Efficiency measurement of EEE detectors with a new gas mixture

Federico Schirru and EEE CAGL-01 students at Liceo Scientifico A. Pacinotti

Table of contents

- Introduction
  - What is an efficiency test?
  - Why perform a new efficiency test?
- Test procedure layout
  - Preliminary requirements
  - The measurement
  - Data evaluation
- Efficiency test results
  - Efficiency curves
  - Results discussion

What is an efficiency test?

Efficiency is defined as follows:

$$\eta = \frac{n_{det}}{n}$$

η = efficiency

n_{det} = detected events
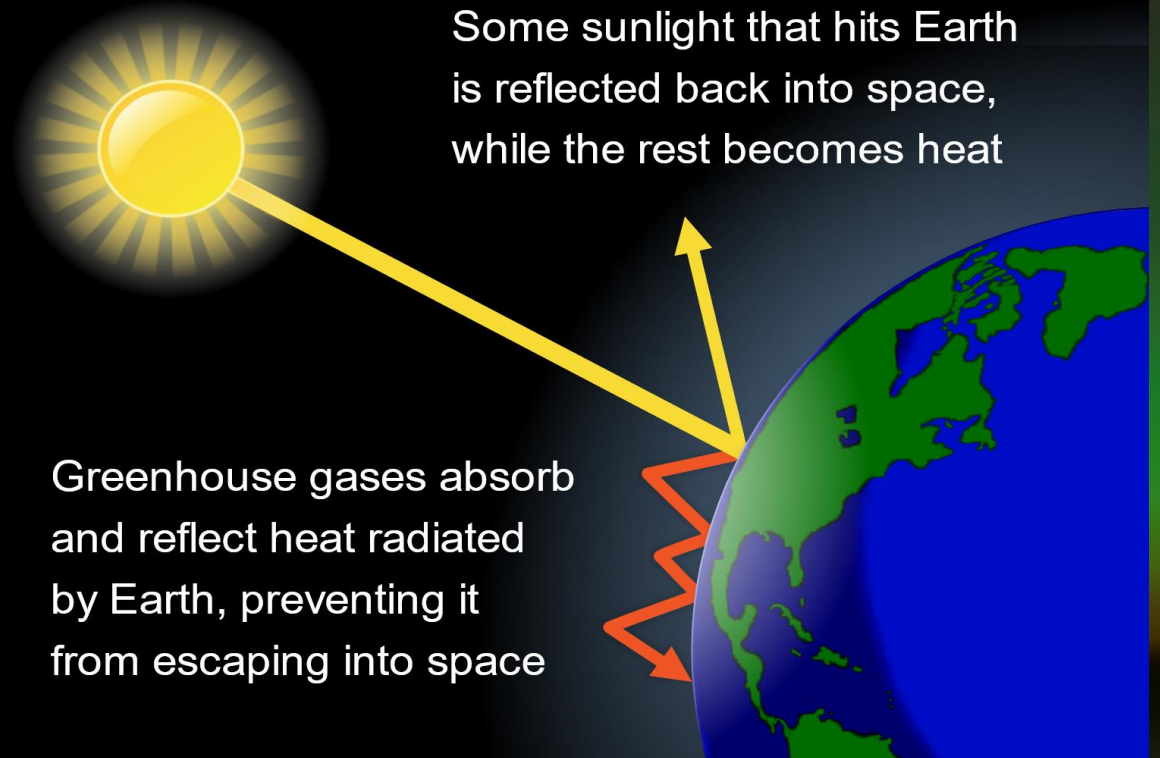
n = ideal events

- It is a quantitative measure of gas performance

- It makes us select the best HV level

- Each MRPC chamber was tested upon construction

Why perform a new efficiency test?

- Test the performance of a new gas mixture

- GWP of the standard mixture is 1900 times that of CO_2

- GWP of the new gas mixture (50%He + 50%HFO) is about 2 times that of CO_2

The Greenhouse Effect

Some sunlight that hits Earth is reflected back into space, while the rest becomes heat

Greenhouse gases absorb and reflect heat radiated by Earth, preventing it from escaping into space

Test procedure layout

How do you calculate efficiency?

Preliminary requirements

- Gas-tightness of the MRPC chambers (dV/dt < -0.1 l/h)

- Determine the time T of each HV step (based on trigger rate)

- Trigger logic: triple coincidence → double coincidence

- Prepare data transfer

The measurement

- Start the telescope on DAQ mode (50000 event runs until time T)

- Compare triple coincidence and double coincidence mean rates

- Step up the LV entering the DC-DC converter (+ 0.15V)

- Wait 10 minutes

- Repeat the previous steps until LV == 4.9V
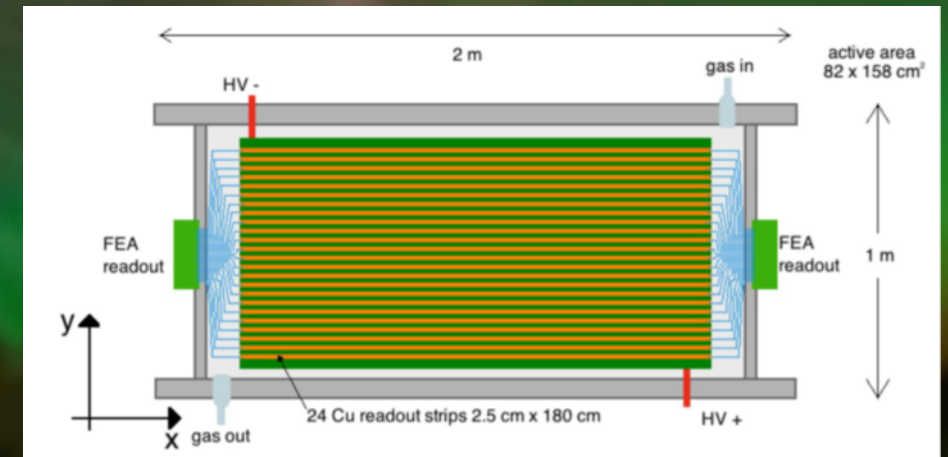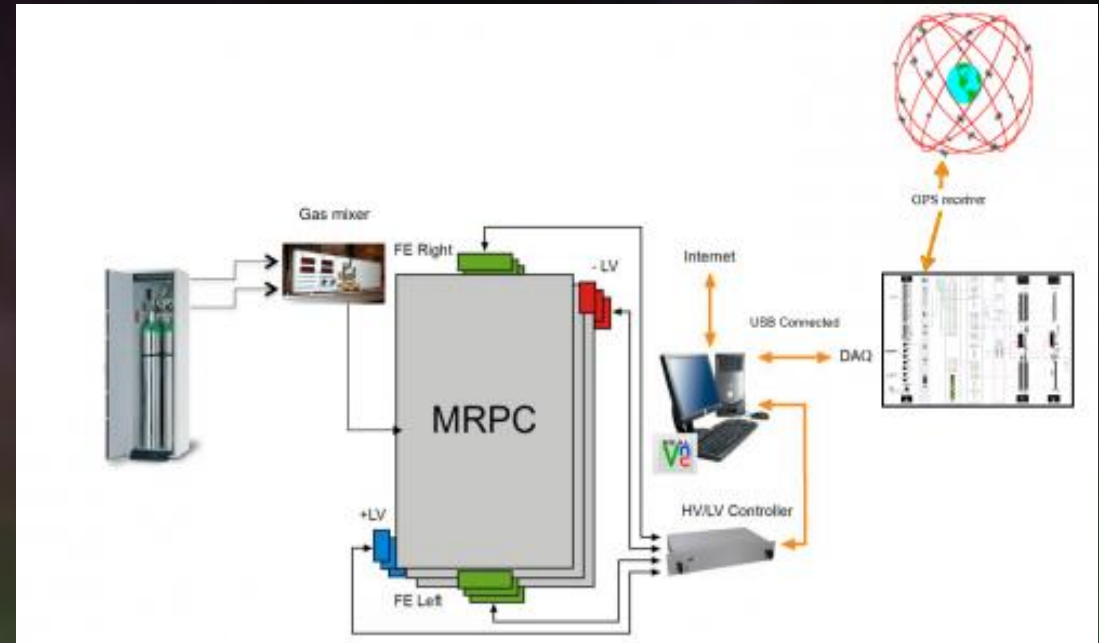
Data evaluation

- HV values are normalized with respect to pressure and temperature:

$$HV_{ref} = HV \frac{P_{ref}}{P} \frac{T}{T_{ref}}$$

HV/HVref = High Voltage / corrected *HV*

P/Pref = atmospheric pressure / reference pressure
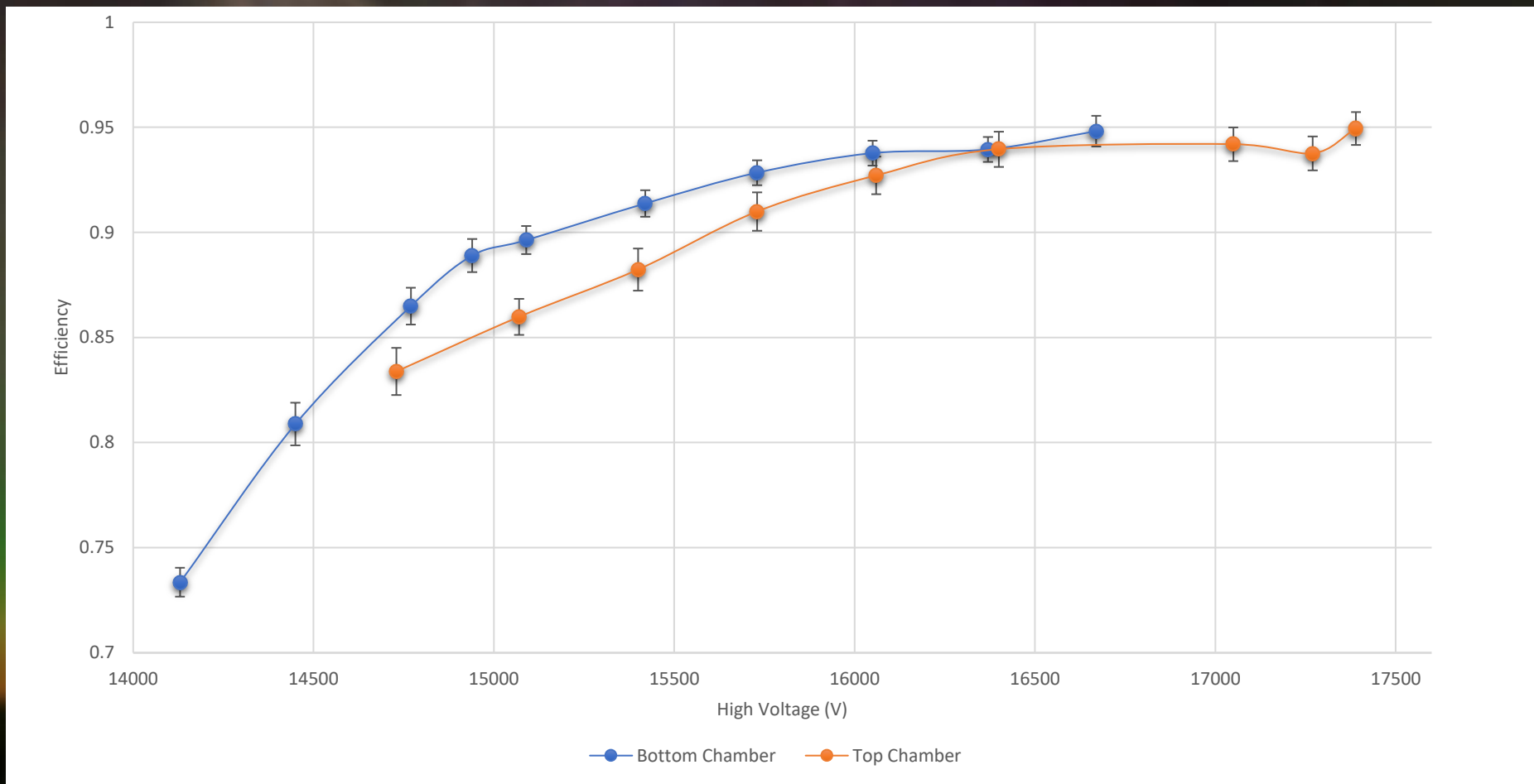
T /Tref= temperature / reference temperature

- Plot efficiency values vs HV
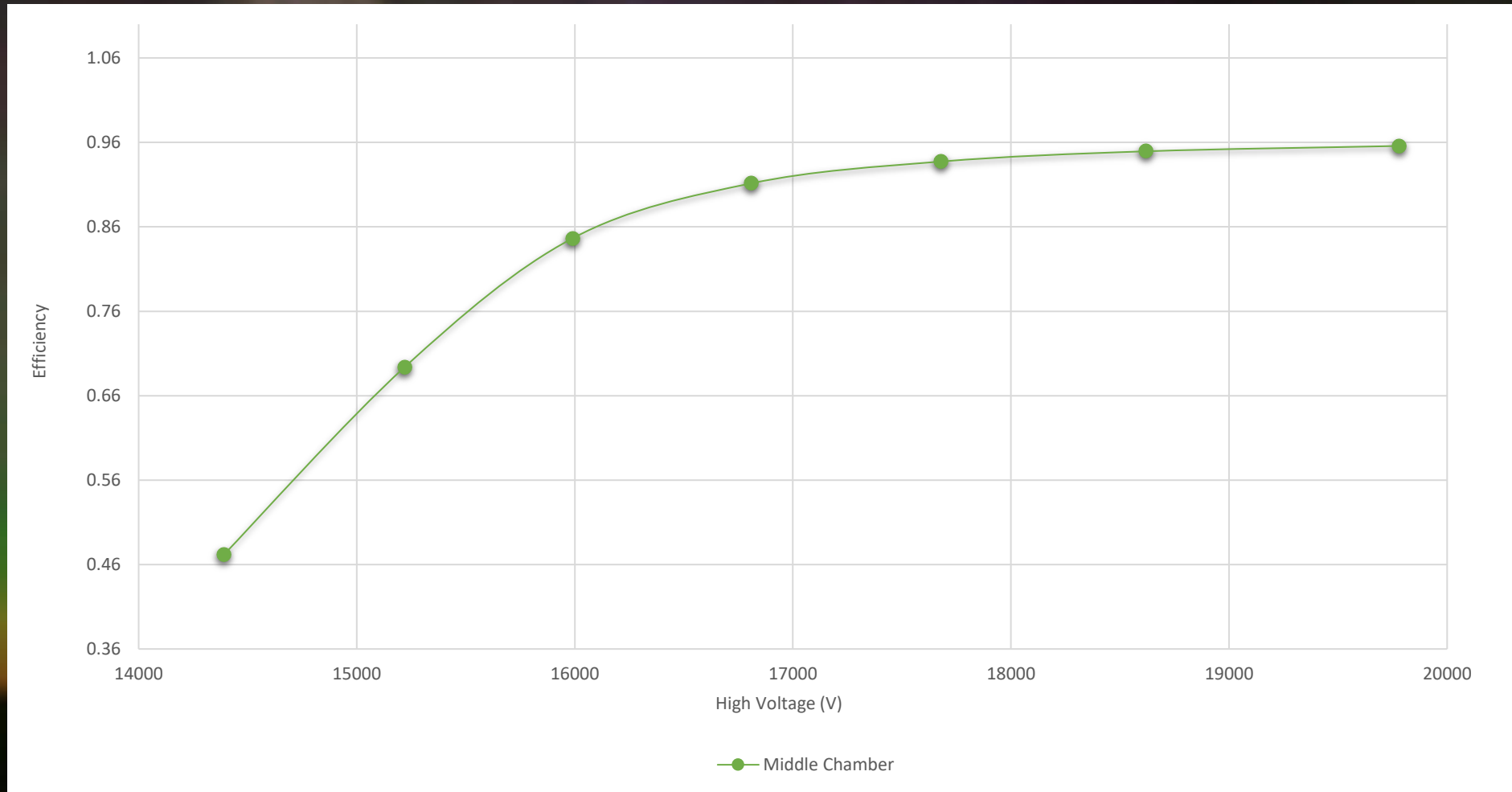- Repeat for each MRPC chamber
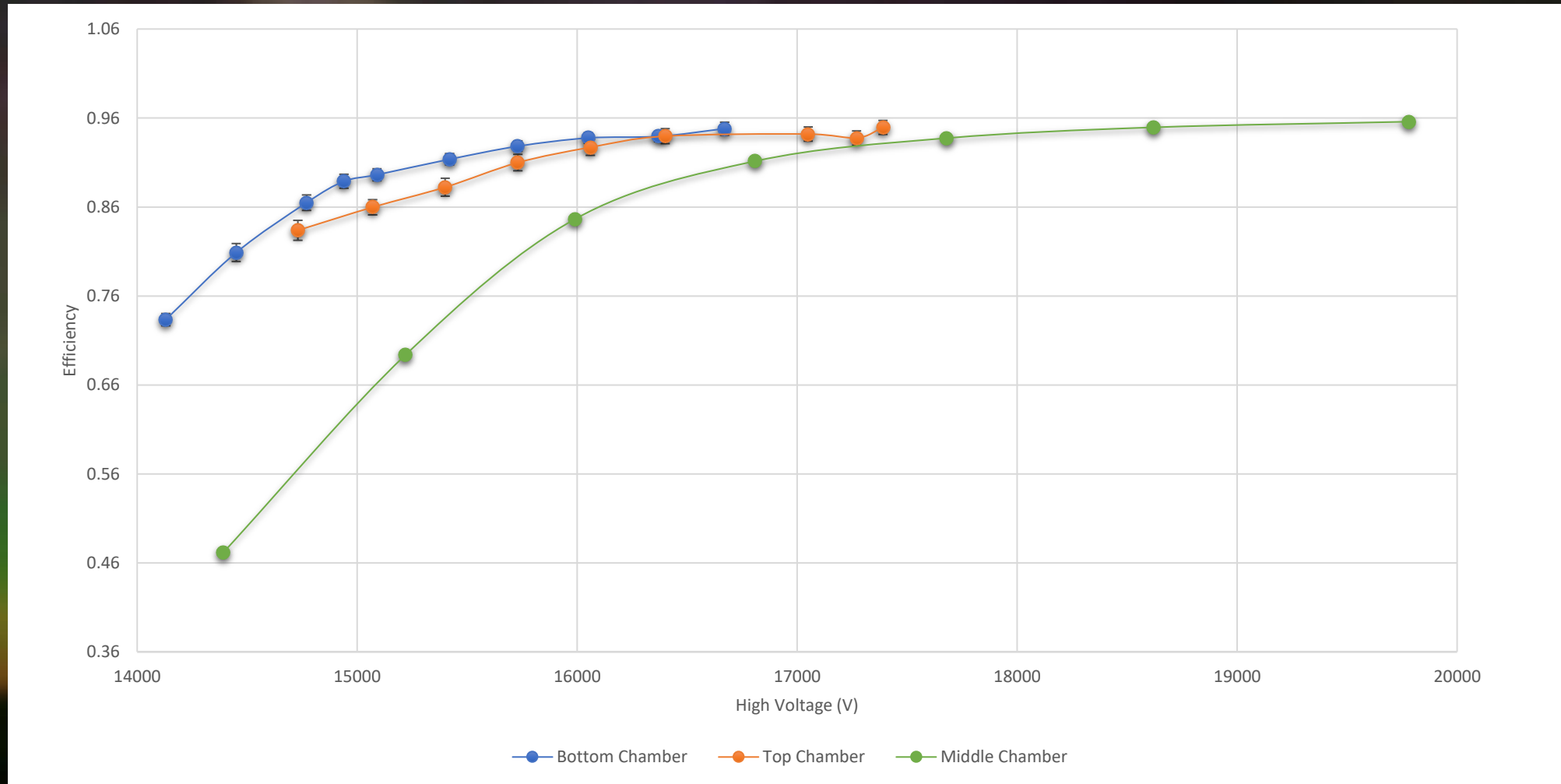
Efficiency test results

What did we find out?

Top and Bottom chambers (300 micron gaps)

Middle chamber (250 micron gaps)
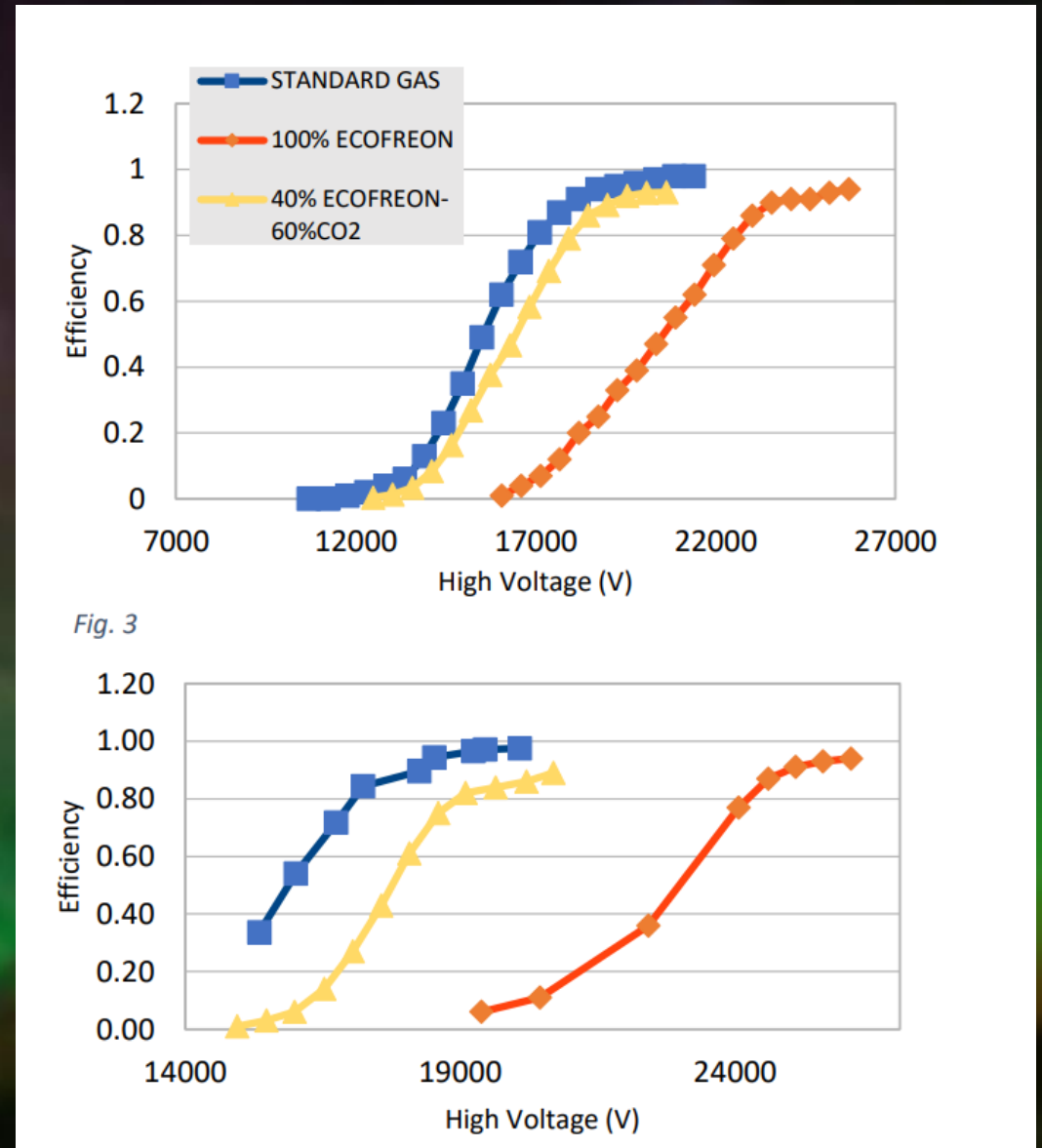
Chamber comparison

What does this mean?

The optimum efficiency of our detector is reached at around:

- 16kV for the bottom chamber
- 16.5kV for the top chamber
- 18kV for the middle chamber

Our data is in accordance with previous results from CERN-01 and BOLO-01 (ηmax around 0.95)

Fig. 3

By the CAGL-01 Team

We thank you for your attention!