

Trigger studies and measurements of gas mixtures for the OPERA experiment

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Topics' overview



Trigger
studies and
measurements
of gas
mixtures for
the OPERA
experiment

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Overview

Neutrino
Physics

OPERA

Noise studies

Event studies

Triggerless
events

Learning
experience

Thanks

- ① Neutrino Physics
- ② OPERA Experiment
- ③ Noise and Event Studies
- ④ Triggerless Events

Neutrino Physics at OPERA



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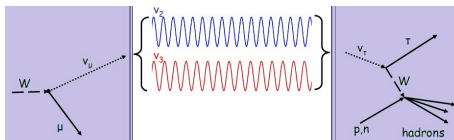
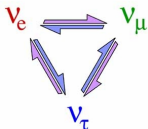
Event studies

Triggerless events

Learning experience

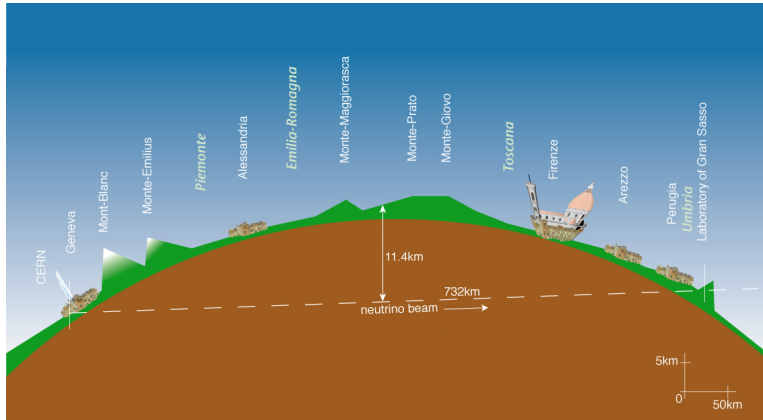
Thanks

- Neutrino Oscillations



- Experimental evidence for ν oscillations
- OPERA: direct detection of $\nu_\mu \leftrightarrow \nu_\tau$ oscillation
- Importance of experimental observation of $\nu_\mu \leftrightarrow \nu_\tau$
 - ⇒ experimental evidence and explanation of atmospheric ν_μ disappearance

The OPERA Experiment



$$\nu_{\tau} + N \longrightarrow \tau^{-} + X$$

The OPERA Experiment



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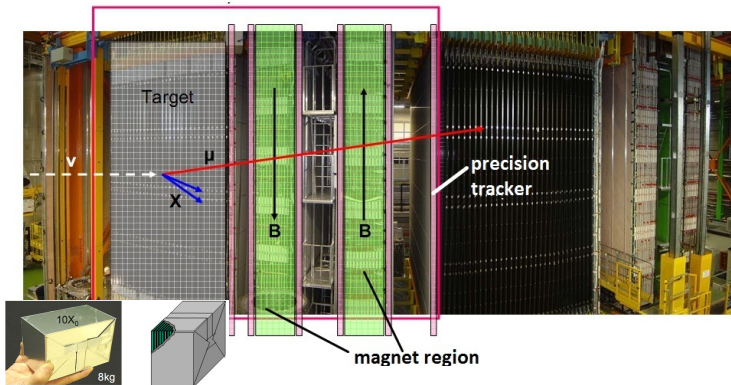
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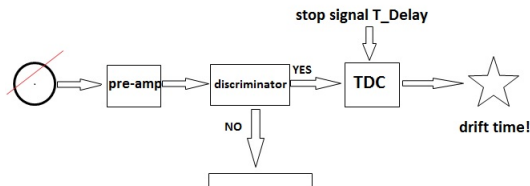
- Detector characteristics

The Hamburg Experimental Setup



Trigger studies and measurements of gas mixtures for the OPERA experiment

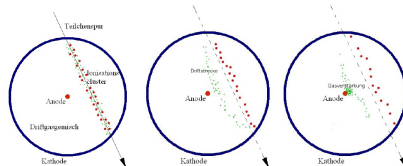
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$$t_{Drift} = t_{Delay} - t_{TDC}$$

➡ Always room for development!

- Gas mixtures
- Electronics
- Trigger techniques



The Hamburg Experimental Setup



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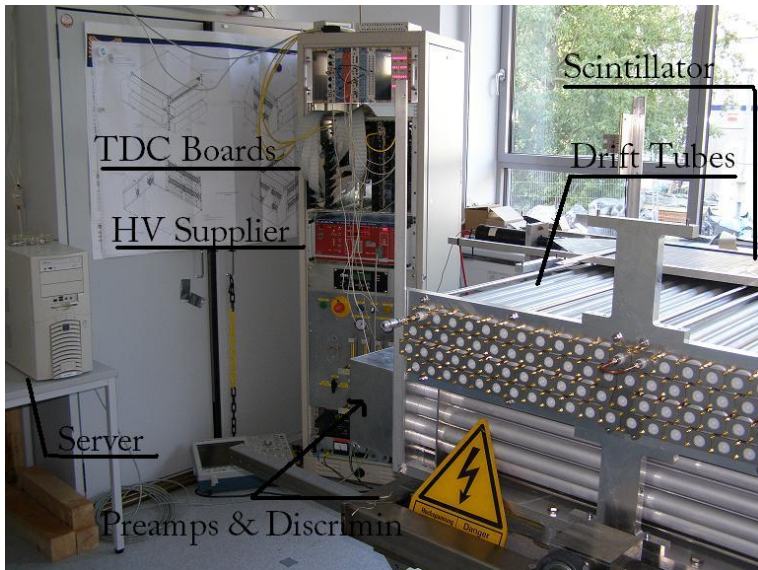
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Noise studies



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Thanks

- Purpose of study: the device is noisy!
- Main source: the electronics
 - ➡ Events with too few number of drift tubes activated (hits)
 - ➡ Events with too many tubes activated
- Investigation technique
- Through the OTB software the OTB send test pulses
- Record Data
 - ➡ for a range of thresholds 10–50mV
 - ➡ for a range of High Voltage 0–2600V

Noise studies: results



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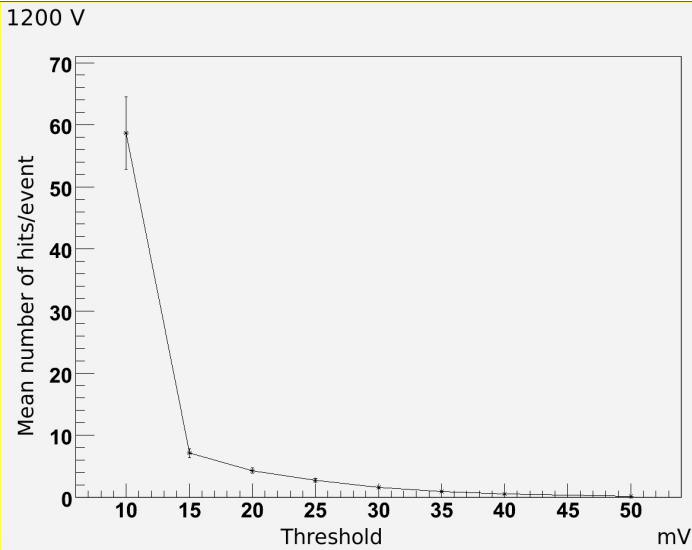
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Noise studies: results



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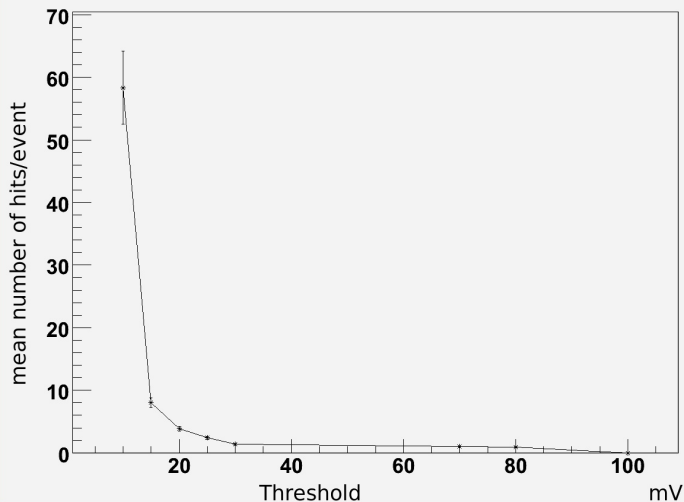
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2600 V



Event studies



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- Strong correlation between the number of detected events and high voltage
 - Very important for the calibration of the setup
- Examination of Cosmic Event in perspective of the threshold and the voltage
 - Large statistics of cosmic events
 - Examination of mean number of hits per event
 - 50 mV, 75 mV and 100 mV thresholds
 - 2000-2630V high voltage

Event studies: results



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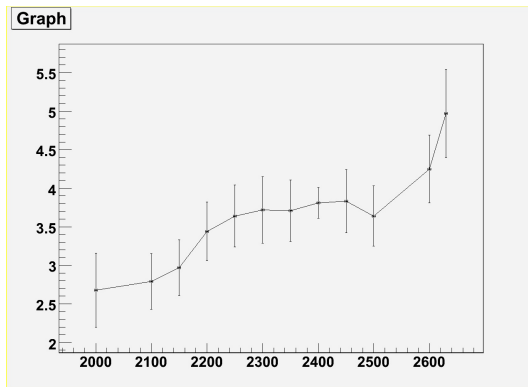
Triggerless events

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- Masking the data

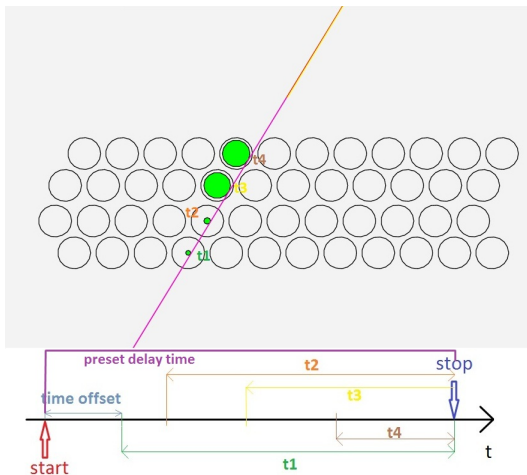
- Clear picture of the detection behaviour of the test setup



Trigger studies



- Track reconstruction



Trigger studies



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- Track parameters
 - ◇ α = the fit angle
 - ◇ p = starting position
- Fit quality control:

$$\chi^2 = \sum_{i=1}^N \frac{1}{\sigma_i^2} (d_{m,i} - d_{t,i})^2$$



Trigger studies



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- Purpose of study: improvement of the data
- Investigation technique:
 - Simulation of triggerless events



- Track reconstruction with triggerless events
- Comparison with original data

Trigger studies: results



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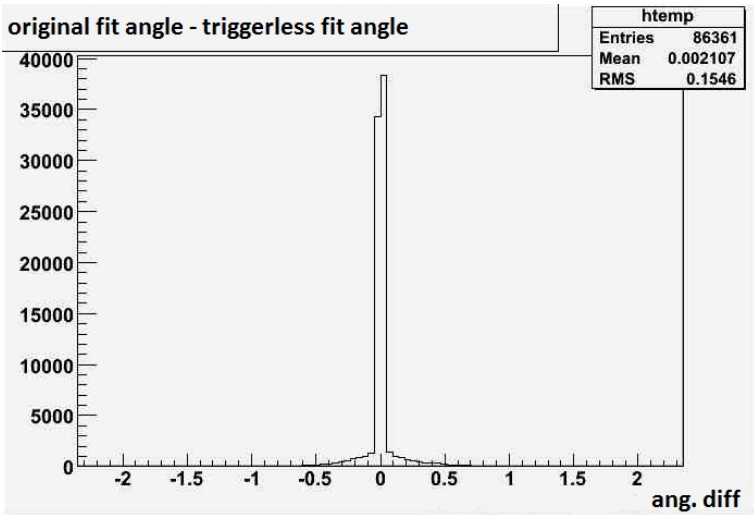
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Trigger studies: results



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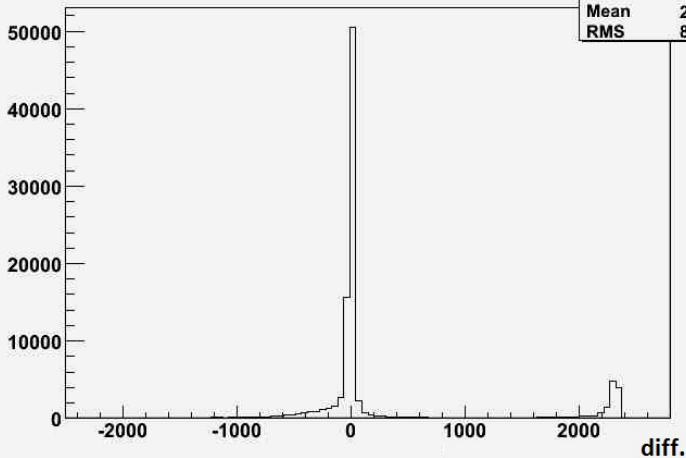
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original time offset - triggerless time offset



Trigger studies: results



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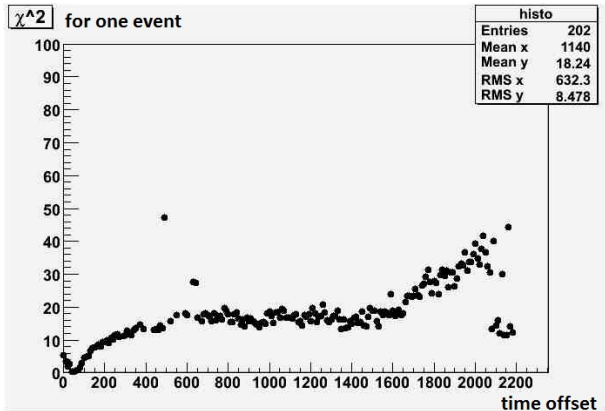
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- Original time offset=54;
- Triggerless time offset=40;
- Original fit angle=3.25717;
- Triggerless fit angle= 3.25784;

What have we learned...



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Thanks

- On a professional level
 - The importance of studying neutrinos
 - The true challenges of experimental neutrino physics
 - Valuable knowledge regarding research techniques and tools
- On a personal level
 - We learned what the daily work in a research group is like

Acknowledgements



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Thanks

THANK YOU!

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