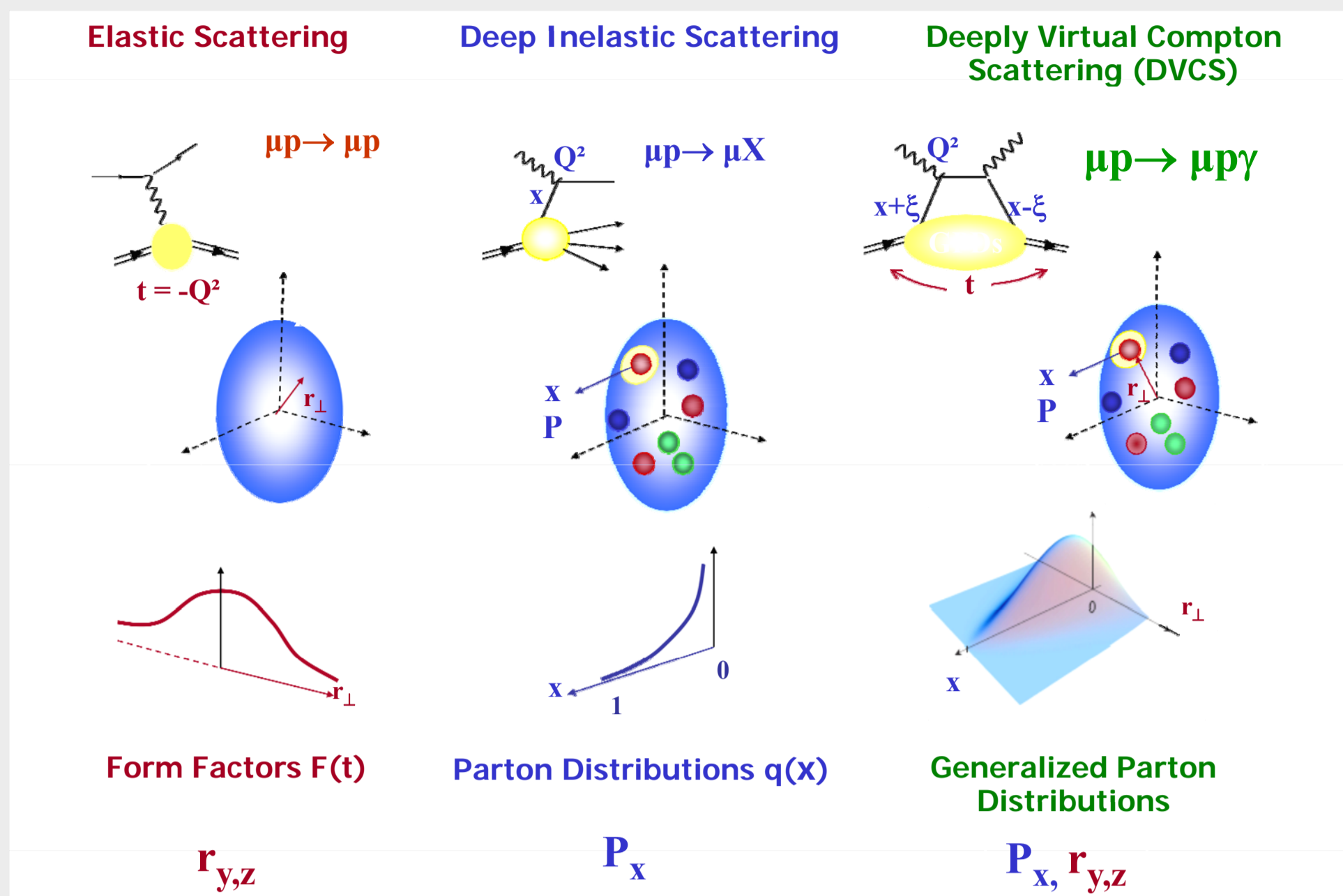


# Development of a 1 GS/s High-Resolution Sampling ADC System

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## The COMPASS Experiment @ CERN

### Generalized Parton Distributions



2.5 m Liquid H<sub>2</sub> target  
 $(L = 1.3 \cdot 10^{32} \text{ cm}^{-2} \text{ s}^{-1})$   
 - to be designed and built

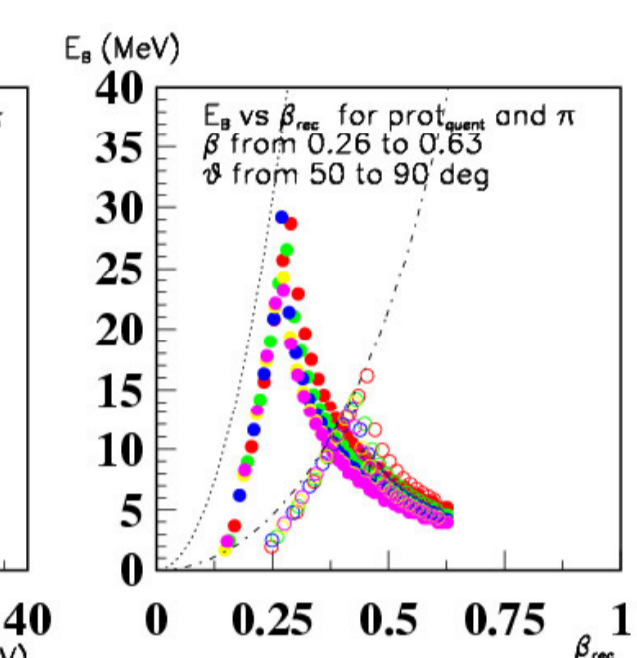
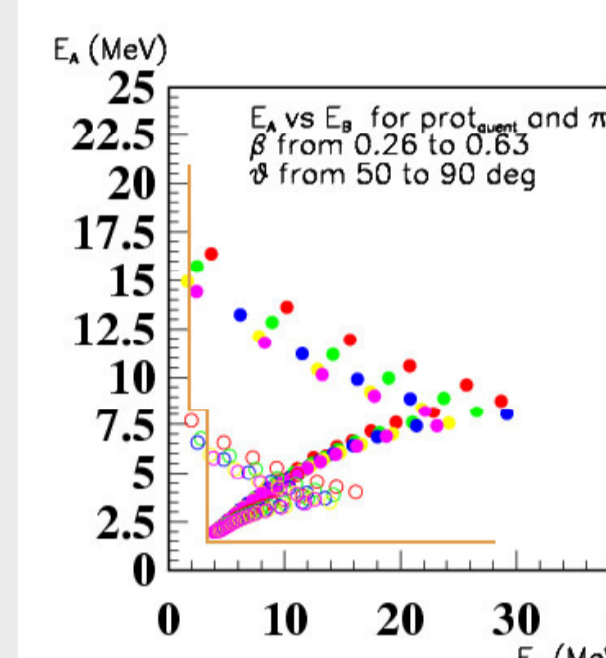
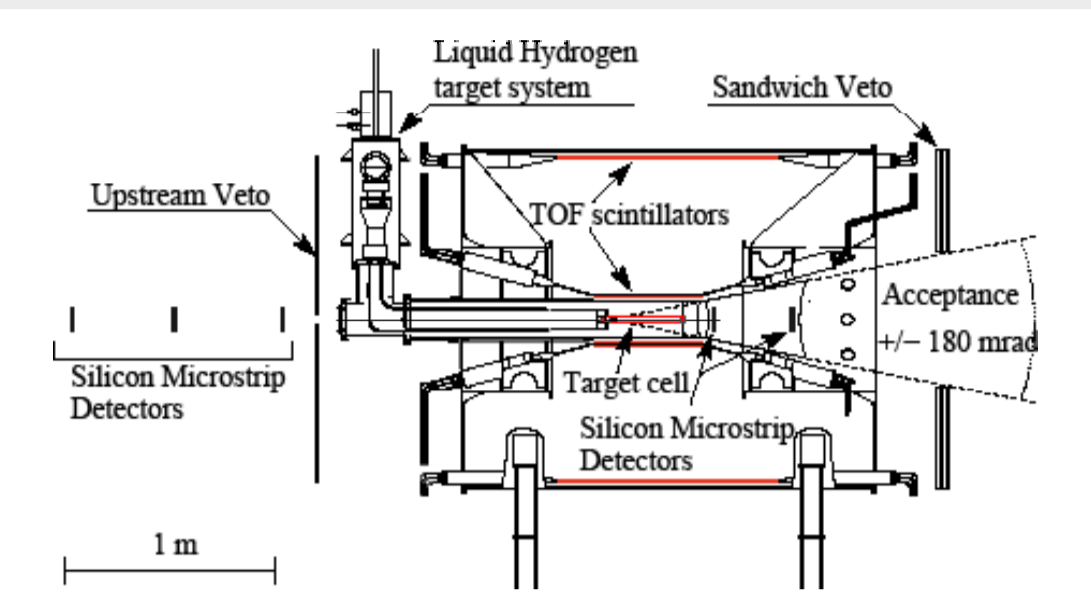
Beam:  
 Energy: 100 GeV  
 Intensity:  $2 \cdot 10^{10}/\text{spill}$   
 Polarization:  $P(\mu^-) = +0.8$   
 $P(\mu^+) = -0.8$

Additional calorimetry  
 at large angle ( $\pi^0$  bkg)

Recoil detector to ensure exclusivity  
 - to be designed and built

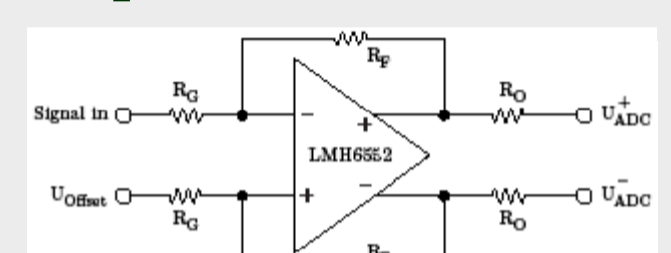
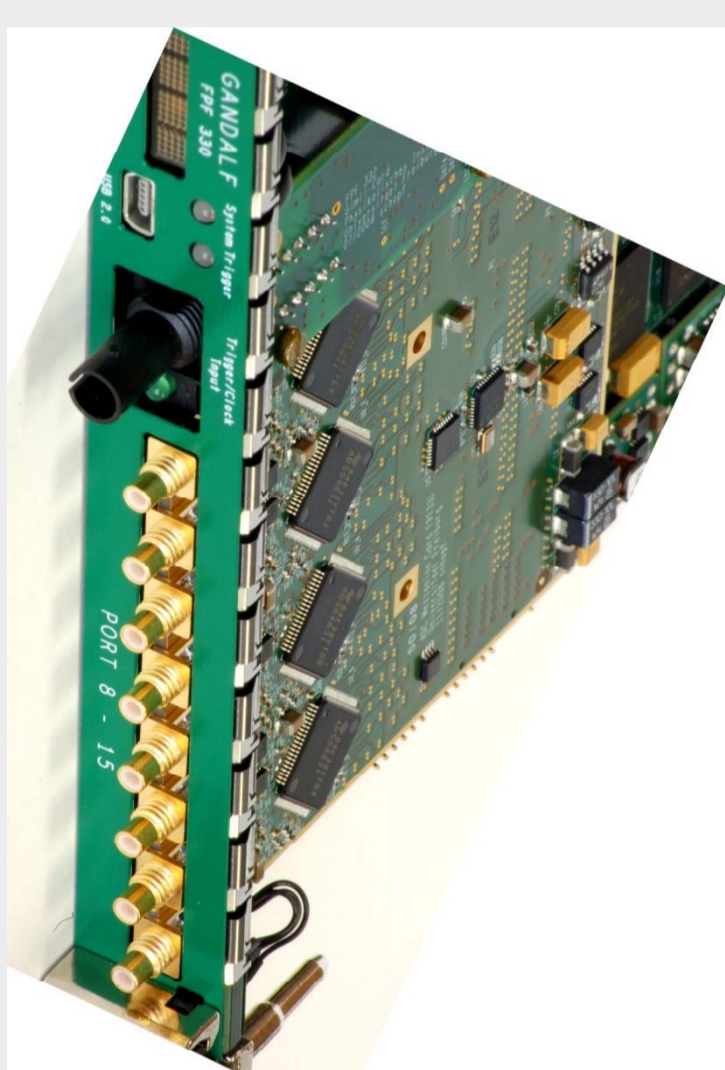
### Recoil-Proton Detector

Used for  
 - particle identification  
 - charged veto  
 - trigger decisions

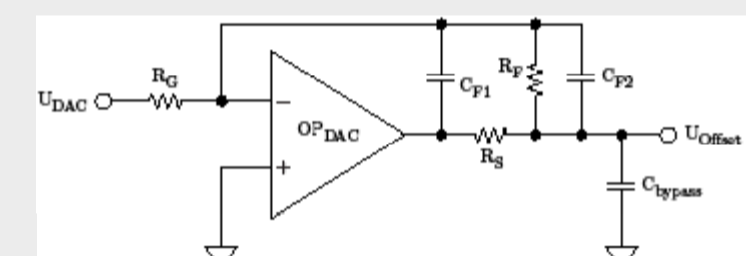


Make use of correlation  
 between amplitudes  
 and time-of-flight of  
 two rings of scintillation  
 counters

## Analog Input

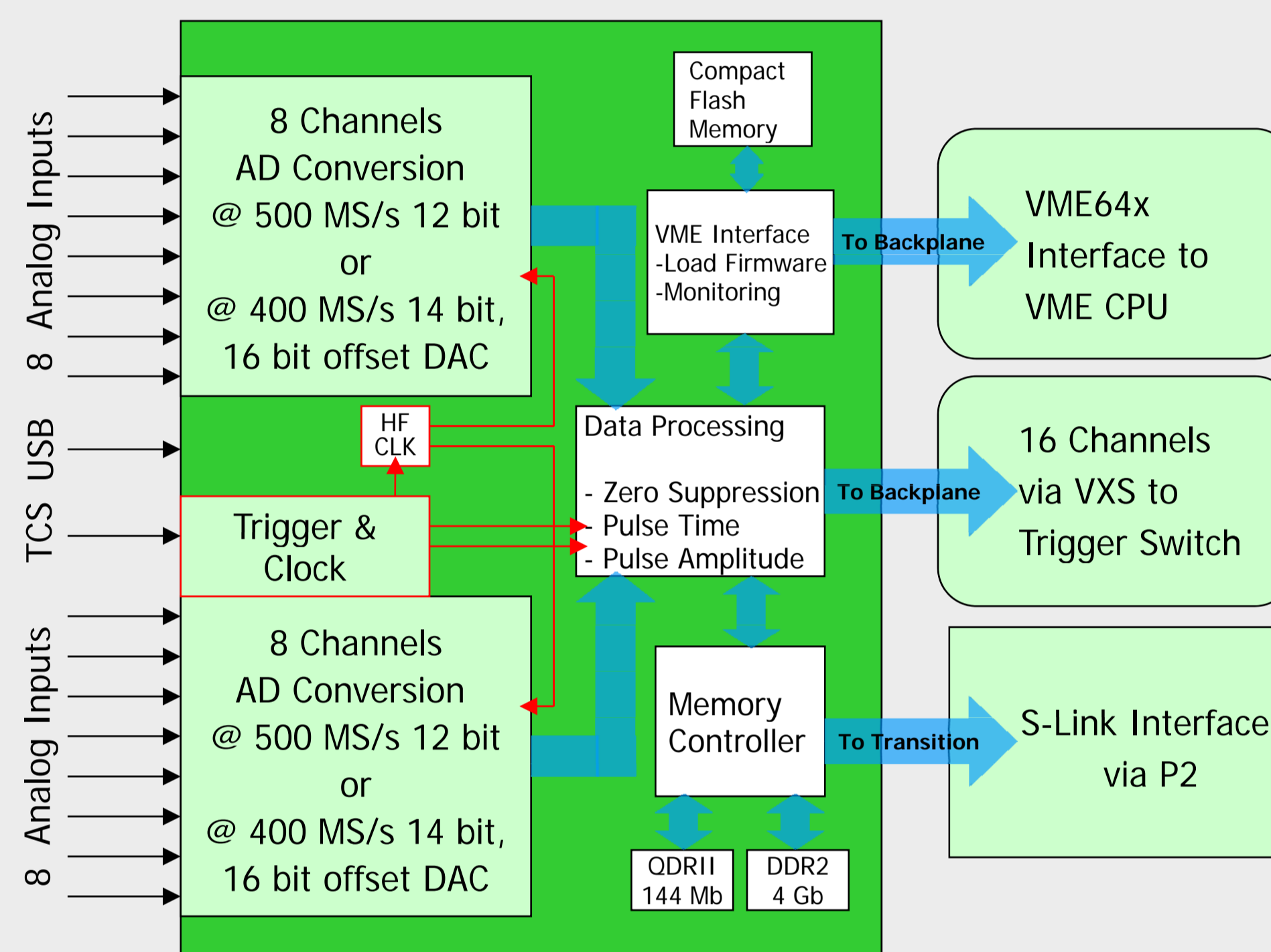


- Single ended DC-coupled inputs
- Input impedance 50  $\Omega$
- Dynamic range 4 V
- Bandwidth 500 MHz



- 0...2 V programmable baseline offset with 16 bit DAC

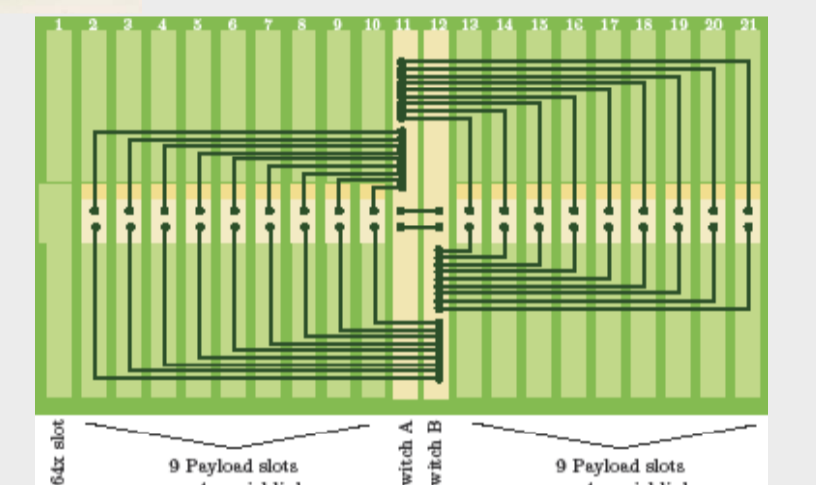
## The GANDALF Readout System



### Backplane I/O



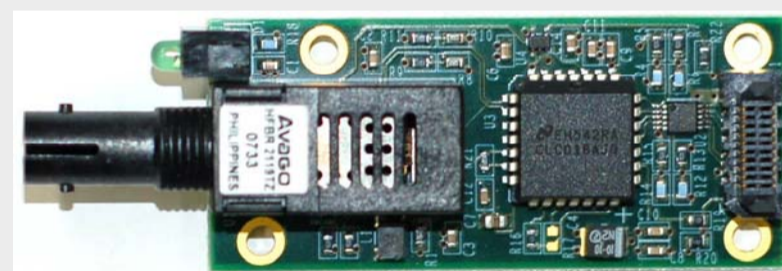
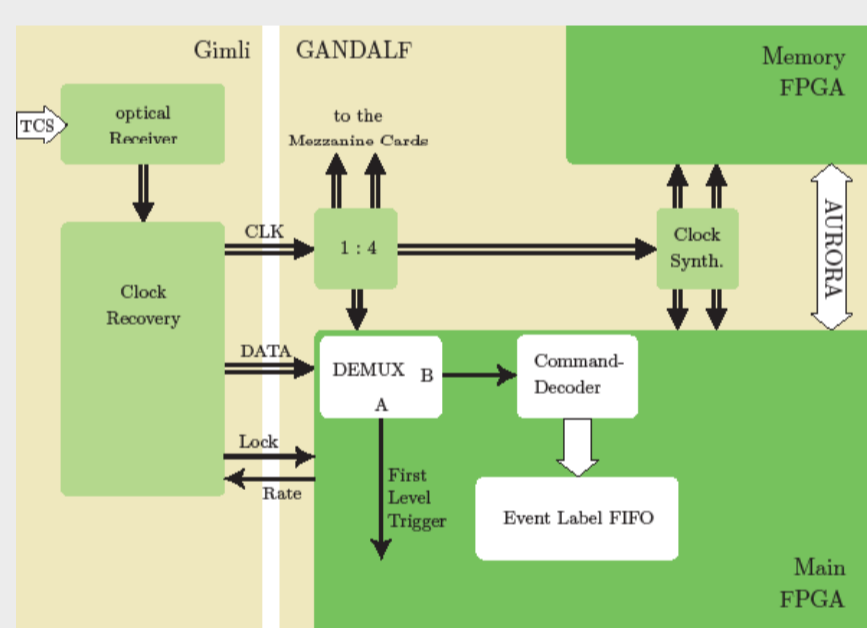
- VME64x
- Configuration
- Monitoring



- VXs
- 16 high speed connections to trigger electronics

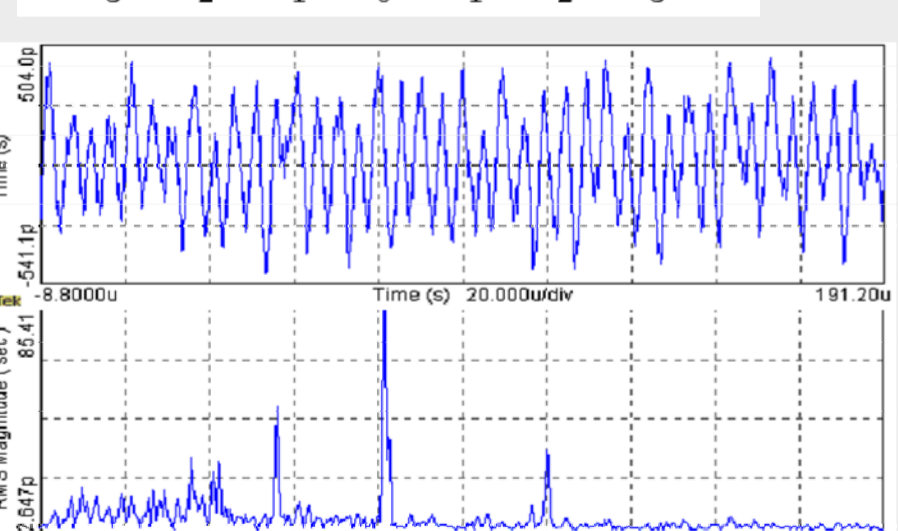
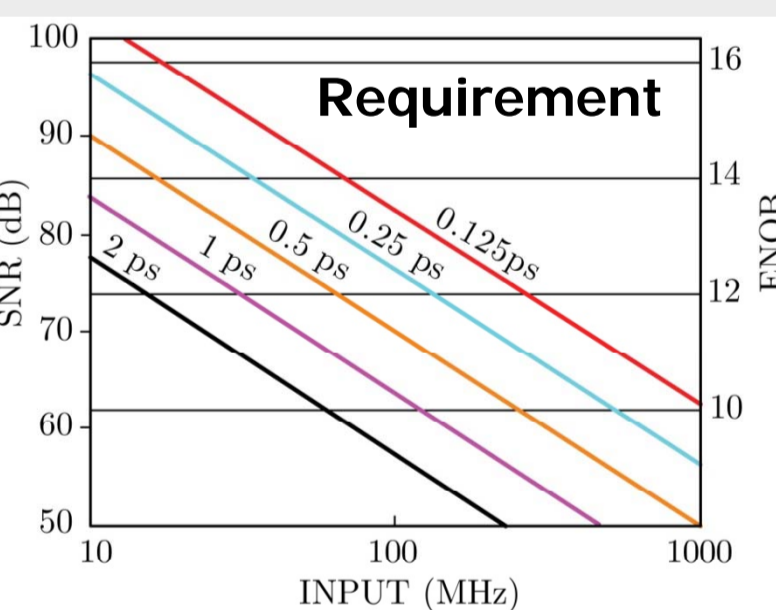
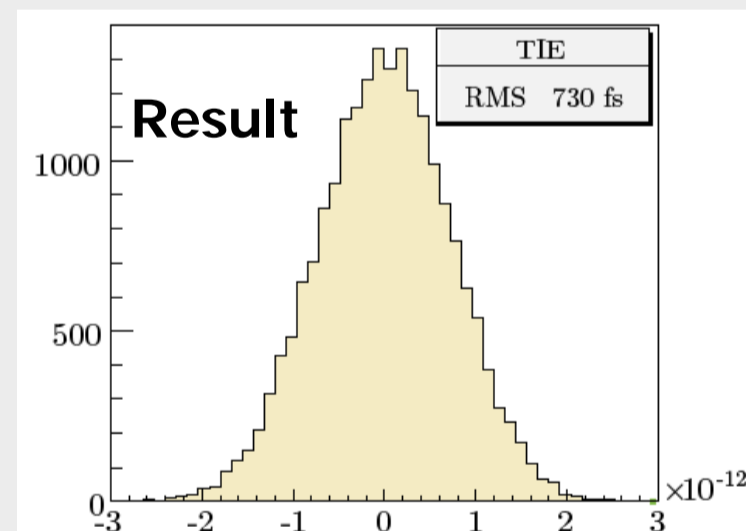
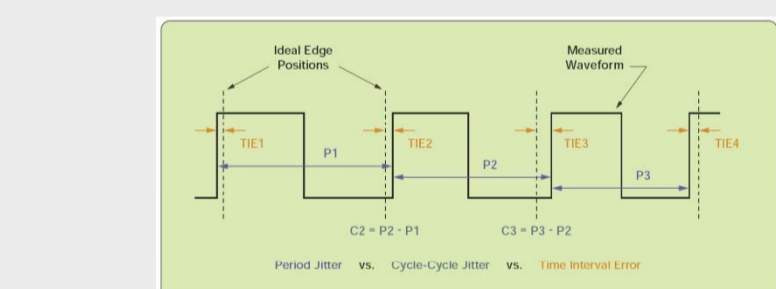
- Data I/O optional via
- S-Link
- Ethernet
- VME64x (640 Mbit/s block r/w)
- USB 2.0

## Experiment Clock & Trigger



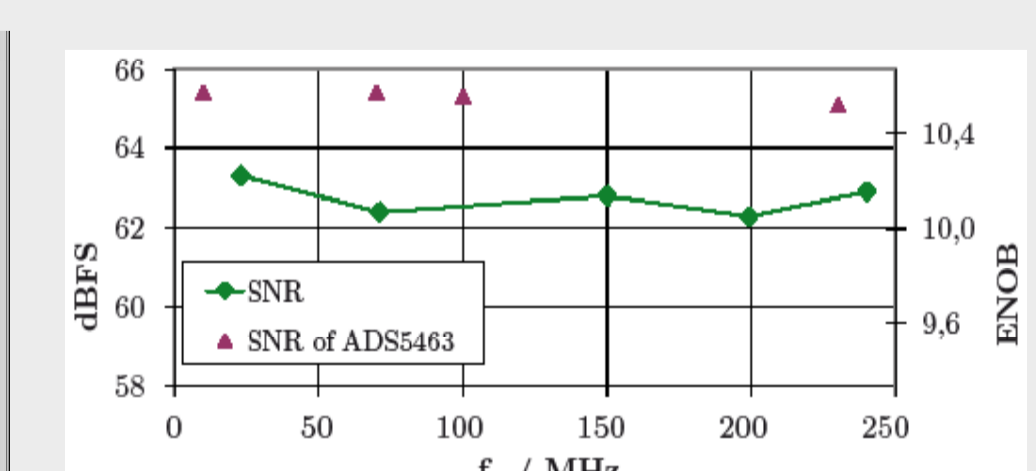
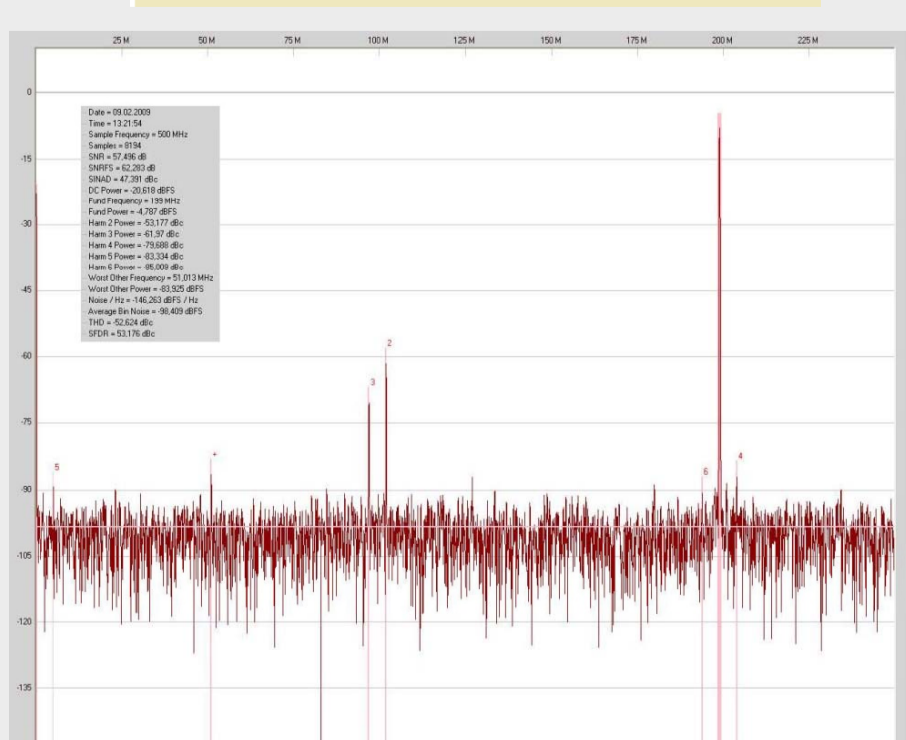
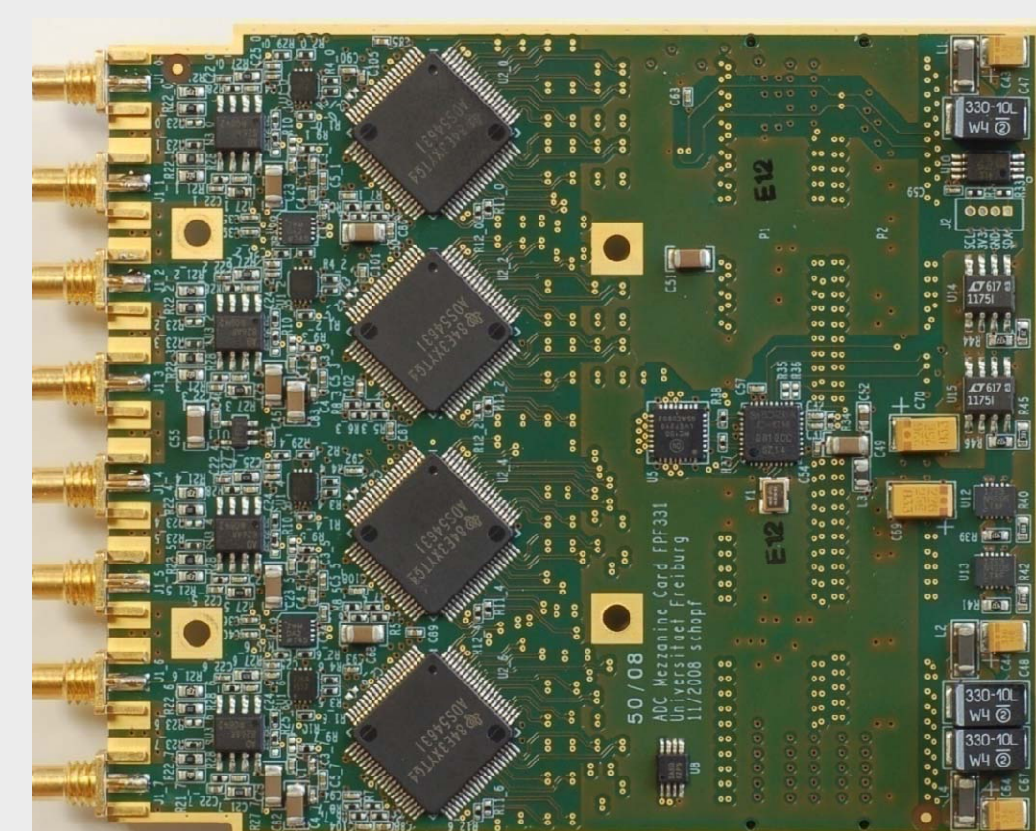
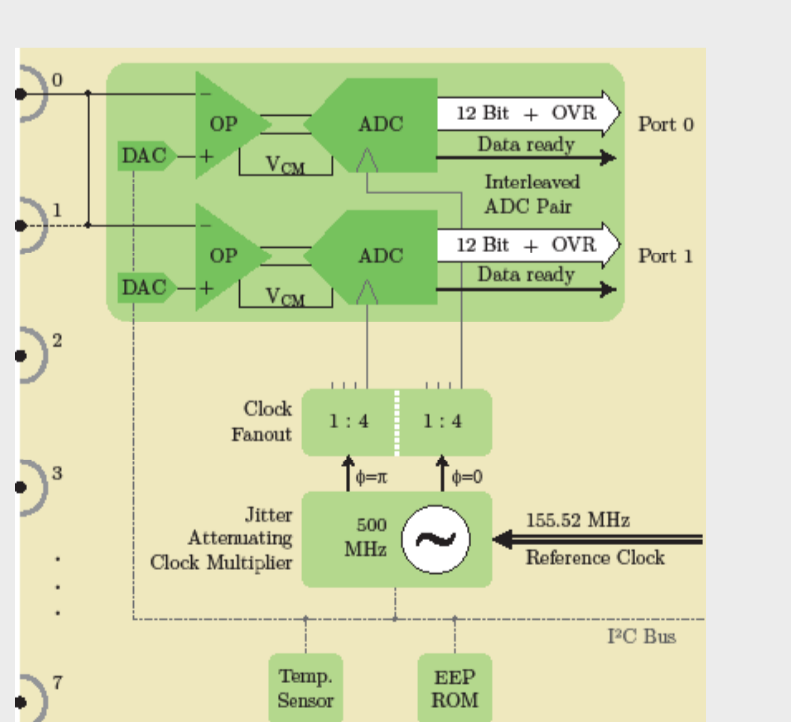
- Experiment clock
- Synchronization of front-ends
- Trigger distribution

Time interval error:



## ADC Mezzanine Card

- 12 or 14 Bit digitization
- 8 channels 1 GS/s (interleaved)
- 16 channels 500 MS/s



Digitization error as function of analog input frequency

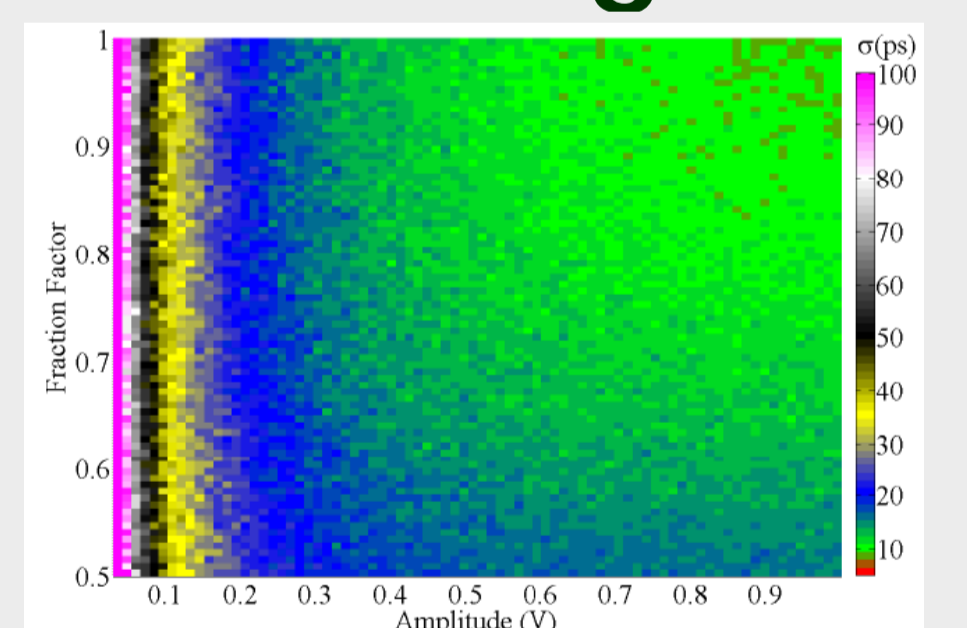


- The GANDALF Readout System – a versatile and highly cost efficient digitization tool for nuclear, particle and atomic physics experiments

- System applications as:
  - self-triggered high-resolution sampling ADC
  - 128 ch TDC (100 ps)
  - 128 ch Scaler (250 MHz)
  - 128 ch Trigger Matrix Board

## Data Processing

Time resolution as function of pulse amplitude and constant fraction:



- Online zero suppression
- Pulse analysis
- Pulse time
- Pulse amplitude
- Disentangle Pile-up pulses

Time resolution as function of pulse amplitude:

