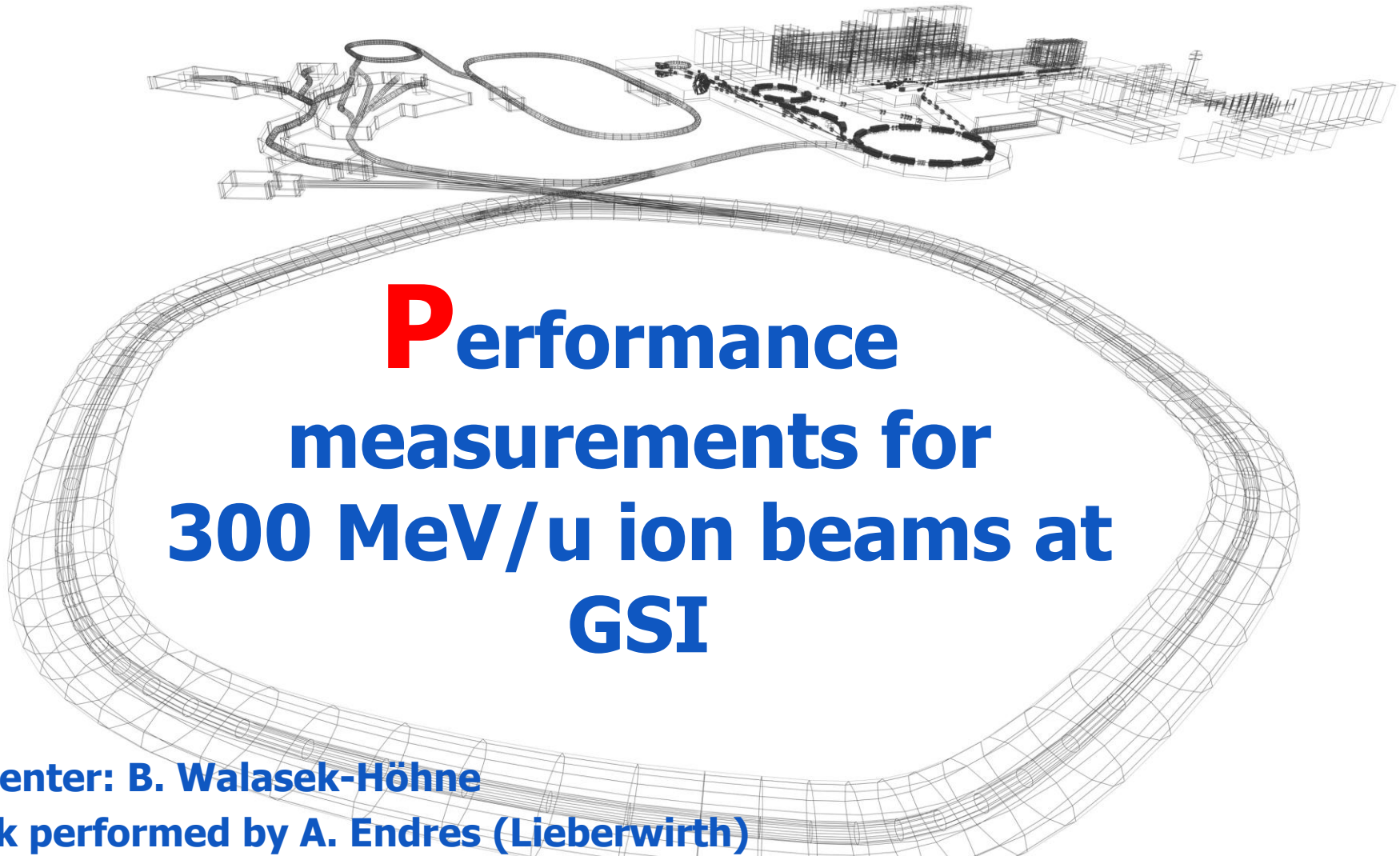


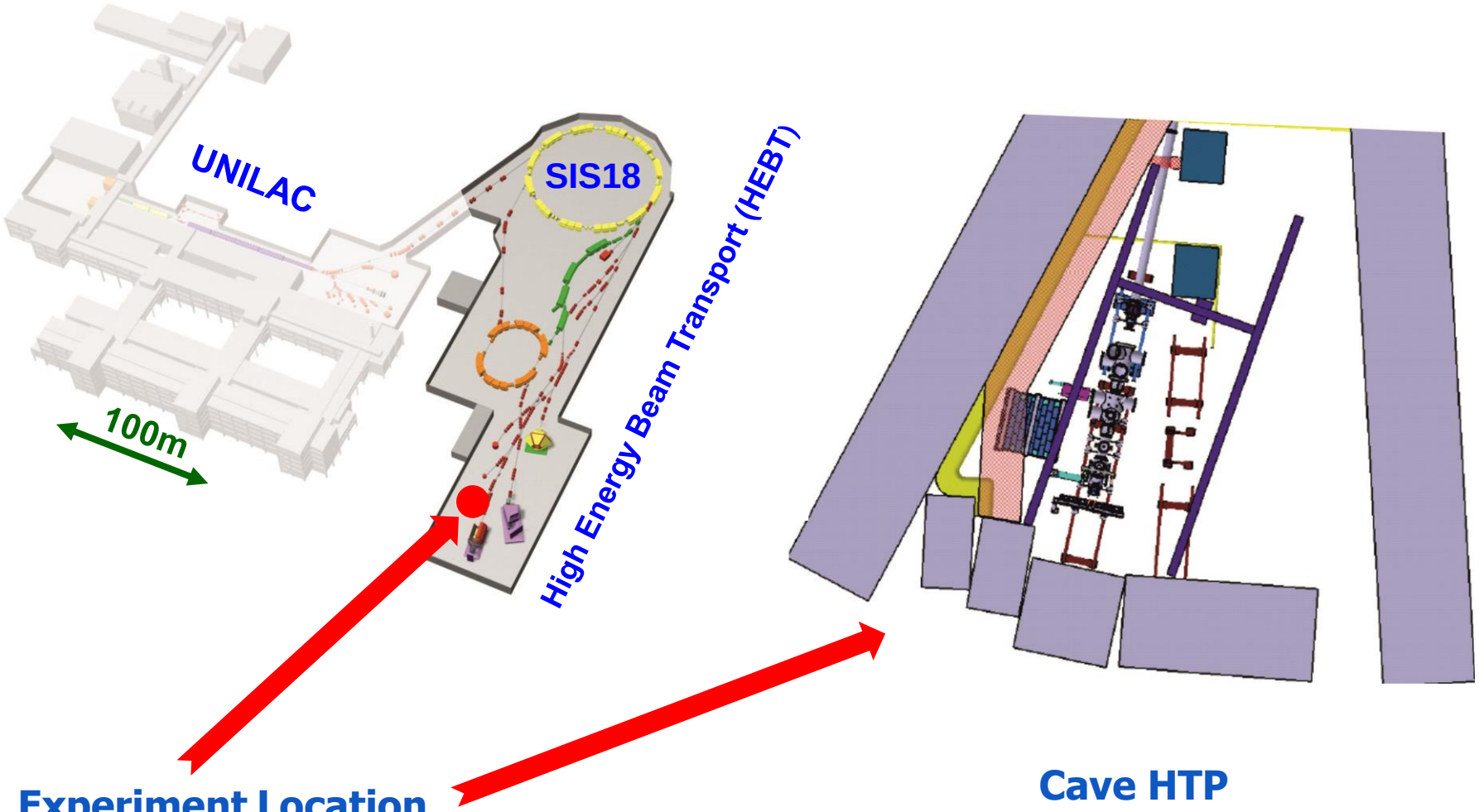
Performance measurements for 300 MeV/u ion beams at GSI

Presenter: B. Walasek-Höhne
Work performed by A. Endres (Lieberwirth)
with support by: P. Forck, S. Lederer, T. Siebert, A. Reiter, W. Ensinger

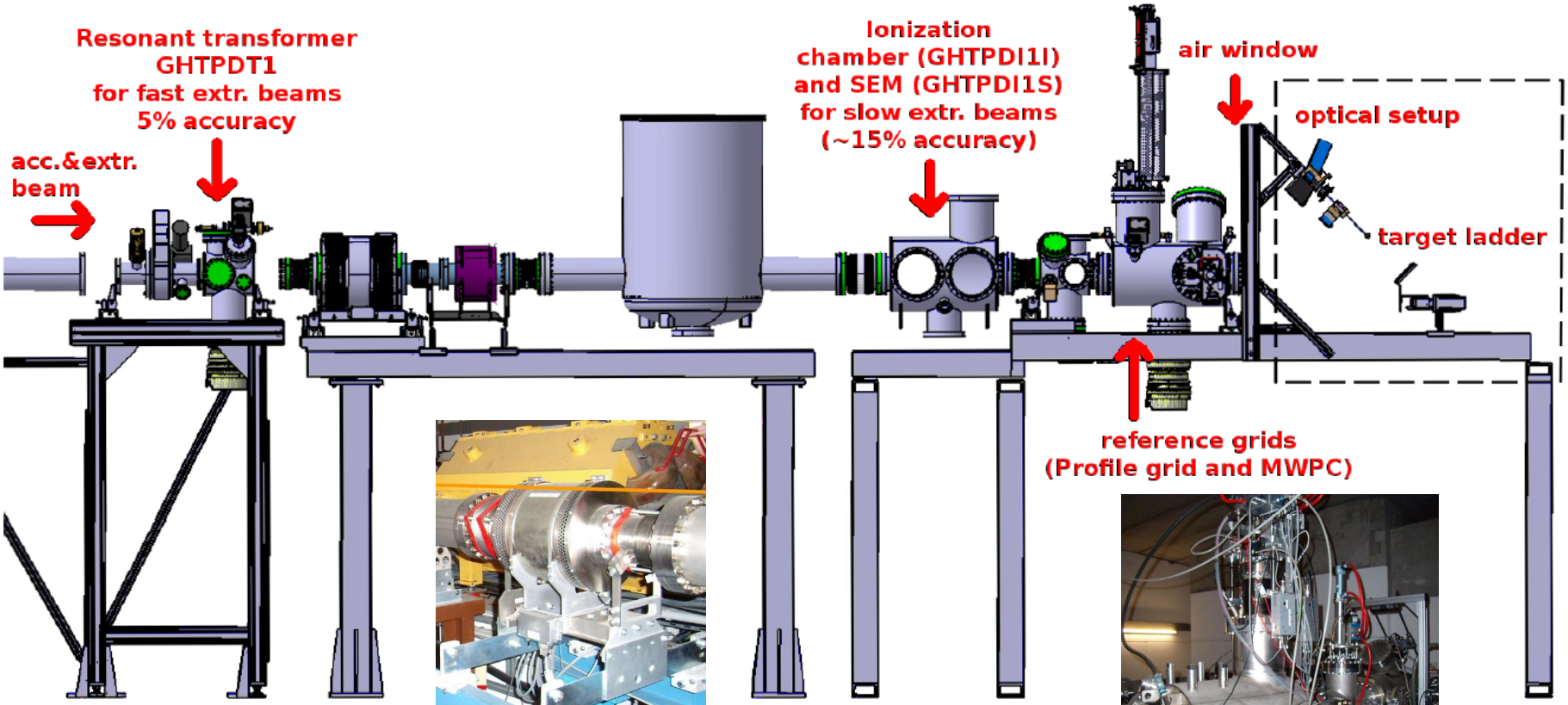
Outlook

- Experiment Location
- Experimental Setup
- Results
- Summary

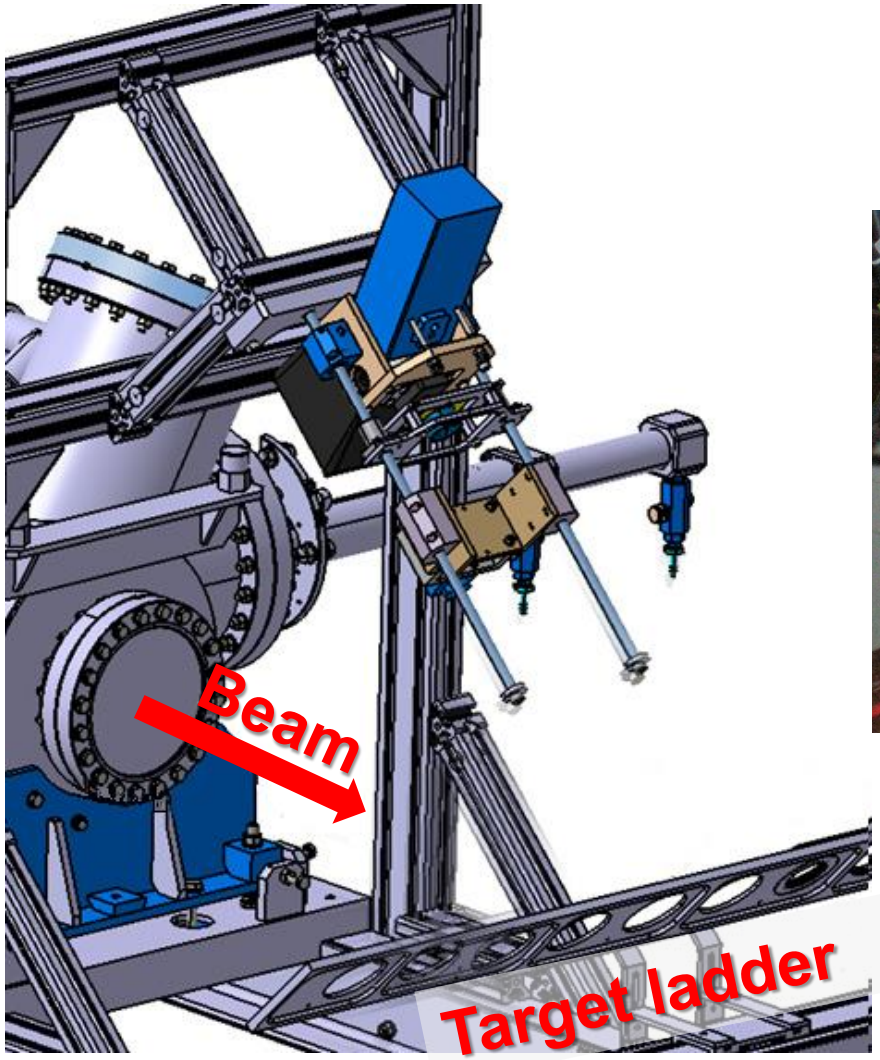
Experiment Location



Experiment Location



Experimental Setup: Target Ladder



Experimental Setup: Samples

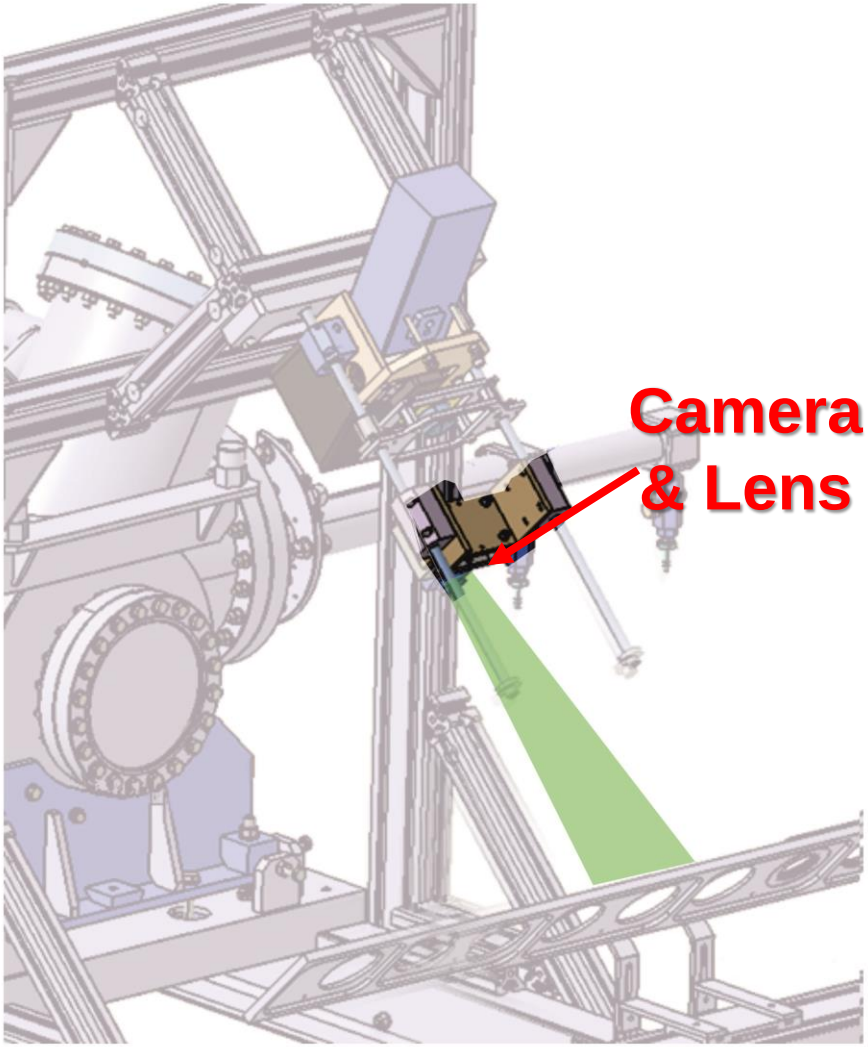
- 7 different scintillating screens
- inorganic materials

  single crystals: $Y_3Al_5O_{12}$:Ce (YAG: Ce)

  phosphors: Gd_2O_2S: Tb (P43) and $Y_3Al_5O_{12}$: Ce (P46)

  ceramics: A999* and Al_2O_3:Cr
- emission in the visible range
- decay time t: 60 ns – 2.1 ms
- density ρ: 3.7 – 7.2 g/cm^3
- thickness d: 50 µm - 1 mm

Experimental Setup: Camera



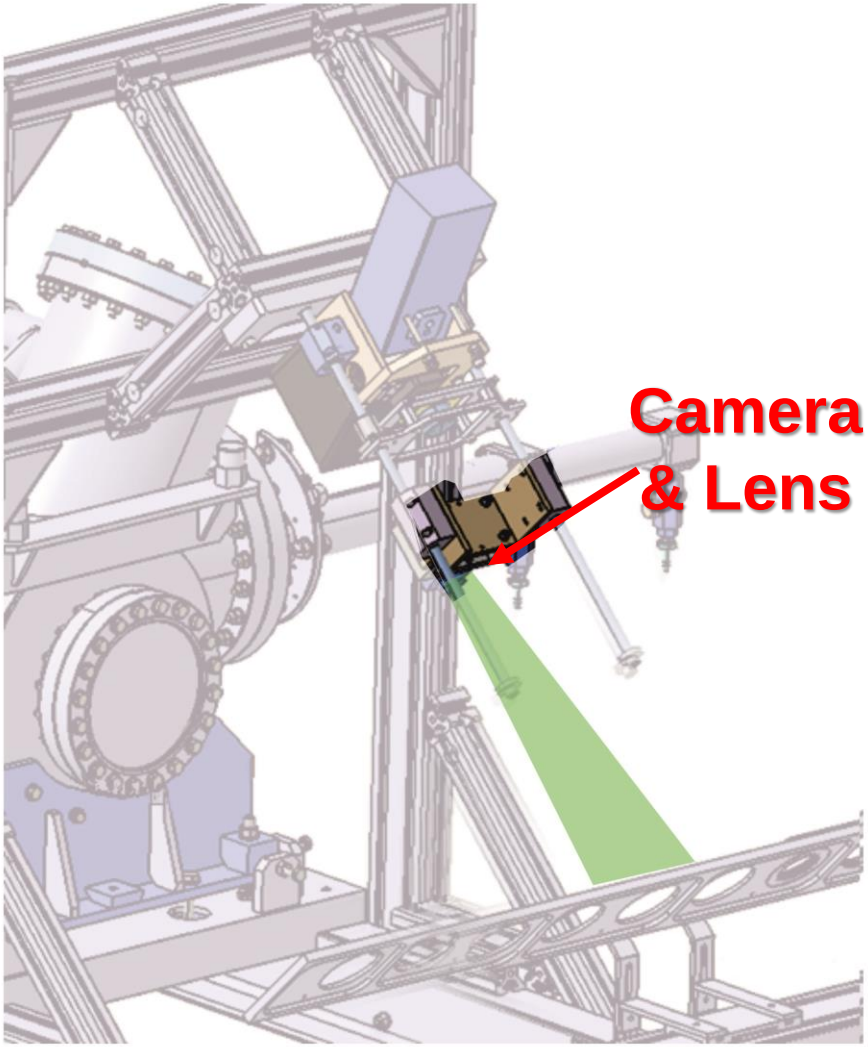
Camera:

AVT Marlin or AVT Stingray
1/2" CCD chip with 8-bit depth
monochrome

Lens:

Pentax C1614ER 16 mm focal length,
remote control

Experimental Setup: Camera



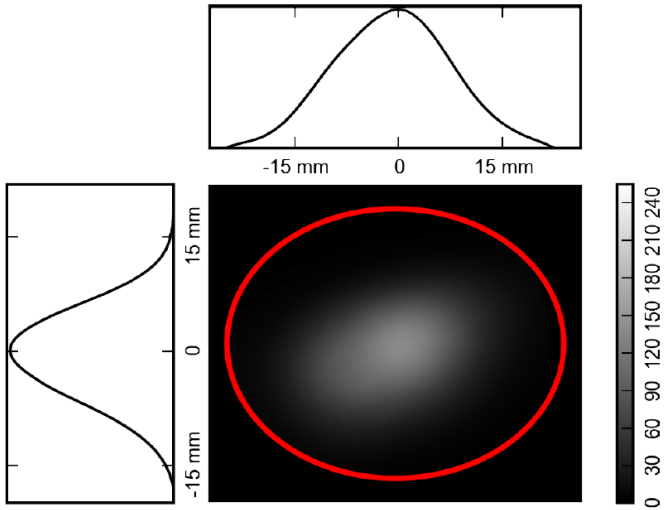
Camera:

AVT Marlin or *AVT Stingray*
1/2" CCD chip with 8-bit depth

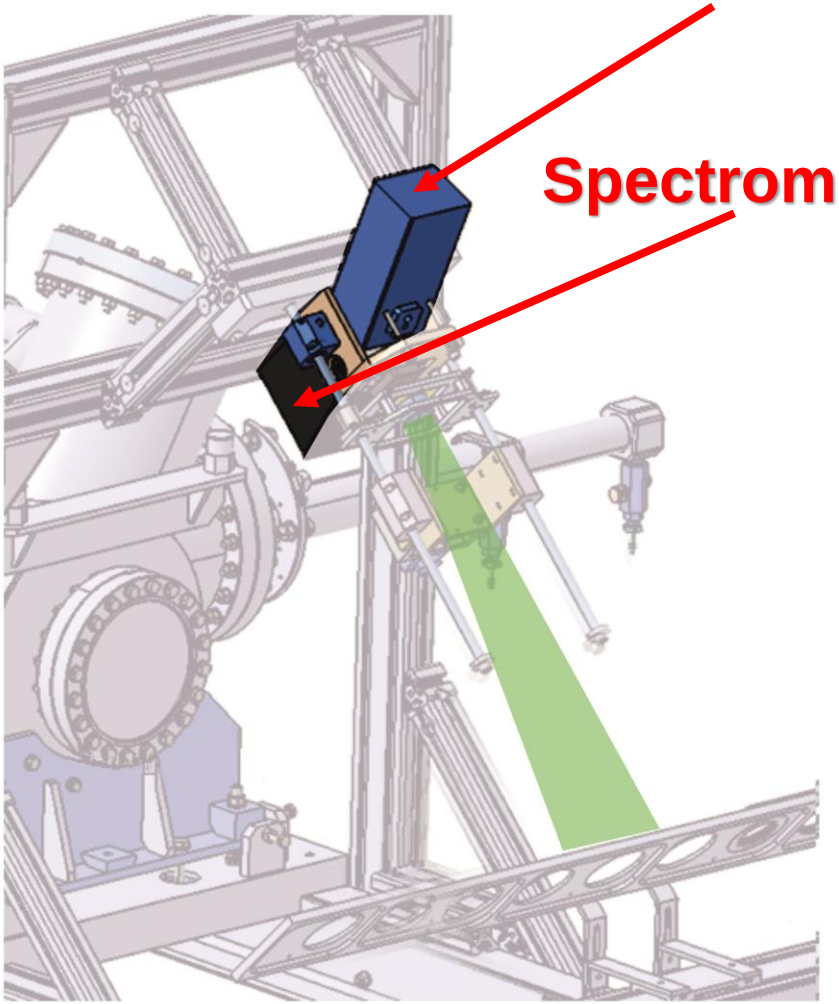
Lens:

Pentax C1614ER 16 mm focal length, remote control

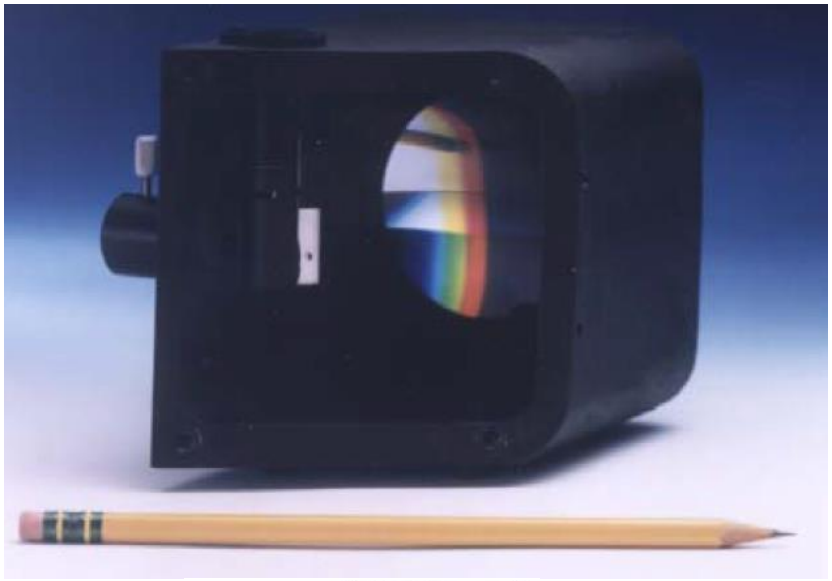
Working distance: 40 cm



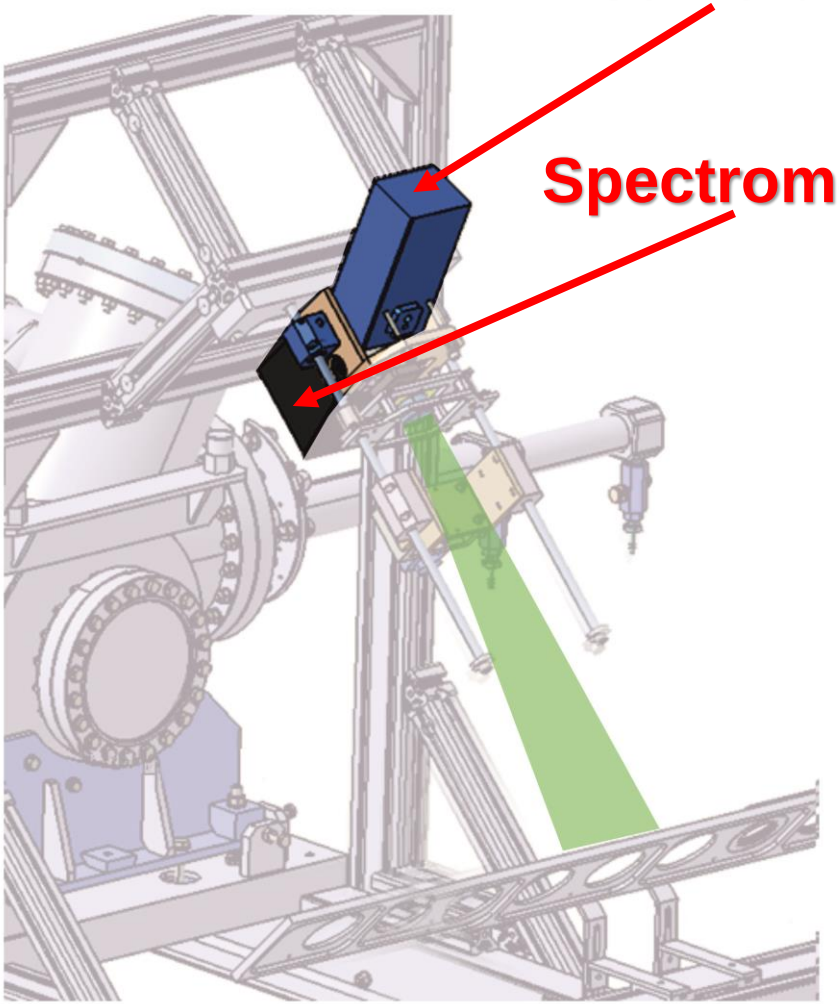
Experimental Setup: Spectrometer



Spectrometer: *Horiba CP140-202*
spectral regions 190 nm – 1000 nm
average dispersion 50 nm/mm
length of spectrum 12.2 mm

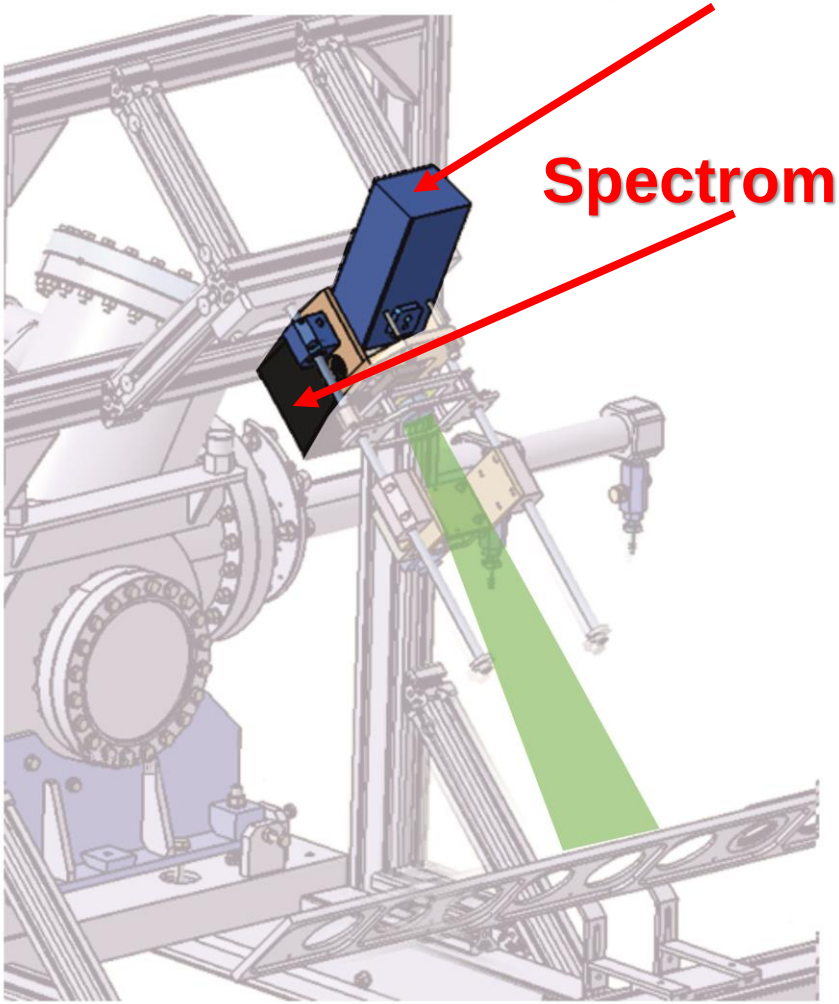


Experimental Setup: Spectrometer

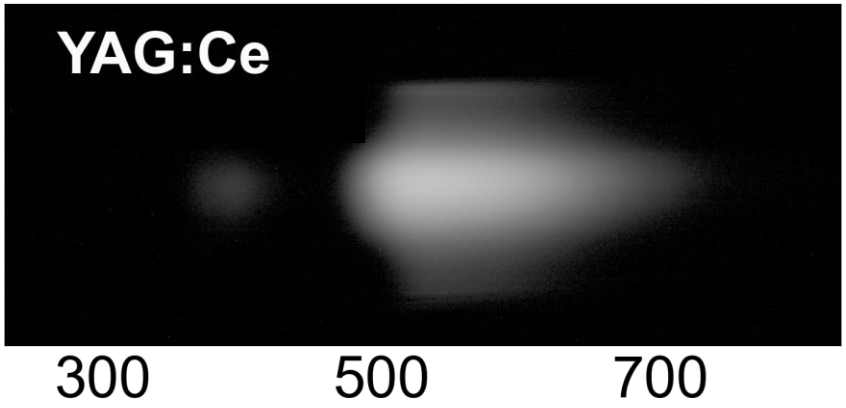


Camera: *pco 1600*
(12.2 mm x 9 mm sensor)
14 bit resolution, monochrome
Lens:
Pentax C2514ER 25 mm focal length
Linos MeVis Inspec 50 mm focal length

Experimental Setup: Spectrometer



Working distance: 55 cm



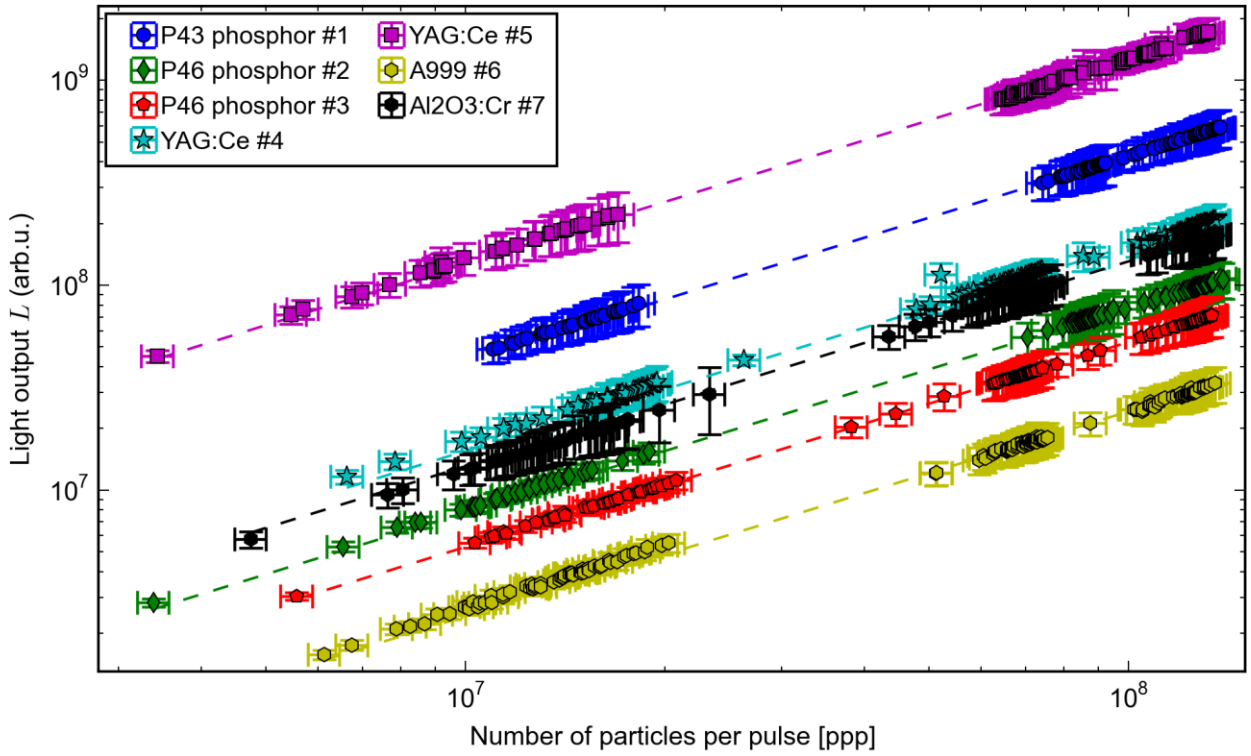
Results

- Light Output L
- Light Yield Y
- Beam Profile
- Emission Spectrum
- Radiation Hardness Tests
- Ex-situ measurements (UV-VIS, Raman and XRD)

Results

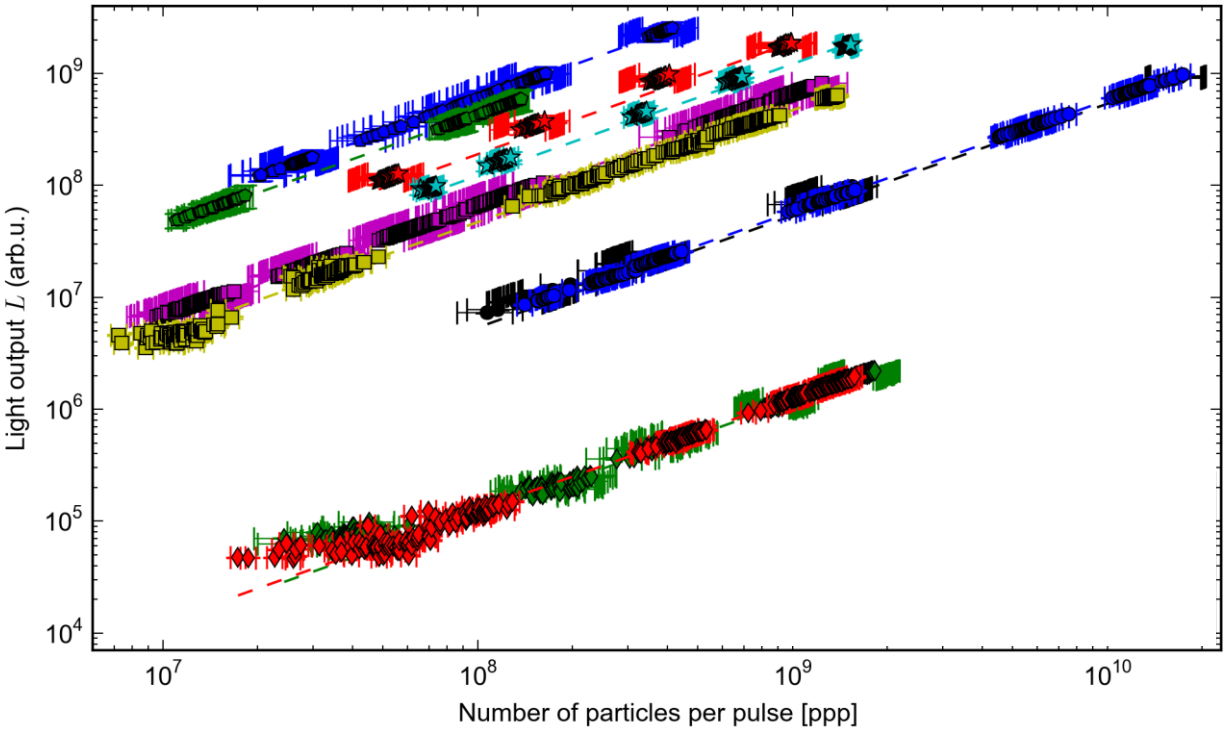
- Light Output L

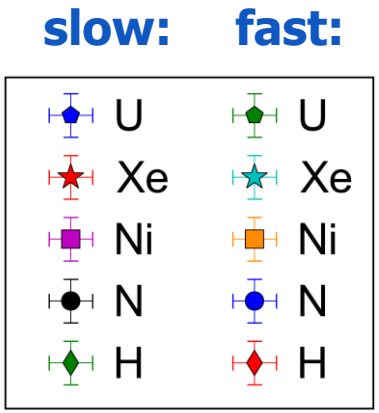
Light Output L



- YAG:Ce #5: max. L observed (10 times more than YAG:Ce #4)
- Al_2O_3: Cr doping results in five times more L per ion as for Al_2O_3
- P43 is the most efficient from all the phosphors

Light Output L P43 # 1



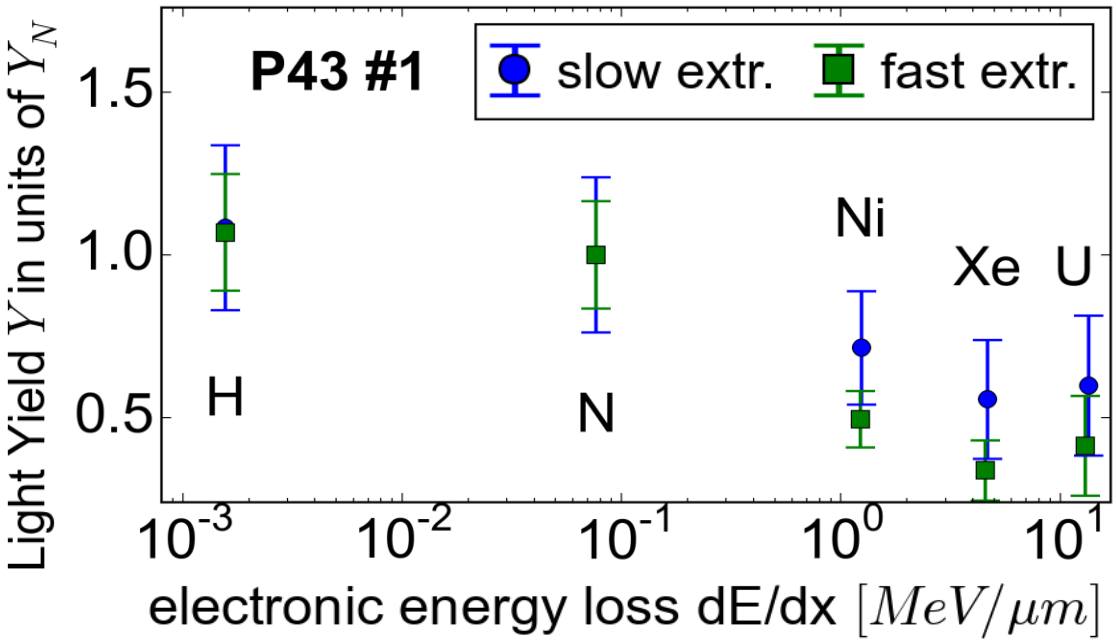


- protons induce the lowest light output
- light output increase with atomic number
- similar behavior for others materials

Results

- Light Output L
- Light Yield Y

Light Yield Y P43 # 1

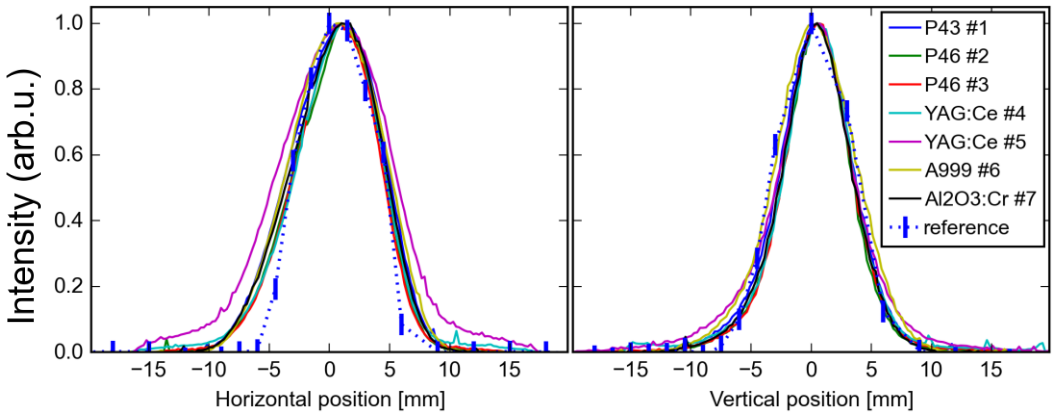


- light yield falls with atomic number (Z), non-linear behavior
- faster decrease observed during fast extraction
- others targets show similar behavior

Results

- Light Output L
- Light Yield Y
- **Beam Profile**

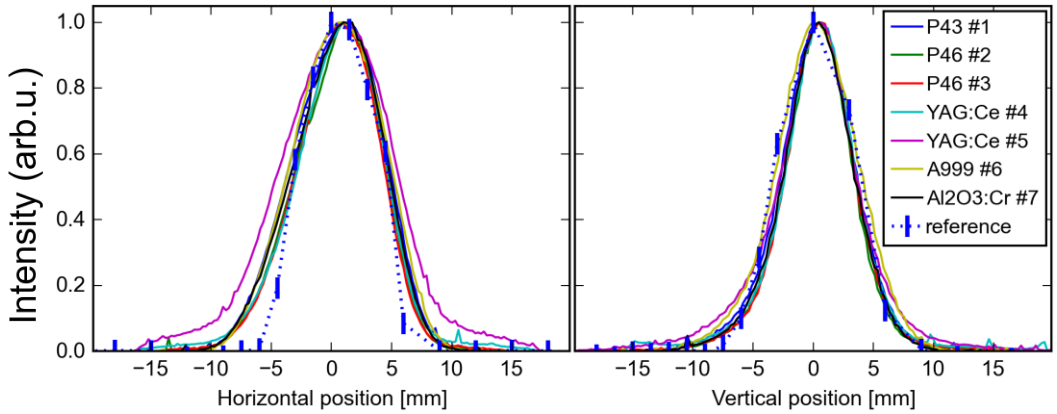
Beam Profile



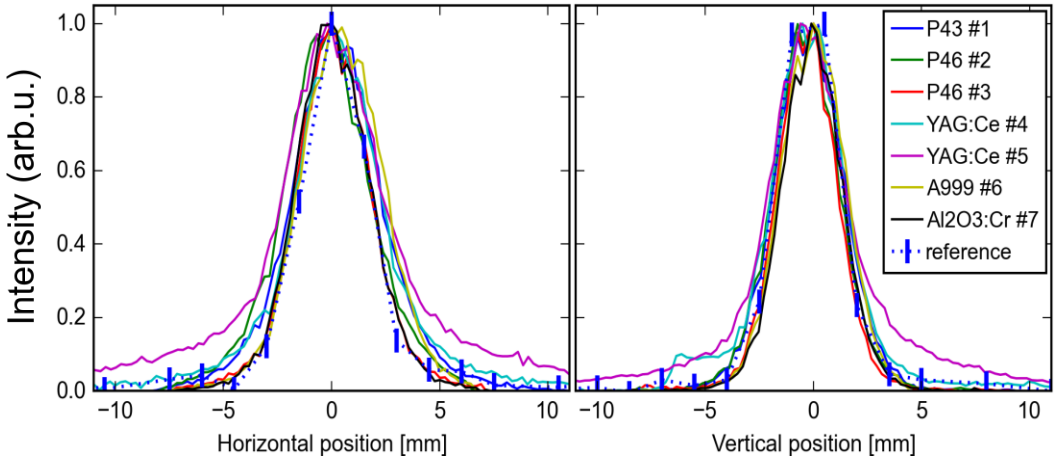
fast extraction N-beam 10^9 ppp

- **good agreement with reference method (SEM-Grid profile)**

Beam Profile



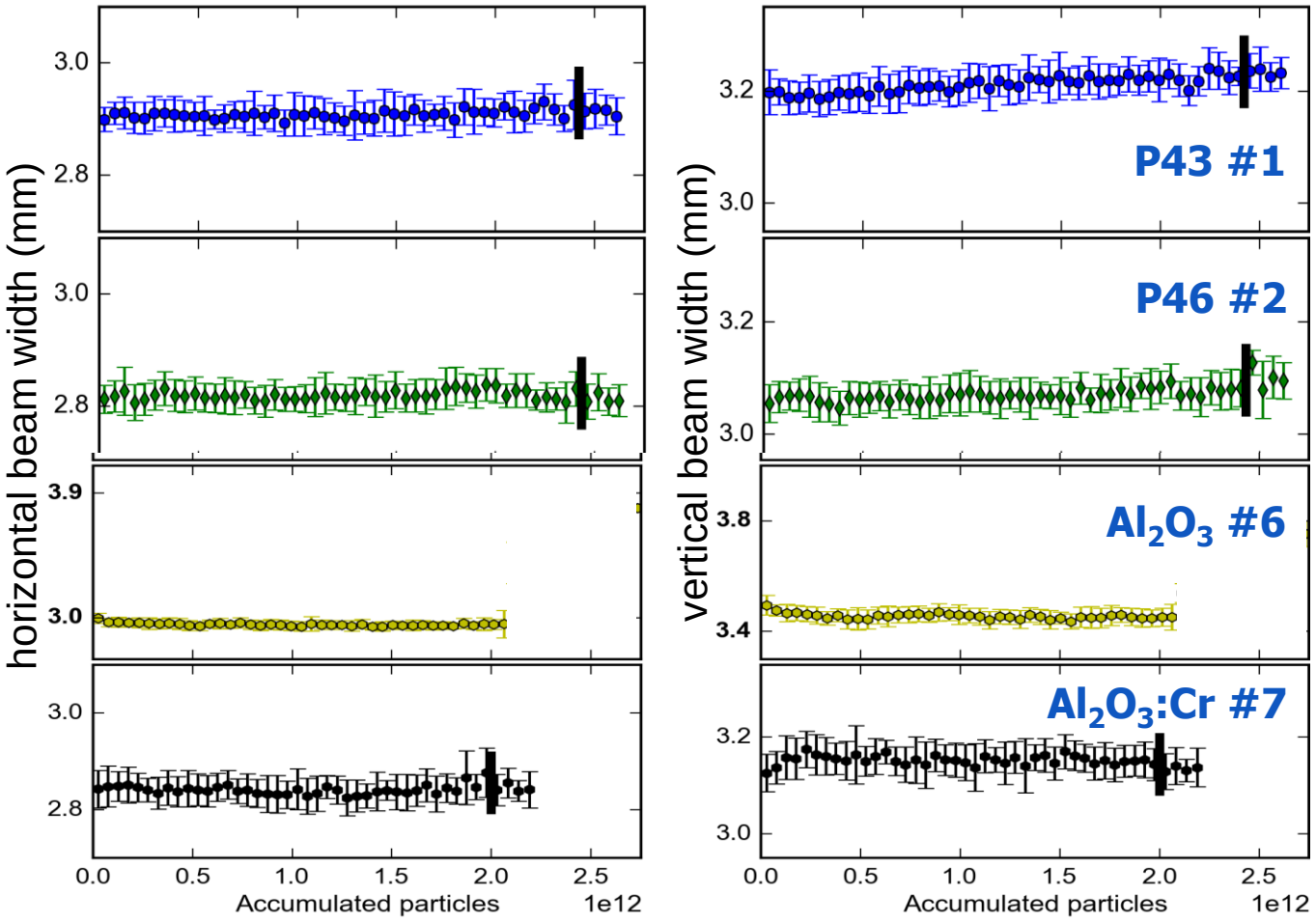
fast extraction N-beam 10^9 ppp



fast extraction Xe-beam 10^9 ppp

- **good agreement with reference method (SEM-Grid)**
- **no significant changes**

Beam Profile



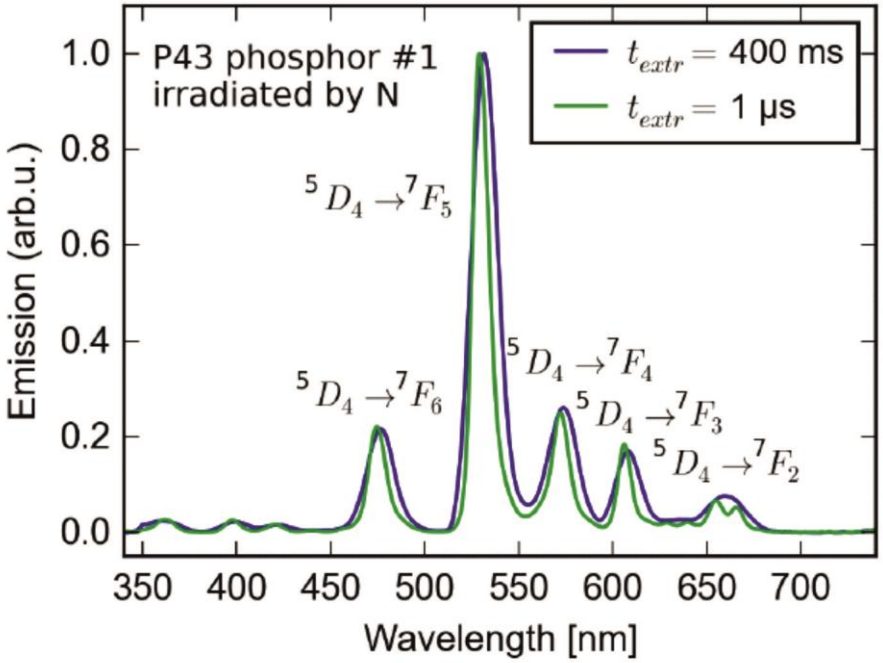
- **no significant changes in beam with reading during long time irradiation**

Results

- Light Output L
- Light Yield Y
- Beam Profile
- Emission Spectrum

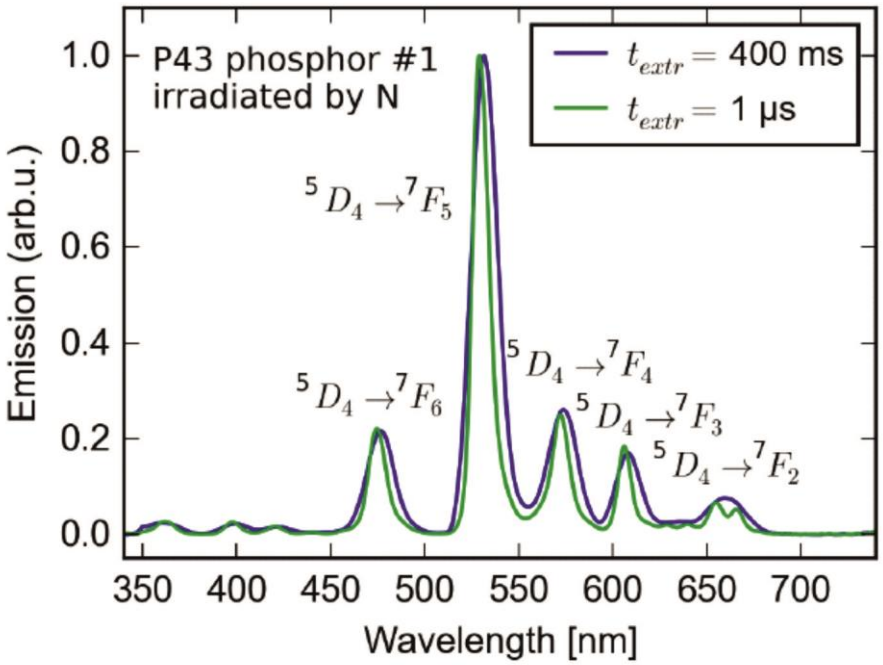
Emission Spectrum P43 # 1

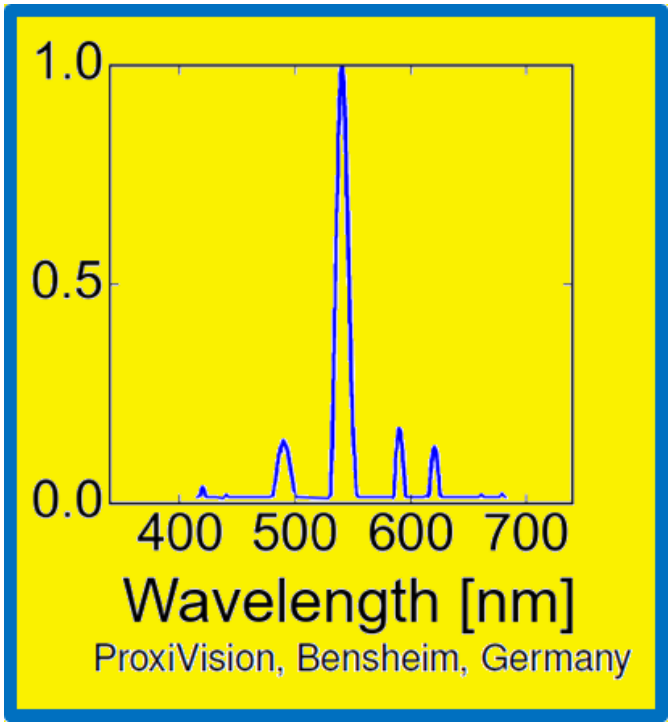
N-beam 10^9 ppp



Emission Spectrum P43

N-beam 10^9 ppp

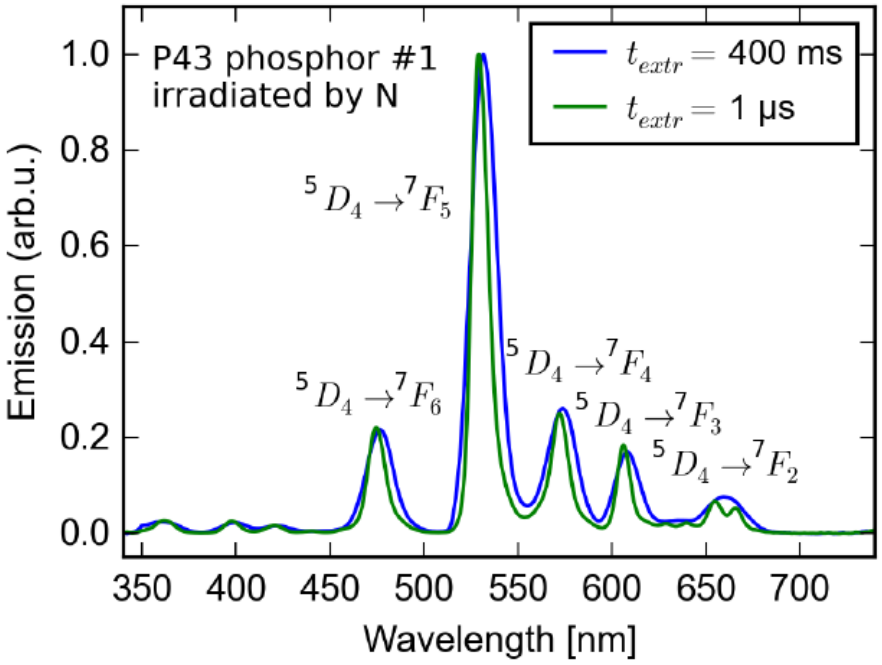




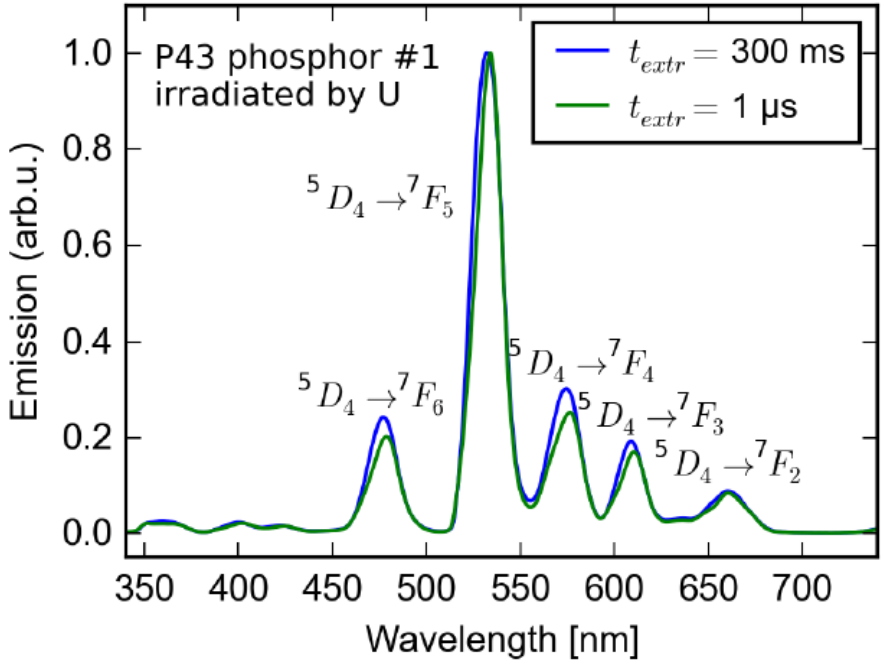
❖ **good agreement with literature values**

Emission Spectrum P43 # 1

N-beam 10^9 ppp

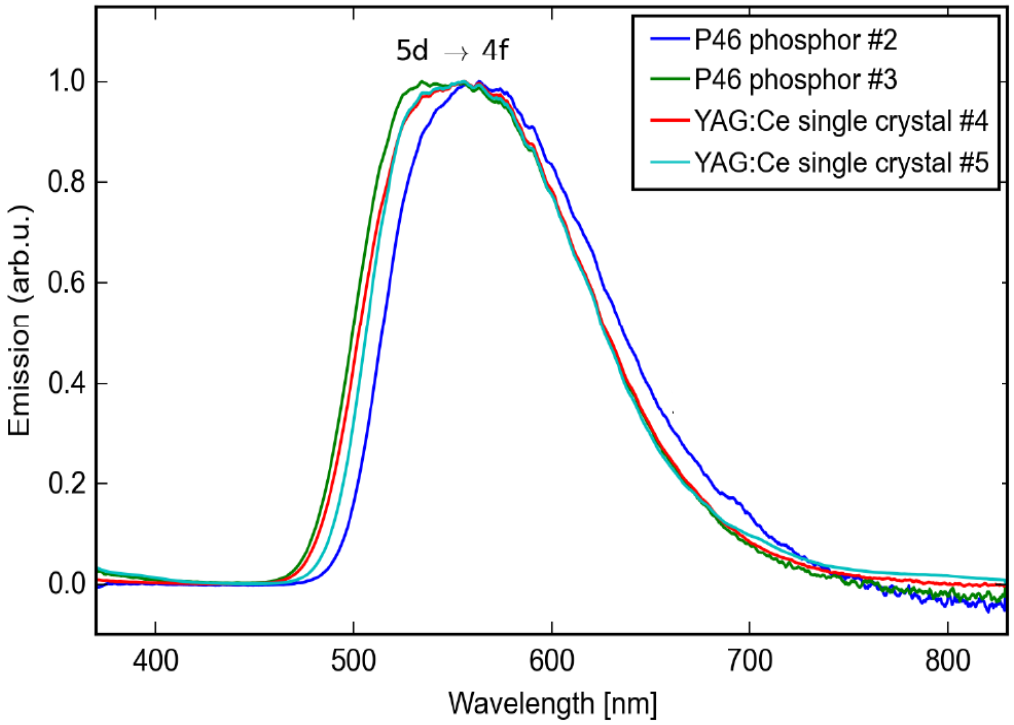


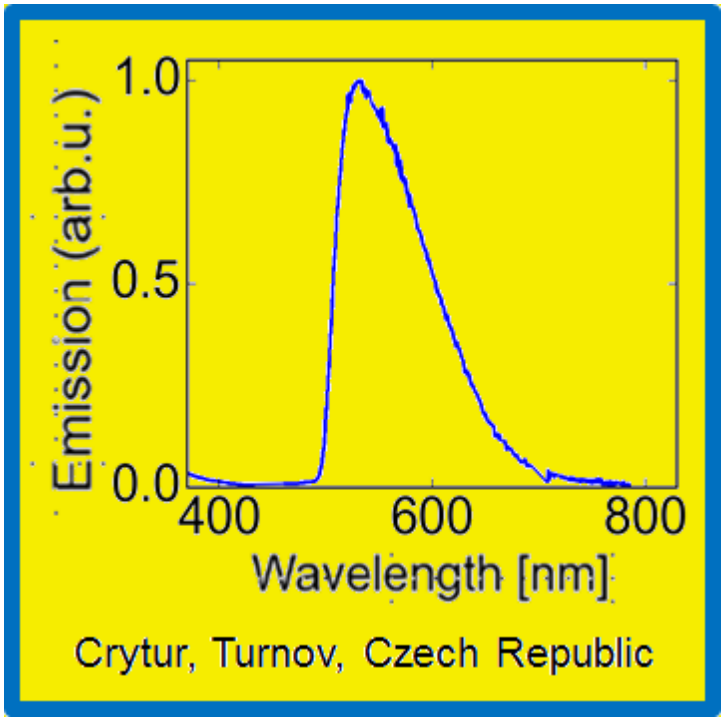
Xe-beam 10^9 ppp



- **good agreement with literature values**
- **no significant deviations observed**

Emission Spectrum $Y_3Al_5O_{12}$:Ce





- **good agreement with literature values**
- **no significant deviations observed**

Results

- Light Output L
- Light Yield Y
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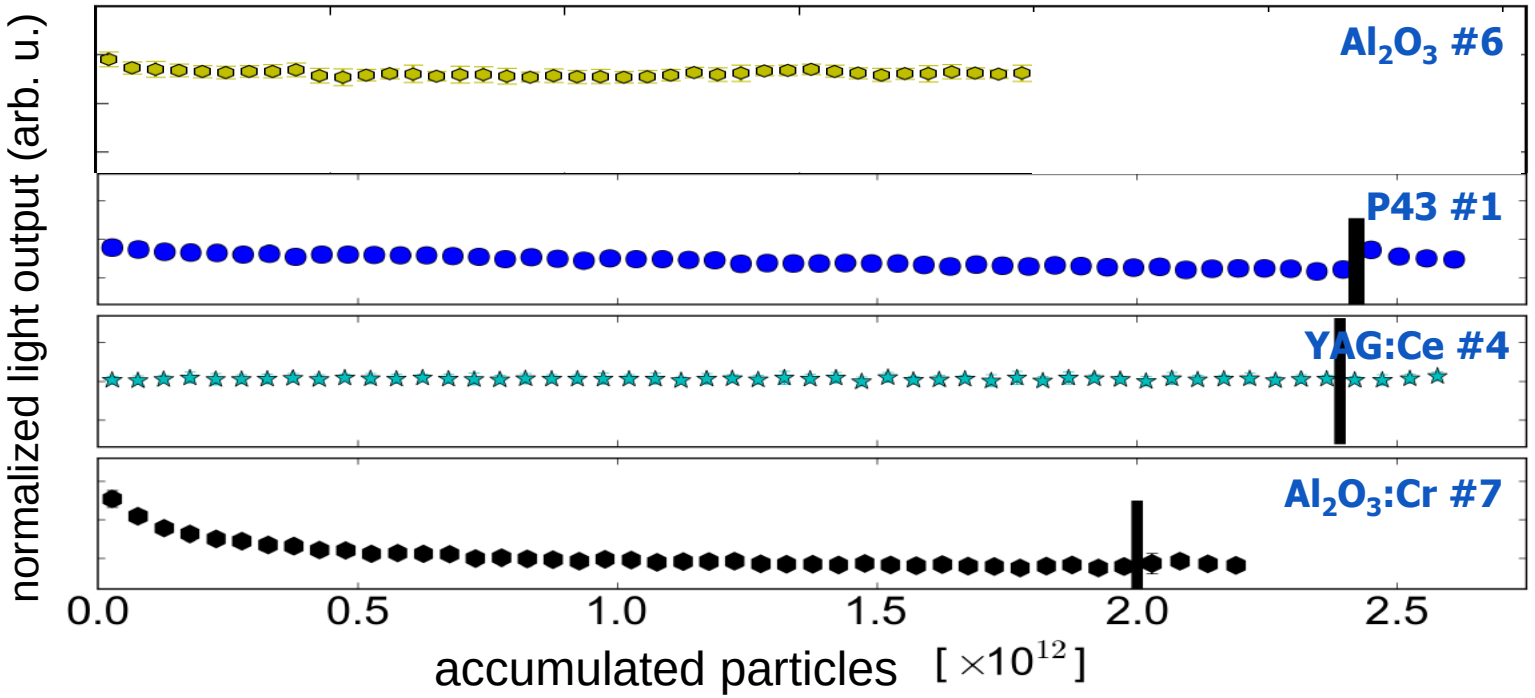
- **Radiation Hardness Tests**

Radiation Hardness Tests

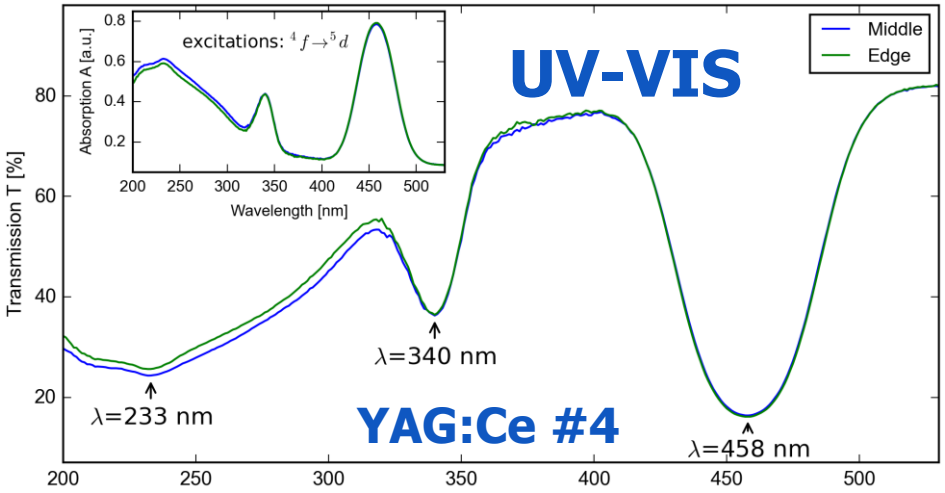


- generally: high stability of the light output
- biggest change observed for Al_2O_3:Ce (12%)
- small decrease in light output during long-term irradiation

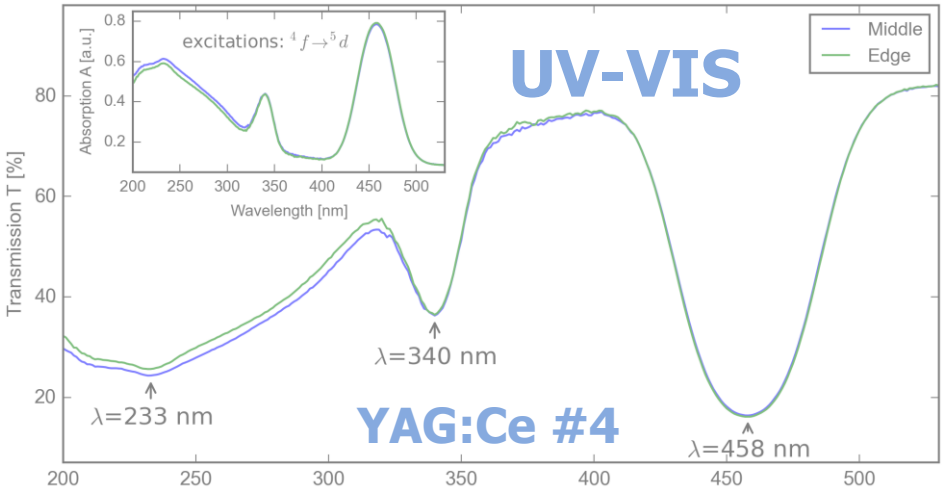
Results

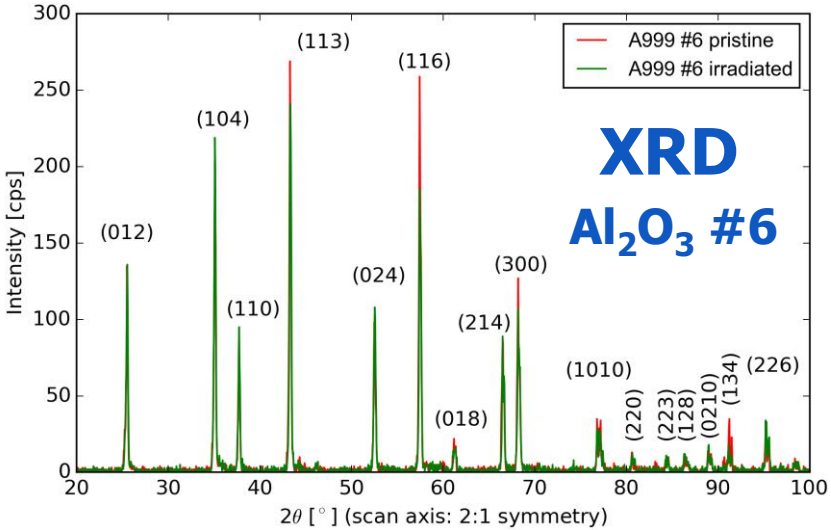
- Light Output L
- Light Yield Y
- Beam Profile
- Emission Spectrum
- Radiation Hardness Tests
- **Ex-situ measurements (UV-VIS, Raman and XRD)**

Ex-situ measurements

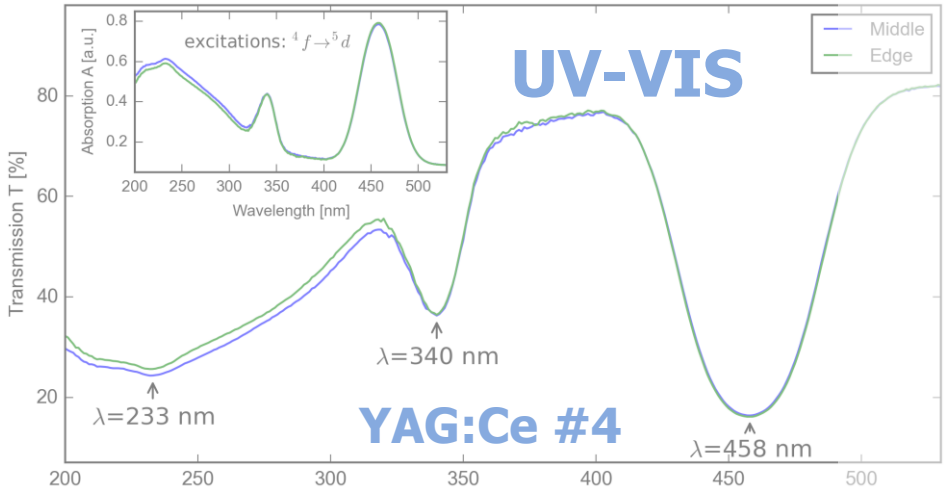


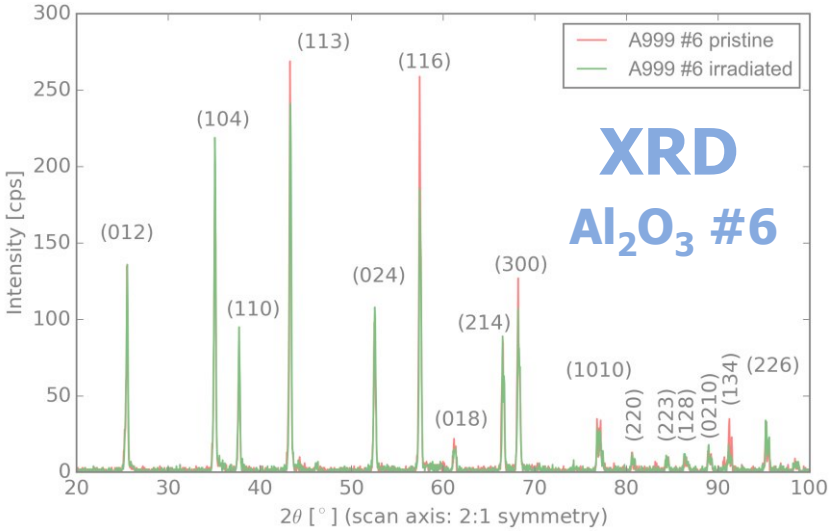
Ex-situ measurements

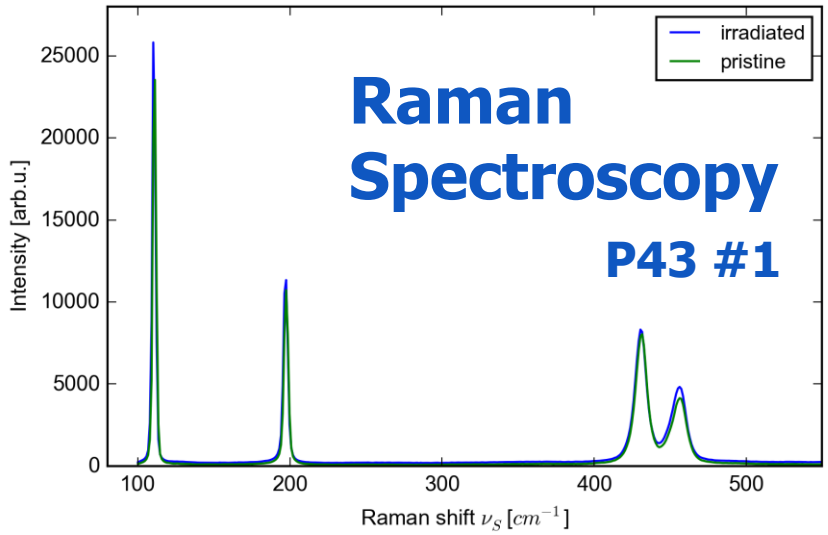




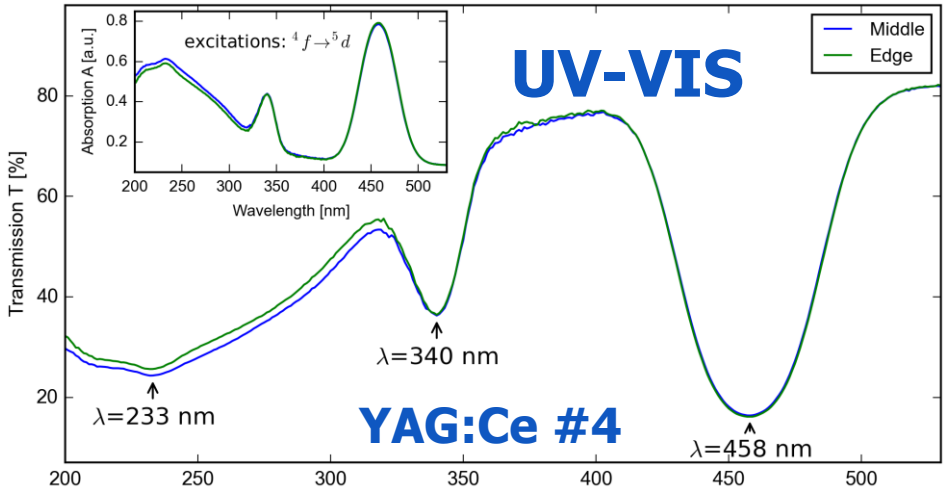
Ex-situ measurements

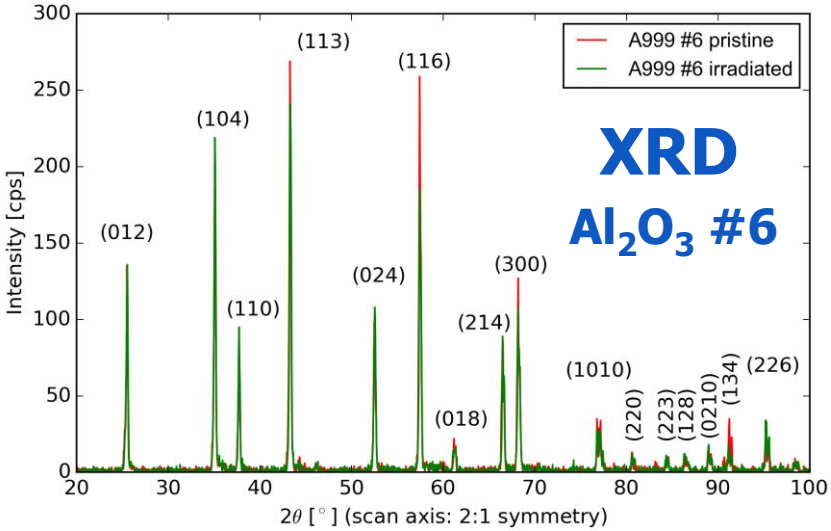


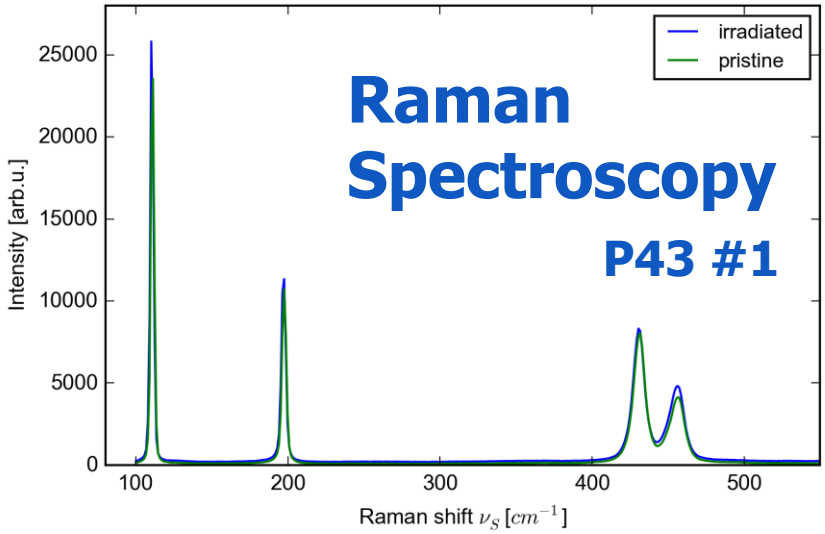




Ex-situ measurements



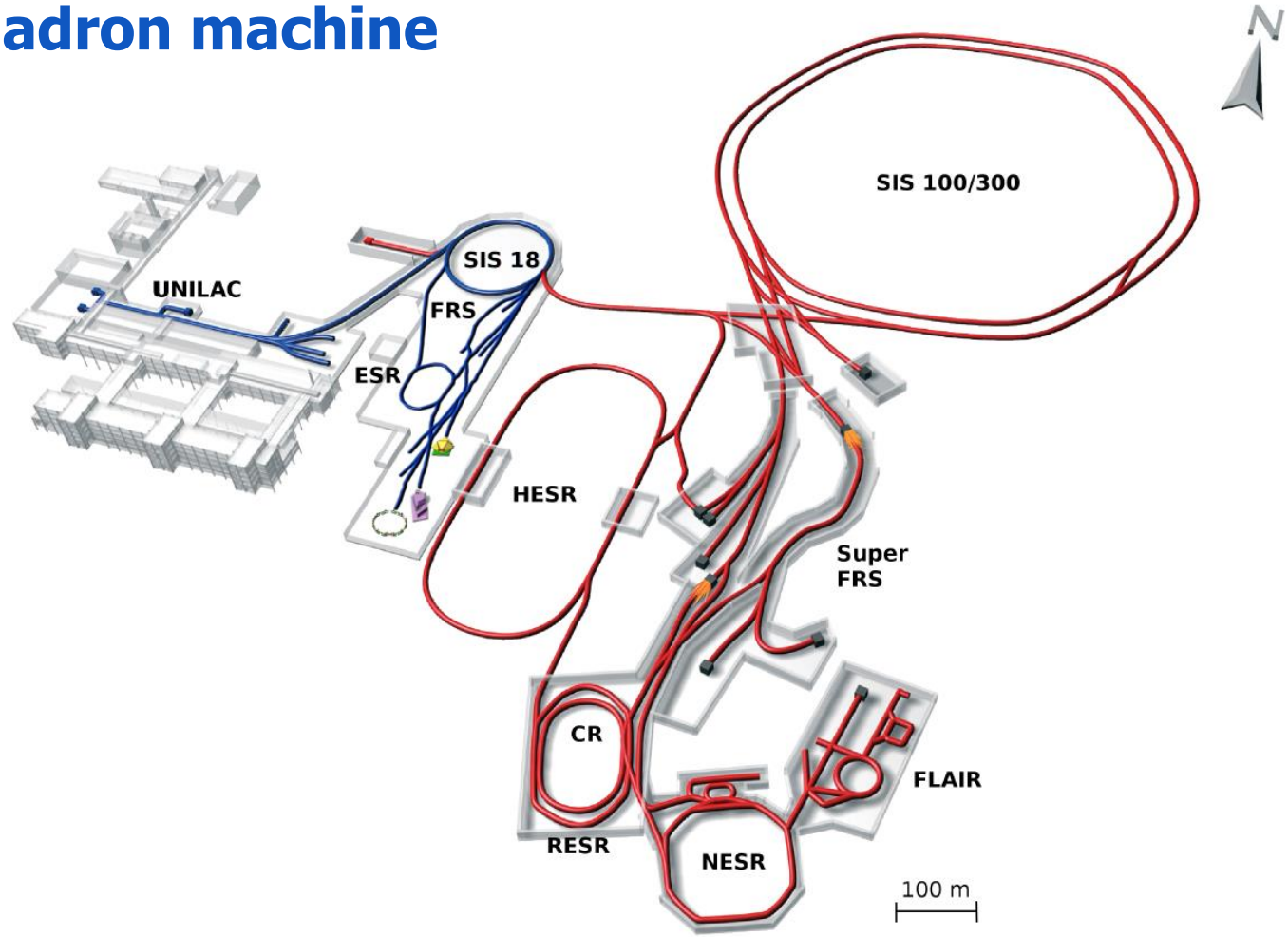




- **no structural changes in material observed**

Summary

- **Inorganic materials well suitable beam diagnostics element in hadron machine**



Summary

- Inorganic materials well suitable beam diagnostics element in hadron machine

- **Stability in light output, beam profile reading and emission spectra, only small differences for different extraction modes**

Summary

- Inorganic materials well suitable beam diagnostics element in hadron machine
- Stability in light output, beam profile reading and emission spectra, only small differences for different extraction modes
- **Quenching: light yield as a function of electronic energy loss dE/dx**

Summary

- Inorganic materials well suitable beam diagnostics element in hadron machine
- Stability in light output, beam profile reading and emission spectra, only small differences for different extraction modes
- Quenching: light yield as a function of electronic energy loss dE/dx
- **Radiation hardness test and laboratory measurements confirm high stability of materials**

Summary

- Inorganic materials well suitable beam diagnostics element in hadron machine
- Stability in light output, beam profile reading and emission spectra, only small differences for different extraction modes
- Quenching: light yield as a function of electronic energy loss dE/dx
- Radiation hardness test and laboratory measurements confirm high stability of materials
- No evidence of structural damages

The End!

Thank you for your attention!