# A general trigger system for ICARUS

- Physics considerations
- Input signals
- A few preliminary ideas
- A segmented trigger proposal
- Possible implementations
- General Trigger Architecture

# Physics sources

- Events:
  - Cosmic rays muons
  - Atmospheric neutrinos
  - Solar neutrinos + neutrons $\rightarrow$ E ~ MeV
  - Neutrinos from Supernova (burst) $\rightarrow$ E ~ MeV
  - Proton decay
  - CNGS neutrinos $\rightarrow$ external timing
  - Beam muons

# Supernova burst (A. Rubbia)

- Specific time structure

  Ex.: ~ 100 SN triggers in T300 in 1 sec

- Global trigger: bandwidth + storage problem

  1 event = 27648 ch $\times$ 2500 samples $\times$ 2 bytes

  ~ 130 MB $\rightarrow$ 13 GB total

- Local trigger: SN events are localized and limited to 1 crate per view

  – 5 events per crate in COLL + IND2 views ~ 40 MB/crate

  – 13 events per crate in IND1 view ~ 60 MB/crate

$\Rightarrow$ Each crate can be read-out as a separate event

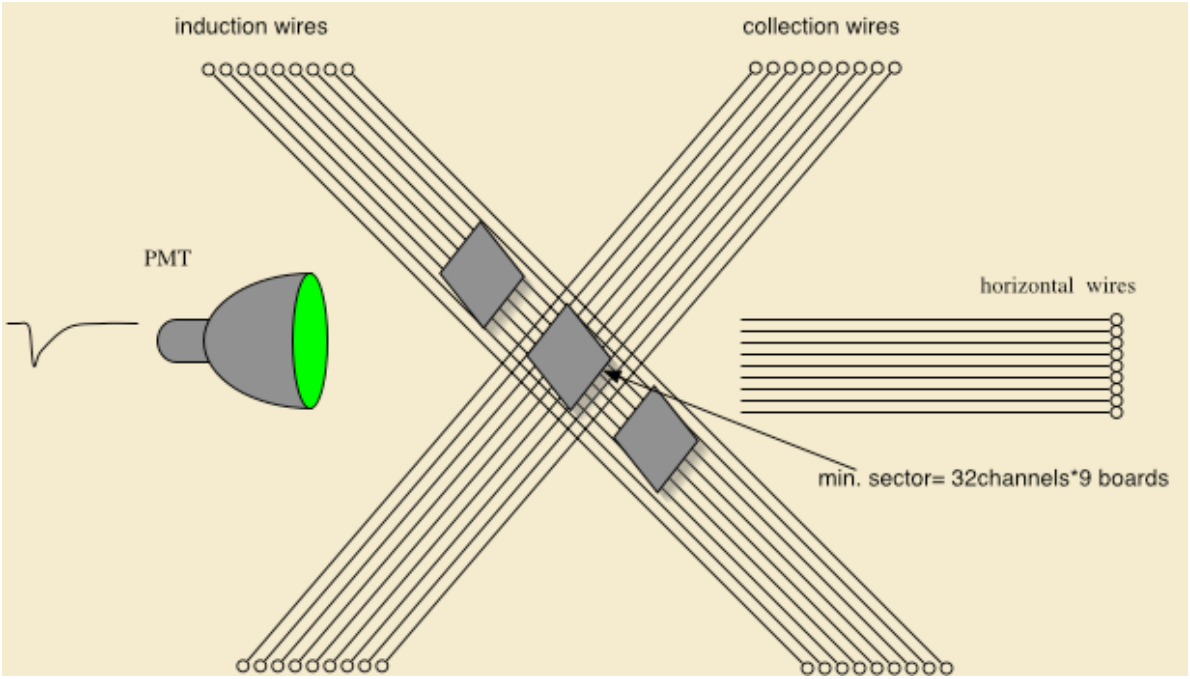
# Trigger Input

- PMTs
- DAEDALUS
- AWS (Analog wire sum)
- External (beam profile chambers, cern-spill, ...)

# Preliminary ideas (A.Rubbia)

- Redundancy important to measure efficiency
- Global trigger:
  - Generated by PMTs or external
  - drift time GLOBAL_DRIFT (1ms)
  - Read-out GLOBAL_BUSY (1s) vetoes new global triggers
  - Local triggers vetoed during GLOBAL_DRIFT
- Local trigger:
  - Generated by Daedalus/AWS + PMT
  - LOCAL_DRIFT (1ms) vetoes new local triggers

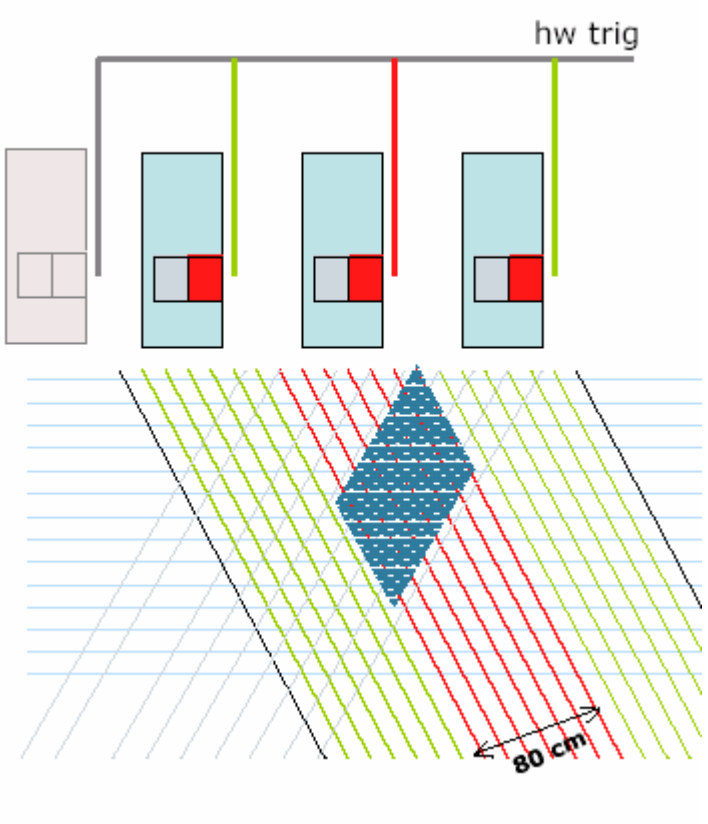
# Proposal for a segmented trigger (Padova)



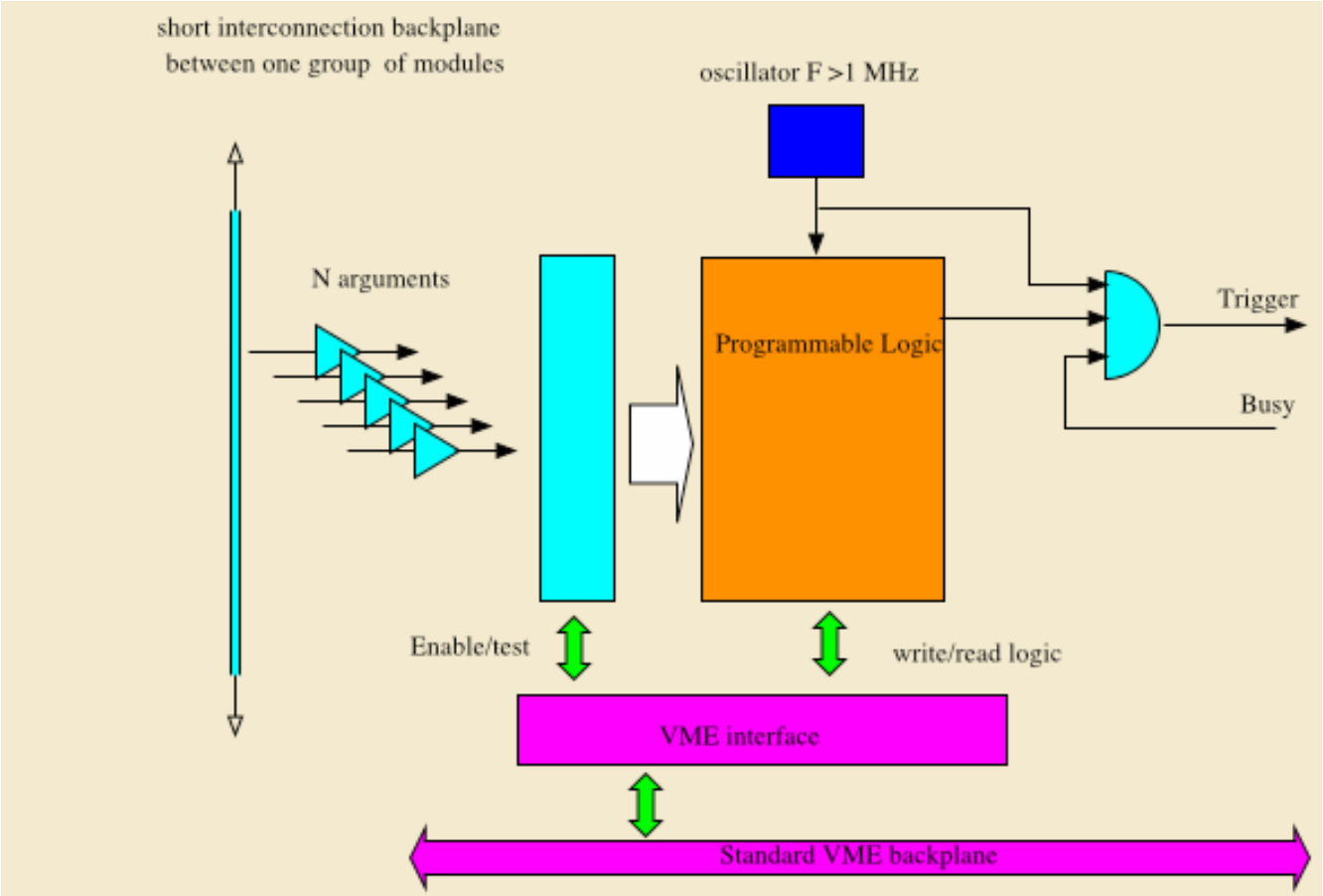

- Intrinsic granularity of the trigger is a crate (same signal for all the V789)
  - D = 3 mm * 32 ch * 9 boards = 83.7 cm
  - Analog Wire Sum (AWS)

# Segmented trigger (2) (S. Ventura)

- Single half crate selection per view
  - 1/8 chamber
  - 1350 samples
  - (80 cm in drift)
- Physics requirements could involve selection of neighbor boards. In such case trigger logic might need more detailed knowledge of the triggering boards within the crate. Assuming 3 half crates per view:
  - 1/4 chamber 2500 samples

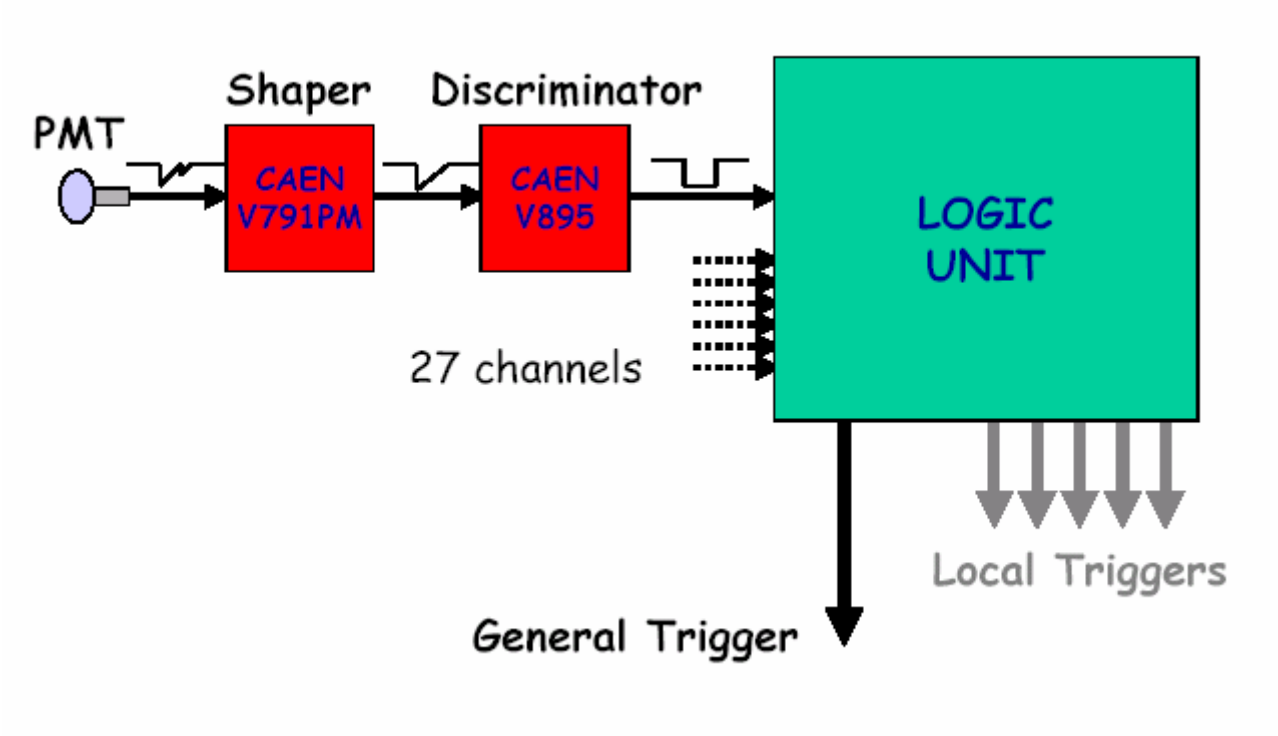


# Trigger Control Unit (T600) (B. Baboussinov)

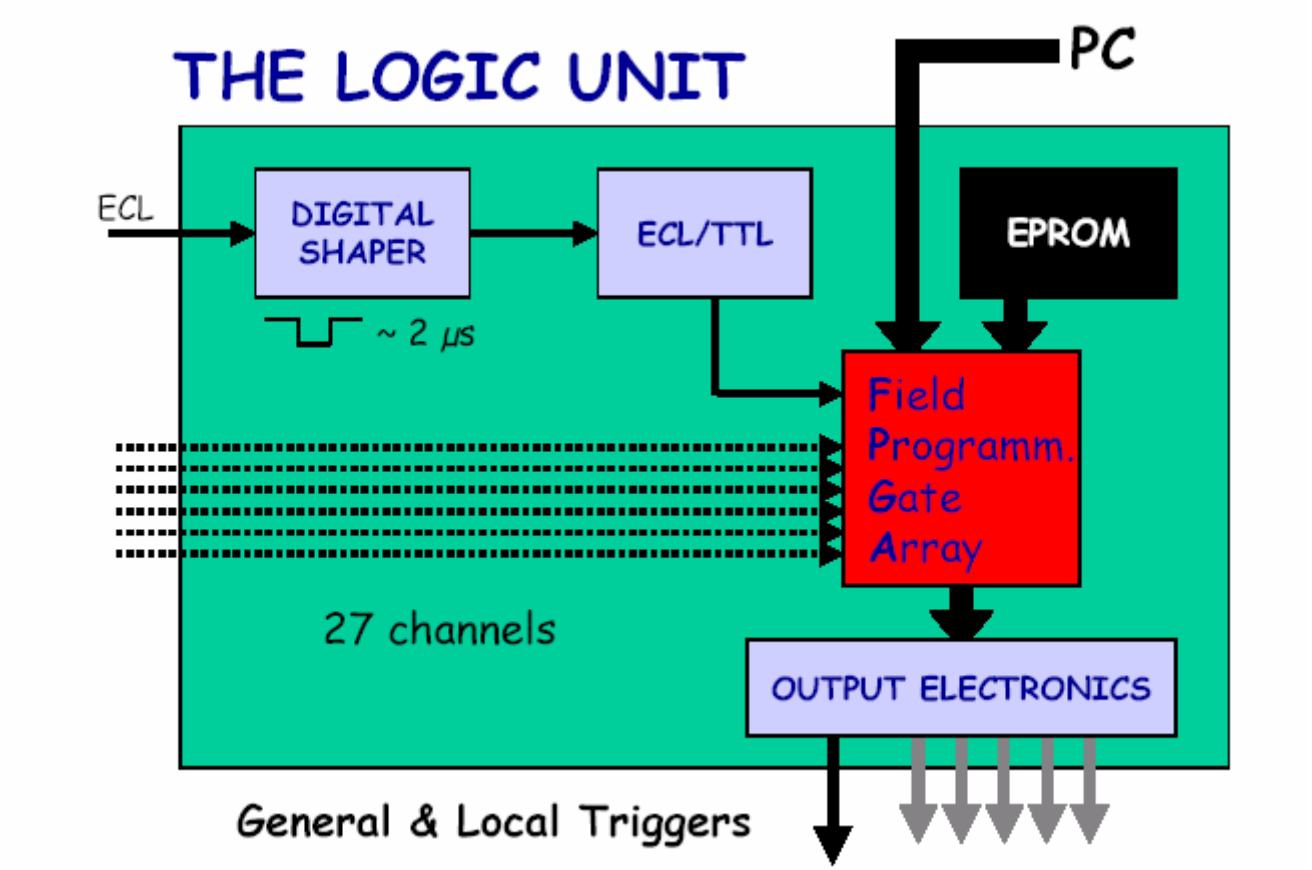



Sum signals from crates: 24 AWS $\times$ 4 chambers = 96

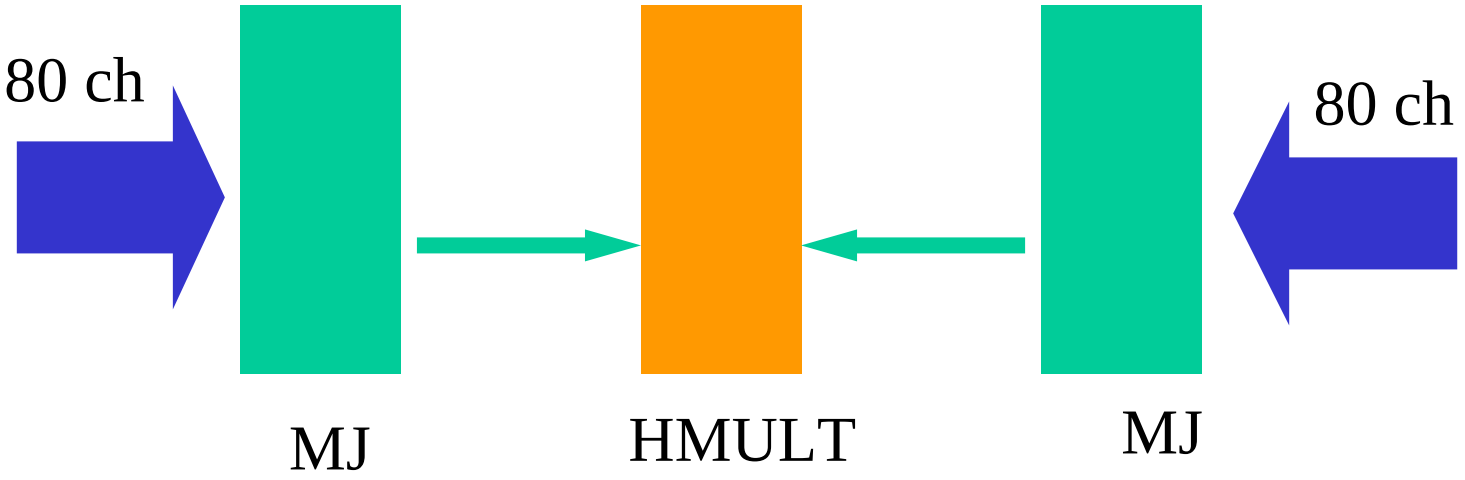
# A PMT based trigger (G. Raselli)



# The PMT system TCU (G. Raselli)

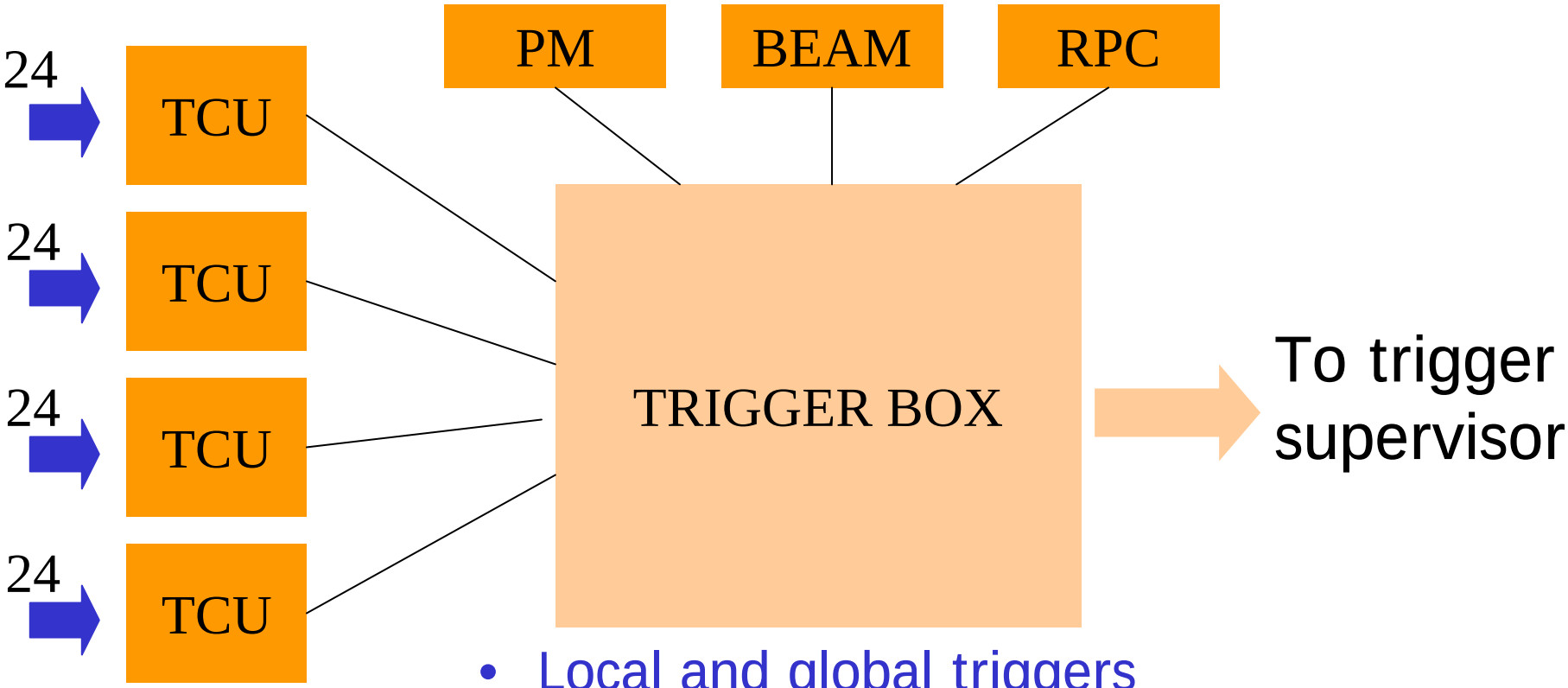


# The TCU of ARGO (P. Parascandolo)




- Majority board (MJ)
  - VME double height
  - 80 input ch
  - 8k * 18 bit FIFO
  - XILINX FPGA
  - clock @ 30 MHz
- HMULT
  - Collects data from 2 MJs
  - Sends a trigger proposal to trigger box
  - Receives a trigger accept flag

# General trigger




- Local and global triggers
- Fully programmable
- Monitoring capabilities

# Outlook

Features of a general trigger system for T600

- Trigger Control Units for each subsystem (AWS, PMTs, ...)
- Trigger Box
  - Global and Local triggers to cope with bursts
- Trigger Supervisor $\rightarrow$ triggers' distribution, BUSY handling, dead-time monitoring, statistics, debugging, …

# Activity overview

- MC studies can help in the definition of physics requirements
- TCUs design
- Verify the functionality of existing boards
- General trigger logic design
- Define the Trigger Supervisor functions + interactions with DAQ

$\Rightarrow$ specialized workshop to coordinate activities