Efficiency Measurement with the Tag-and-Probe Method and Trigger Monitoring

Saskia Plura

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

NETZWERK TEILCHENWELT

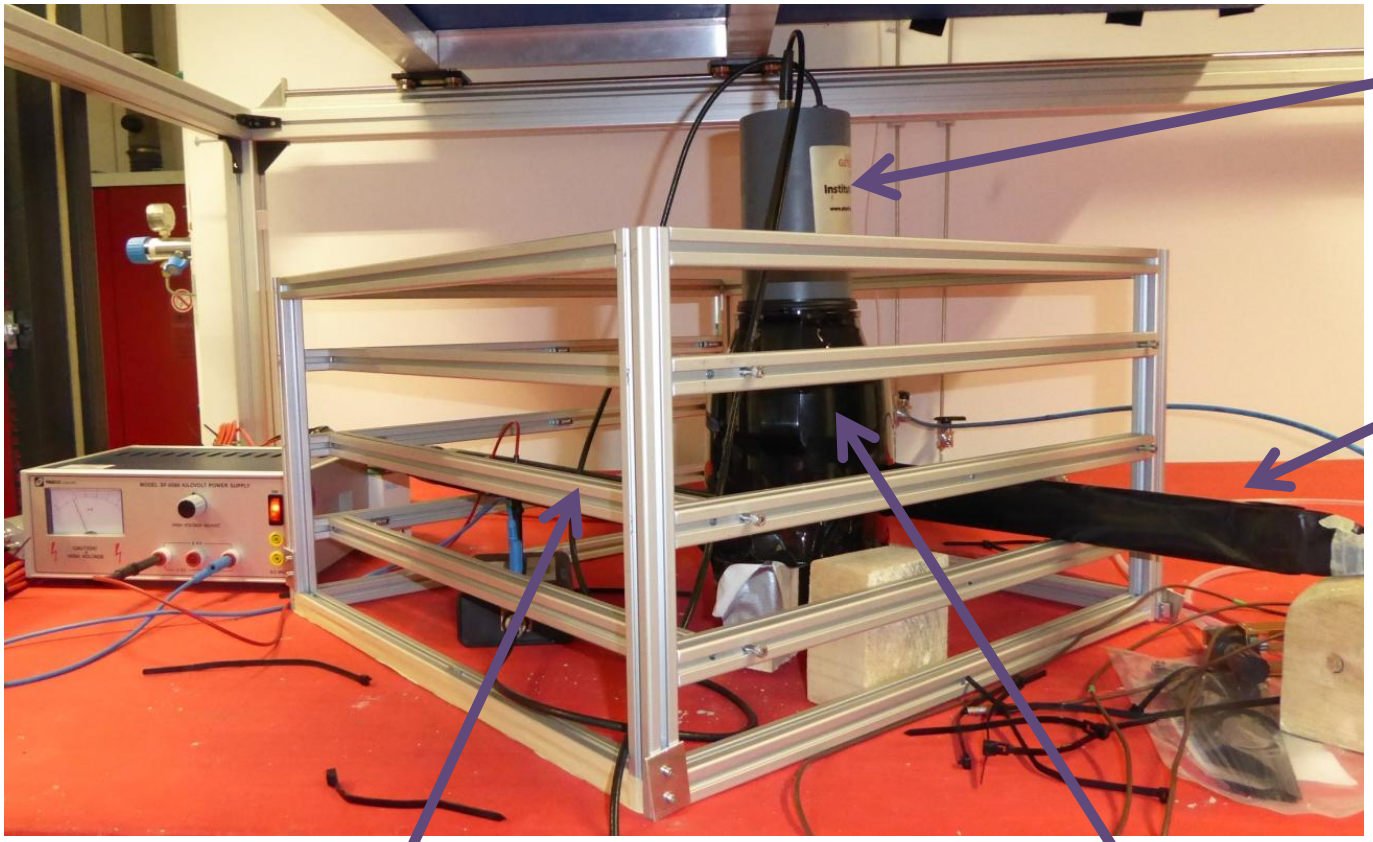
Outline

- Efficiency measurement
  - What is an efficiency?
  - Measurement of the efficiency
  - Comparison of the “Kamiokanne” and ATLAS experiments
- Trigger Monitoring
  - What is a trigger?
  - Trigger levels: L1 and HLT
  - Trigger monitoring
  - Comparison of the “Kamiokanne” and ATLAS experiments

Efficiency Measurement

- What is an efficiency?
  - Gives information about the system performance
    - here: how many of the particles are registered
  - Equation: $\varepsilon = \frac{registiered\ particles}{all\ particles}$

Efficiency Measurement



Efficiency Measurement

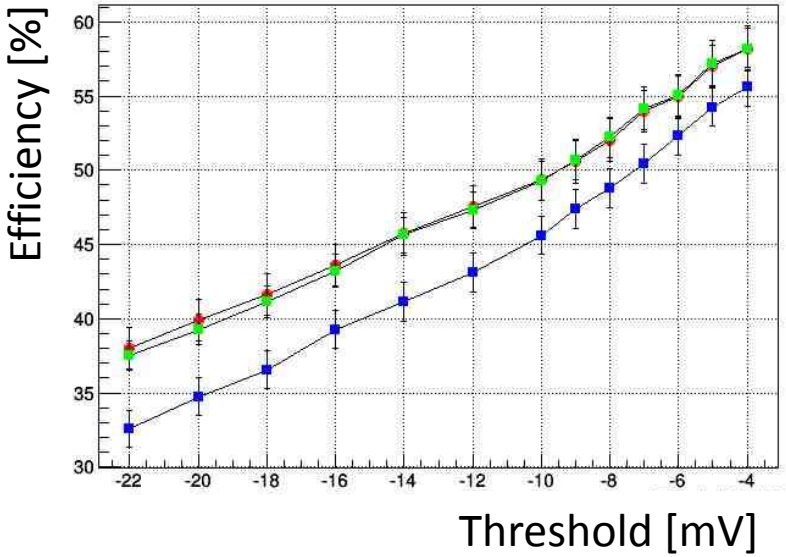
- Measurement of the efficiency
  - Tag-and-probe method

"Kamiokanne"	ATLAS (Z -> μ- + μ+)
"Kamiokanne" with 2 external scintillators	No additional independent information available -> develop a concept based on ATLAS-trigger information alone
External scintillators: "There was a muon!" -> tag Kamiokanne: "Did you see it, too?" -> probe	First muon: "I fired the trigger!" -> tag Second muon: "Did you fire the trigger, too?" -> probe
$\varepsilon = \frac{reg.muons\ by\ both\ detectors}{reg.muons\ by\ scintillators}$	$\varepsilon = \frac{both\ muons\ triggered}{one\ or\ both\ muons\ triggered}$

Efficiency Measurement

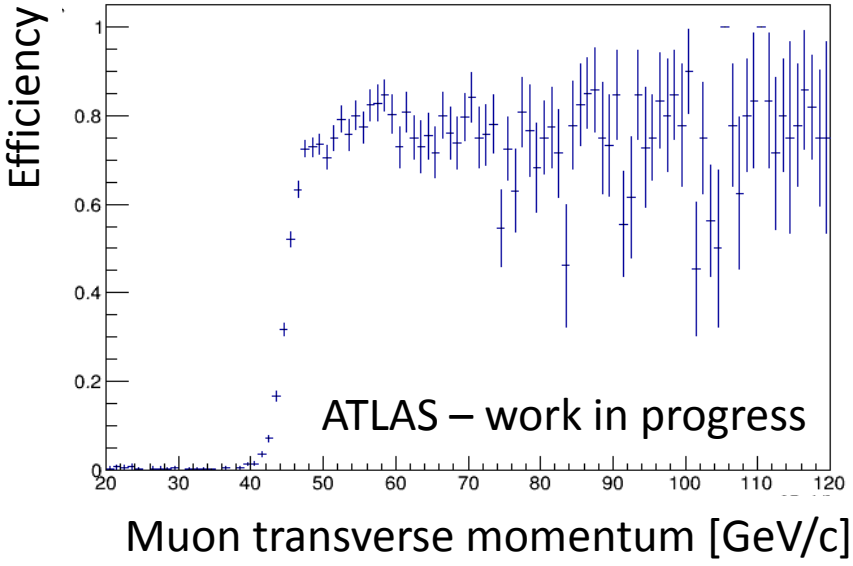
“Kamiokanne”

Threshold: -4 to -22 mV



ATLAS (Z -> μ- + μ+)

Trigger: 50 GeV



Efficiency Measurement

- Comparison of the efficiencies
  - ATLAS: simulation vs. real data
    - Simulation: ~ 86%
    - Real data: ~ 76%
  - “Kamiokanne” vs. ATLAS
    - ATLAS is much more efficient
    - “Kamiokanne”: 30 - 60% depending on the threshold
    - ATLAS: ~ 76%

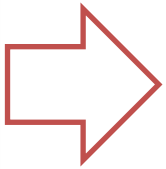
Trigger Monitoring

- What is a trigger?
  - Finds “interesting events”
    - When is there an event?
    - What is an “interesting event”?
  - Ensure that only “interesting events” are read out and not the “uninteresting background”
    - Dead-time during readout
    - But: some “interesting events” might get kicked out
      - Efficiency can’t get 100%

Trigger Monitoring

- Trigger levels: L1 and HLT

L1: Level 1 Trigger
- hardware-based trigger
- takes only a quick look at the events and makes a rough decision
- if it's a "good" event -> HLT



HLT: High Level Trigger
- software-based trigger
- analyses the filtered event further and takes more time for that
- if it's a "good" event -> readout and storage

- decision time: 2.5 µs
- output rate: 100 kHz

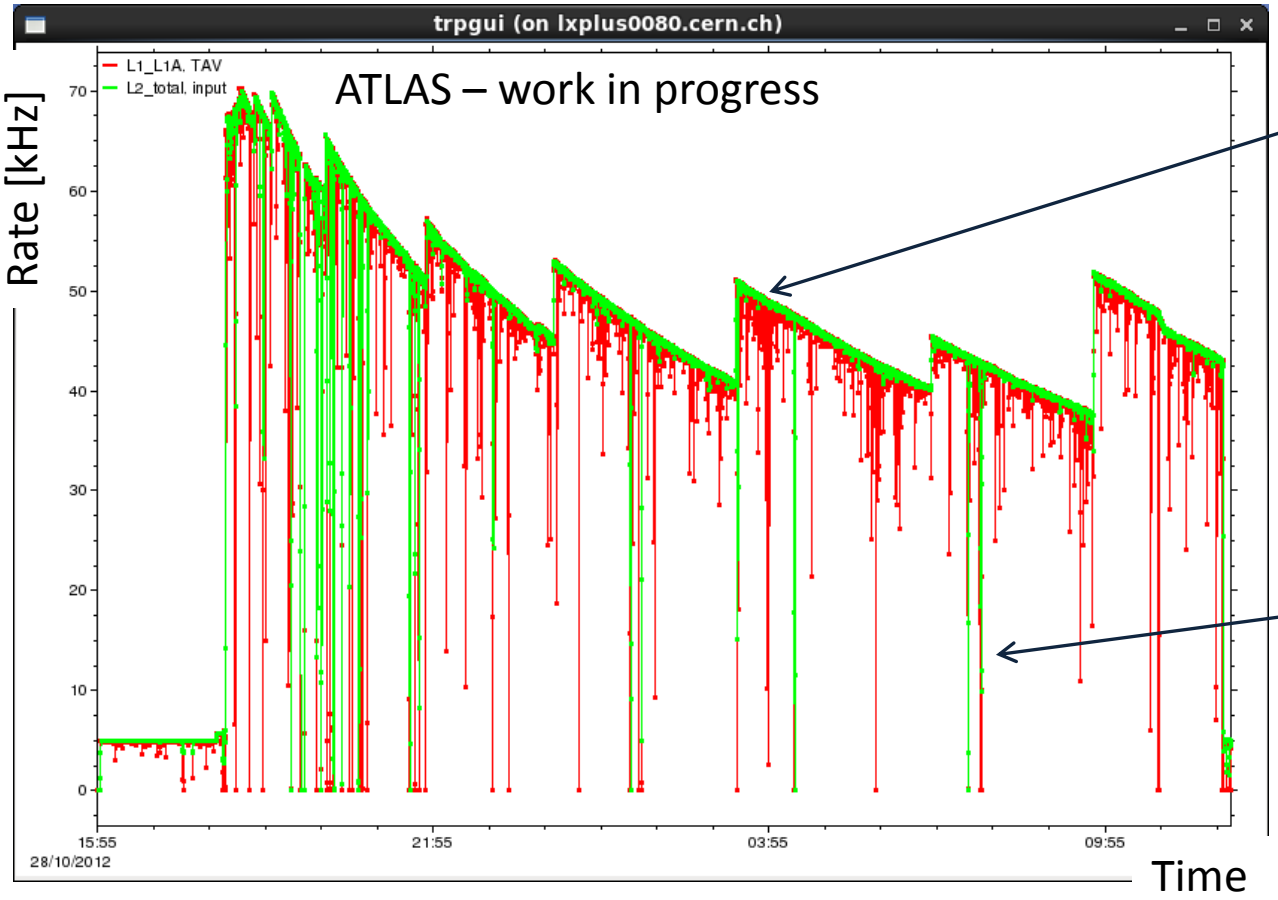
- computing farm: 28,000 CPUs
- output rate: 2 kHz

Trigger Monitoring

- Comparison: trigger systems

“Kamiokanne”	ATLAS
One trigger level	L1 and HLT
Simple trigger (only one condition)	Complex trigger (several triggers)
Time of the event isn’t set	Time of the event is known
When does the event come?	What kind of event is it?

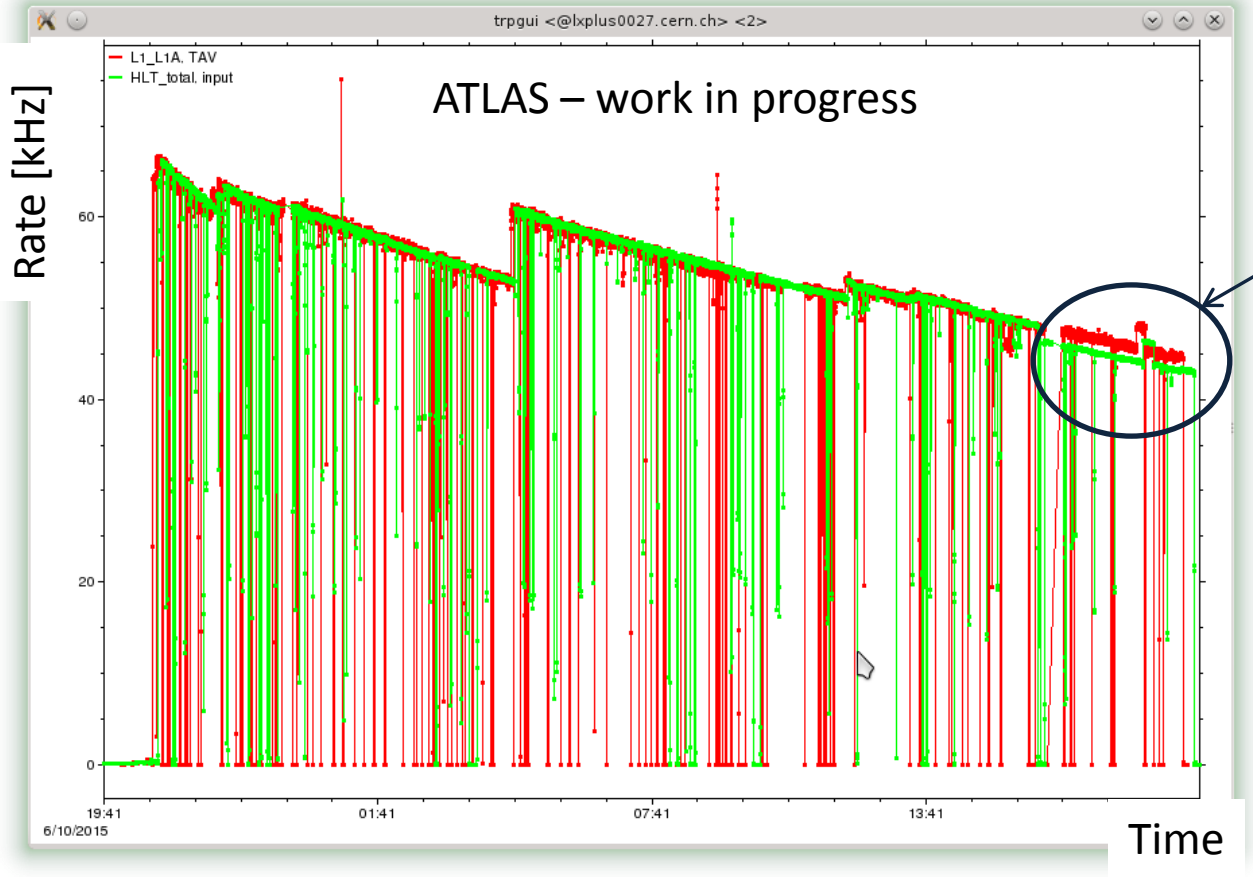
Trigger Monitoring



L1 output and HLT input have the same rate

Delay between HLT and L1 signals is small and does not change

Trigger Monitoring



Last 3 hrs:
Difference in the rates and an increasing delay between L1 and HLT

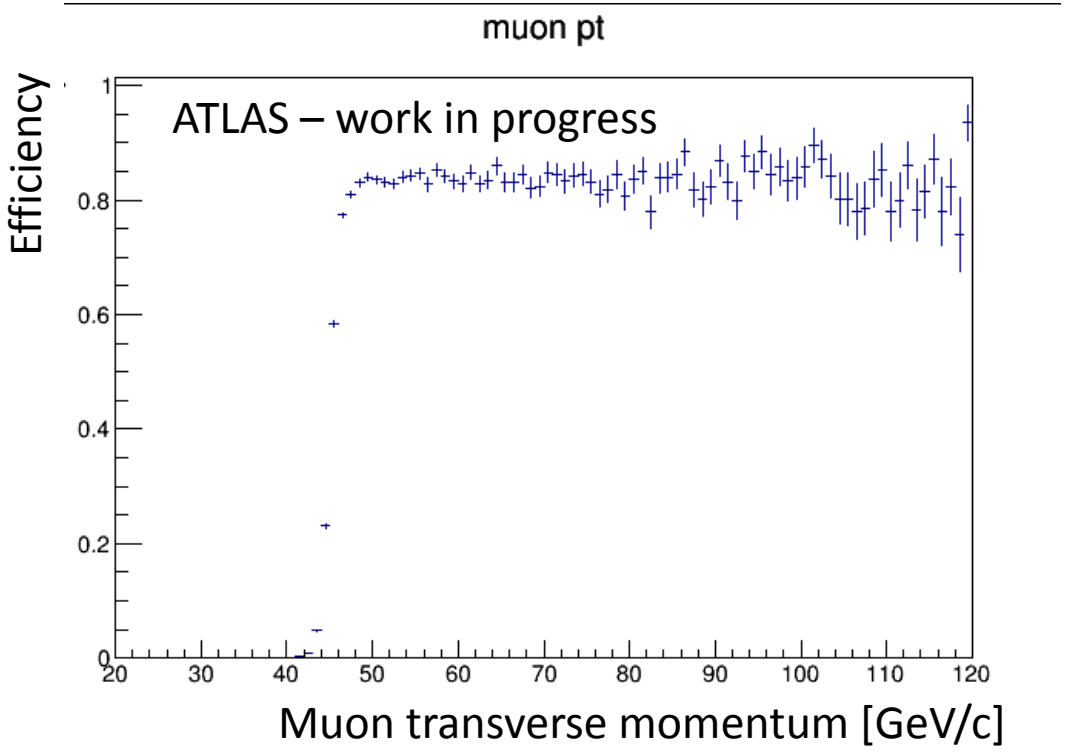
Maybe due to a restart of a system component

Conclusions

- Efficiency:
  - Calculation of the efficiency with tag-and-probe
    - ATLAS: simulation ~ 86%; real data: ~ 76%
    - “Kamiokanne”: 30 -60%
- Trigger Monitoring:
  - ATLAS vs.“Kamiokanne” trigger
    - ATLAS:
      - complex, more leveled trigger; time of the event is known
      - important question: What kind of event is it?
    - “Kamiokanne”:
      - one simple trigger; time of the event is unknown
      - important question: When does the event happen?

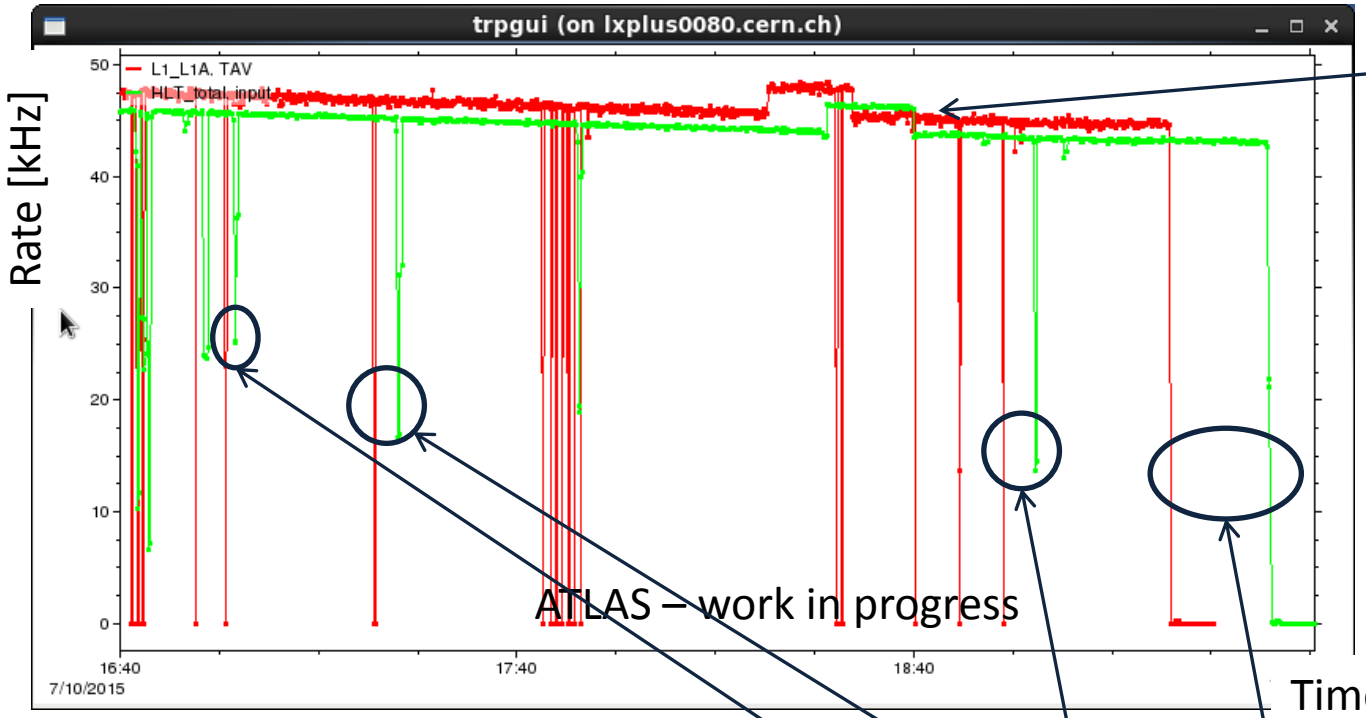
Thank you for your attention!

Backup Slides



Efficiency measurement
- Monte-Carlo-Simulation
- Trigger: (50 GeV)
- Efficiency: ~ 83%

Backup Slides



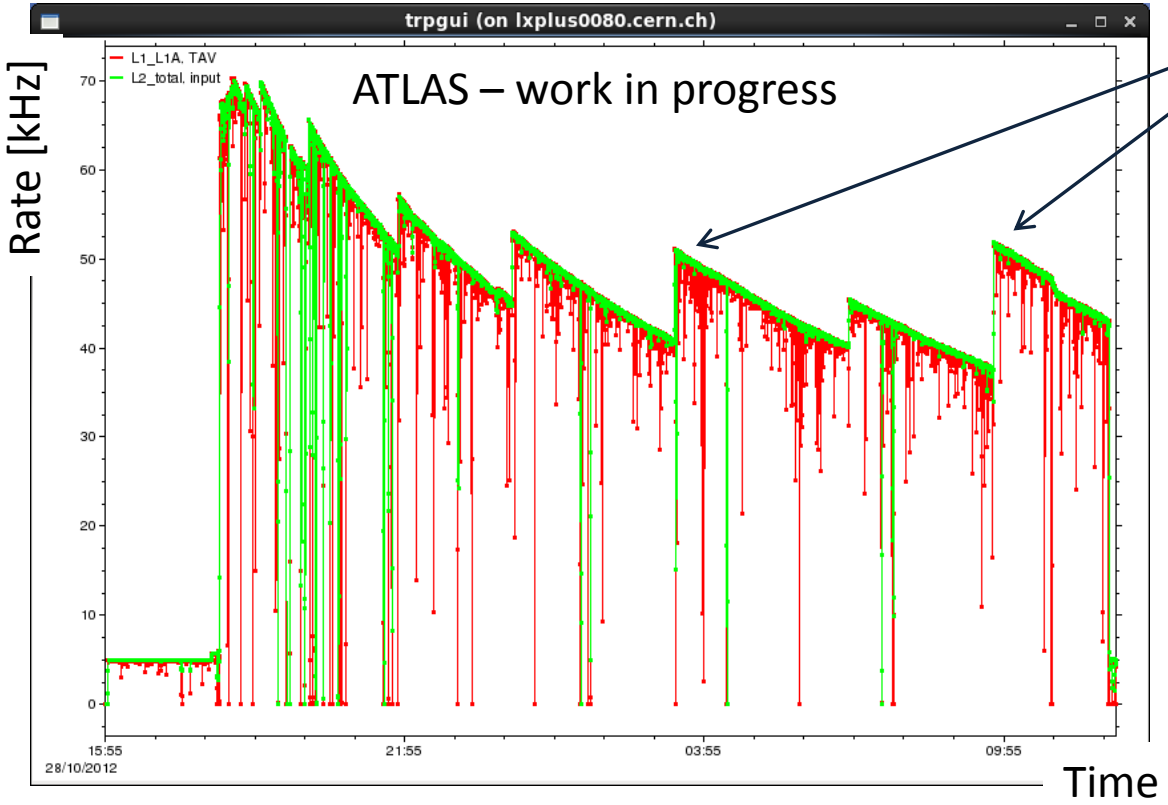
Different rates of L1 output and HLT input

Delay between L1 and HLT gets bigger as the time progresses

Backup Slides

- Dead-time: the time a detector cannot take any new data and is “dead”, should be as low as possible
- Prescale: if a trigger has a too high output, it gets prescaled, for example, at a prescale of 10, every tenth event is taken

Backup Slides



Dips and edges:

- luminosity goes down
- rate gets lower
- to hold the rate almost stable in total, prescales are changed
  - for ex.: a prescale of 10 is set to a prescale of 5
  - rate gets higher again