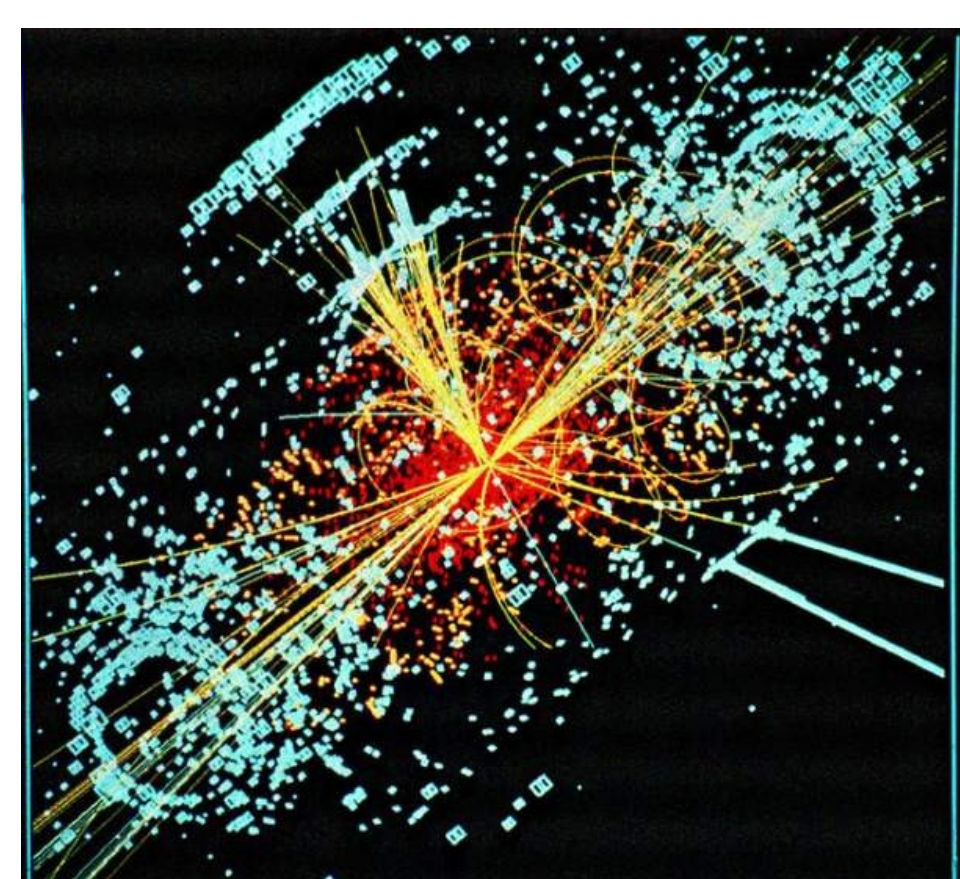
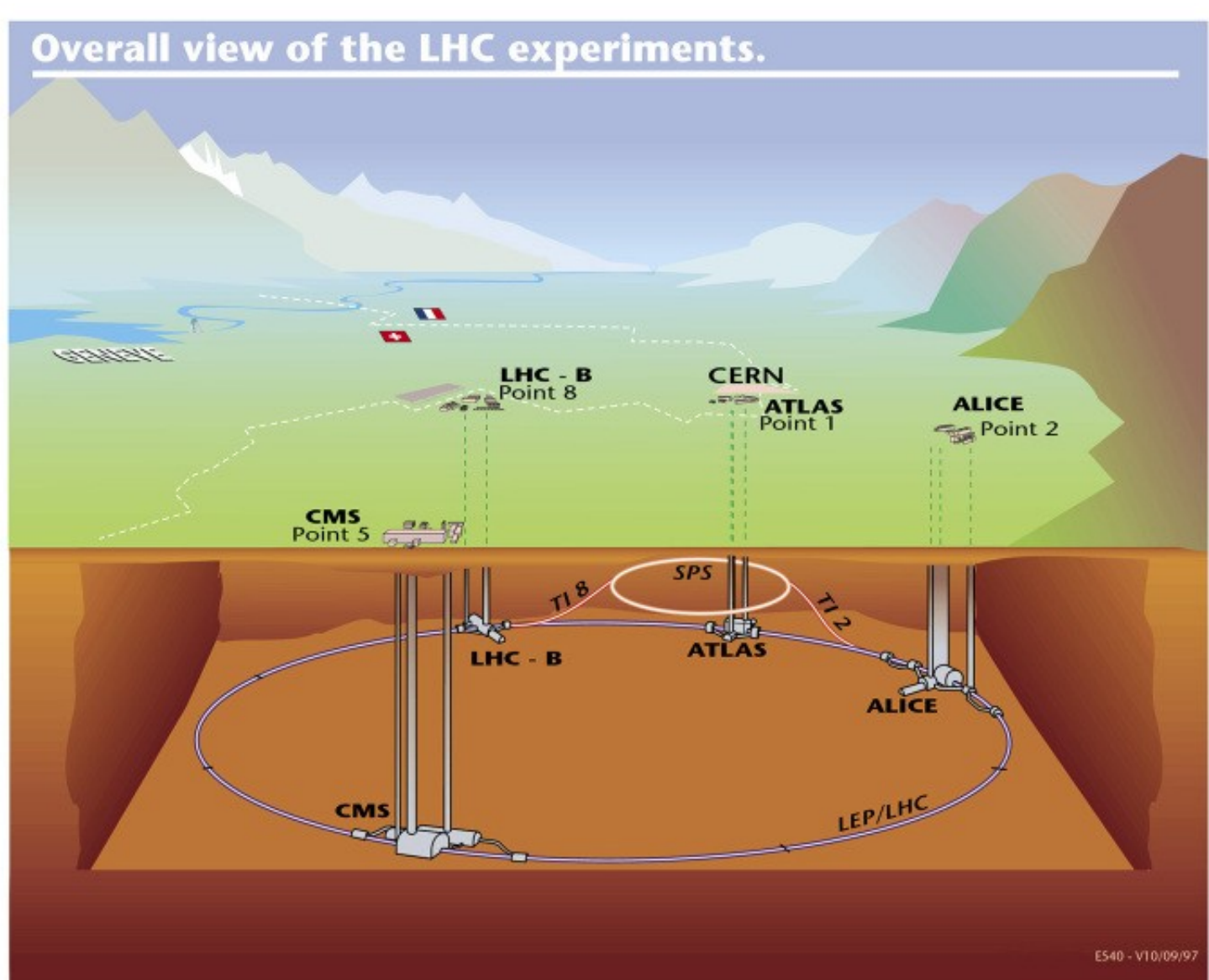


1. High Energy Physics at CERN

LHC – The Large Hadron Collider

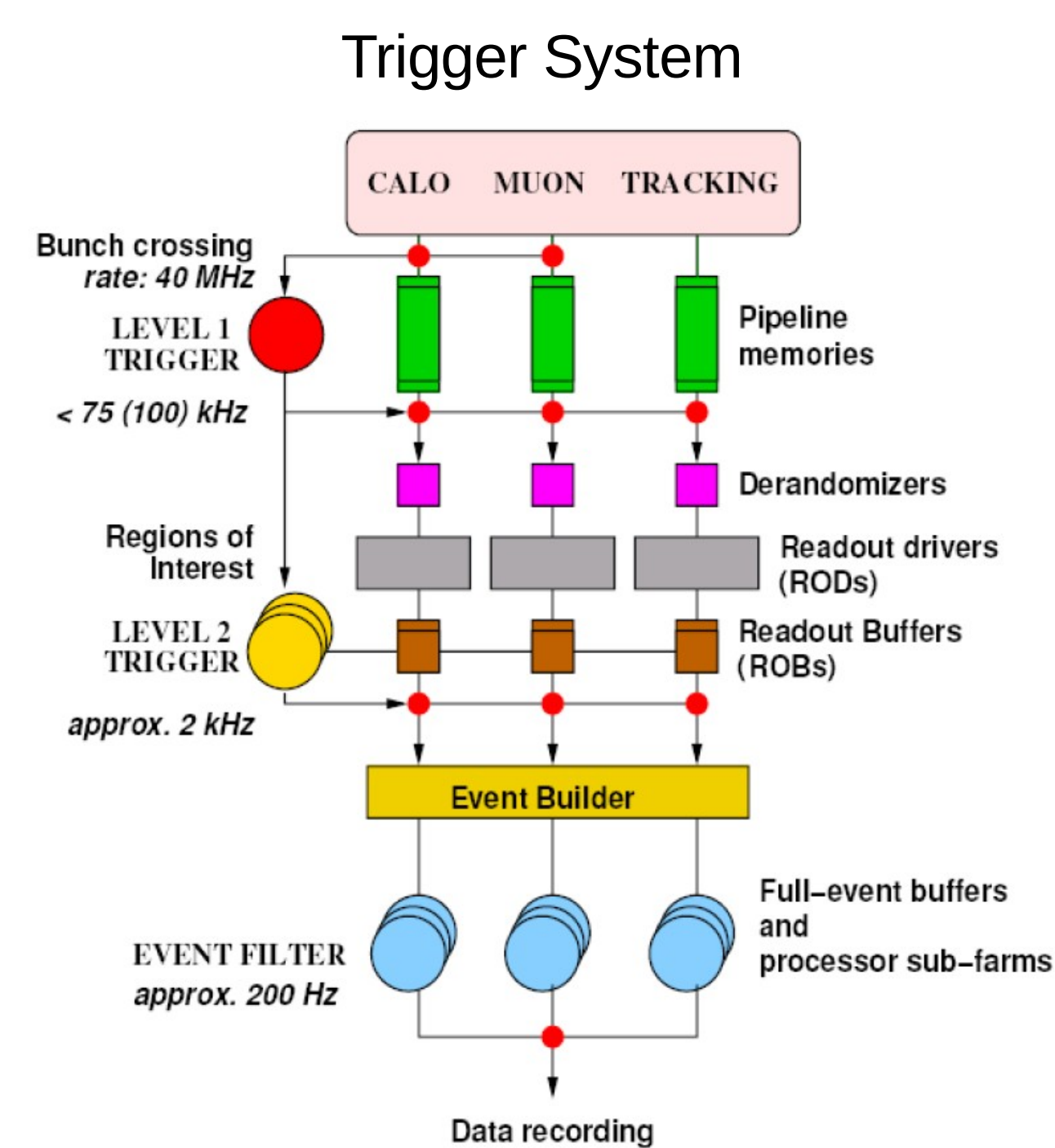
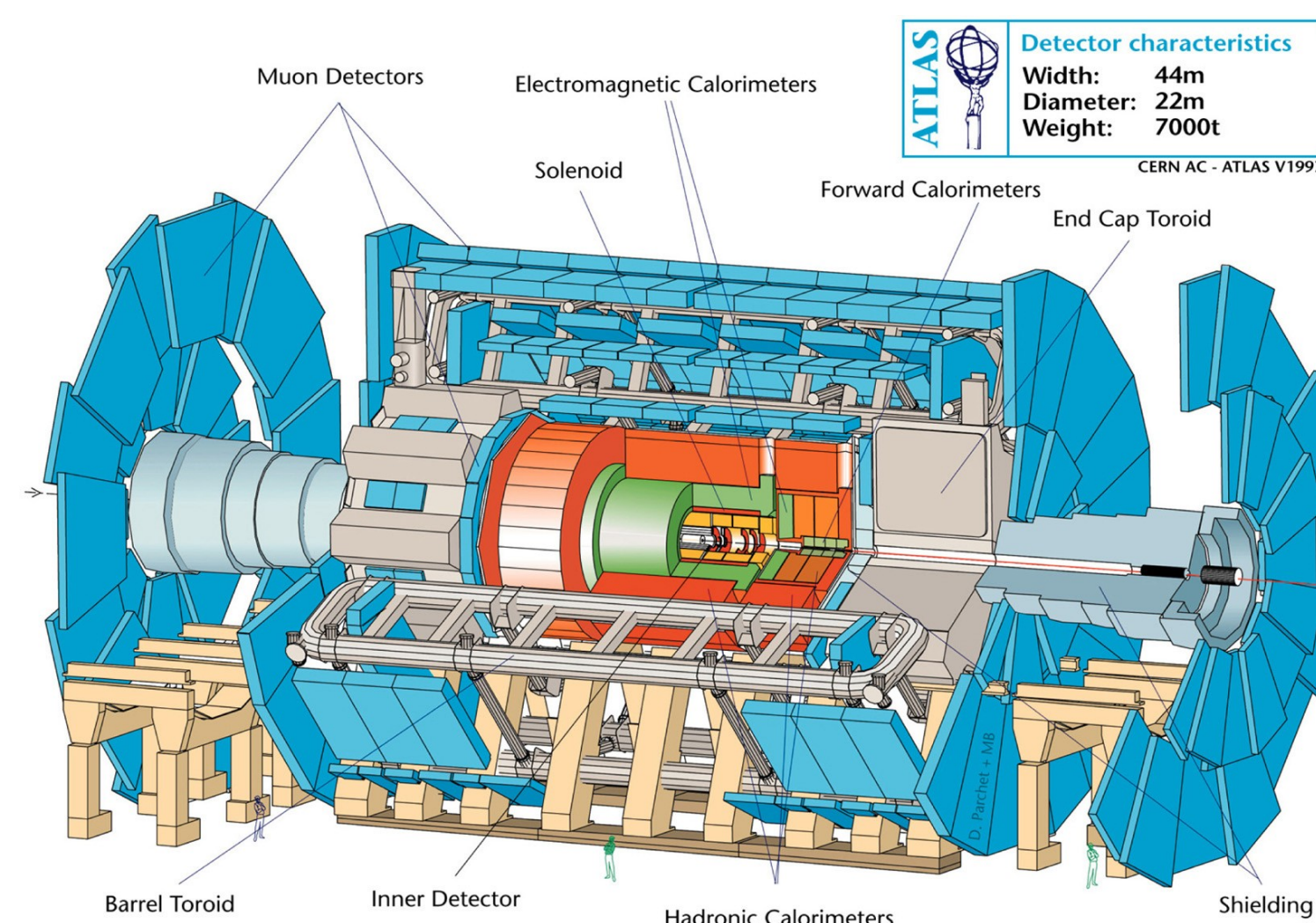
- 27 km circumference (100 m underground tunnel)
- Proton-proton collisions (up to 14 TeV at the center of mass)
- New physics discoveries
 - Supersymmetry
 - CP violation
 - Dark matter
 - Higgs Boson
 - Standard model and beyond
- Extremely high collision rate
 - Collisions every 25 ns
- Up to 25 interactions per collision



2. A Toroidal LHC Apparatus - ATLAS

A general purpose detector

- Tracking
- Calorimetry
- Muon chambers
- Engineering challenge
 - Assembled in a cavern
 - Several integrated subsystems
 - Incredible high data flow – 60 TB/s!
 - Online Trigger is mandatory



An engineering playground

- Online filtering and monitoring
- HW and SW development
- Distributed control systems
- Data acquisition and quality
- Cutting-edge technology

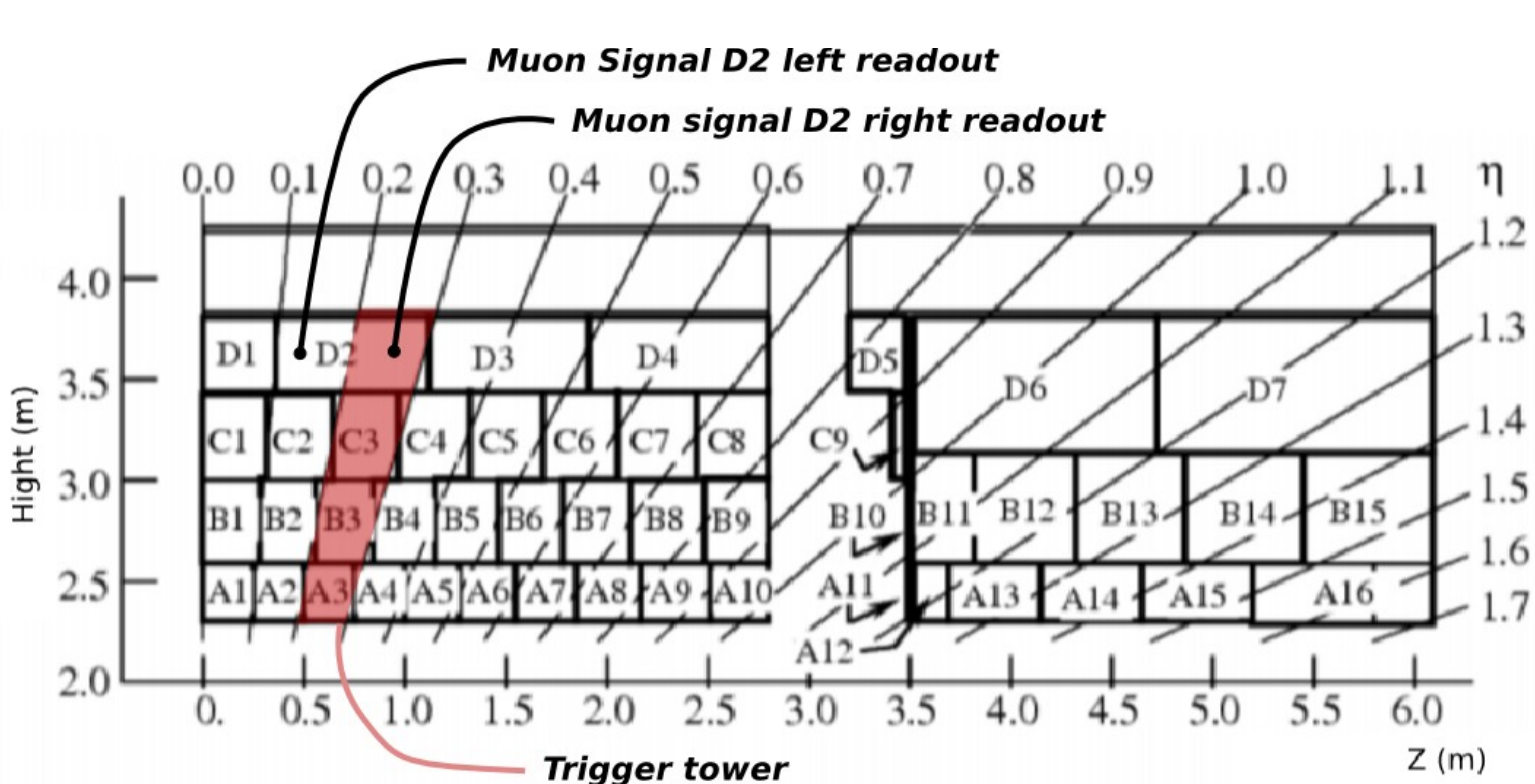
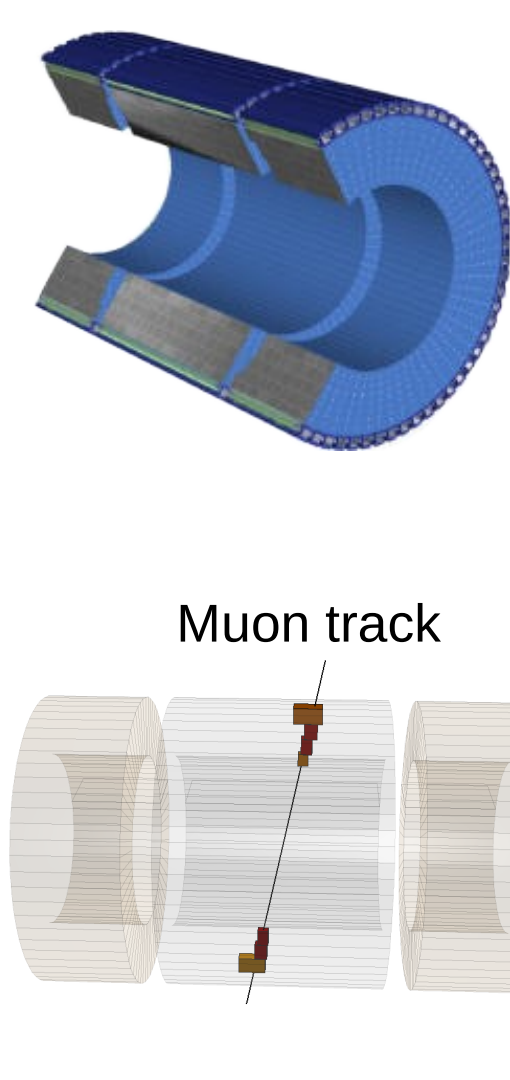
3. The Tile Calorimeter - TileCal

ATLAS central barrel hadronic calorimeter

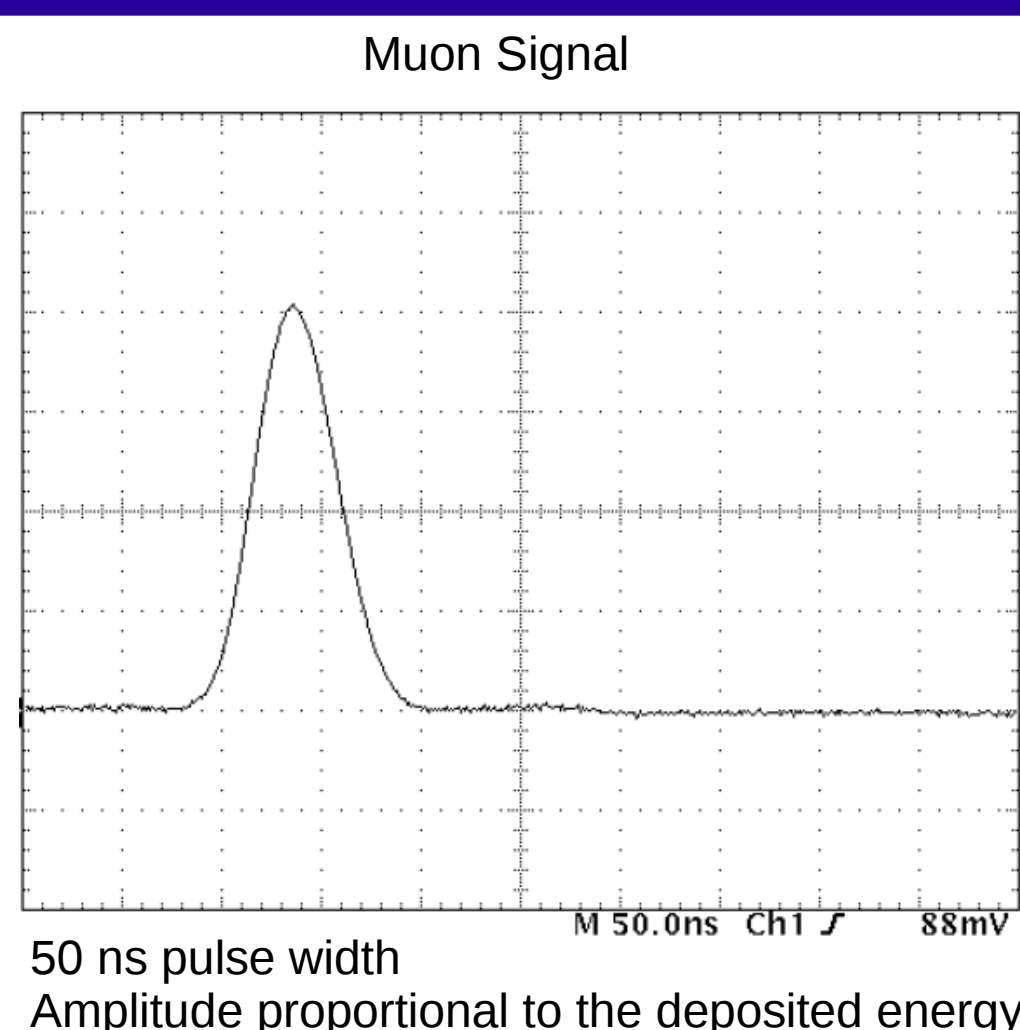
- 256 modules
- Scintillating tiles as active material
- Iron as structure and absorber
- 10,000 data channels
 - Double readout per cell (redundancy)

Trigger interface

- Trigger tower region
- Muon signal – D cell readout
- Analogue signal

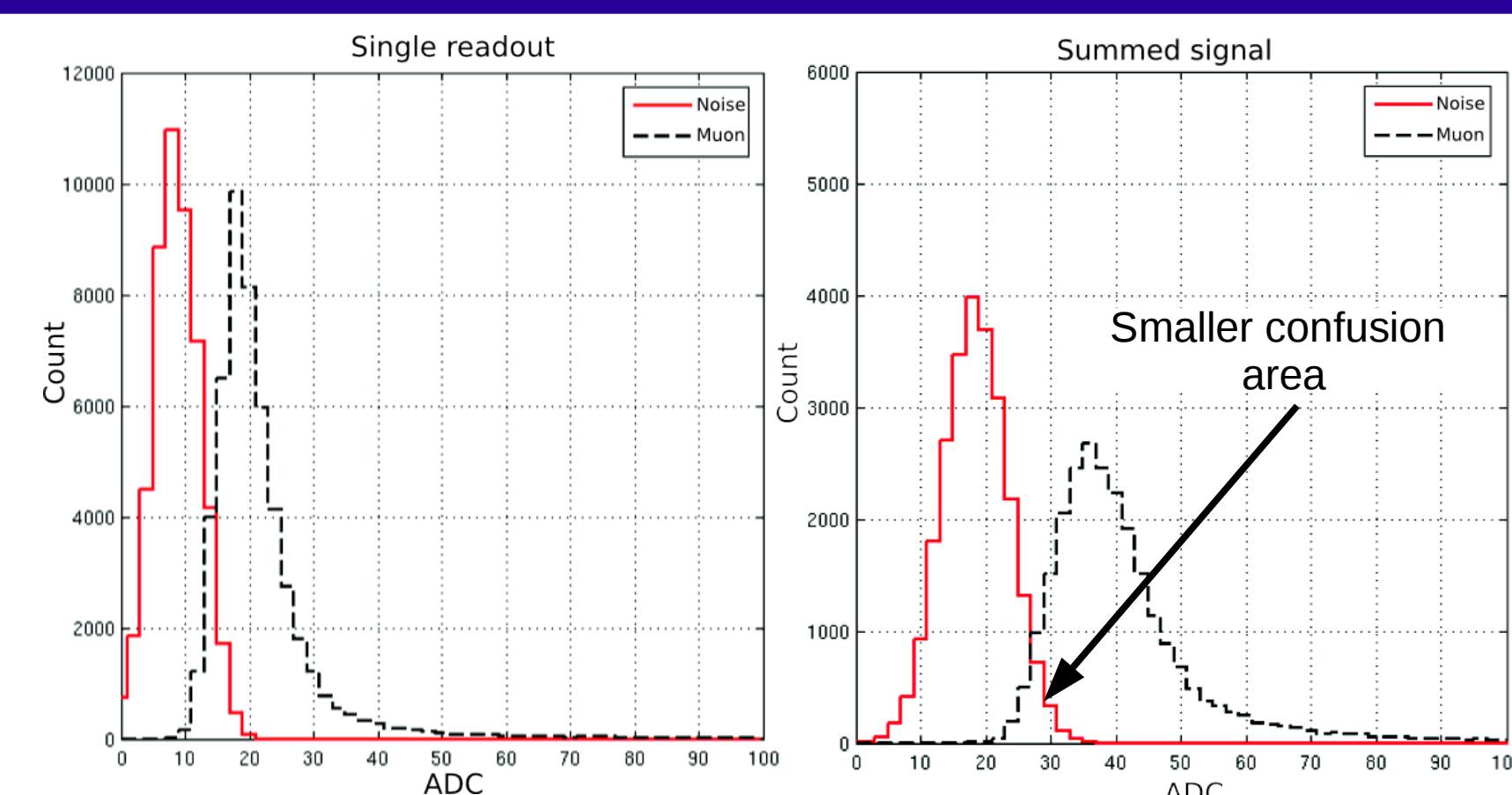


4. The muon signal



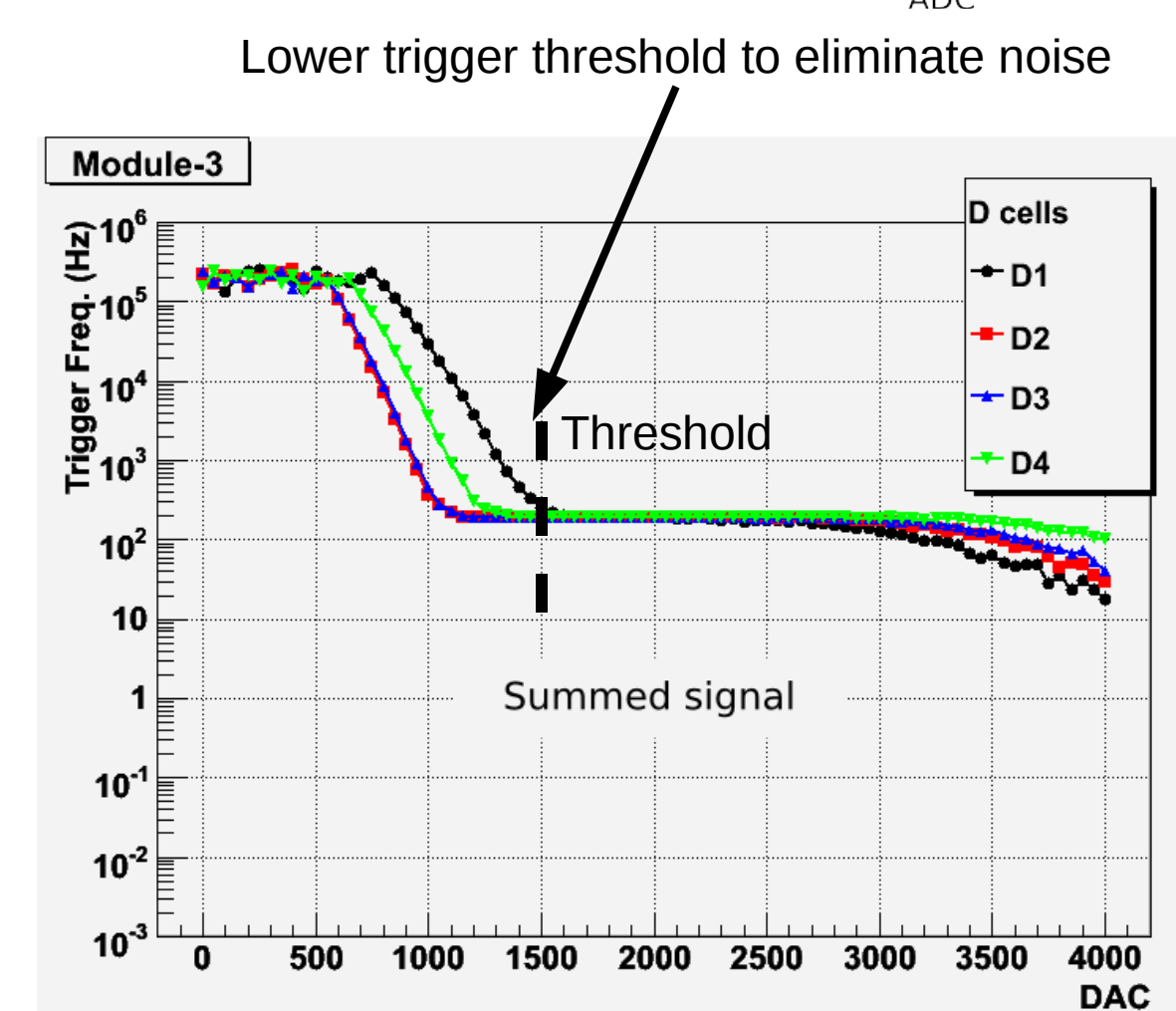
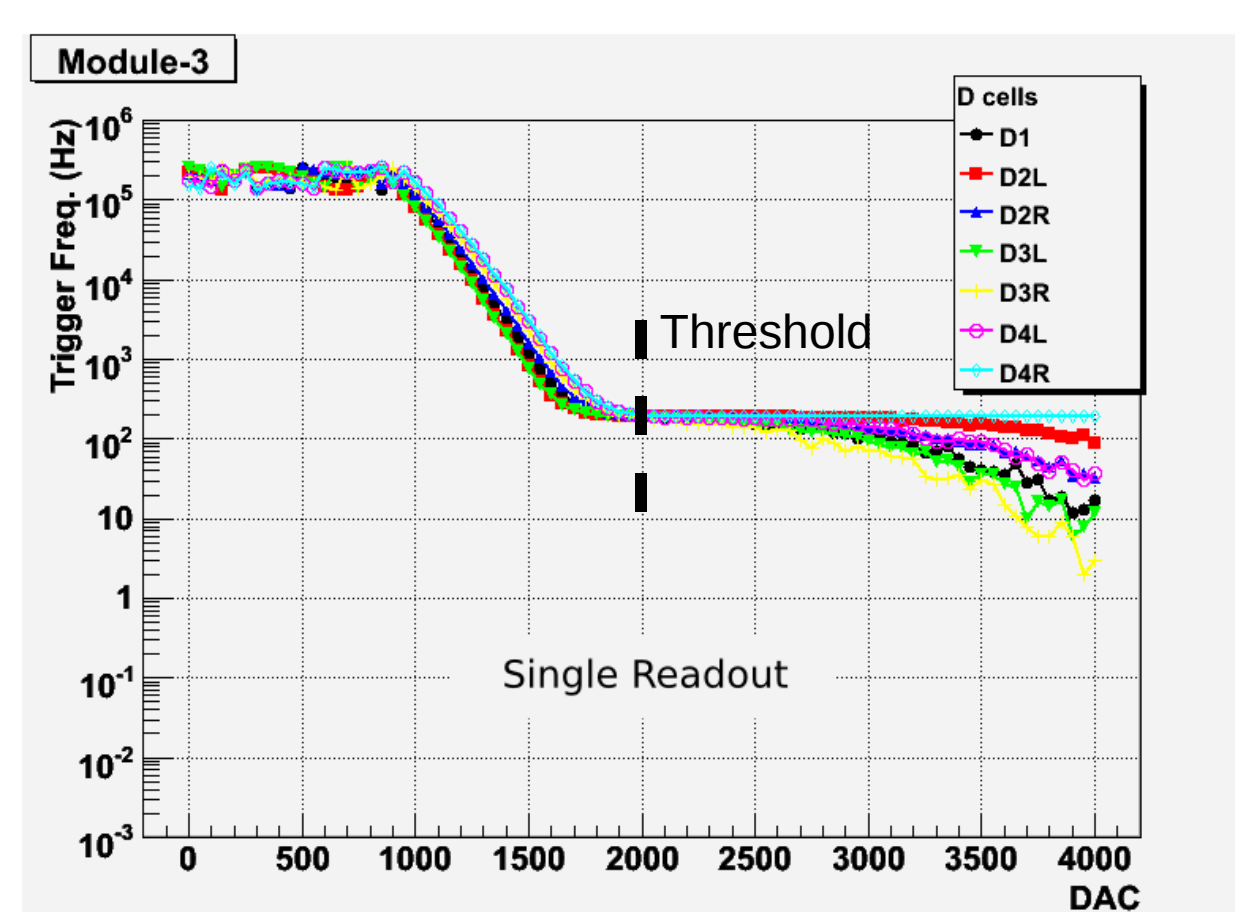
Summing muon signals

- Increases the signal-to-noise ratio
- More discriminant against noise



Laser tests

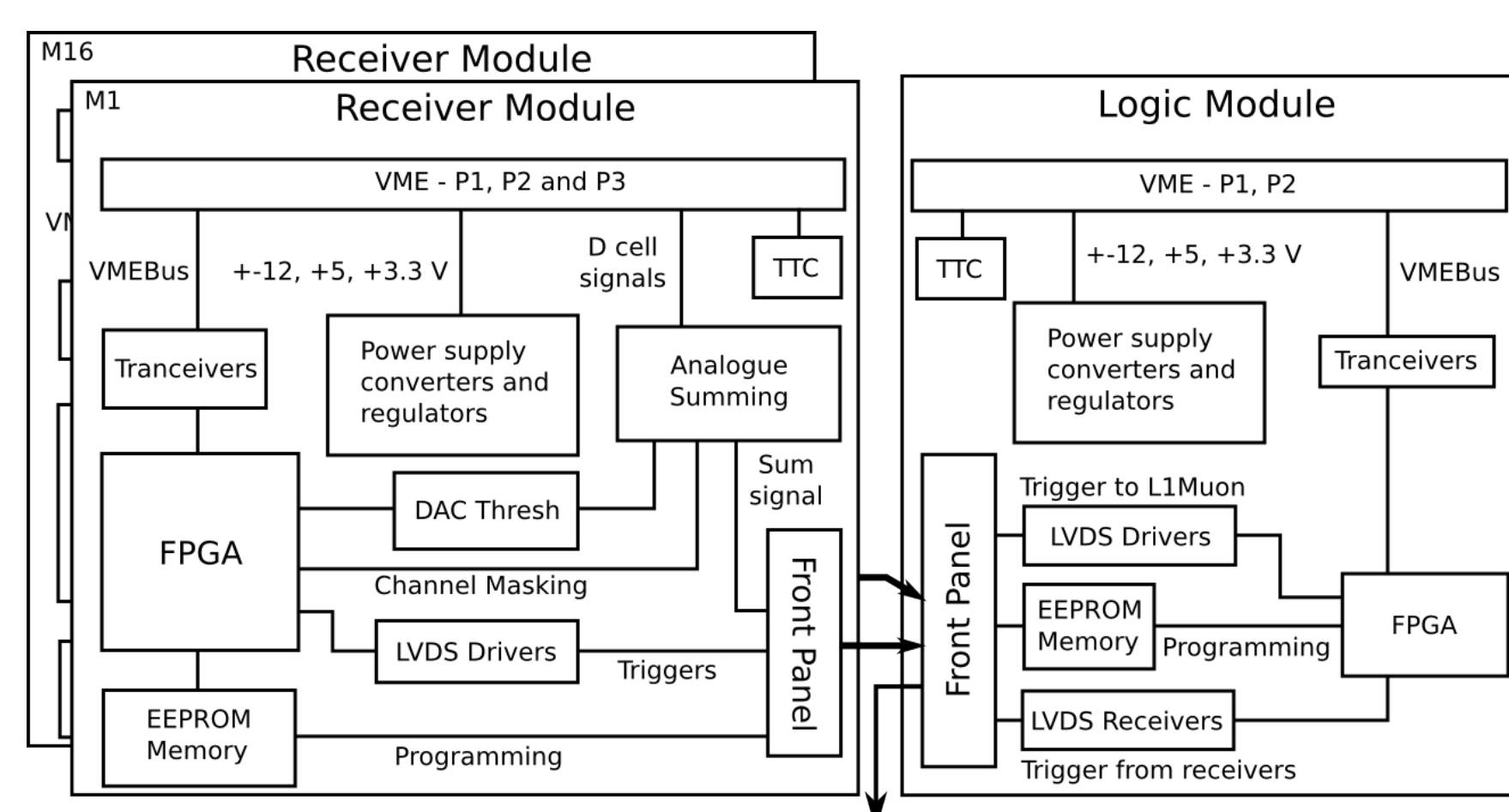
- Injection of laser pulses
- Pulses at a constant rate
- Trigger cut variation
- Detection of muons with lower energy



5. TileMuonReceiver

Combined level-1 trigger with the Muon Chambers

- Up to 768 trigger signals
- Avoid veto: geometry alignment
- 2 independent partitions: A and C detector side



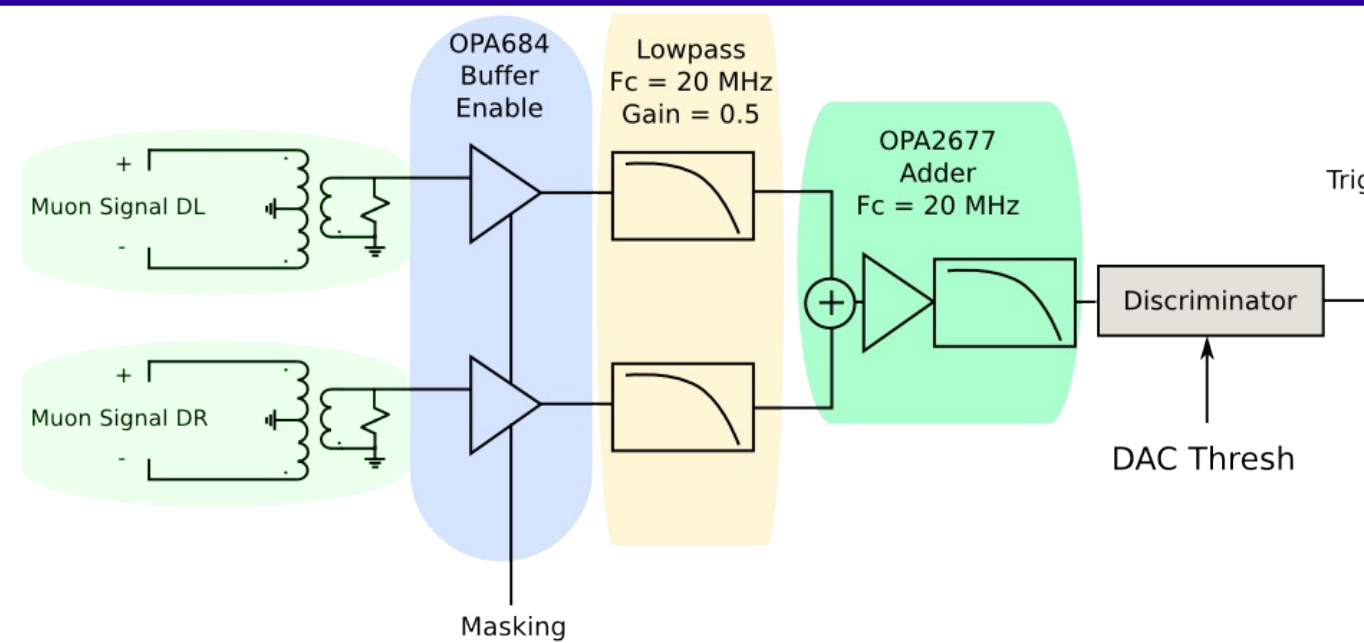
Receiver Module

- Adds both muon signals from the same D cell
- Communicate over VME bus for calibration purposes
- Threshold discrimination
- Channel masking
- TTC circuit for LHC clock
- FPGA for all features

Logic Module

- Receives trigger information from receiver modules
- Trigger region alignment and bunch-cross ID
- Furnishes trigger information to level 1 ATLAS muon trigger

Summing Circuit

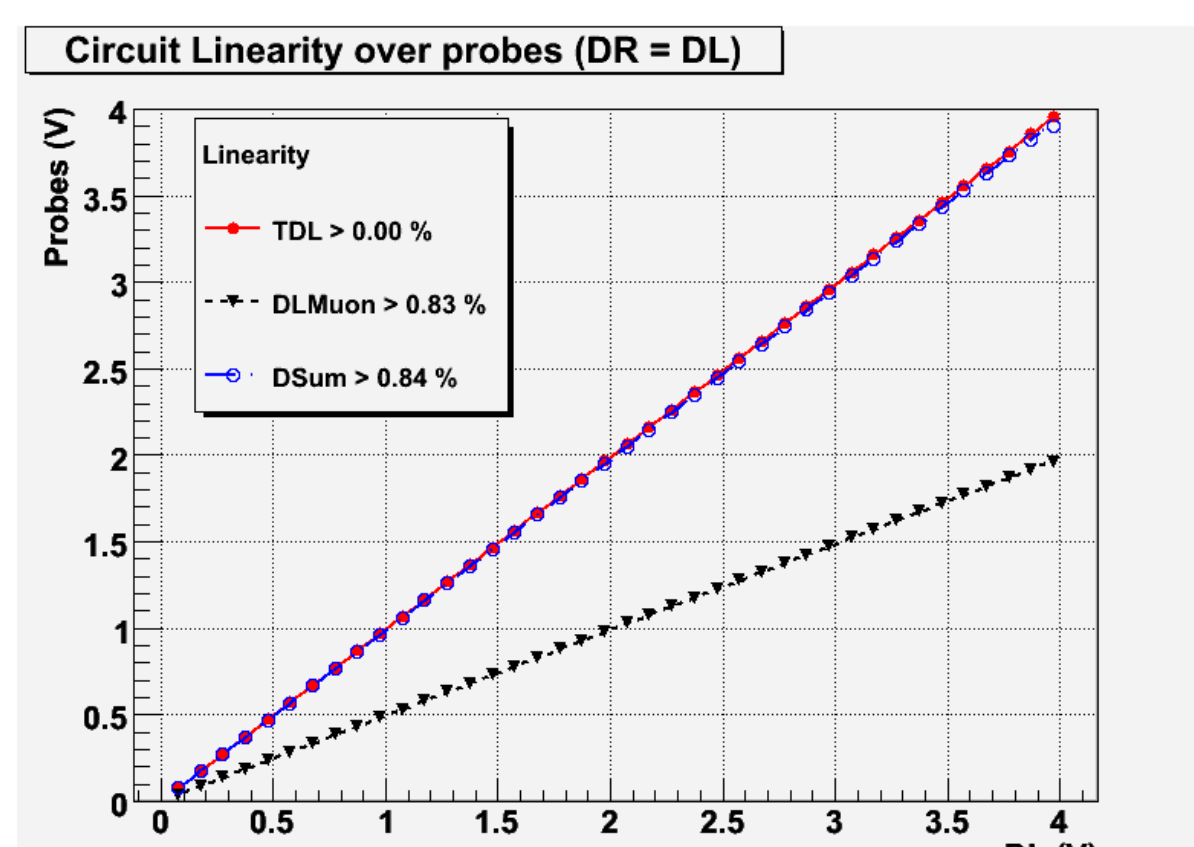


6. Circuit Simulations

Simulation on Pspice

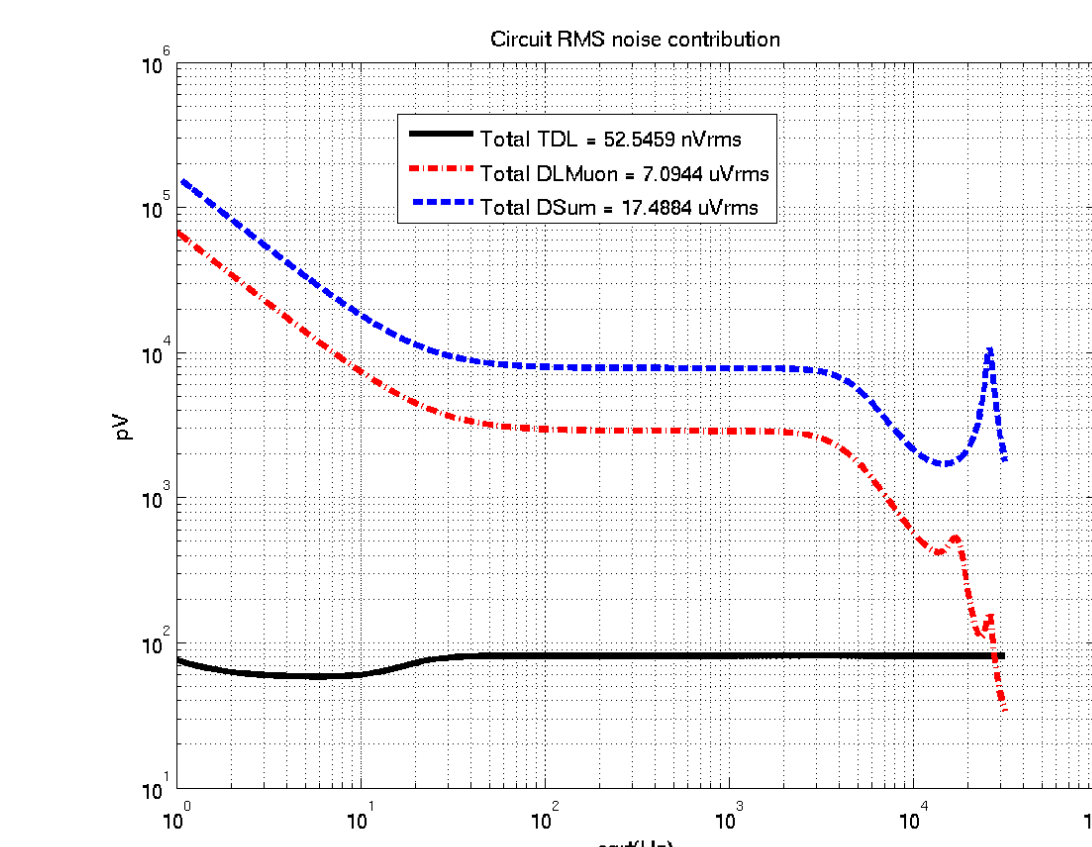
Circuit Linearity

- Non linearity smaller than 1 %



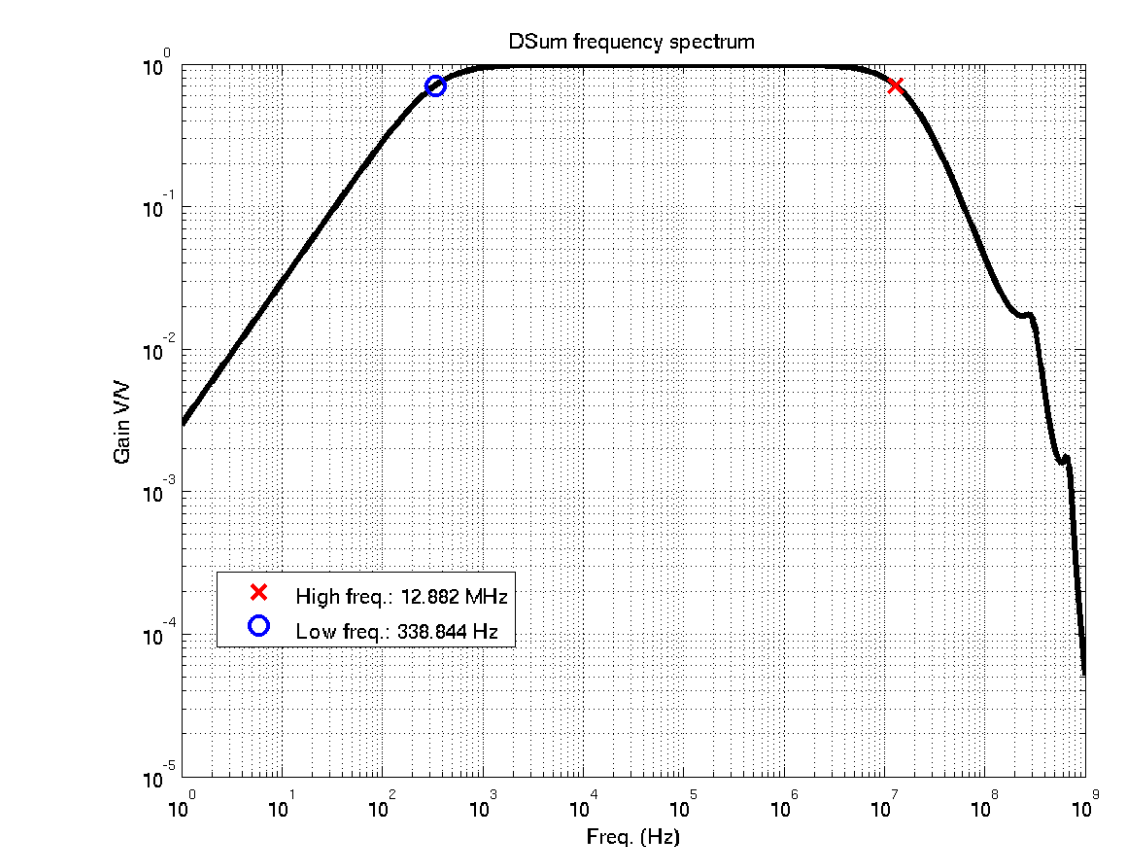
Circuit Noise Spectrum

- Contribution around 17 uVrms



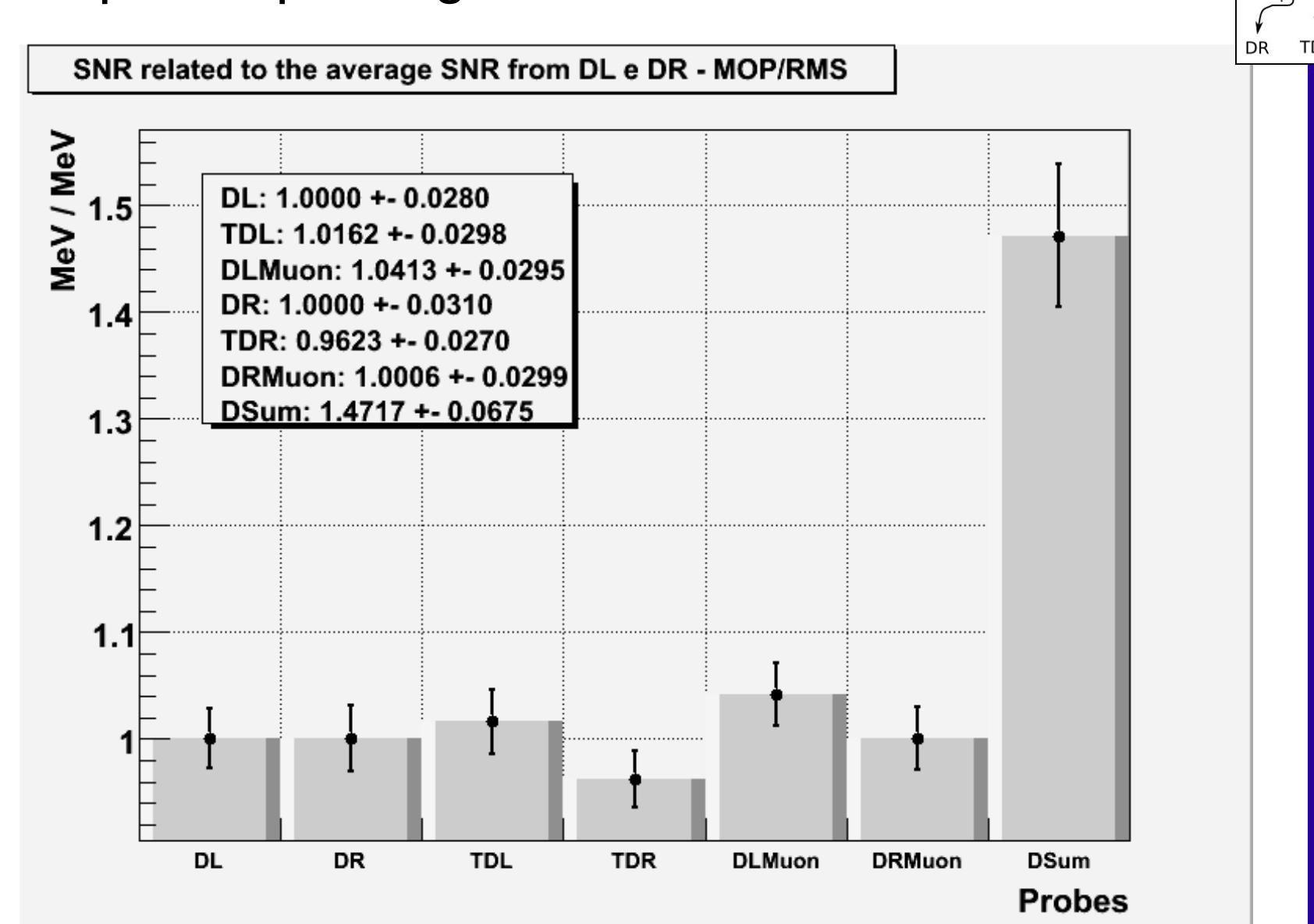
Frequency Response

- 2 poles: 12 MHz



Signal-to-noise Ratio

- Input-output: a gain of ~1.5



Muon Detection

- Sum: muon detection efficiency 5pp higher, with a 10% false alarm

