

# DAQ for LC-TPC

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LCTW 2009  
Orsay, 04. 11. 2009

- ALTRO
- AFTER
- TDCs
- Muros2 for Timepix
  
- Silicon Envelope

Status up to beginning of the year

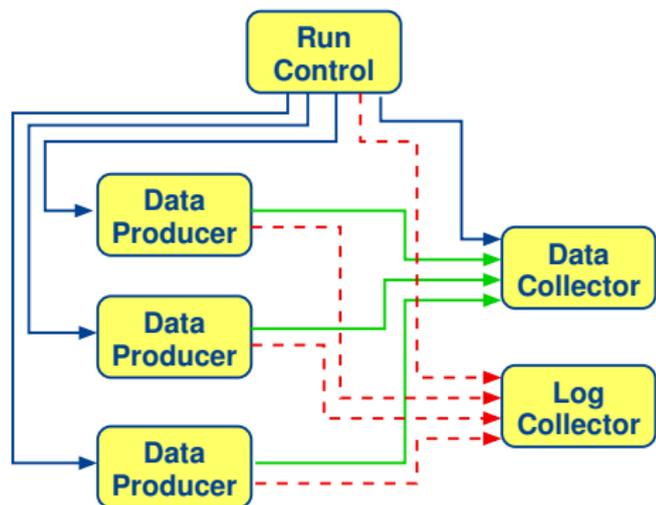
- All systems are stand alone
- Local (online) monitoring tools
- Most have local reconstruction and analysis
  
- Converters to LCIO for all data formats
- Analysis in Marlin has started on all systems

**DataProducer:** One Data Producer for each DAQ sub system

- Receives commands from Run Control
- Sends data to Data Collector
- Sends messages to Log Collector

**DataCollector:**

- Receives raw data
- Performs event building
- **New: Plugin mechanism**  
LCIO converter plugin for every raw data format
- Data collector writes common LCIO file



Command

Data

Log Message

- The producer sends raw data, not LCIO
  - Producers can run directly on the DAQ hardware (FPGA)
  - `eudaq:RawDataEvent` is a container for a raw data block, implements TPC/IP streaming
  - Data collector can also dump raw data stream for debugging
- The data collector has to know how to convert to LCIO  $\Rightarrow$  Plugin
  - Base class defines interface
  - User provides the plugin together with the producer
  - Can be loaded at run time

### Status for the TPC:

| DAQ              | Producer | Converter Plugin |
|------------------|----------|------------------|
| ALTRO for LP     | ×        | ✓                |
| ALTRO USB (Bonn) | ✓        | ✓                |
| AFTER            | ×        | ×                |
| TDCs             | ×        | ×                |
| Timepix          | ✓        | ✓                |

**Trigger Logic Unit** provides trigger signals and allows synchronisation of several components.

## Original Handshake

- Trigger and Busy lines to keep all components in sync
- Clock out the event number
- Requires LVDS connection (not so easy to implement into existing hardware)
- ALTRO: Distributor Box + special front end card
- All other components: No LVDS connector

## Simple Handshake

- Easy to implement with LEMO connectors soldered to parallel port connector
- Easy to integrate into DAQ software
- No event number from TLU

Currently: Local monitoring in the individual DAQ systems

EUDAQ: Root-Monitoring for *StandardEvent*

- Only works offline
- Only works on raw data, not LCIO
- Optimised for pixel readout (rectangular matrix)

Wish List:

- Monitor receives events (LCIO or StandardEvent) on request from data collector
- User extension for detector specific event display and histograms (plugin?)



- Integrate slow control data into run control
  - Configuration of HV for every run
  - Store trigger / beam information
  - ...

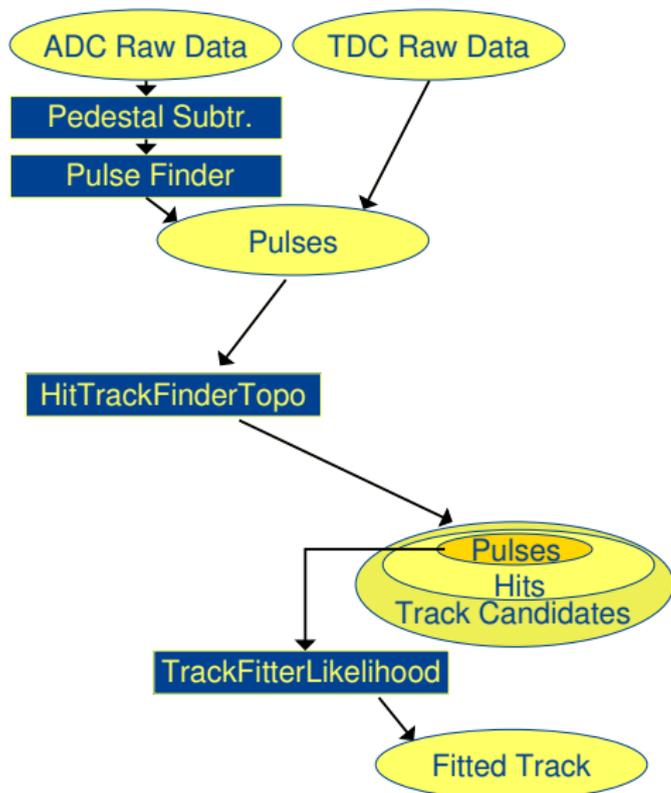
## How about a SlowControlProducer?

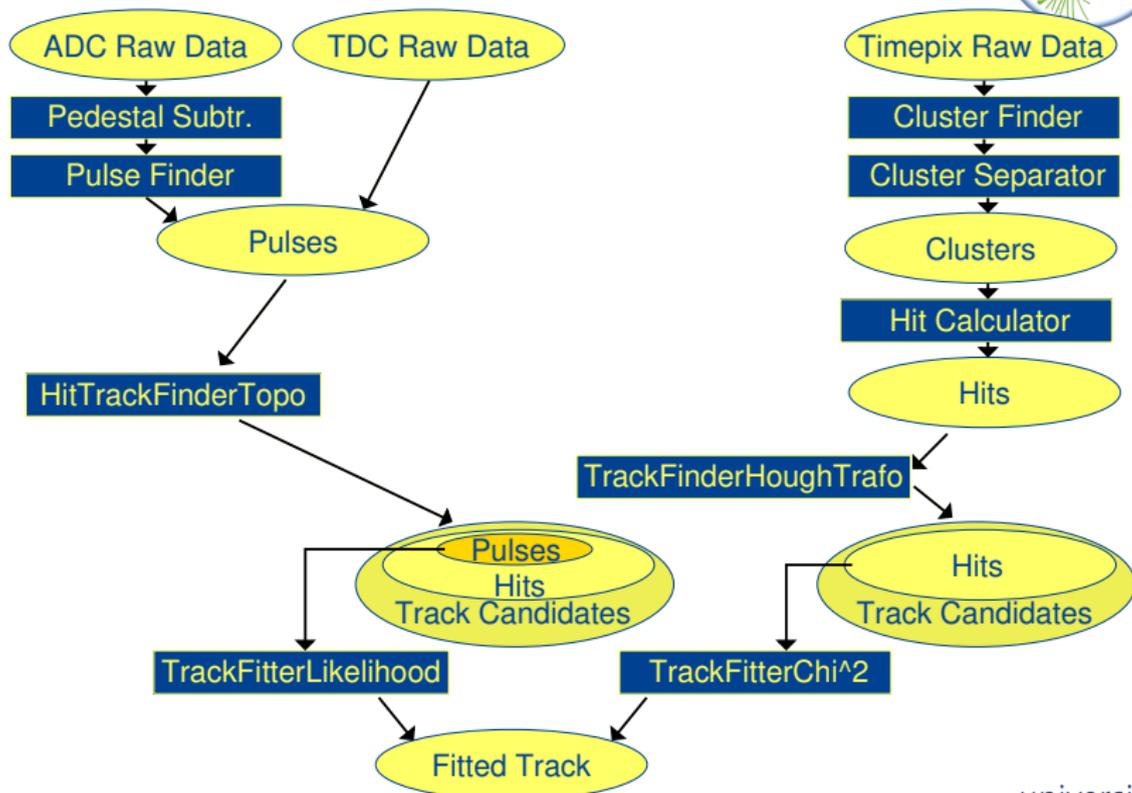
- GUI which pops up before every run
  - User actively has to acknowledge the settings
  - Easy modification of parameters, no need to edit config file
  - Everything is automatically written to run header or data base
- Script controlled running (automated taking of several runs, incl. change of slow control parameters like HV settings)

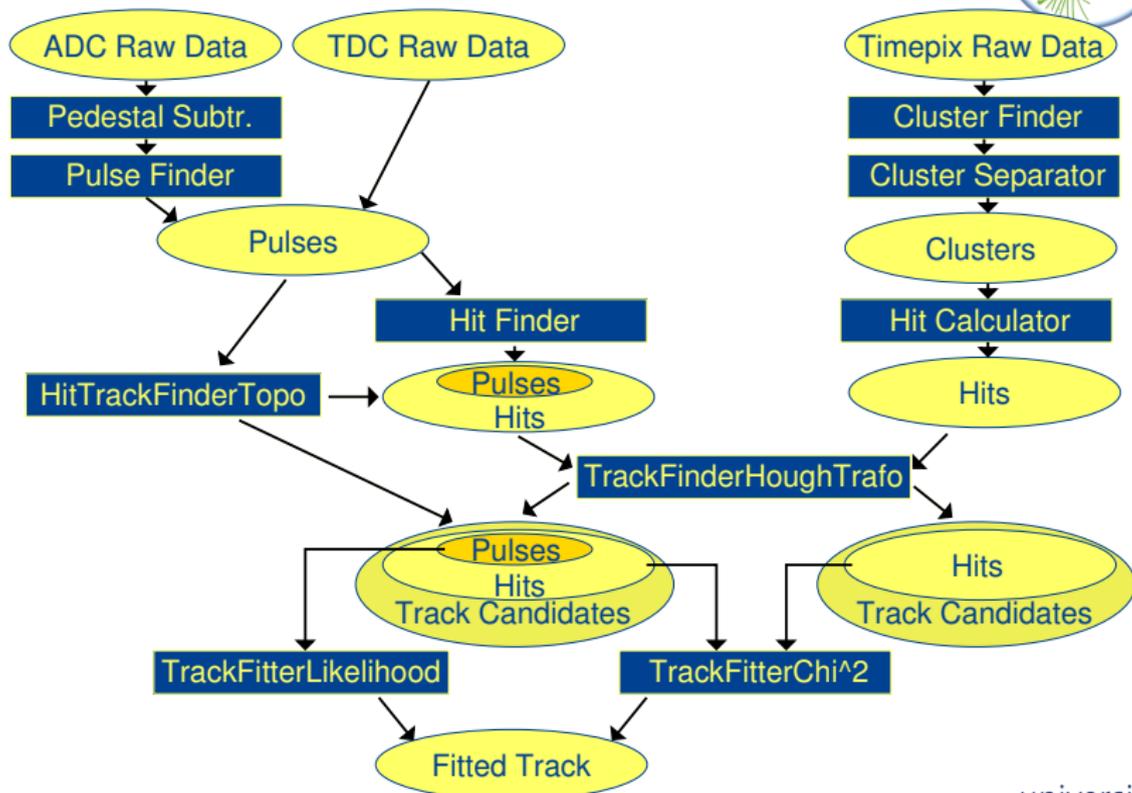
Highly modular (more than 50 processors) simulation, digitisation, reconstruction and analysis toolkit for TPC studies in Marlin

## Reconstruction and Analysis

- Basic reconstruction chains exists
- Designed to be readout independent
- Special processors can be plugged in (e. g. pad response for MircoMegas with resistive layer)
  
- Control histograms can be created
  
- Conditions data classes







## Beam timing at the ILC

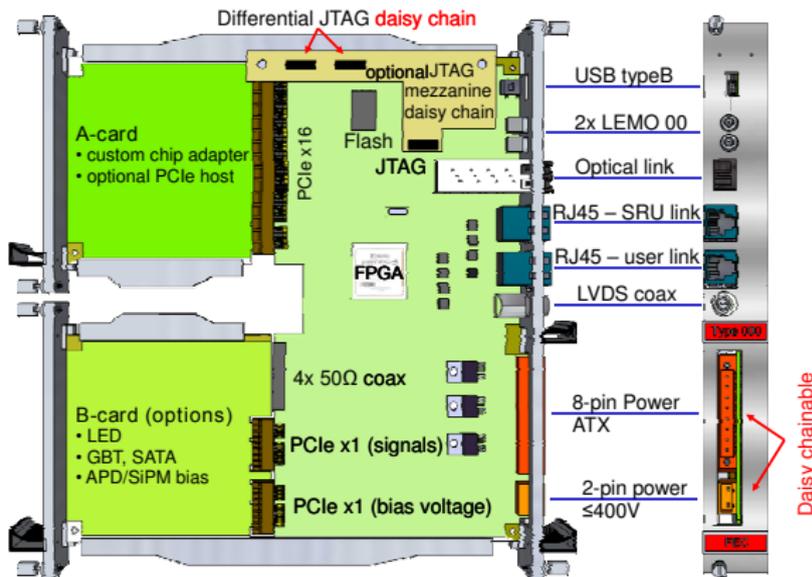
$\approx 1$  ms bunch trains with 199 ms pause

- **Power Pulsing**

- Turn off the FE electronics between bunch trains

- **Triggerless Operation**

- TPC has to record 1 ms
- Quasi continuous readout
- ⇒ Data driven readout (data block with timestamp)
  
- One bunch train is one picture in the TPC
- Assignment to bunch crossings has to be done offline
- ⇒ Revisit the “event” concept in the data format



Graphics taken from Jose Toledo

## One readout system for all components?

Very different requirements for  
different detectors  
⇒ Modular system

- Same front end card with FPGA for all components
- Common interface for power, I/O, trigger, control
- Daughter board A interfaces with individual ASICs
- Optional extension board B for bias voltages, calibration pulses etc.

## Status and Current Work

- Many different existing readout systems
- Synchronisation with EUDAQ and TLU
  - Only modified ALTRO implements Handshake with event number transmission
  - Event building in data collector
- LCIO as common data format
- Offline reconstruction with MarlinTPC has started

## The Future

- Common readout hardware (like the Scalable Readout System)?
- Data driven TPC readout (not event based)
- Integration of slow control data into run control