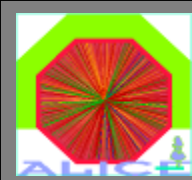


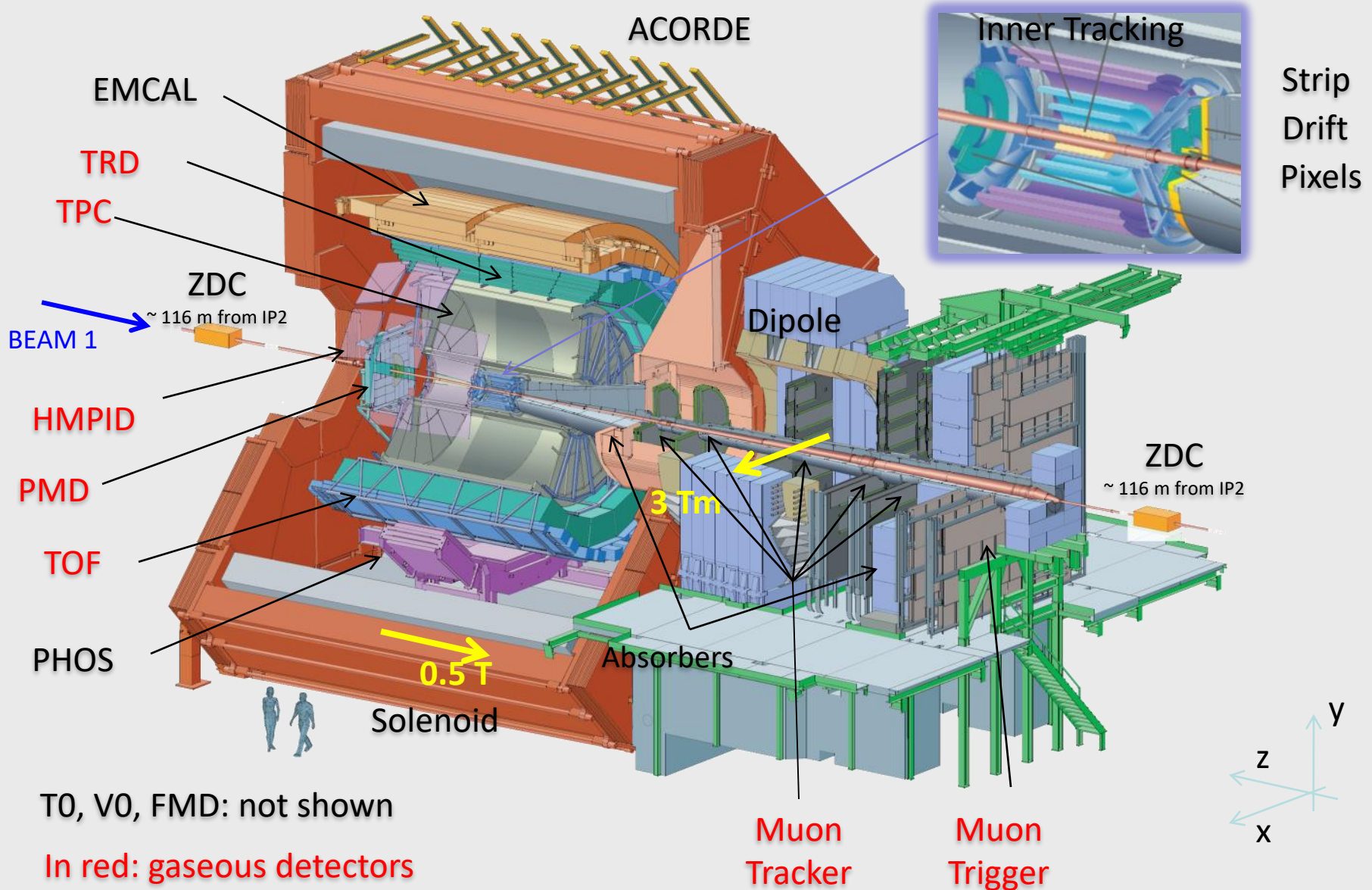
# Luminosity “jumps” issues in ALICE

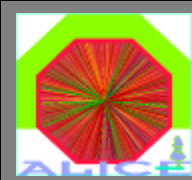
Antonello Di Mauro (CERN)

MPP, 25/03/2011



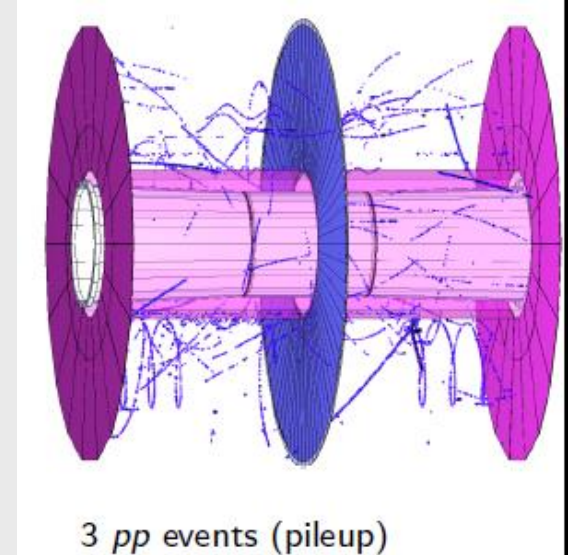
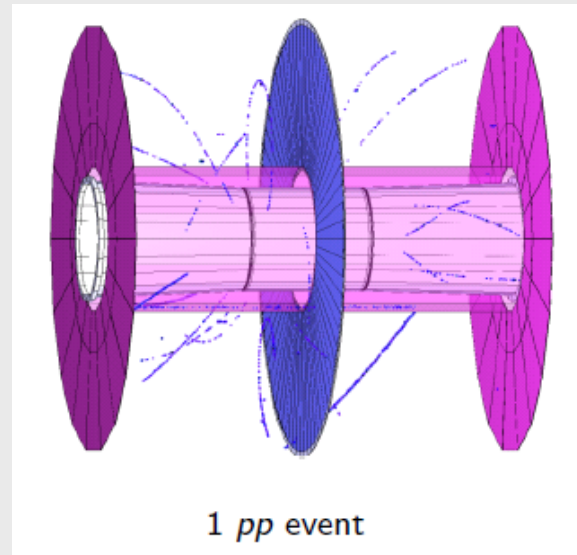
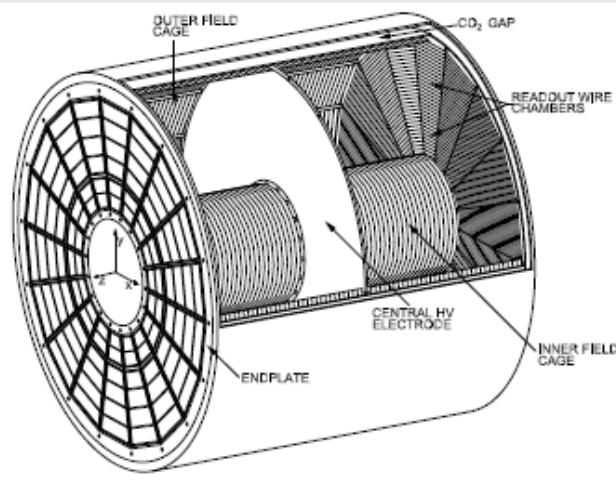
# The ALICE detector



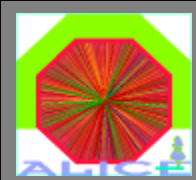


# Luminosity limitations in ALICE

- The most relevant limiting factor is the ionization electrons drift time in the TPC (96  $\mu\text{s}$ ) and the consequent need to keep the max no. of pile-up events to  $\sim 20$  for effective event reconstruction (“late” tracks are shorter)



- Past-Future protection (never used so far) is implemented in TRIGGER system : events can be rejected if in a time window up to  $\pm 100 \mu\text{s}$  the amount of pile-up events exceed a given threshold
- No issues for DAQ system, except increase of data transfer load (max bandwidth 4.5 GB/s) and dead-time saturation
- **But here we are more interested in safety issues...**

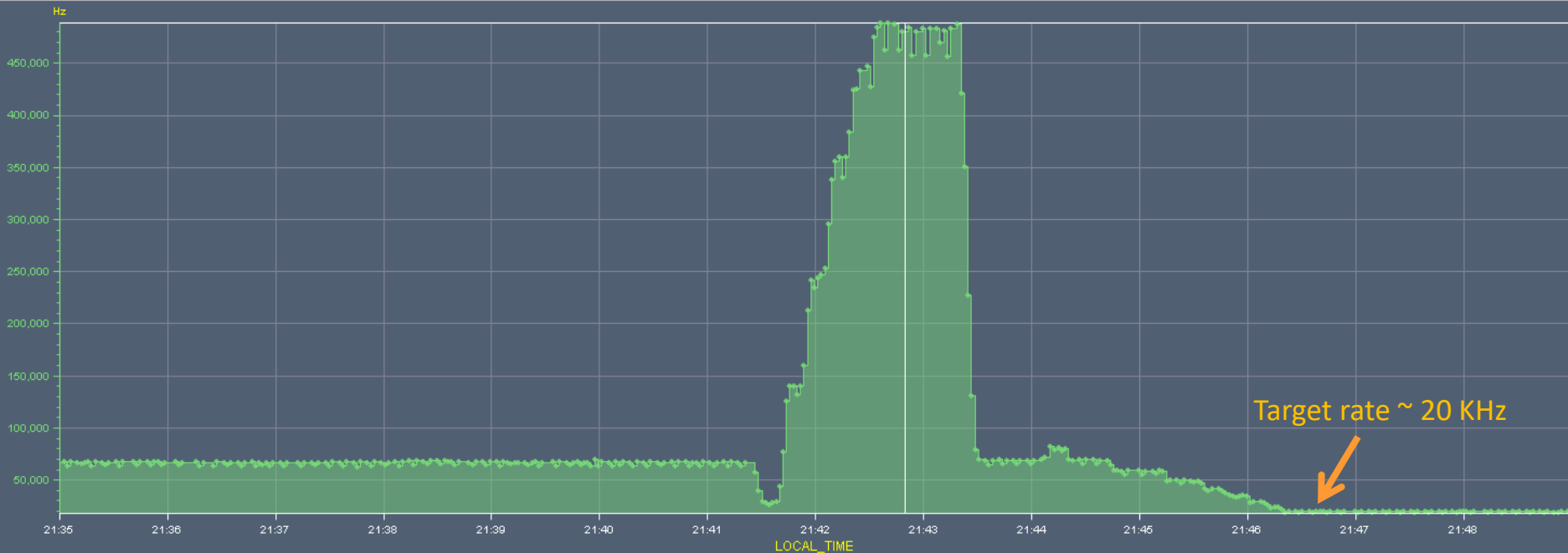


# FILL 1640: a nice lumi-jump example

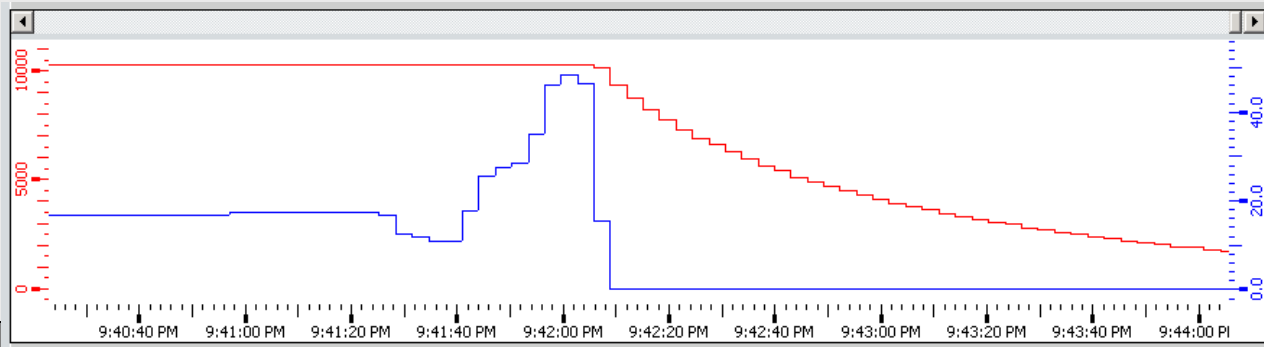
75ns\_136b+4small\_138\_102\_105\_24bpi11inj

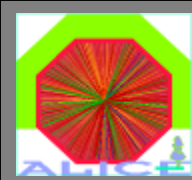
Timeseries Chart between 2011-03-20 21:30:00.000 and 2011-03-20 21:50:00.000 (LOCAL\_TIME)

ALICE:LUMI\_COLLISION\_RATE



$\mu$ -TRIGGER chamber trip



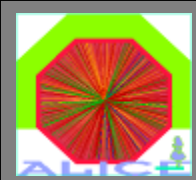


# Luminosity “jumps” vs gaseous detectors

Issues related to increase above “safety” limit (3-400 KHz):

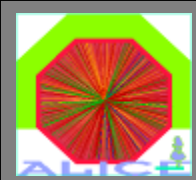
- Gaseous detectors may reach current limits (HV trips)
  - The TPC, the largest and most important detector, is also one of the most sensitive: current limit in triggered mode is  $5 \mu\text{A}/\text{ROC}$  corresponding to 500 KHz interaction rate in p+p (i.e.  $L \sim 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$ ) ; on Sun 20/03 at 21:44 when rate reached 500 KHz, the TPC was not triggered and the current was  $\sim 200 \text{ nA}/\text{ROC}$ .
  - The  $\mu$ -Trigger RPCs (which tripped on Sun 20/03 at 21:44) have a current limit of  $50 \mu\text{A}$  (typical current recorded @ 100 KHz in p+p is  $\sim 15 \mu\text{A}$ )
- Other detectors current limit allows reaching MHz interaction rate, although at limit of design specifications
- Large currents increase sparking probability which could result in Front-End Electronics damages and detector ageing





# Lumi jump protection system in ALICE

- Goal: bring ALICE to a safe state on detection of high rates
- System is not meant to be a fail safe system to protect detectors from being damaged
  - Rather to alert the shift crew there is a problem
  - Otherwise a more robust system is needed to dump the beam
- Mechanism to initiate 'go\_safe' is already in place
  - Used for 'unsafe' beam transitions (=leaving 'stable beams')
- Based on what input?
  - $V0-AND > R_{high} \rightarrow$  Alert operator (call CCC)
  - $V0-AND > R_{too\_high} \rightarrow$  Initiate automatic 'go\_safe'
- Such a protection will result in not proper RUN closing (loss of data) and no data taking for 30'-60'



# Preventive measures

From discussion on Luminosity levelling application with Massi and Reyes:

- Limit usage of separation knobs via TRIM application
- Prefer Lumi-levelling application where safe limits on beam displacement could be defined (although not trivial)