Particle Detectors for the Most Energetic Particles

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Outline

MARTA - Pierre Auger Observatory

MARTA

Muon
Array with
RPCs for
Tagging
Air Showers

Figure 1: Cherenkov water tanks for cosmic rays detection
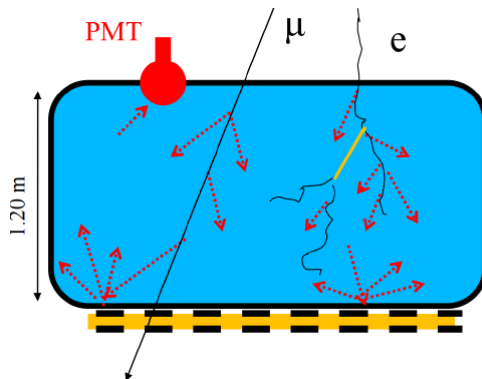
RPC - Resistive Plate Chamber

Figure 2: RPC schematic

Outline
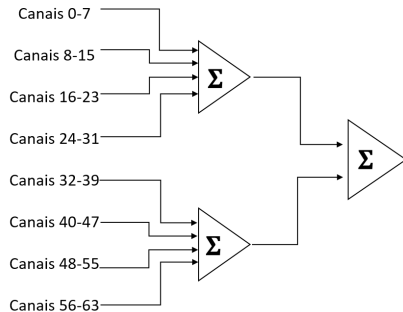
Circuit Board

Figure 3: Used Circuit Board

Figure 4: Summation Circuit Schematic

Schematic
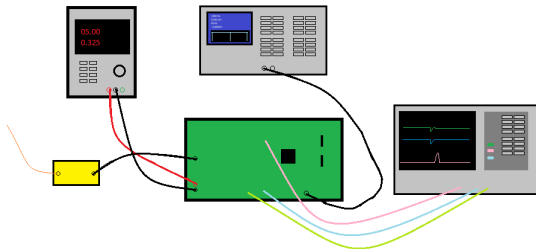
Figure 5: Circuit Setting

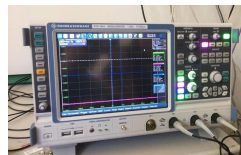

Figure 6: Oscilloscope, Power Supply, Signal Generator and Raspberry Pi
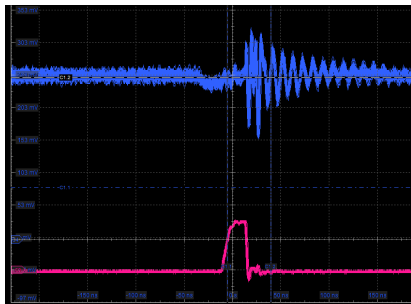
Outline

Signal at the OpAmp

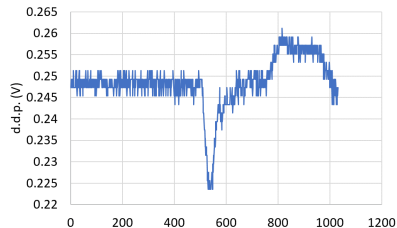Figure 7: Signal at TP27 with 32 channels on with 64 gain with noise

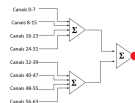Figure 8: Signal at TP27 with 32 channels on with 128 gain without noise

Figure 9: TP27 - Output of the Third
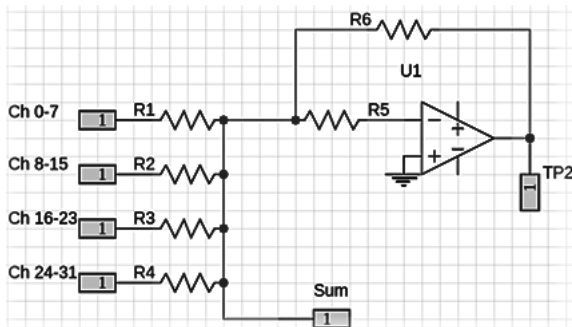
Initial Testing

Figure 10: Summation Amplifier Circuit
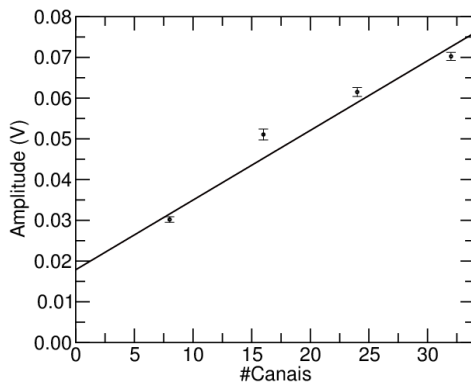
Voltage Measurements - First OpAmp

Figure 11: Fit of a linear curve over the voltage of the Summation for a gain of 32
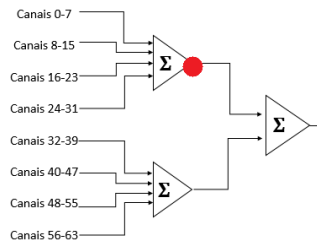

Figure 12: Signal Measured
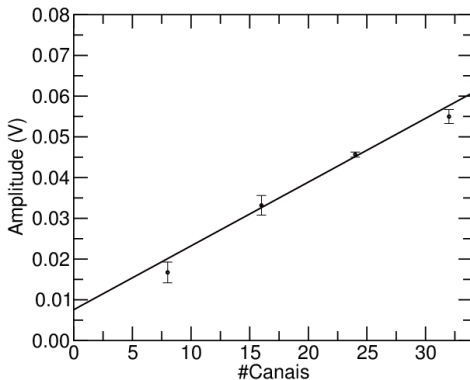
Voltage Measurements - Second OpAmp

Figure 13: Fit of a linear curve over the voltage of the Summation for a gain of 32
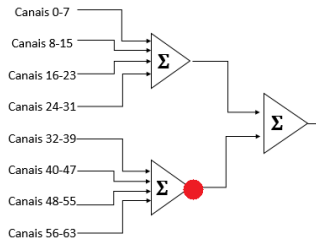

Figure 14: Signal Measured
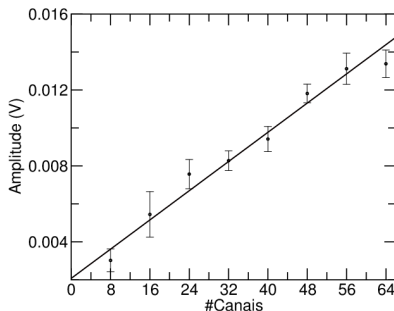
Voltage Measurements - Third OpAmp

Figure 15: Fit of a linear curve over the voltage of the total Summation for a gain of 32
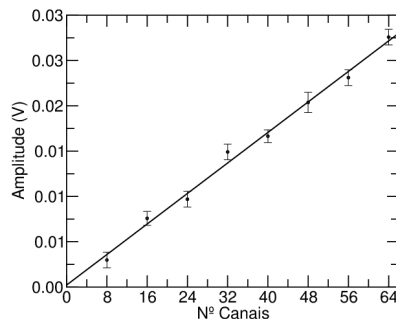

Figure 16: Fit of a linear curve over the voltage of the total Summation for a gain of 64
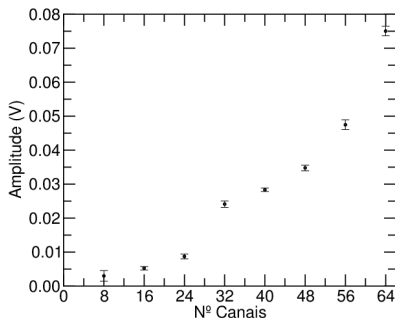
Voltage Measurements - Third OpAmp

Figure 17: Plot of the voltage of the total Summation for a gain of 128
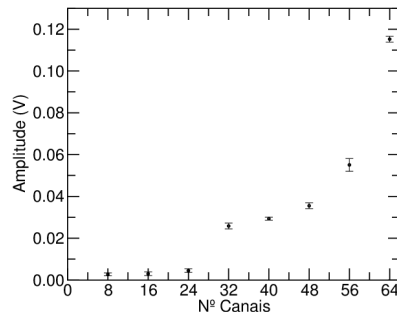

Figure 18: Plot of the voltage of the total Summation for a gain of 256
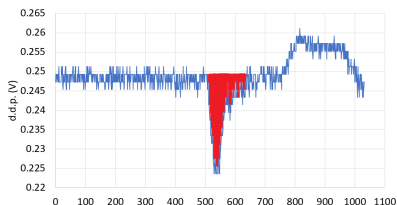
Charge Measurements

$$q = C.V$$

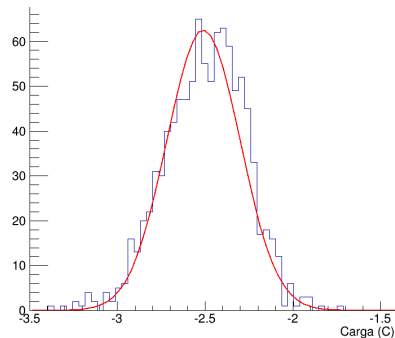Figure 19: Integral of the Slope Curve to Calculate the Charge

Figure 20: Normal Distribution of the Integrated Charge over 1000 measurements with 48 channels enabled
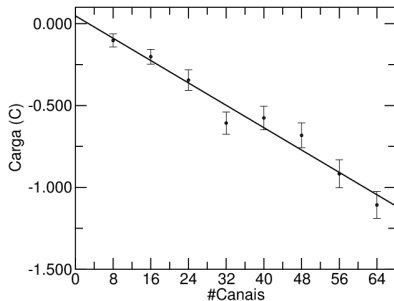
Charge Measurements

Figure 21: Fit of a linear curve over the integrated Charge of the total Summation for a gain of 32
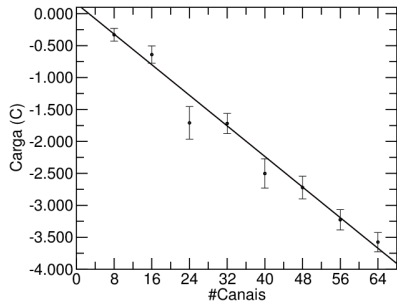

Figure 22: Fit of a linear curve over the integrated Charge of the total Summation for a gain of 64
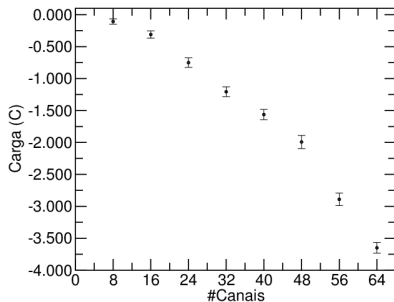
Charge Measurements

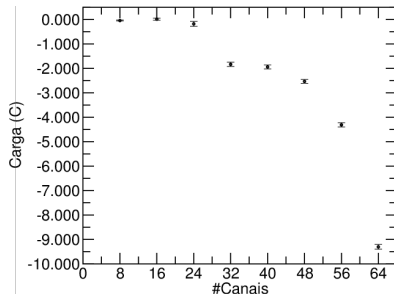Figure 23: Plot of the integrated Charge of the total Summation for a gain of 128

Figure 24: Plot of the integrated Charge of the total Summation for a gain of 256

Outline

Conclusions

The output of the OpAmps didn't behave as previously expected:

- It was expected a symmetry of results on the output signal of the OpAmp 1 and OpAmp 2.
- It was also expected a small gain on the summed signal (Summing Amplifier)

Measuring Problems

There was a significant amount of noise on the measured signal, possibly due to signal reflections, and pickup noise.

Impact on The Project

We helped improving the first part of the circuit board: the group decided to move the summation part to a side board.

The End

Questions ?