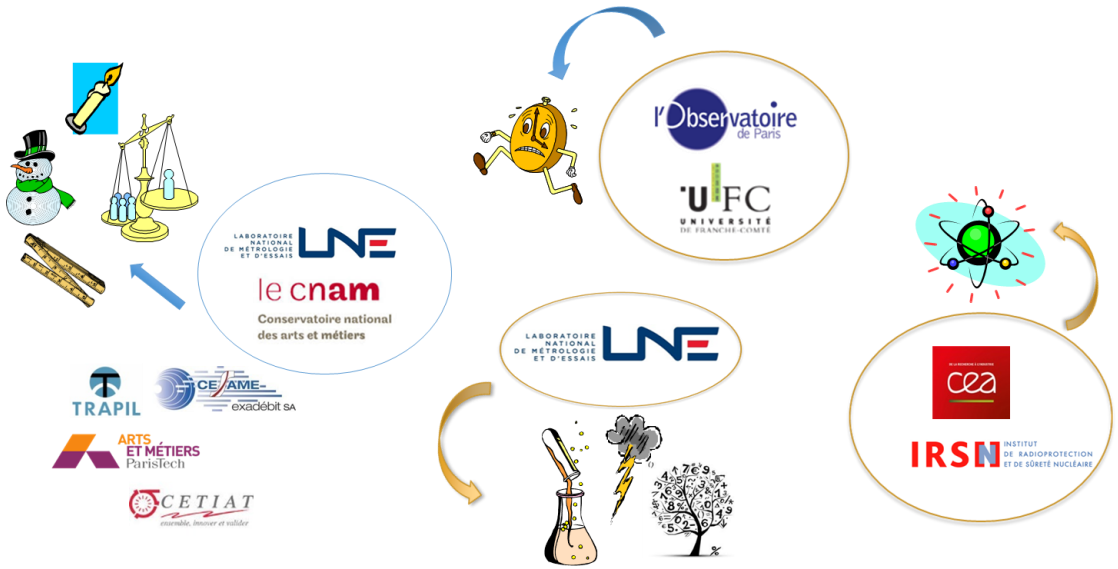
# Réseau national de la métrologie française

**LNE: Laboratoire national de métrologie et d'essais**
**- *Institut LNE-Nanotech***

**LNE-LNHB: Laboratoire national Henri Becquerel**

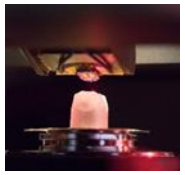



**François Piquemal**
**LNE**

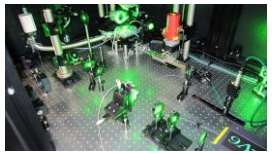
**GDR NAME – 9 mai 2021**

# LNE-Nanotech Institut de Métrologie pour les Nanotechnologies

## Thermal

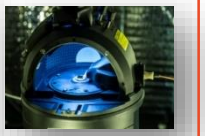


SThM



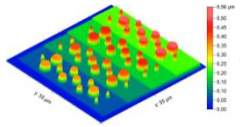
Frequency domain PTR

## Electrical



SMM in controlled env.

C-AFM

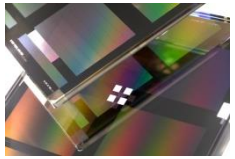


Cal. kits

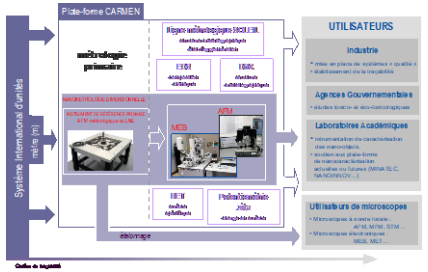

**Evaluation of metrological performances of new instruments / sensors**

**Characterization of nanomaterials in complex medias** (*consumer product, water, biological media…*)

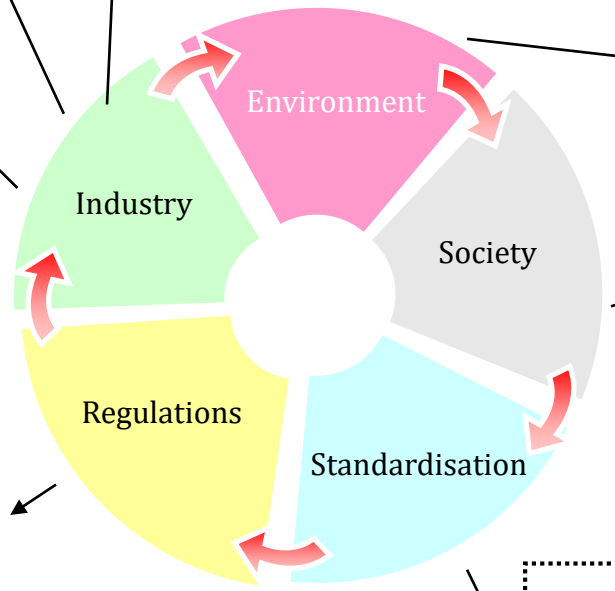
**Aerosols characterisation** (*generation, air pollution, occupational risk…*)



**Characterisation of materials properties at the nm scale** (thermal, electrical, …)




**Development of tools and methods to allow implementation of national or European regulations on nanomaterials**




**Characterisation of health and environmental risks of manufactured nanomaterials**

→ Dustiness, Wear, Migration from packaging material, End-of-life (*combustion / waste incineration*)

VAMAS afnor NORMALISATION cen ISO

**Measurement protocols transfer towards standardisation bodies**

# Laboratoire National Henri Becquerel (LNE-LNHB)

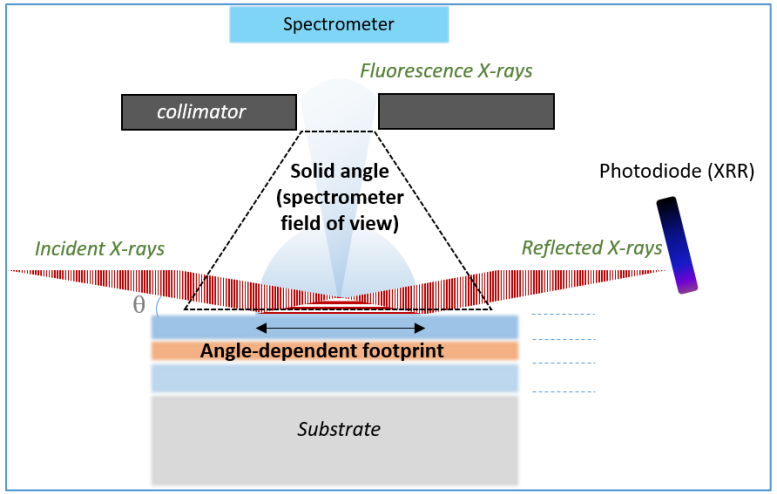
Metrology of ionizing radiation (Designated Institute)
Development of analytical methods by X-ray fluorescence

## Combined X-ray analysis by X-Ray Reflectivity (XRR) and Grazing Incidence X-Ray Fluorescence (GIXRF)

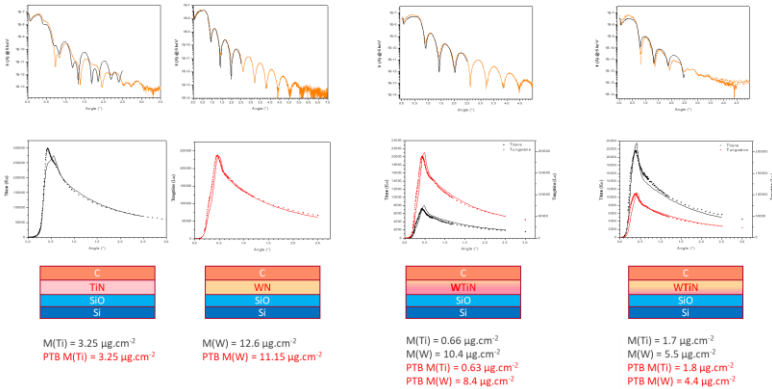
**Non-destructive** technique to control the precision of **thin film deposition** by giving access to the parameters of the different layers (**thickness**, **roughness**, **composition**, **density**, **depth profile**).

### Measurement principle:

- Monochromatic X-rays grazing the sample surface,
- Rotation of the sample (small angles),
- The incident beam progressively penetrates the sample and allows the analysis of its depth structure.

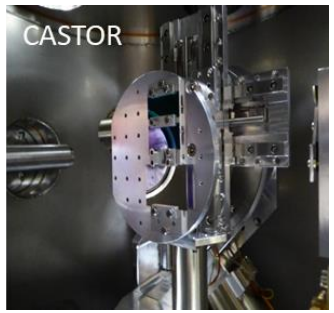



Characterization of layers with thicknesses of a few nm




### Experimental set-up:

Use of synchrotron radiation (**SOLEIL**) with a specific goniometer (**CASTOR**).




The LNHB develops its own software for data acquisition, XRF spectra processing and multilayer modeling.

The use of both techniques allows to obtain complementary information and to remove ambiguities.

The reference-free approach uses only fundamental atomic parameters to characterize the multilayer:

**No need of reference standard**.

Merci de votre attention !