter test should be given by the laboratory, including updating the beamline to handle high energy electrons and low energy pions. This will need a dedicated beamline physicist for the test beam.