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CF_4 primary scintillation: UV-visible spectrum and photon yield

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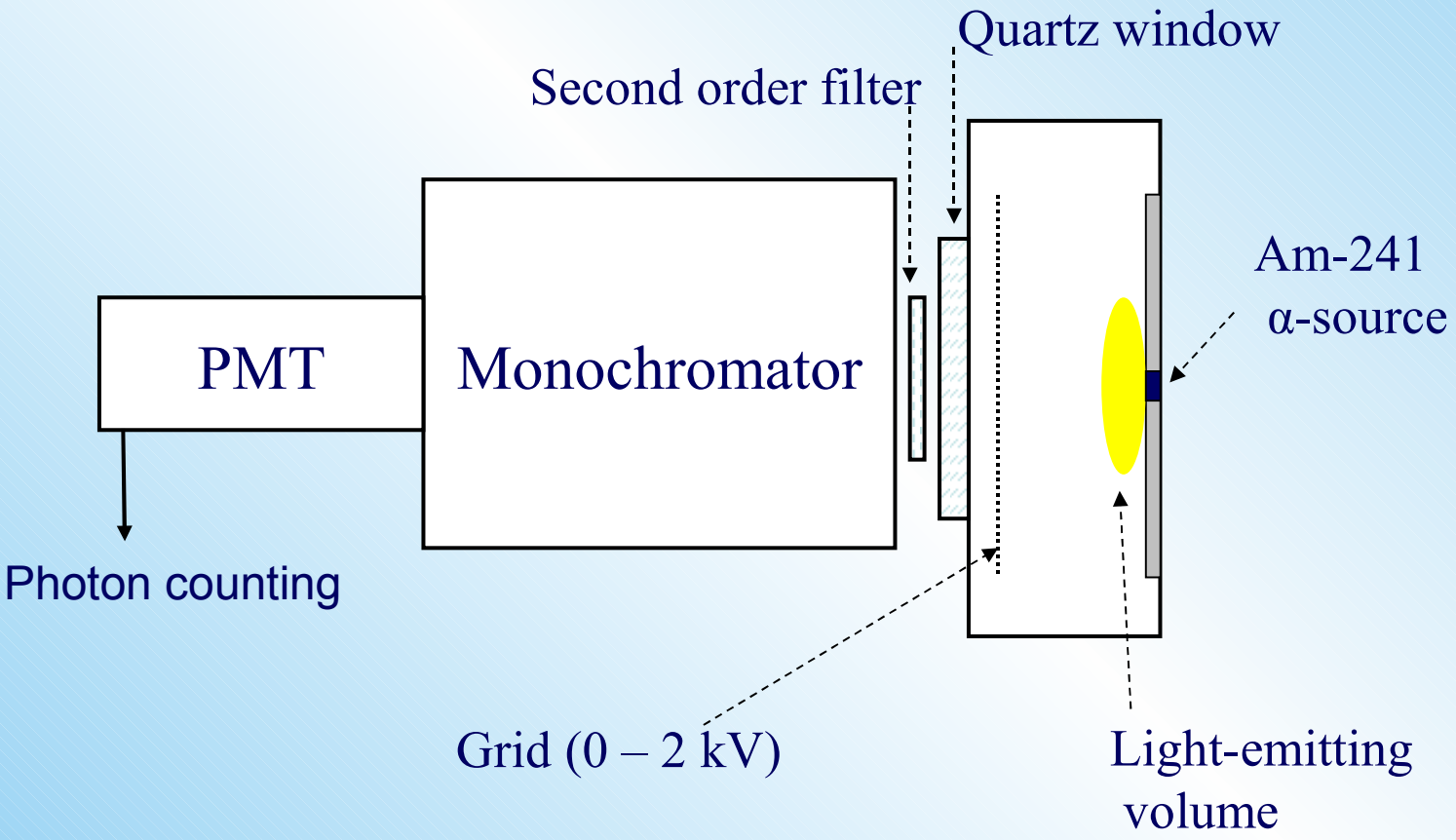
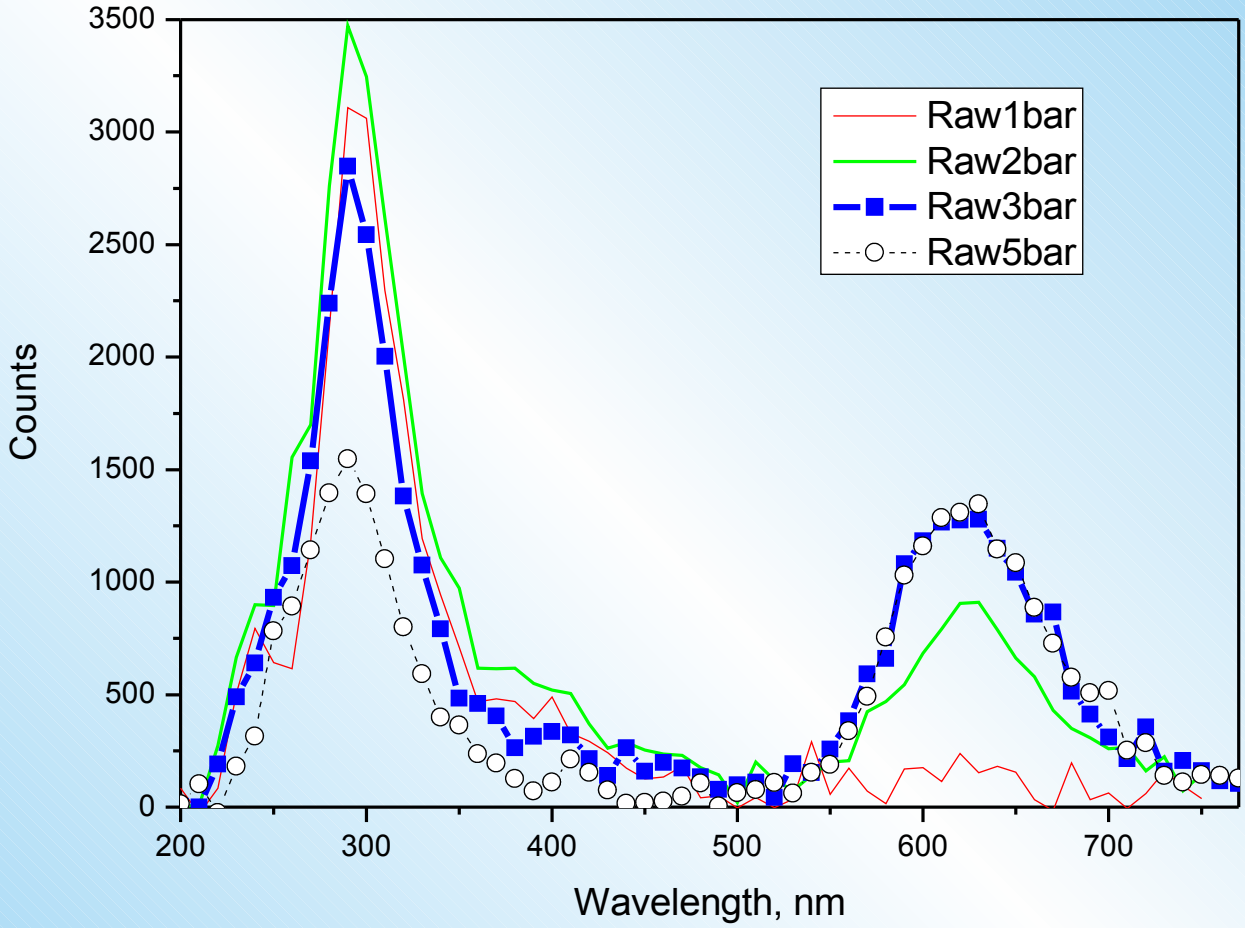
Content

- Spectra from 200 to 800 nm (1 to 5 bar)
  - Intensity calibration
- Photon flux (absolute measurements)
- α-source characterization
  - Flux, energy distribution
- Photon yield
- Effect of the electric field

Spectral studies



CF_4 primary scintillation: Raw spectra



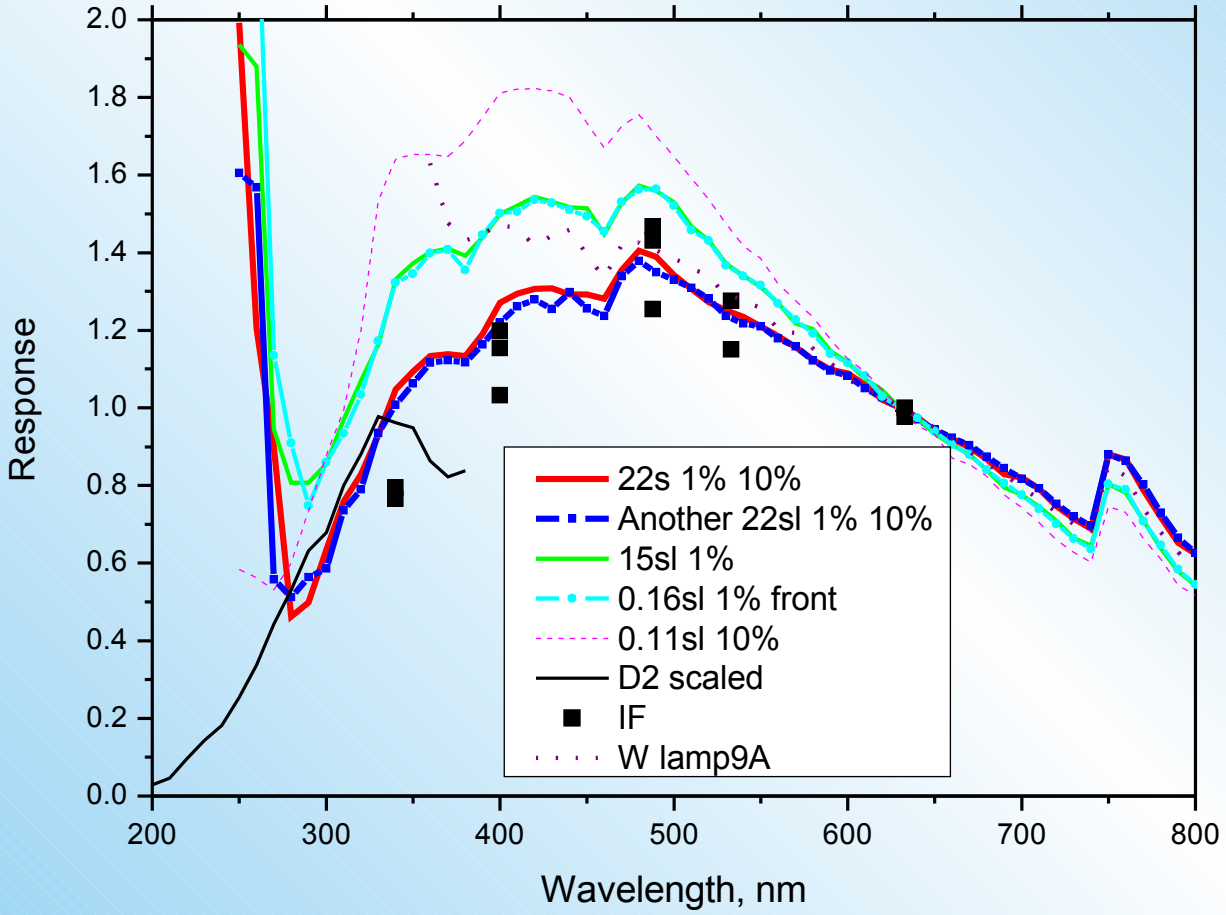
Gas aging effects: UV component – 5% drop over 3 hours
red component – 20% drop over 3 hours

Spectra: Intensity calibration

Calibration light sources:

- Tungsten strip lamp (needs focusing): 450-800 nm
- Halogen lamp: 320-800 nm
- Halogen lamp + interference filters: 300, 340, 400, 488, 533, 633 nm
- Deuterium lamp: 200-360 nm *!Old calibration!*

Response measurements

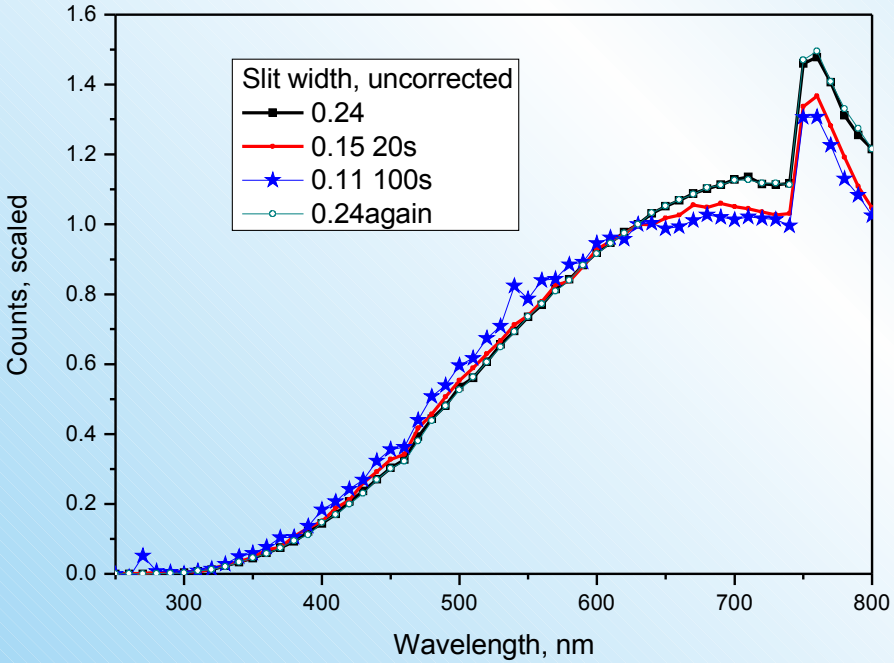


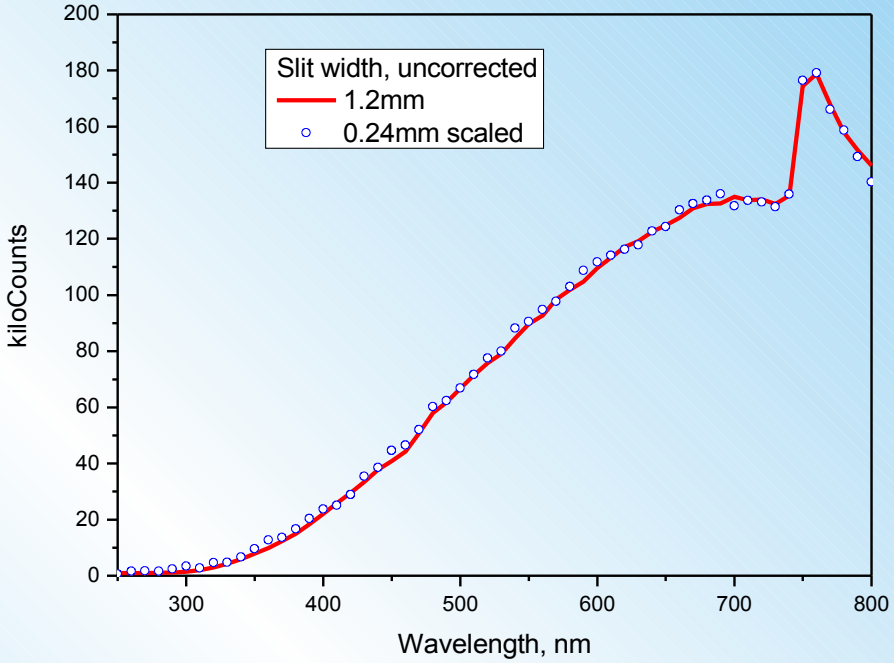
Huge difference in photon fluxes from the lamps and the gas cell

Have to use neutral filters!

Slit width dependence?

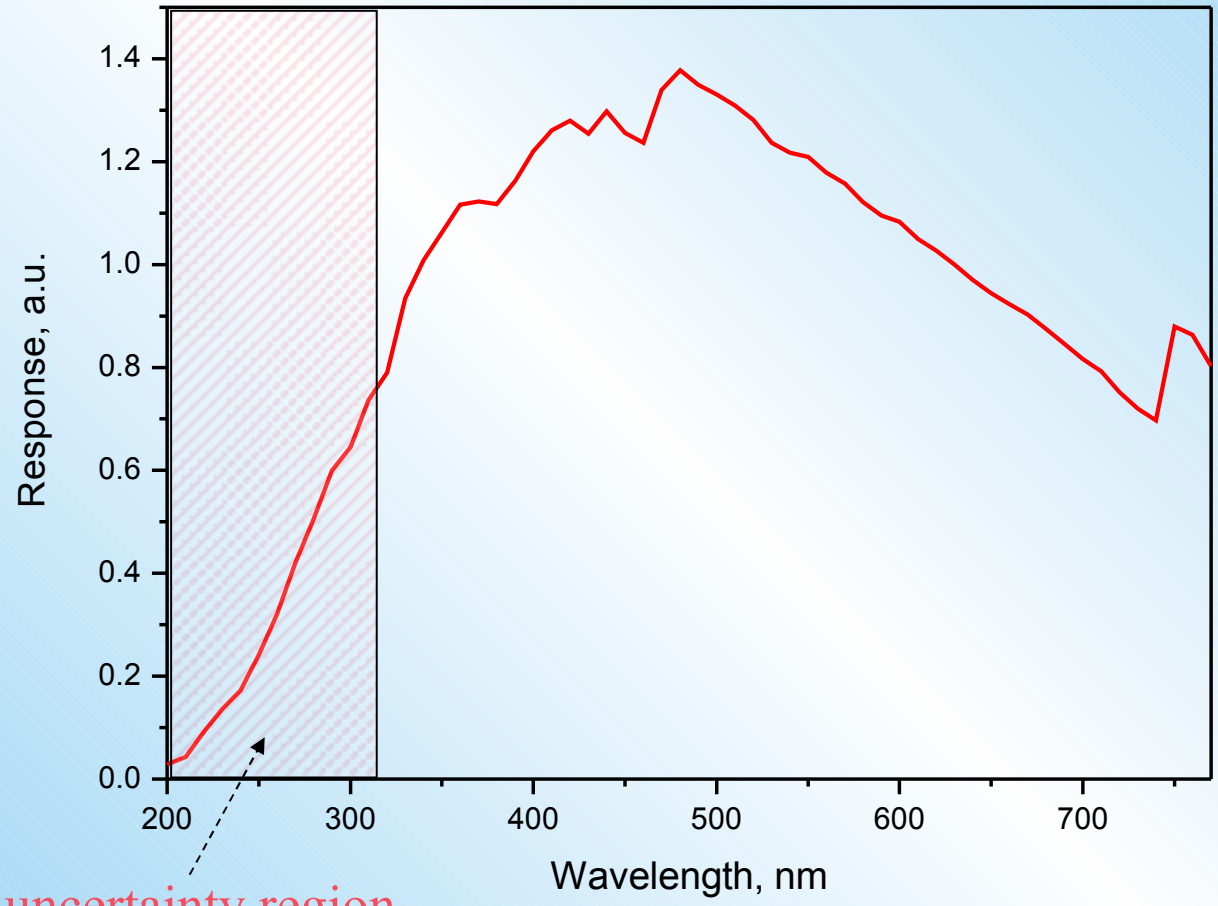
Slit width effects



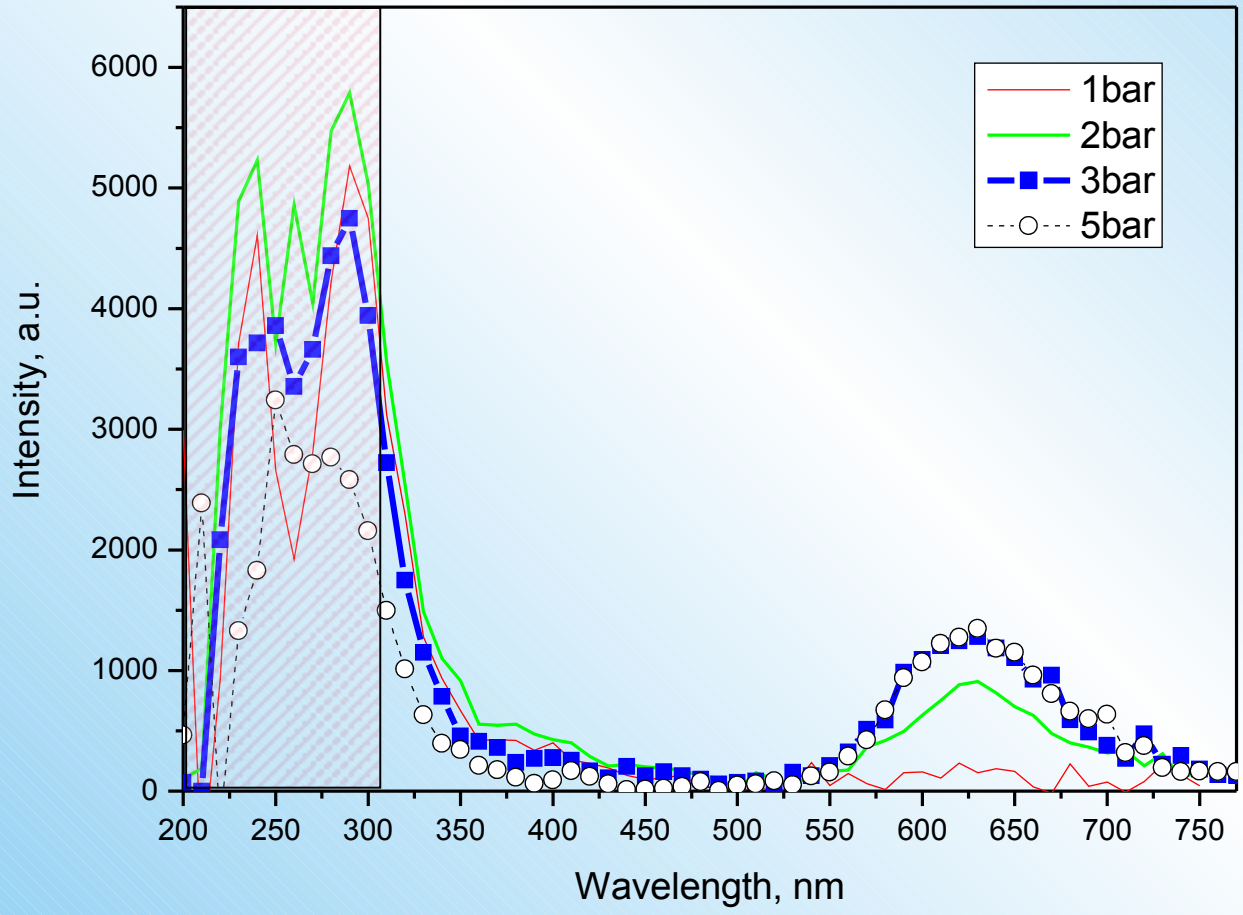


Conclusion: 0.24 mm and more – consistent results

Monochromator+PMT response curve



Instrumental response-corrected spectra



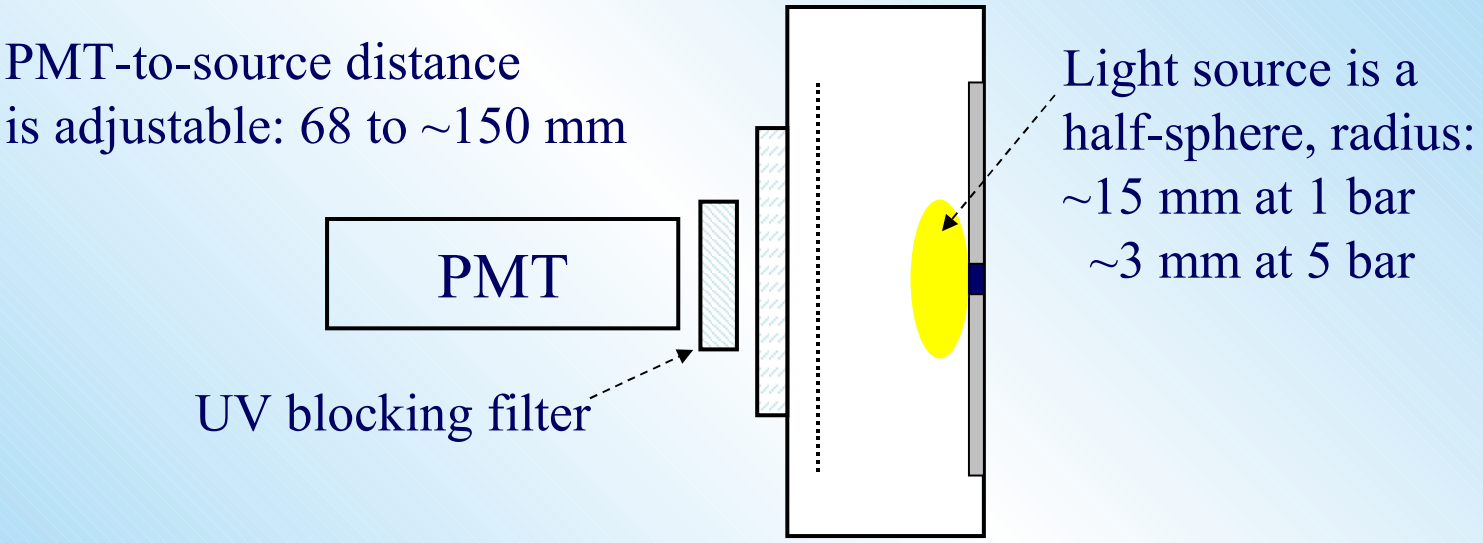
Geometrical factor is strongly pressure dependent!

↓

Spectra from different pressures are not to scale!

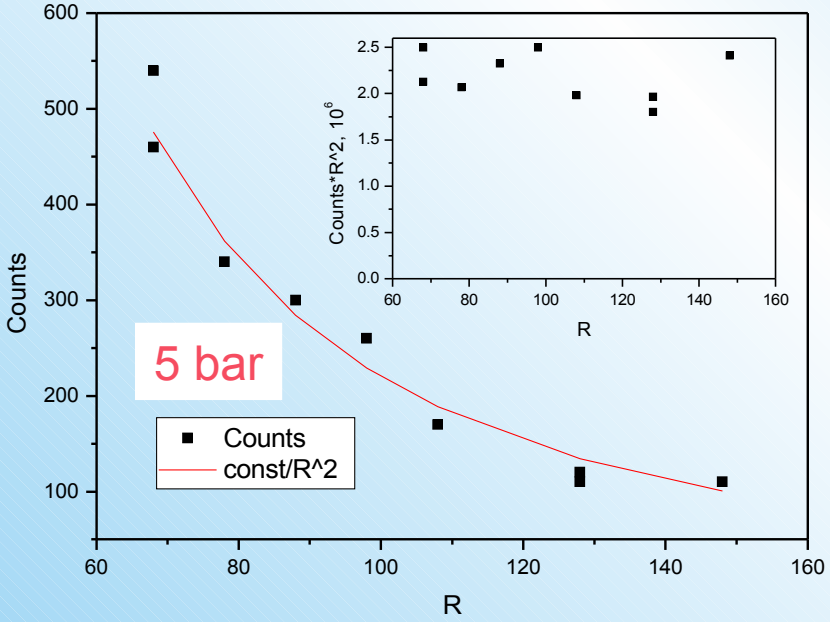
Absolute photon flux measurements

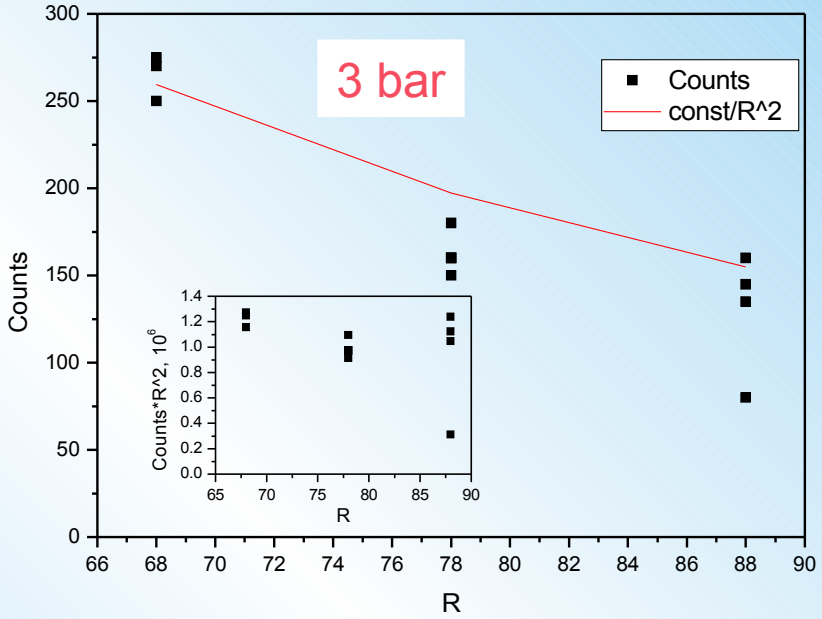
Only visible region!



Flux vs. PMT-to-source distance

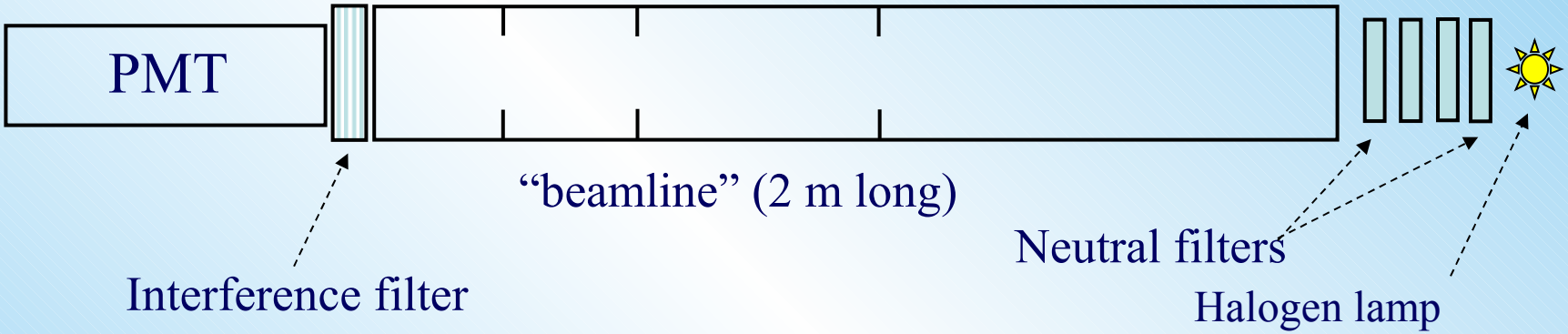
Wavelength-integrated (500 – 800 nm) photon flux



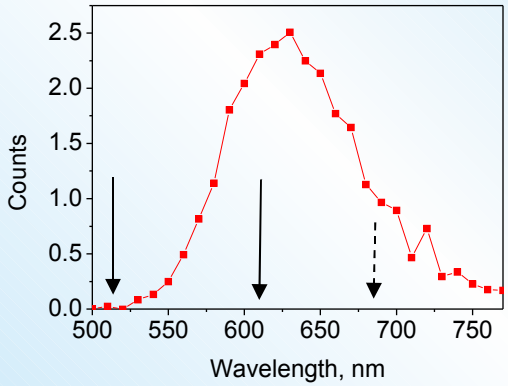


Photon detection probability?

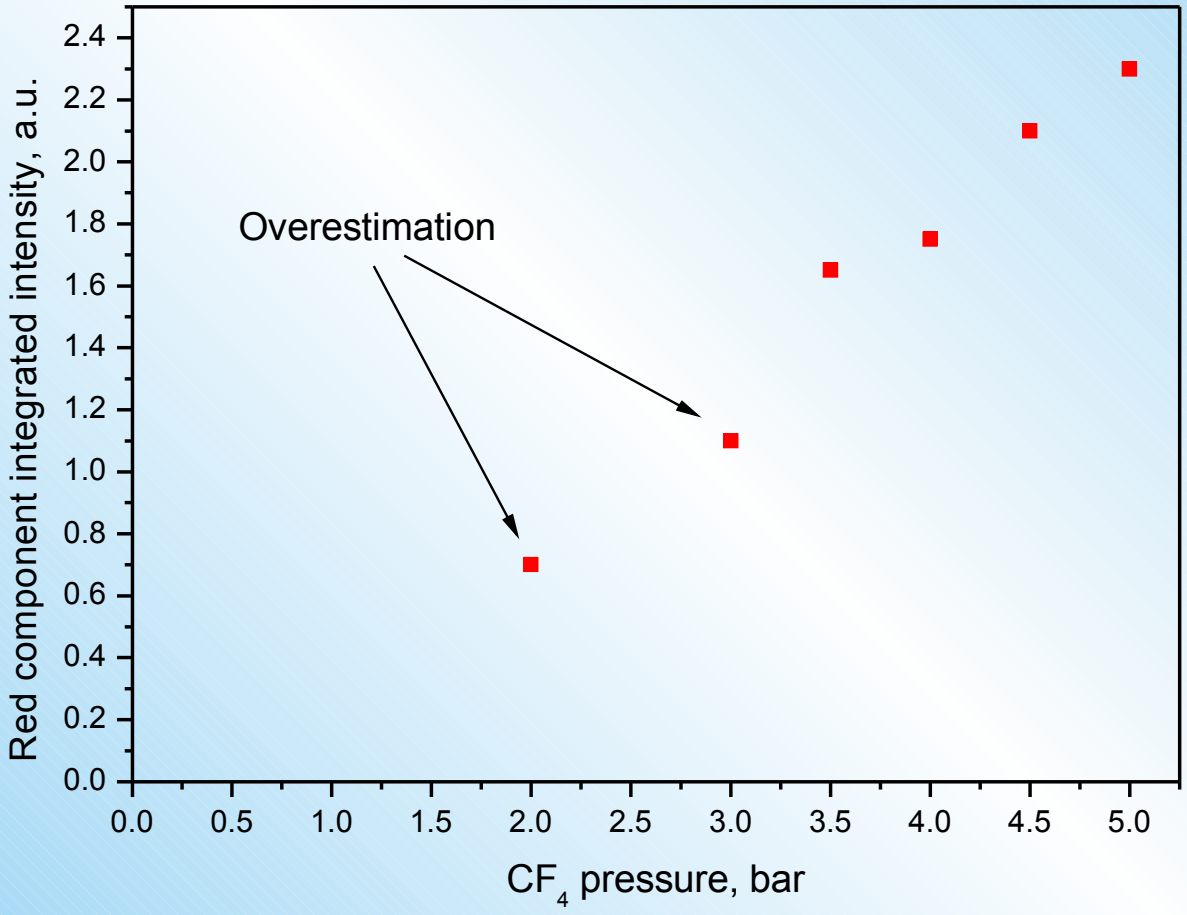
Photon detection probability



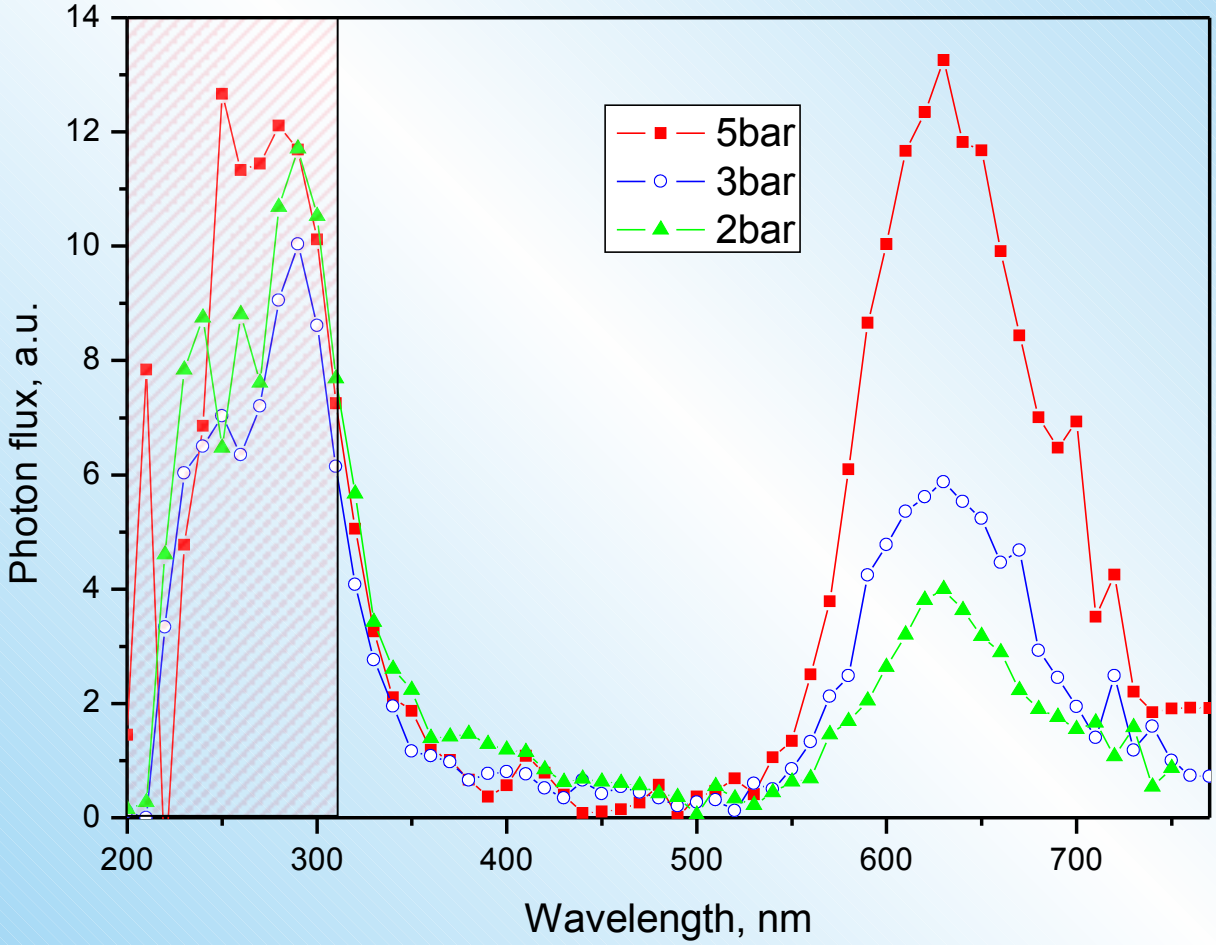
Has been checked
with interference filters:
533 nm (~10 nm FWHM)
633 nm (~3 nm FWHM)



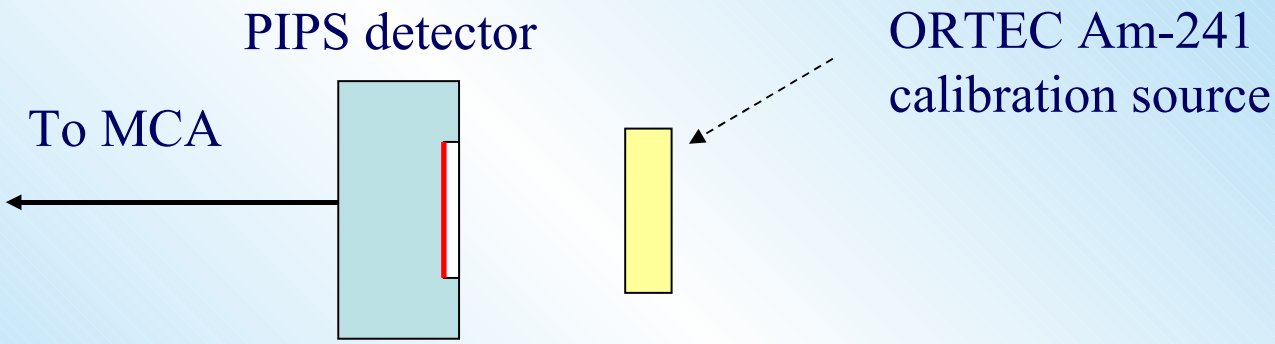
Photon flux in the red component vs. CF_4 pressure



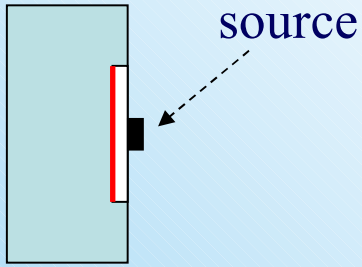
Spectra corrected for the geometrical factor



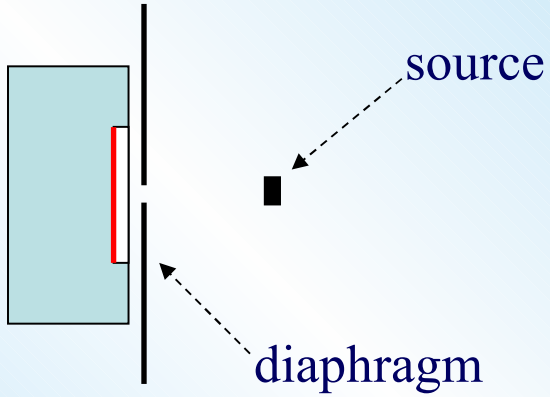
α-source characterization



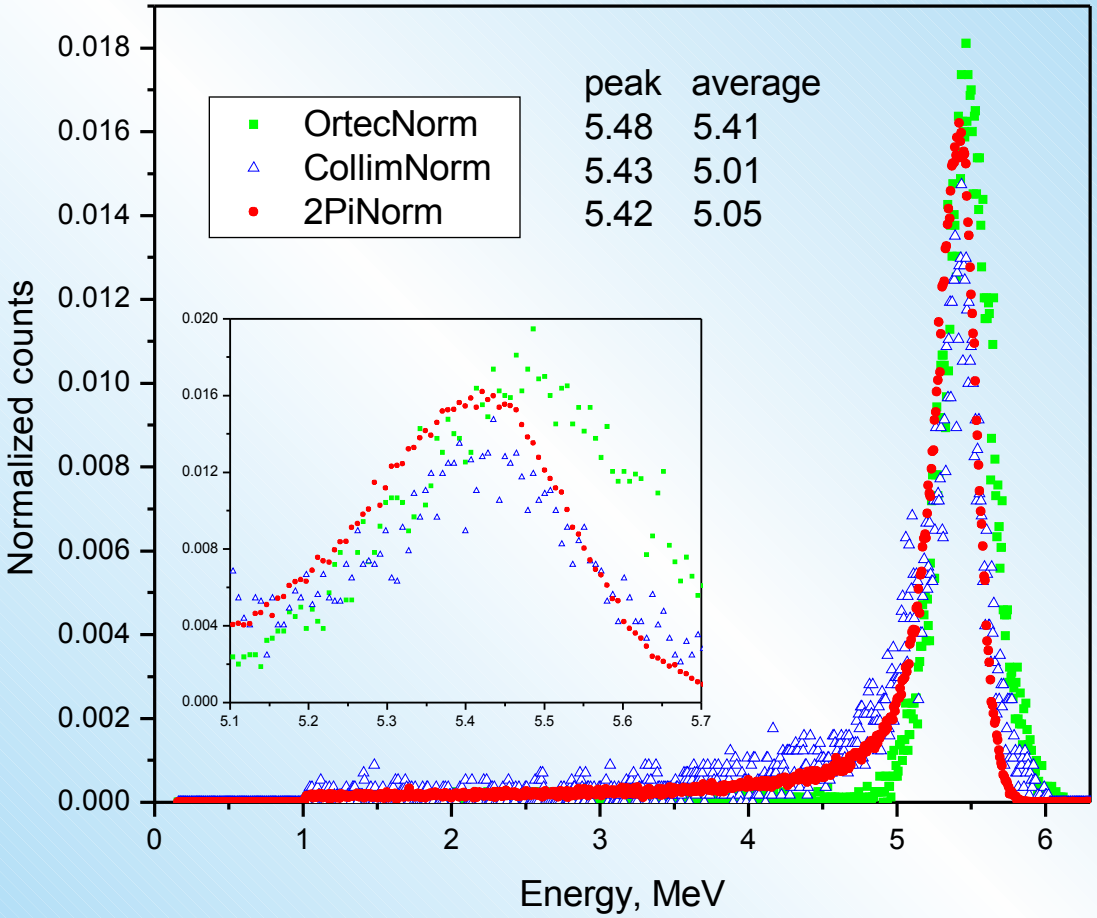
2π emission



Collimated emission

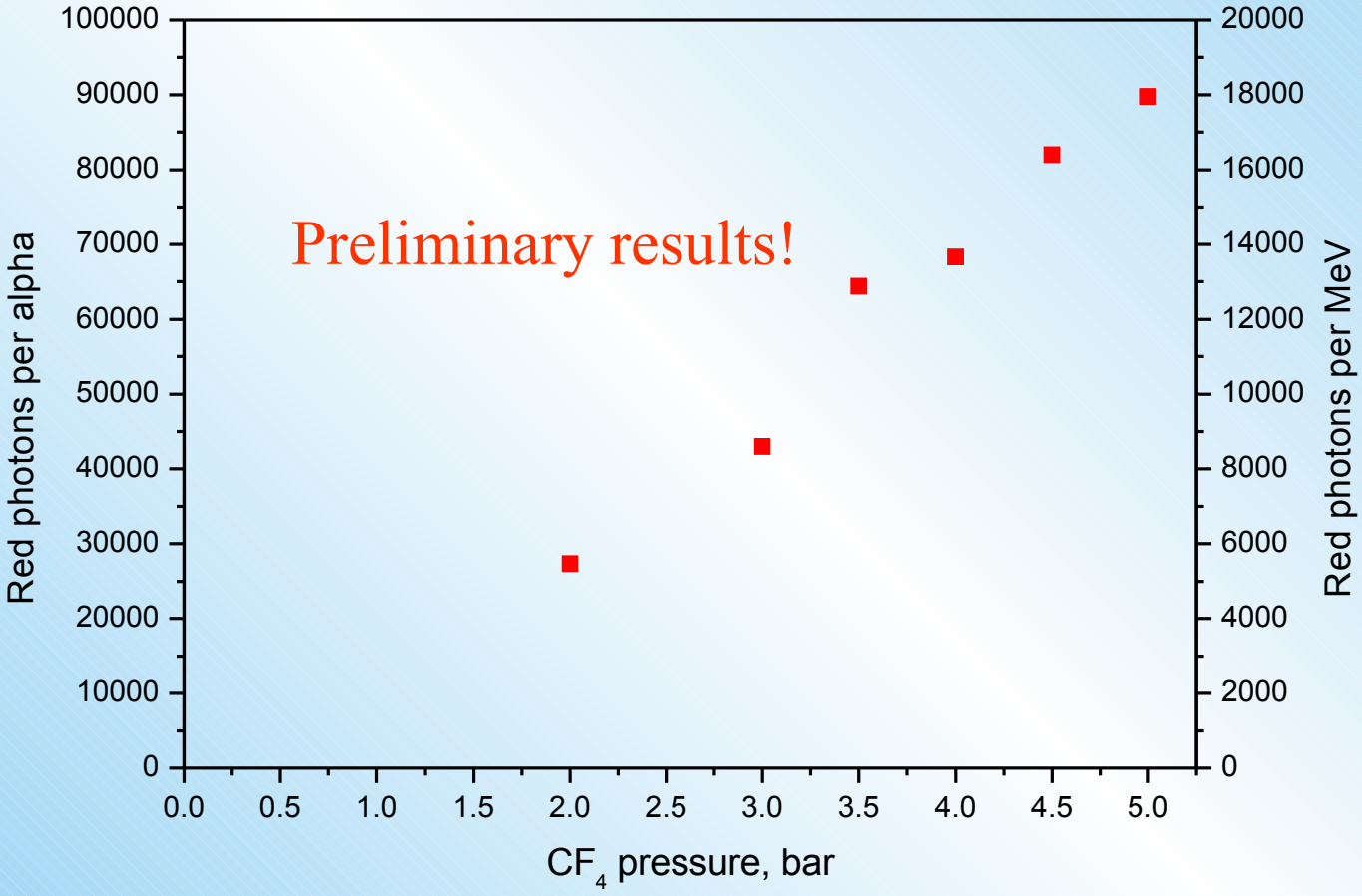


Energy distributions

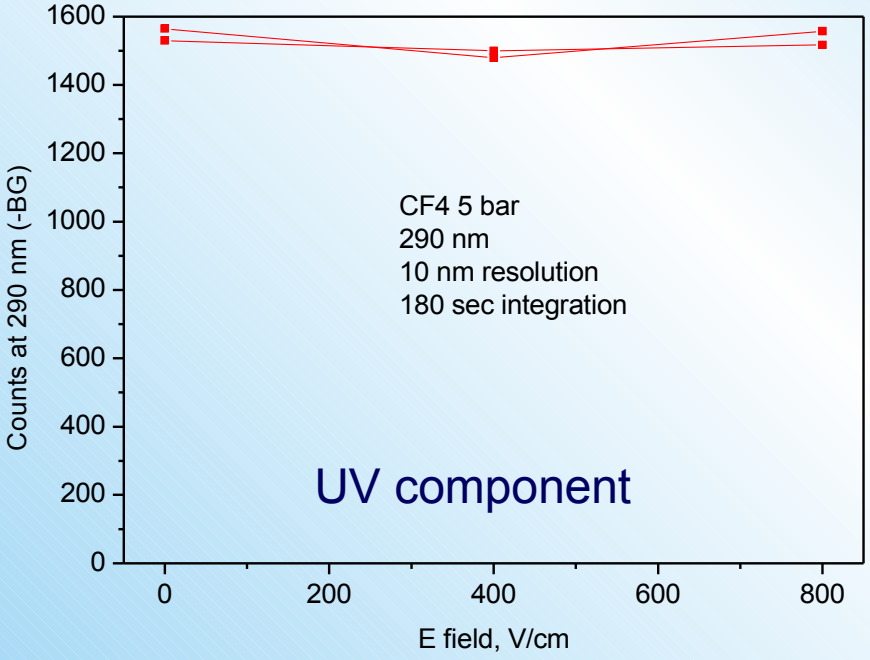


α-particle flux in 2π is 592 ± 5 s^{-1}

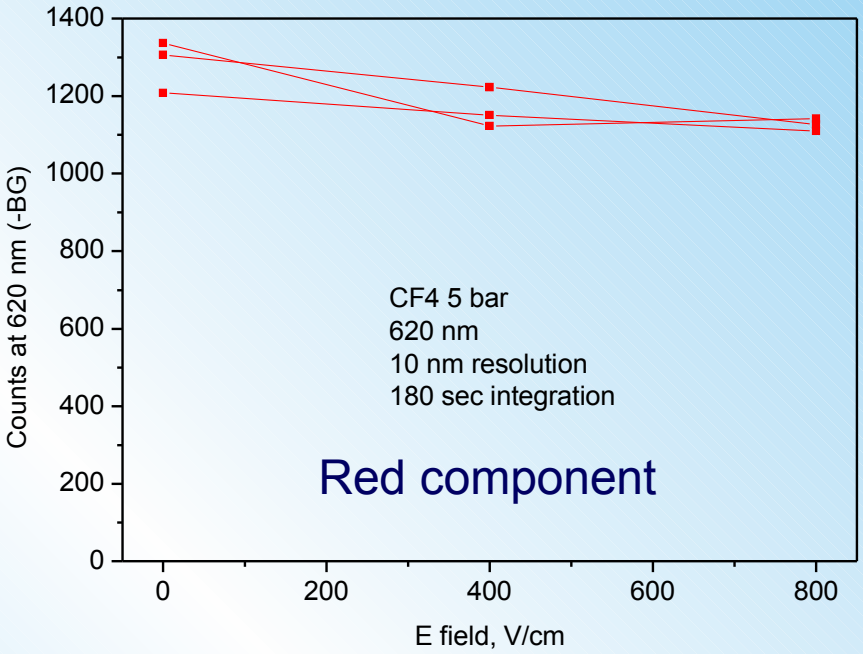
Photon yield (red component, integrated)



Effect of the electric field



No dependence



Weak reduction with the field

Similar behavior at lower pressures

Future work

- UV-component
  - A freshly calibrated D_2 lamp is needed
  - Have to use more UV-sensitive monochromator and PMT for spectral and flux studies of the UV component
- Red component
  - Extend to higher pressures – where is the saturation?
- Yield uncertainty estimation
  - Need better signal-to-noise ratio in absolute measurements
  - Cross-check with another PMT
  - Accurate transmission/reflection measurements