SAMBA: General Purpose DAQ System

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Introduction

SAMBA is a general purpose, scalable, user-configurable Data Acquisition System that has been used for Edelweiss, NEWS-G and others

It was originally written and designed by Michel Gros in 2005 with an emphasis on flexibility

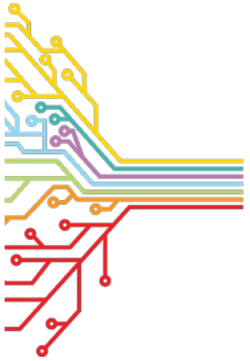
It includes the following general features:

- Multiple, user-defined detectors with multiple channels for each
- Multiple ADC/DAC of various types
- Completely configurable setup of an experiment
- Slow Control integration
- Continuous data recording or triggering and event reconstruction
- Live, user configurable plotting including histograms, FFT and trigger display
- Scalable to multiple DAQ machines

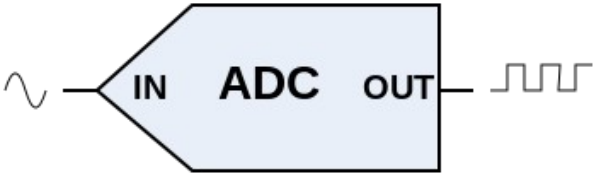
Typical Experimental Setup

Detector

Readout Electronics



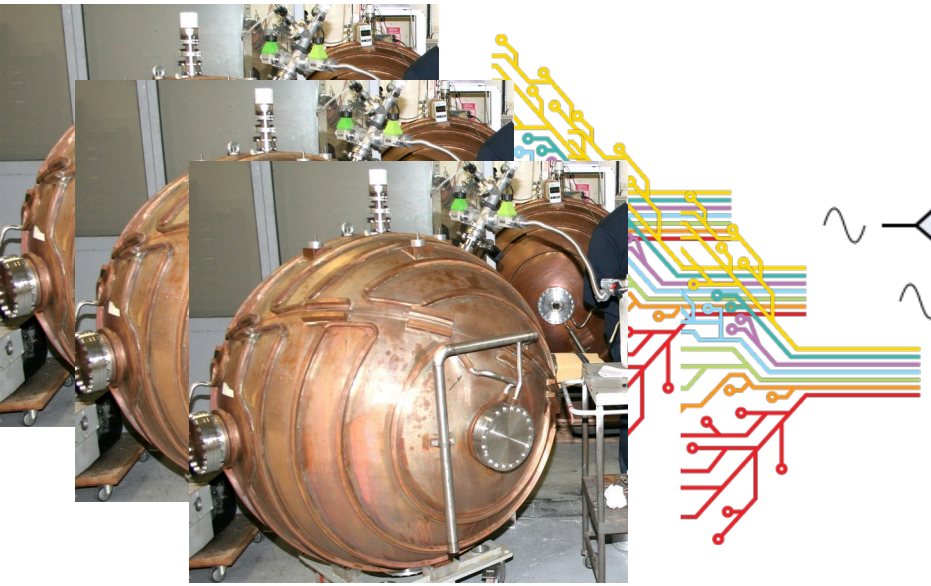
Analog to Digital Converters

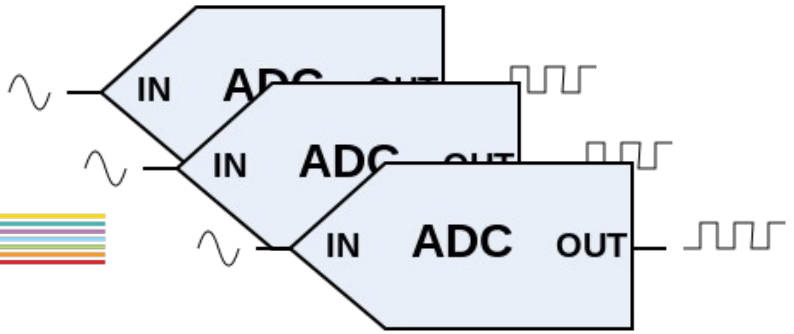


Signal Processing

Typical Experimental Setup

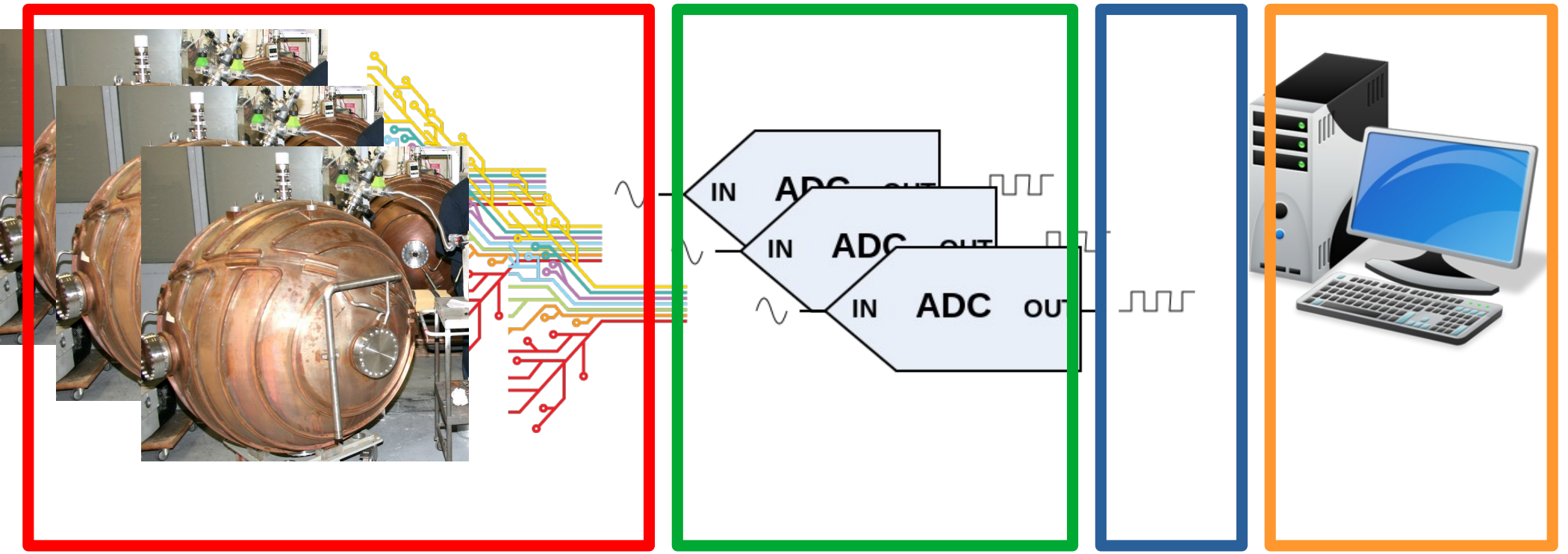
Detectors | Readout Electronics | Analog to Digital Converters | Signal Processing





A SAMBA Model

Detectors | Readout Electronics | Analog to Digital Converters | Signal Processing



Detectors ***Digitisers*** ***Dispatchers*** ***Acquisition***

Configuring SAMBA

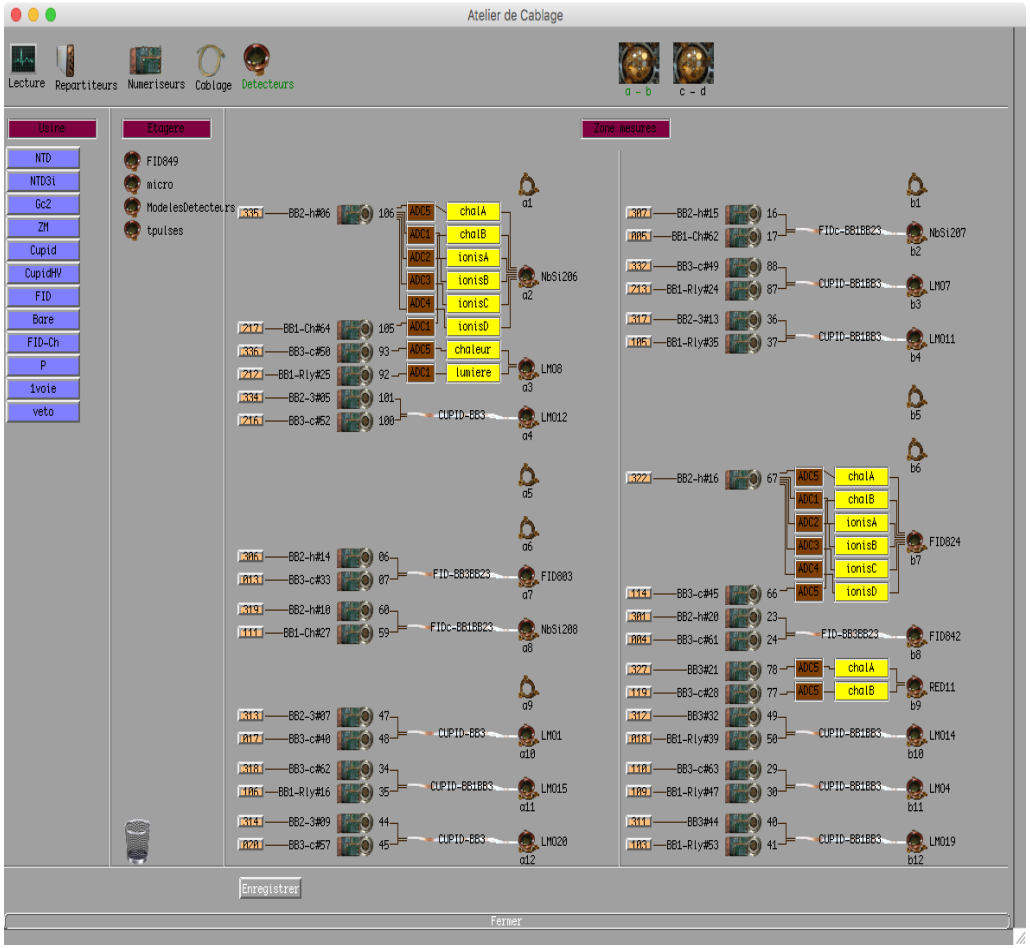
A SAMBA Configuration (or Model) for a particular experiment describes the following:

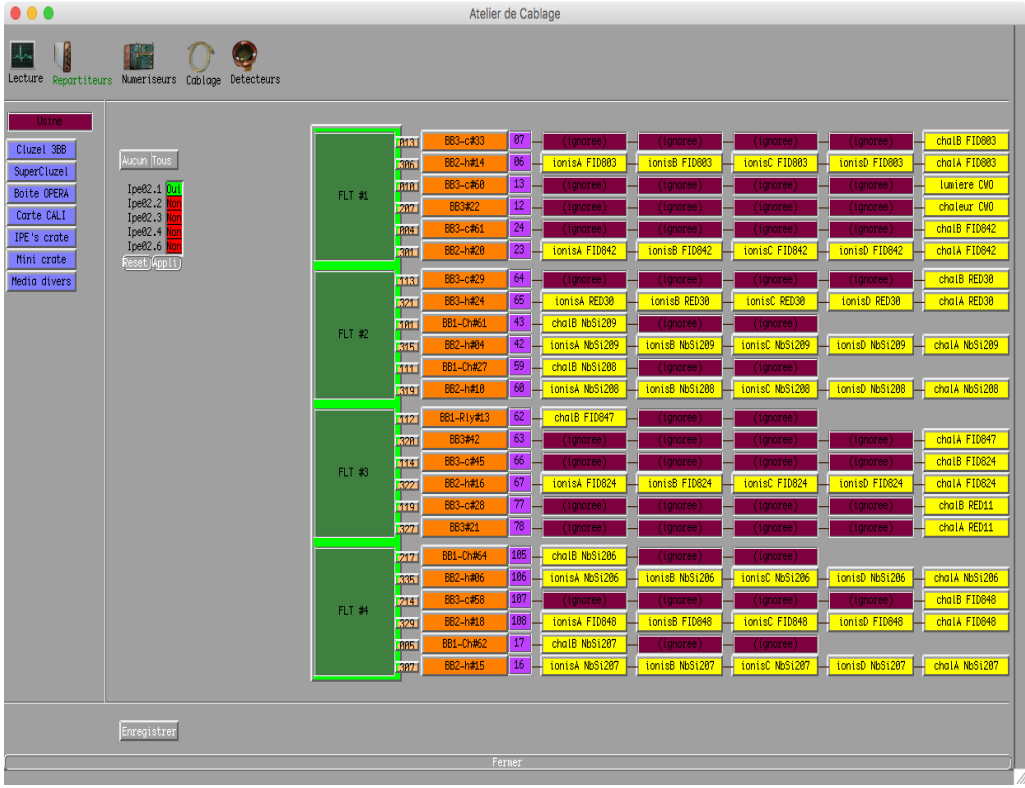
- Detectors
- Digitisers of output signals with appropriate parameters
- Interfaces (dispatchers) that tell SAMBA how to do I/O with the hardware
- Slow Control commands linked to this
- Channels for each of the above
- Signal processing chains (triggering, smoothing, filtering, etc.)
- Plots for Monitoring
- Data Storage

Thanks to the modular design, any unsupported hardware elements such as Dispatchers, etc. can be easily added in

Configurations are stored in human-readable JSON-style formats or can be viewed and edited through the GUI

EDELWEISS Setup





Taking Data

Data coming from channels can be split/combined as required and can be recorded either as a stream or as a series of events and processed using a number of ready-to-use algorithms included with SAMBA

Stream-based algorithms include:

- Filtering (butterworth, chebyshev, elliptic)
- Smoothing
- Demodulation
- Mean value

Methods for triggering include

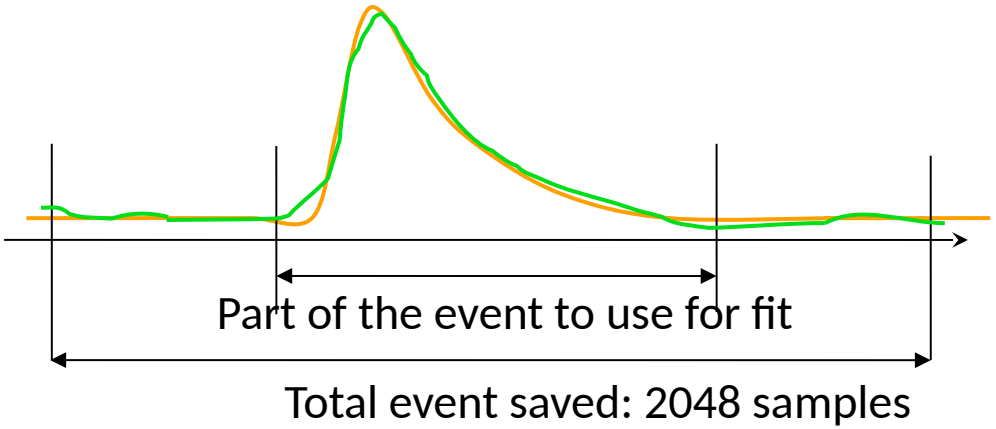
- Threshold
- Amplitude+rise time
- Derivative
- Random

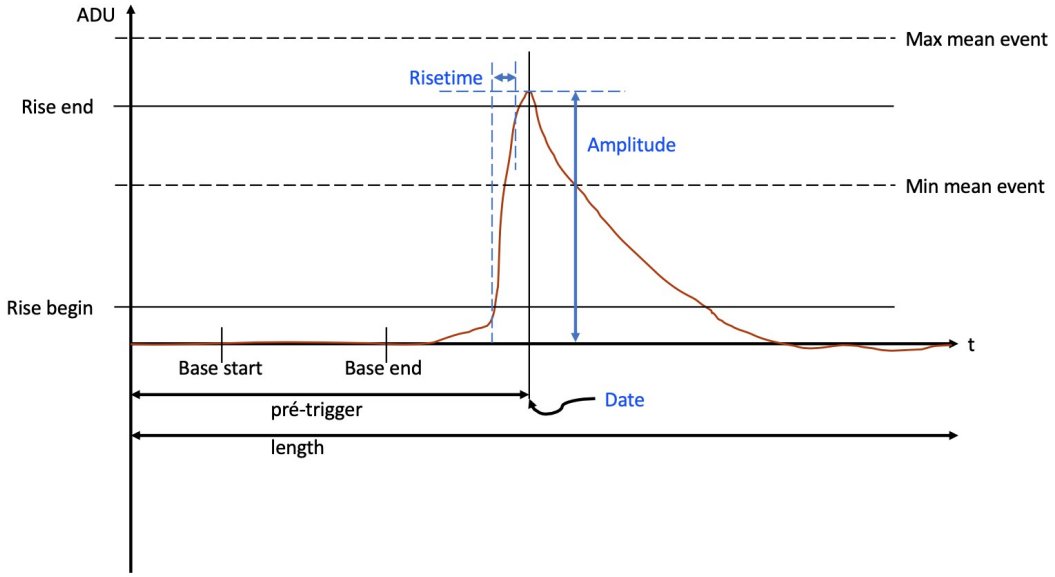
Processing, Events and Storage are all user-defined by channel

Event Definition

An adaptive trigger is used for event based recording

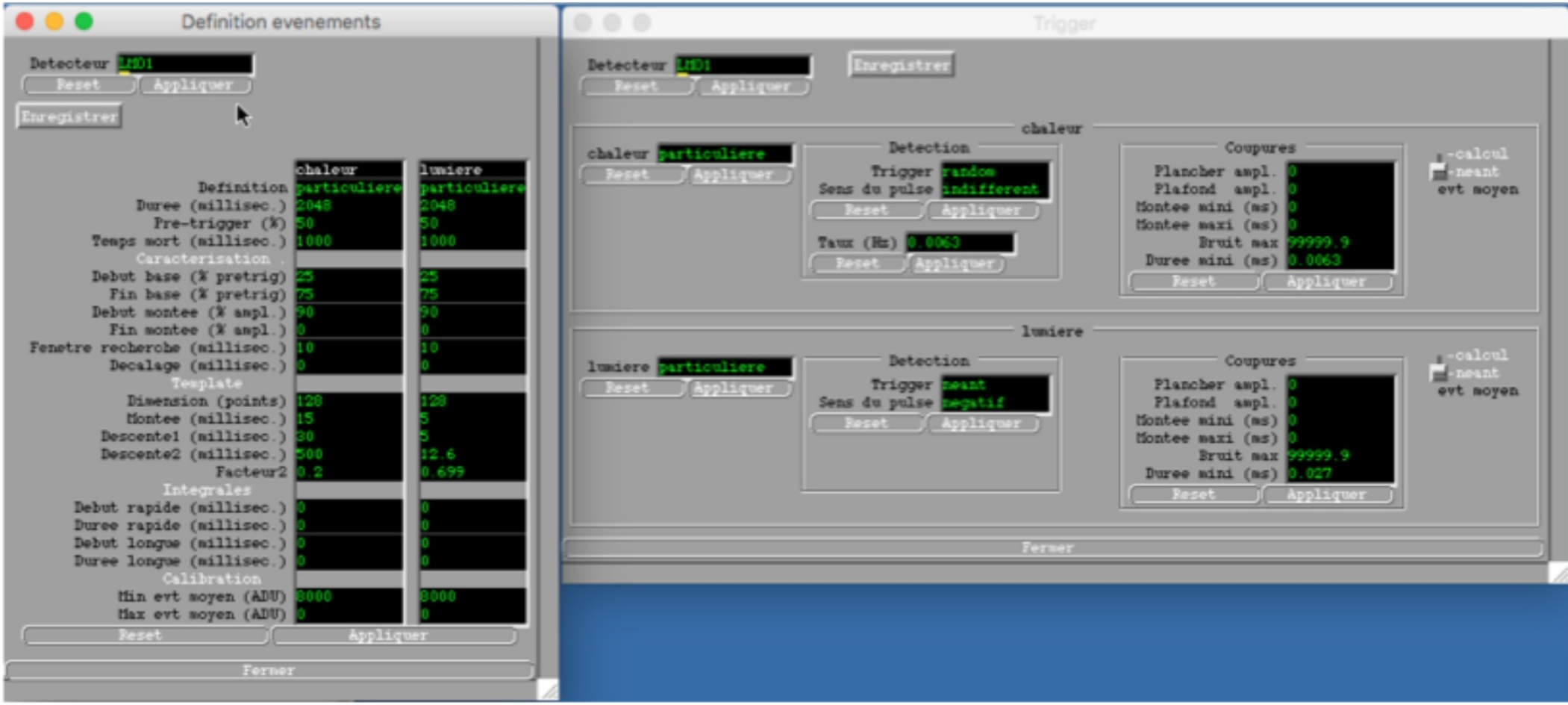
A fit to a pulse shape (either analytic or tabular) is then used to define the properties of the event





After the fit has been done, further triggering and filtering can be applied on the fitted values

Event Definition via GUI



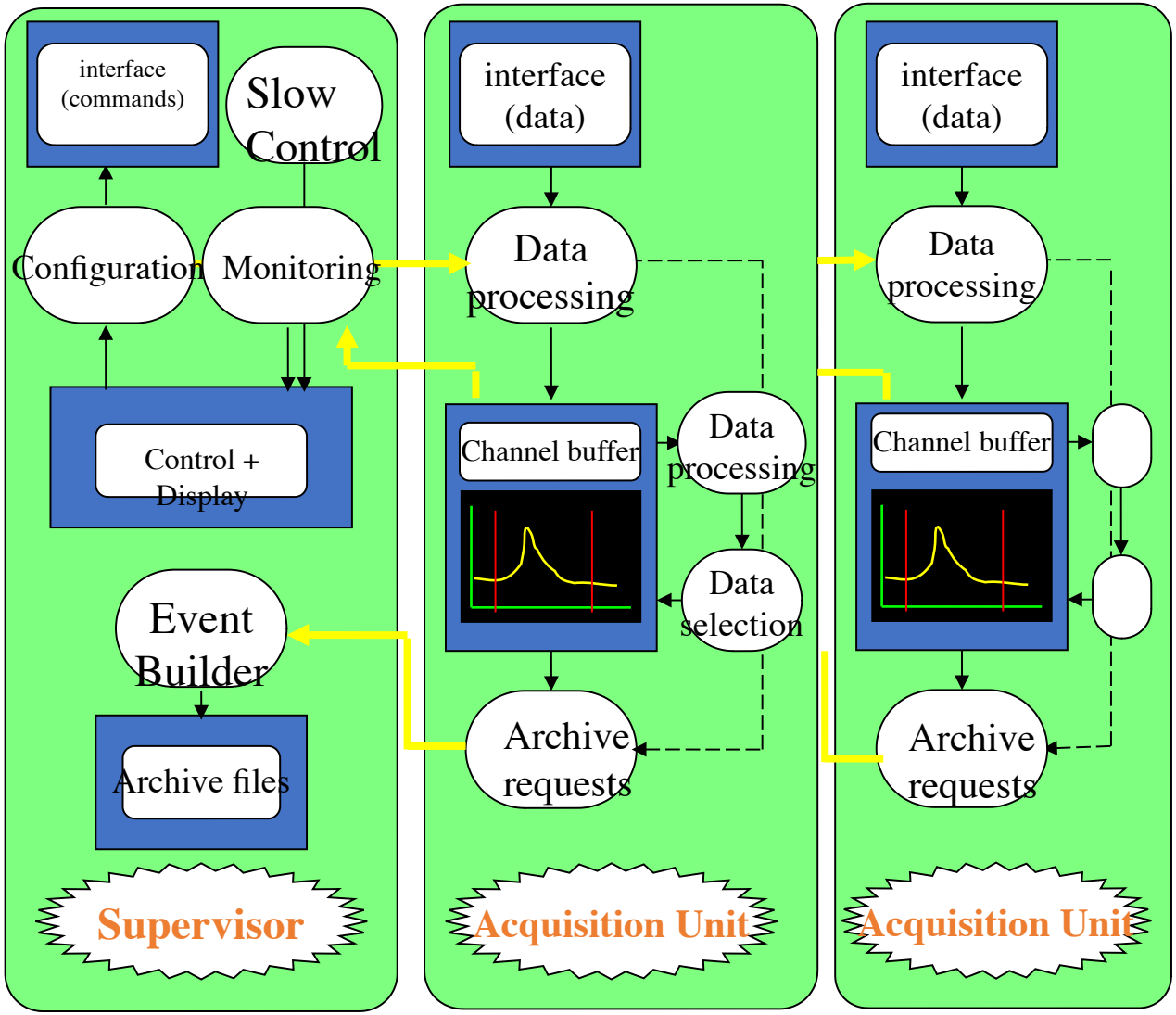
Typical Data Taking

Oscilloscope

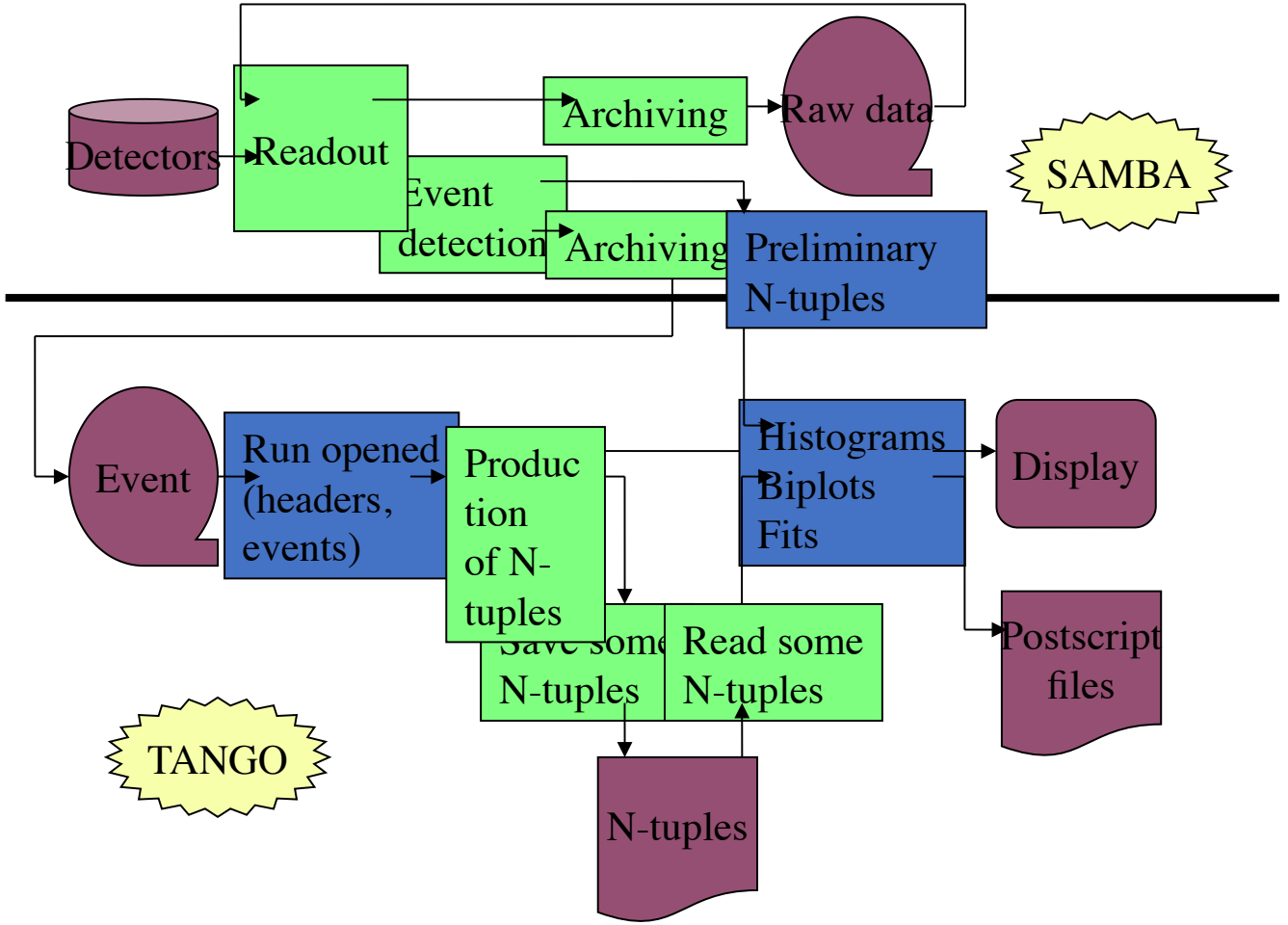
To aid with debugging, a live oscilloscope function is provided so you can monitor the channel inputs that SAMBA is seeing. In addition, you can check event triggering and definitions as well

Scaling Up….

For particularly large experimental setups, the SAMBA DAQ system can be split across multiple machines



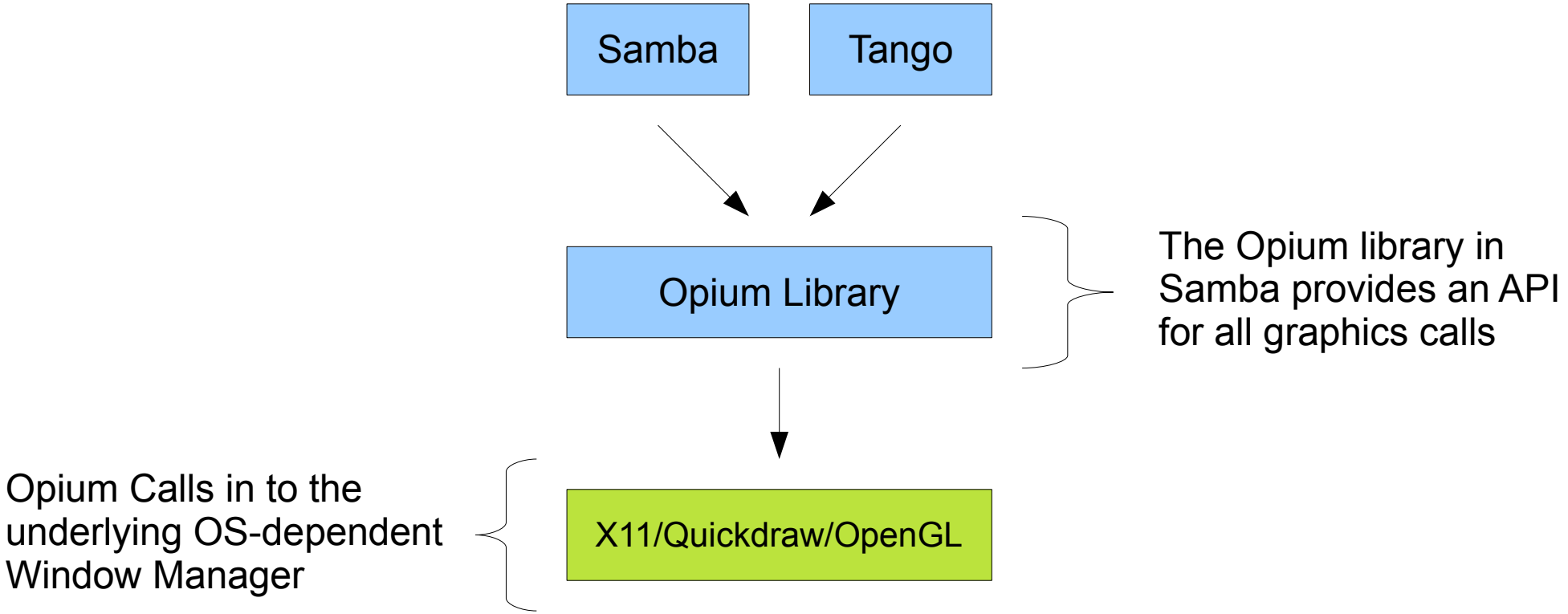
In addition to the DAQ part of SAMBA, there is also a data analysis part based on the same code base to aid with fast turnaround post-processing and Data quality checks



Modernisation of the GUI

In the last 6-12 months, we at Birmingham started helping with ongoing SAMBA development, the main focus of which has been the GUI

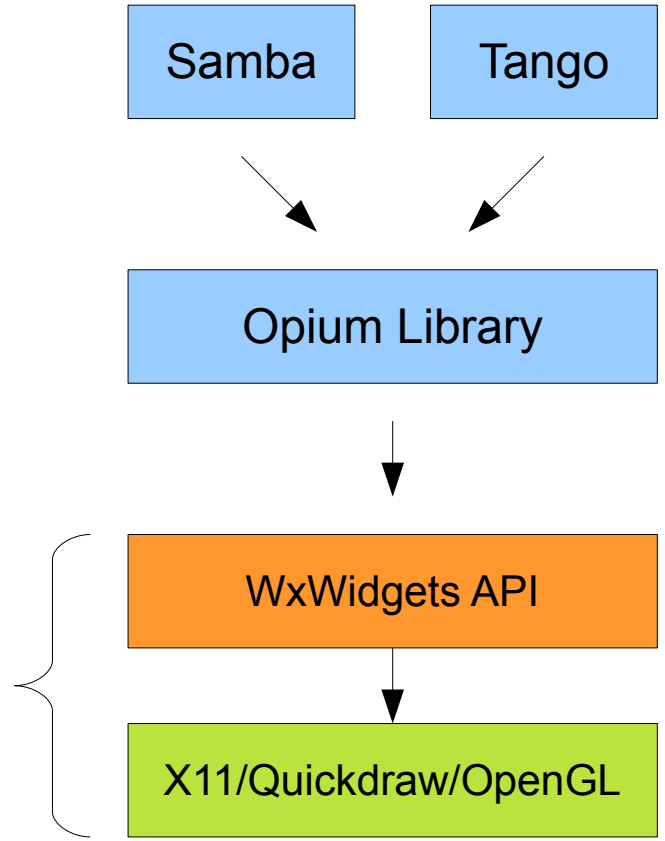
The GUI has become increasingly difficult to support due to platform and WM dependant code being all that was available when the code was initially designed



Cross Platform Graphics

Switching the GUI elements to a cross platform library (wxWidgets in our case) means that SAMBA is now somewhat insulated from changes to the underlying OS and libraries

This also had the added benefit of allowing it to be compiled and run on Linux (rather than just Apple) and possibly even Windows in the future



The Opium library in Samba provides an API for all graphics calls

Opium will call into WxWidgets which will then call the appropriate OS API

wxWidgets
Cross-Platform GUI Library

Future developments

SAMBA is already very feature rich. However, there are a few areas where development is ongoing:

- Better integrated Slow control using externally defined JSON packets
- Generic IP control for ADC boards
- HTTP Access and communication
- Easier distribution and configuration for new users
- Improved Documentation