DATA ACQUISITION SYSTEM FOR J-PARC E36 EXPERIMENT

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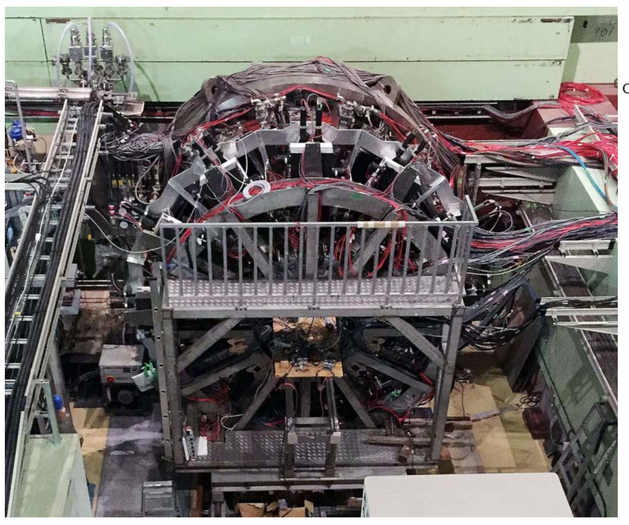
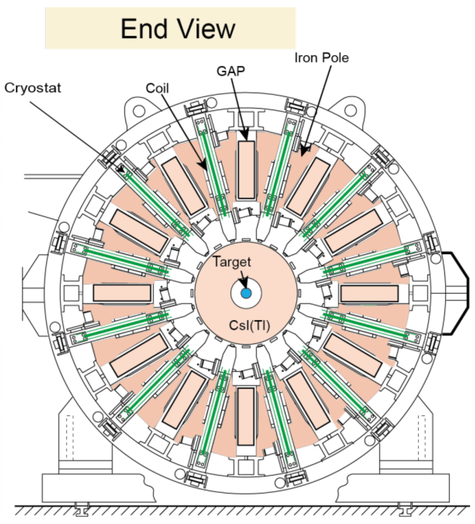
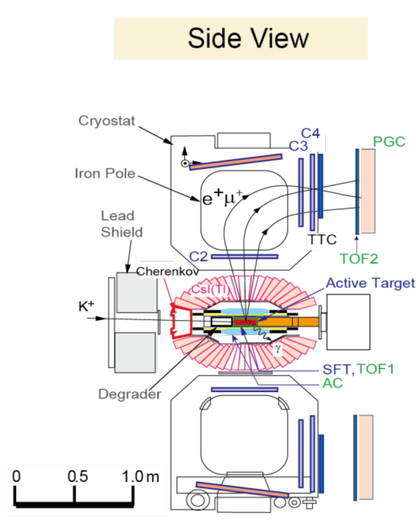
J-PARC E36 : A test of the lepton universality







J-PARC E36 experiment is a test of Lepton Flavor Universality (LFU) using a precise measurement of the decay width ratio of the two-body K^+ decay with a e^+ and a μ^+.

$$R_K = \Gamma(K^+ \to e^+\nu) / \Gamma(K^+ \to \mu^+\nu)$$

The experiment was performed at the K1.1BR beam-line of the Japan Proton Accelerator Research Complex (J-PARC) Hadron Hall. The experiment completed data taking in December 2015.

The aim of the measurement : $\Delta R_K/R_K \sim 0.0025$

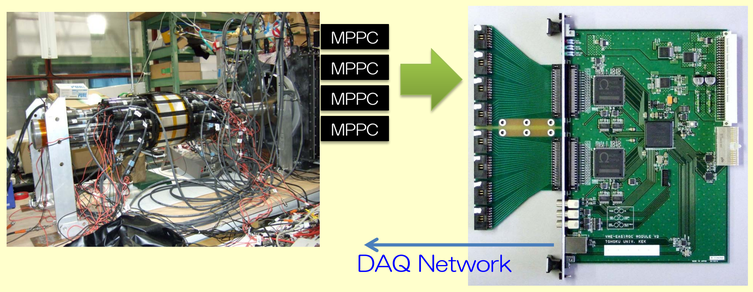
Detectors and readout devices

Detector	No. of Ch.	ADC	TDC
Beam hodo-scope	24	---	TRIUMF VT48
Fitch cherenkov	28	---	TRIUMF VT48
TOF	72	CAEN V792	TKO HR-TDC
Trigger counter	17	CAEN V792	TRIUMF VT48
Lead glass counter	84	CAEN V792	TRIUMF VT48
Gap veto counter	12	CAEN V792	TRIUMF VT48
Aerogel cherenkov	24	TKO ADC	TRIUMF VT48
MWPC	496	TKO ADC	---
Spiral fiber tracker	128	Network oriented EASIROC board	
Fiber target	256	Network oriented EASIROC board	
CsI(Tl)	768	TRIUMF VF48	

- 3 types of the readout interface VME, TKO, and Network
- VME and TKO can send data to the network using VME-SBC.

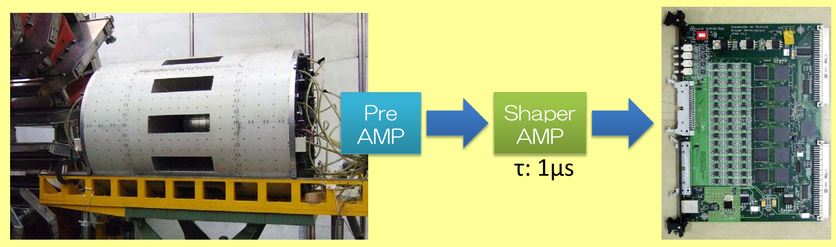
VME / TKO / Network

Fiber target/Spiral fiber tracker



Network oriented EASIROC board
- 64-ch input : 2 EASIROC (A front-end ASIC to read SiPM)
- 10-bit ADC
- 0.7-nsec FPGA based TDC
- FPGA based TCP/IP engine
- KEK-VME module with a trigger/busy interface

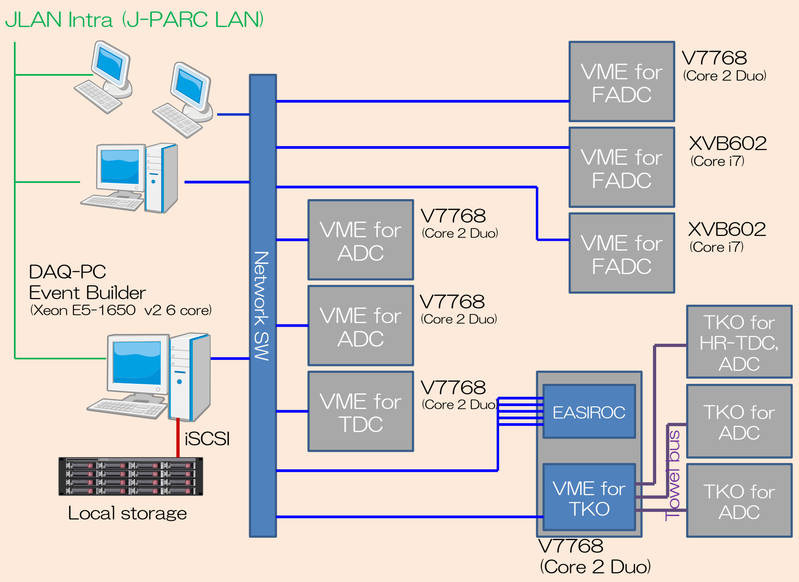
CsI(Tl) Photon detector



TRIUMF VF48 waveform sampler
- 48-ch, 10-bit FADC
- up to 60-MHz sampling
- We used 25-MHz sampling to analyze pile up signals

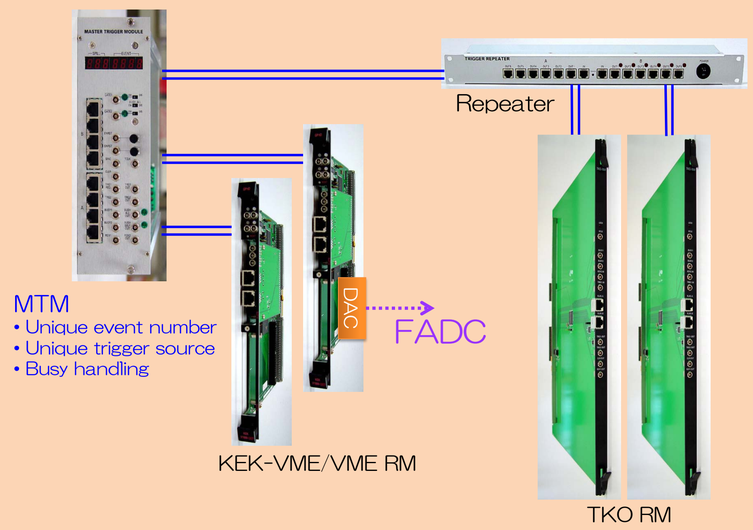
System integration

E36 DAQ network



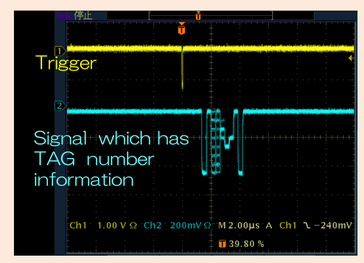
Event synchronization

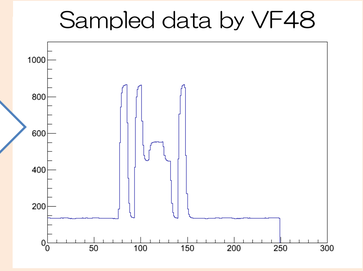
MTM/RM Trigger distribution system
- MTM handles Trigger/Busy hand-shake.
- Global event number (EVENT TAG) is delivered with the trigger signal.
- It works effectively under multi event buffered sub-systems environment.



Event synchronization for VF48

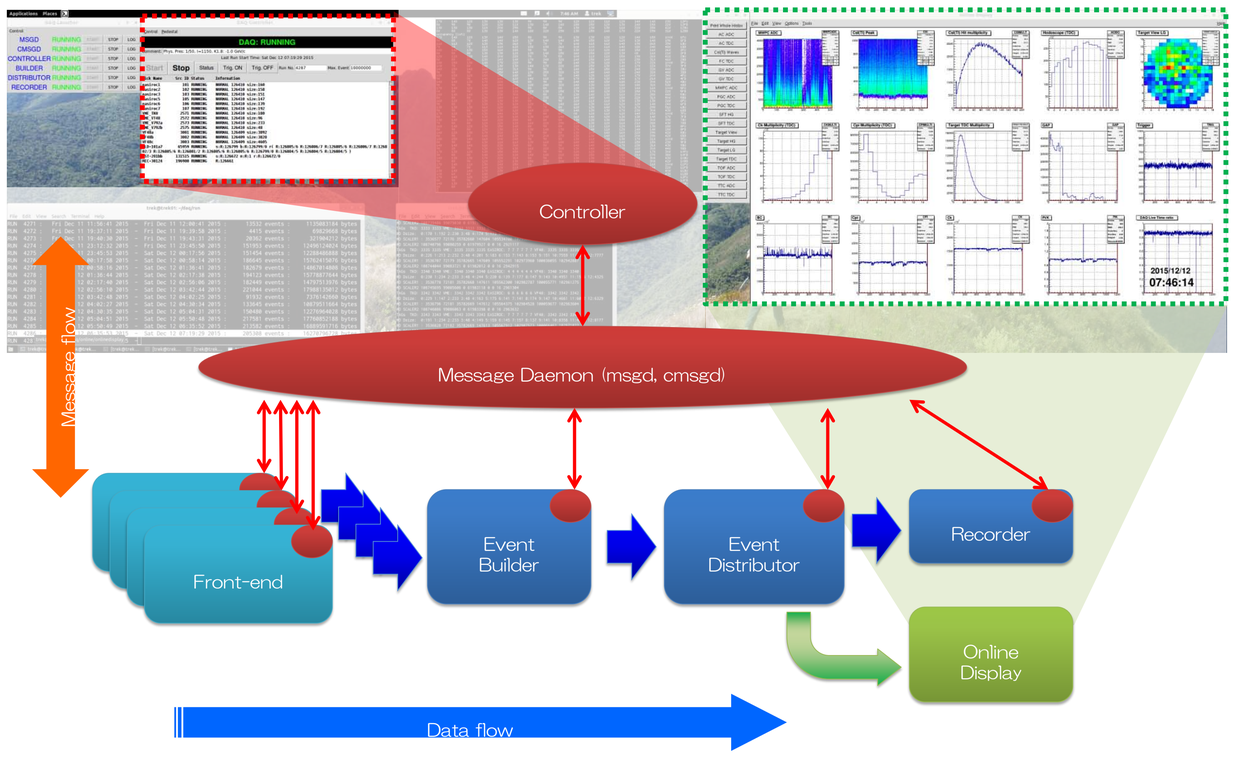
Analog Encoding
- VF48 has no interface for the EVENT TAG
- Making a signal which includes EVENT TAG information using FPGA and DAC
- VME-RM + DAC mezzanine card





Network based DAQ software

The DAQ works cooperatively with many simple single function processes.



Performance

	Number of readout channel	Typical Data size (Bytes)	Dead time (μs)
TKO	256	800	400
VME ADC Crate	288	928	200
VME TDC Crate	384 (multi-hit)	860	200
VME FADC Crate	384	35000	20 (Pipeline readout)
EASIROC board	64	800	12 (Pipeline readout)
			Entire 400

DAQ works with 10 % dead time at 250 Hz trigger typically.

Stability (March - December, 2015)

Incident	Frequency
Event slip	A few times / week
Software crash	Almost none
FADC freeze	A few times / month