

## Results from samples extracted during SPS shutdown

Diagnostics of the apparent disagreement between the SPS data on coated dipoles and the e-cloud suppression in coated monitors:

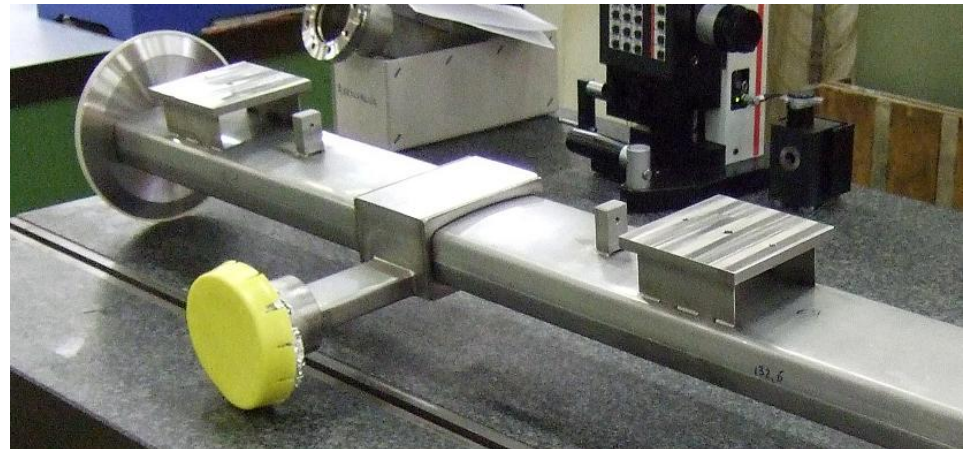
-endoscopy of the magnets

-cut open the magnet chamber (not yet)

-measurement of SEY on the sample stored in the pumping port (last SPSU): aged up to 1.3

-measurement of the SEY of the removable sample

-cut open the e-cloud monitor with a-C strip and measure SEY





## endoscopy of the magnets

Various defects and spots visible, but no easy conclusion

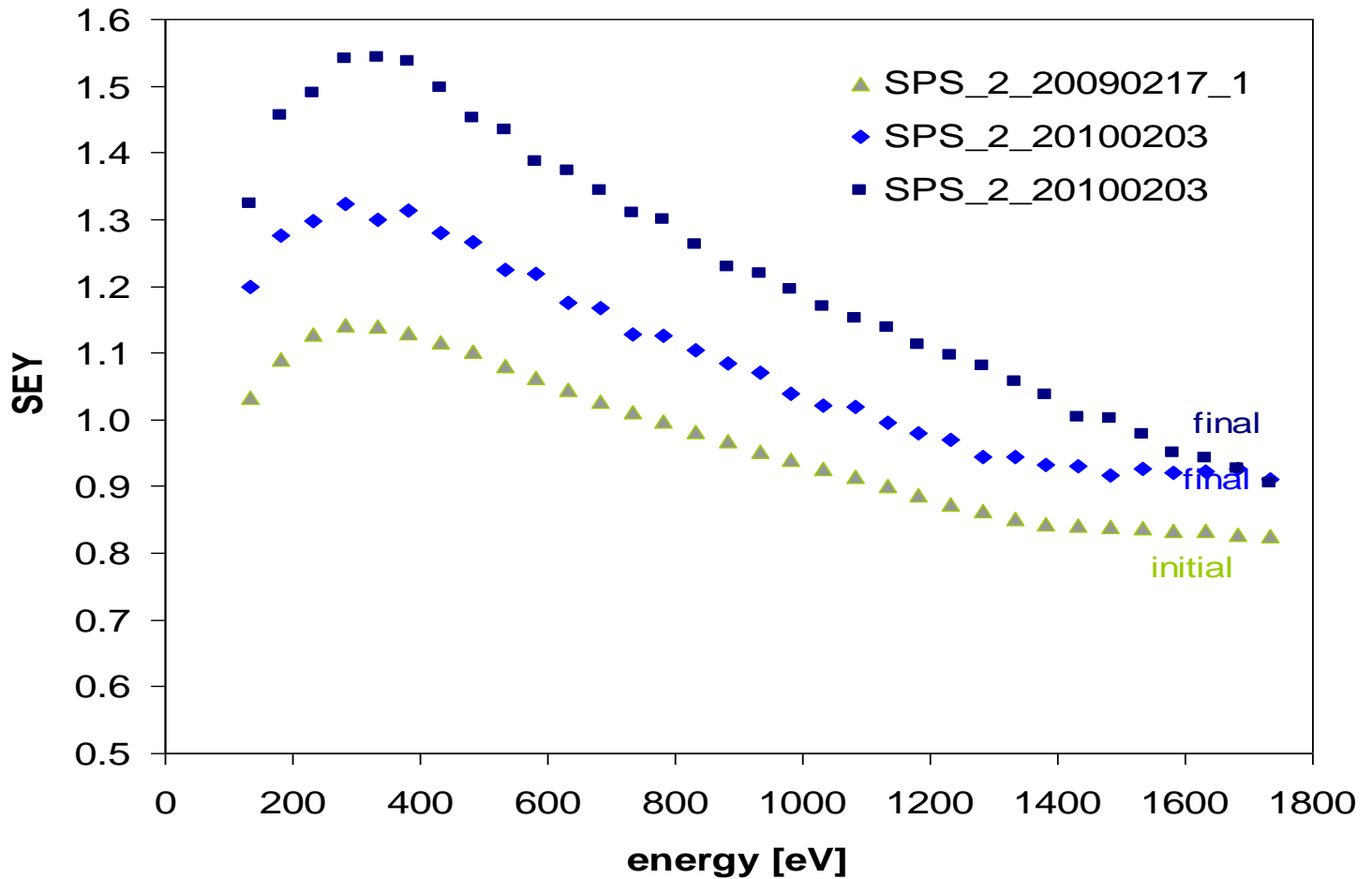
-→ cut open the magnet chamber (not yet)

-measurement of the SEY  
of the removable sample

-cut open the e-cloud monitor  
with a-C strip and measure SEY

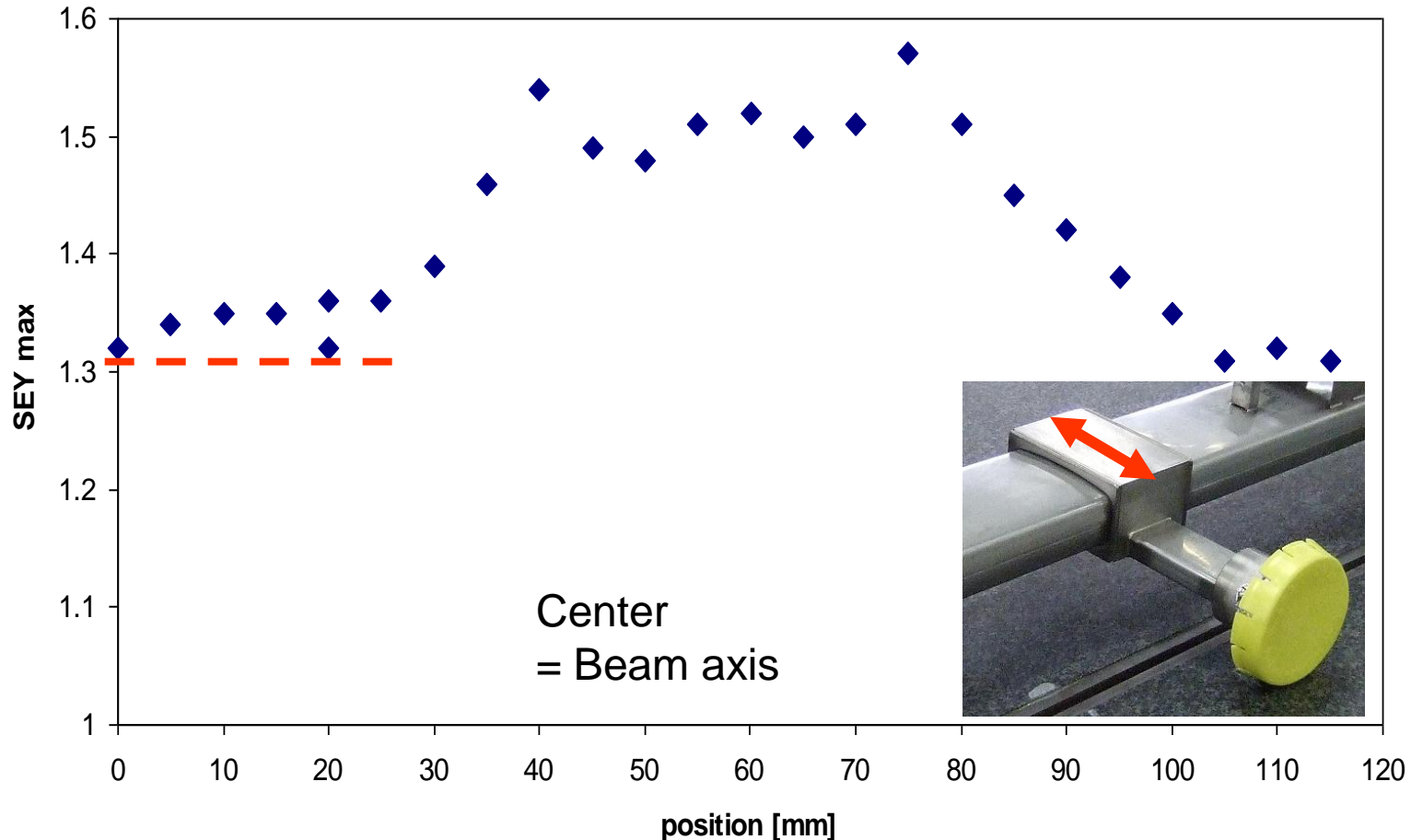
# SEY on removable sample from SPS

History: -coated with same parameters as a liner      May 2008  
          -inserted in SPS:                                      February 2009  
          -vented:    January 2010  
          -extracted:    February 2010



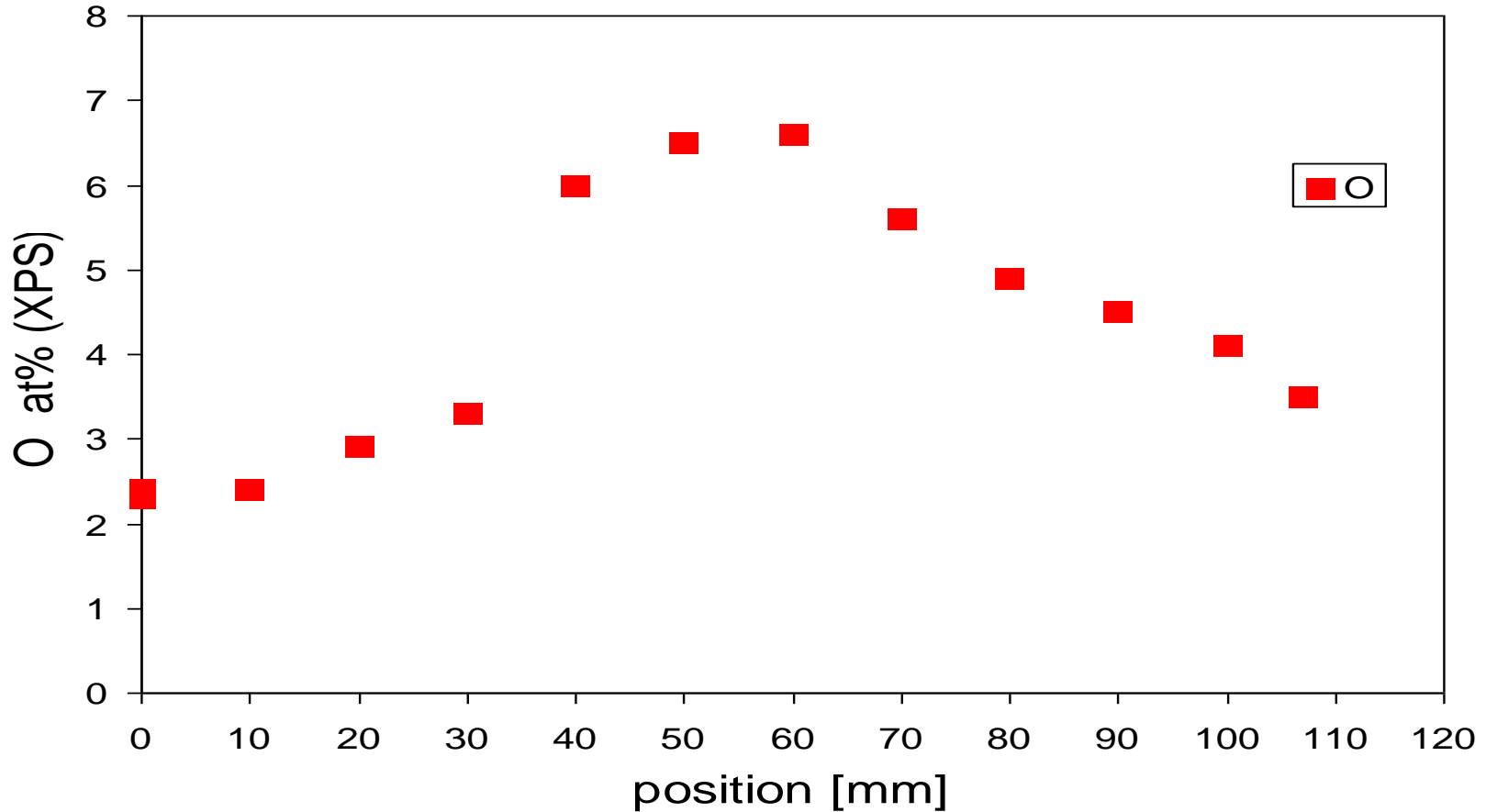
## SEY along the sample

Sample coated with MBB dipole and stored in pumping port of dipole



- The central part has experienced e-cloud, since the opposite wall is made of stainless steel, without coating
- Aging up to 1.55 at the center is related to irradiation
  - Aging from 1.1 (initial value) to 1.3 on the edge is related possibly to the residual gas only. As for samples in the MBB pumping port

## Surface analysis: oxygen concentration

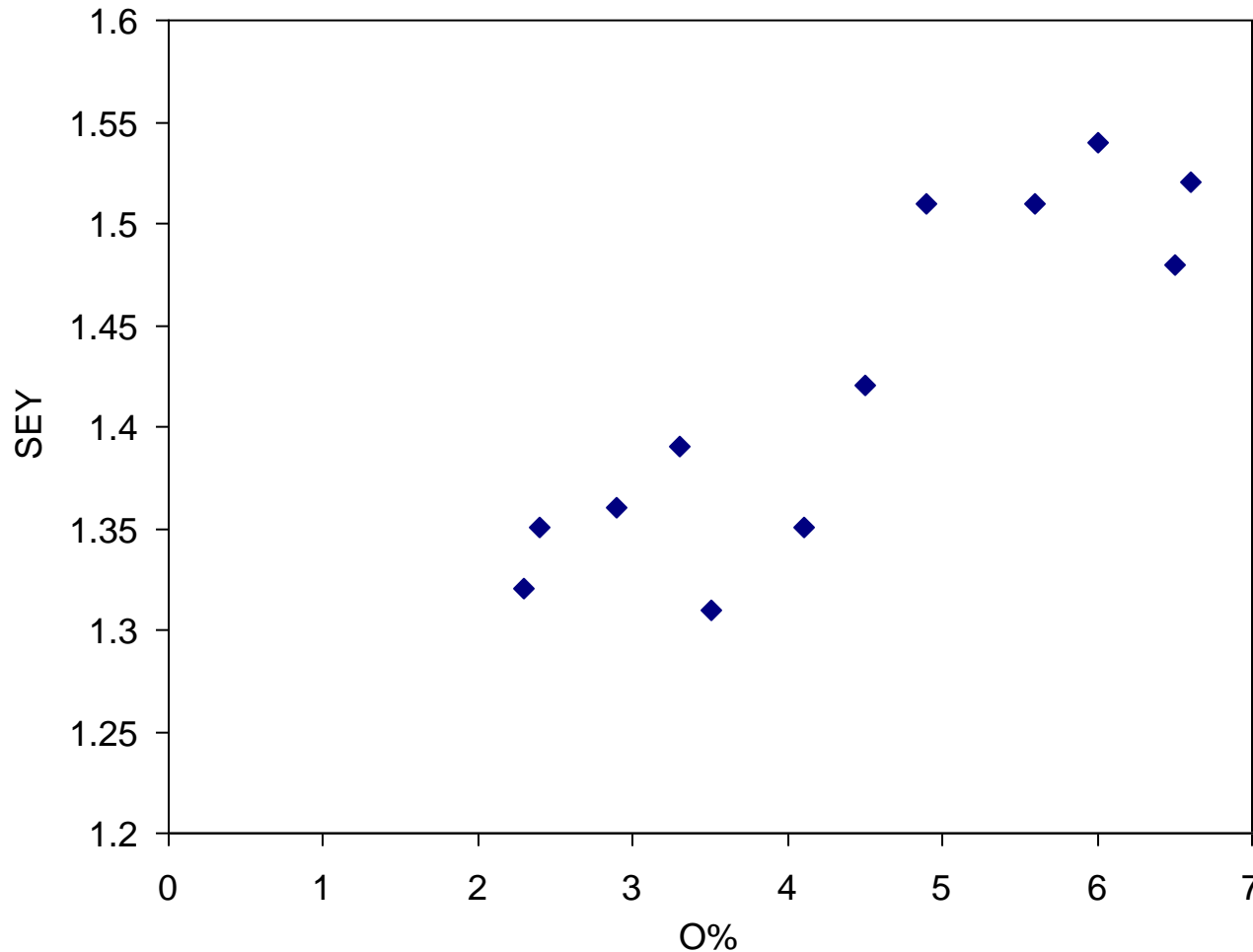


The central part of the plate has a higher oxygen concentration

→ the irradiation induces **reactivity of the surface, either to the residual gas (unbaked) or to the venting gas**

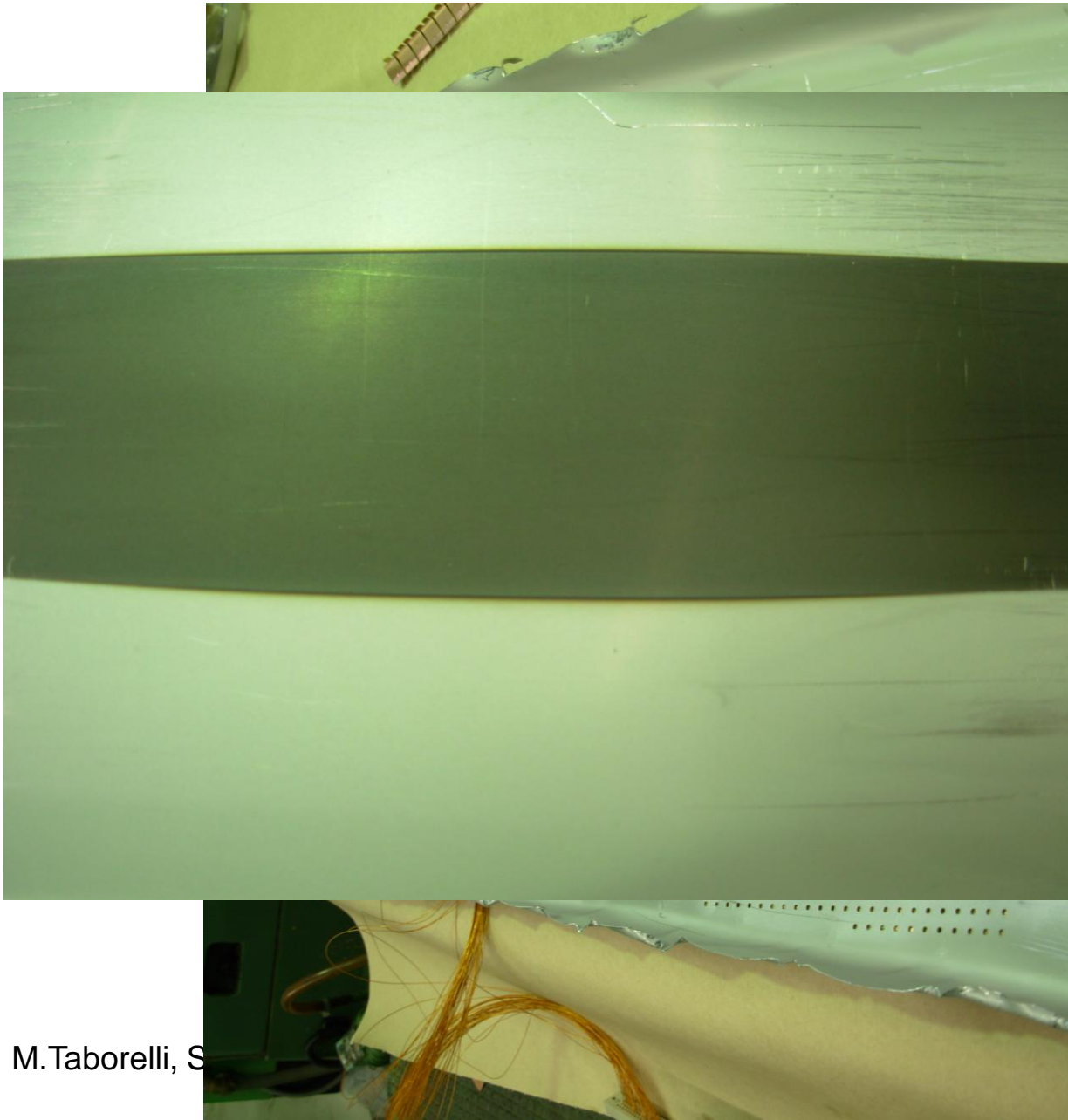
→ the amount of oxygen is still very low compared to other coatings with lower SEY

# Once more: SEY correlation with oxygen amount on a single coating



The presence of O correlates well with the SEY increase: **is it O from O<sub>2</sub>, H<sub>2</sub>O or hydrocarbons? Is it the source of the problem?**

## Samples from liner in e-cloud monitor:



Stripe liner inserted in  
SPS from March 2009 to  
February 2010

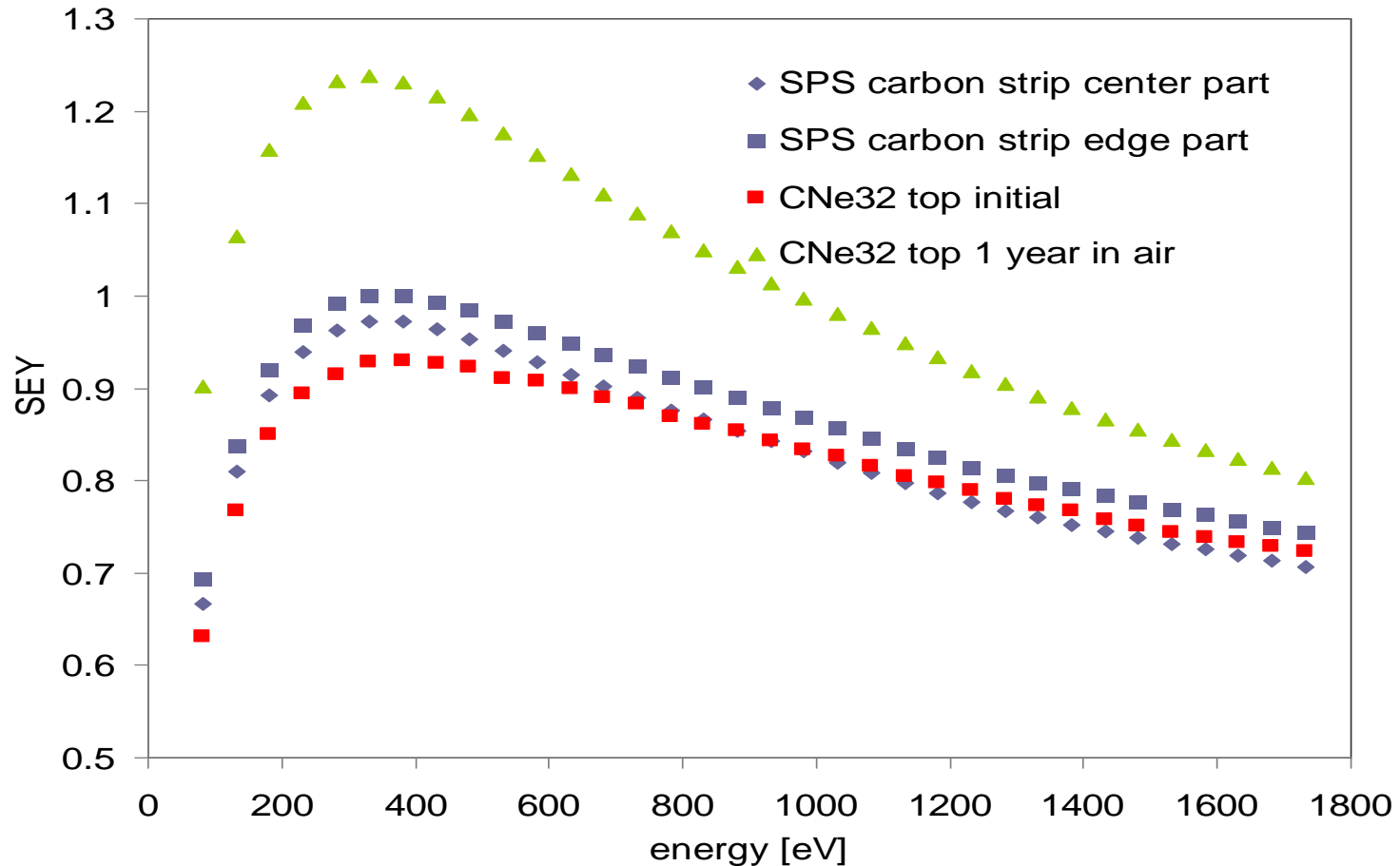
Cut open 15/2/2010

Coating is uniform  
(visual inspection)



# SEY of a sample cut from liner

History: the liner was 1 year in SPS + 1 month in air

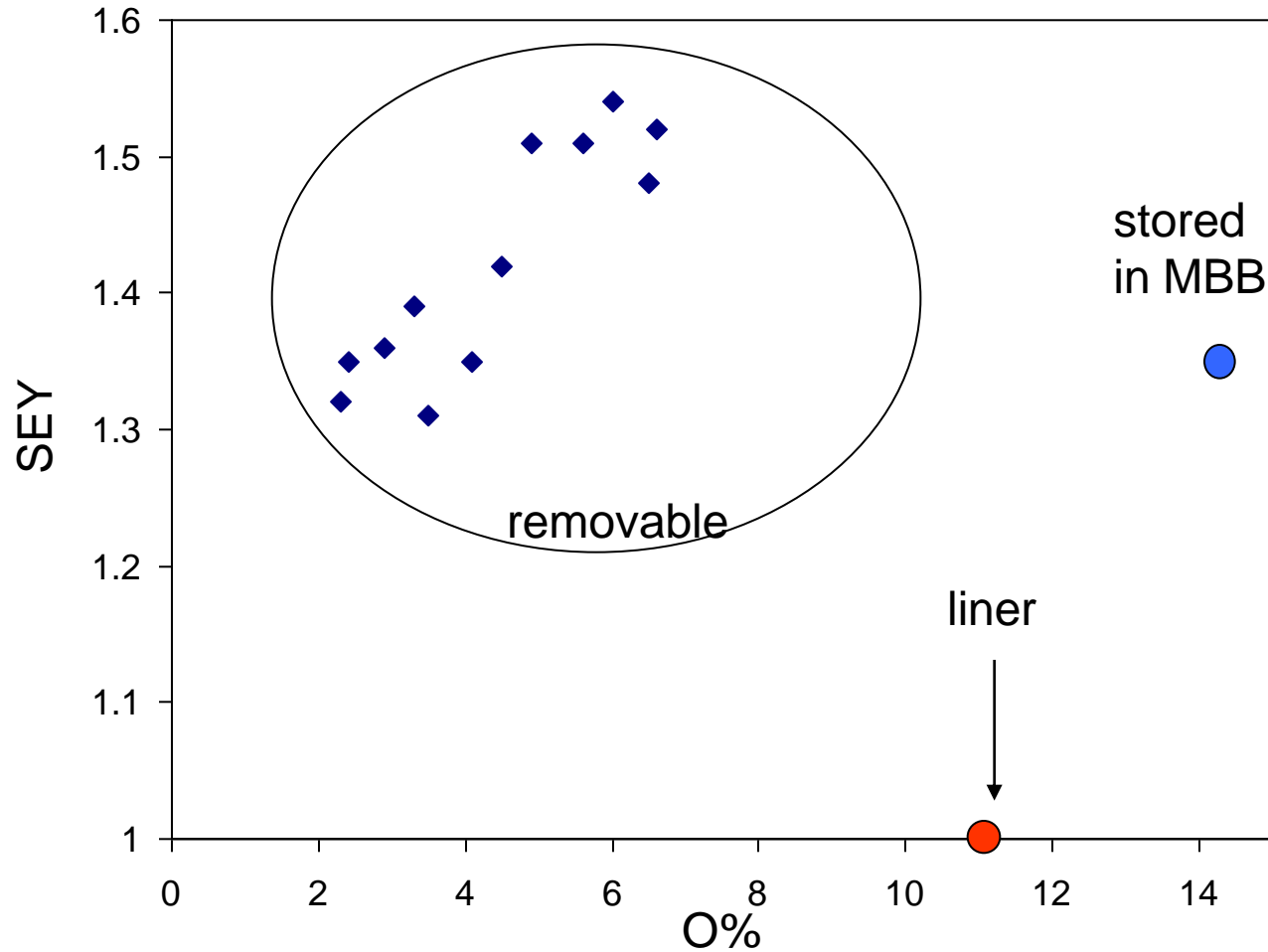


-Aging is very weak

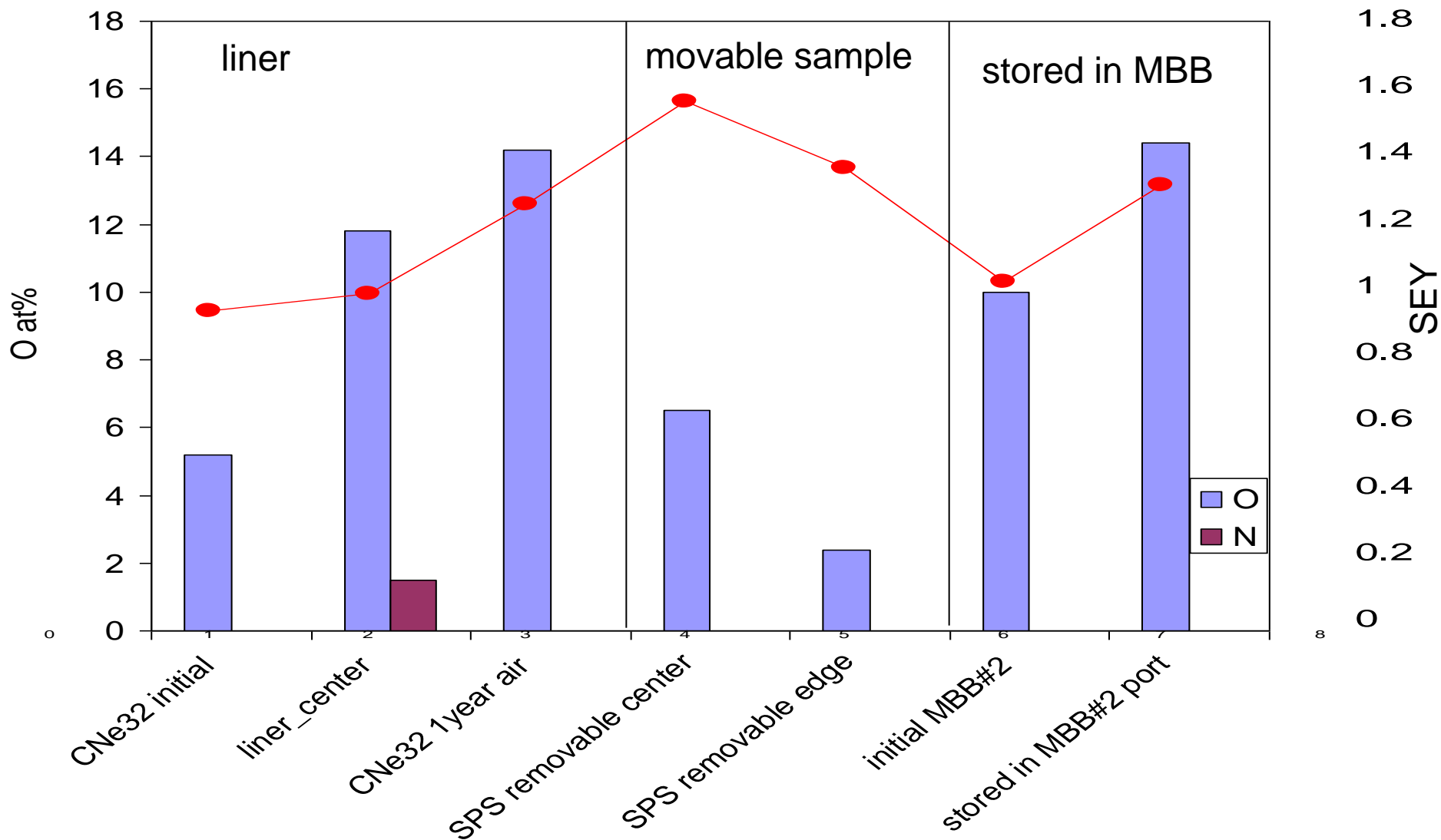
-Aging in air for the witness sample is faster

-NB: the witness samples from the MBB1# MBB#2 coating was at 1.21 and 1.23 after only one month air (1.16 after one week)

## Comparison of samples in the SPS



The correlation with the oxygen amount obviously does **not** work like this!

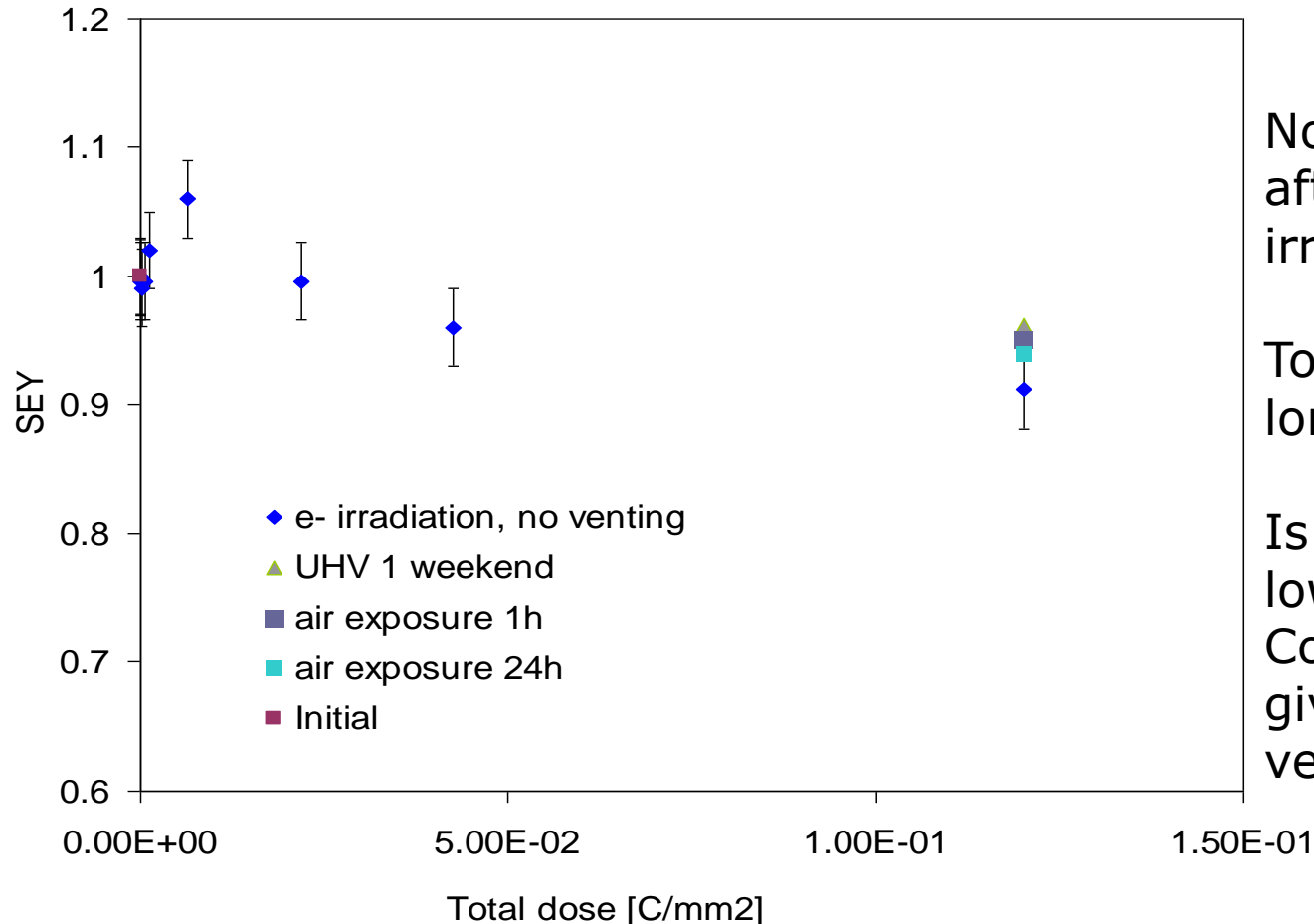


The oxygen amount correlates with SEY if we take a single sample  
**Is O the cause of the aging or is just increasing in parallel any time we have aging?**

The liner sample is the only one having N after irradiation and venting

## Irradiation in the lab of the liner sample

Irradiation with 500eV electrons to reproduce what happens in the SPS  
In a baked system in  $10E-10$  mbar range



No deterioration  
after large dose of  
irradiation+ venting

To be tested for  
longer times

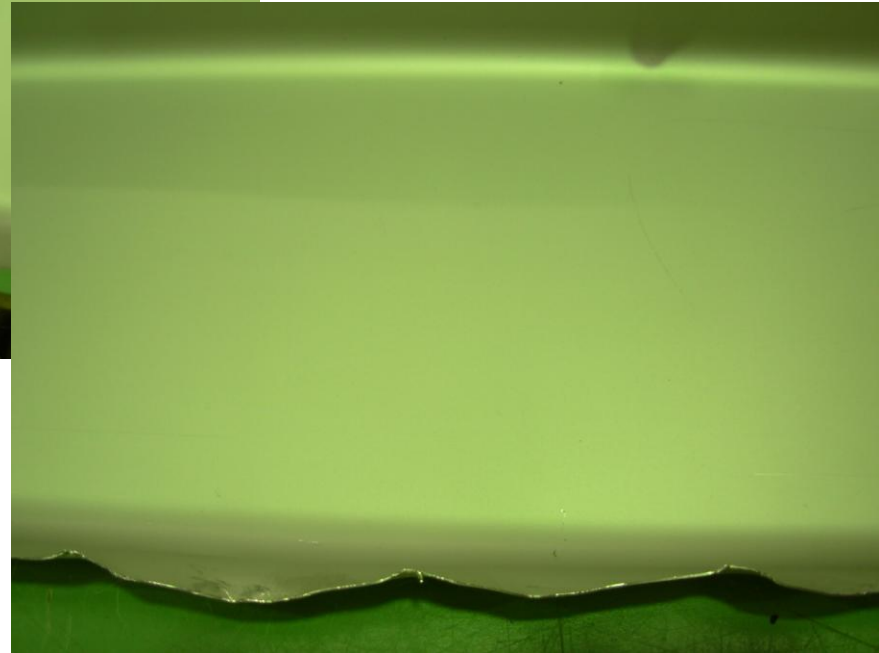
Is the increase at  
low doses real?  
Could a low dose  
give sensitivity to  
venting?

## Extracted stainless steel (StSt4)

StSt liner inserted in  
SPS from March 2009  
to February 2010



Uniform, no visible traces  
of conditioning



- XPS does not show strong amount of C as it is usual for irradiated samples
- SEY is 1.7-1.9, not conditioned (but they were air exposed for one week)

## Conclusions

On the mobile sample irradiation (e-cloud) and venting or irradiation and exposure to the residual gas of the unbaked SPS increased the SEY. The areas with the highest aging show more oxygen: they are more reactive.

The liner sample (not irradiated, no e-cloud) shows only weak aging in the SPS. In air aging is faster, but still better than for the MBB coatings.

It has some N on the surface and is not very sensitive to high dose irradiation in (baked) UHV and subsequent air exposure

By looking at a single sample O increases together with SEY, but might be a parallel effect and not the source of the increase

## Next

Reproduce the effect of irradiation in the lab (in progress)

- expose to air and unbaked vacuum
- irradiate at low doses to verify that the surface does not get more reactive than at high doses

SEM images of liner sample: is it like the usual slightly rougher coatings of liners?

SEM images of the removable sample (some radioactivity issues)

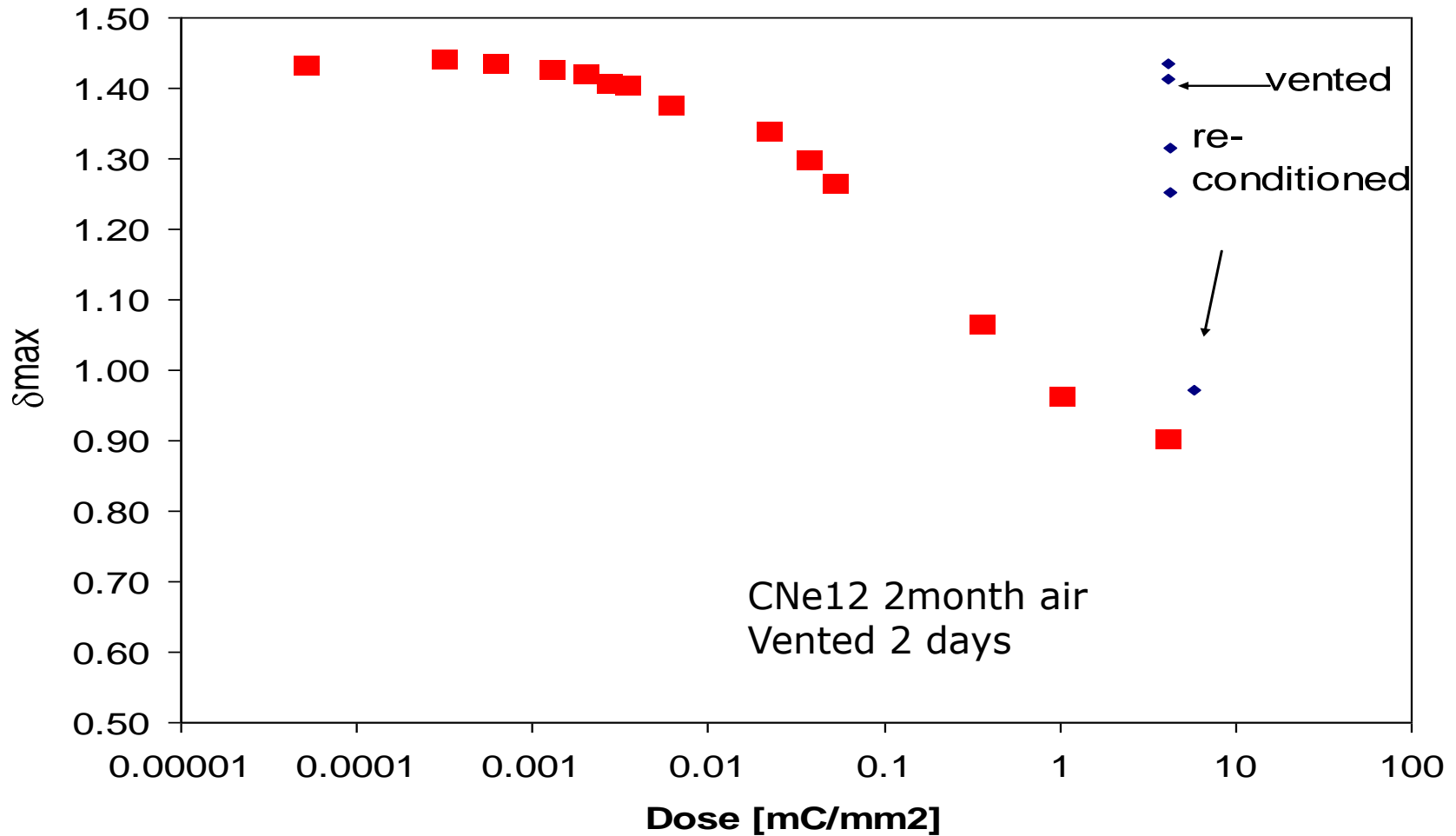
Cut open the extracted MBB chamber

Longer term (for discussion):

- insert a liner with a coated and uncoated part to see whether the "disease" can propagate
- insert two dipoles with a chamber coated in liner mode (before insertion in the magnet)

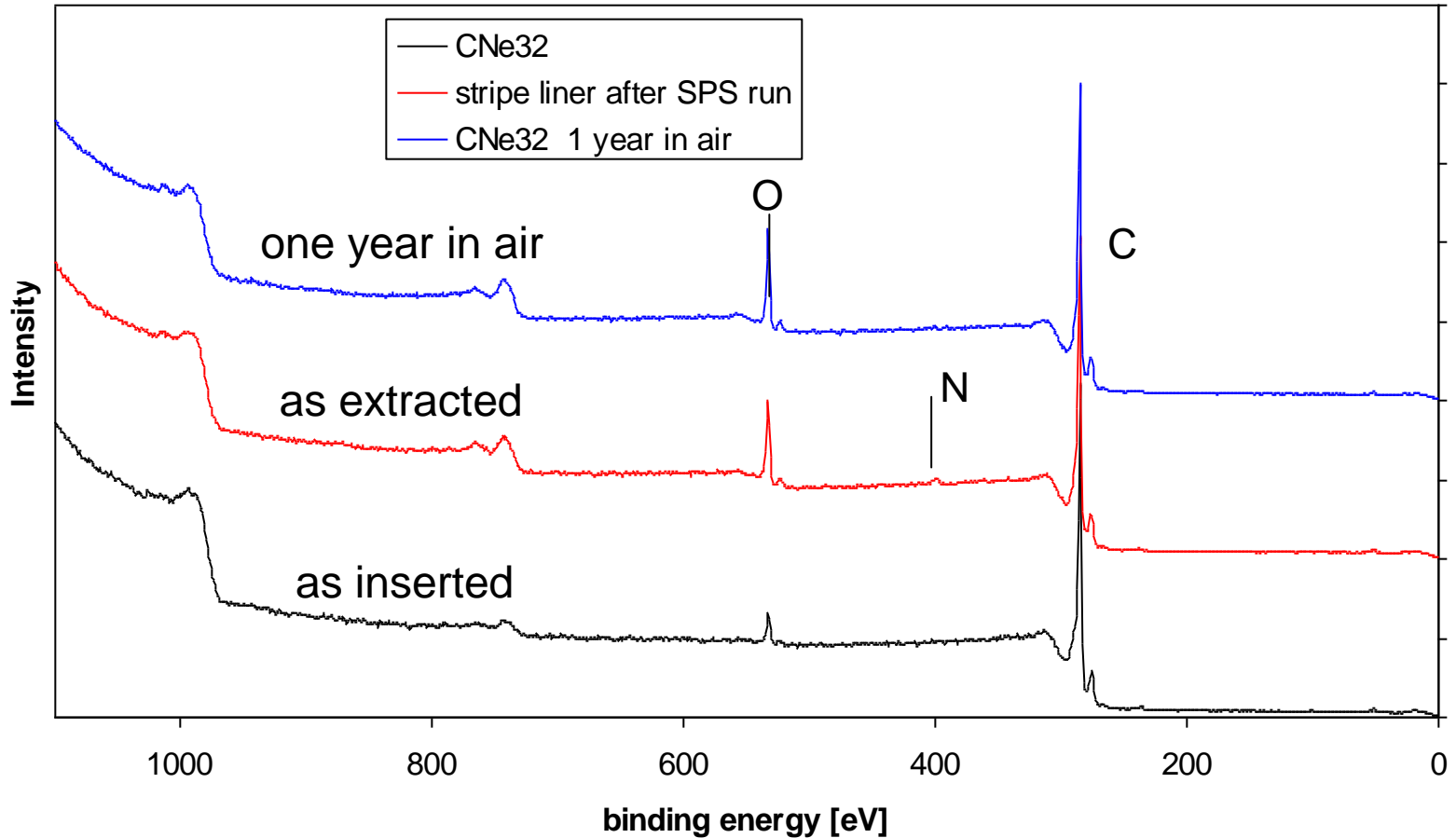
## Old: conditioning with electrons

Electrons at 500eV, **relative** SEY measured directly with the irradiation gun, at 500eV by polarizing the sample +/-45V





# Evolution of surface composition for liner sample



O increases and also a trace of N is visible  
The sample aged in air has even more O