

# WP4 Cryogenic Beam Vacuum System Conception: Activity report @ LNF R. Cimino and M. Angelucci LNF-INFN, Frascati (Italy)

EuroCirCol meeting: Barcellona 7-11-2016

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#### D4.1: ANALYSIS OF VACUUM STABILITY AT CRYOGENIC TEMPERATURE.

Determine vacuum stability and adsorption isotherms at different cryogenic beam-screen operating temperature ranges (D-4.1).

- I) measurement set-up status at INFN
- > 2) Performed measurements (see Marco's talk)
- > 3) Future measurements (new techniques soon available)
- > 4) samples to be measured

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## I) measurement set-up status @ LNF

 Control and put in operation the experimental stations at RT and LT:



- SEY at RT and LT - XPS only at RT (now)



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## I) measurement set-up status @ LNF



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# 3) FUTURE MEASUREMENTS @ LNF:

- See what can be measured with the available set-up: SEY and TPD to (contemporarily) study physisorbed gas versus:
  Temperature
  Electrons?
  Ions?
  Photons?
- New funds will be available in 2017 → A new optimized mass spectrometer and a new LT manipulator will be available mid/late next year.
  - It will be possible to measure XPS, SEY and TPD etc., on the same samples held at
     Cryogenic temperatures (10 < °K < 300)</li>
     of interest!





#### XPS for understanding scrubbing: PRL 2012



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#### XPS to monitor and understand desorbtion.

• Ar physisorption on GR/Ru(0001)



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#### XPS to monitor and understand desorbtion.

Soon we will be able to follow desorbtion from technical surfaces by TPD,
 SEY and XPS at LT



# 3) FUTURE MEASUREMENTS @ LNF:

- SR (WL and Monochromatic) will soon (March / June 2017) be available in the laboratory.
- Strong potential for FCC-hh and HL-LHC study has been identified
- A MoU between INFN-LNF and CERN is under definition.
- The details of such MoU will define what, if and when such Synchrotron Radiation light will be available to the collaboration and with what priority.
- The usual bottleneck being man-power!



# Bending Magnet source for UV and XUV and its Laboratory (covers from 20 to 1000 eV)



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# XUVI: Low Energy BL 30-200 eV.

# XUV2: High Energy BL 60 - 1000 eV.



#### Experimental hall: the two beamlines and the two operating experimental set-ups

- $\rightarrow$  UHV ~1x10<sup>-10</sup> mbar
- $\blacktriangleright$  IxIcm<sup>2</sup> max. sample
- Sample T: RT 1100°C
- preparation chamber
- ➢ fast-entry lock
- Electron gun
- Faraday Cup
- SEY set up
- > UPS (UV ph. Spectr.)
- > XPS (Xray ph. Spectr.)
- Sputtering
- > Material grow
- RF magnetron 50W



- UHV ~Ix10<sup>-10</sup> mbar
- IxIcm<sup>2</sup> max. sample
- Sample T: 10° 300°K
- > preparation chamber
- fast-entry lock
- Electron gun
- Faraday Cup
- SEY set up
- ➢ UPS (UV ph. Spectr.)
- Mass Spectometer (desorbtion)
- > Sputtering
- Material grow

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## We are presently carefully aligning the existing beamlines:

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# Time scale

> A collimated WL beam is already available in the laboratory.

A commissioning phase is actively ongoing. Light (mono and WL) will be characterized and optimized on photodiodes at sample position. Than the experimental set-ups will be moved in, at focus. (4 to 6 months activity)

One can measure in a small spot  $(1 \times 1 \text{ mm})$  not at grazing angle (min. ~  $10^{\circ}$ ):

- PY and SEY
- Photo desorption (with the new "Ad hoc" Mass spec)
- Photo scrubbing (SEY and PY variation vs Photon doses)
- Photo induced Chemical modification (XPS) (possibly at LT)

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@ 10 K

to

300 K

# **Comments:**

The WL reaching the sample position in a small spot (1x1 mm) is focused so can not be used to perform very grazing experiments (need of collimated beam) even using an "ad hoc" set-up. It can not be used on long samples!



The WL reaching the laboratory is a parallel collimated beam and can be used to perform very grazing experiments on long samples. Need an "ad hoc" set-up.



## Present situation: pre-optics in the ring



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# NEW: Use of DAFNE-L Synchrotron Radiation to perform R&D studies for High Luminosity LHC and FCC-hh.



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Prospective: A MoU with CERN (Kick-off meeting last month) to exploit the use of SR to common R&D activity for High Luminosity LHC and FCC-hh).

- From March/June 2017 it will be possible to use the existing beamlines in the framework of a CERN-INFN collaboration agreement.
- It is conceivable at reasonable costs and time to open a new WL beamline compatible with the existing activities and fully dedicated to irradiate long (2<L<4 m) pipes for grazing Reflectivity, PY and desorption (eventually at Low T and in Magnetic field). Irradiations will take place in the lab with full accessibility during studies rendering the system flexible and easy to use.
- Combining small spot (WL and Monochromatic) study with ones on realistic beam pipes, is a fundamental issue to better understand most phenomena involving SR and material science in accelerators.

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PS: such MoU will imply opening of working position (to be discussed/defined later) Meanwhile:

INFN Fellowship Programme 2017/2018 offers 20 (twenty) positions for research activity in Experimental Physics (2 years positions) (see <a href="http://www.ac.infn.it/personale/exp\_fellowships/">http://www.ac.infn.it/personale/exp\_fellowships/</a>).

- Eligible candidates are non-Italian citizens, phd after 15-11-2008
- deadline:November 15, 2016.
- http://www.ac.infn.it/personale/exp\_fellowships/priv/index2.php?inf=modulo
- Those positions are not badly paid (40k€/y) and with a nice program with SR measurements a good candidate could have some chances.

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# 4) samples to be measured (open to suggestions)

- We plan to continue working on well characterized surfaces (clean OFHC Cu), as a function of various gas dosing to establish a working protocol.
- Validate SEY and LE-SEY as a spectroscopic technique to measure surface changes due to gas absorption/desorption.
- TPD with available tools.

- Electron stimulated desorption
- Benchmarking results with "large surface" CERN approach.
- In few months we will be ready to measure more realistic surfaces.
- Then we can study samples produced by the collaboration.

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# **CONCLUSION:**

- We are ready to continue full exploitation of the available resources to meet milestones and to produce promised deliverables.
- We are ready to invest next year available funds to upgrade the existing set ups with new hardware.
- Starting from mid 2017 we will be able to measure XPS, SEY, TPD, etc. on the same samples held at at variable temperatures between 10 and 300 °K.
- It is conceivable to add SR light to our resources for the EuroCirCol project.
- SR would be extremely beneficial but it is not easily compatible with available human and economic resources devoted to EuroCirCol.

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• CERN and LNF-INFN are working hard on a MoU and you will be updated asap.

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#### People

Tecnical staff of DA $\Phi$ NE-L

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