

# SPS SEY drum measurements

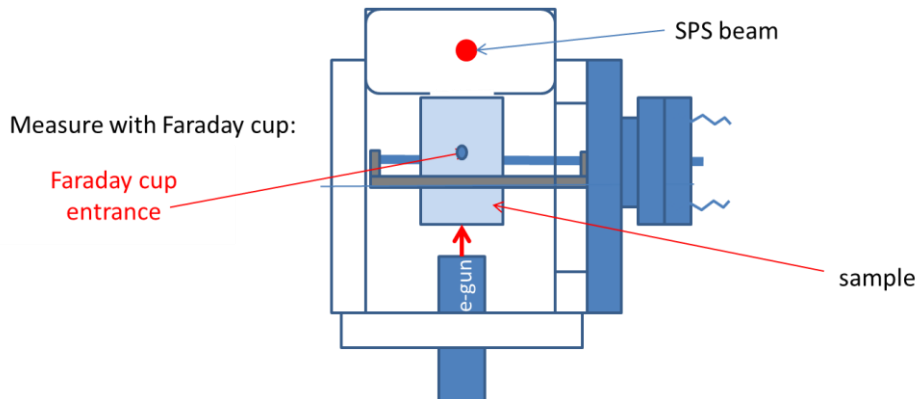
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# Outline

- Experimental setup
- In situ measurements and observations
  - Conditioning
  - Deconditioning
- Post extraction analysis

# Experimental setup

- BA5
- In situ SEY measurement
- Field free region
- MBB chamber



# Experimental setup

Jan 2015

June 2017

Feb 2018

Stainless steel

Cu OFE  
(degreased)

## Installation

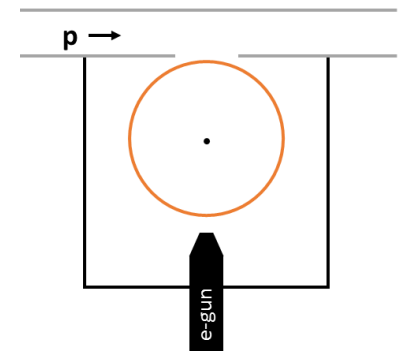
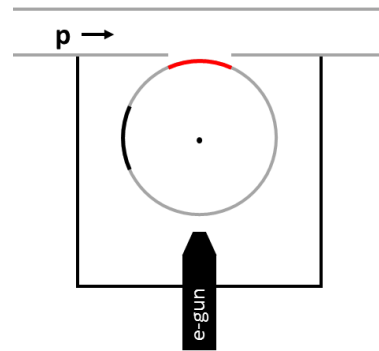
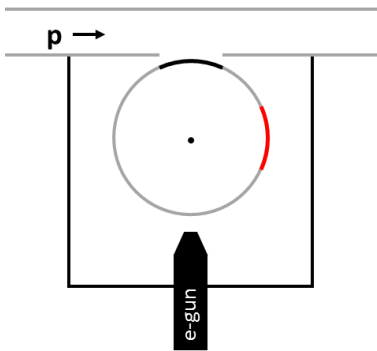
- Surface 1 exposed to beam
- Rest of the drum (incl. surface 2) in beam vacuum

## Changing surface configuration under vacuum

- Surface 2 exposed to beam
- Surface 1 in beam vacuum

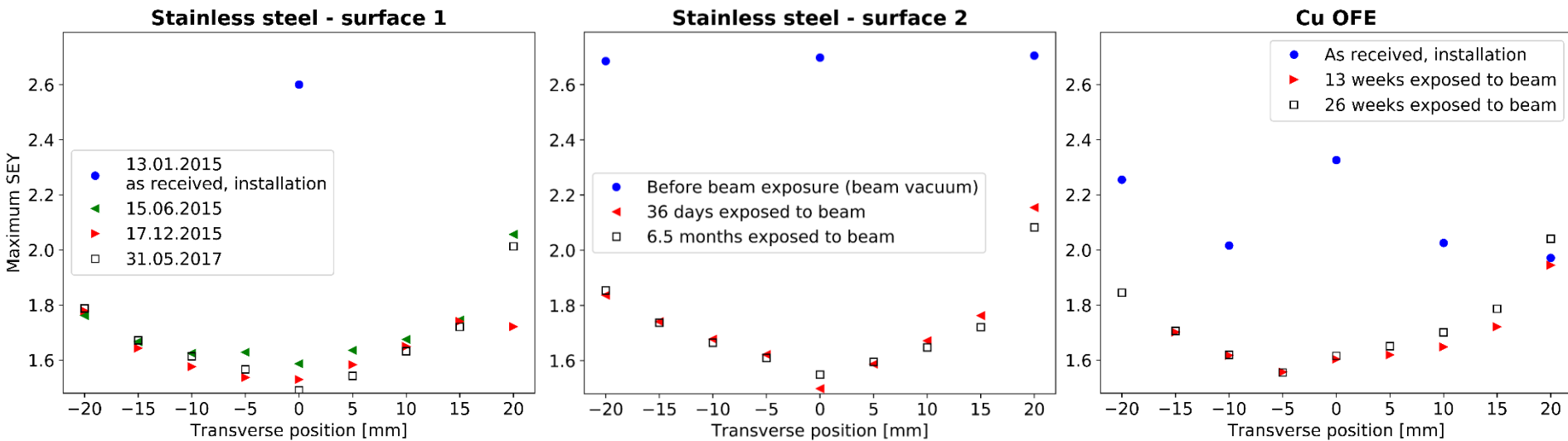
## Venting, changing material

- 1 surface exposed to beam
- Rest of the drum in beam vacuum



# In situ measurements and observations

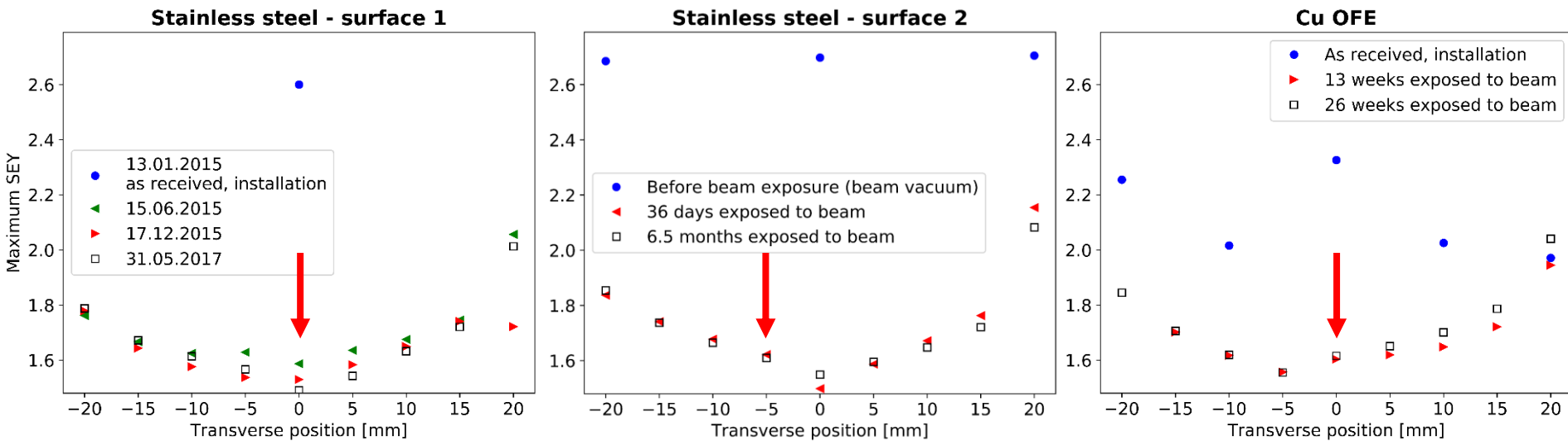
## Beam exposed surfaces



- Clear conditioning effect visible on the two materials : the maximum SEY decreases all over the exposed surface, the minimum  $\delta_{\max}$  being in the center of the chamber.
- Maximum SEY decrease saturates at  $\sim 1.55$ , already after 36 days of beam exposure
- Compatible with e-cloud build up threshold?

# In situ measurements and observations

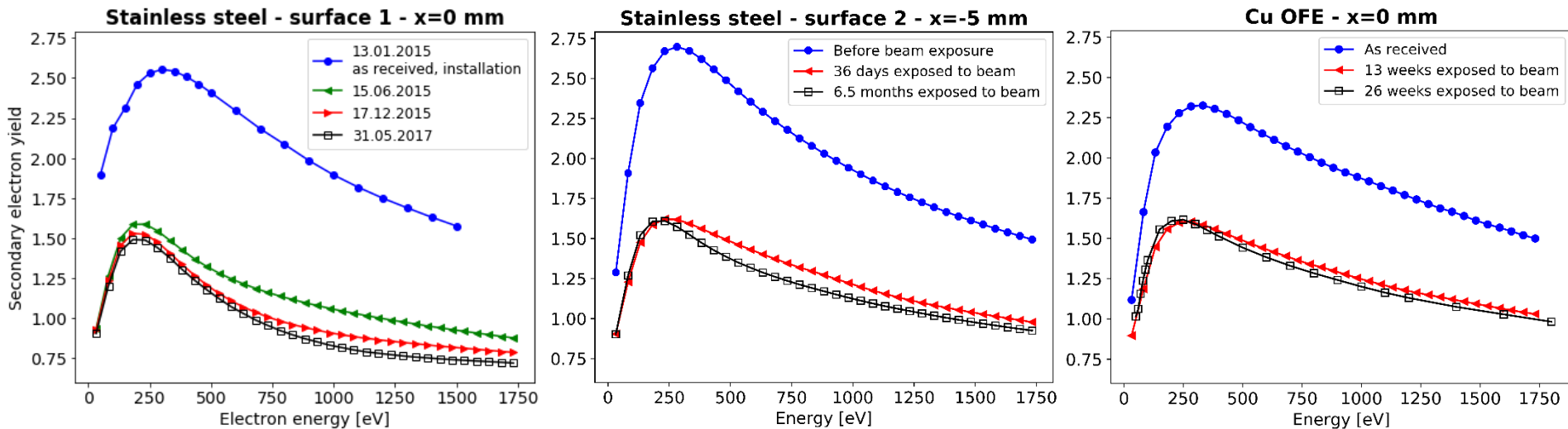
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# In situ measurements and observations

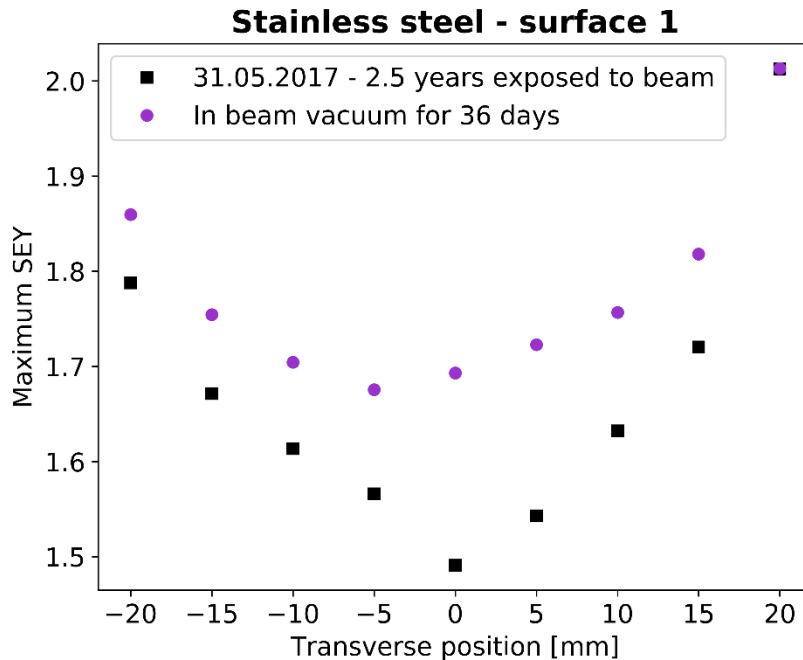
## Beam exposed surfaces



- Decrease of SEY together with a shift of  $E_{\max}$  to lower energy (opposite to lab)
  - For the longest beam exposed surface, modification of the SEY curve: the tail is moving down
- maximum SEY does not decrease anymore, but something is still happening!

# In situ measurements and observations

## Surface in beam vacuum

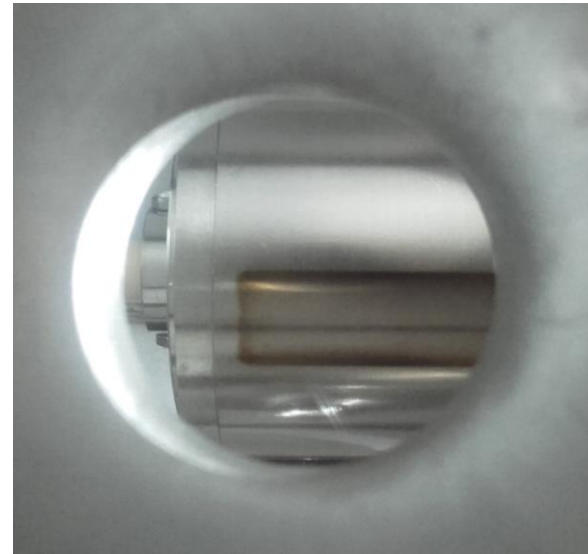
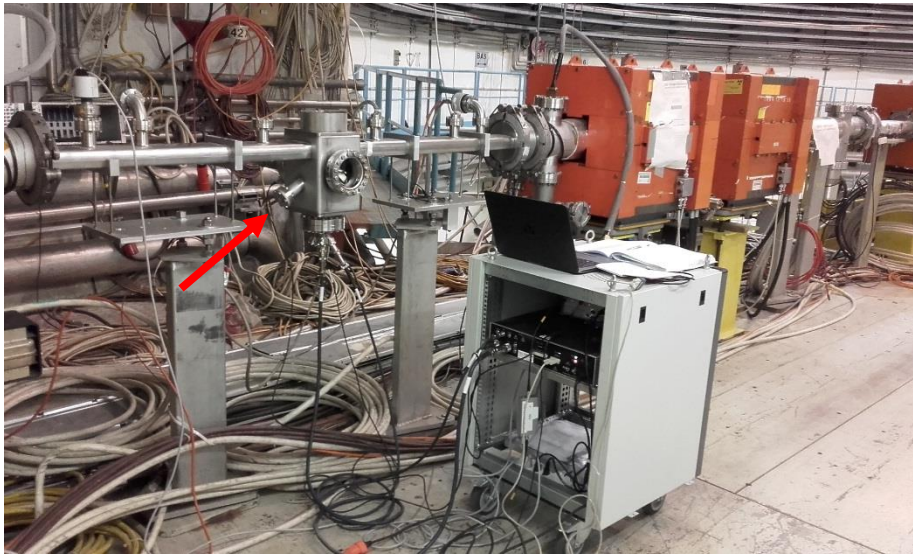


- Maximum SEY increase observed for a conditioned surface « stored » in beam vacuum
- The lowest the SEY after conditioning, the largest the increase of  $\delta_{\max}$



# In situ measurements and observations

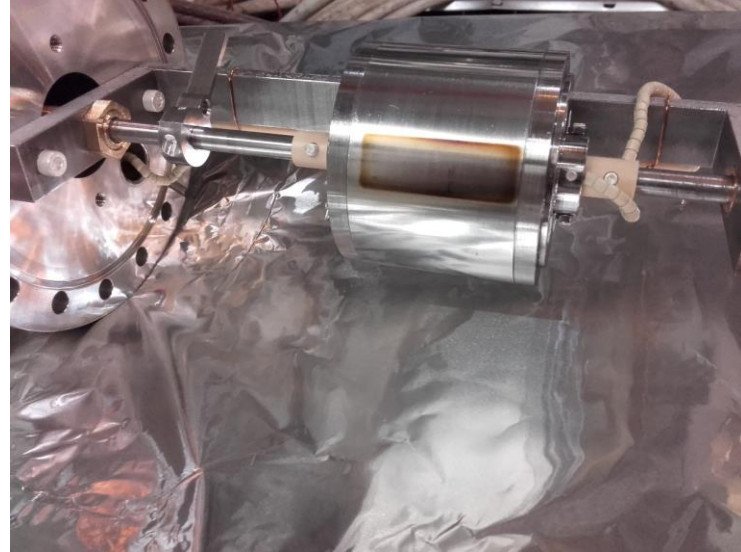
## Visual inspection



Surface exposed to beam for 2.5 years

# Post extraction analysis

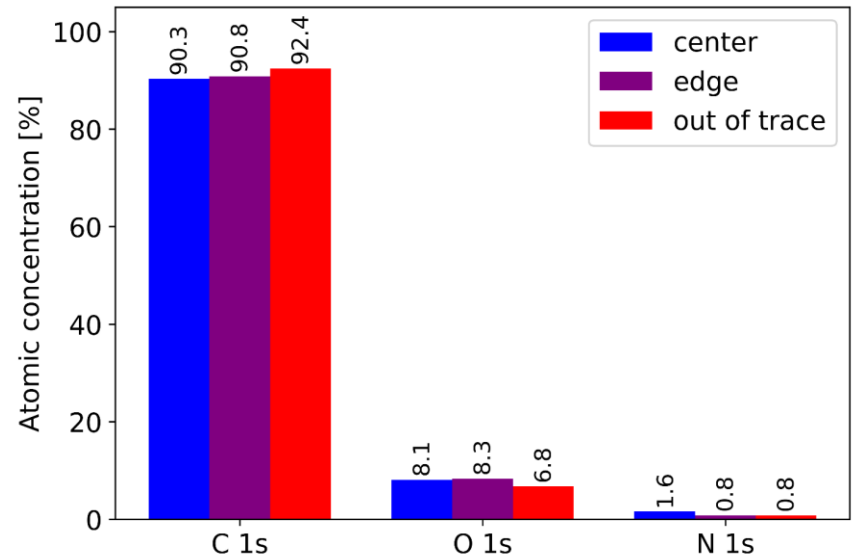
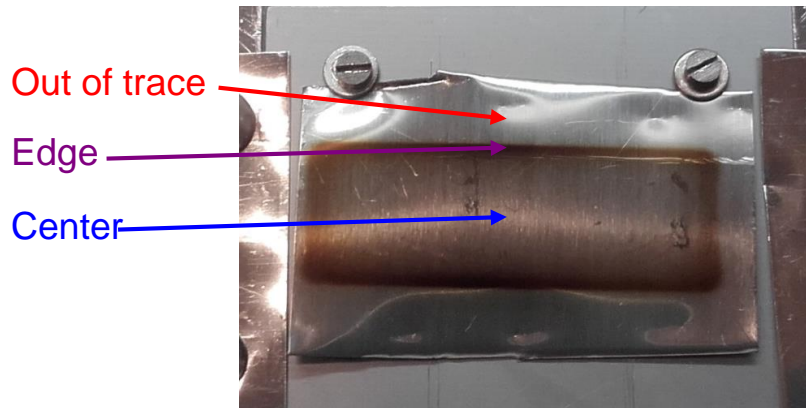
## Visual inspection



- Clear print of the beam pipe window on the 2.5 year exposed surface (change of color mainly visible on the contour of the area)
- Dark trace barely visible on the surface exposed for 6 months
- Would have been a nice idea to look at the beam pipe surface facing the window...

# Post extraction analysis

Stainless steel foil: 2 weeks in air

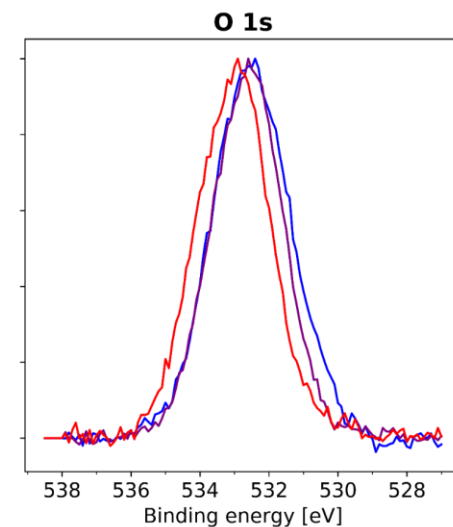
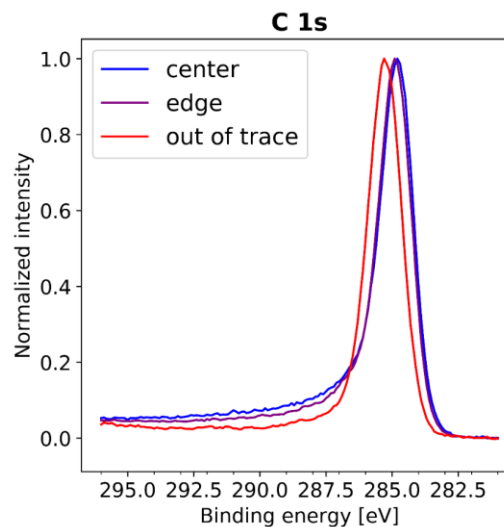
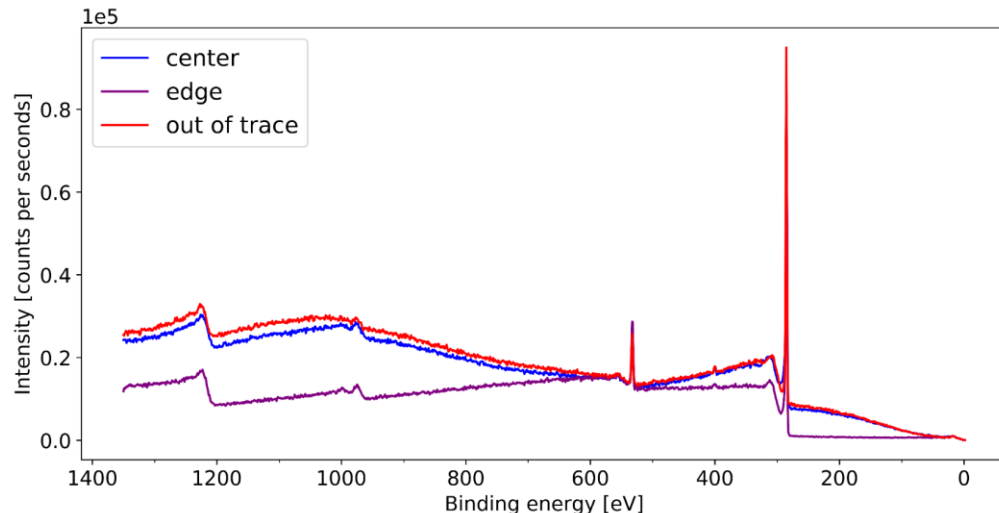


- Carbon everywhere, including outside of the exposed area!

# Post extraction analysis

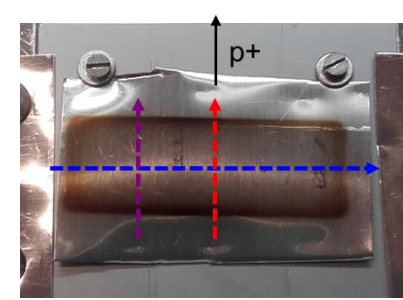
Stainless steel foil: 2 weeks in air

- Different background for the point measure at the edge of the trace (darkest area)  
→ effect of carbon thickness or cristallinity?
- Exposed area: C 1s shifted to lower binding energies (more graphitic, coherent with lab), and higher high energy tail
- Exposed area: O 1s shifted to lower binding energies (coherent with lab)

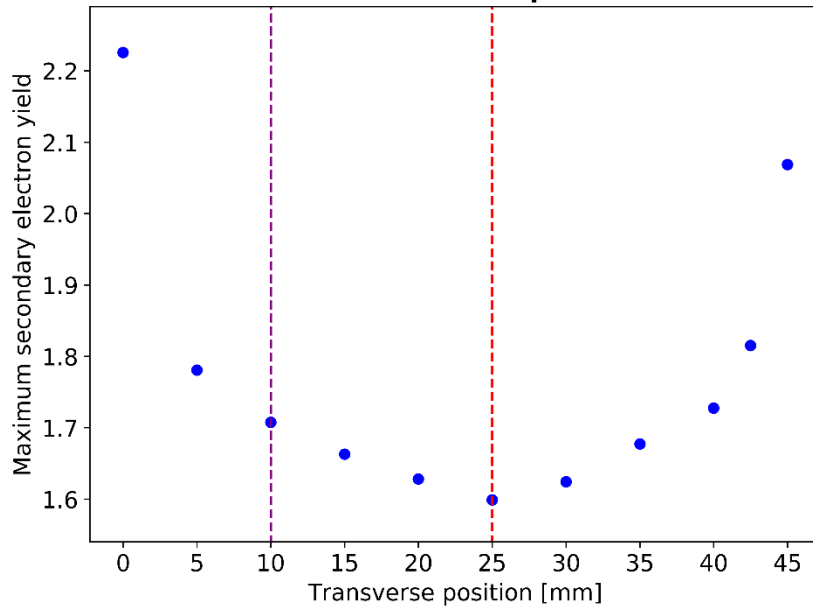


# SPS SEY drum

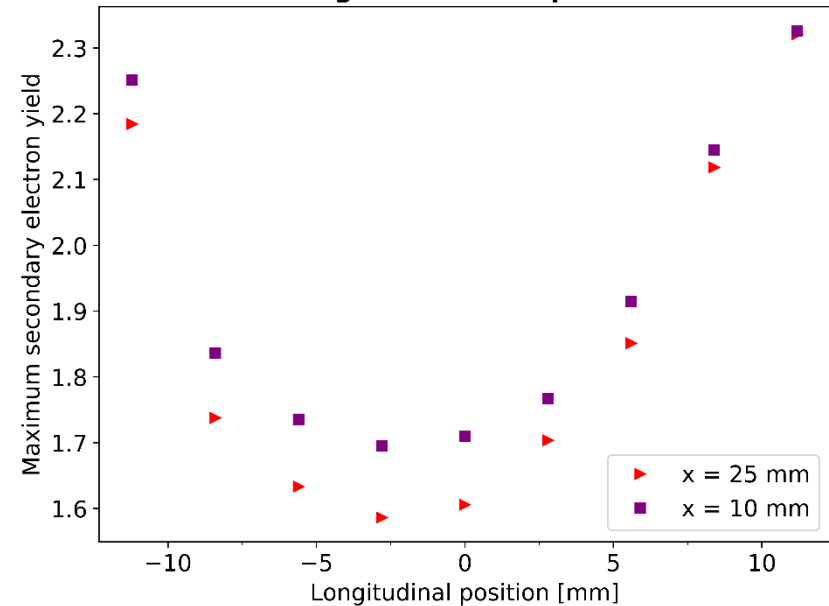
Stainless steel foil: 2 weeks in air



Transverse SEY profile



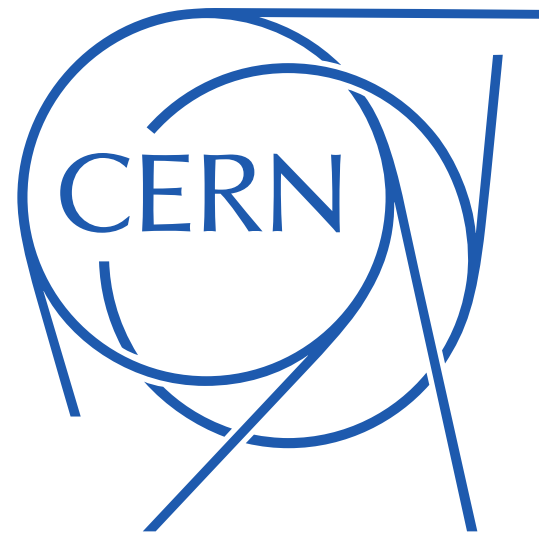
Longitudinal SEY profile



- After 2 weeks in air, minimum  $\delta_{\max} \approx 1.6$ , while it was almost 1.7 under vacuum... One cannot exclude that in-situ measurement is not performed perfectly in the center of the trace, or that we have an effect of different measuring setups In anycase, the SEY increase during two weeks is small!

# Summary, conclusions and next steps

- Conditioning is effective down to  $\delta_{\max} = 1.55$  for both copper and stainless steel
- During conditioning  $E_{\max}$  shifts to lower energy (opposite to lab)
- For long-term beam exposure the surface is getting dark and the high energy tail of the SEY curves goes down
- Surface (even not directly exposed to beam) is full of carbon
  
- Setup to be moved during LS2
- Extract Cu foil for XPS analysis → look for carbon growth
- Put a new Cu foil for long-term irradiation and potential carbon growth?



# Stainless steel – conditioning curve

