DIRC Work in Erlangen

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- MCP lifetime measurements
- Work at new Hamamatsu 2 inch MCP-PMTs
- Experiences with May CERN beam data
- Summary

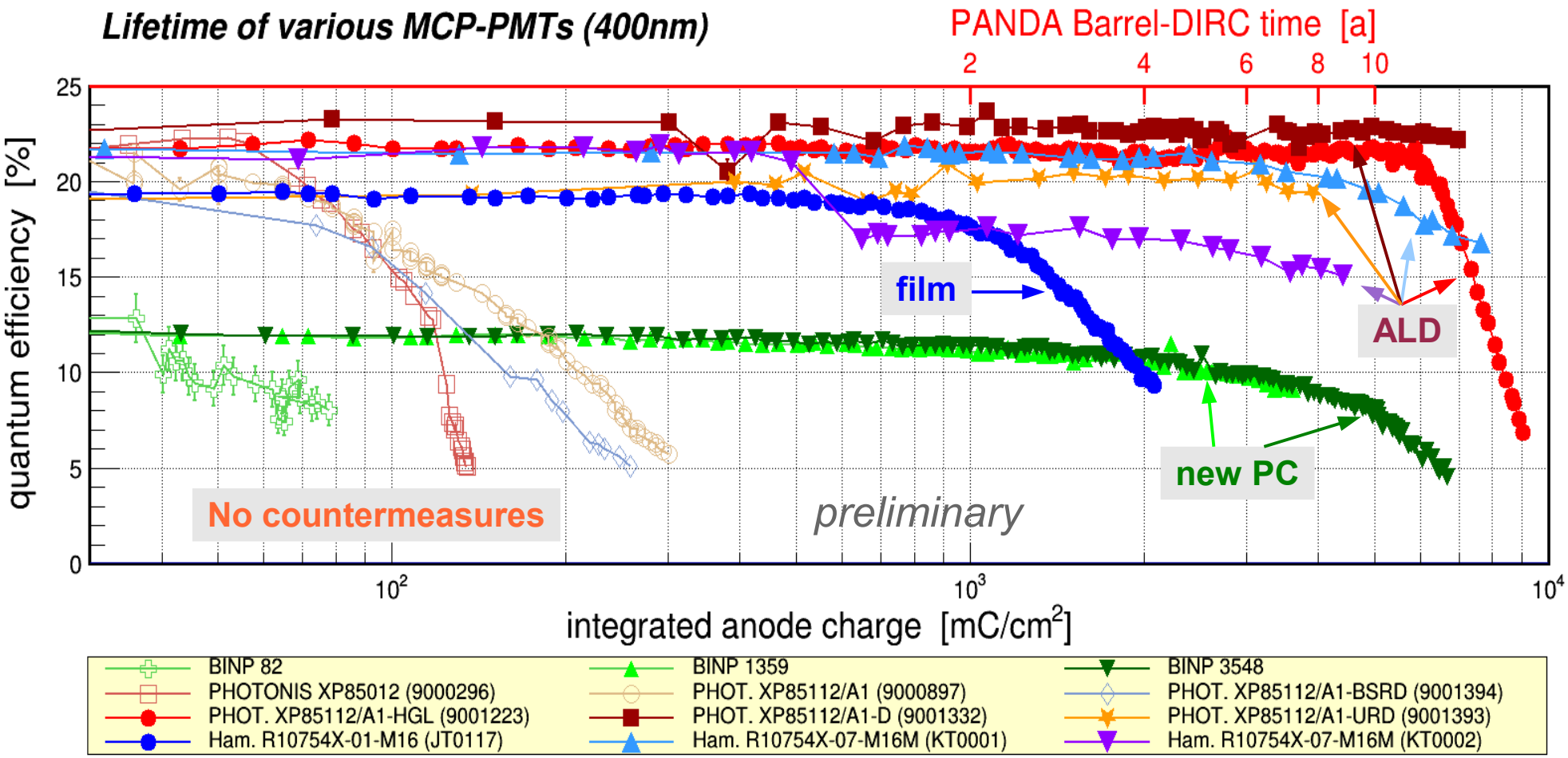
Illumination Overview (1)

	Sensor ID	Integral charge (June 2, 2015) [mC/cm2]	Diff. charge (maximum) [mC/cm^2/d]	# of measurements	# of QE scans	Comments
Photonis XP85112	9001223	**9036**	13.5	156	15	Start: 23 Aug. 11 ongoing
	9001332	**6992**	21.8	60	8	Start: 12 Dec. 12 ongoing
	9001393	**3925**	11	24	4	Start: 23 Jan. 14 ongoing
Hamamatsu R10754X	JT0117 (M16)	**2086**	14.1	86	7	Start: 23 Aug. 11 Stop: 24 Jul. 12
	KT0001 (M16M)	**7644**	30.1	36	6	Start: 20 Aug. 13 ongoing
	KT0002 (M16M)	**4414**	20.1	31	7	Start: 21 Oct. 13 ongoing
BINP	1359	**3616**	10.6	90	8	Start: 21 Oct. 11 Stop: 06 May 13
	3548	**6674**	11.8	133	12	Start: 21 Oct. 11 ongoing

Illumination Overview (2)

	Sensor ID	Integral charge (June 2, 2015) [mC/cm2]	QE start [%]	QE latest [%]	QE latest / QE start [%]	Comments
Photonis XP85112	9001223	**9036**	22.11	6.9	**31%**	Start: 23 Aug. 11 ongoing
	9001332	**6992**	22.62	22.18	**98%**	Start: 12 Dec. 12 ongoing
	9001393	**3925**	19.05	19.41	**102%**	Start: 23 Jan. 14 ongoing
Hamamatsu R10754X	JT0117 (M16)	**2086**	19.97	9.32	**47%**	Start: 23 Aug. 11 Stop: 24 Jul. 12
	KT0001 (M16M)	**7644**	21.71	16.77	**77%**	Start: 20 Aug. 13 ongoing
	KT0002 (M16M)	**4414**	21.14	15.06	**71%**	Start: 21 Oct. 13 ongoing
BINP	1359	**3616**	12.27	9.06	**74%**	Start: 21 Oct. 11 Stop: 06 May 13
	3548	**6674**	12.23	4.52	**37%**	Start: 21 Oct. 11 ongoing

Lifetime of MCP-PMTs (June 2015)



- Photonis 9001332: no Q.E degrading observed yet at ~7 C/cm^2
- 1 inch ALD Hamamatsu MCP-PMTs: both close or beyond 5 C/cm^2
- MCP-PMTs with ALD layers: **very good performance to 6 C/cm^2**

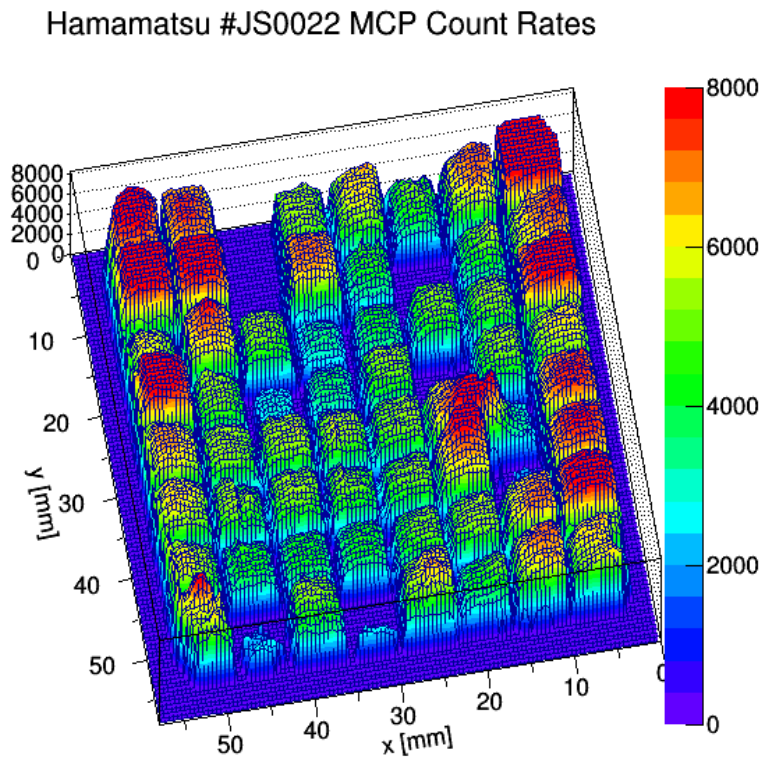
Other ongoing DIRC Work

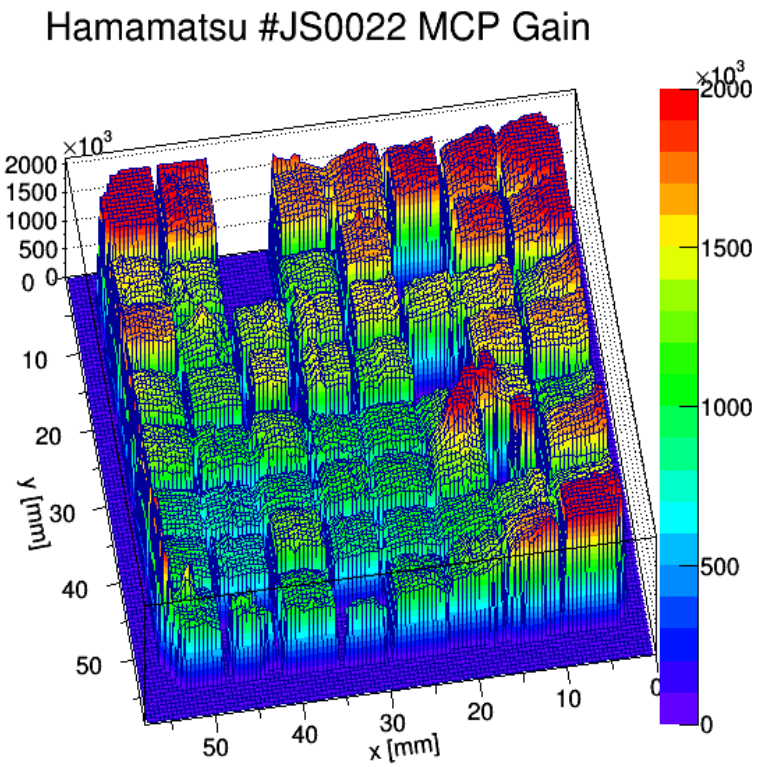
- Self-built picoammeter to accelerate lifetime measurements
  - Potential-free pA-measurements up to 2 kV
  - Planned application: measure MCP-in currents at high photon rates
  - First tests and calibrations have started

- New 2 inch Hamamatsu MCP-PMTs (8x8 pixels)
  - Readout boards and HV dividers ready
  - First gain and QE scans done for 1 tube (JS0022) [using VME-DAQ]
  - Second tube (JS0025) showed short circuit between PC and MCP-in (sent back to Hamamatsu)

- New 2 inch Hamamatsu MCP-PMTs (6x128 pixels)
  - Readout not yet ready

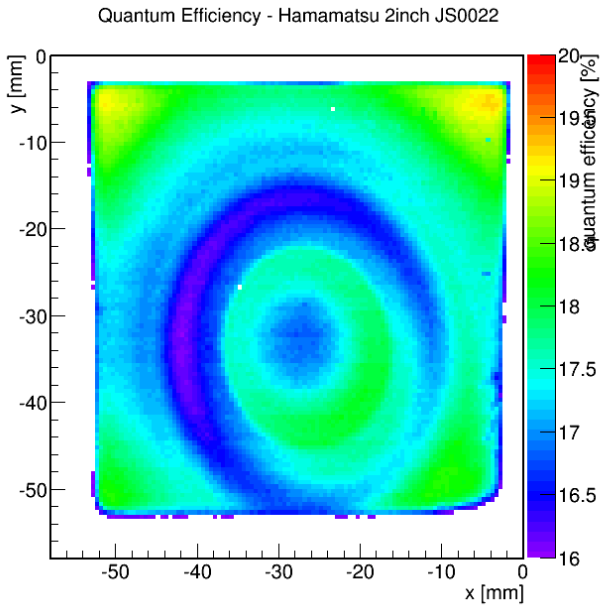
Surface Scan of 8x8 Hamamatsu

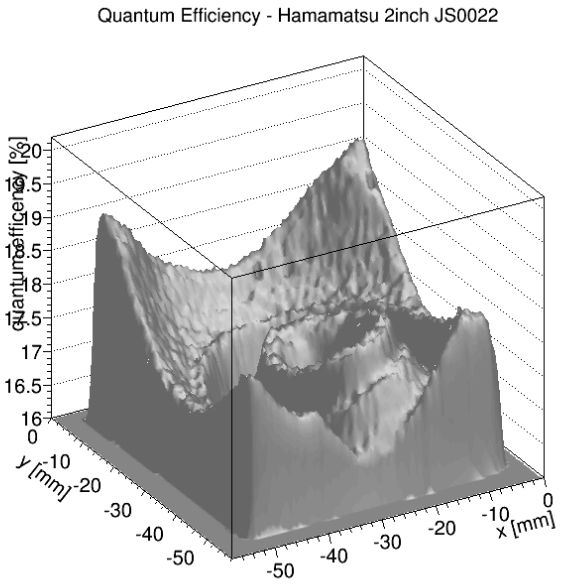


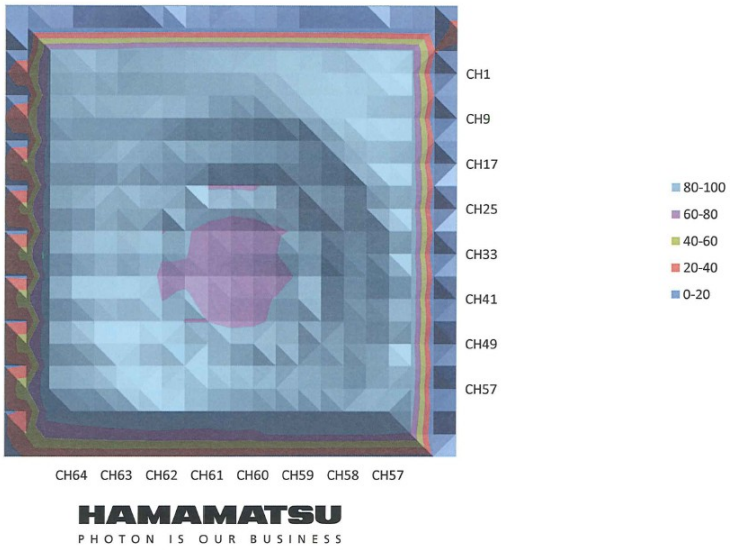


- Empty pixels come from broken QDC/TDC channels in VME-DAQ
- Gain between 1.e6 and 2.e6 at 3.3 kV (comparable to data sheet)

QE Scan of 8x8 Hamamatsu (JS0022)

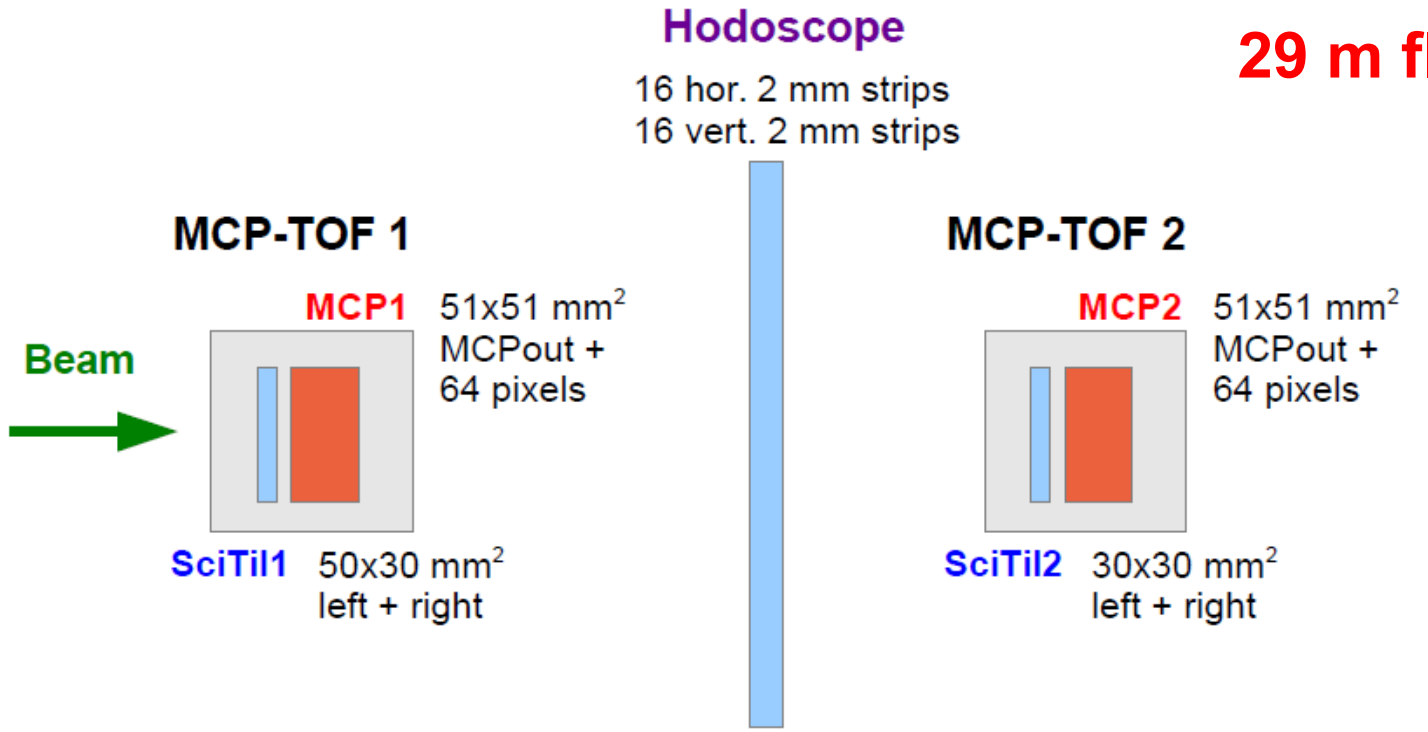






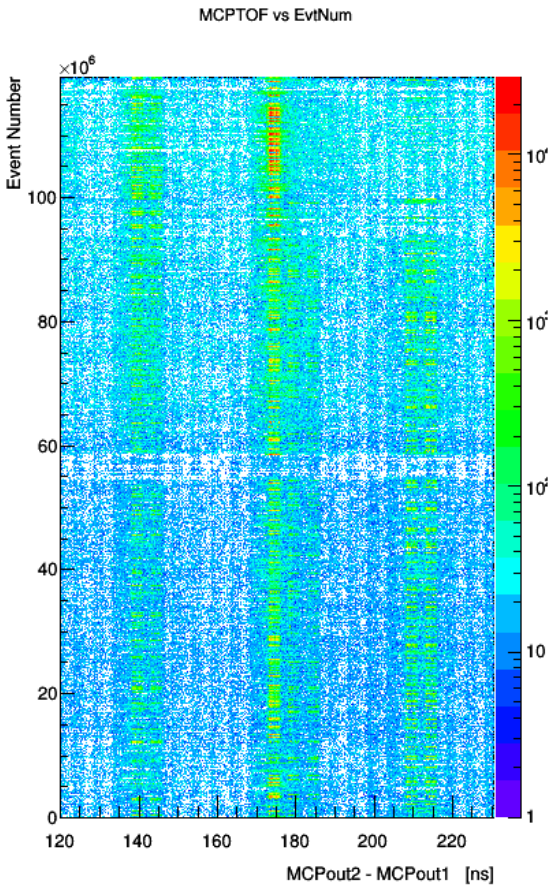
- QE structures across surface roughly comparable with Hamamatsu in-house measurement, but ours with much better resolution
- QE values slightly worse in our measurement, but applied methods were different
- QE still quite non-uniform with rather strange fine structures

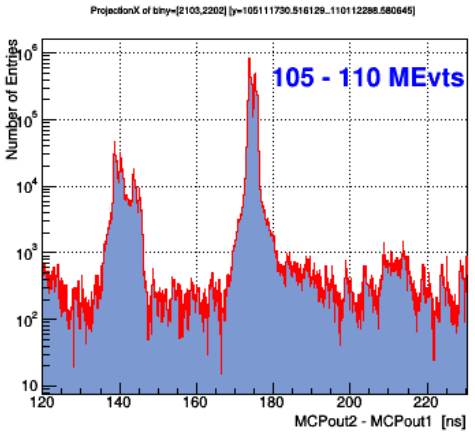
MCP-TOF Setup

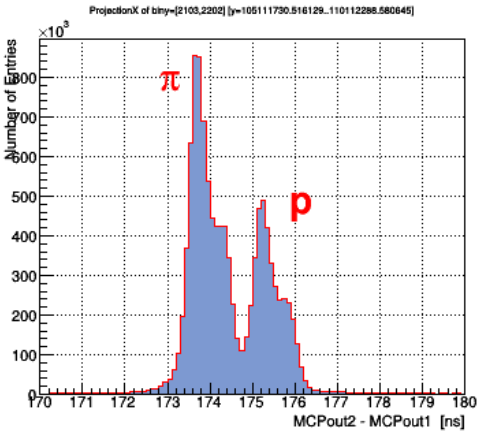


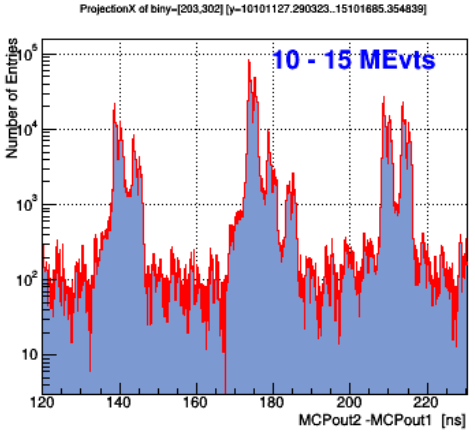
- In both MCP-TOF stations 1 SciTil and 1 MCP counter each
  - MCP-TOF1 (MCP-out, SciTil_l, SciTil_r) at one Padiwa (no reftime needed)
  - MCP-TOF2 (MCP-out, SciTil_l, SciTil_r) at one Padiwa (no reftime needed)
  - Different TRB-boards for MCP-TOF1 and MCP-TOF2 (reftime necessary)
- 4 TOF infos → determination of time resolution for each counter possible

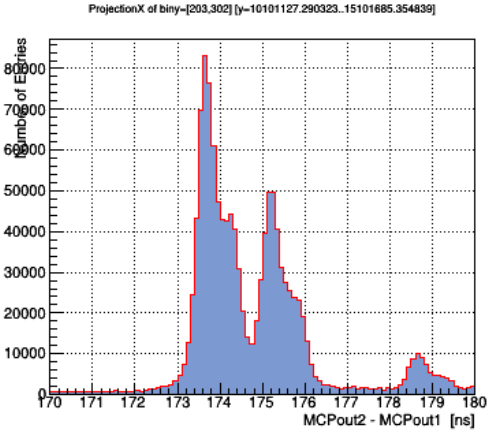
MCP-TOF vs Event ID









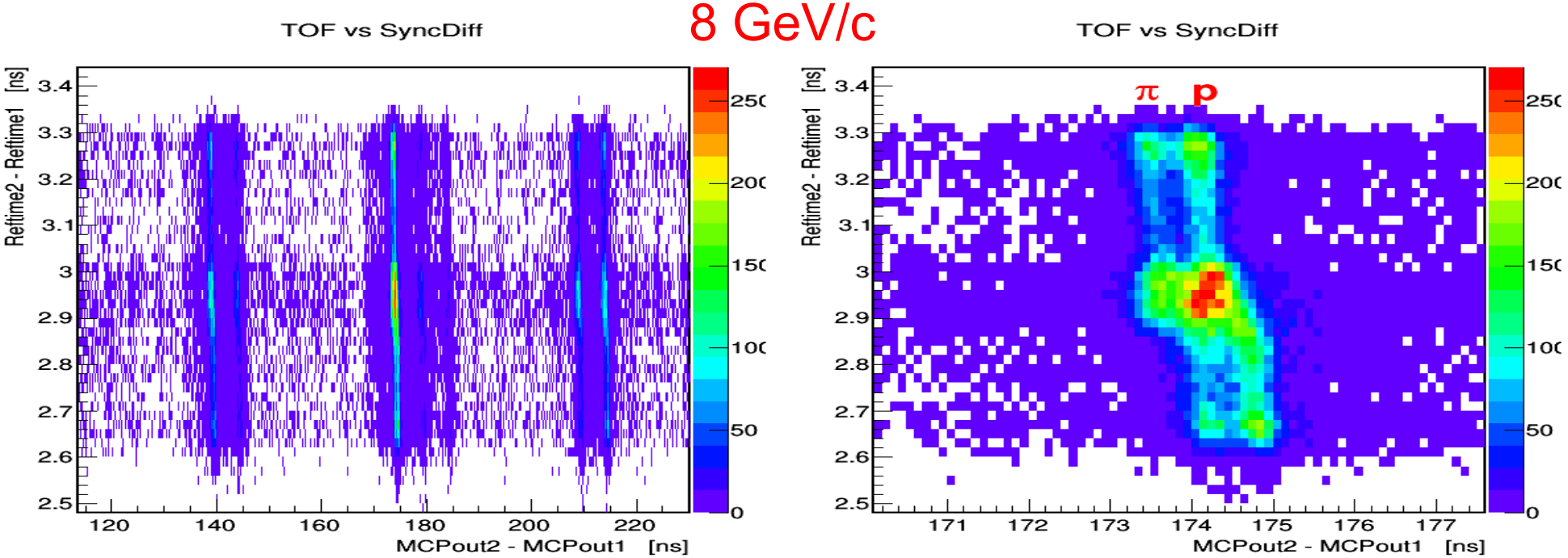


5 GeV/c
All data
~120 Mevts

- Many structures visible in MCP-TOF spectra (better at beam time end)
- Clear separation of pions and protons
- **Double structure seen in both pion and proton TOF peak**

MCPtof vs RefTime Difference

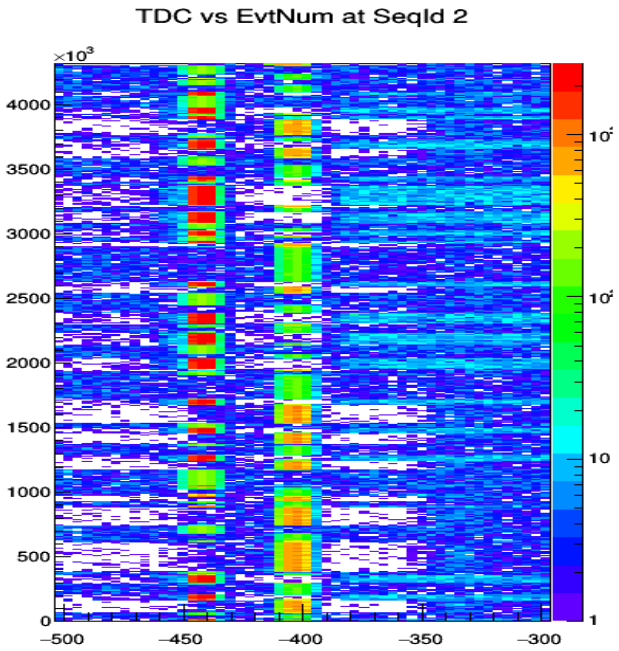
8 GeV/c



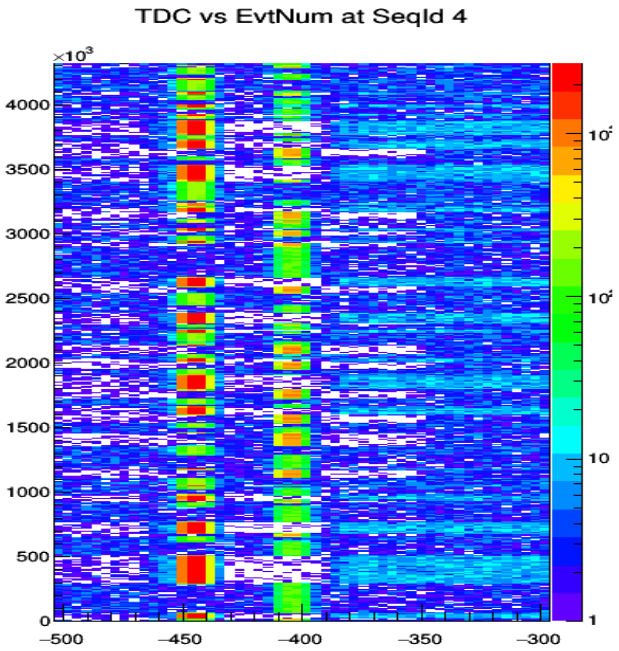
- In principle this should be a narrow vertical line, but we observe a correlation → MCPtof depends on difference of reference time
- Explains “double peak structure” in many MCPtof spectra
- More observations:
  - RefTime difference can jump to other values
  - Shape of correlation does not always look the same

TDC Info vs Event-ID (8 GeV/c)

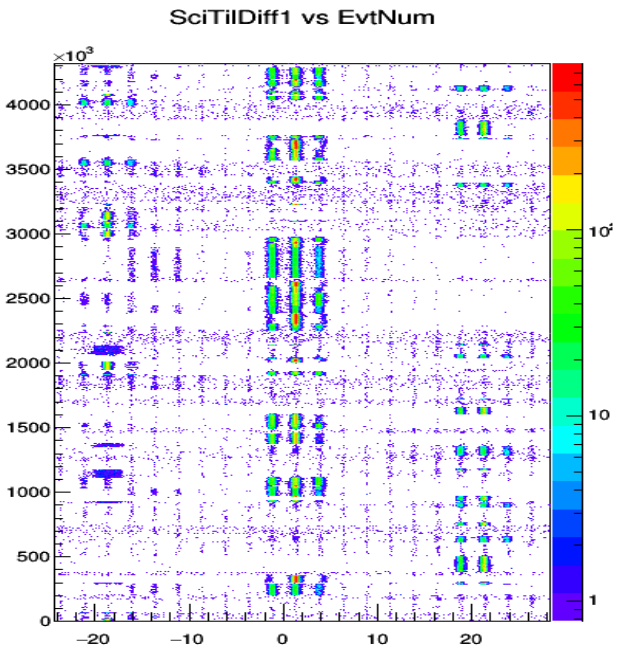
SciTil 1 left



SciTil 1 right



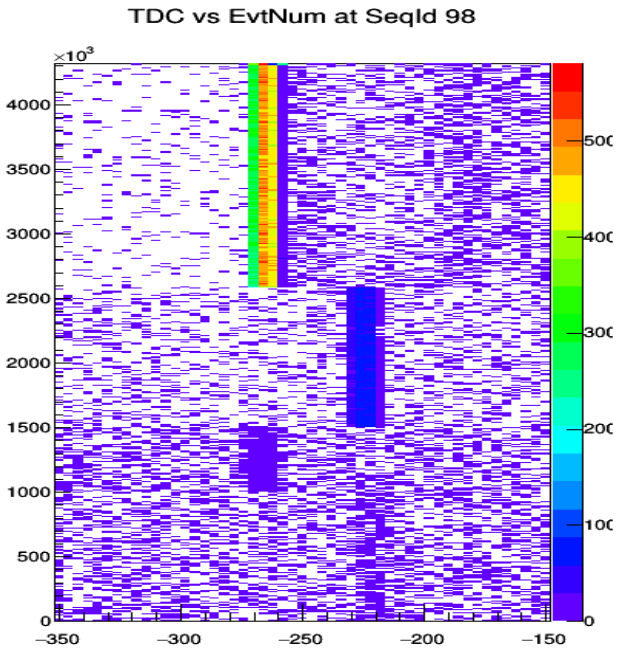
TDC_left – TDC-right



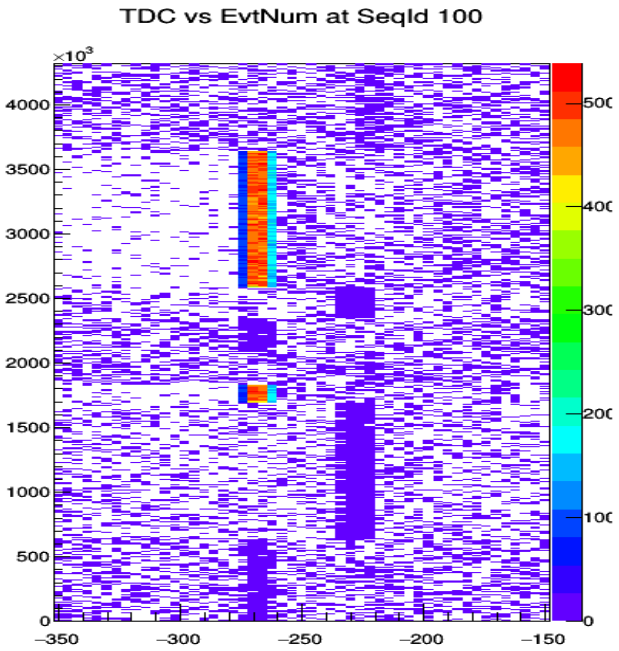
- Upstream TOF-station (#1): main signals at same Padiwa
- Jumps in TDC peak seen also within same Padiwa/TRB-boards
- Meaningful time difference only when both TDC peaks at nominal position (551k [12.8%] good events out of 4.3M total)

TDC Info vs Event-ID (8 GeV/c)

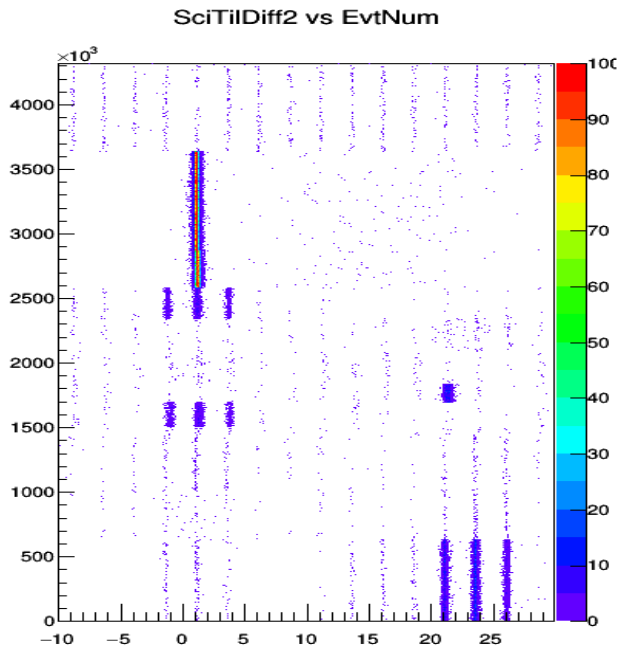
SciTil 2 left



SciTil 2 right

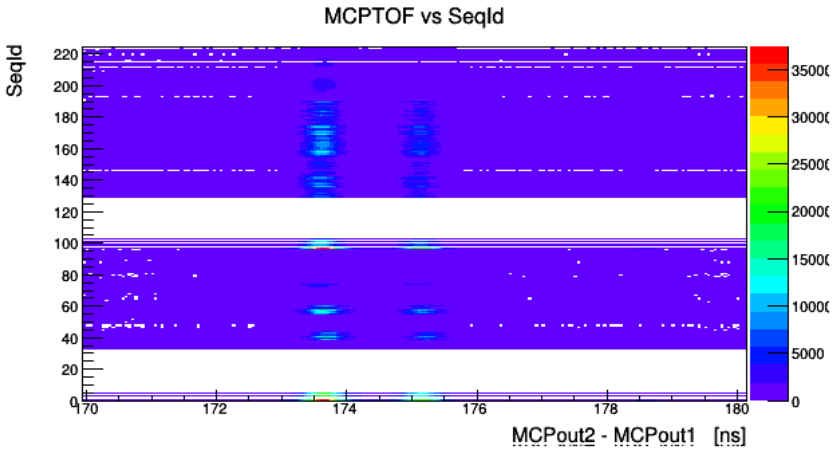


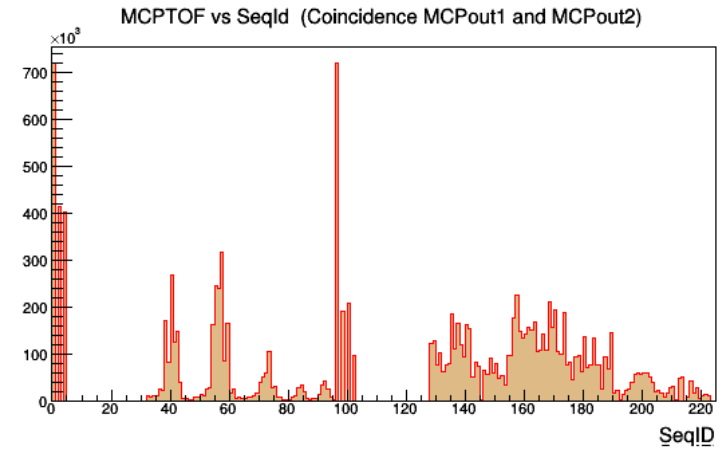
TDC_left – TDC-right

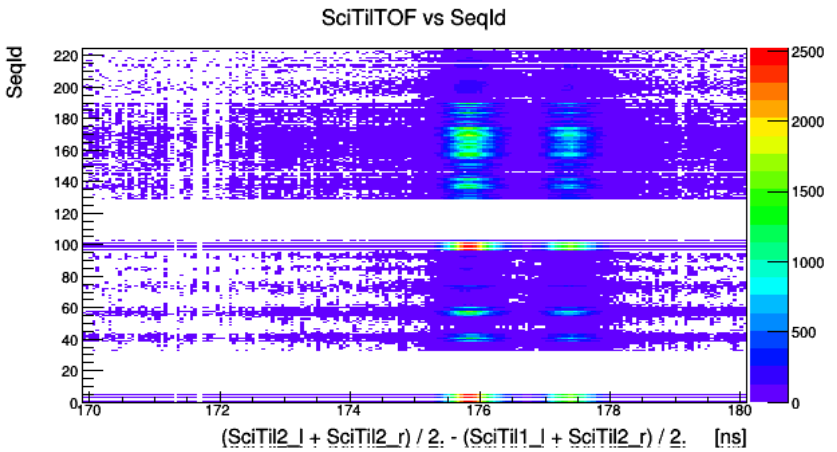


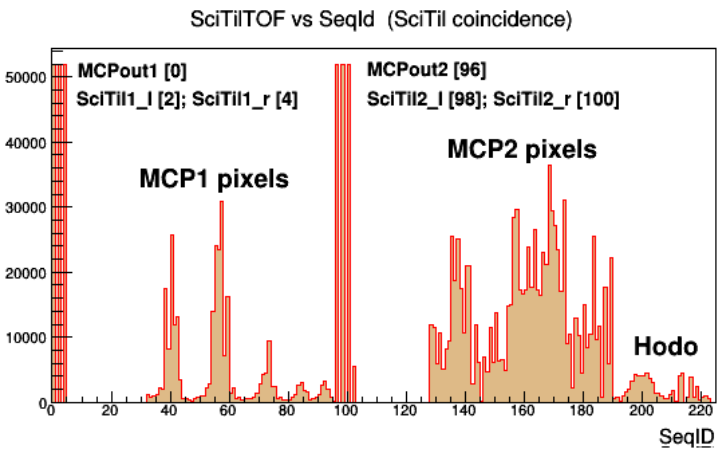
- Downstream TOF-station (#2): main signals at same Padiwa
- Jumps in TDC peak seen at lower rates (~35 ns apart) → mixing of leading edge and trailing edge?
- Meaningful time difference only when both TDC peaks at nominal position (only 138k [3.2%] good events out of 4.3M total)

TOF vs Counter ID





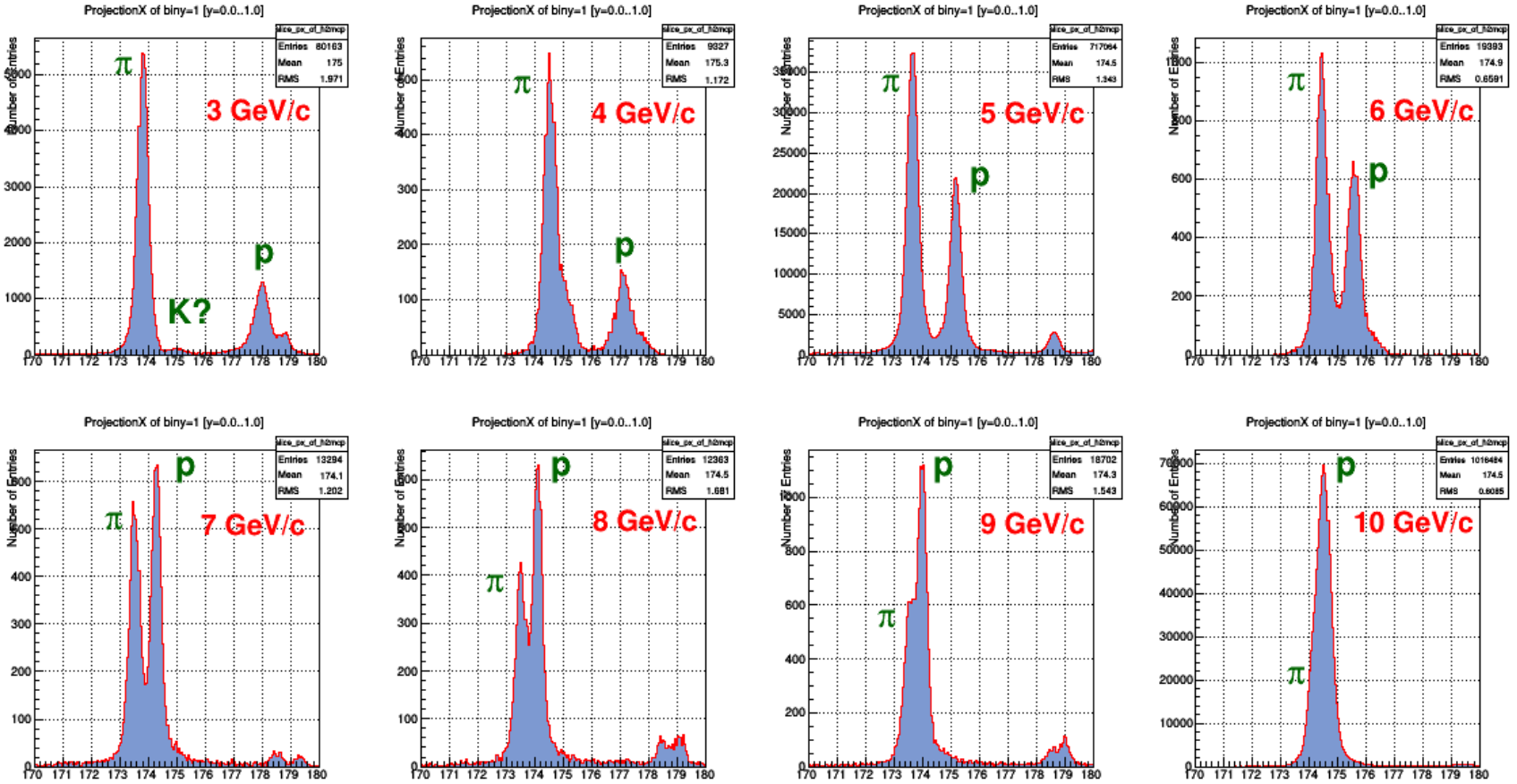




5 GeV/c
All data
~120 Mevts

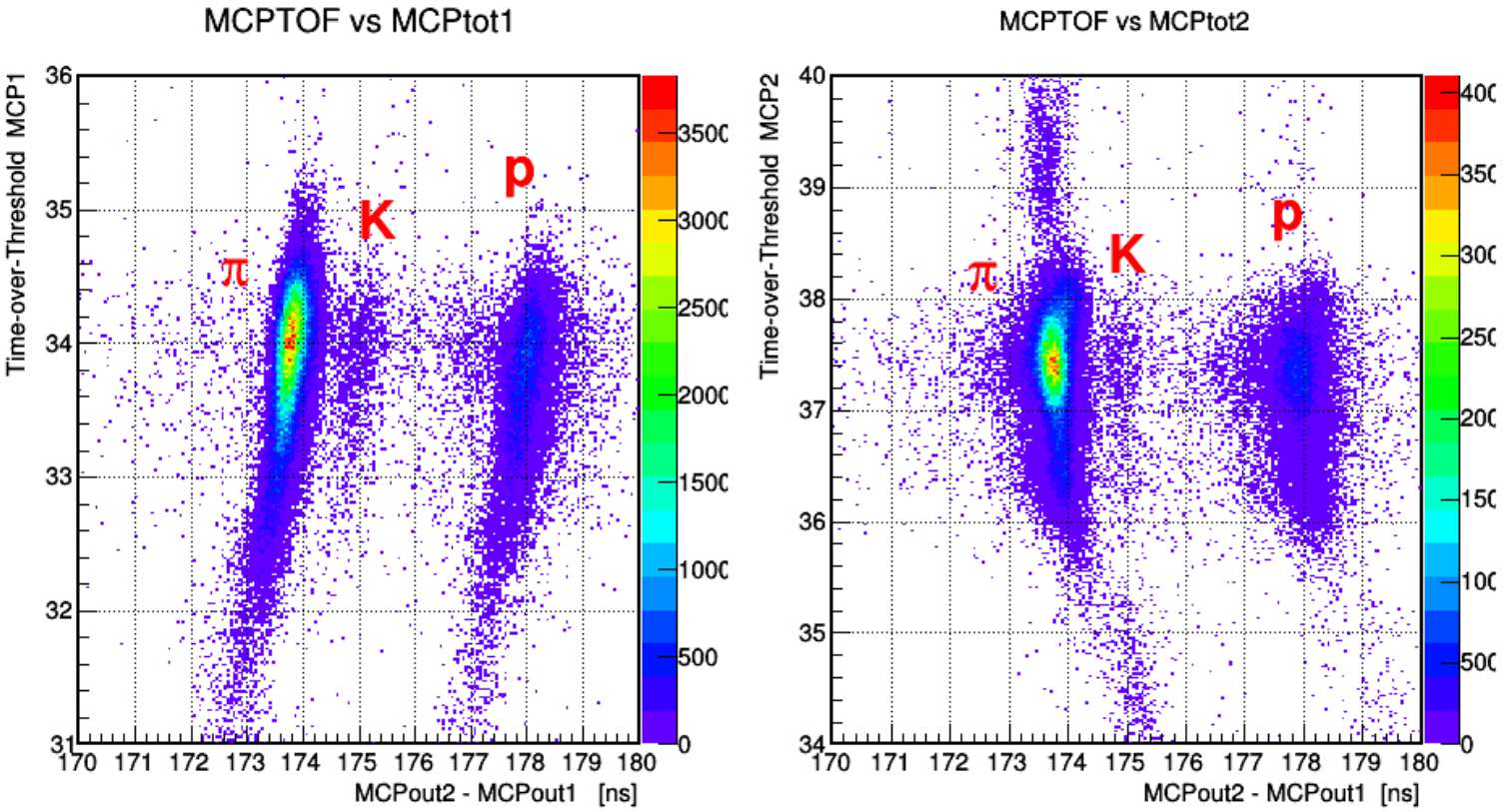
- Clear beam profiles seen in upstream MCP (#1) pixel count rates
- Beam profile seen in hodo rates (SedID >= 192)
  - Hodo efficiency from MCP-TOF: ~74%
  - Hodo efficiency from SciTil-TOF: ~76%

TOF and PID for Different Momenta



- Pions and protons separable up to 7/8 GeV/c
- TOF roughly corrected for Reftime difference
- TOF **not corrected** for timewalk (could be significant: up to 50% better)

Kaons at 3 GeV/c



- TOF resolution here: ~160 ps (only very rough reftime diff correction)
- TOF resolution seen in special configurations (thin slices in Tot1, Tot2 and reftime diff): 100 – 120 ps
- SciTil (left-right) resolution with MCP pixel cut: 70 ps

Summary

- Lifetime of MCP-PMTs
  - 9001223 at 9 C/cm^2, but only 31% QE left
  - 9001332 still good (no degradation) at 7 C/cm^2
  - 9001393 with 2 ALD-layers: no degradation seen up to ~4 C/cm^2
  - KT0001 and KT0002 at 7.6 C/cm^2 and 4.4 C/cm^2, respectively
- Started measuring 8x8 pixel Hamamatsu 2 inch tubes
- First look at CERN MCP-TOF data from May
  - Problems with reference time
  - Problems with TDC stability (leading/trailing edge mix-up?)
  - Fiber hodoscope with ~75% efficiency
  - Clear pion/proton separation for <8 GeV/c