

# **Proposal for a versatile Readout for Scintillator Test Stands**

**Uli Schäfer, Rainer Wanke**

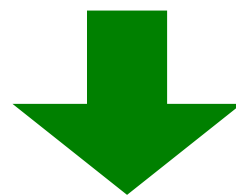
**PRISMA Photodetector Lab**  
**April 4, 2013**

# Why a Common Readout?

---

## Typical test setup:

- ❑ Scintillator/fibre/PMT/SiPM/... shall be tested for light yield, time resolution, uniformity, etc.
- ❑ Light sources may be **cosmics, LEDs, laser, or radioactive sources**.
- ❑ **Triggering** usually done by 1 or 2 trigger scintillators + light guides + PMTs (or just by e.g. the LED trigger).



***Common readout very useful for all different test setups***

(Trigger for this proposal: Test measurements for CALICE, NA62 Muon Veto, and NA62 Hodoscope)

# Requirements for a common Readout System

---

**Wish list for a common multi-purpose readout system:**

- ❑ **Charge, amplitude, and time resolution** as good as possible to be suitable for all different applications. ( $\sigma_Q \sim 0.1 \text{ pC}, \geq 10 \text{ bit ADC}, \sigma_t \ll 1 \text{ ns}$  for pulse widths of  $\mathcal{O}(10 \text{ ns})$ )
- ❑ **Discriminators, coincidence units, fan-out, amplifier, etc.** for triggers and multi-purpose use.
- ❑ **"Plug & play"** for fast and simple use.
- ❑ **Software** should be reusable, but also easy to expand for non-experts.
- ❑ **Mobility** for use of different test stands.



# Requirements for a common Readout System

VME

Pulse width  $\sim 10\text{ ns}$

Crate + PS

Time resolution:  $\sim 0.1-0.2\text{ ns}$

Charge: QDC / FADC  $\sigma_Q \sim 0.1\text{ pC}$

$\hookrightarrow$  FADC sampling rate  $\geq 1\text{ GHz}$

Timing: TDC / FADC  $\sigma_t \ll 1\text{ ns}$

Channels: 8-10

Amplitude: ADC / FADC  $\geq 12\text{ bits}$

Frequency: Scalor

FADC + QDC / TDC / ADC

Discriminators / Coincidence

Analog Fan-Out, Amplifier

Pulse Generator, Timer

NIM or controlled by VME

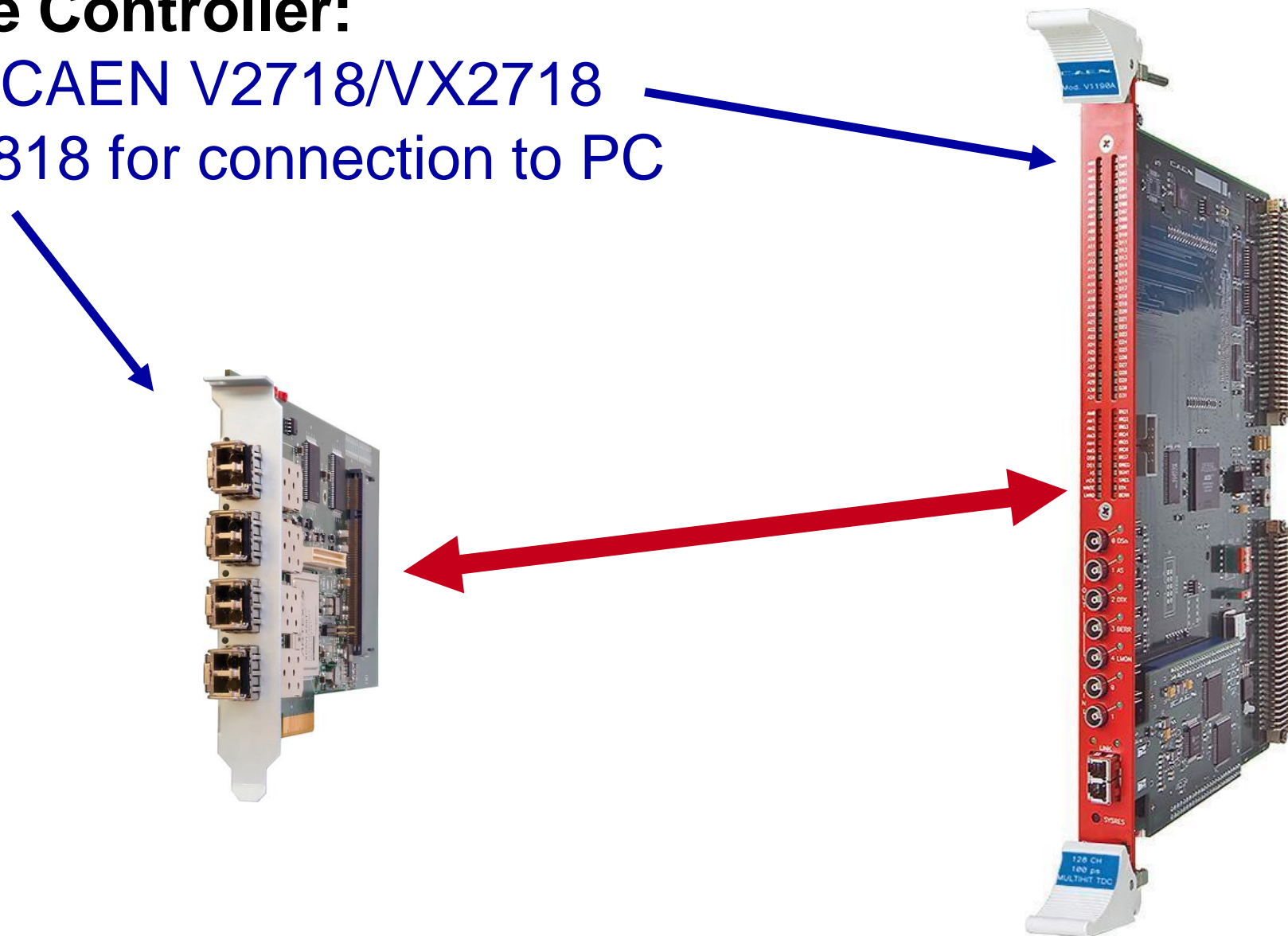
VME CPU

Cables



# Modules

- ❑ **One common VME crate**, controlled by a **CPU** or similar with (possibly) a **multi-channel FADC** or digitizer and **other modules** for amplification, discrimination, coincidence, etc.
- ❑ **Crate Controller:**  
e.g.: **CAEN V2718/VX2718**  
+ **A3818** for connection to PC



# Modules

## □ FADC/ADC:

e.g.: Struck SIS 3305 10-bit FADC or CAEN V1742 digitizer



- Single width 6U VME card
- 2/4/8 channels
- 5 GS/s/2.5 GS/s/1.25 GS/s per channel
- 512/256/128 MSamples/channel memory
- 2 GHz bandwidth
- Internal/External clock
- readout in parallel to acquisition
- Multi event mode
- Sparsification
- Pre/Post trigger capability
- Trigger or output (4 individual thresholds)
- A32/D32/BLT32/MBLT64/2eVME/SST
- 1/2/4 GBit/s optical link option
- In field JTAG and VME firmware upgrade capability

(also in use by Xenon group)



- 32+2 channel
- 12 bit: Selectable 5, 2.5, 1 GS/s Switched Capacitor ADC
- 1 Vpp input dynamics, single ended, 50 Ohm, MCX coaxial connectors
- Based on DR54 chip (Paul Scherrer Institute design)
- 1024 storage cells per channel (200 ns recorded time per event @ 50 Samples)
- Trigger Time stamps
- Memory buffer: 128 events/ch (optional: 1024 events/ch)
- Dead Time: 110µs Analog inputs only, 181µs Analog inputs + TR0, TR1 inputs
- Possibility of FPGA for real-time data processing (for example Zero Suppression and Data Reduction algorithms)
- VME64X-compliant and Optical Link interfaces
- PCI controller available for handling up to 8 Modules daisy chained via Optical Link
- Firmware upgradable via VME/Optical Link
- Libraries (C and LabView), Demos and Software tools for Windows and Linux

# Very rough Cost Estimate

---

- ❑ VME 64x standard Crate: 7 k€
- ❑ VME master module/CPU: 5 k€
- ❑ 10-bit FADC or equivalent: 14 k€
- In total: ~ 26 k€

Other VME-controlled modules  
(trigger logic, discriminator, ...): ~ 2 – 3 k€ each

Decision on specific modules to be taken after  
discussion with all participating groups  
(and solid offers, of course).

# ... extend for upcoming R&D

- Large scale experiments (most CERN experiments including ATLAS) moving on to xTCA shelf architecture
  - First ATCA based R&D projects imminent
- ➔ Complement the “classic” VME based systems by ATCA equipment

**ATCA shelf** incl. shelf manager and power supplies ~ **10k€**





# Further needs (general use)

---

For any kind of lab we require

- Oscilloscope (1.5GHz + probes) **20 k€**
- Pulse generator **~5 k€**
- Meters... **k€**
- ...