MIPP Low Momentum Beam

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Fermilab

MIPP beam line elements

Z-cent [ft]	X-cent [ft]	Y-cent [ft]	Position Code	Element Code
1323.39	0	4.38	MC6IC1	Ion Chamber
1323.88	0	4.39	MC6WC1	SWIC
1324.82	0	4.41	MC6T1	Primary Target
1327.83	0	4.48	MC6TC	Target Cage
1334.82	0	4.64	MC6ABS	Absorber
1345.92	0	4.9	MC6Q1-1	FRD-11909
1356.92	0	5.15	MC6Q1-2	FRD-11910
1368.32	0	5.39	MC6D-1	FRD-10801
1379.32	0	5.6	MC6Q2	FRD-11528
1390.32	0	5.77	MC6D-2	FRD-20147
1397.96	0	5.87	MC6SC1	Scraper 1
1405.6	0	5.96	MC6Q3	FRD 11596
1412.85	0	6.05	MC6VT1	TDTA003
1416.35	0	6.1	MC6HT1	TDTA006
1432.92	0	6.28	MC6CY	FRD50095 Momentum Collimator
1437.36	0	6.33	MC6SC2	Scraper 2
1445	0	6.41	MC6VT2	TDTA007
1448.5	0	6.45	MC6HT2	TDTA005
1450	0	6.47	MC6T0	T0 Counter
1455.75	0	6.54	MC6Q4-1	FRD 11417
1466.75	0	6.65	MC6D-3	FRD-11244
1477.75	0	6.73	MC6Q5	FRD-11742
1488.75	0	6.78	MC6D-4	FRD-20018
1499.75	0	6.79	MC6Q6	FRD 11415
1505.5	0	6.79	MC7WC1	SWIC
1506	0	6.79	MC7HD1	Beam Hodoscope
1506.92	0	6.79	MC7BC1	Beam Chamber
1546.92	0	6.79	MC7CR1	Beam Cerenkov
1586.92	0	6.79	MC7BC2	Beam Chamber
1607.74	0	6.79	MC7CR2	Beam Cerenkov
1628.56	0	6.79	MC7BC3	Beam Chamber
1629.64	0	6.79	MC7HD2	Beam Hodoscope
1630.48	0	6.79	MC7WC2	SWIC

Primary target to JGG:	95.85 Meters
To TBD:	55.23 Meters
To T01:	92.92 Meters

From
http://ppd.fnal.gov/experiments/e907/Beam/mipp_beam_sheet_8.htm

6 Test Runs

- This analysis is based on 6 short test runs taken on 2/17/2006
  - Nothing tuned, nothing optimized
  - Trigger on any beam particles, no selection

Momentum	Run Number	Events	Spills w/ beam	Events per Spill	Start time	End time	Secondary beam/spill	Intensity [ppp]
-3	17559	415	4	103.75	04:42:50 PM	04:53:23 PM	17000	1.18E+011
-1	17560	474	7	67.71	04:57:52 PM	05:14:51 PM	1800	1.18E+011
-5	17561	1149	10	114.9	05:18:53 PM	05:34:01 PM	85000	1.17E+011
5	17562	1002	11	91.09	10:44:42 PM	10:57:16 PM	9000	3.82E+010
3	17563	1058	14	75.57	10:58:13 PM	11:13:39 PM	3500	3.47E+010
1	17564	930	24	38.75	11:17:12 PM	11:45:59 PM	300	3.41E+010

MIPP beam at low momentum

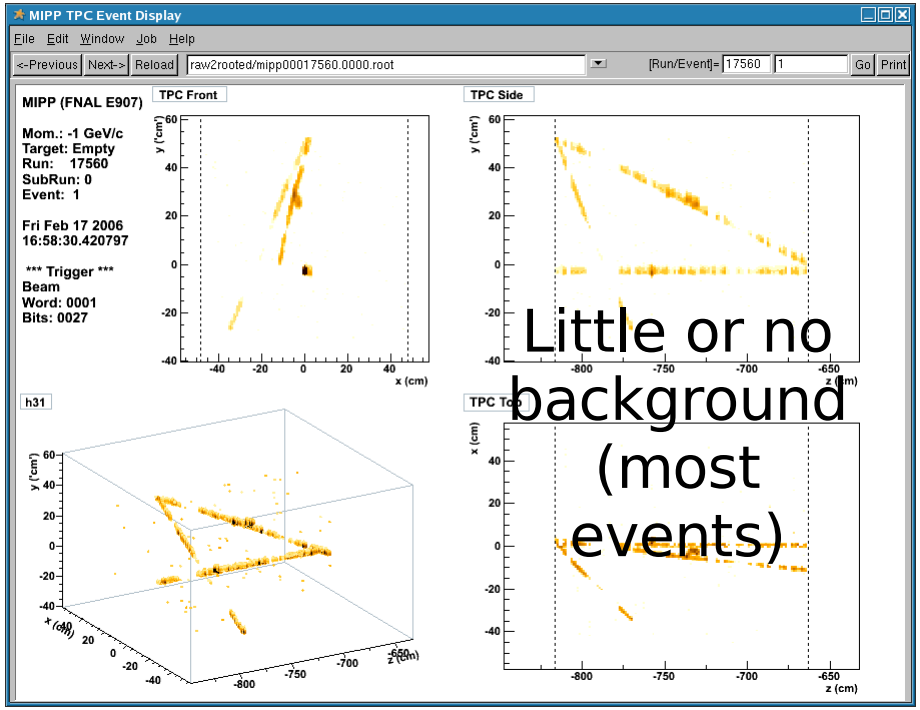
Momentum	Events per Spill	Secondary beam/spill	Intensity [ppp]
5	91.09	9000	3.82E+010
3	75.57	3500	3.47E+010
1	38.75	300	3.41E+010
-1	67.71	1800	1.18E+011
-3	103.75	17000	1.18E+011
-5	114.9	85000	1.17E+011

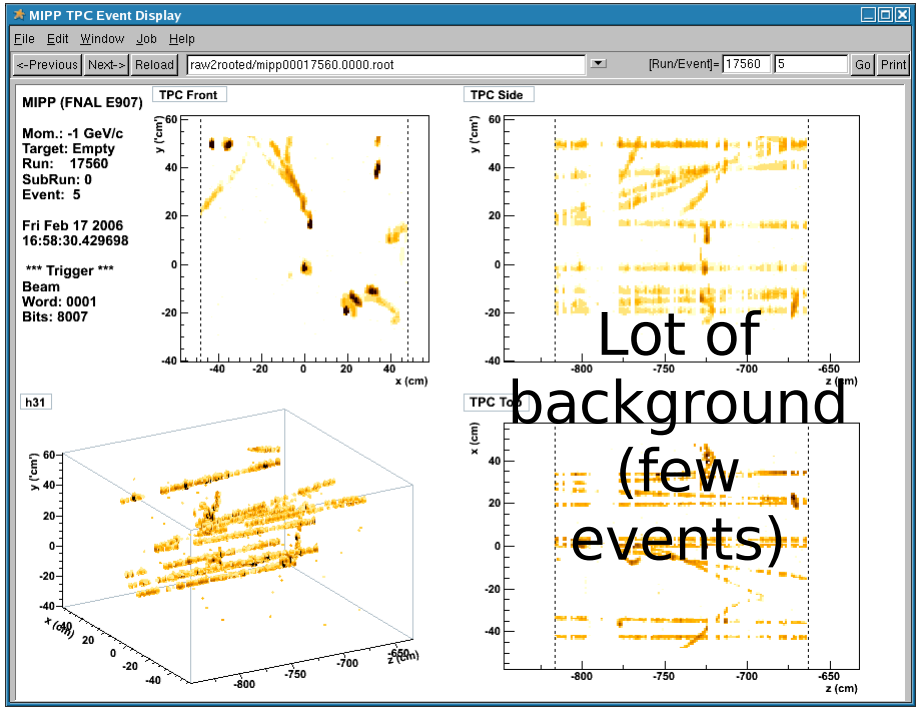
Beam Survival Probability and ToF

Beam particle decay and ToF in the MIPP beam line								
Particle	Mass (M) [GeV/c ^2]	Livetime (tau) [ns]	Beam Momentum [GeV/c]					
			1	3	5	10	15	20
Beam-length	95.85 [m]		Survival Probability [%] in MIPP beam:					
Pion	0.14	26.03	18.01	56.48	70.98	84.25	89.20	91.79
Kaon	0.49	12.38	0.00	1.43	7.82	27.96	42.75	52.87
Proton	0.94	1E+39	100.00	100.00	100.00	100.00	100.00	100.00
			Particle Beta:					
Pion	0.14	26.03	0.99	1.00	1.00	1.00	1.00	1.00
Kaon	0.49	12.38	0.90	0.99	1.00	1.00	1.00	1.00
Proton	0.94	1E+39	0.73	0.95	0.98	1.00	1.00	1.00
X(T01-TBD)	37.69 [m]		Time of Flight [ns] between TBD and T01:					
Pion	0.14	26.03	126.94	125.86	125.77	125.73	125.73	125.72
Kaon	0.49	12.38	140.21	127.41	126.33	125.87	125.79	125.76
Proton	0.94	1E+39	172.40	131.73	127.91	126.27	125.97	125.86
			Time of Flight [ns] between TBD and T01 wrt beta=1:					
Pion	0.14	26.03	1.22	0.13	0.05	0.01	0.00	0.00
Kaon	0.49	12.38	14.48	1.69	0.61	0.15	0.07	0.04
Proton	0.94	1E+39	46.67	6.00	2.19	0.55	0.24	0.14

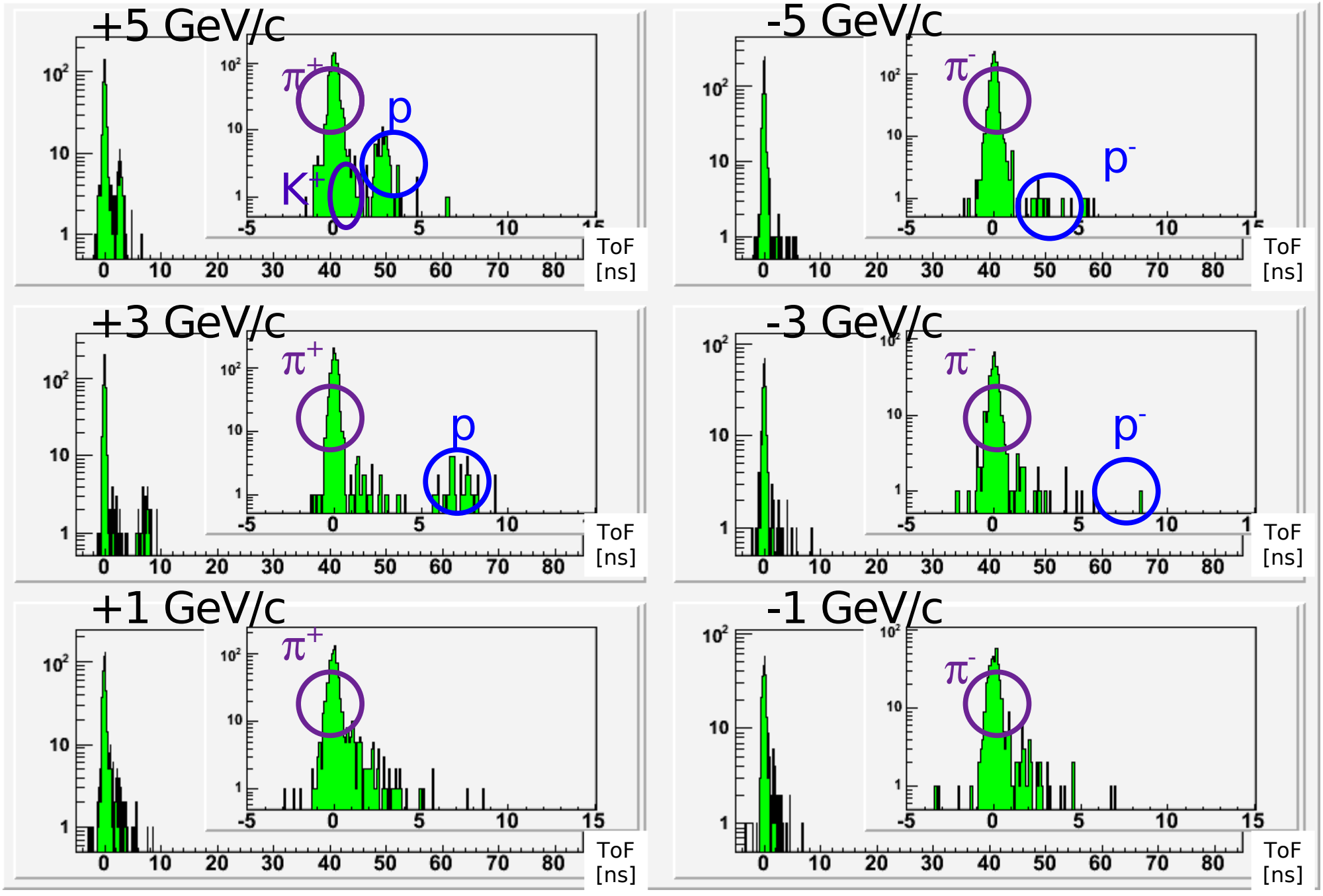
Beam backgrounds

- Beam halo and background from spray off collimators – Not a problem
  - Number of Beam tracks per event
  - TPC gives ±8 μs view around the trigger time



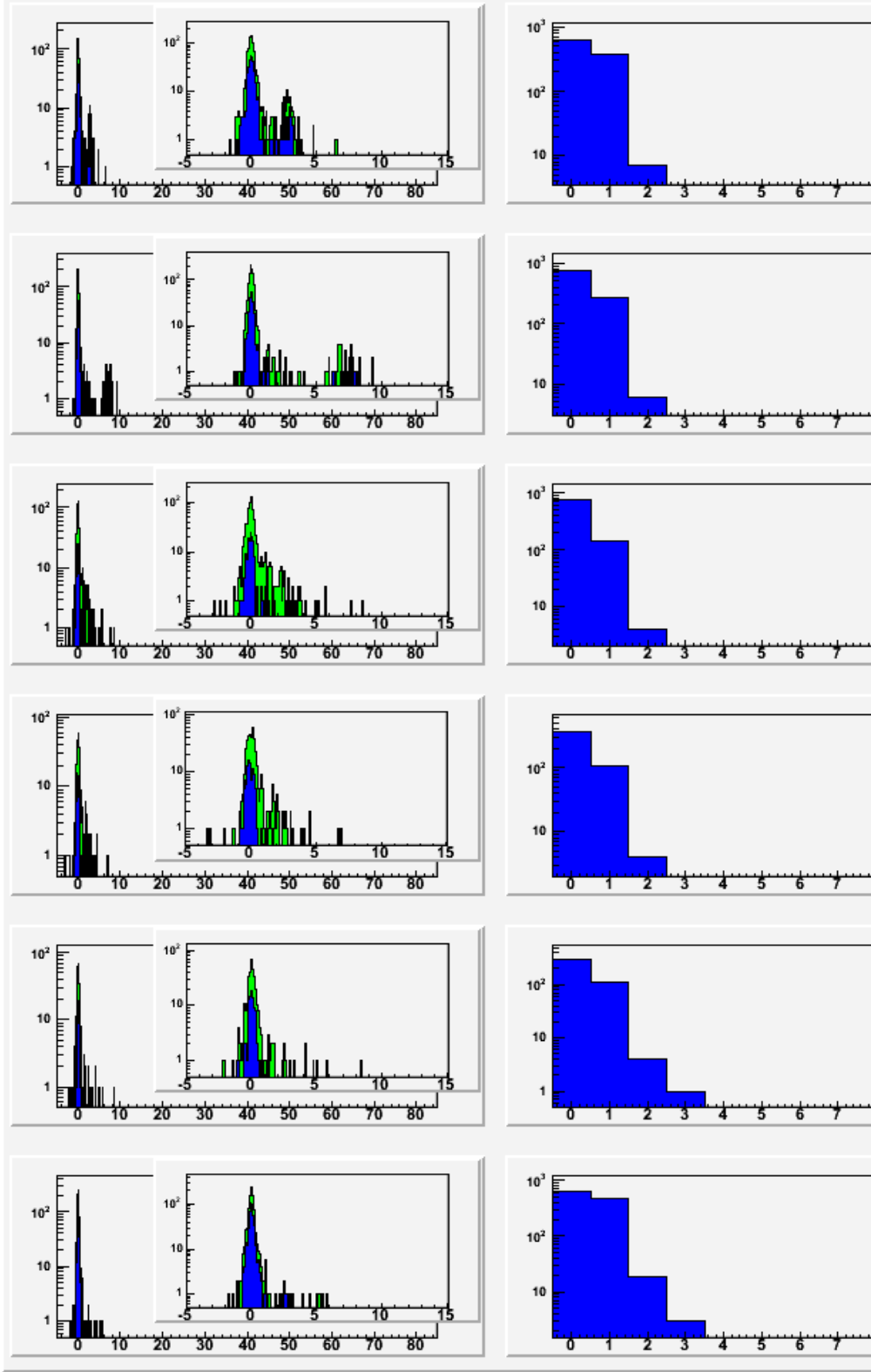


MIPP beam at low momentum



Beam ToF

- Left pads: BToF
  - Time of flight in MIPP beam (β=1 particles at 0 ns)
    - Pions at 0 ns and Protons at >2 ns
- Right pads: NBTrk
  - Number of reconstructed beam tracks
    - Often don't reconstruct.



Summary and Comments

- Low momentum beams with high quality in MIPP are possible
  - Certain upgrades to the beam line will help, cf. P960 proposal
- ToF resolution does not allow beam momentum determination particle by particle
  - May want to run with 1% momentum bite instead of the usual 5%, even at the cost of lower rate.