Characterization of the secondary light from MSGC in CF4: Preliminary results

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LIP – Coimbra, 2010

GSPC – Meeting, Barcelona, May 10-11, 2010

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- Photons-per-electron ratios
- Secondary scintillation spectra
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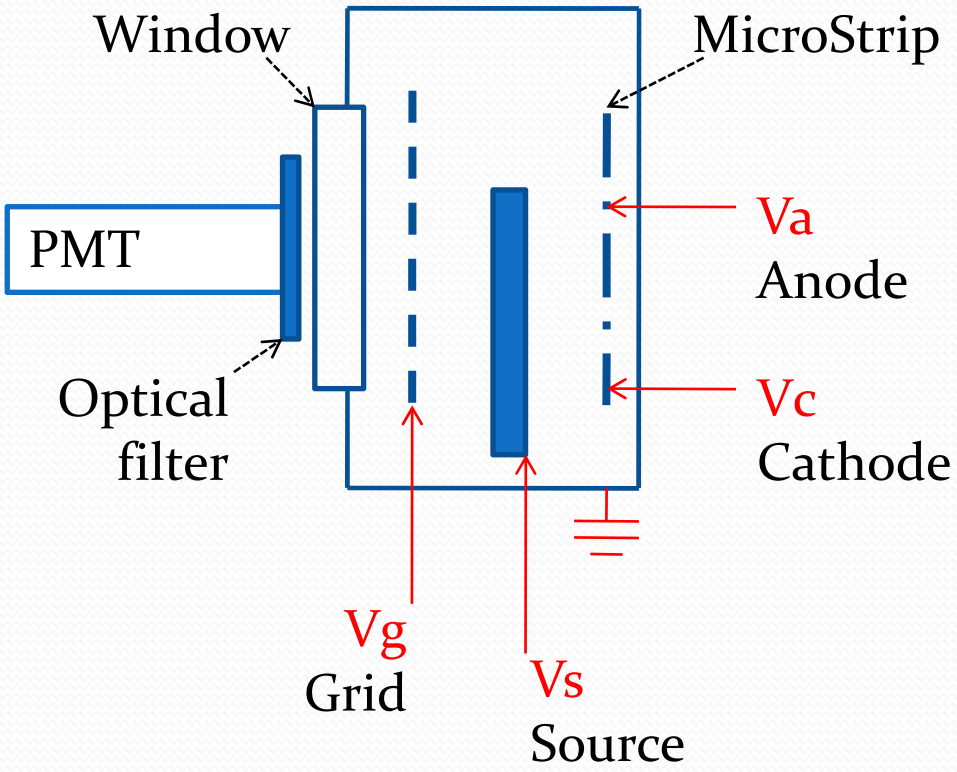
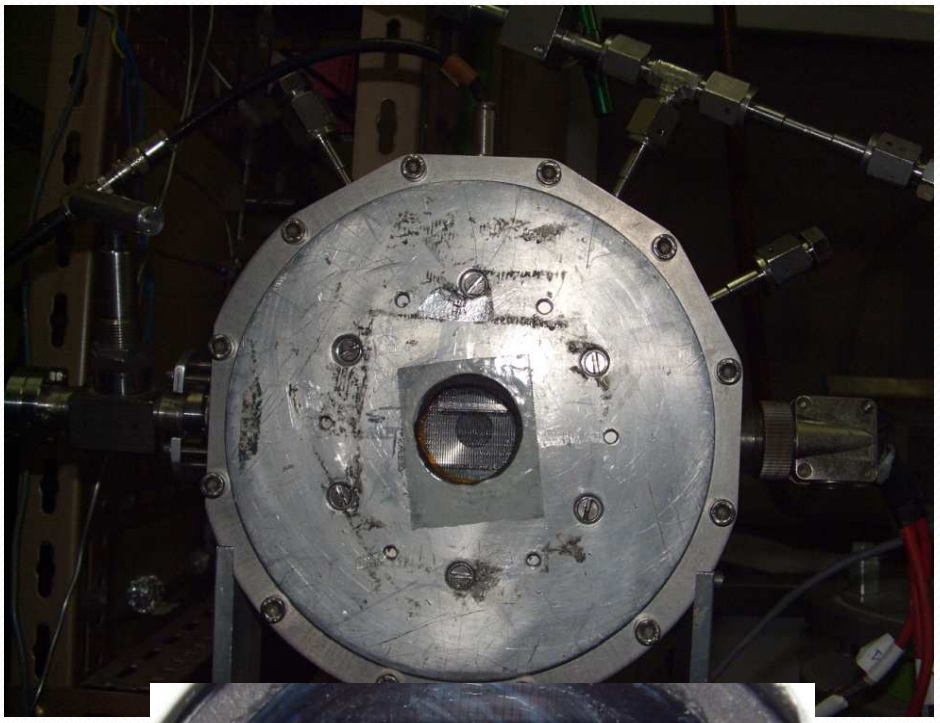
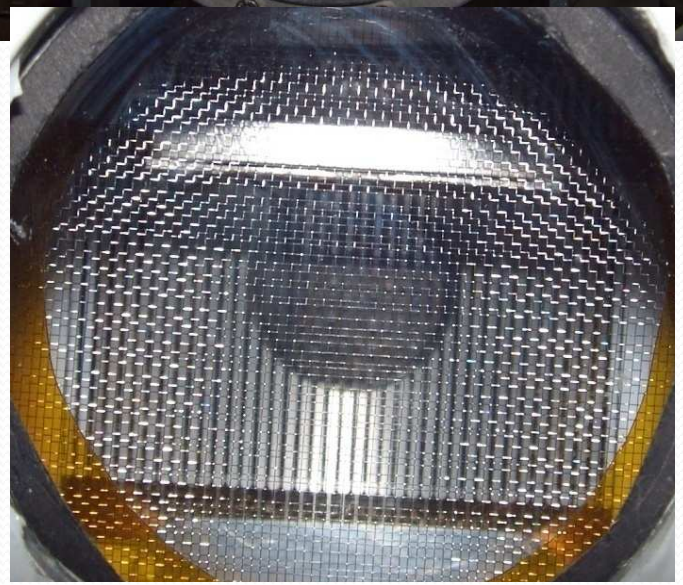
Setup



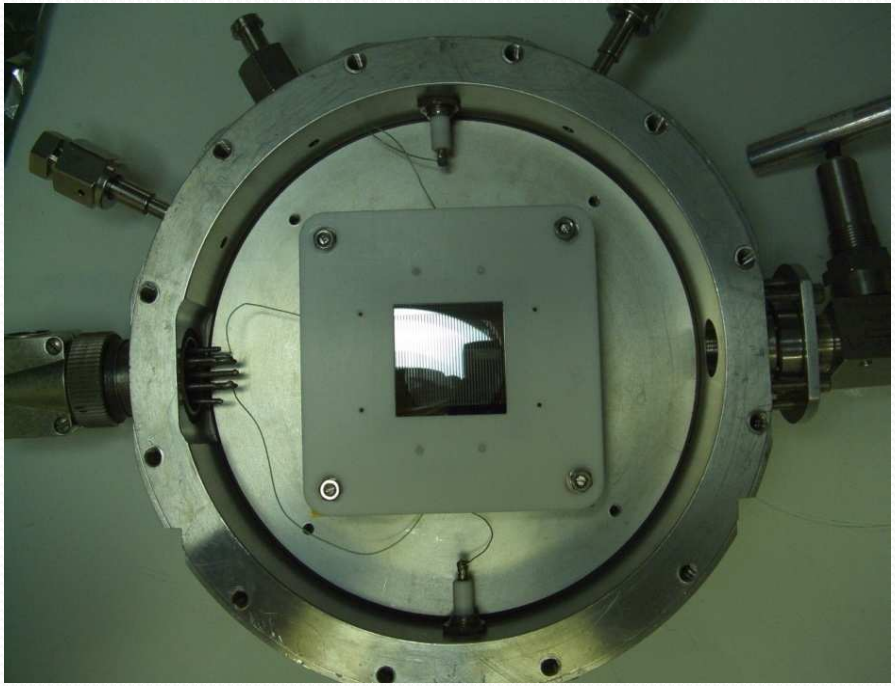


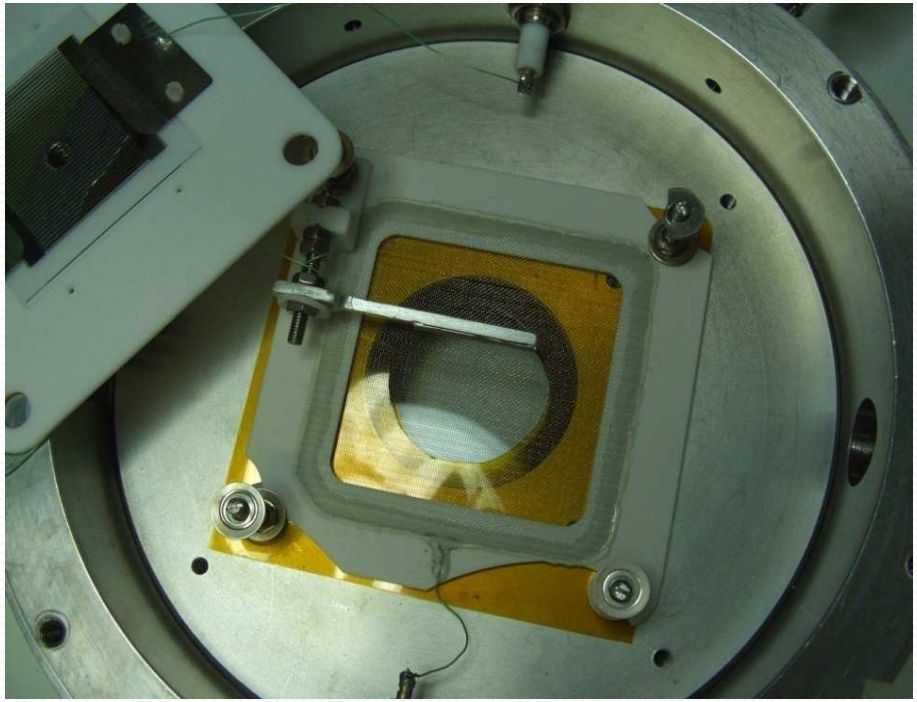


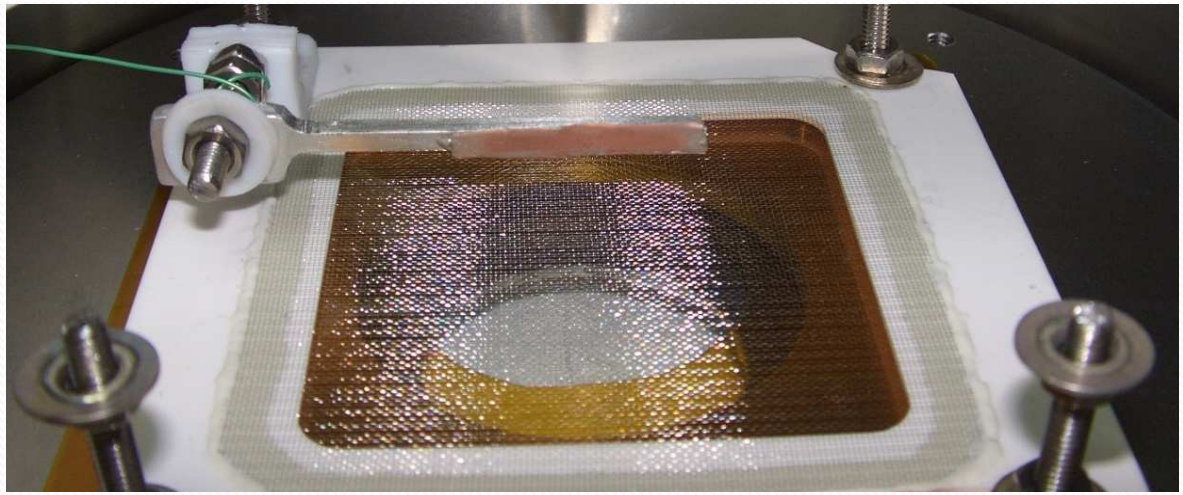
PMT can “see” the whole light-emission region.

Point-source calculations are applicable:
Counts*R*R is constant *vs.* R

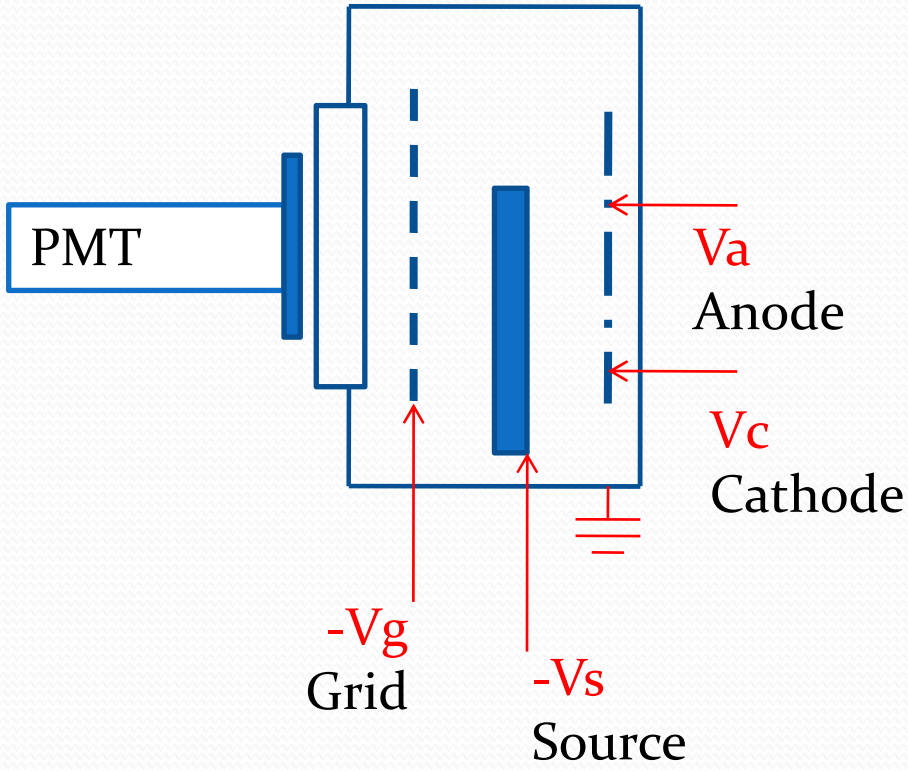
Setup





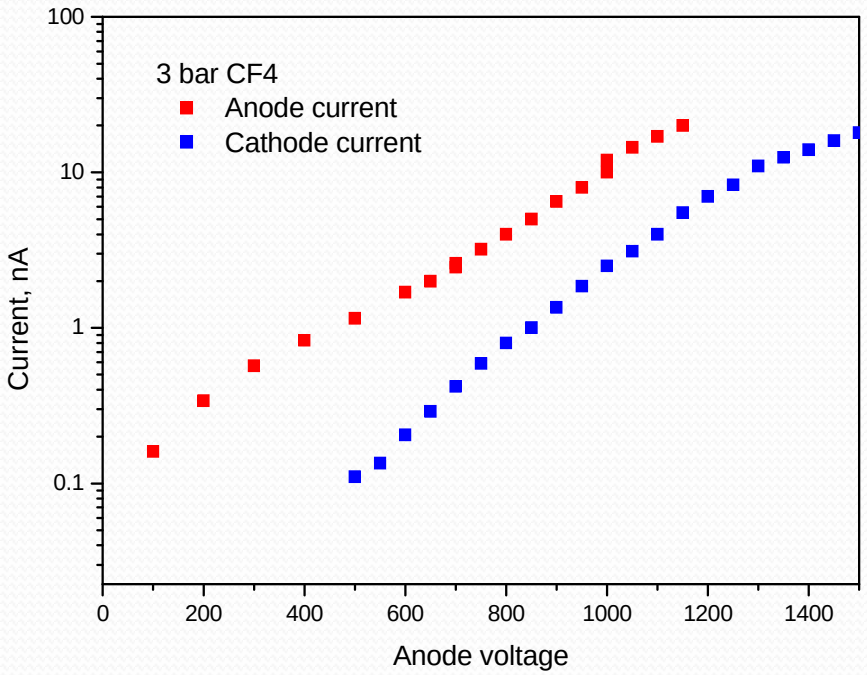


Read-out arrangements

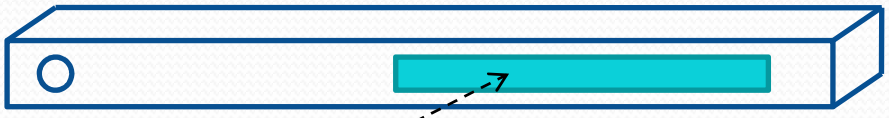


- Ammeter in cathode line,
  cathode grounded, anode at +HV: Bad!

- Ammeter in anode line,
  cathode grounded, anode at +HV: Bad!
- **Ammeter in anode line,**
  cathode at -HV, anode grounded: Optimal!



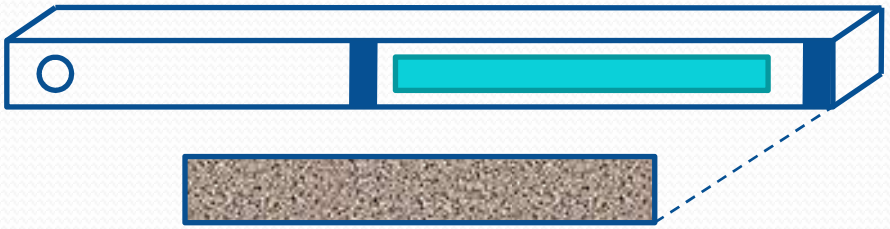
α-source



Activé region:

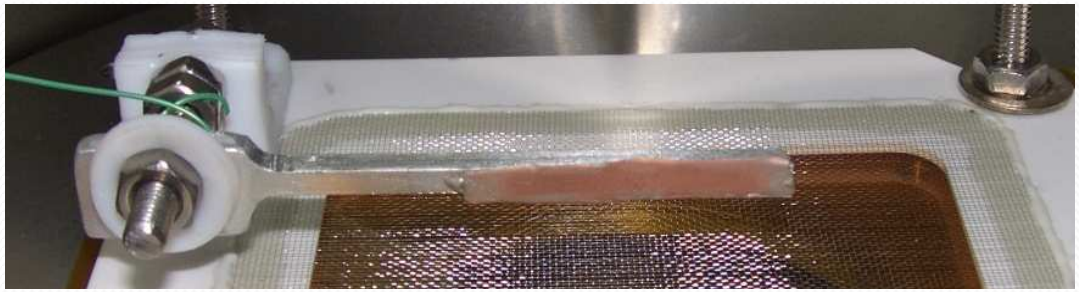
~100 000 alphas/s

Too many alphas:
Saturation effects already
at gains of ~10!

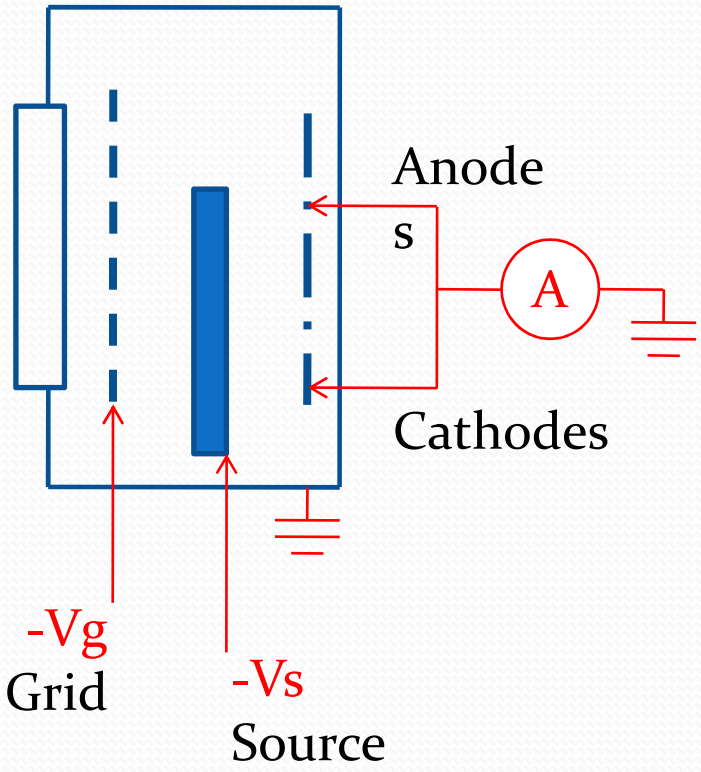


~3 000 alphas/s

An attenuator (GEM) is glued ~0.8 mm away from the surface on a metal frame.
Conductive glue!



Primary current measurements

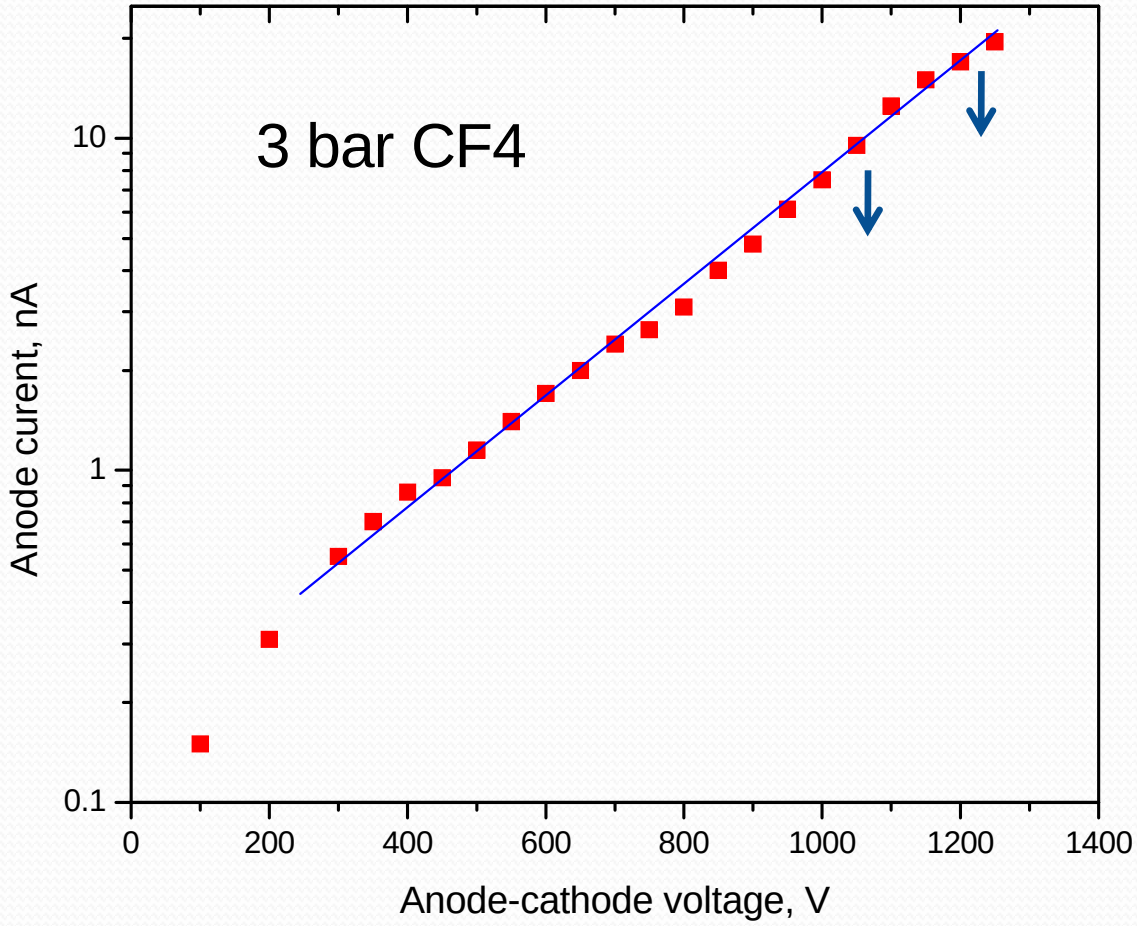


Primary ionization current:
Uncovered source: 2.0 nA
Source with GEM: **0.073 nA**

Constant current
in a broad range of grid and source voltages!

Measured at 1 bar where recombination is weak!

MSGC operation



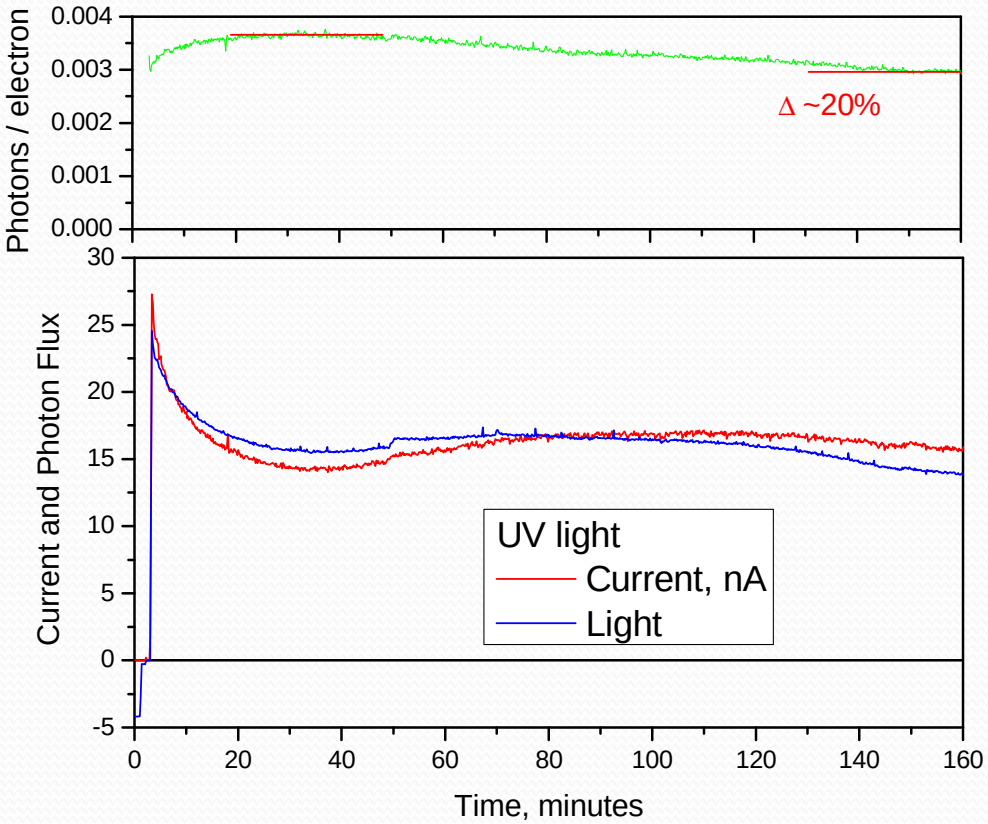
After ~5 nA
current noticeably reduces with time!

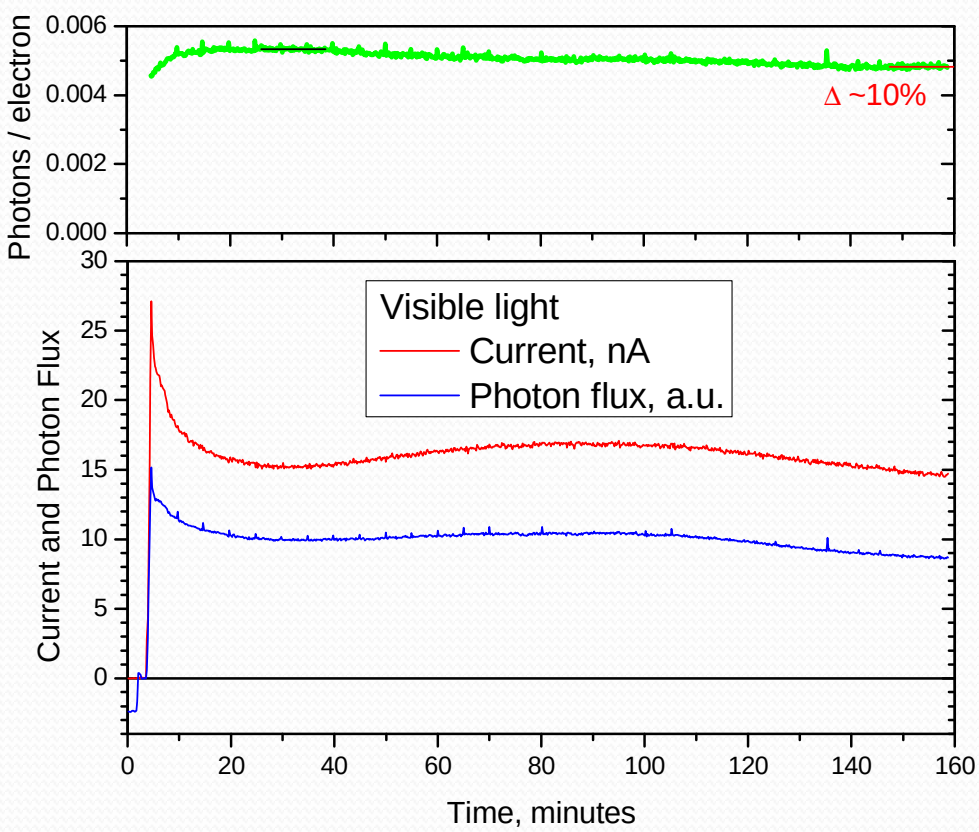
Is Light/Current ratio constant?

Gas aging effects were observed!

Stability?

Operation stability



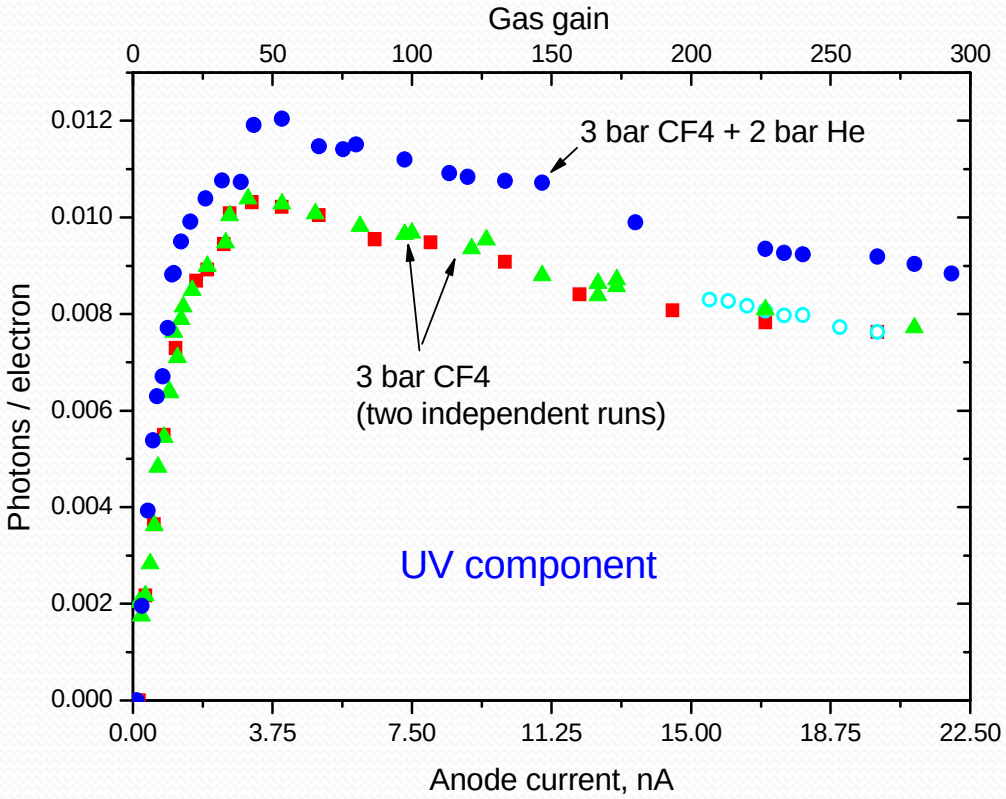


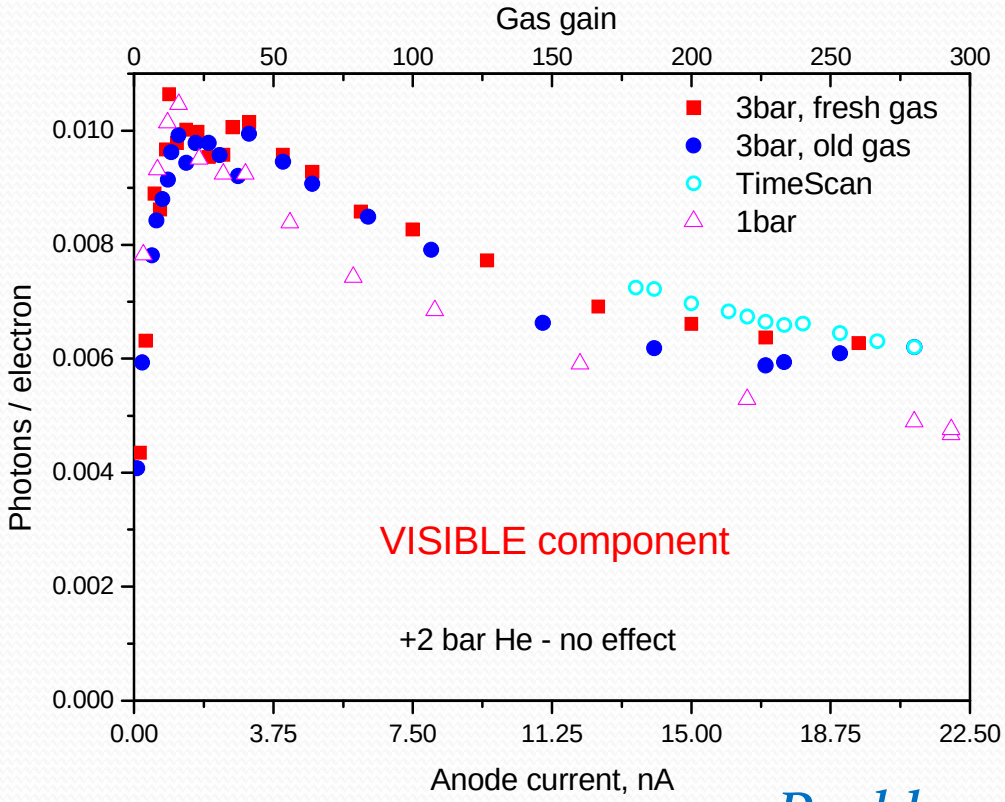
3 bar CF_4

Anode: +1200 V

Grid: -2kV, Source : -2.5 kV

Photons-per-electron ratios



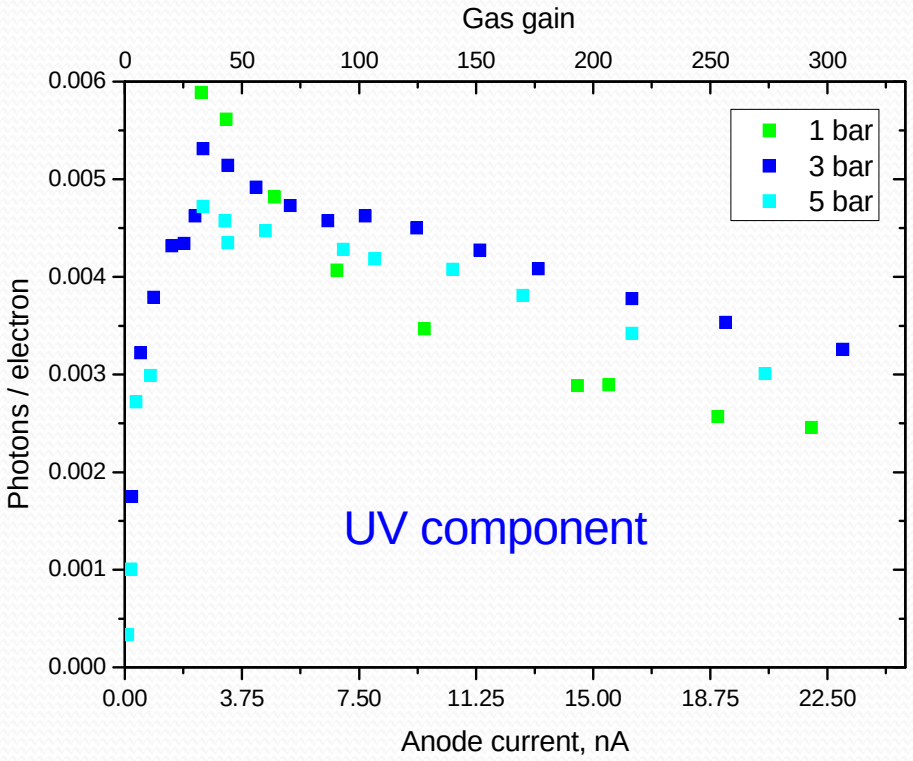


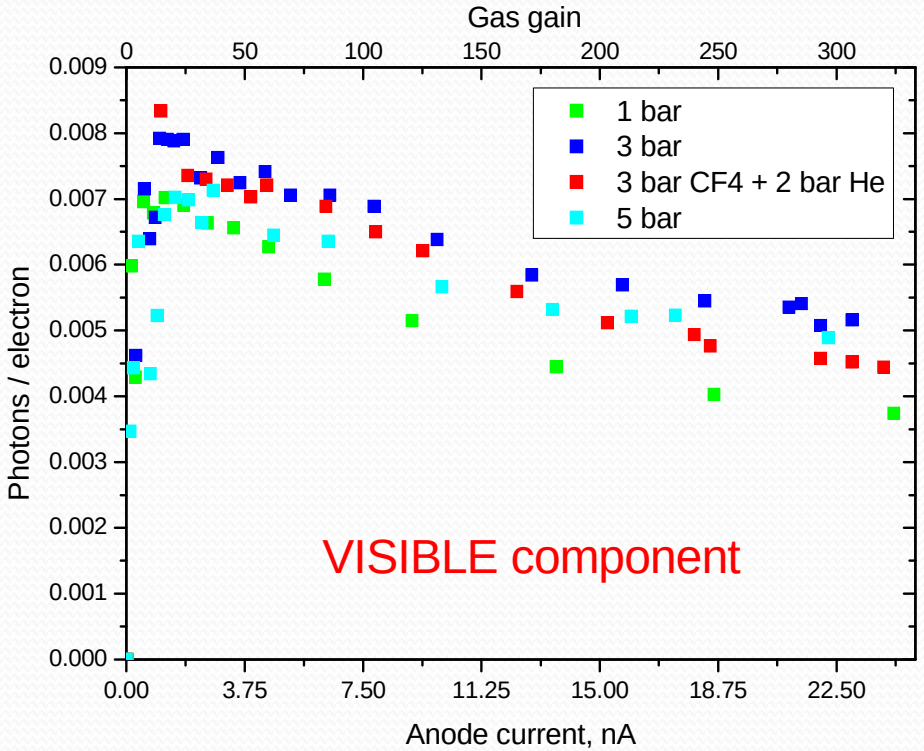
Problems?

Data in the graphs: from a fresh microstrip, photons in 4π, assuming that all light is emitted on top of the anodes (90% reflectivity)!

If one assumes zero reflectivity:
Total yield (UV + visible), "fresh" microstrip: ~0.035 photons/electron

Photon / electron ratios





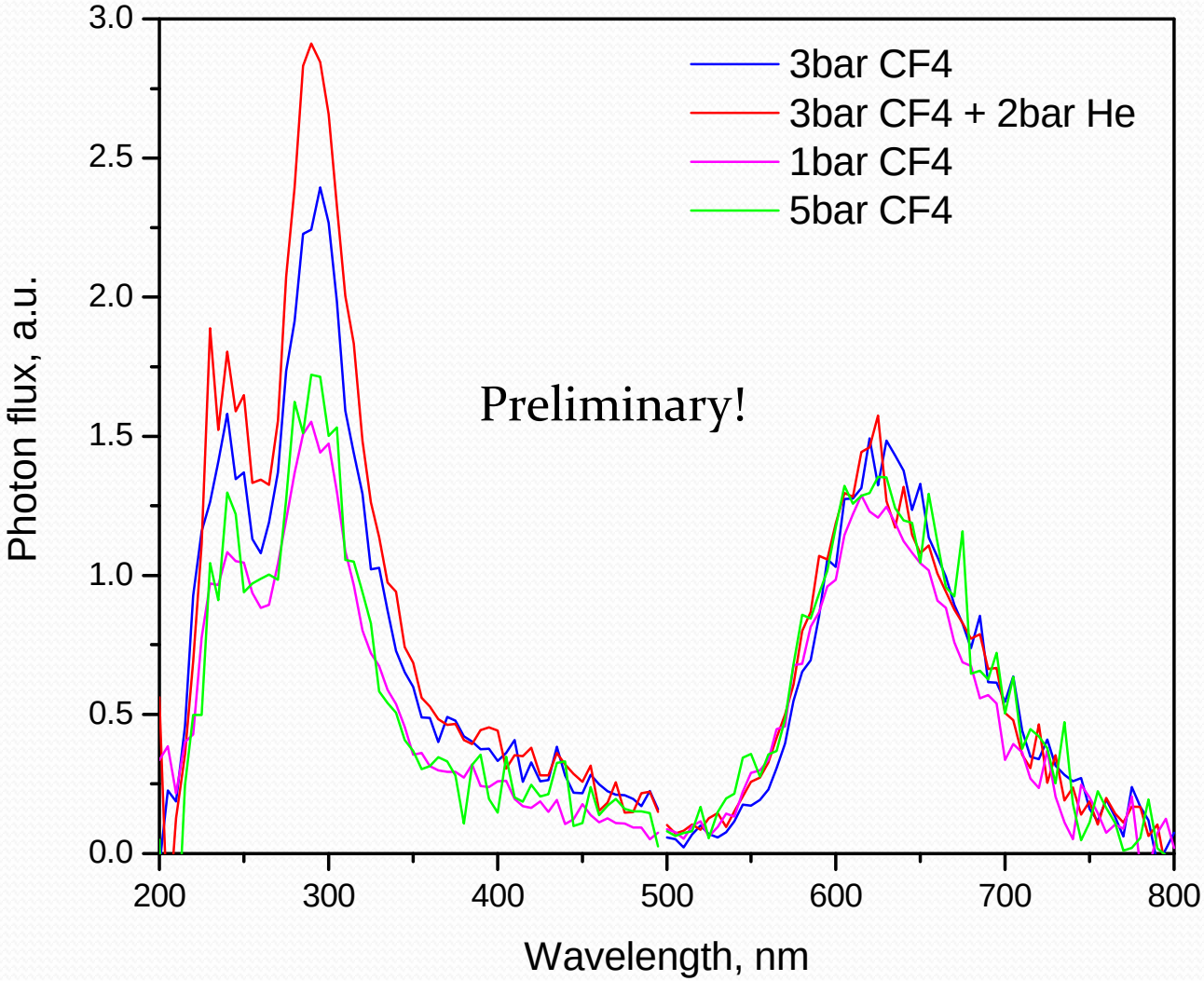
Data from a "used" microstrip

UV: about 50% drop, Visible: about 20% drop

Checked: Still good short-time reproducibility

(More on aging is at the end of the presentation)

Secondary scintillation spectra



Fully corrected for the spectrometer + PMT sensitivity!

Average recording time is 5 hours

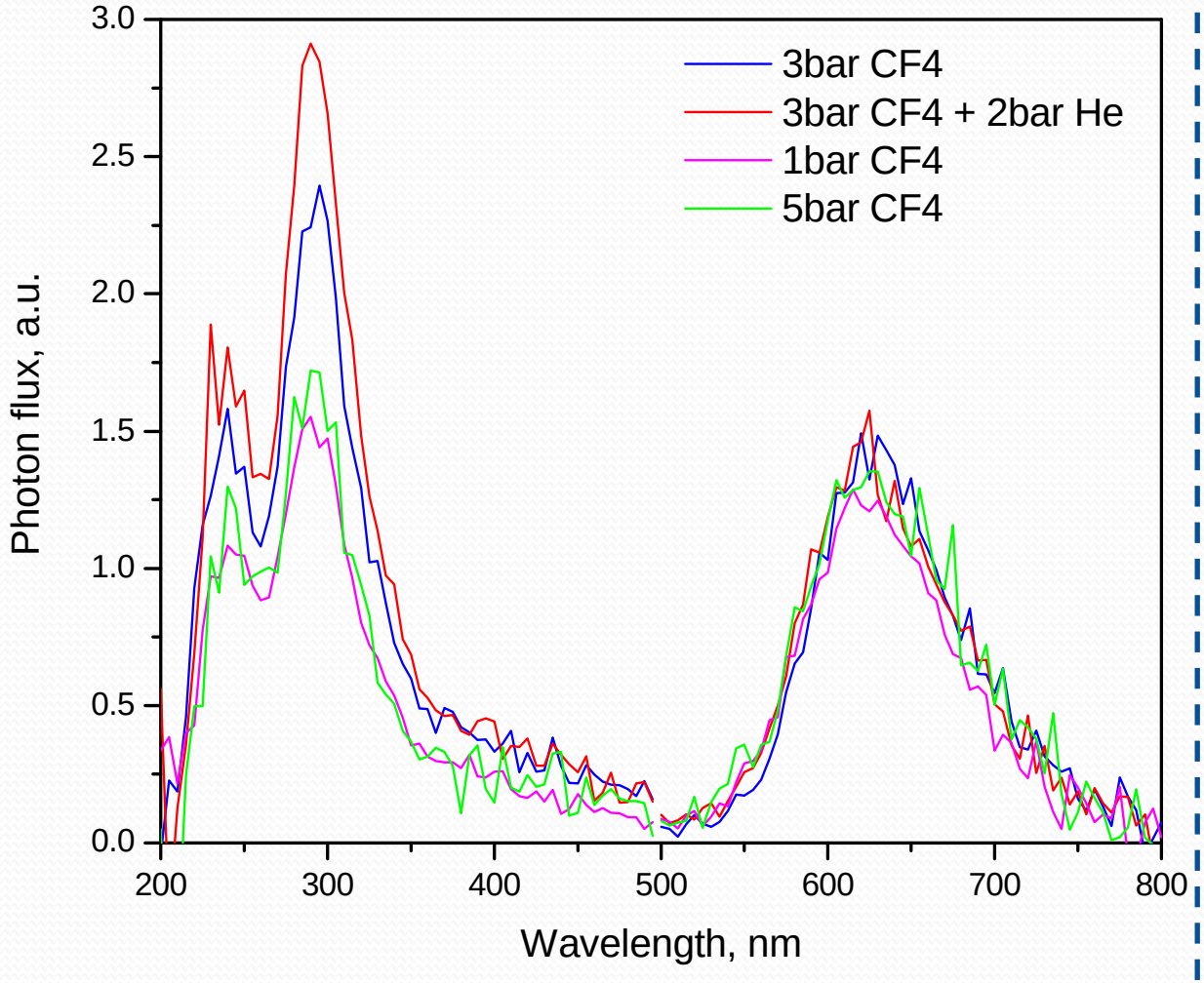
Intensity of the visible component of each spectrum is scaled using fresh gas measurements with the spectrometer at 300 and 620 nm! Δ ~20%

To provide an absolute scale for all spectra, they are scaled using photons/electron ratios for the visible component.

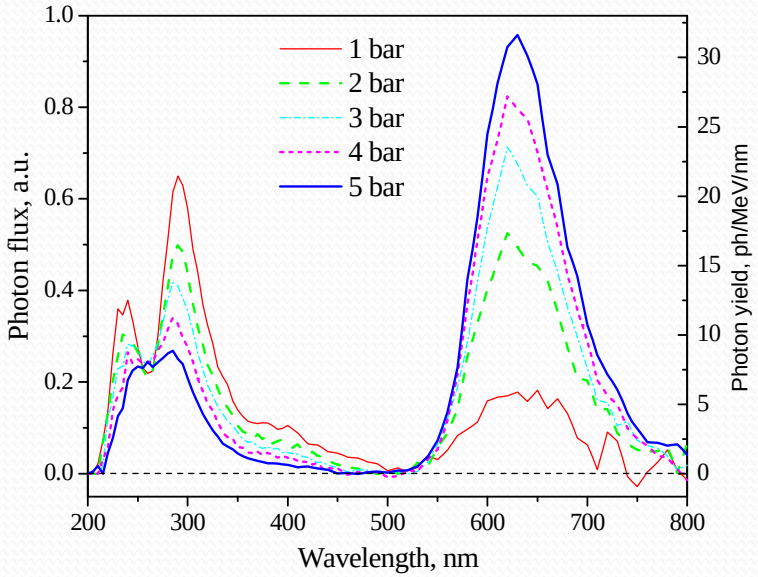
Δ ~20%

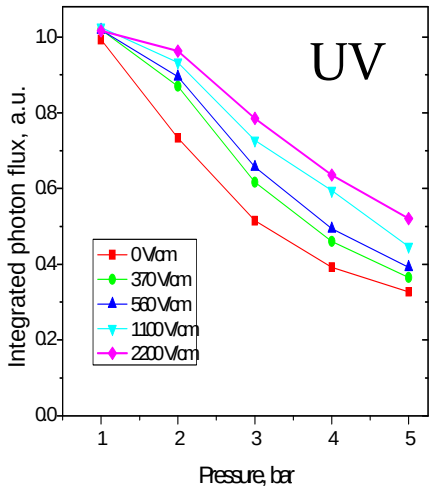
Spectra: Comparison with primary

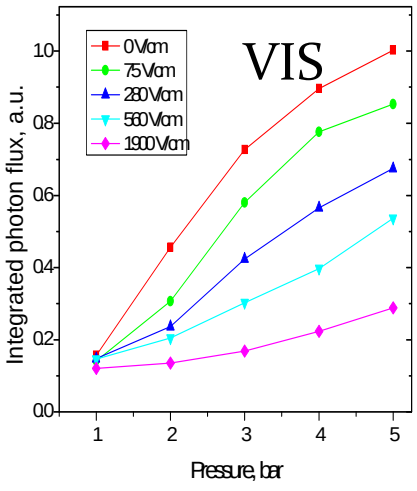
Secondary



Primary

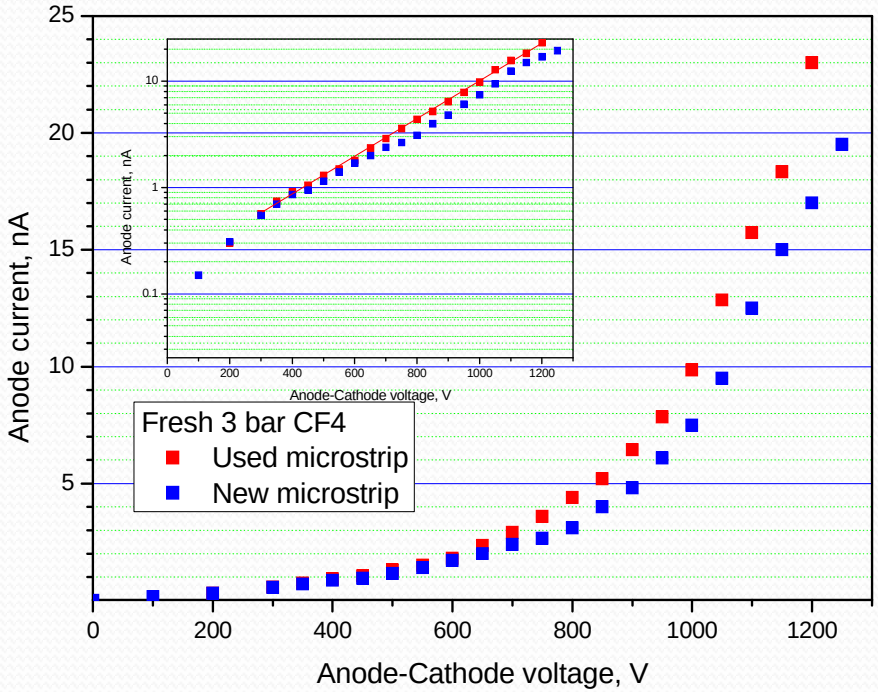


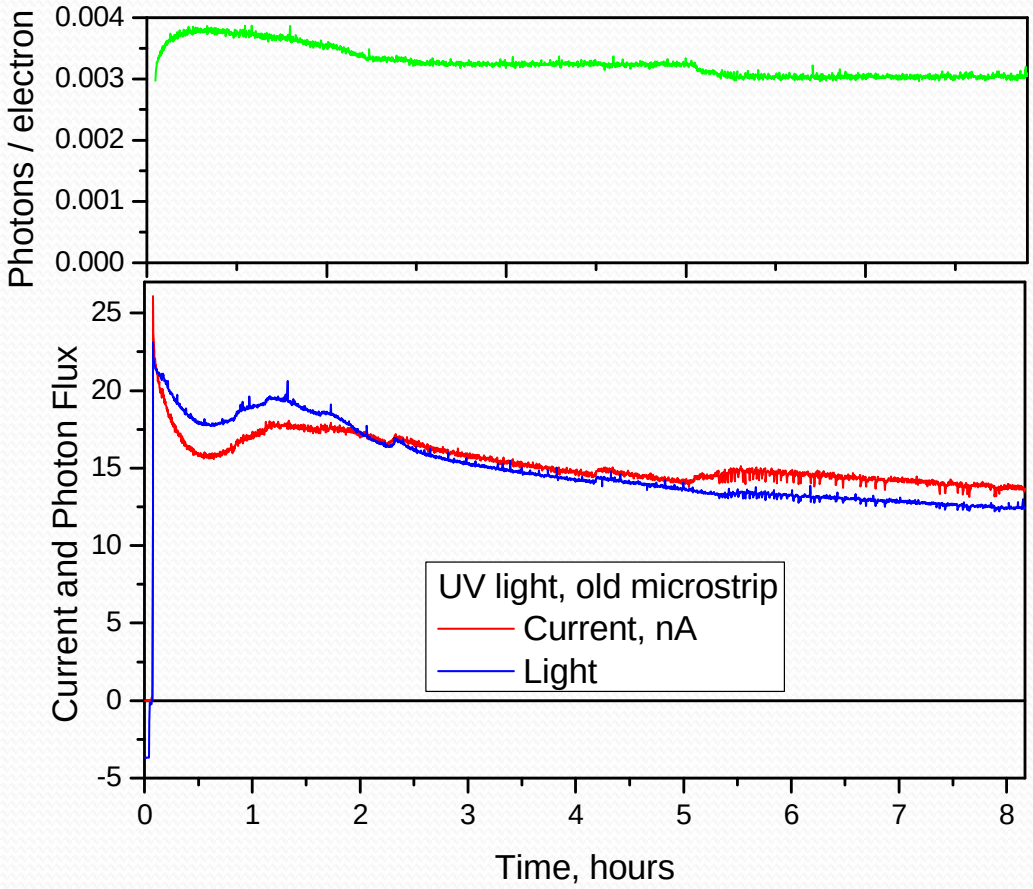




Aging effects

- Drop of Photons/electron ratios (20 – 50%)
- Increase of the current at the same voltages (still exponential, not just leakage!)
- Current jumps
- New "features" in Ph/el *vs* current graphs





3 bar CF4, anode-cathode: +1200 V
Old microstrip!

Aging effects

- Loss of reflectivity
- Damage to anodes
  Loss of some anodes?
- Debris deposition
  Change of field configuration
  Change of spatial charge
- Shift of the light-emitting region

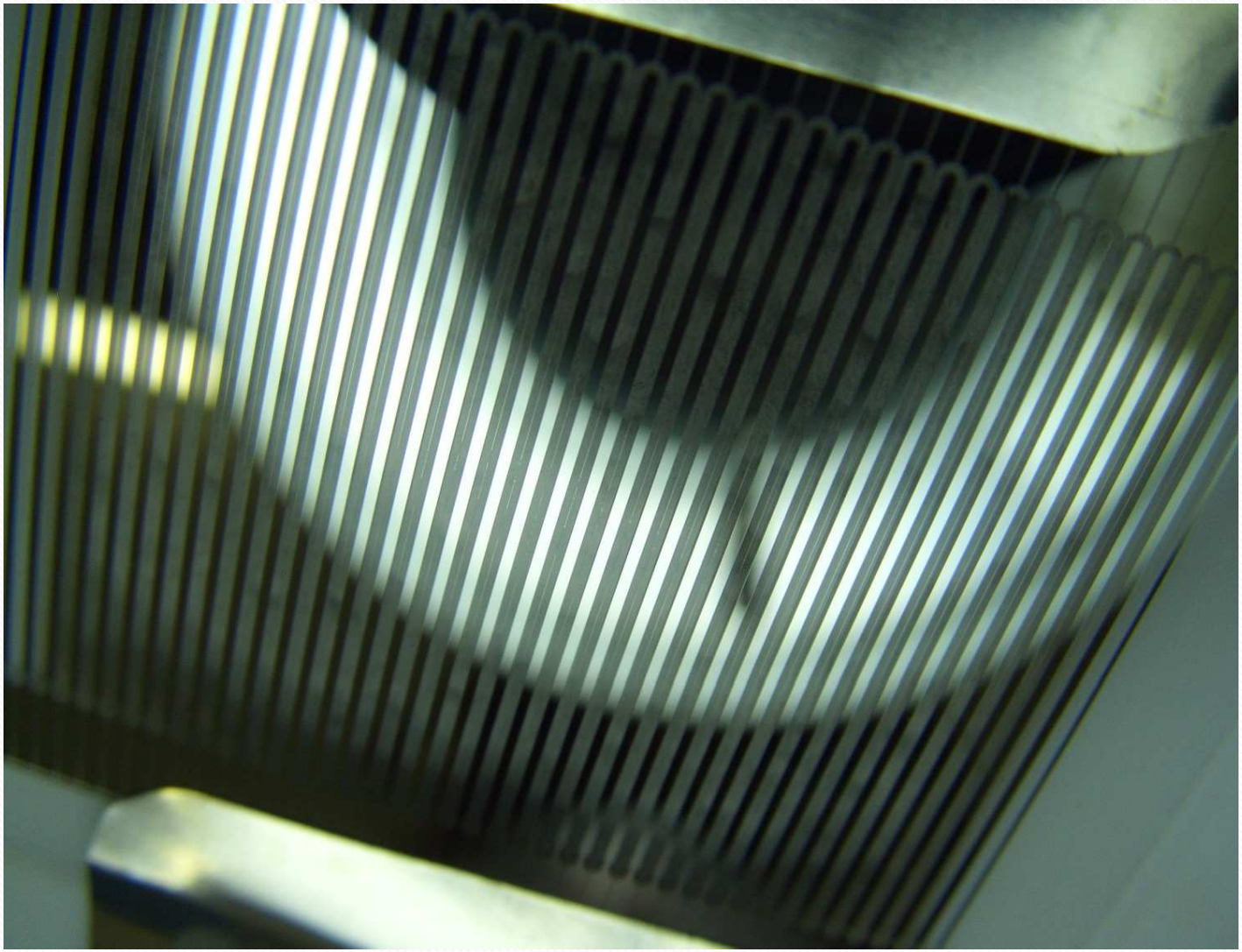


Photo of the microstrip after completing this experimental run

Conclusions

- The secondary scintillation shows a weak dependence on the CF_4 pressure. 3bar of CF_4 gives the highest photons-per-electron ratios.
- At 3 bar CF_4, an admixture of 2 bar of He gives a slight (~20%) enhancement of the UV emission and practically does not affect the visible emission.
- Photons-per-electron ratios (assuming no reflectivity at the microstrip!) are

  about 0.020 in the UV and

  about 0.015 in the visible
- The spectral profiles of the secondary emission in the UV and in the visible are similar to the corresponding profiles of the primary emission in the presence of a strong electric field.

Outlook

- A similar study has to be performed at a lower flux of the primary electrons!
- Gas chamber has to be improved and the effect of impurities on the aging has to be studied.
- Reliable uncertainties are still to be calculated.
- Additional measurements with improved statistics have to be performed prior publication of the final results.