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# X-ray time resolved spectroscopy of capillary discharge

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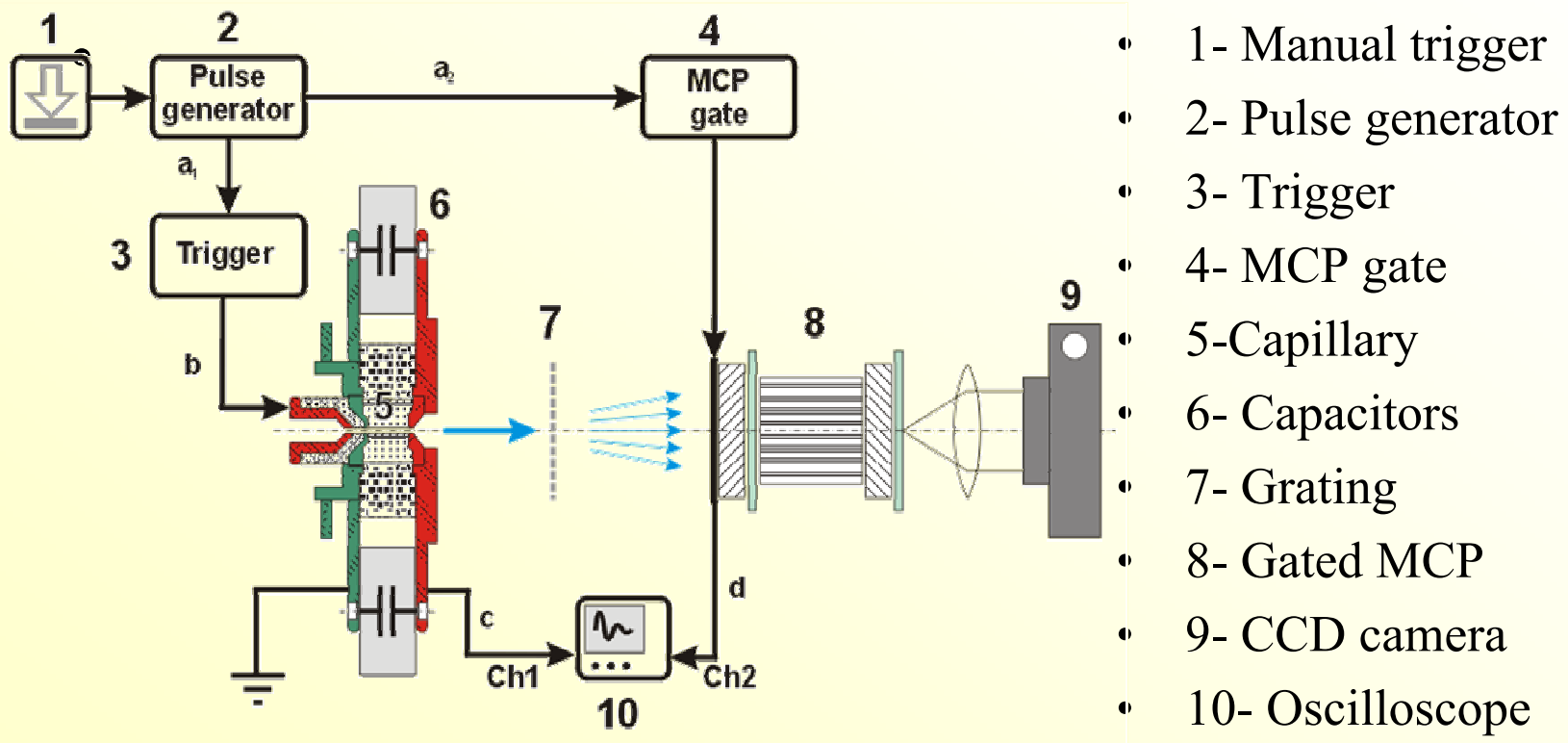
# Ablative capillary discharge

- Evacuated capillary
  - Polyethylene  $[\text{C}_2\text{H}_4]_n$
  - Polyacetal  $[\text{CH}_2\text{O}]_n$
- Expected ions at  $T_e = 40\text{eV}$ :  $\text{C}^{5+}$ ,  $\text{C}^{4+}$ ,  $\text{O}^{6+}$ ,  $\text{O}^{5+}$ ,  $\text{O}^{4+}$

# Ablative capillary discharge

- Electronical characteristics
- Time resolved spectral diagnostics

# Experimental setup



# Electronical characteristics

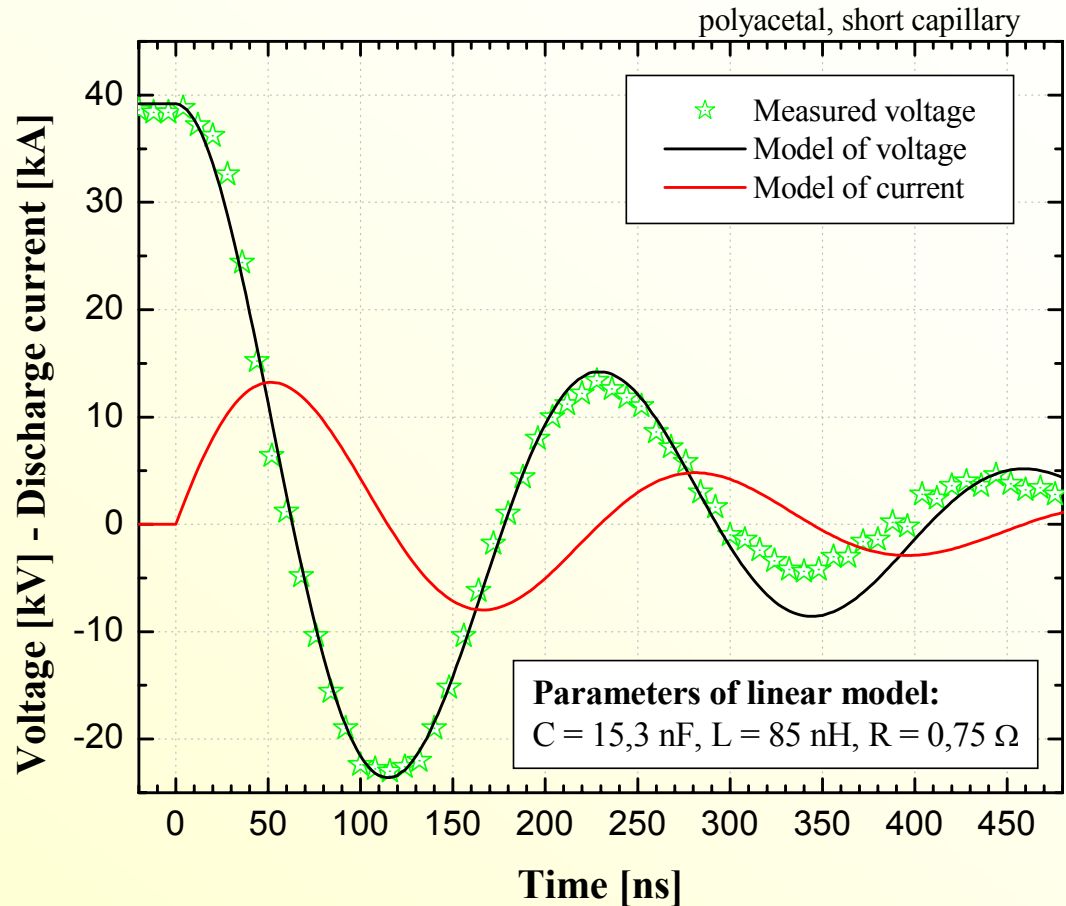
- Discharge part of the system:
  - 24 capacitors-  
total capacity of  
15.3 nF
  - Capillary length  
25, 35 or 55 mm
  - Capillary diameter  
1.1 mm
  - Charging voltage  
12- 42 kV



# Electronical characteristics

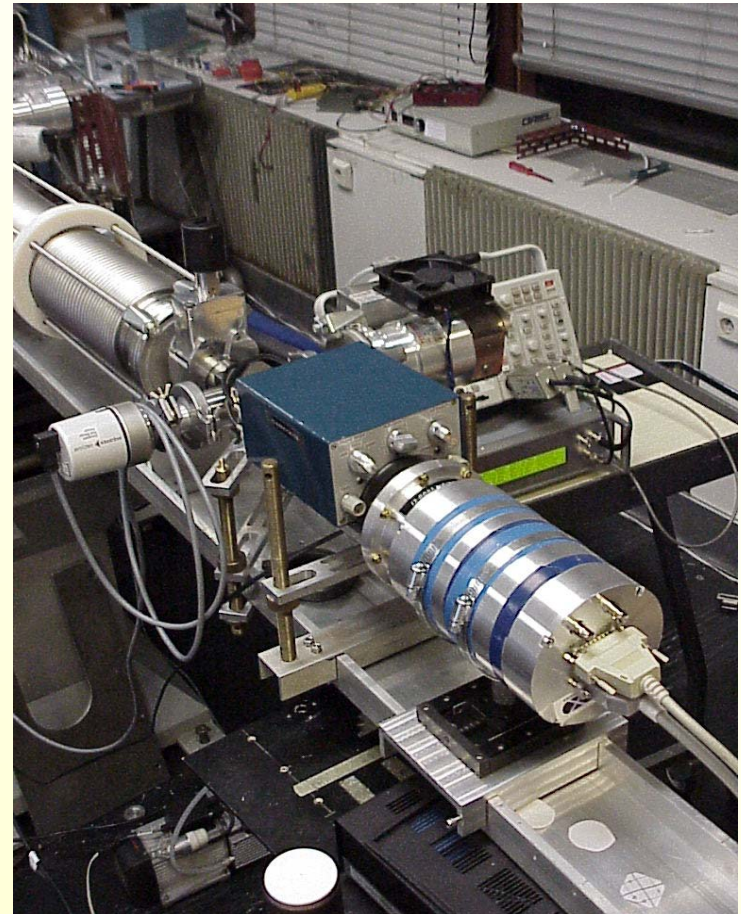
- Linear model of current

$$I(t) = I_0 \sin\left(\frac{\pi t}{2t_0}\right) \exp\left(-\frac{t}{t_1}\right)$$



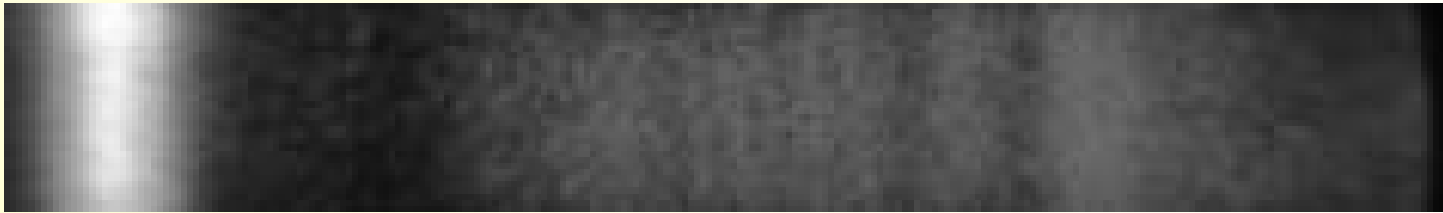
# Time resolved spectral diagnostics

- Transmission grating spectrograph
  - $800 \text{ line.mm}^{-1}$
  - $L_A = 940 \text{ mm}$
  - $L_B = 1350 \text{ mm}$
- Gated MCP framing camera
- CCD camera for digital readout

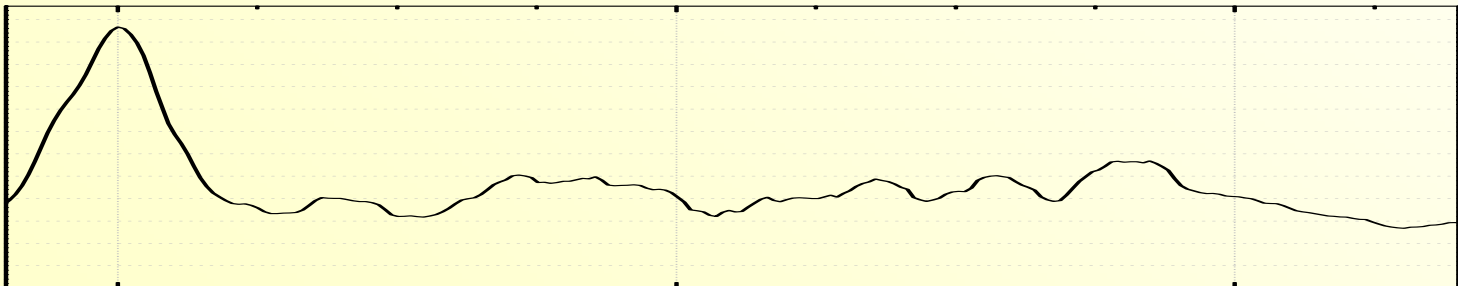


# Data processing

- Framing spectra- gate interval of 20 ns



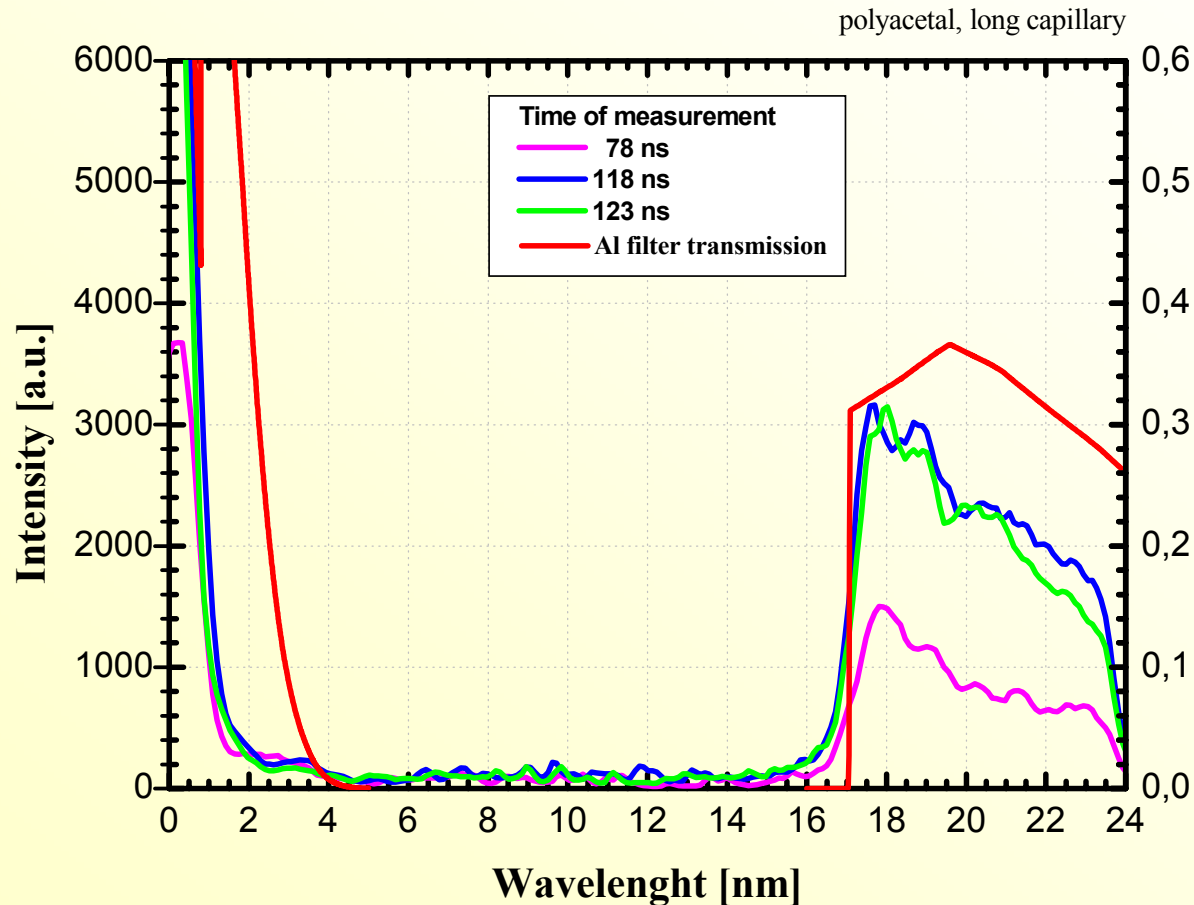
- Picture from CCD stored in PNG format
- Intensity histogram over data array



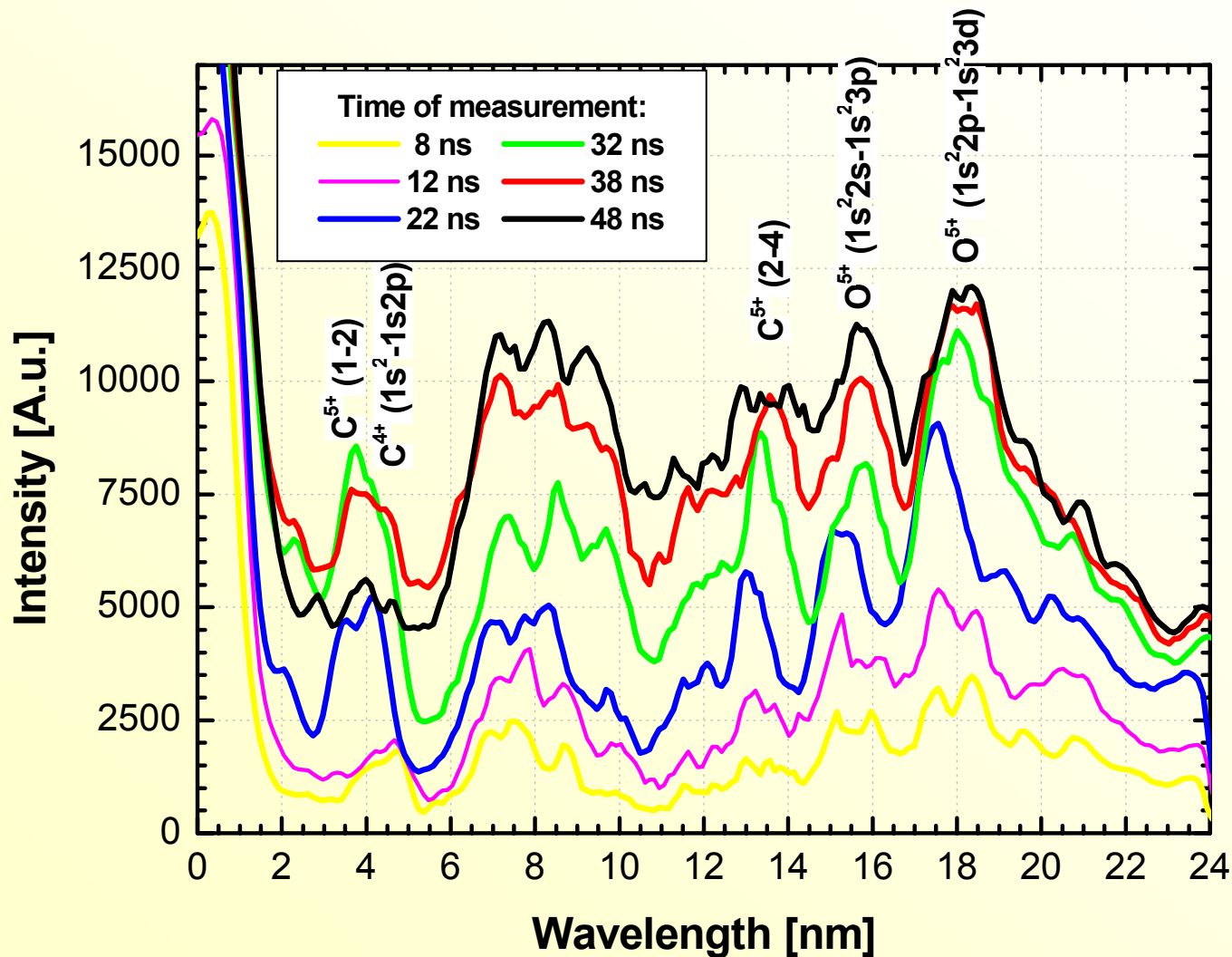


# Calibration

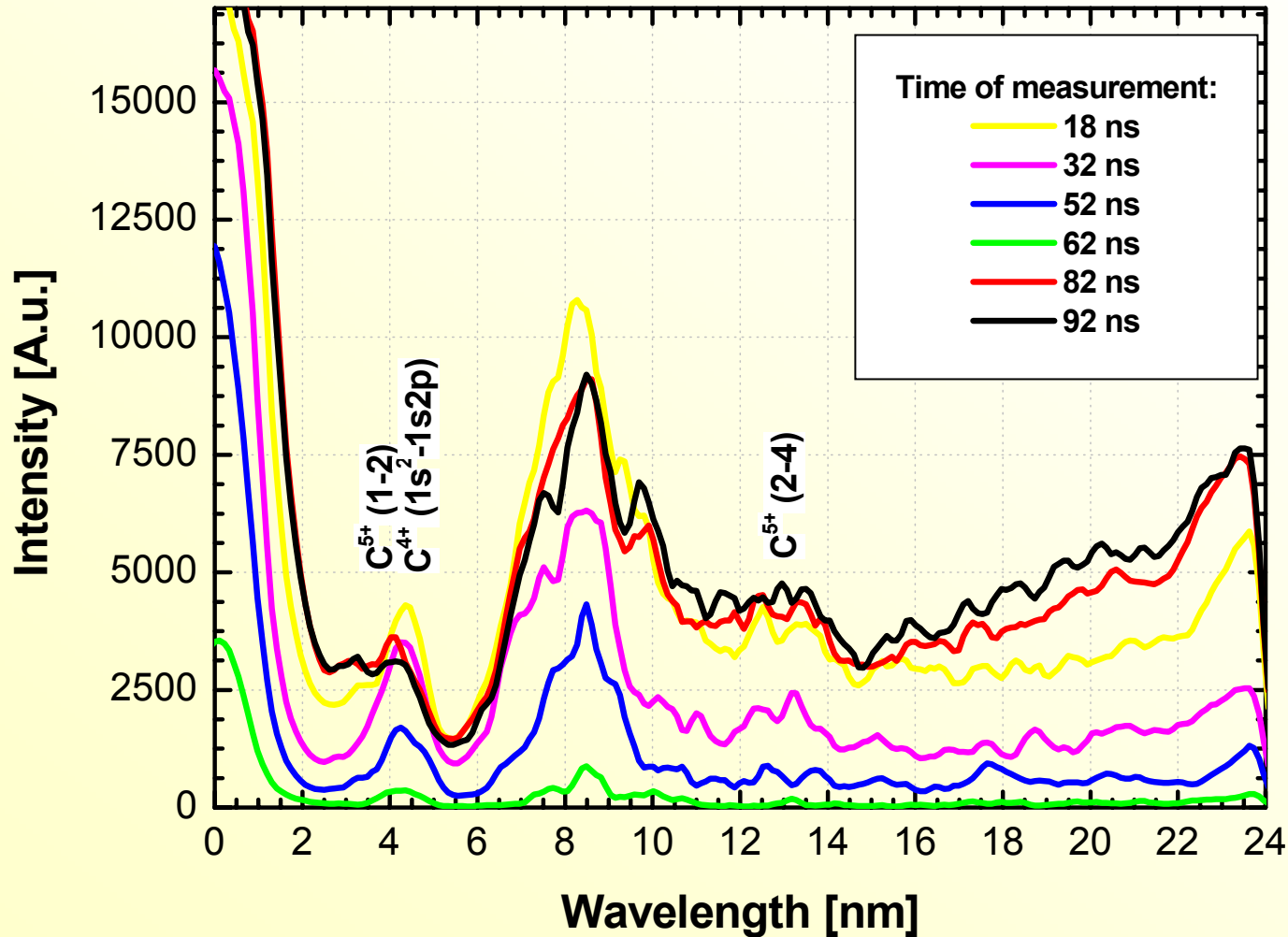
- Sharp loss of transmission of 0,75 $\mu$ m Al foil on 17nm:



# X-ray spectra- polyacetal



# X-ray spectra- polyethylene



# Ions and transitions identified

$C^{5+}$ (1-2)	3,37 nm
$C^{4+}$ ( $1s^2-1s2p$ )	4,03 nm
$C^{5+}$ (2-4)	13,50 nm
$O^{5+}$ ( $1s^22s-1s^23p$ )	15,01 nm
$O^{5+}$ ( $1s^22p-1s^23d$ )	17,29 nm

# Conclusion

- Comparison of polyacetal- polyethylene spectra
  - Missing oxygen lines in polyethylene
  - Unidentified peaks
- Limited resolution- improvement with using spectrograph Jobin-Yvon PGM-PGS 200

- Thank you for your attention.