UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Radioactivity

2122-1-F1701Q106

Aims

Description of the basics of radioactive decay, of radioactive sources and methods for radioactivity measurements.

Contents

Introduction to nuclear models

Characterization of radioactive decays

Radioactive decay law

Natural radioactive sources: fossils and cosmogenics

Artificial radioactive sources

Activity measurements of radioactive sources

Concentration measurements of radioactive sources

Numerical simulation methods for radioactive source characterization

Detailed program

Introduction to nuclear models

- General characteristics of atomic nucleus
- Mass defect concept
- Binding energies of nucleons
- Description of table of nuclides
- Liquid drop model of nuleus and von Weizsäcker formula

Characterization of radioactive decays

- Alpha decay
- Beta decay
- Gamma decay

Radioactive decay law

- General formula of radioactive decay
- Variation in time of the concentration and activity of the parent and daughter nuclei
- Definition of activity and identification of physical units
- Multiple decays and radioactive chains
- Secular equilibrium conditions

Natural radioactive sources: fossils and cosmogenics

- Natural fossil radioactivity
- Natural radioactive chains: secular equilibrium and its breaking
- Primary and secondary cosmic rays
- Cosmogenic radioactive nuclei

Artificial radioactive sources

- Nuclear reactions for the production of anthropogenic radioactivity
- Basics of nuclear fission: bombs and nuclear reactors
- Dispersion of artificial radioactivity in the environment

Characterization of detector for radioactivity measurements

- Radiation interaction with matter
- Characterstics of detectors for radioactivity measurements
- Introduction of signal analysis for nuclear radiation detectors

Characterization of radioactive sources with activity measurements

- Alpha spectroscopy
- Gamma and X spectroscopy
- Beta spectroscopy
- Radon measurements

Numerical simulation methods for radioactive source characterization

- Numerical simulation applied to radiation matter interaction
- Methods to correctly determine the radioactivity measurement efficencies

Characterization of radioactive sources with concentration measurements

- Mass spectroscopy aalysis
- Neutron activation analysis
- X ray fluorescence

Application of radioactivity measurement techniques

- Cultural Heritage applications
- Studies on neutron sources from nuclear reactors and accelerators

Prerequisites

Basic knowledge of the three-year degree in physics

Teaching form

Lectures.
Some seminars on specific arguments will be organized as parts of the course program.
Some guided tours to radioactivity measurement laboratories will be organized.

During the COVID-19 emergency period the course will be delivered remotely with asincronous registered lessons. In any case, videoconference meetings will be periodically organized and, if it will be possible, some meetings in presence will be held.
Seminars will be in any case organized remotely with the support of a videoconference remote connection.
During the emergency period tours to radioactivity measerement laboratories could not be guaranty.

Textbook and teaching resource

Kenneth S. Krane - Introductory Nuclear Physics, ed. John Wiley & Sons Inc

Merril Eisenbud - Environmental Radioactivity, ed. Academic Press

Glenn Knoll - Radiation detection and measurement, ed. John Wiley & Sons Inc

http://nucleardata.nuclear.lu.se/toi/

http://atom.kaeri.re.kr/

Semester

Second semester

Assessment method

Oral examination - No intermediate evaluation will be organized

- Discussion on argument presented during the course
- Analysis on some radioactivity aspects
- Description of possible instrumental approaches to radioactivity measurements

Office hours

Monday - Friday by appointment