# Desorption, scrubbing and surface modifications during Synchrotron Radiation light irradiation of accelerator walls

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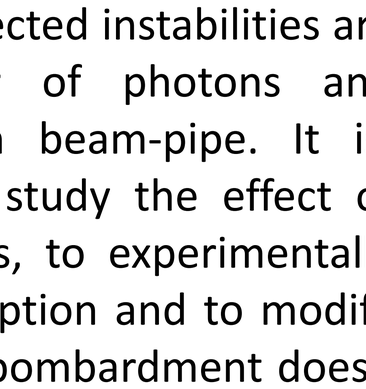
## Introduction

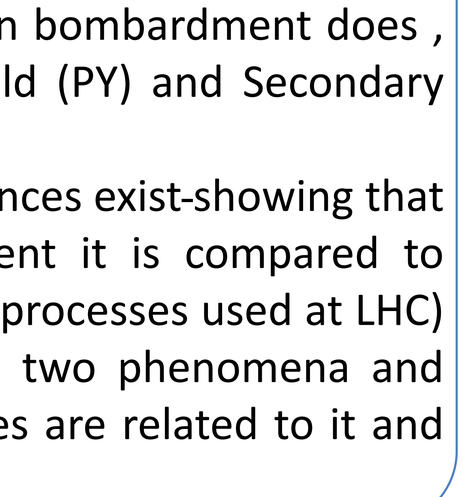
In FCC-hh, one of the most challenging issue will be to limit all possible instabilities that could occur. Expected instabilities are mainly related to the large number of photons and photoelectrons present in the vacuum beam-pipe. It is, therefore, of paramount importance to study the effect of photon irradiation on technical materials, to experimentally address its capability to induce gas desorption and to modify the actual surface chemistry, as electron bombardment does , eventually reducing material Photo Yield (PY) and Secondary Electron Yield (SEY).

Up to now, no clear experimental evidences exist-showing that photon irradiation "scrub", how efficient it is compared to electron scrubbing (the base mitigation processes used at LHC) [1-3], what are the links between the two phenomena and what detailed surface chemistry changes are related to it and to the gas induced desorption.

## Experimental

At LNF, by using the SR light emitted from a bending magnet in DAΦNE , we performed the first test experiments following simultaneously gas desorption, PY, SEY and surface chemistry modification (by using XPS spectroscopy) during the focused WL irradiation of a LHC Cu sample at room temperature. The Photon Flux delivered to the sample is calculated by taking into account the total Photon Flux of DAΦNE [4] and the reflectivity of all optical elements.



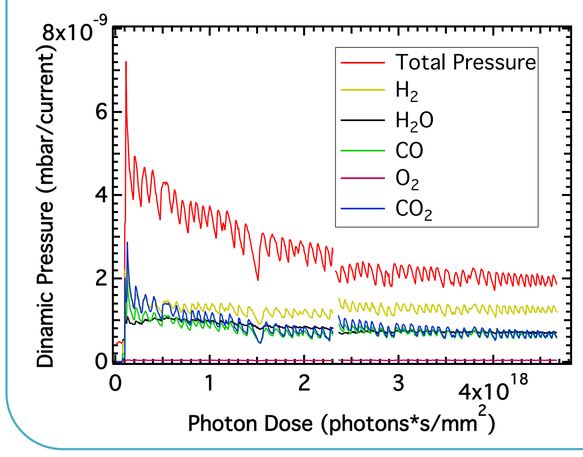


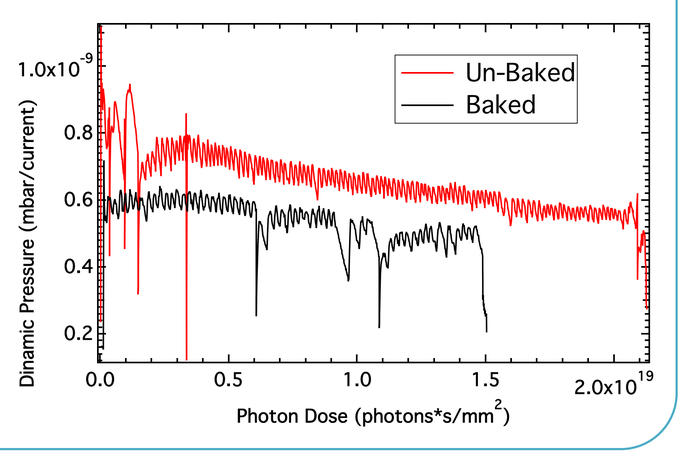

## Conclusions

Fundamental information about photo-stimulated desorption, Photo-Yield and photon scrubbing can be obtained studying photon irradiation processes under high flux White Light from DAΦNE. A complete characterization of the system can be performed through PY, SEY and XPS studies and is necessary for the complete understanding of SR interaction with accelerator walls.[5] WINDY, A White light beamline for Desorption studies from long beam pipes is under construction @ LNF.

## Photo-Stimulated Desorption

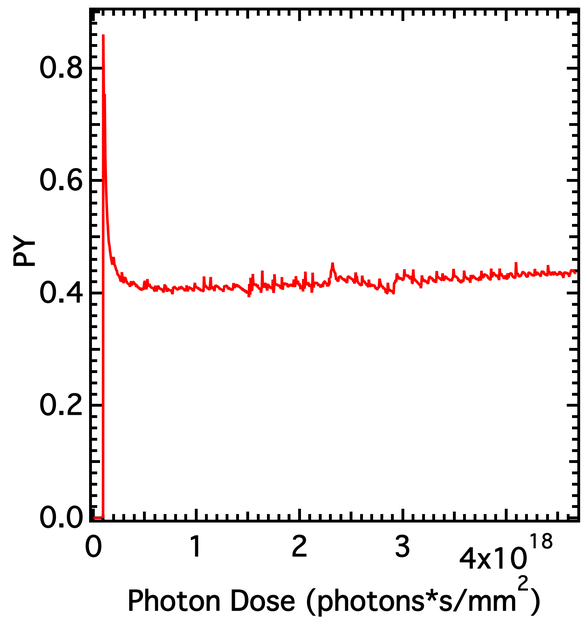
Desorption from unbaked and baked small samples. Different contributions to the total desorption process (to be calibrated).

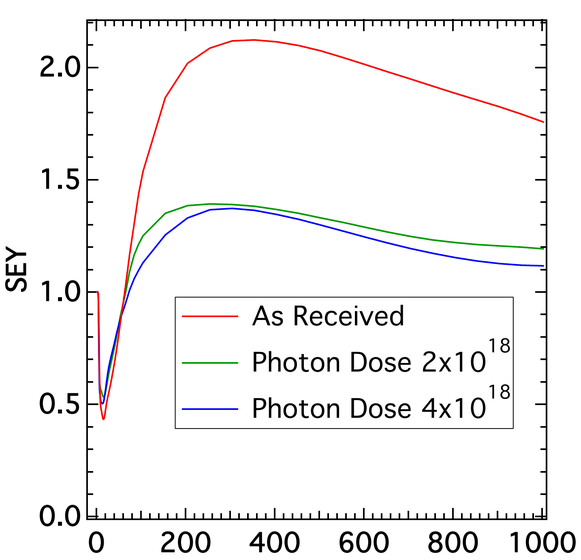


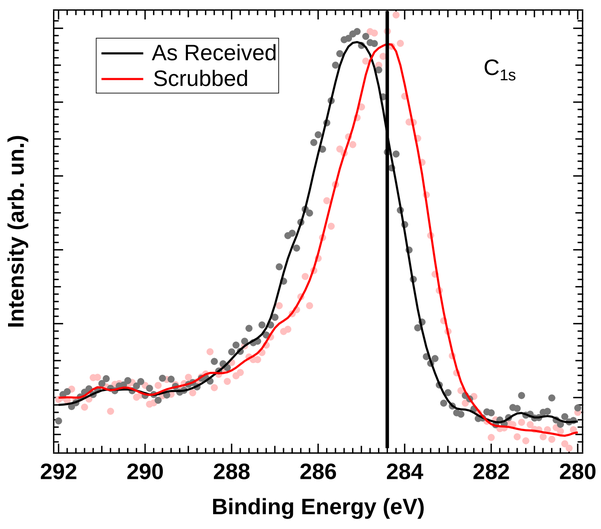

## Photon "Scrubbing"

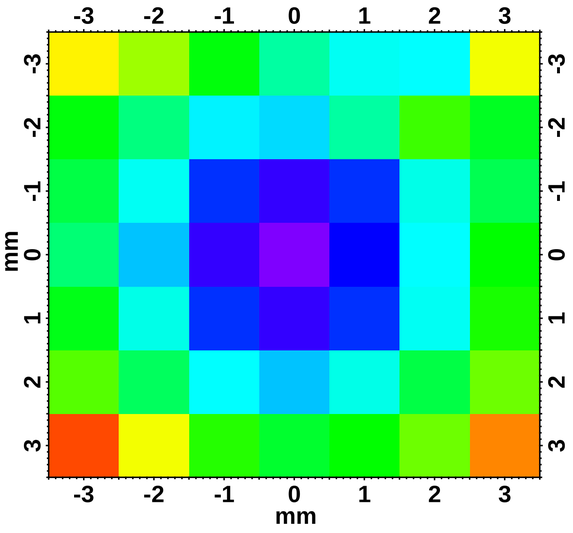
Photon Scrubbing process induces surface chemical reactions that can be studied with Photon Yield, Secondary Electron Yield and X-Ray Photoemission Spectroscopy




- Strong PY variation for photon dose below $5x10^{17}$ followed by stabilization.
- Scrubbing effect similar to $e^-$ scrubbing
- Higher $\delta_{max}$ values compared with $e^-$ scrubbing




- Modification of C 1s photoemission peak from surface impurities to graphitic carbon [3]
- XPS Map of graphitic Carbon peak @ 284.4
- Surface modifications in the irradiated spot

### *References*

1) R. Cimino, T, Demma, *Int. J. Mod. Phys. A* 29, 1430023, 2014
2) R. Larciprete, D. R. Grosso, M. Commisso, R. Flamini, R. Cimino, Phys. Rev. Special Topics - Accelerators and Beams 16, pp. 011002, 2013
3) R. Cimino, M. Commisso, D. Grosso, T. Demma, V. Baglin, R. Flammini, R. Larciprete, Phys. Rev. Lett. 109 (2012) 064801
4) http://henke.lbl.gov/optical_constants/
5) Angelucci M. et al. in preparation

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