Electrets and different detectors on their basis

VITALII HAVRYLENKO

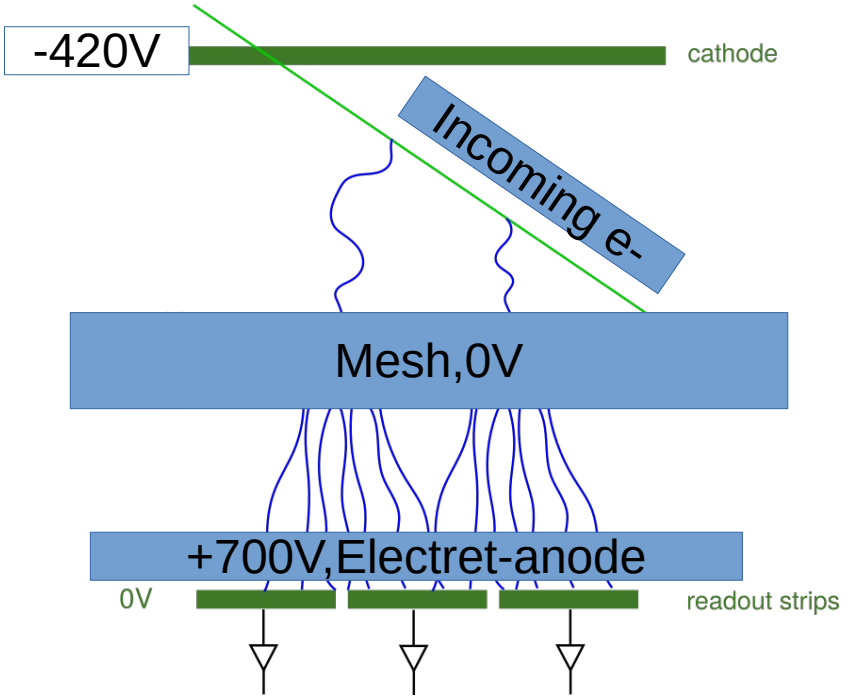
SUPERVISORS: CHRISTOPH JAGFELD,

OTMAR BIEBEL, RALF HERTENBERGER

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Electret Micromega Detector

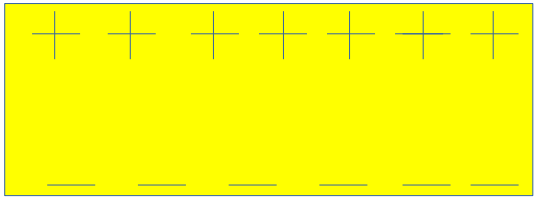
- Micromega detector is filled with gases. Incoming particle ionize the mixture of gases and ions are accelerated to the readout strips. That gives a signal
- The foil has constant voltage supply from external source
- An Electret foil need no external supply



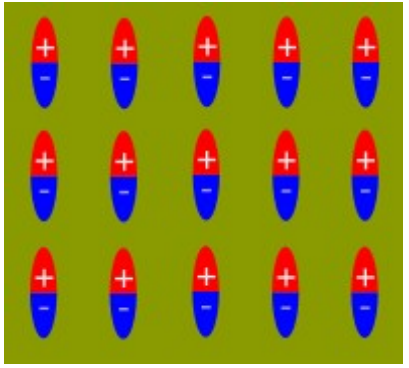
Electret

- Material that keeps polarization or electric charge quasi permanently
- Charged foil is like a permanent magnet

Foil-electret



Epoxy-electret



Goals for the needed electret

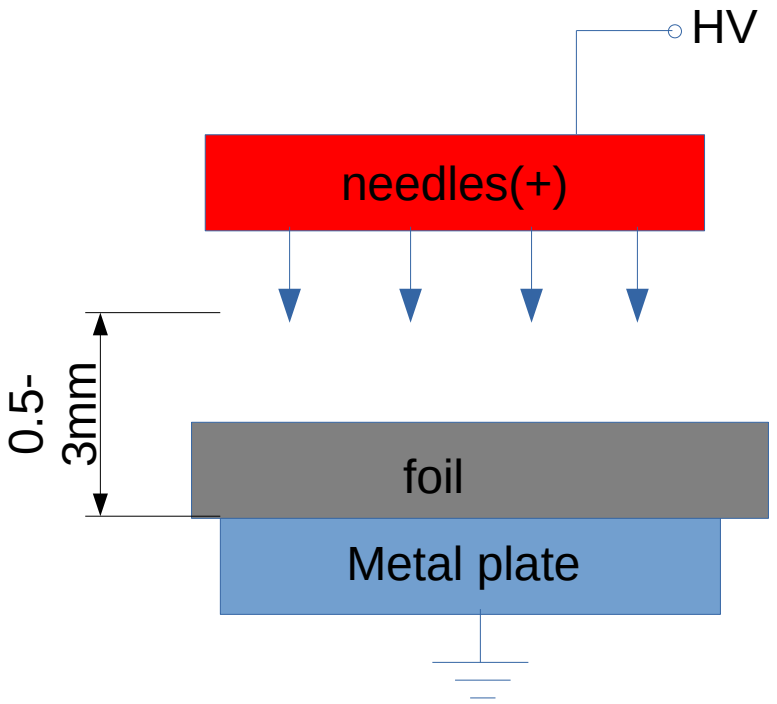
1)Stable Electric field

2)Spatial homogeneous charging

3)High enough electric field! O(kV/cm).

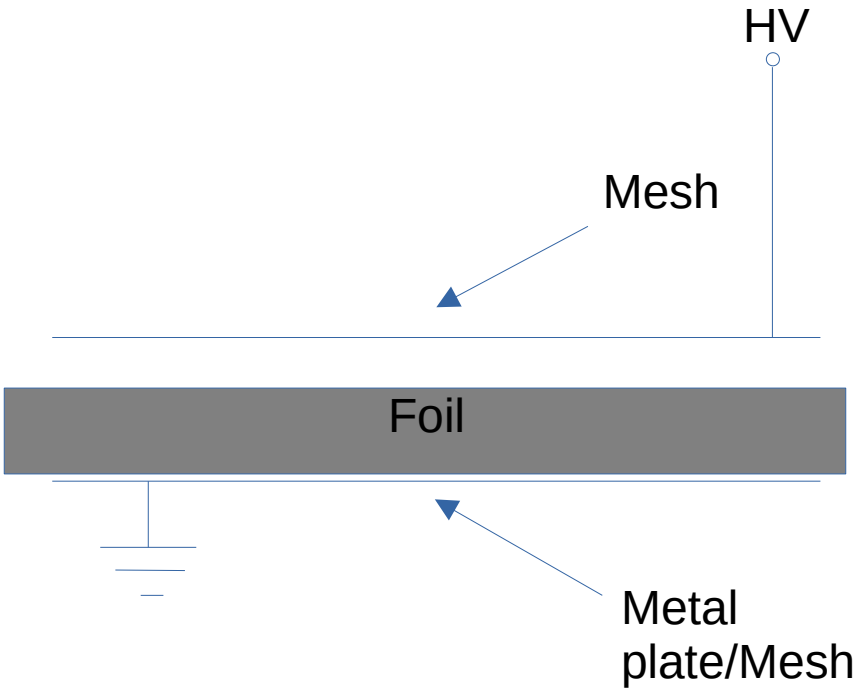
Production technique: Corona-Charging 1

- Application of 5-20kV between plate and sharp needles => high enough for air ionization electric field at needle tip
- Acceleration of the ions towards the planar electrode
- Collection of the ions on polymer foil (e.g. Teflon)



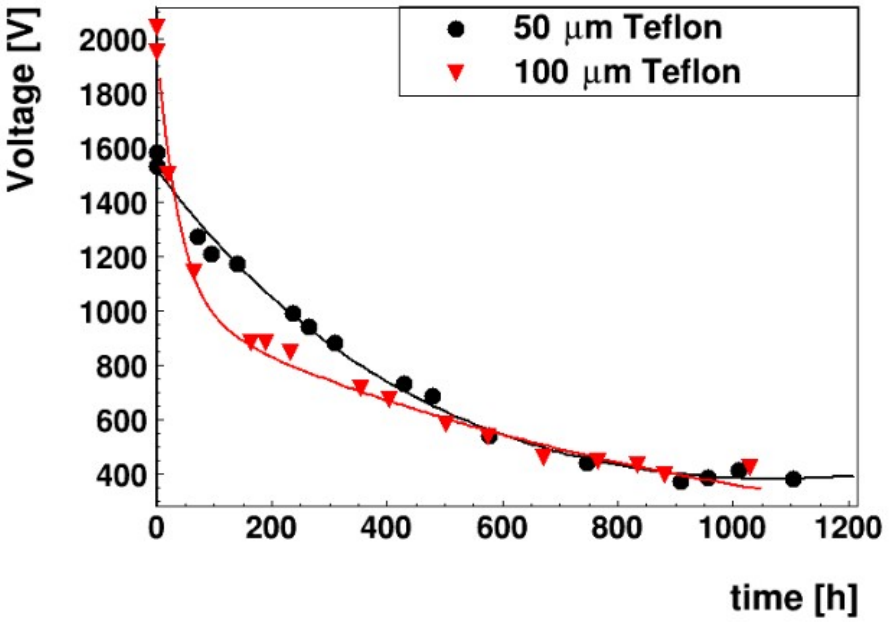
Production technique: Corona-Charging 2

- Usage of a mesh to achieve better homogeneity (since mesh has in order of 10 strips/cm)



Different thickness Teflon foils

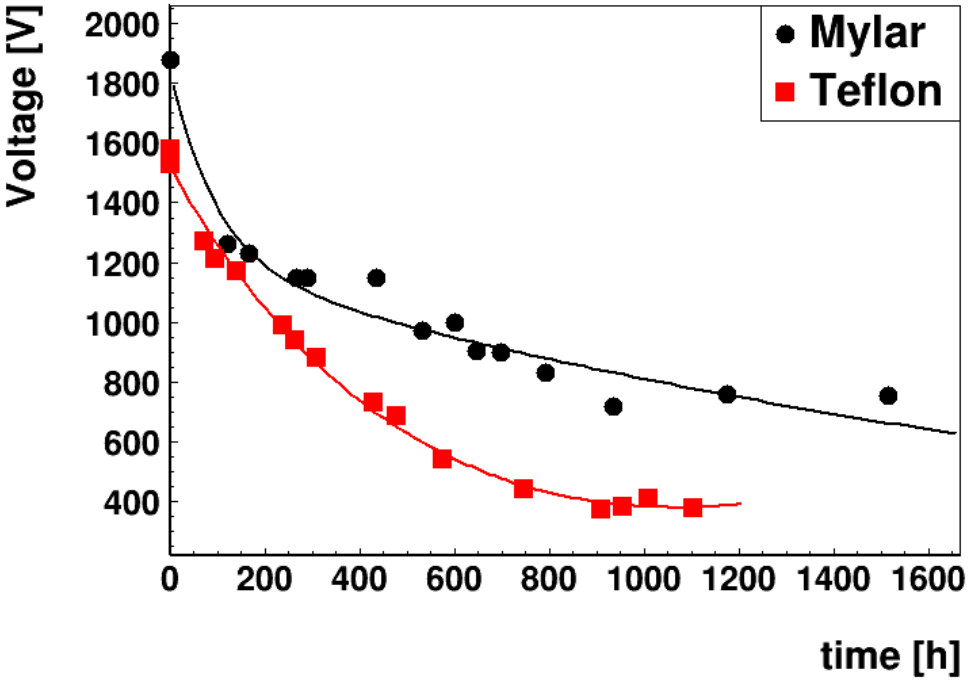
- Charged with 8 kV
- Almost no dependence on thickness
- Relative-stability (10% lose in 10 days) at 475 V



Teflon vs Mylar

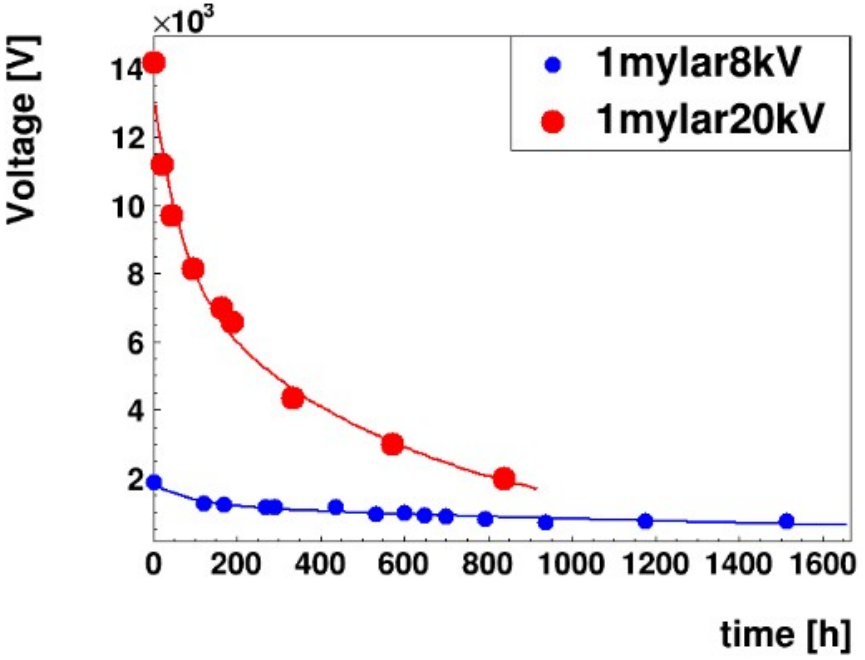
- 8 kV needle-charging
- 190 microns Mylar

  vs 50 micron Teflon
- Mylar is more stable



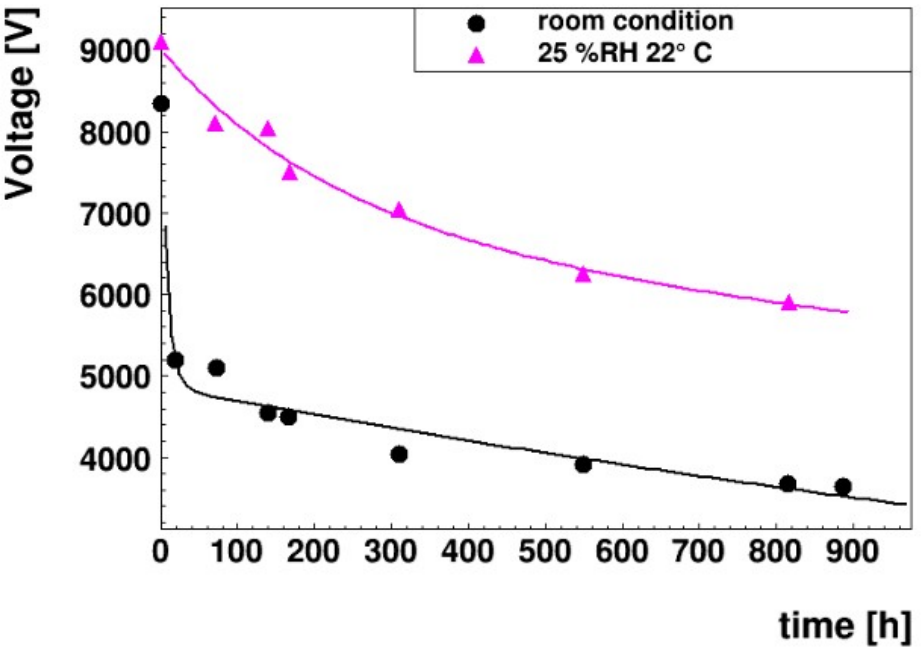
190 µm Mylar,needles-charging

- Mylar charged by 8kV is quasi-stable electret, but not homogeneous enough
- Charged by 20kV is unstable for 900 hours



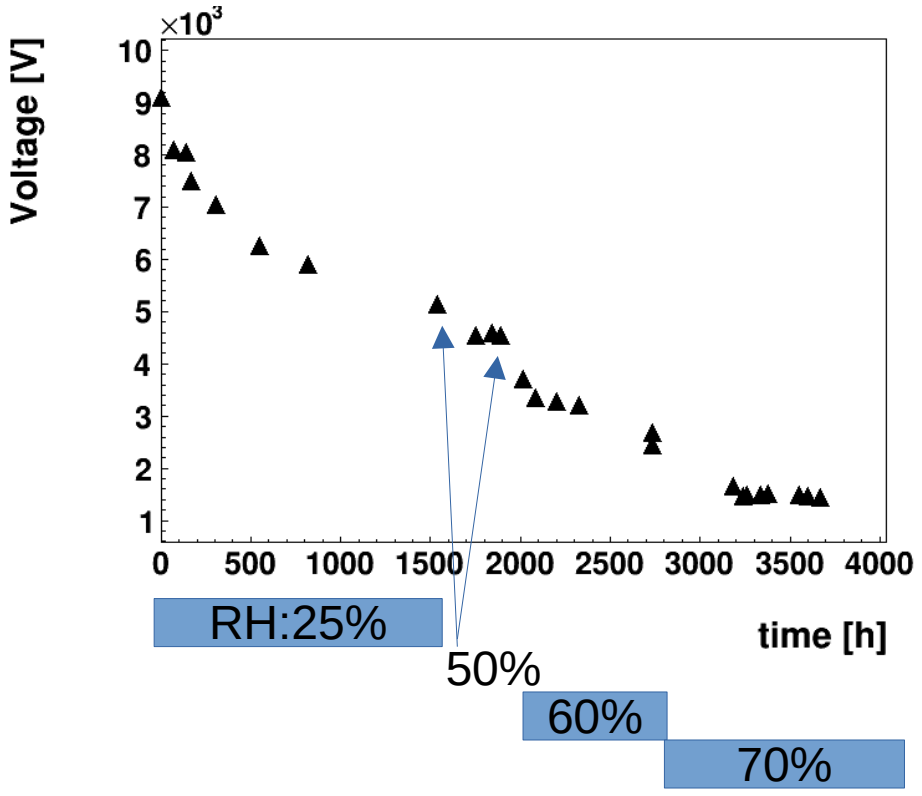
Charged Mylar, stored in different conditions

- 20 kV applied on two meshes
- One sample stored at room conditions
- Another sample conserved at const T, const RH
- Further investigation ongoing:at different T and RH



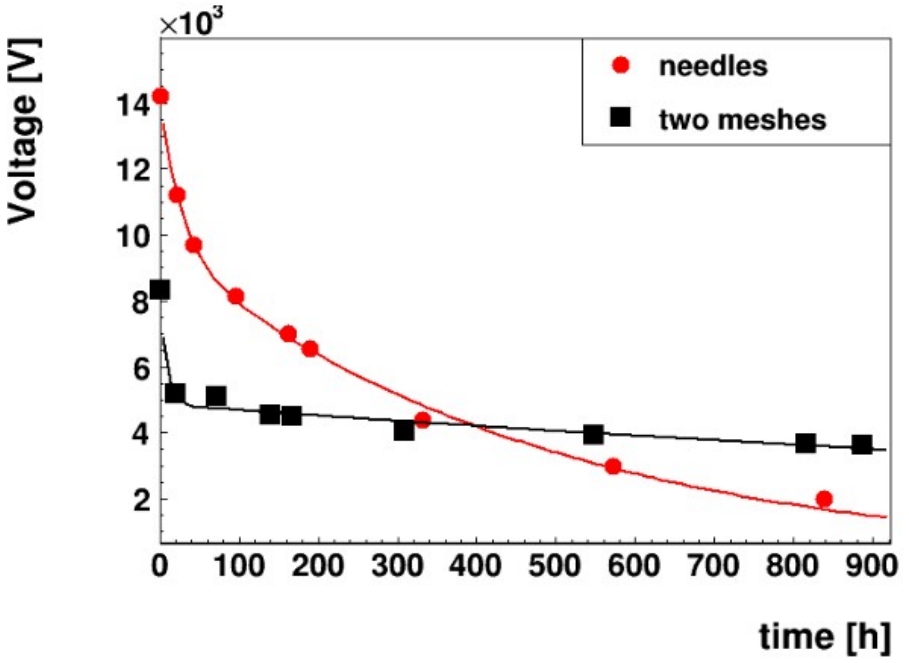
Voltage dependence

- Increase of RH causes Voltage decrease



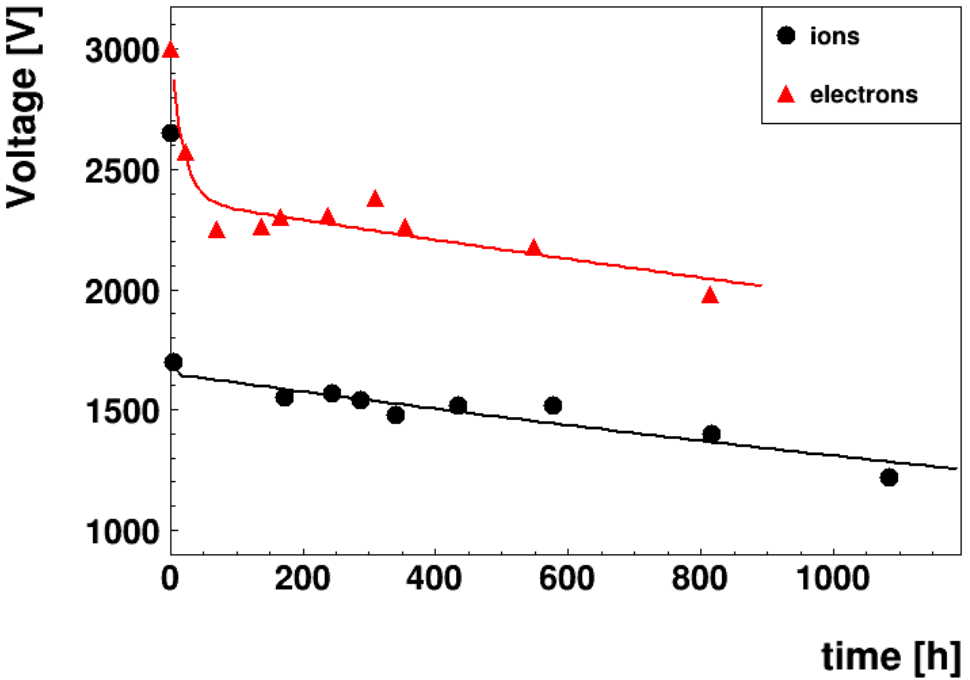
Needles- vs two-meshes-charging

- Mylar foil charged
- Two-meshes charging gives more homogeneous and more stable electret



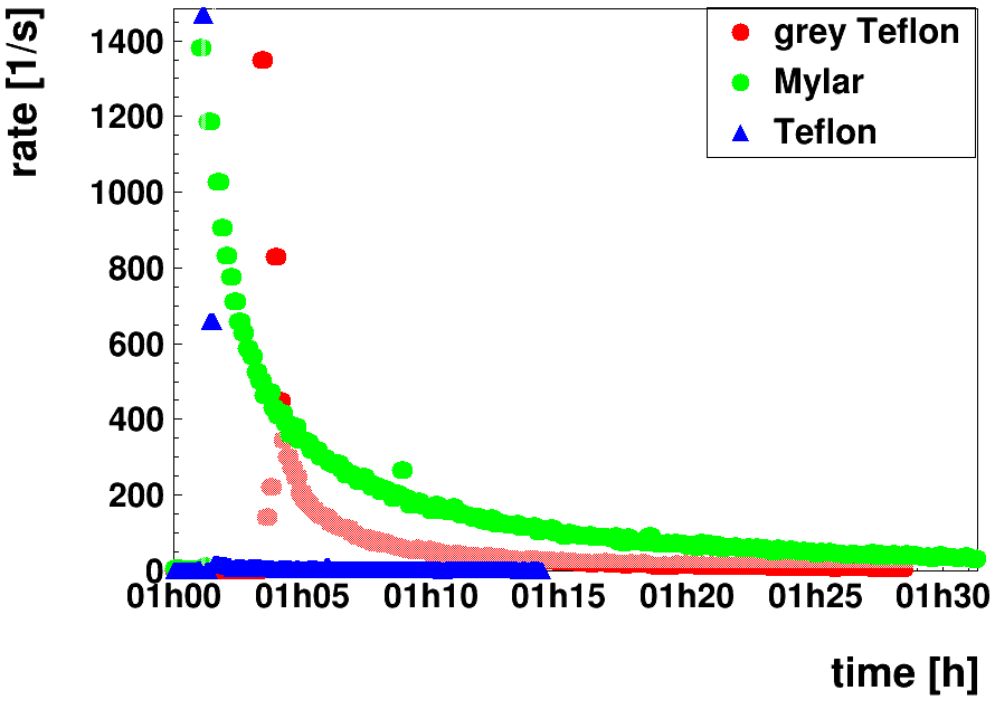
Teflon,11 kV needle-charging

- Changing applied Voltage on the opposite, electrons are collected on the Teflon foil.
- Electrons are conserved longer than ions



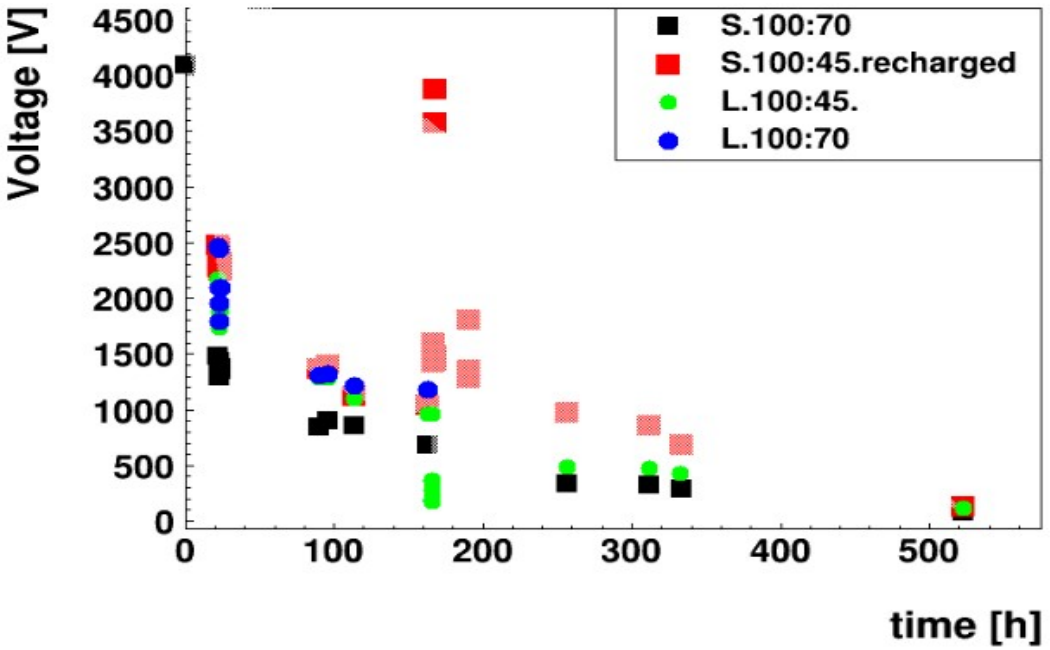
Rates. Mylar,Teflon,grey “Teflon with 50 microm. glue” charged to 2.7kV

- Mylar gives the most stable rate



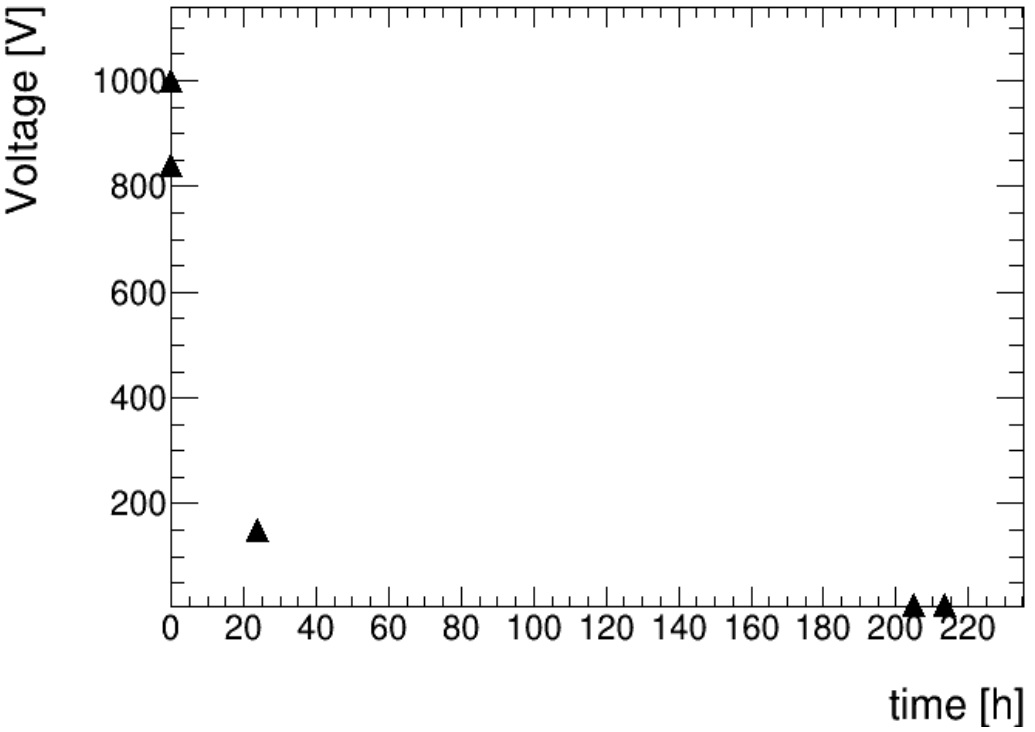
“2mm Glue on 2 Teflon foils”

- 17 kV Corona-charged
- Epoxy with Hardner L.100:70 is the best
- L 100:45 discharged to 200V, recharged by itself to 450V (green)



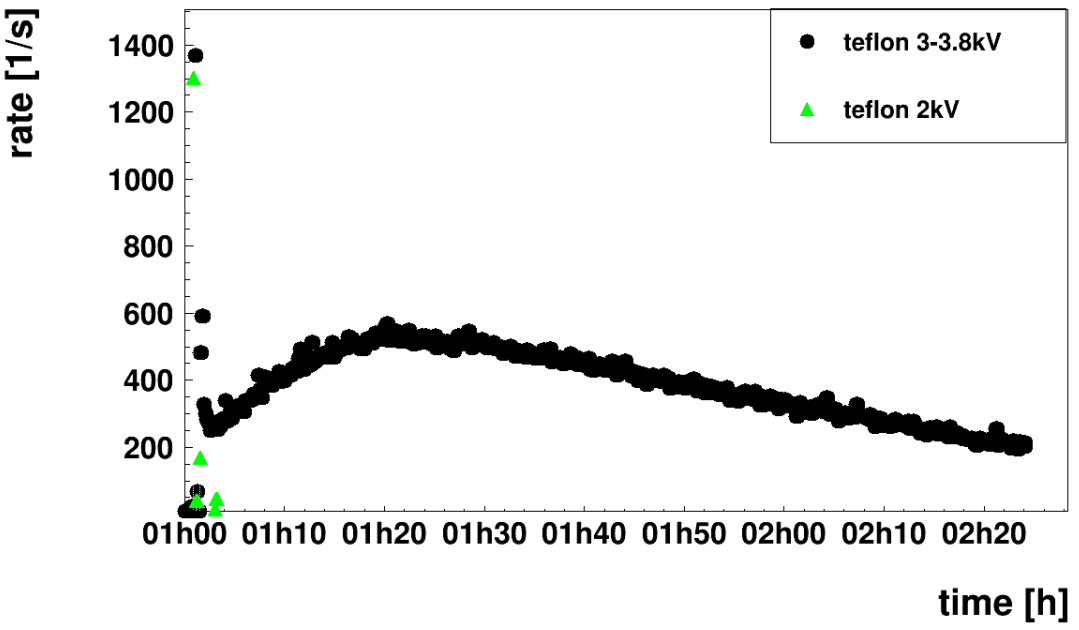
Corona-charged Glue(L 100:70)

- Not stable enough for a relatively stable detector-production



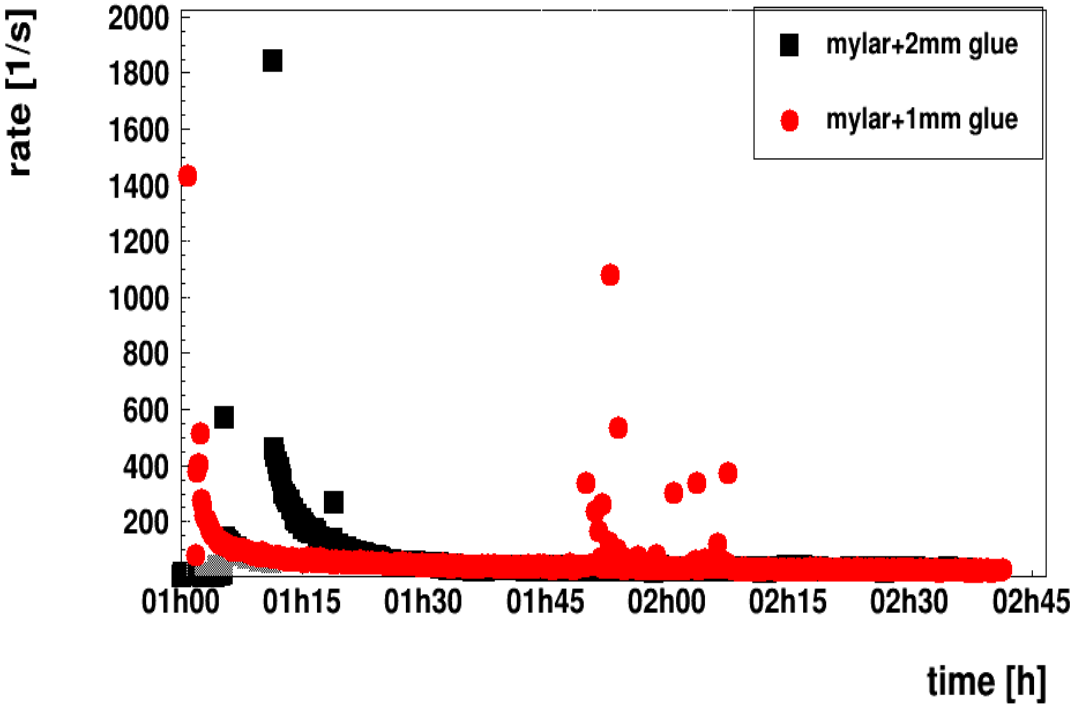
Teflon with 1.5 mm layer of glue charged

- Not fully flashed detector with 3-3.8kV charged Electret (20 min of flashing effect observed!)
- Initial Electret's Voltage does matter a lot!



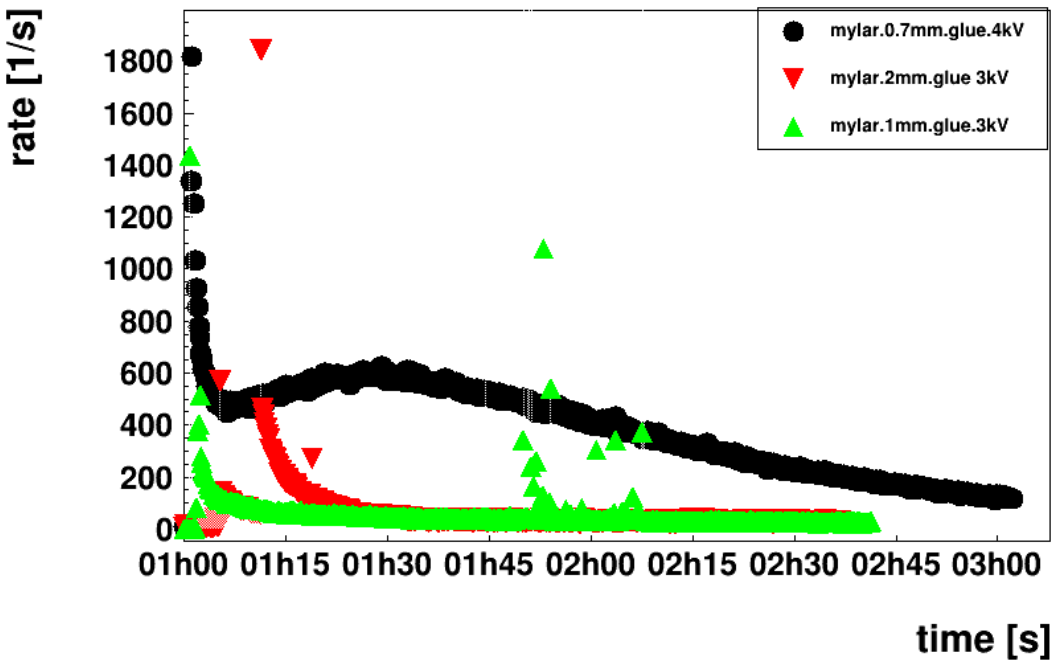
Mylar+ 1mm,2mm,3mm glue;3kV

- 2mm layer of glue is better than 1mm
- Mylar+3mm glue was decreasing its voltage too fast to be tried in the detector(3kV → 500V in 15 min)



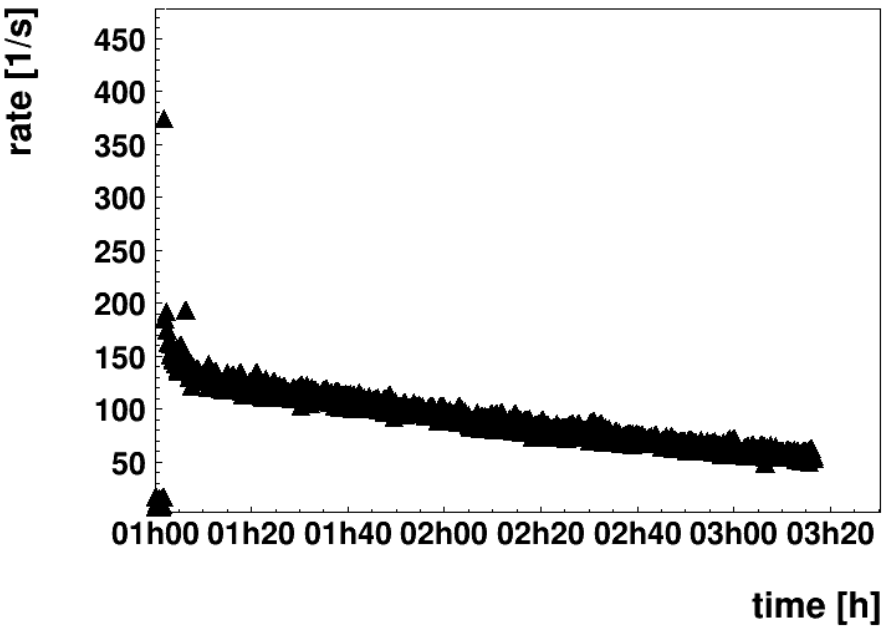
Mylar

- Initial electret's Voltage plays significant role (analogy to teflon-glue-electrets' rates!)



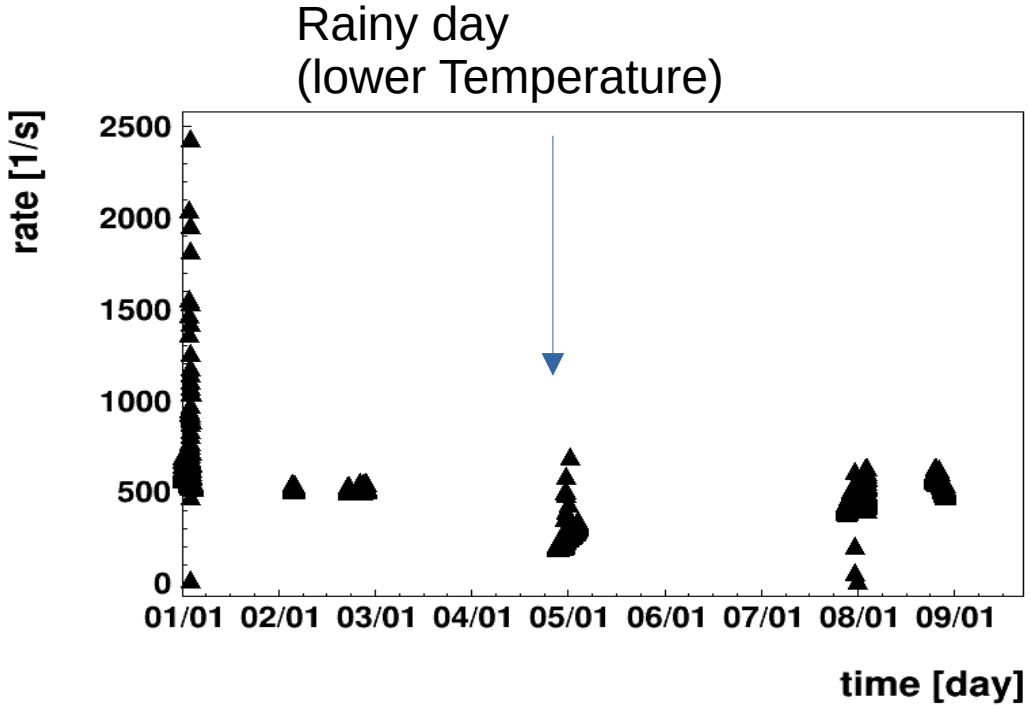
Electret as Cathode and Anode!

- Anode recombination by avalanches is the main reason decreasing the rate



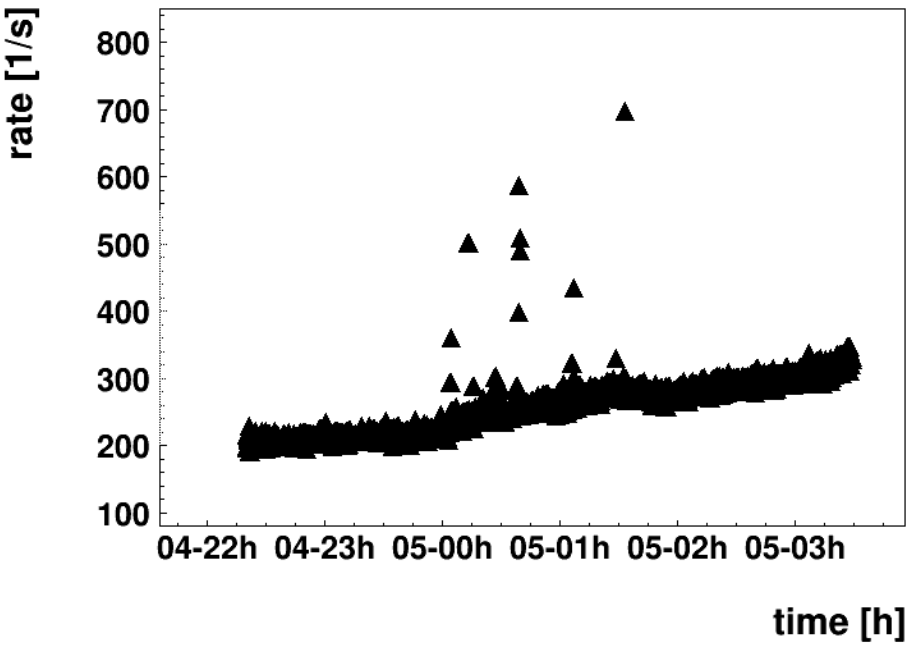
Detector with Cathode based on “electrons-Electret”

- Rate is higher and more stable comparing to detector with anode-Electret
- 20% decrease of rate in 8 days



Rate dependence on surrounding! The 3rd day,Temperature rise up

- The V(T) of electron-charged Electret to be done!
- T goes down,rate decreases. May be related to ionization of gas' mixture dependence on pressure, temperature

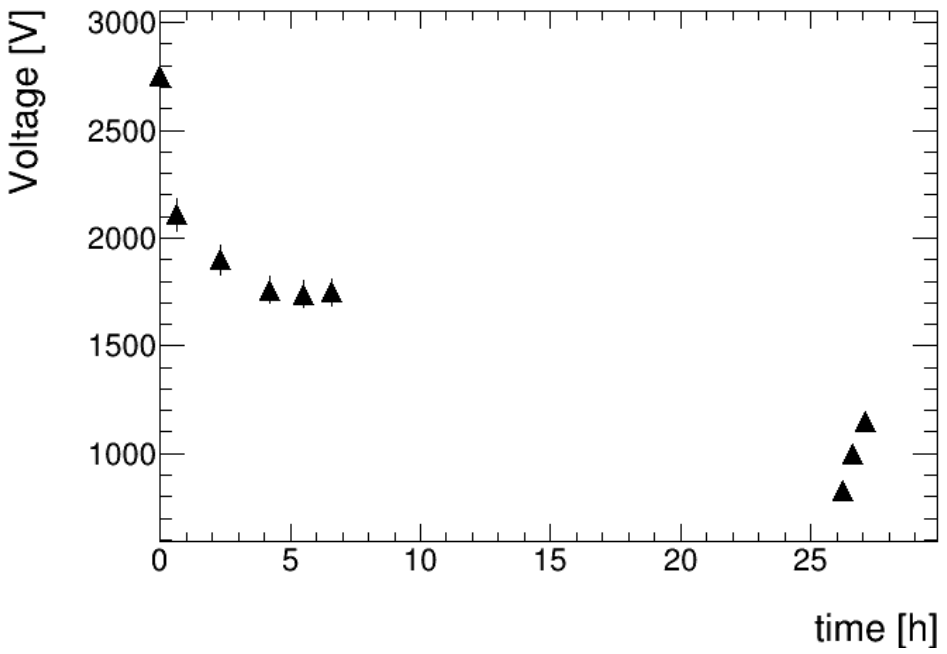


V(T)

- 25 degree(up to 10h)

  → 10degree

  → 25 degree (from 26h on)



Conclusions

- Relatively stable electrets were achieved
- Conservation of charge in different conditions(Temperature,RH) were researched
- Rates of different detectors were obtained
- Detector with Electrets as Cathode and Anode works!
- Detector with Electret-based Cathode with over 8 days working time achieved
- Have a great day!