### **BM@N Data Acquisition System**

A. Baskakov, S. Bazylev, V. Burtsev, A. Fediunin, I. Filippov, T. Gandzhelashvili, S. Kuklin, A. Shchipunov, A. Shutov, I. Slepnev, V. Slepnev, N. Tarasov, A. Terletskiy

#### Joint Institute for Nuclear Research, 2020



## Outline

- DAQ Architecture
- DAQ Electronics
- DAQ Data Processing
- DAQ IT Infrastructure
- STS Integration





### **DAQ Architecture**



### **DAQ Electronics — Readout Control**

**FVME2** Controller is a VME64x bus controller module, which collects data from VME modules, transmits the data to the server (FLP) via optical link and controls modules within one VME crate.

**FVME2 TMWR** module is used for clock and trigger distribution and time synchronization via White Rabbit protocol within one VME crate. Every FVME2 TMWR module at different VME crates are synchronized between each other by White Rabbit network.



PEXML-4 is PCI-E interface module. It's mounted into FLP, receives data from FVME Controller and transmits setups for VME modules to Controller using M-Link protocol.



**UT24VE RC** is universal 24 TTL I/O VME64x board with White Rabbit support, which used for implementation trigger logic.





### DAQ Electronics — Digitizing modules

**TDC72VHL** is 72-channels VME64x modules with 25 ps resolution. This module is using to digitize signals from TOF400 and FFD detectors.



**TDC64V** is 64-channels VME64x module with 100 ps resolution and used for digitize signals from DCH detector.

**TDC64VHLE** is 64-channels VME64x modules with 25 ps resolution. This module is using to digitize signals from TOF700 detector.







# DAQ Electronics — Digitizing modules (cont'd)

**ADC64VE** is 64-channels 62.5 MSps waveform digitizers. ADC64VE is used at GEM, STS and CSC detectors. **ADC64s2** is 64-channels 62.5 MSps waveform digitizers. ADC64s2 is used at FHCal and ECal detectors.







### DAQ Electronics — Detector Control Modules and Front-End Electronics

**U40VE** module is applied. It's a universal 40 I/O VME64x board with White Rabbit support. Used as remote control for tuning specific parameters for frontend electronics at GEM, STS, CSC and TOF700. It has personal firmware for different kinds of front-end electronics.



MAPD\_FEB module is intended for placing 9 MPPCs Hamamatsu at the ECal module.



ADC64Amp electronic module was developed for amplification and shaping signals from ECal and ZDC detectors.





### **DAQ Electronics — Specific Modules**

**HRB6ASD** is used for readout signals from MWPC detector. It's a 96-channels readout board with adjustable thresholds



**TTB9V** is a trigger and timing distribution module. This module is used for synchronization of HRB6ASD modules



**TQDC16VS** is a VME64x 16-channel time and amplitude digitizer. Used to digitize analog signals from T0 unit of FFD detector. **MSC16VE** is a VME64x 16-channel scaler module. Used to count signals from T0 unit of FFD detector.



## VMM3a readout board status

### VMM3a 128 channels readout board

FPGA readout	Kintex-7 Family	
Input channels	128	
Input charge	-2 to 2 pC	
Shaping time	25 to 200 ns	
Noise	500e ENC at 25pF	
Gain	0.5 to 16 mv/fC	



- 3 SFP data, trigger, white rabbit
- 4 VMM3a direct output LEMO analog/ digital calibration signal output
- 4 VMM3a channels unmuxed output IDC 10 pin
- 4 FPGA I/O LEMO bidirectional LVTTL compatibile
- 4 FPGA diffirential, 4 FPGA singe I/O IDC 10 pin
- 4 FPGA XADC input IDC 10 pin

## DAQ Data Processing



Run Control DCS DCS FLP mstream EVB TDS

#### Software data processing

#### Hardware data processing

## **Event Builder Architecture**



#### Event Builder Tasks:

- 1. Receiving data from DRE
- 2. Analyzing data (check that data is not corrupted) and distinguish sub-events data blocks
- 3. Combining completed event from sub-events
- 4. Output completed events

## DAQ IT Infrastructure



Specifications		
Input power	50 kW	
IT power	24 kW (N+1) / 30 kW max	
Rack count	4 racks	
Redundancy	N+1 (UPS, HVAC)	
Battery backup	8 minutes	
Rack size	600 x 1200 x 42U	

Stage-1 Equipment	Rack Units
Passive network	16
Active network (switches, controllers)	18
Infrastructure nodes	4
FLP, Event Builder nodes	44
Transient Flash Storage	13
Message Logging and Search	5
Reserve (Stage-2)	68

MDC (modular data center) specifications and views.







## DAQ IT Infrastructure



## STS integration



At BM@N all subdetectors connects with DAQ using identical connection scheme. To integrate new STS detector with its own DAQ into existing BM@N DAQ the best solution would be to implement the same scheme.

To implement this scheme STS DAQ software and hardware should support:

- Data & Control Link from BM@N Run Control and Event Builder software
- White Rabbit Link (optional)
- Two coaxial connections (LVTTL, 50  $\Omega$ ) for trigger distribustion and busy collection.
- PnP protocol (description will be published at our web page)
- packing data into MPDRawData format
- send events sequentially, without reordering

Thank You

### **Extra Slides**

#### Seans 55 - Busy Time Analisys

#### Busy time rc\_20180404\_041747\_24.txt



#### **Krypton Run**

Average XOFF Time



#### **Krypton Run**

**EvB TCP Output Rate** 

