



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	<b>Rentgenske spektroskopske metode</b>
<b>Course title:</b>	<b>X-ray spectroscopic methods</b>

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA		1. ali 2.	1., 2. ali 4.
PHYSICS		1. or 2.	1., 2. or 4.

**Vrsta predmeta / Course type**

Izbirni za vse module

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje	Samost. delo Individ. work	ECTS
10	5				165	6

**Nosilec predmeta / Lecturer:**

Jana Padežnik Gomilšek

**Jeziki /**

**Languages:**

**Predavanja /**

**Lectures:**

slovenski/Slovenian

**Vaje / Tutorial:**

**Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**

poznavanje osnov atomske fizike

**Prerequisites:**

preknowledge of atomic physics

**Vsebina:**

1. Pregled rentgenskih spektroskopskih metod:  
- izviri rentgenske svetlobe  
- rentgenske difrakcijske spektroskopije  
- rentgenske absorpcijske spektroskopije  
- rentgenska fluorescenčna spektroskopija  
- spektroskopija elektronov  
  
2. Metodi EXAFS in XANES:  
- teoretične osnove

**Content (Syllabus outline):**

2. Survey of x-ray spectroscopic methods:  
- x-ray sources  
- x-ray diffraction spectroscopies  
- x-ray absorption spectroscopies  
- x-ray fluorescent spectroscopy  
- electron spectroscopy  
  
2. EXAFS and XANES:  
- theory

- priprava vzorcev  
- izvedba meritev  
- obdelava meritev  
- interpretacija rezultatov  
- tipični primeri

- sample preparation  
- measurements  
- data processing  
- interpretation of results  
- typical examples

### Temeljni literatura in viri / Readings:

- 1) B.K. Agarwal, X-ray Spectroscopy: An Introduction (Springer Series in Optical Sciences), Springer-Verlag Berlin and Heidelberg GmbH & Co. KG (1991).
- 2) D. C. Koningsberger, R. Prins, X-ray absorption spectroscopy (principles, applications, techniques of EXAFS, SEXAFS and XANES). John Wiley and Sons, New York (1988).
- 3) B. K. Theo, EXAFS: Basic Principles and Data Analysis (Springer, Berlin, 1986)
- 4) G. B. Bunker: Introduction to XAFS: A Practical Guide to X-ray Absorption Fine Structure Spectroscopy, (Cambridge University Press, 2010).
- 5) J. Als-Nielsen, D. McMorrow: Elements of Modern X-ray Analysis (John Wiley & Sons, 2001).

### Cilji in kompetence:

Študentje si zgradijo pregled nad rentgenskimi spektroskopskimi metodami v atomski fiziki, razumejo njihove fizikalne principe in možnosti uporabe.

### Objectives and competences:

Students obtain an overview of x-ray spectroscopic methods in atomic physics, they understand physical principles and range of application of the methods.

### Predvideni študijski rezultati:

Znanje in razumevanje:

Študentje poznajo prednosti in omejitve posameznih spektroskopskih metod in znajo izbrati primerno metodo ali kombinacijo metod za dani problem, pripraviti vzorce, poiskati možnosti merjenja in obdelave ter interpretirati rezultate.  
Za metodi EXAFS in XANES znajo tudi sami obdelati izmerjene spektre.

Prenosljive/ključne spretnosti in drugi atributi:

Kritičen odnos do zahtev in rezultatov posameznih merilnih metod, pripravljenost na samostojno delo, spretnost načrtovanja in izvedbe eksperimentov.

### Intended learning outcomes:

Knowledge and understanding:

Students understand advantages and limitations of particular spectroscopic methods and are able to select the appropriate one or their combination for an actual problem. They are able to prepare samples, find possibilities where and how to measure and process the data, they can interpret the results.  
Students are able to process EXAFS and XANES data by themselves.

Transferable/Key Skills and other attributes:

Critical attitude to demands and results of particular methods, preparedness for individual work, skills at planning and conducting of the experiment.

### Metode poučevanja in učenja:

### Learning and teaching methods:

Predavanja Seminarsko delo	Lectures Seminar work
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Načini ocenjevanja:		Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt)			Type (examination, oral, coursework, project):
Seminarska naloga	50 %		Seminar work
Ustni izpit	50 %		Oral exam

#### Reference nosilca / Lecturer's references:

1. CERC KOROŠEC, Romana, UMEK, Polona, GLOTER, Alexandre, PADEŽNIK GOMILŠEK, Jana, BUKOVEC, Peter. Structural properties and thermal stability of cobalt- and chromium-doped [alpha]-MnO [sub] 2 nanorods. *Beilstein journal of nanotechnology*, ISSN 2190-4286, 2017, vol. 8, str. 1032-1042, ilustr. <https://www.beilstein-journals.org/bjnano/articles/8/104>, doi: 10.3762/bjnano.8.104. [COBISS.SI-ID 1537419971]
2. KOŠAK, Aljoša, BAUMAN, Maja, PADEŽNIK GOMILŠEK, Jana, LOBNIK, Aleksandra. Lead (II) complexation with 3-mercaptopropyl-groups in the surface layer of silica nanoparticles: Sorption, kinetics and EXAFS/XANES study. *Journal of molecular liquids*, ISSN 0167-7322. [Print ed.], March 2017, vol. 229, str. 371-379. <http://www.sciencedirect.com/science/article/pii/S0167732216308078>, doi: 10.1016/j.molliq.2016.11.115. [COBISS.SI-ID 20042774]
3. HAUKO, Robert, PADEŽNIK GOMILŠEK, Jana, KODRE, Alojz, ARČON, Iztok, AQUILANTI, Giuliana. Edge profiles in K shell photoabsorption spectra of gaseous hydrides of 3p elements and homologues. *Radiation physics and chemistry*, ISSN 0969-806X. [Print ed.], Oct. 2017, vol. 139, str. 66-73, doi: 10.1016/j.radphyschem.2017.05.018. [COBISS.SI-ID 20594454]
4. HAUKO, Robert, PADEŽNIK GOMILŠEK, Jana, ARČON, Iztok, KODRE, Alojz. Absolute determination of the X-ray absorption coefficient of strontium in the K edge region. *Radiation physics and chemistry*, ISSN 0969-806X. [Print ed.], Oct. 2014, vol. 103, str. 203-208. <http://www.sciencedirect.com/science/article/pii/S0969806X14002424#>, doi: 10.1016/j.radphyschem.2014.05.059. [COBISS.SI-ID 17976854]
5. KODRE, Alojz, PADEŽNIK GOMILŠEK, Jana, HAUKO, Robert, ŠALA, Martin, ARČON, Iztok. Absolute determination of the X-ray absorption coefficient of barium in the L region using a liquid absorption cell. *X-ray spectrometry*, ISSN 0049-8246, 2013, vol. 42, iss. 2, str. 63-67. <http://onlinelibrary.wiley.com/doi/10.1002/xrs.2434/pdf>, doi: 10.1002/xrs.2434. [COBISS.SI-ID 2611451]