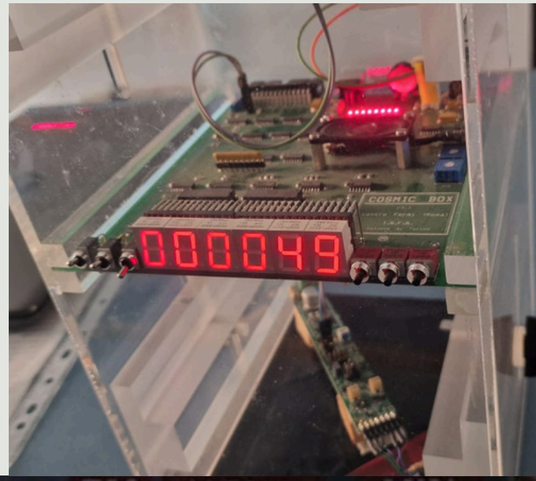
EXPERIMENT: DELOREAN



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Progetto Extreme Energy Events (EEE)
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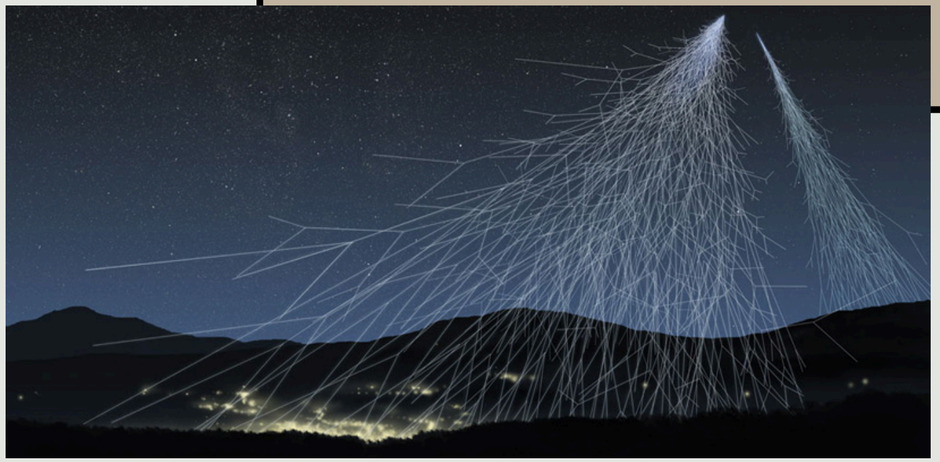
INTRODUCTION

The experiment aimed to study the correlation between the **muon count** and the **altitude** at which the measurement is made. Specifically, CB 6 was taken to **4** different altitudes at **500ft (152,4m)** intervals, maintaining constant speed and altitude for **5 minutes**, the interval used for the measurements.

HYPOTHESIS

Our preliminary assumption was that as the altitude **increases**,
the counts **increase** too
because as we move **further** from the impact of the cosmic rays,
it’s **more likely** for the mouns to **decay**



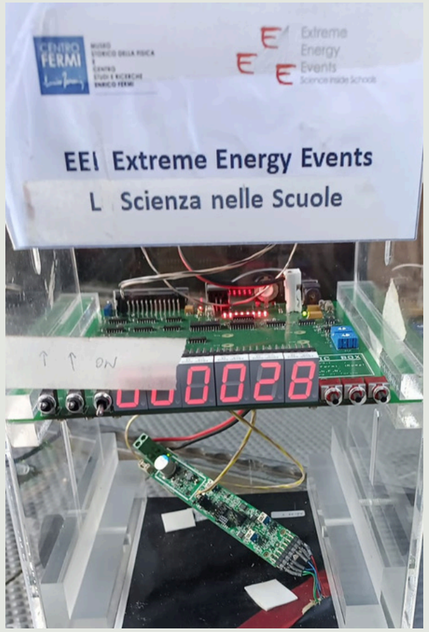
ERROR CALCULATION

Error calcolated for each measurement:

$\sqrt{N}$

As for the other parameters, we weren’t able to quantify the errors

RESULTS

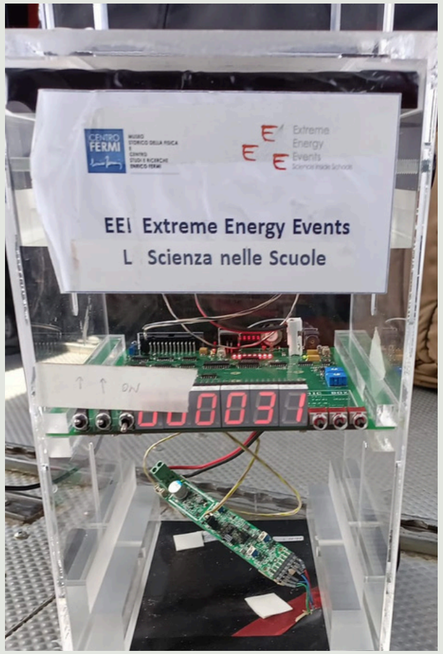


N=28±5

h=500ft=152,4 m

v=100 knts=185,2 km/h

ρ=1007 hPa



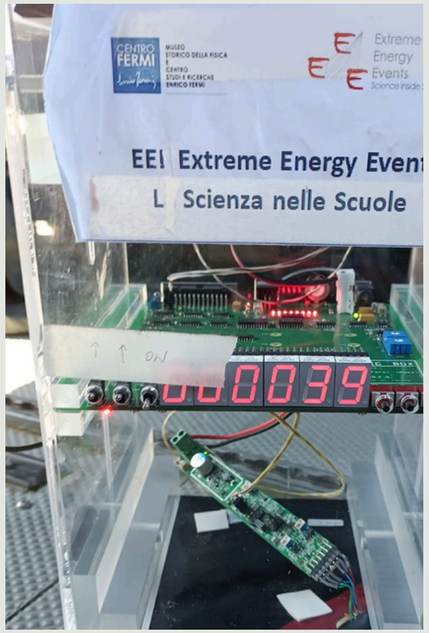
N=31±6

h=1000ft=304,8 m

v=100 knts=185,2 km/h

ρ=1007 hPa

RESULTS



N=39±6

h=1500ft=457,2 m

v=100 knts=185,2 km/h

ρ=1007 hPa

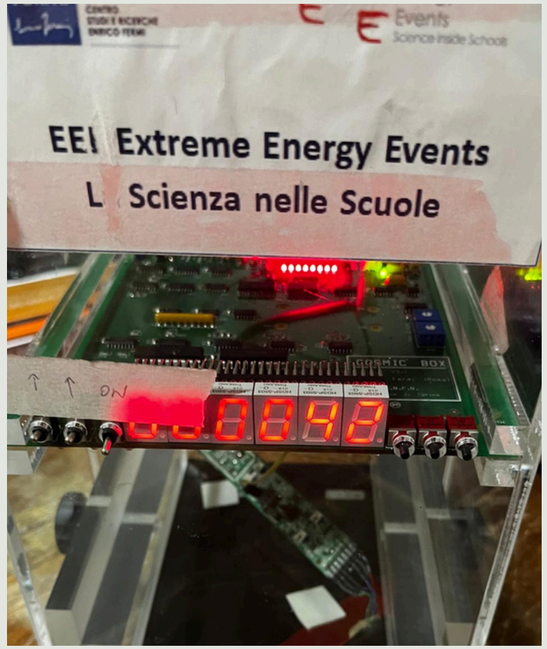
N=54±7

h=2000ft=609,6 m

v=100 knts=185,2 km/h

ρ=1007 hPa

RESULTS



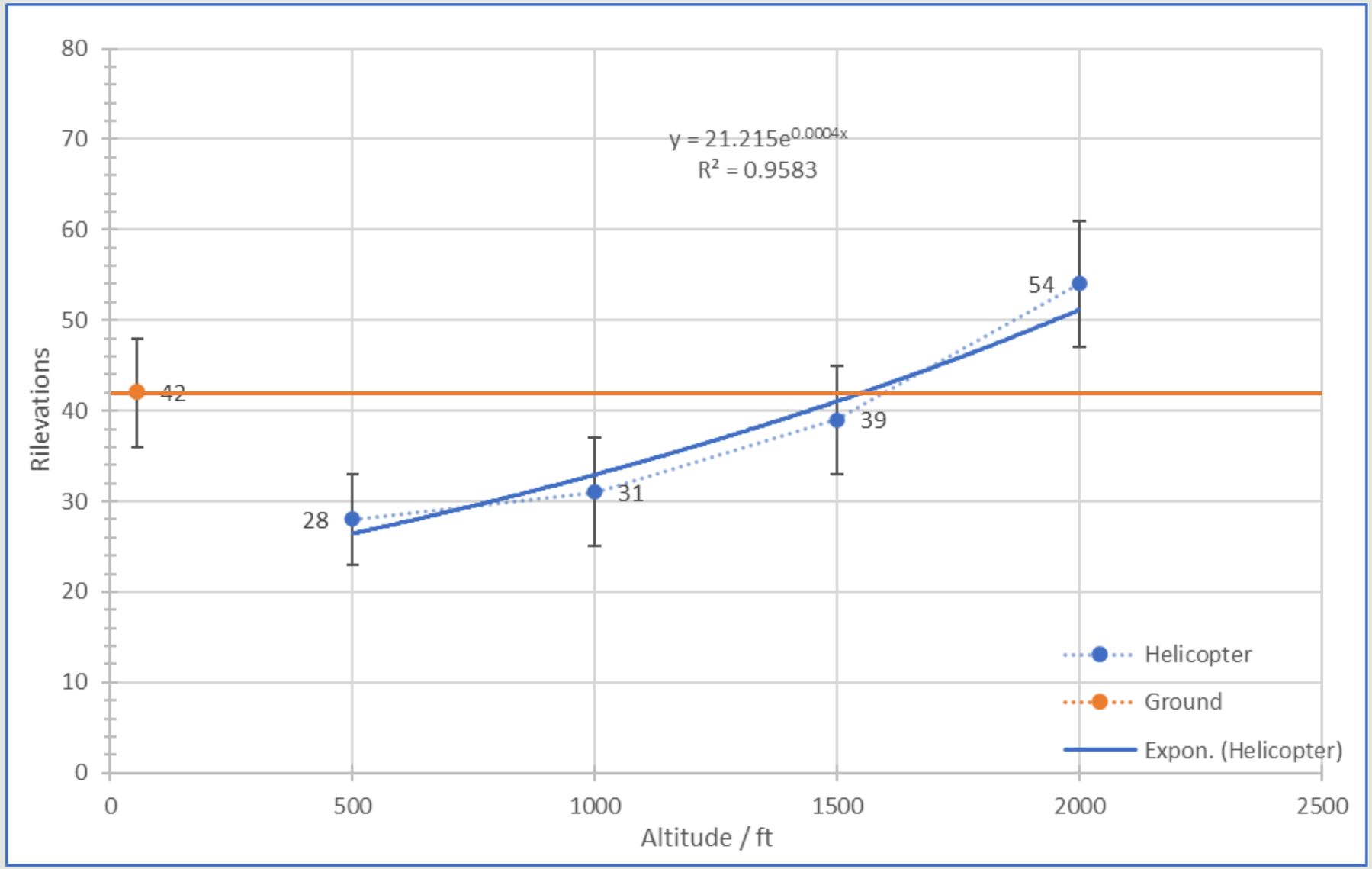
N=42±6

h=55.8ft=17m

v=0

p=1007 hPa

RESULTS


y = 21.215e^0.0004x
R² = 0.9583
Rilevations
Altitude / ft
0
10
20
30
40
50
60
70
80
0
500
1000
1500
2000
2500
42
28
31
39
54
Helicopter
Ground
Expon. (Helicopter)

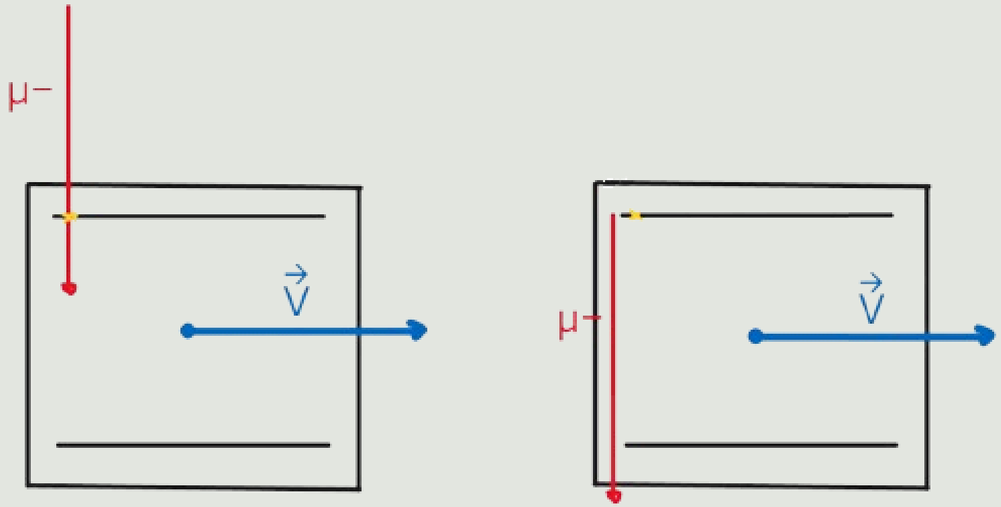
ANALYSIS OF RESULTS

The gap between data increases as the altitude increases suggesting a **non-linear correlation**, in fact, even though the polinomial would have fitted better, we used an **exponential function** to fit the data due to the nature of the event

But we did not expect measurements to be mostly **lower** than **ground** measurements so we hypothesized two different interferences:
Helicopter cell **inclination**
Horizzontal **velocity**

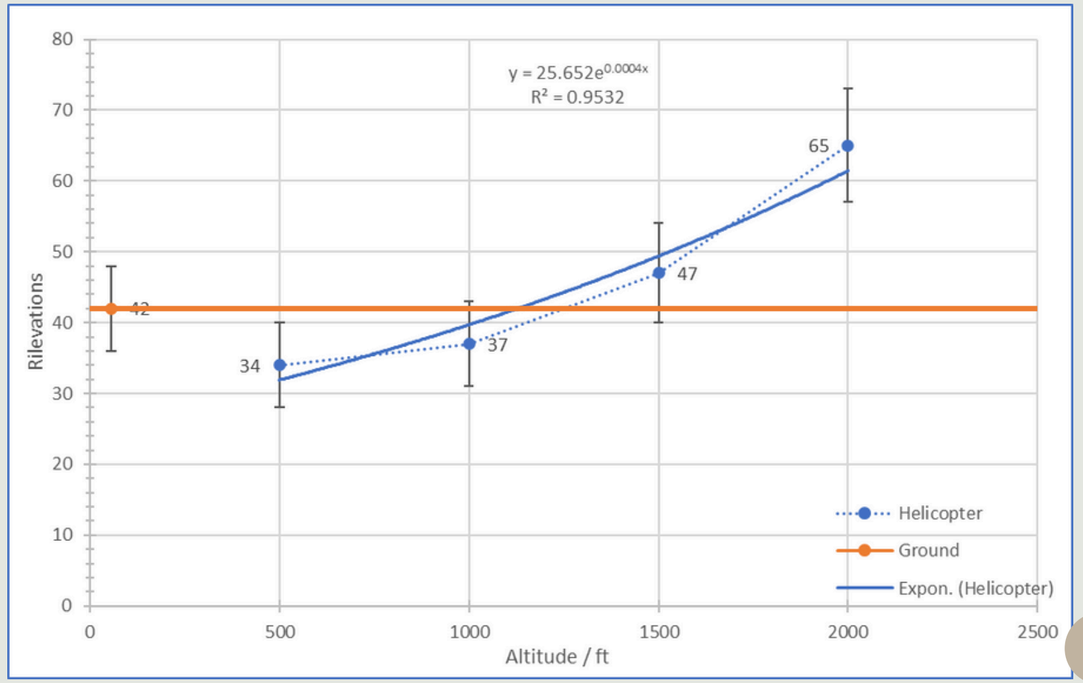
ANALYSIS OF RESULTS

- Let’s assume that the horizzontaly velocity interfered with the single rilevation, the time taken for the moun to pass through both plates the measurement is on the order of **10^-10s**; during this interval, the helicopter would have travelled about **10^-8m**, interfering with only about **0.000000044%** of the rilevations.



ANALYSIS OF RESULTS

- For what concerns inclination, the pilot has assured us that the helicopter cell was **parallel** to the ground.
- However we **supposed** a small inclination **not recognized** by the instruments. By using data from a previous study made by our school that related inclination of the CB with mouns counts, we found for each angle a "**moun loss**" in percentage to correct our data. Even considering 25°, however, the ground measurement was still **too high**.



SUGGESTIONS

- Even though we **teoretically proved** that the horizontal velocity **does not** interefere, we propose an experiment in train in order to reach **similar speeds** at about ground level
- We also would like to **repeat**, if possible, the experiment for **longer** misurations and for **higher** altitudes

THE ELECTROMAGNETIC ISSUE

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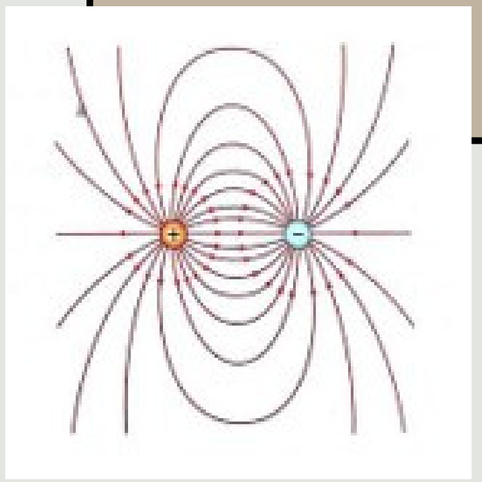
INTRODUCTION

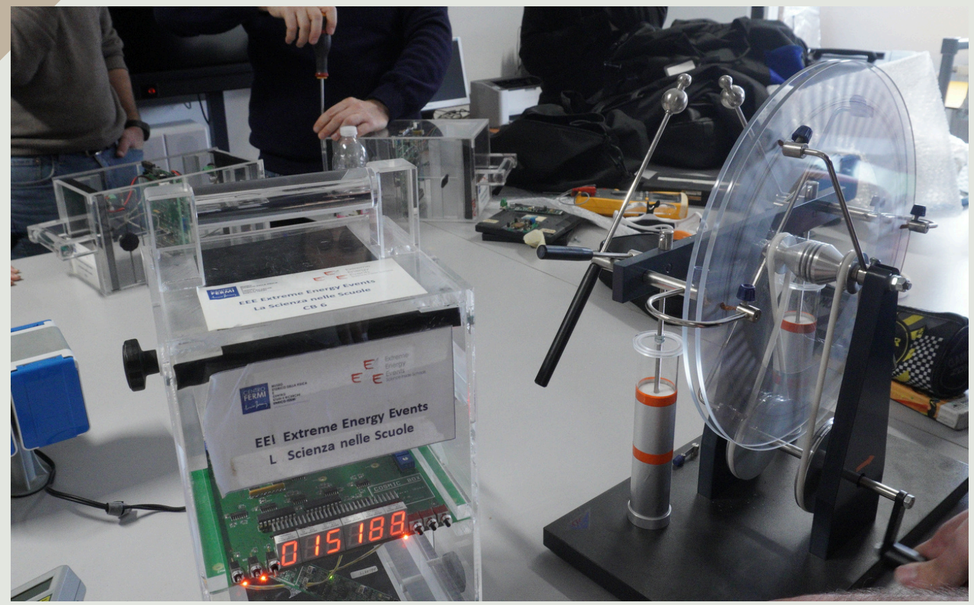
During our measurements we noticed that the cosmic box has an abnormal behavior, namely a high number of counts in a short period of time, when exposed to a strong electric field generated by a Wimshurst machine. To overcome this problem we tried various ways reported below to shield the CB.

HYPOTHESIS

After numerous measurements we hypothesized that the electric field significantly interferes with the electronics and consequently alters the counting.



RECORDINGS WITHOUT SHIELDING



RECORDINGS WITH E=0

N=122±11
RECORDING TIME = 600s
RATE =0,20Hz

RECORDINGS WITH E≠0

N=17378±132
RECORDING TIME = 30s
CB-W.M. DISTANCE = 50CM
RATE =579,26Hz

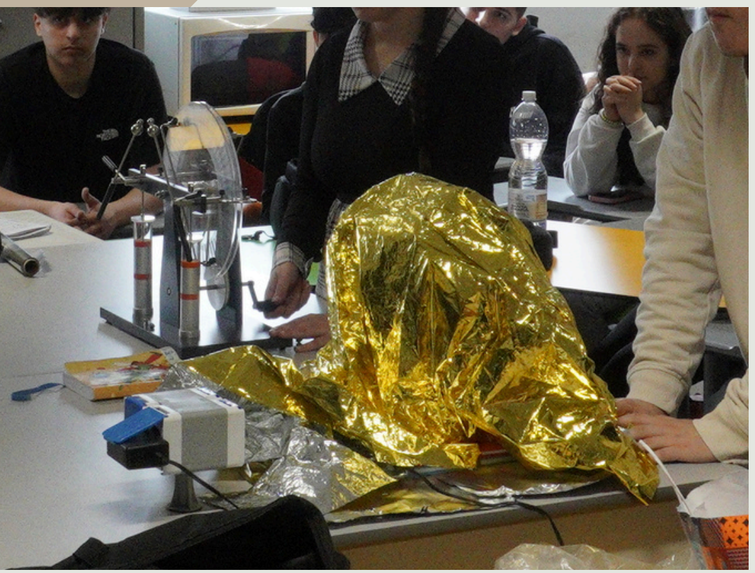
W.M.=Wimshurst machine

RESOLUTION OF THE PROBLEM

As mentioned at the beginning, to decrease or almost cancel the interaction between the electric field and the CB we tried several ways:

1. using a thermal blanket wrapped around the instrument
2. placing the instrument in a metal cabinet
3. using a metal bird cage
4. placing the instrument in a self-built cage

THERMAL BLANKET



We wrapped the C.B. with the thermal blanket

RECORDINGS WITH E=0

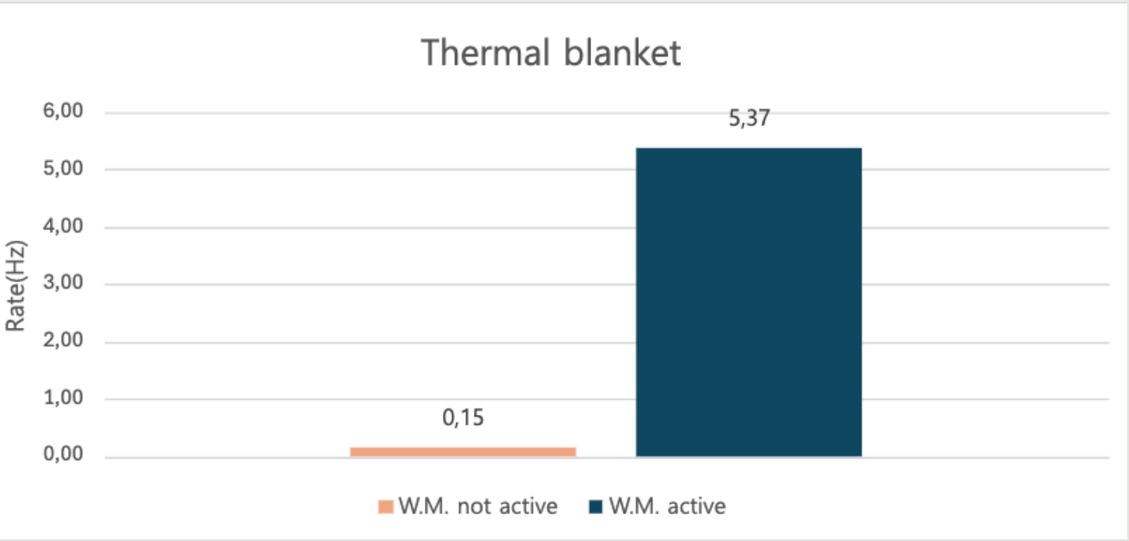
N=92±10
RECORDING TIME = 600s
RATE =0,15Hz

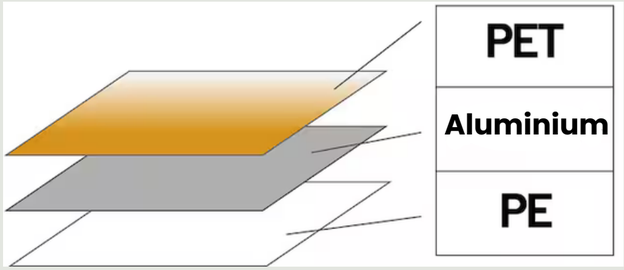
RECORDINGS WITH E≠0

N=161±13
RECORDING TIME = 30s
CB-W.M. DISTANCE = 50CM
RATE =5,37Hz

RESULTS

The thermal blanket partially shielded the CB from the electric field. The problem therefore persisted and above all the solution was not portable. In fact the material is too thin (12 μm approx.) and with some research we discovered that the metal part makes up a third of the thickness which weakens the protection.





METAL CABINET

we put the C.B. inside our lab's metal cabinet

RECORDINGS WITH E=0

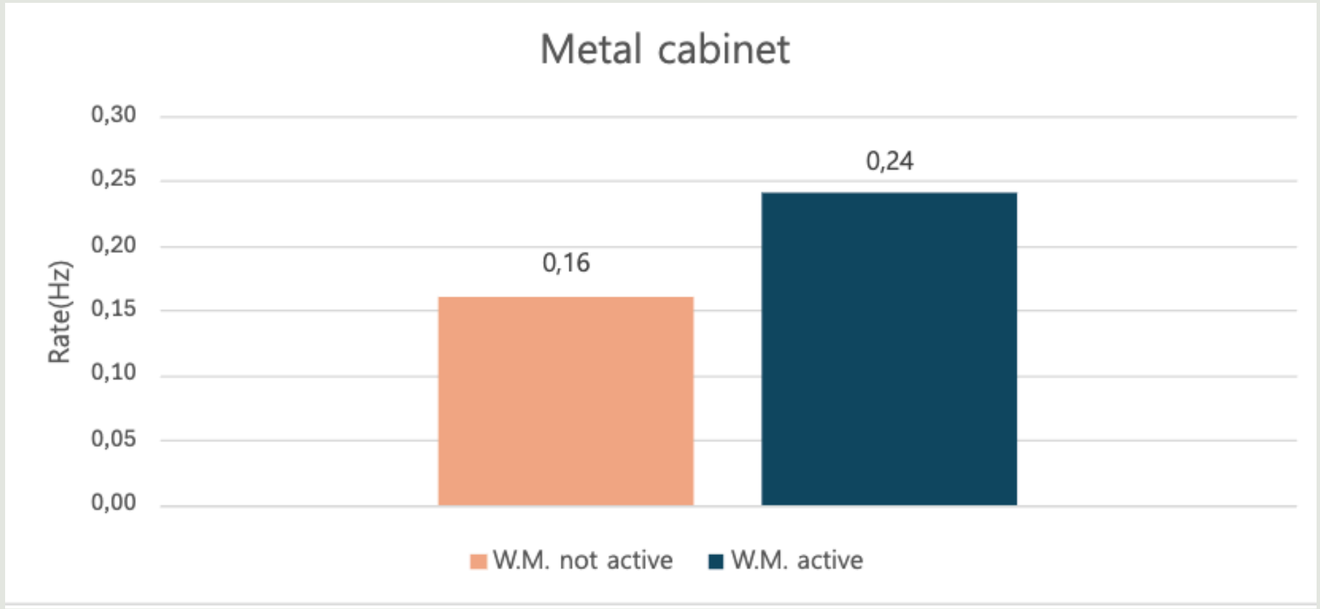
N=98±10
RECORDING TIME = 600s
RATE =0,16Hz

RECORDINGS WITH E≠0

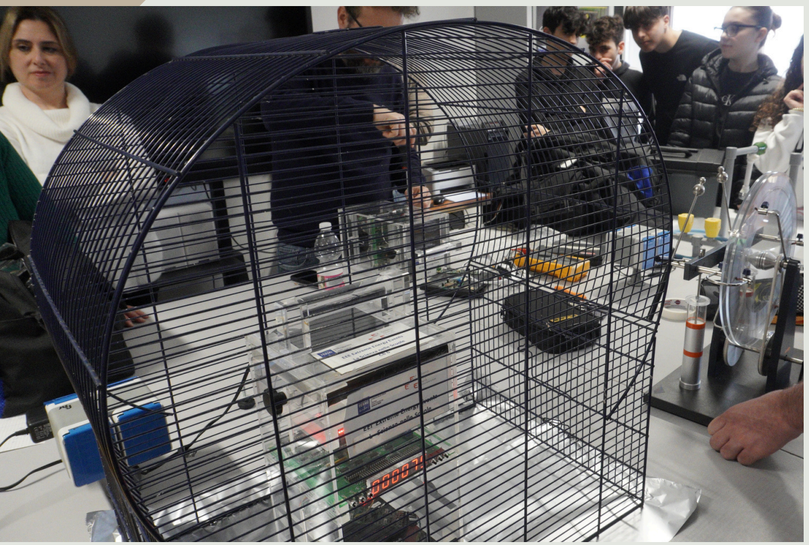
N=7±3
RECORDING TIME = 30s
CB-W.M. DISTANCE = 50CM
RATE =0,24Hz

RESULTS

The cabinet significantly reduced the effect of the electric field but the problem continued to be the portability of the shielding.



BIRD CAGE



we put the C.B. inside the bird cage

RECORDINGS WITH E=0

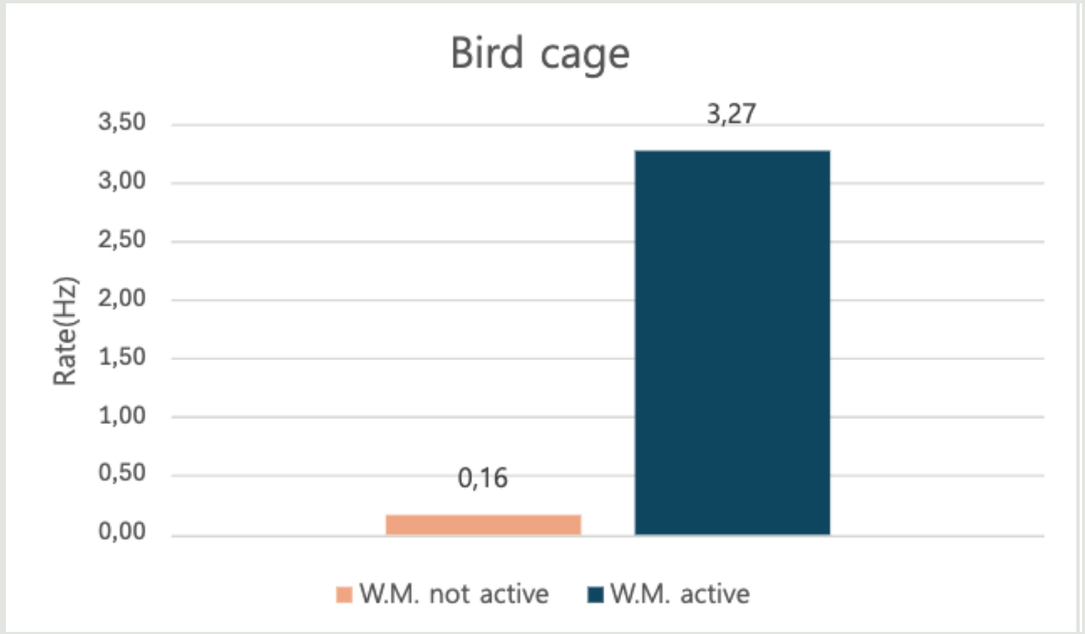
N=98±10
RECORDING TIME = 600s
RATE =0,16Hz

RECORDINGS WITH E≠0

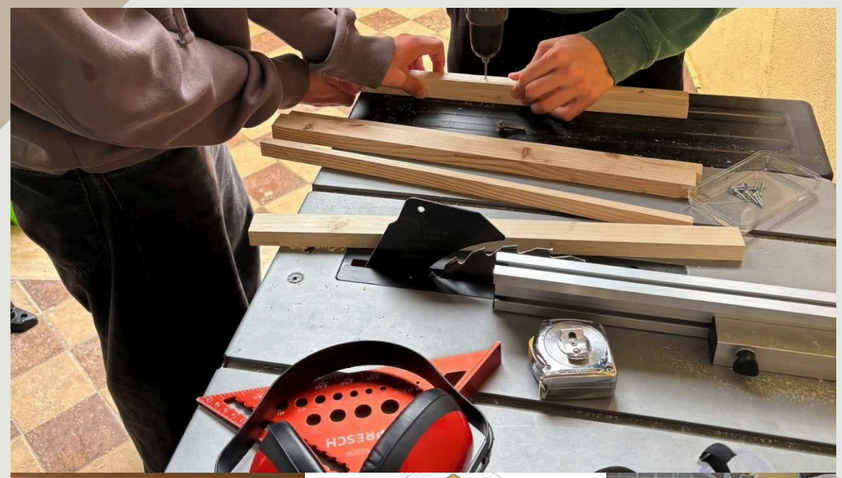
N=98±10
RECORDING TIME = 30s
CB-W.M. DISTANCE = 50CM
RATE =3,27Hz

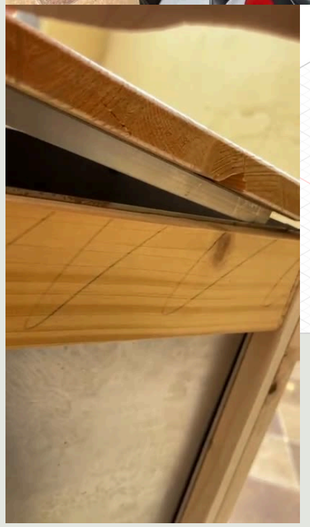
RESULTS

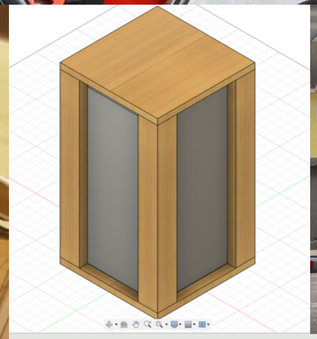
Given the lattice structure of this cage, the shield was not entirely effective and still required the use of additional aluminum sheets to cover the base which otherwise remained uncovered.



SELF-BUILT CAGE

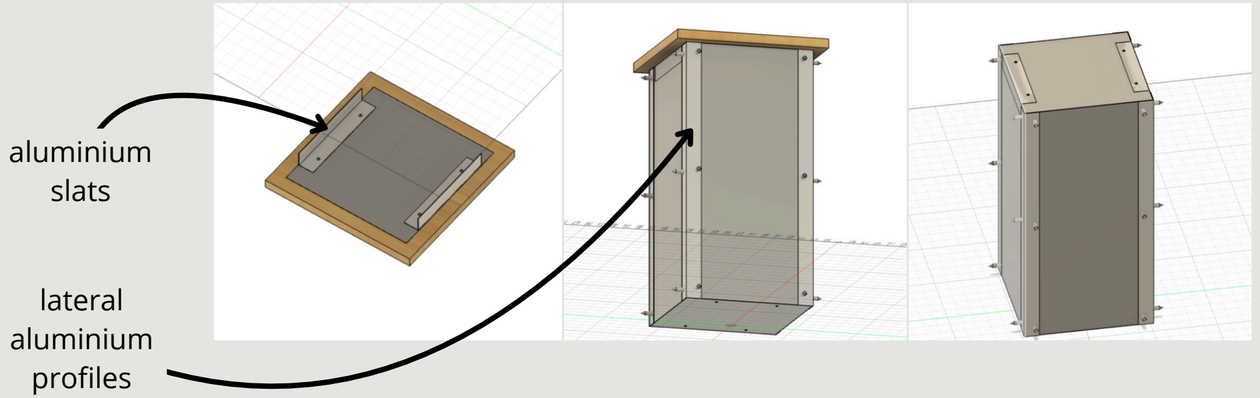






LID

VIEW WITHOUT WOOD



BRIEF DESCRIPTION

To therefore have an effective and portable solution we have designed and built a Faraday cage. The wooden structure forms a support to fix 6 galvanized steel plates of 0.75 mm thickness. The side plates are interconnected with aluminum profiles. The lower plate is interconnected by contact with those on the sides while the lid plate has aluminum slats that adhere to those below when closed

CONTINUITY TEST

To test the electrical connection between the metal plates we used a multimeter in continuity mode

SELF-BUILT CAGE

RECORDINGS WITH E=0

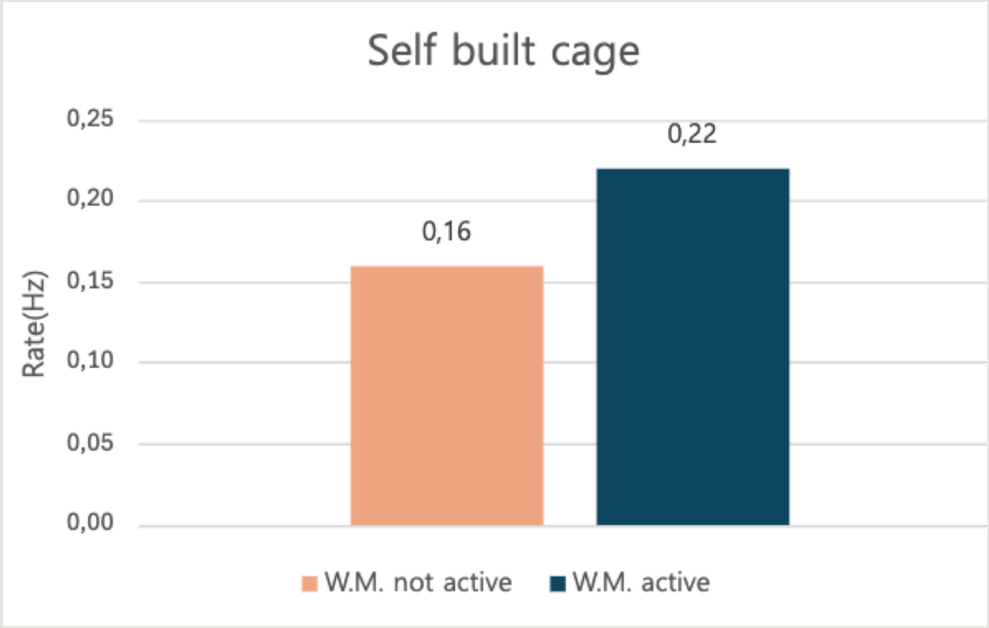
N=19±5
RECORDING TIME= 120s
RATE =0,16Hz

RECORDINGS WITH E≠0

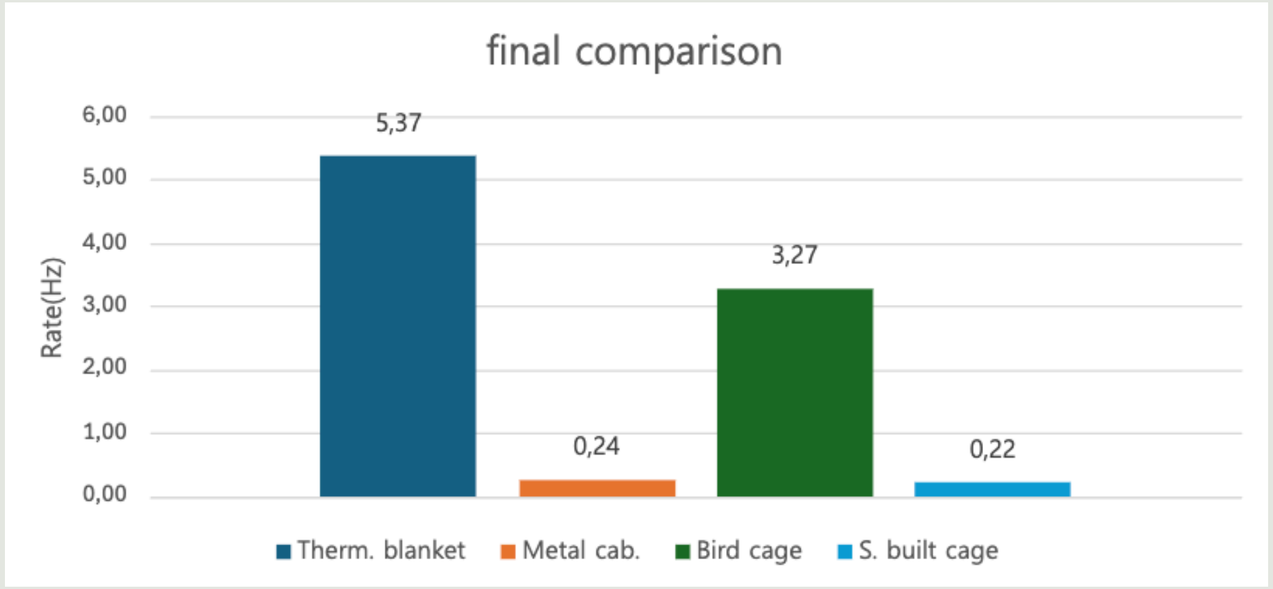
N=26±5
RECORDING TIME = 120s
CB-W.M. DISTANCE = 50CM
RATE =0,22Hz

RESULTS

from the measurements turns out that the cage is able to decisively shield the CB from the electric field. This is our definitive solution as it is both effective and portable

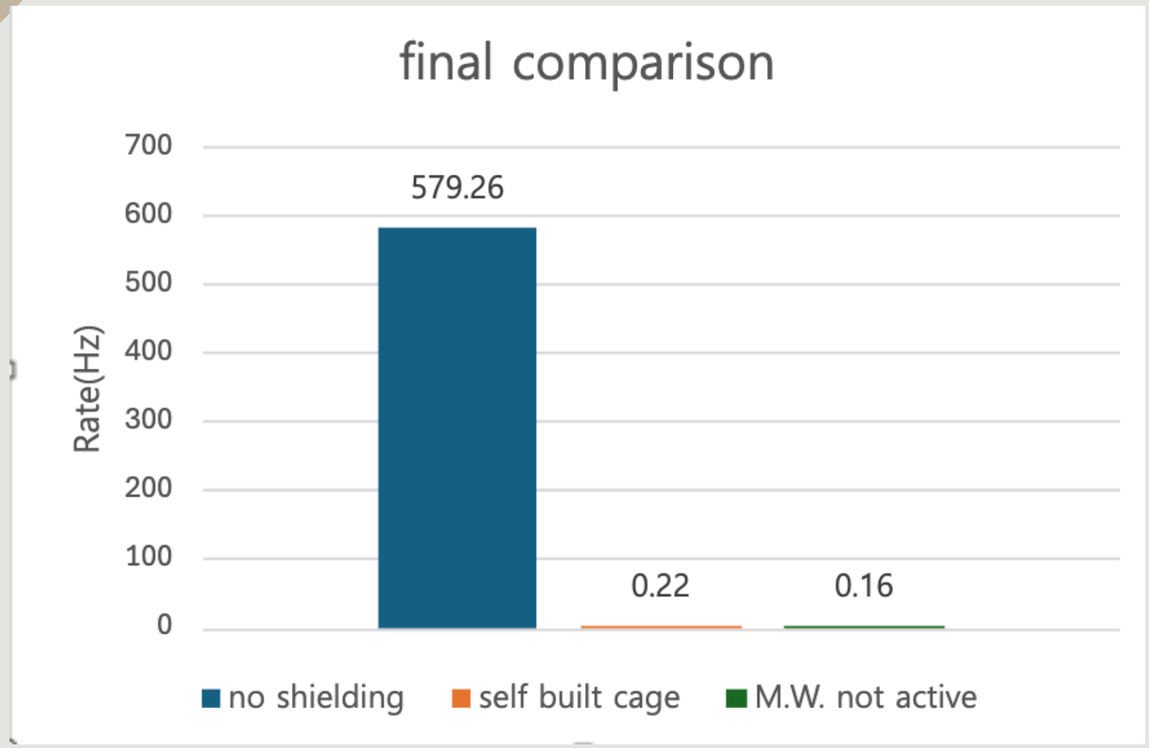


RESULTS' ANALYSIS



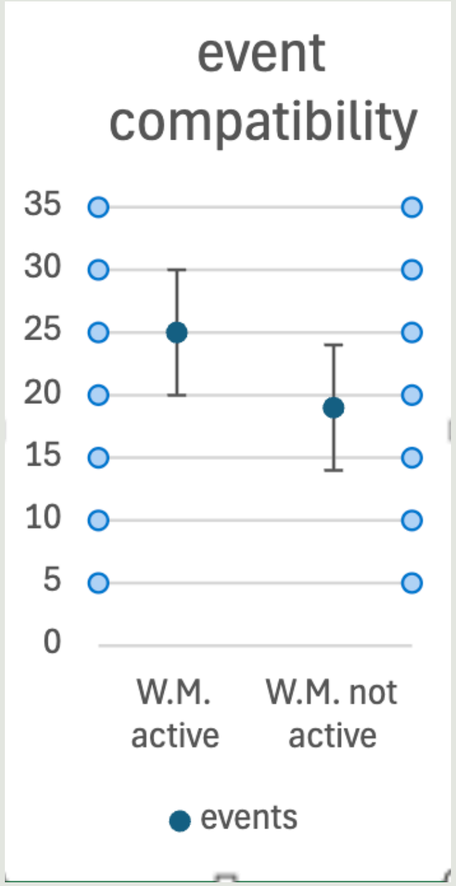
The graph compares the rates of each measurement depending on the type of shielding. It can be seen that the measurements that show a frequency of events in the absence of strong electric fields are those performed in the cabinet and in our cage

RESULTS' ANALYSIS



Furthermore, comparing the rate of a measurement with the CB shielded by our cage and the rate of a measurement without the shielding (with M.W. active) we can notice how the effect of the electric field is highly reduced and is very close to the rate recorded with the absence of the electric field of the Wimshurst machine.

RESULTS' ANALYSIS



Finally, by analyzing the measurements made with the shielding of our cage we can see how there is a compatibility between events with the active M.W. and that with the inactive M.W.

ACKNOWLEDGEMENTS

We would like to thank:

- The EEE Collaboration for giving us the opportunity to use the Cosmic Box;
- Our professors for accompanying us during the measurements;

THANKS FOR THE ATTENTION

End of presentation

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