

**Course:** X-rays based methods in chemistry, pharmaceutical sciences and materials sciences and engineering

**Duration:** 24 hours

**Teacher(s):** S. Gross, V. Causin, P. Centomo (DiSC)  
C. Dalconi, G. Artioli, L. Valentini (Geoscienze)  
C. Maurizio (DFA)

**Description:**

The course is aimed at providing the students basics of X-ray/matter interaction, along with a description of the main X-ray based methods for investigation of molecules and materials. Applications in the different fields will also be outlined.

In particular, the following topics will be addressed:

Course scope, historical introduction and definition of X-rays (1 h) (S. Gross)  
X-rays and X-ray matter interactions (2 hrs C. Maurizio)  
X-ray absorption (2 hrs C. Maurizio)  
XAS in situ/operando applied to catalysis and reaction mechanisms elucidation (2 hrs P. Centomo)  
XPS and XRF (4 hrs, S.Gross, with practical session)  
X-ray diffraction and crystallography: introduction (2 hrs G. Artioli)  
X-ray powder diffraction (3 hrs C. Dalconi, with practical session)  
X-ray single crystal diffraction (3 hrs A. Lanza, with practical session)  
SAXS (V. Causin 2 hrs)  
Tomography (L. Valentini 2 hrs)  
Multi-technique approaches (1 hr G. Artioli)

**Additional information:** (*guest speakers, practical sessions, etc*)

The course will be delivered at Department of Chemical Sciences

The course will entail also practical sessions devoted to data analysis, structure elucidation and refinement

Guest teacher: Arianna Lanza, PhD, CNI@NEST, IIT, Italy

**Course schedule**

**17.9 Thursday**

Course scope, historical introduction and definition of X-rays (1 h) (S. Gross)  
X-rays and X-ray matter interactions (2 hrs C. Maurizio)

**18.9 Friday**

X-ray absorption (2 hrs C. Maurizio)  
XAS in situ/operando applied to catalysis and reaction mechanisms elucidation (2 hrs P. Centomo)

**21.9 Monday**

XPS and XRF (4 hrs, S.Gross, with practical session)

**22.9 Tuesday**

X-ray diffraction and crystallography: introduction (2 hrs G. Artioli)  
X-ray powder diffraction (3 hrs C. Dalconi, with practical session)

**23.9 Wednesday**

X-ray single crystal diffraction (3 hrs A. Lanza, with practical session)  
SAXS (V. Causin 2 hrs)

**24.9 Thursday**

Tomography (L. Valentini 2 hrs)  
Multi-technique approaches (1 hr G. Artioli)