NPS DAQ trigger and beam test stand

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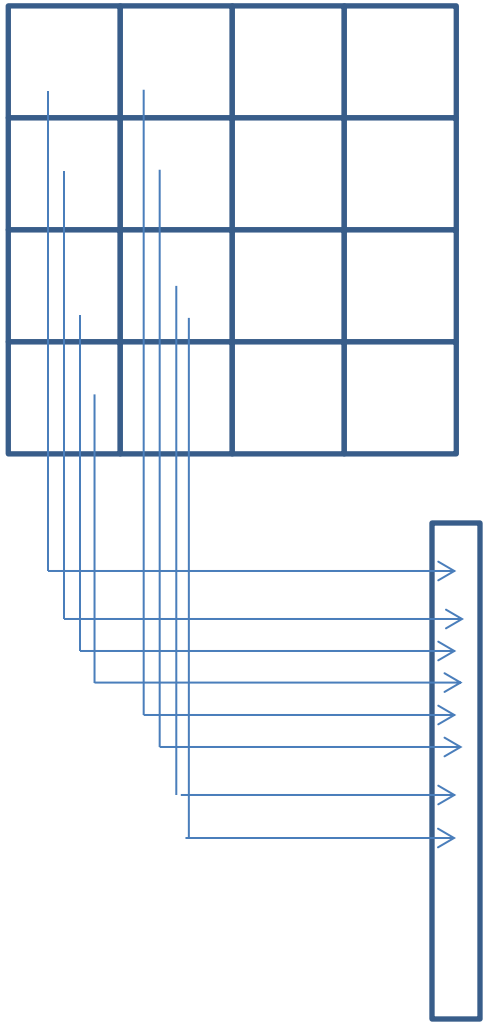
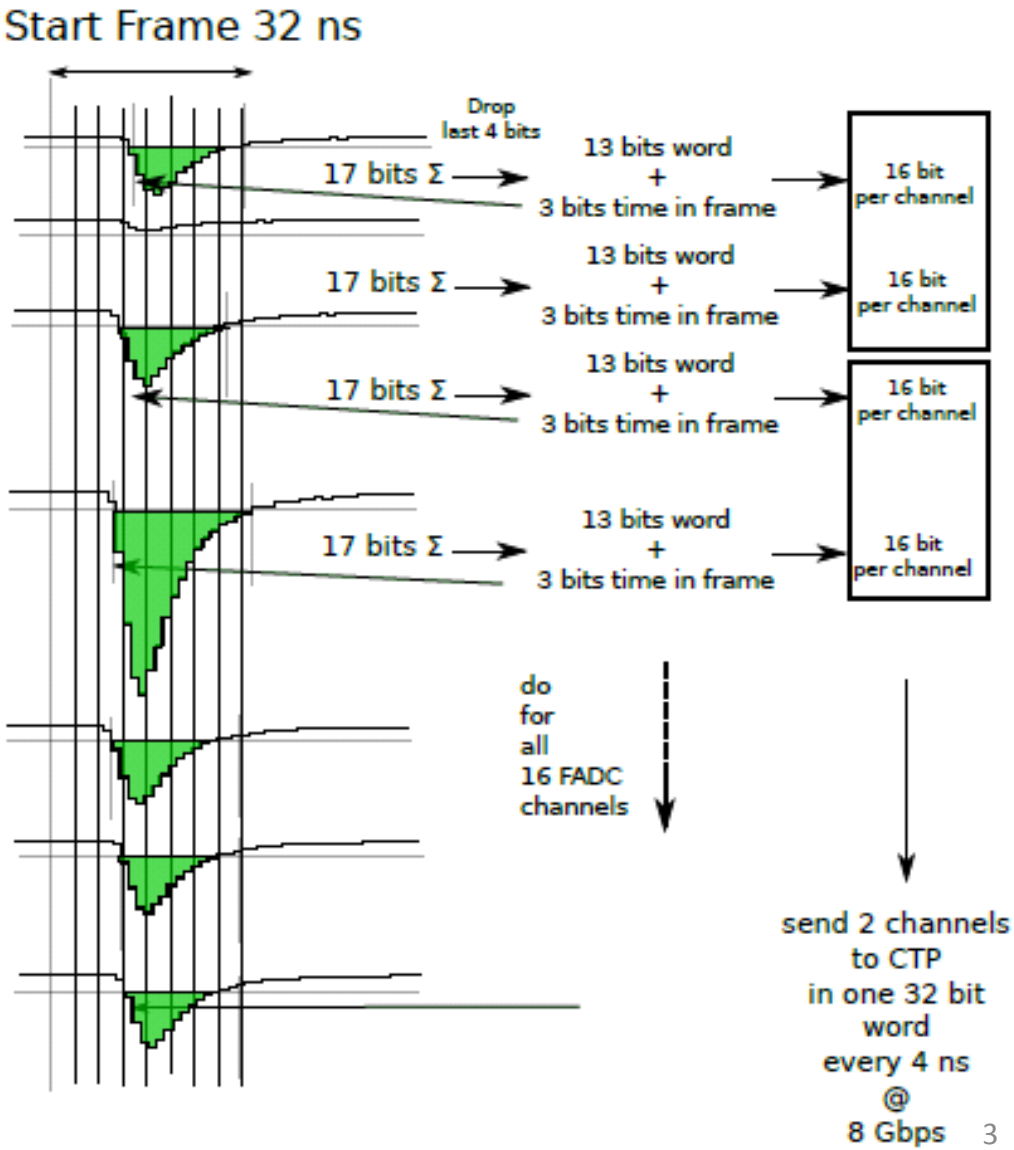
NPS collaboration meeting

VTP

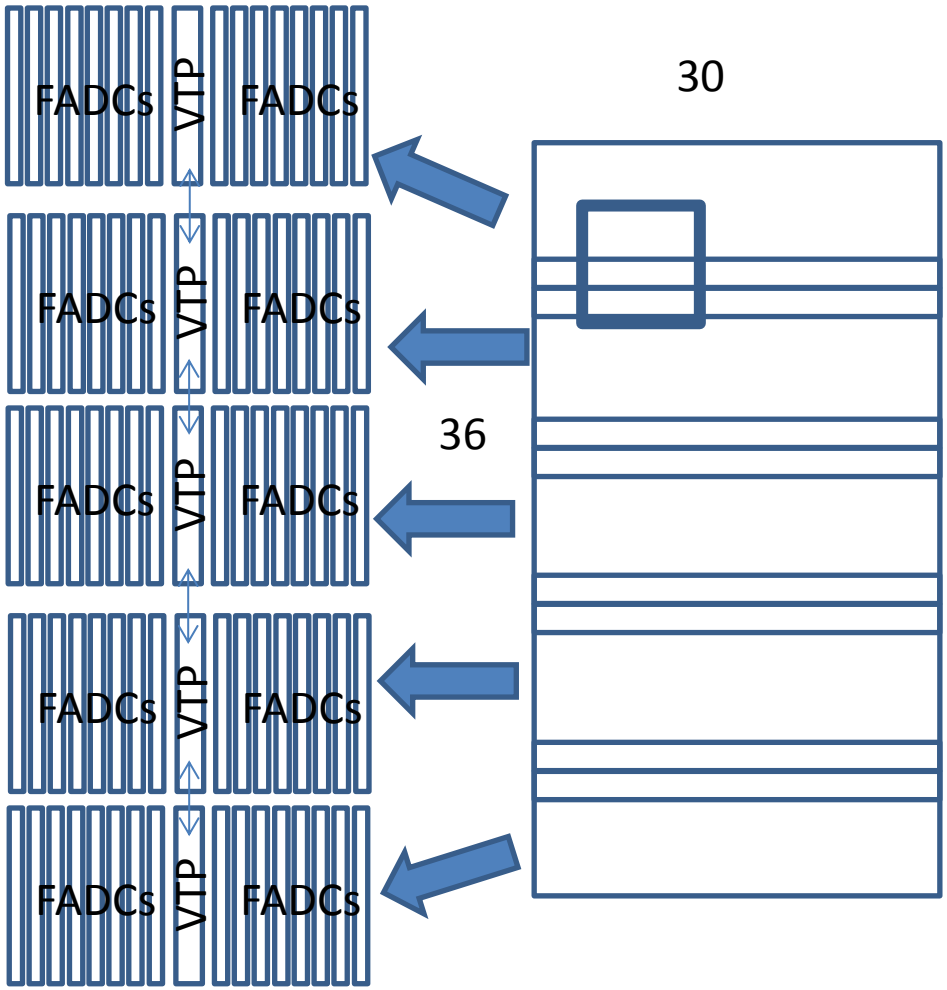
- VTP readout
  - VME backplane limited to 100 MB/s
  - Development of parallel readout of FADC through serial link = 16x 125 MB/s
  - good option for cluster readout (read all FADC and only transfer clusters)
  - Development of streaming option
  - Would be safer to have VTP readout of FADC for NPS in case we need to record full waveform and have higher than expected trigger rate

Clustering HPS like





Trigger and readout layout



- 1080 = 36 x 30 channels
- Similar to SBS HCAL going from 2 to 5 crates
- Transfer adjacent block to the other crate for clustering through VTP optical fiber
- Trigger is OR of each crate
- Other scheme possible

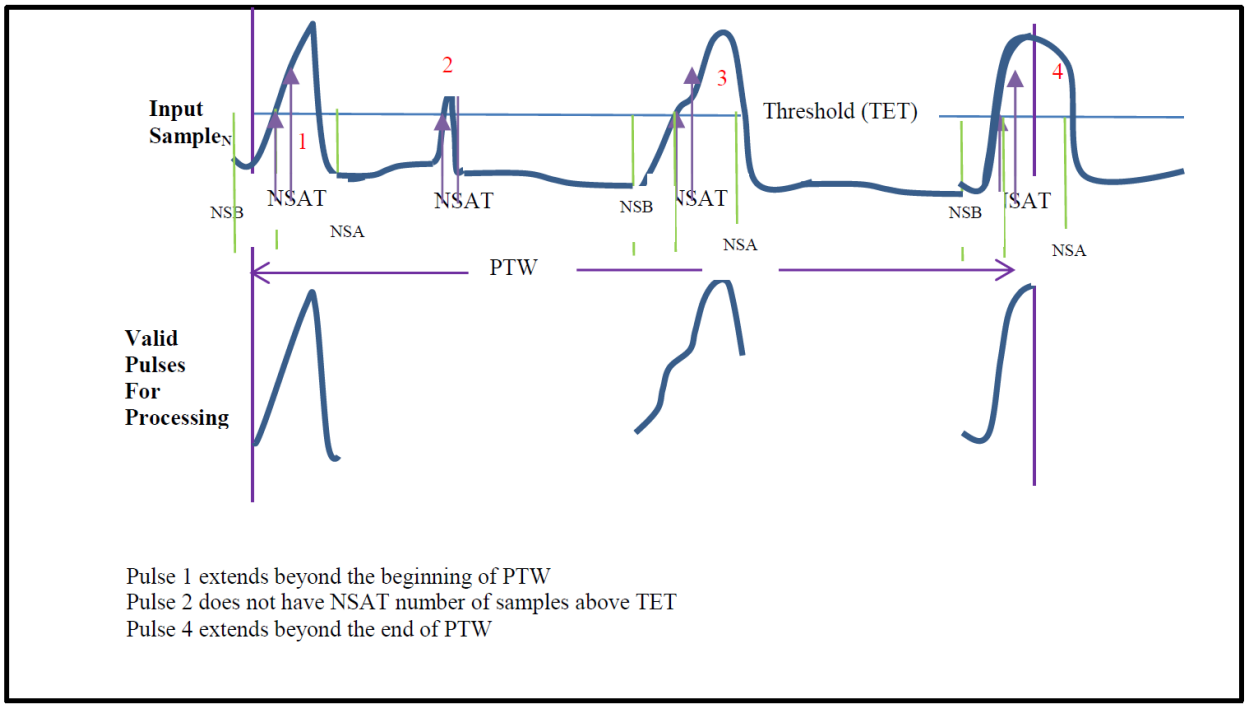
Coincidence trigger

								1 GeV	300 MeV	Accidental	
Kin	SIDIS	k (GeV)	Q2	x	Days	DIS rate(Hz)	Coinc gate	Calo rate (MHz)	Calo rate (MHz)	calo 1 GeV	coinc rate(Hz)
0		6.6	3	xBj=0.36	1	730	5.00E-08	27	115	1.35E+00	
1		8.8	3	xBj=0.36	2	4400	5.00E-08	11	68	5.50E-01	2420
2	B	11	3	xBj=0.36	1	13000	5.00E-08	7	52	3.50E-01	4550
3		8.8	4	xBj=0.36	1	1200	5.00E-08	41	145	2.05E+00	
4	C	11	4	xBj=0.36	3	2900	5.00E-08	22	100	1.10E+00	
5		8.8	3.4	xBj=0.50	3	3300	5.00E-08	2	26	1.00E-01	330
6		11	3.4	xBj=0.50	2	9000	5.00E-08	1.3	20	6.50E-02	585
7	E	11	4.8	xBj=0.50	5	1700	5.00E-08	6.1	48	3.05E-01	518.5
8		6.6	5.1	xBj=0.60	5	53	5.00E-08	14	79	7.00E-01	37.1
9		8.8	5.1	xBj=0.60	1	340	5.00E-08	4.2	39	2.10E-01	71.4
10		11	5.1	xBj=0.60	5	1100	5.00E-08	2.2	27	1.10E-01	121
11	F	11	6	xBj=0.60	10	450	5.00E-08	5	43	2.50E-01	112.5
12		6.6	2	xBj=0.20	1	260	5.00E-08	14	30	7.00E-01	182
13		8.8	2	xBj=0.20	1	1300	5.00E-08	5.9	18	2.95E-01	383.5
14	A	11	2	xBj=0.20	1	9400	5.00E-08	8	28	4.00E-01	3760
15		11	3	xBj=0.20	1	700	5.00E-08	14	30	7.00E-01	490
16	D	11	5.5	xBj=0.36	5	530	5.00E-08	86	222	4.30E+00	
17		11	8.1	xBj=0.50	5	72	5.00E-08	84	220	4.20E+00	
18		11	10	xBj=0.60	12	17	5.00E-08	85	220	4.25E+00	

- For some kinematics does not help unless higher threshold on calorimeter
- Might be useful for high rates kinematics
- Might need to recheck calorimeter single rates estimates

Integral + time

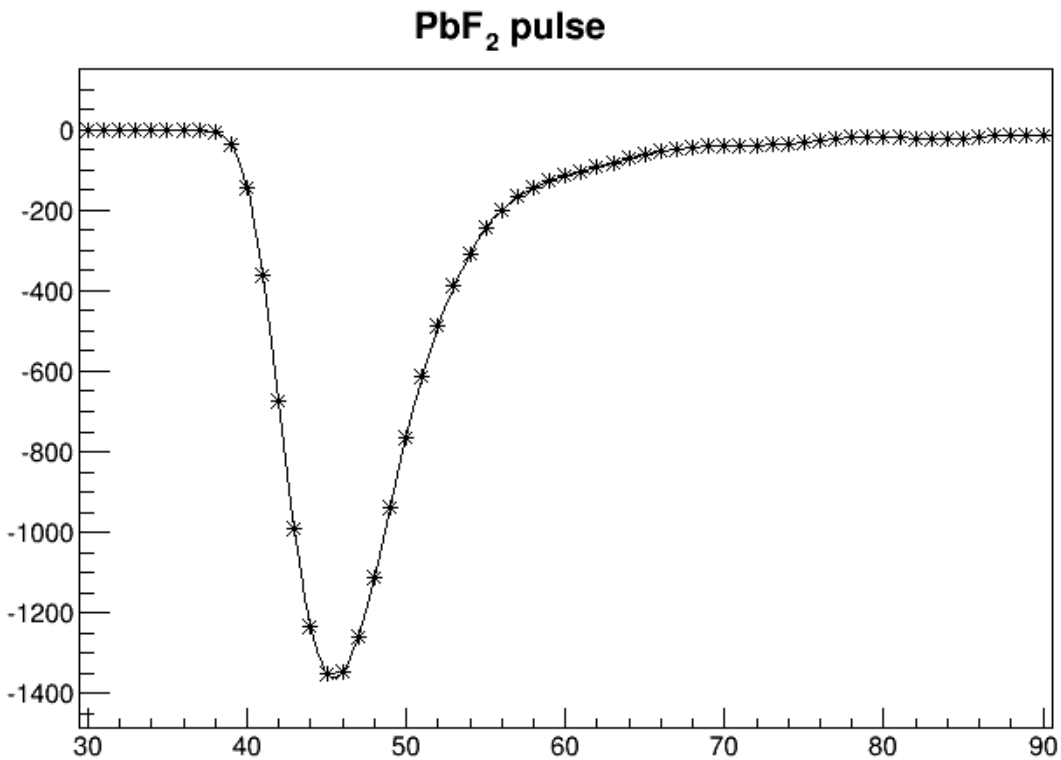
- FADC can record up to 4 pulses in time window



- Data about 10 times smaller if reading 25 samples

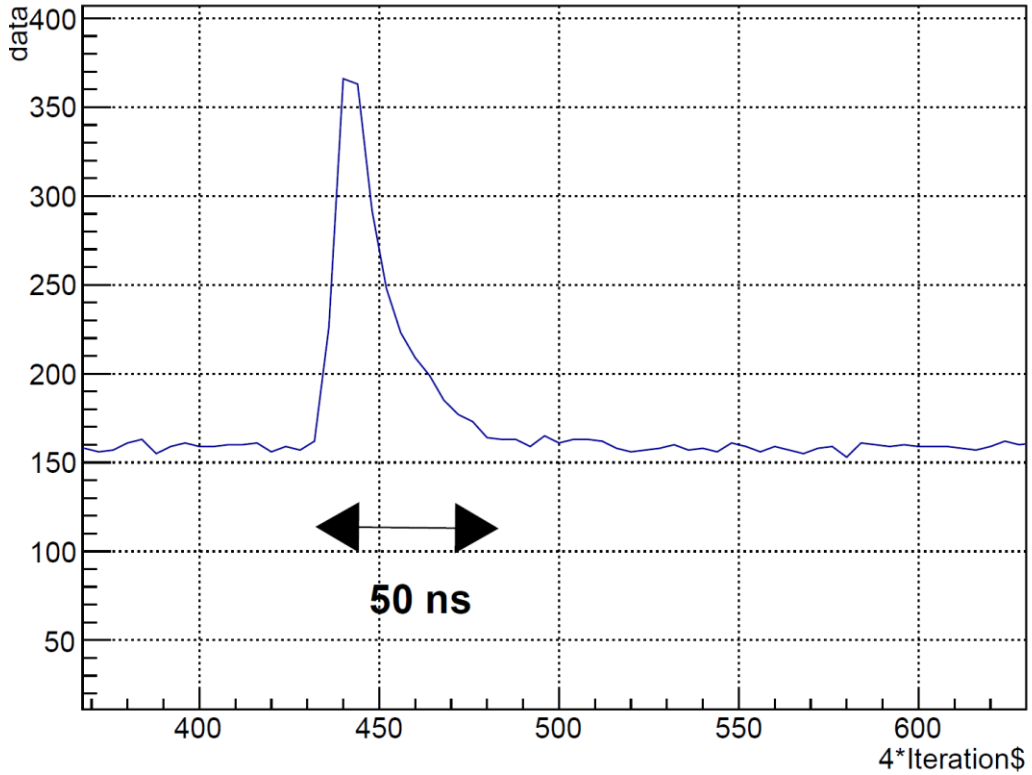
Waveform

- Hall A DVCS recorded full waveform 128 samples



Waveform

- NPS pulse fairly fast, need to check with final base and cable length



Data rates

- DIS from 1 KHz to 13 KHz single e trigger

Kin	SIDIS	k (GeV)	Q2	x	Days	DIS rate(Hz)	All calo (KB)	(MB/s)	Nb blocks	N blocks firing : ev size KB	Calo rate (MB/s)
0		6.6	3	xBj=0.36	1	730	71.424	52.13952	75	4.8	3.504
1		8.8	3	xBj=0.36	2	4400	71.424	314.2656	75	4.8	21.12
2	B	11	3	xBj=0.36	1	13000	71.424	928.512	75	4.8	62.4
3		8.8	4	xBj=0.36	1	1200	71.424	85.7088	75	4.8	5.76
4	C	11	4	xBj=0.36	3	2900	71.424	207.1296	75	4.8	13.92
5		8.8	3.4	xBj=0.50	3	3300	71.424	235.6992	75	4.8	15.84
6		11	3.4	xBj=0.50	2	9000	71.424	642.816	75	4.8	43.2
7	E	11	4.8	xBj=0.50	5	1700	71.424	121.4208	75	4.8	8.16
8		6.6	5.1	xBj=0.60	5	53	71.424	3.785472	75	4.8	0.2544
9		8.8	5.1	xBj=0.60	1	340	71.424	24.28416	75	4.8	1.632
10		11	5.1	xBj=0.60	5	1100	71.424	78.5664	75	4.8	5.28
11	F	11	6	xBj=0.60	10	450	71.424	32.1408	75	4.8	2.16
12		6.6	2	xBj=0.20	1	260	71.424	18.57024	75	4.8	1.248
13		8.8	2	xBj=0.20	1	1300	71.424	92.8512	75	4.8	6.24
14	A	11	2	xBj=0.20	1	9400	71.424	671.3856	75	4.8	45.12
15		11	3	xBj=0.20	1	700	71.424	49.9968	75	4.8	3.36
16	D	11	5.5	xBj=0.36	5	530	71.424	37.85472	75	4.8	2.544
17		11	8.1	xBj=0.50	5	72	71.424	5.142528	75	4.8	0.3456
18		11	10	xBj=0.60	12	17	71.424	1.214208	75	4.8	0.0816

- If all blocks read with waveform, large amount of data

Data rate, time and amplitude

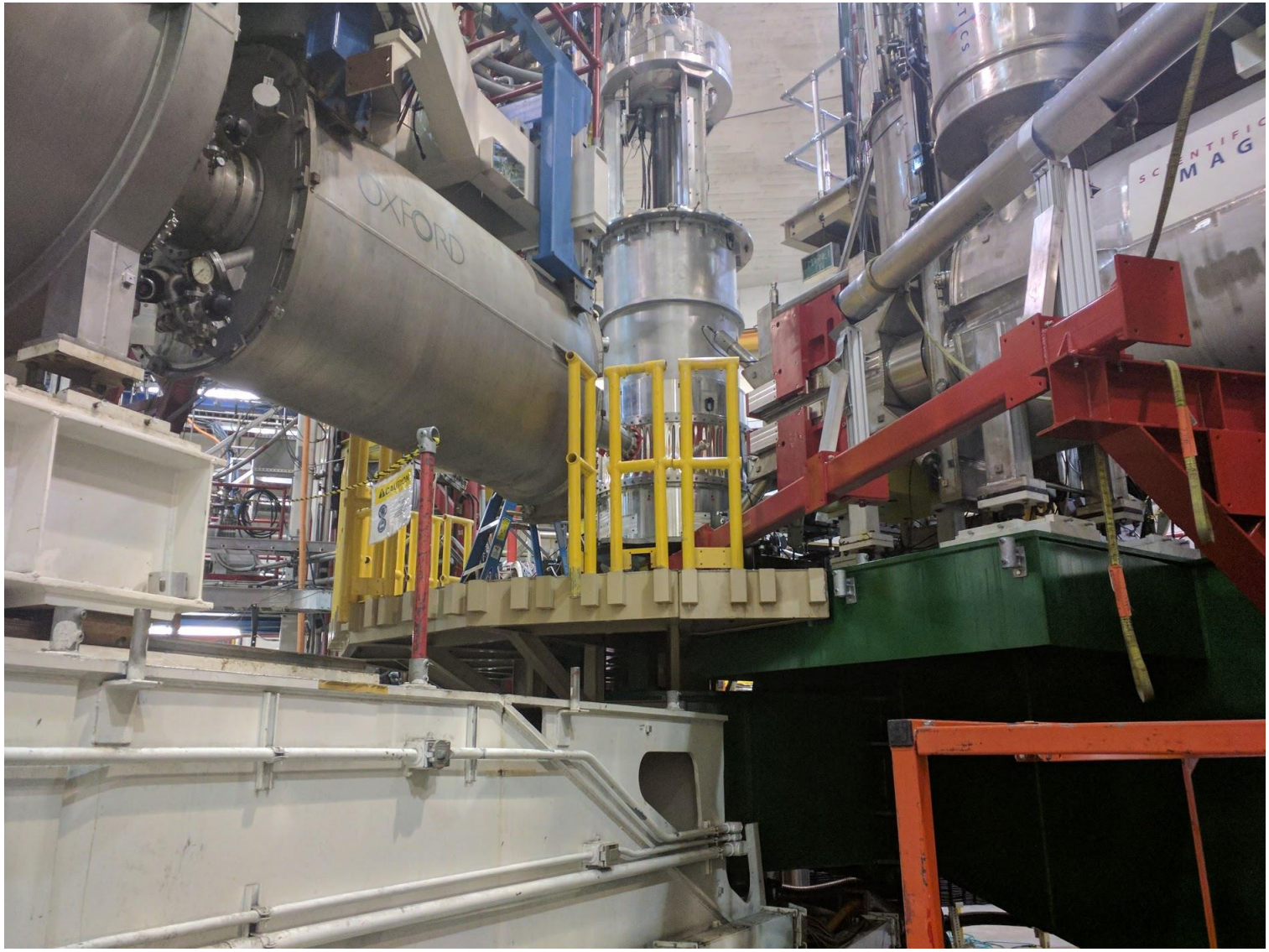
Kin	SIDIS	k (GeV)	Q2	x	Days	DIS rate(Hz)	calo angle (degrees)	All calo (KB)	(MB/s)	Nb blocks	N blocks firing : ev size KB	Calo rate (MB/s)
0		6.6	3	xBj=0.36	1	7.30E+02	11.7	17.856	13.03488	75	1.2	0.876
1		8.8	3	xBj=0.36	2	4.40E+03	14.7	17.856	78.5664	75	1.2	5.28
2	B	11	3	xBj=0.36	1	1.30E+04	16.2	17.856	232.128	75	1.2	15.6
3		8.8	4	xBj=0.36	1	1.20E+03	10.3	17.856	21.4272	75	1.2	1.44
4	C	11	4	xBj=0.36	3	2.90E+03	12.4	17.856	51.7824	75	1.2	3.48
5		8.8	3.4	xBj=0.50	3	3.30E+03	20.2	17.856	58.9248	75	1.2	3.96
6		11	3.4	xBj=0.50	2	9.00E+03	21.7	17.856	160.704	75	1.2	10.8
7	E	11	4.8	xBj=0.50	5	1.70E+03	16.6	17.856	30.3552	75	1.2	2.04
8		6.6	5.1	xBj=0.60	5	53	13.8	17.856	0.946368	75	1.2	0.0636
9		8.8	5.1	xBj=0.60	1	3.40E+02	17.8	17.856	6.07104	75	1.2	0.408
10		11	5.1	xBj=0.60	5	1.10E+03	19.8	17.856	19.6416	75	1.2	1.32
11	F	11	6	xBj=0.60	10	4.50E+02	17.2	17.856	8.0352	75	1.2	0.54
12		6.6	2	xBj=0.20	1	2.60E+02	6.3	17.856	4.64256	75	1.2	0.312
13		8.8	2	xBj=0.20	1	1.30E+03	9.2	17.856	23.2128	75	1.2	1.56
14	A	11	2	xBj=0.20	1	9.40E+03	10.6	17.856	167.8464	75	1.2	11.28
15		11	3	xBj=0.20	1	7.00E+02	6.3	17.856	12.4992	75	1.2	0.84
16	D	11	5.5	xBj=0.36	5	5.30E+02	7.9	17.856	9.46368	75	1.2	0.636
17		11	8.1	xBj=0.50	5	72	8	17.856	1.285632	75	1.2	0.0864
18		11	10	xBj=0.60	12	17	8	17.856	0.303552	75	1.2	0.0204

- Data rate more manageable
- need to check zero suppression (indvidual FADC channel threhsold)
- Pile-up

Test setup(s)

- No VXS crate with available FADC slots in SHMS, need to install one
- Can install 1 VXS crate after PREX
- Cerenkov test stand on floor
  - 1 Hall A VME64x behind green wall for Cerenkov test
  - 2 Hall C and 3 Hall A FADC ordered

Beam line side



Temple Cerenkov Test stand

Conclusion

- A few pieces of hardware required for running
  - get a bit every year
  - or make large order
    - 2 x (VXS crates+CPU+TI+SD)
- If want calorimeter trigger
  - order VTP : additionnal cost possibility of fast readout (need 5 = 35 K$)
  - reuse old CTP,GTP (Hall D, Hall B might upgrade to VTP)
  - order of VTP coming up soon
- Default time and amplitude, is full waveform useful ?
- Beam test in SHMS or Cerenkov test stand
  - occupancies
  - effect of pile-up
  - Timing resolution
  - Data rates
  - Resolution
  - Radiation damage