GMn experiment ERR DAQ

Alexandre Camsonne

June 15th 2017

Outline

- Experimental setup
- GEM readout
- Expected trigger rates
- Expected data rates
- Manpower
- Timeline
- Conclusion

Experimental setup GMn

- BigBite
  - Shower
  - Preshower
  - Scintillator
  - GRINCH

Detector	Channels	NINO	Readout	ADC	TDC
Shower	7x27 = 189 27 sums		Fastbus	X	
Preshower	2x27 =54 2 sums		Fastbus	X	
Scintillator	200 x 2	X	VME	X	X
GRINCH	550	X	Fastbus/VME ?	?	X
GEM	5 planes		VME		

- Neutron detector
  - CDET
  - HCAL

Detector	Channels	NINO	Readout	ADC	TDC
HCAL	288	?	VME	X	X
CDET	2352	X	Fastbus		X

Expected trigger rates

Preferably single electron trigger to avoid biased in neutron detector

Q^2 GeV^2	n+p QE xsec fb	L(per atom) 10^38/cm^2/s design	QE rate Hz	Beam time Hours	Total Hz
3.5	6700	0.35	235	12	2100
4.5	1015	0.7	70	12	1400
5.7	97.9	1.4	13.5	18	140
8.1	47.4	1.4	6.6	18	390
10.2	31.6	0.7	1.5	24	210
12	5.04	1.4	0.7	36	200
13.5	6.25	1.4	0.87	96	100

Maximum trigger rate 2.1 KHz, assume factor 2 safety
margin for 4.2 KHz for low Q^2
less than 500 Hz at high Q^2
Single electron trigger is a good option
(possibility to add Cerenkov in the trigger if needed)

High trigger rate capabilities : rates high for 2 low Q2 points
rates are modest for other points

GEM occupancy and data rates

- occupancies from Q2 = 13.5 GeV2, with luminosity 2.8 10^38 A^{-1} cm^{-2} s^{-1} (44uA on 10cm LD2 target) and rates from low Q2 point : 1.3 KHz

	Rate per (KHz/cm2)	Rate per plane (MHz)	hits in 325 ns	Occupancy (%)	strip hits	x2 XY (strips)	x6 samples	Evt size (bytes)	Rate MB/s
1	89.6	537.6	174.72	27%	612	1223	7338	29357	123.30
2	101.6	609.6	198.12	31%	693	1387	8321	33284	139.79
3	101.4	608.4	197.73	30%	692	1384	8305	33219	139.52
4	98.1	588.6	191.295	29%	670	1339	8034	32138	134.98
5	89.3	535.8	174.135	27%	609	1219	7314	29255	122.87
								Total	660.46

Worse case scenario using High Q2 occupancies with low Q2 rates

Deconvolution on SSP : **expect factor of 3 reduction about 220 MB/s**

GEM MPD readout

- SSP readout implemented in December
- 2.5 Gbit/s = link MPD to SSP
- Up to 32 SSP per MPD
- 10 KHz for 8 APV with 3 samples, 5 KHz for 6 samples
- Ben implemented
  - 2 GB buffer on SSP
  - Working on deconvolution on SSP and additional zero suppression with calorimeter correlation

GEM readout

- 5 planes
- MPD readout
- VME backplane readout
- 3 VME readout crates = 3 x 100 MB/s or
  1 VTP readout = 1 x 1250 MB/s (if Hall A network upgraded to 10 GigE)

- Maximum expected rate 220 MB/s with VME SSP readout and deconvolution

HCAL data rate

- 2 VME crates
- 18 FADCs
- 5 TDCs
- Estimated data max at 4.2 KHz at 100 % occupancy
  - FADC amplitude only : 3 MB/s
  - TDC : 5 MB/s

- 8 MB/s maximum

Fastbus configuration

- Fastbus crates
  - CDET + Bigbite weldments 3x3+3 =12 Fastbus crates (on hand ready)

- 700 ADC channels = 11 ADCs (on hand)
- 2352 + 550 = 2900 = 31 TDCs (on hand)

- 1 ADC per crate and 3 TDCs per crate
- 1440 bytes per event up assuming 100 % ADC occupancy and 1 hit per channel in TDC (
- 6 MB/s per crate at 4.2 KHz
- 72 MB/s no suppression
- all module have zero suppression expect 7 MB/s with reasonable threshold and 100 ns TDC window

VME

- V1190 (available from Glasgow or use F1)
  - No LVDS adapter required
  - 400 channels = 4 modules
  - 2 MB/s
- FADC
  - 288 channels = 18 boards (on hand)
  - 3 MB/s
- F1
  - 288 channels = 5 boards (on hand)
  - 5 MB/s
- MPD : 5 planes = 20 MPDs (on hand)
- 1 VXS crate TS (on hand)
- 2 VXS crates for FADC, TDC (on hand)
- 3 VME64X for GEM (2 on hand, one in HRS)

- 17 MB/s in two crates
- GEM 220 MB/s
- Total about 240 MB/s in 5 crates (5x100 MB/s)

Infrastructure

- Current network
  - 1 gigE = 0.125 GB/s from each ROC to router
  - 10 gigE = 1.25 GB/s to DAQ computer
  - 10 gigE =1.25 GB/s to silo
- Disks
  - 5.5 TB x2 Raid 5 up to 250 MB/s
- SILO
  - 14 tape drives = 2.240 GB/s

Manpower

- GEM readout (On going optical readout)
  - Alexandre Camsonne
  - Danning Di
  - Evaristo Cisbani
  - Paolo Musico
  - Benjamin Raydo
  - Bryan Moffit
- FADC readout (done)
  - Alexandre Camsonne
- Fastbus (12 crates ready working on CDET and Bigbite)
  - Robert Michaels
  - Mark Jones

Milestone Timeline

- Debug SSP readout (3 months)
- Implement deconvolution (1 month)
- BigBite cabling, trigger and readout (3 months)
- Cdet DAQ (6 months) and cabling (1 month)
- HCAL cabling (1 month)

Timeline

2017						2018					
7	8	9	10	11	12	1	2	3	4	5	6
Cosmics INFN GEMs			SSP readout fully operational	MPD deconvolution Implemented and tested	CDET Fastbus CDET Cosmics	HCAL cabling	HCAL cosmics	Bigbite cabling	Bigbite Cosmics with GEM	Unified DAQ BigBite CDET HCAL	

Full GMn DAQ ready next year in Test Lab

Months			
+1	+2	+3	+4
Move weldment (1 week) Move Bigbite (1week) and HCAL (1 week) Cdet (3 days)	Detectors cabling (1 month)	Single detectors Cosmics Detector checkout	Add HRS to GMn DAQ Test all in one DAQ

Experiment ready in 4 months or less depending on manpower

Conclusion

- Trigger rate of 2.1 KHz maximum expected
- Maximum data rates estimated for 4.2 KHz about 240 MB/s
- Expect less with real occupancies and GEM calorimeter correlation
- Data rates can be handled by DAQ, network and SILO

Possible upgrades

- DAQ to more RAID5 or SSDs for up to 500 MB/s (8 SSDs for about 4 K$)
- Network upgrade to 10 GigE in Hall for 60 K$