

# SoLID DAQ update

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SoLID collaboration meeting

# Overview

- PVDIS events and data rates
- SIDIS event size and data rates
- Cerenkov readout
- TOF readout options
- GEM readout
- Dead time measurement
- Hardware progress
- Simulations needs

# PVDIS electron trigger

- Coincidence ECAL and Gas Cerenkov

	Old	Hall D
Singles ECAL	290 KHz	230 KHz
Singles rates Cerenkov	1.9 MHz	803 KHz
Accidental 30 ns	16.5 KHz	4.1 KHz
DIS electron	10 KHz max	7.7 KHz
<b>Total rate</b>	<b>27 KHz</b>	<b>12.1 KHz</b>

# Event size data rates PVDIS

				Event size		Data rate MBs	After noise cut	strips firing	event size bytes		MB/s
1	1156	21.17	244.73	3038.03	3038.03	60.76	9.97	115.25	1430.76	1430.76	28.62
2	1374	10.35	142.21	1765.39	1765.39	35.31	5.11	70.21	871.61	871.61	17.43
3	1374	8.81	121.05	1502.71	1502.71	30.05	4.42	60.73	753.92	753.92	15.08
4	2287	3.07	70.21	871.60	871.60	17.43	1.64	37.51	465.61	465.61	9.31
5	2350	2.79	65.57	813.93	813.93	16.28	1.50	35.25	437.60	437.60	8.75
					Total	159.83				Total	79.19
FADC											
	20000						10				
	Event size FADC	Nb channel	Header			Trailer	Sample				
	Calorimeter	14	4			4	12	280			
	Preshower	9	4			4	12	180	400		
	Cerenkov	9	4			4	12	180			
									11600000		
								740	11600000	11.6	
									Total rate	94	MB/s

About 2.9 GB/s for PVDIS at 20 KHz

# Cerenkov PMT readout

- MAROC3 close to what we need
  - 64 channels
  - Variable gain
  - Discriminated fast logic signal
  - Missing : analog sum of 8, need sum of 64
  - 8 sum of 8 available just need to sum them, will check with INFN for modified RICH board, requested 10 K\$ preRD money
  - Radiation hardness is pretty good, need to be tested, possibility of new version to handle Single Event Upset
  - MAROC default option
  - MAROC testboard available
  - Will check design with electronics group for FADC analog output
- Possible readout schemes
  - FADC only ( default )
  - FADC + VETROC
  - VETROC only : needs to be evaluated
  - Preferred : Add TDC readout for each Cerenkov channel 232 VETROC additional 700 K\$, could improve Cerenkov trigger
  - Need simulation to evaluate options
  - Need to follow with electronics group to start testing ( anyone from Cerenkov group interested ? )

# TOF options

- Expected timing resolution 80 to 50 ps
- Default readout
  - NINO + TDC : 20 ps timing resolution
- R&D MRPC : 20 ps
  - Sampling TDC ASICs : PSEC4/5, SAMPIC, DRS4 give 5 to 1 ps resolution
  - Need new chip DRS5 or PSEC5 (AARDVARC NALU) to handle SoLID trigger rate ( analog pipeline ) first prototypes for 2018
- Depends on final detector choice
- sPhenix solution: DRS4 system , existing chip but not optimal
- Need to determine effect of photon background, might need sampling to deal with pile up

# GEM readout

- SRS deployed in Hall B Prad
- MPD implemented in CODA
  - BLT testing few KHz
  - Optical fiber readout to be implemented for high rate test ( 100 MB/s to 1.6 GB/s )
- Preliminary results from Weizhi : one sample no deconvolution not sufficient, new occupancy number
- Data reduction on SSP for SBS
- On chip deconvolution ( implemented in MPD ) still an option if needed
- preRD to get VMM3 chip
- SAMPA chip from ALICE

# GEM readout

- Prove 100 KHz ( or more ) rate capability of APV25 hardware
- Other chips start to be available : VMM3 prototype and SAMPA
- [https://eic.jlab.org/wiki/index.php/Trigger/Streaming\\_Readout](https://eic.jlab.org/wiki/index.php/Trigger/Streaming_Readout)



# SIDIS event size

Occupancies with one sample readout by Weizhi , rates for 100 KHz

GEM	Occupancy	Number of strips	XY strips	Strips per chambers	MB/s
1	2.21	453	906	27180	245
2	8.78	510	1020	30600	1184
3	3.63	583	1166	34980	559.5
4	2.31	702	1404	42120	428.7
5	1.78	520	1040	31200	244.71
6	1.3	640	1280	38400	220
Total	20.01	3408	6816	204480	2901

GEM dominating ( 35 bigger than initial proposal ) 2.9 GB/s same requirement as PVDIS

# Data rate FADC

Event size FADC	Nb channel	Time			Amplitude	Header			
LGC	2.1	4			4	1	0	828	82800000
HGC	1.3	4			4	1	0	180	18000000
SPD_LA	40.3	4			4	1	0	1647	16470000 0
SPD_FA	80	4			4	1	0	270	27000000
Preshower FA	53.8	4			4	1	0	135	13500000
Shower FA	15.6	4			4	1	0	405	40500000
PreShower LA	37.5	4			4	1	0	90	9000000
Shower LA								2900	290
						FADC MB/s			290.1

about 300 MB/s estimated at 355 MB/s before

So far of order of total 3.2 GB/s at 100 KHz

# L3 farm

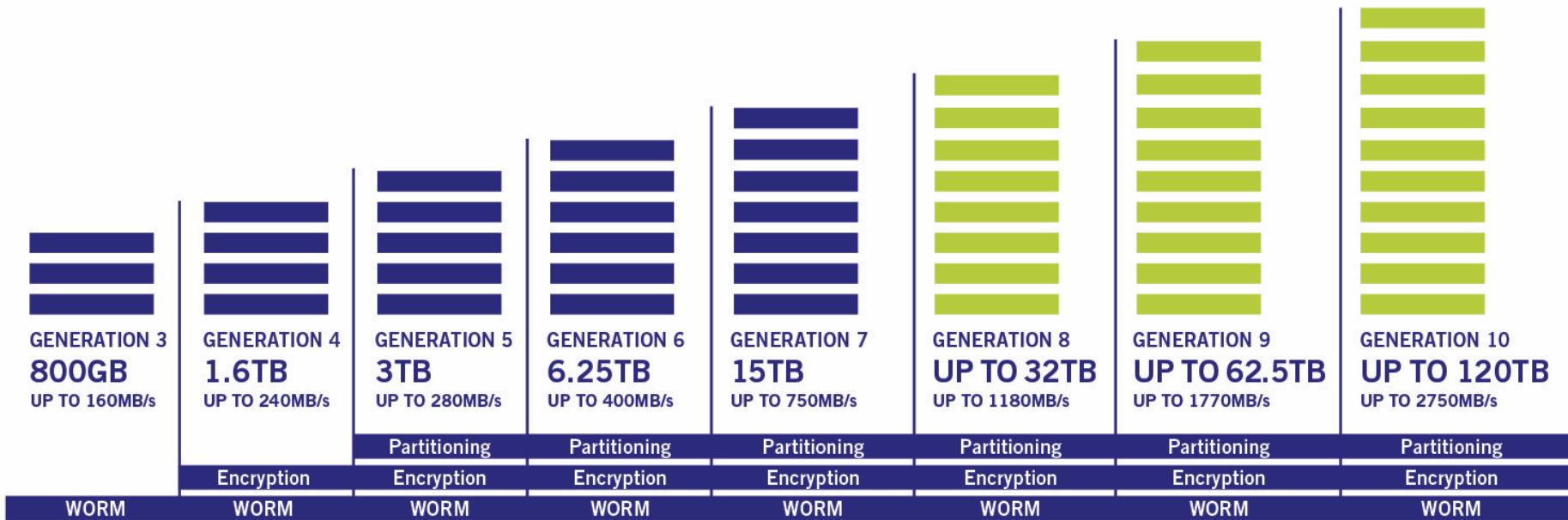
- Have digitized data for GEM for SIDIS and PVDIS
- Weizhi has tracking algorithm take 2 to 10 ms to process one event so about 1000 nodes for 100 KHz
- Need :
  - Other include detector data
  - Additional reduction algorithm
  - Implement tracking
  - Test on Hall D or DAQ cluster
- Discussion with HPC/IT, seems reasonable to assume CPU available

# Hard drives

- SAS/SATA
  - 600 GB 204 MB/s 120 \$
- SSD SATA
  - 500 GB 169 \$ 500 MB/s
- SSD PCIe
  - 1.6 TB 1.2GB/s 3.5 K\$
  - 375 GB 2.2 GB/s 1.5 K\$
- SoLID rates within reach with current drive technology with not too much cost

# LTO timeline

## LTO ULTRIUM ROADMAP ADDRESSING YOUR STORAGE NEEDS



Note: Compressed capacities for generations 1-5 assume 2:1 compression. Compressed capacities for generations 6-10 assume 2.5:1 compression (achieved with larger compression history buffer).  
Source: The LTO Program. The LTO Ultrium roadmap is subject to change without notice and represents goals and objectives only.  
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Currently : 14 drives give 2.24 GB/s ( LTO4 to LTO6) up to 16 drives for now.  
With latest technology could be up to 1.1 GB/s per drive  
Bottomline : 3 GB/s is reasonable by 2020

# Network

- Thanks to 2014 UIM upgrade
  - 2 x 10 GigE link
  - 1 or two more fibers available
  - Upgradable from 10 to 40 GigE when cost go down ( 100 GigE starts to be available ) Hall A counting house upgrade about 60 K\$ most likely done for SBS to go to 10 gigE everywhere
  - additional 20 K\$ for 40 gigE link capability to Computer Center
  - No issue for link from Counting house to Silo / L3
  - Up to 3 x 40 Gbit /s = 15 GB/s  
(3 x 100 Gbit/s = 37.5 GB/s)

# To do list simulation

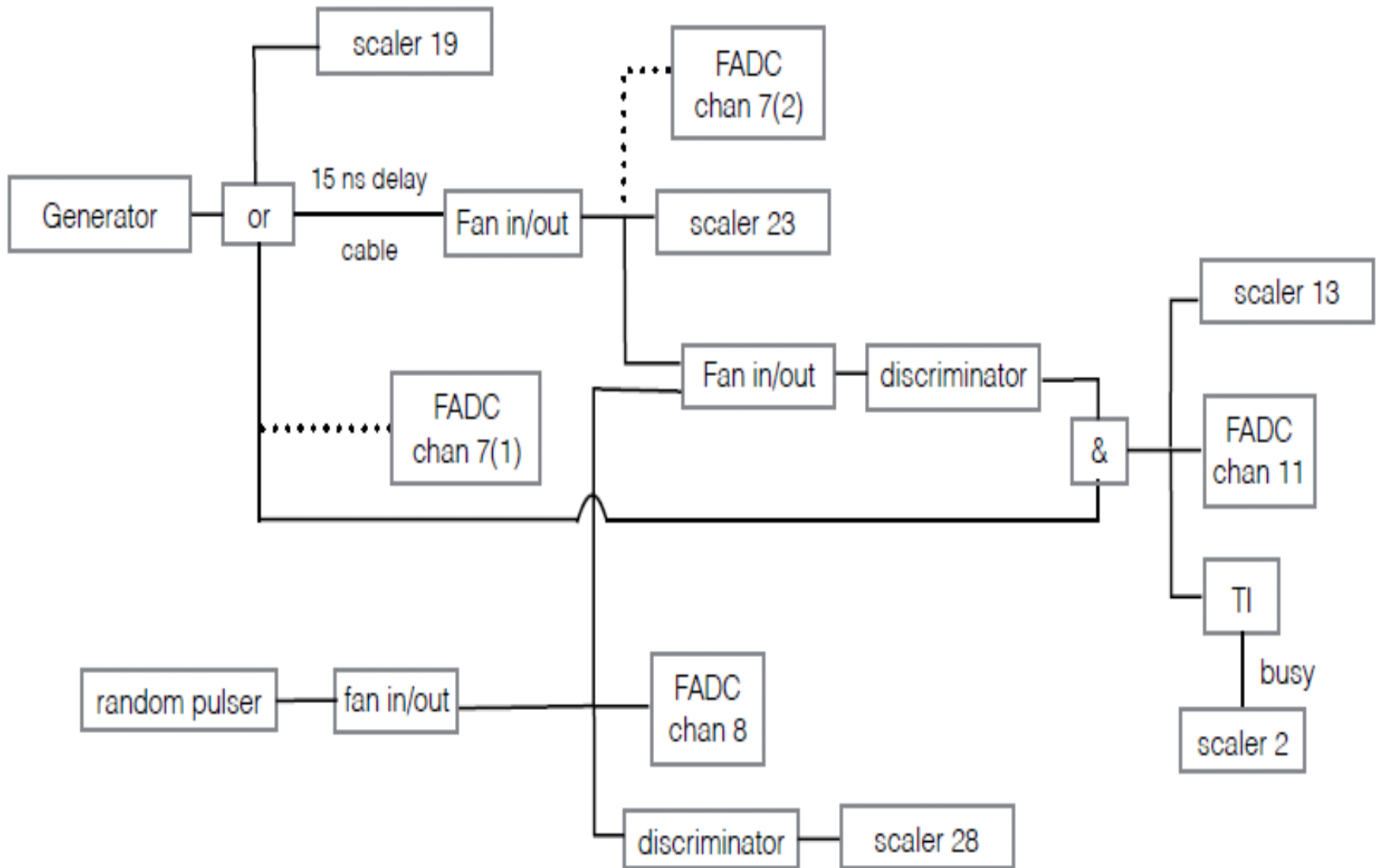
- GEM occupancies and digitization SIDIS for event size, occupancy and tracking (Ole, Zhiwen, Weizhi) ✓
- Updated trigger rates PVDIS, SIDIS(Zhiwen, Rakitah) ✓
- FADC digitization PVDIS : realistic PID and pile up(?)
- Cerenkov simulation only timing readout no FADC(?)
- Effect 1 sample vs 3 samples GEM (Weizhi ) and 20 samples vs time integral SIDIS (?) ✓
- Full FADC trigger simulation : Not started
- SPD waveform analysis ( New : ? )
- MRPC simulation : response to background ( ongoing Sangwa) timing simulation / event size
- Data reduction algorithms (?)

# Hardware on going test

- Trigger test HCAL : 16 FADC + VTP
  - Trigger test on going
  - Need for GEp5 SBS
- GEM readout testing
  - 5 MPDs
  - First iteration of CODA library
  - Implementation optical link readout (complete)
    - Testing : reach 60 KHz with one sample, need to be optimized might be limited by computer
  - SRS : successfully used up to 5 KHz during PRAD
  - HPS : 50 KHz with 6 samples ( should give 300 KHz with 1 sample )
- Compton :
  - Setup moved back in TEDF
  - Deadtime measurement on going and studying assymetry measurement



# PVDIS Deadtime measurement



Deadtime from TI only : fixed dead time

# Hardware to do list

- GEM APV25 test up to 100 KHz ( 200 KHz ) ( need development )
- PVDIS Deadtime asymmetry measurement using Compton setup in TEDF ( 3 months )
- Get PreRD going
  - MAROC test analog sum
  - test data rate capability
  - test GEM chips
  - test MRPC chips

# Conclusion

- New results from Simulation
  - PVDIS rate lower 12KHz, not an issue
  - SIDIS :
    - 1 sample GEM readout seems to work and with occupancies similar to PVDIS data rate
- Up to 3 GB/s most likely can be handled by SILO, L3 most likely not required and could be available mostly for free
  - To do :
    - TOF background
    - Need to check J/Psi and TCS occupancies, rates and efficiencies
- MAROC default option for Cerenkov readout
- TOF : PSEC5 preferred option, need simulation to determine effect of background
- PVDIS deadtime : hardware setup, ongoing study with Compton setup
- Need SPD simulation with FADC waveform to see if waveform is needed and if it is sufficient ( might need more segmentation )