

MODERNI IN KOMPLEMENTARNI PRISTOPI V STRUKTURNI BIOLOGIJI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Moderni in komplementarni pristopi v strukturalni biologiji
Course title:	Modern and complementary approaches in structural biology
Članica nosilka/UL Member:	UL FKKT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Biokemija, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik, 2. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0072196
Koda učne enote na članici/UL Member course code:	BI2I08

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
40	10	25 LV			75	5

Nosilec predmeta/Lecturer: prof. dr. Janez Plavec, prof. dr. Kristina Djinović Carugo

Vrsta predmeta/Course type: izbirni strokovni/Elective Professional

Jeziki/Languages:	Predavanja/Lectures:	Angleščina, Slovenščina
	Vaje/Tutorial:	Angleščina, Slovenščina

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.
Predmet zahteva opravljene obveznosti iz predmeta Metod določanja 3D strukture makromolekul.

Prerequisites:

The course has to be assigned to the student.
Course requires knowledge of course Methods for determining 3D macromolecular structure.

Vsebina:

- Uporaba mehkih roentgenskih žarkov v makromolekularni kristalografiji
- Škoda zaradi roentgenskega žarčenja v makromolekularni kristalografiji (radiation damage)
- Časovno razločeni eksperimenti v makromolekularni kristalografiji
- NMR spektri višjih dimenzij v povezavi z avtomatsko asignacijo
- Moderni pristopi v NMR (asignacija preko heteroatomov, ang. protonless NMR)

Content (Syllabus outline):

- Use of soft X-ray in macromolecular crystallography
- X-ray induced radiation damage in macromolecular crystallography
- Time resolved experiments in macromolecular crystallography
- Higher dimensionality NMR spectra connected with automatic assignment
- Modern approaches to NMR (assignment through heteroatoms, protonless NMR)
- Dynamic properties of macromolecules (intrinsically unstructured proteins)

<ul style="list-style-type: none"> • Dinamične lastnosti makromolekul (naravno nestrukturirani proteini) • Relaksacijska disperzija • NMR v trdnem agregatnem stanju • Elektronska mikroskopija (s poudarkom na single particle reconstruction) • Nevtronska difrakcija za makromolekule • Small angle X-ray scattering (SAXS) za makromolekule v raztopini • Masna spektroskopija za strukturno biologijo <p>Karakterizacija interakcij s biofizikalnimi metodami (izotermna kalorimetrija, površinske plazmonske resonance, microscale thermophoresis)</p>	<ul style="list-style-type: none"> • Relaxation dispersion • NMR in the solid state • Electron microscopy (with emphasis on single particle reconstruction) • Neutron diffraction for macromolecules • Small angle X-ray scattering (SAXS) for macromolecules in solution • Mass spectroscopy for structural biology <p>Characterization of interactions with biophysical methods (Isothermal titration calorimetry, surface plasmon resonance, microscale thermophoresis)</p>
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Temeljna literatura in viri/Readings:

- David Blow, Outline of Crystallography for Biologists, Oxford University Press, 2002.
- Crystallography Made Crystal Clear, Gale Rhodes, Academic Press; 3 edition 2006.
- Bernhard Rupp, Biomolecular Crystallography: Principles, Practice, and Application to Structural Biology, GS, 2009
- J. Cavanagh, W. J. Fairbrother, A. G. Palmer, III, M. Rance, N. J. Skelton, Protein NMR Spectroscopy, Second Edition: Principles and Practice, Elsevier, 2007 (ca. 20% out of 900 pages)
- I. Bertini, K. S. McGreevy, G. Parigi (Eds.), NMR of Biomolecules, Wiley, 2012

Cilji in kompetence:

Predmet je zamišljen kot nadgradnja predmeta Metode določevanja 3D struktur makromolekul. Slušatelj bo seznanjen z modernimi in komplementarnimi metodami, katerih uporaba upodablja integriran, multidisciplinarni pristop k strukturni biologiji. Slušatelj bo znal oceniti primernost in potencial posamezne metode/tehnike za tvorbo in analizo določene strukturne informacije kakor tudi dinamičnih aspektov bioloških makromolekul.

Objectives and competences:

This course is designed as an upgrade of course Methods for determining 3D macromolecular structure. Students will be acquainted with modern and complementary methods, whose use enables integrated, multidisciplinary approach to structural biology. Students will be able to assess the suitability and potential of the individual methods / techniques for the formation and analysis of certain structural information as well as the dynamic aspects of biological macromolecules.

Predvideni študijski rezultati:

Znanje in razumevanje
Študent se seznani s številnimi metodami, ki dajejo strukturno informacijo o bioloških makromolekulah na različnih nivojih ločljivosti in dajejo statično oziroma dinamično podobo tridimenzionalne strukture makromolekule. Študent je seznanjen s prednostmi in omejitvami posamezne metode in predvsem z njeno komplementarnostjo k drugim strukturnim tehnikam, ki se uporabljajo pri strukturni in funkcionalni analizi makromolekul.

Uporaba
Predmet je podlaga za razumevanje molekularno in strukturno usmerjenih raziskovalnih pristopov in metod, ki jih bo študent uporabljal na različnih strokovnih področjih.

Refleksija
Študent pridobi vpogled v serijo komplementarnih strukturnih metod in razvije občutek za integriran strukturno biološki pristop in razumevanje ter razlago bioloških vprašanj.

Intended learning outcomes:

Knowledge and Comprehension
The student gets acquainted with a number of methods which provide structural information on biological macromolecules at different levels of resolution and provide a static or dynamic image of three-dimensional structure of the macromolecules. The student is familiarized with the advantages and limitations of individual method and in particular with its complementarity to other structural techniques in structural and functional analysis of macromolecules.

Application
The course is the basis for understanding molecular and structure-oriented research approaches and methods that student will use in various professional areas.

Analysis
The student gains insight into a series of complementary structural methods and develops sense of an integrated structural biological approach,

Prenosljive spretnosti Timsko delo (pri vajah). Uporaba tuje literature. Podajanje poročil o opravljenem delu in prebrani literaturi (pisмено in ustno).	understanding and interpretation of biological challenges. Skill-transference Ability Teamwork (at exercises). The use of foreign literature. Submission of written reports on lab results and literature survey (written and oral).
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Metode poučevanja in učenja: Predavanja. Laboratorijske vaje. Seminar iz literature.	Learning and teaching methods: Lectures. Laboratory work. Literature seminar.
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Načini ocenjevanja: Kolokvij iz laboratorijskih vaj Seminar naloge. Pisni in ustni izpit (ocena > 6)	Delež/Weight	Assessment: Examination of laboratory exercises Seminar Written and oral exam (mark >6)
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Reference nosilca/Lecturer's references:

- Carugo, O., and **Djinovic Carugo, K.** (2013) Half a century of Ramachandran plots. *Acta Crystallogr D Biol Crystallogr* 69, 1333-1341
- de Almeida Ribeiro, E., Jr., Beich-Frandsen, M., Konarev, P. V., Shang, W., Vecerek, B., Kontaxis, G., Hammerle, H., Peterlik, H., Svergun, D. I., Blasi, U., and **Djinović-Carugo, K.** (2012) Structural flexibility of RNA as molecular basis for Hfq chaperone function. *Nucleic Acids Res* 40, 8072-8084
- Galkin, V. E., Orlova, A., Salmazo, A., **Djinović-Carugo, K.**, and Egelman, E. H. (2010) Opening of tandem calponin homology domains regulates their affinity for F-actin. *Nat Struct Mol Biol* 17, 614-616.
- M. Marušič, R. N. Veeđu, J. Wengel, **J. Plavec**, G-rich VEGF aptamer with locked and unlocked nucleic acid modifications exhibits a unique G-quadruplex fold, *Nucleic Acids Res.* 2013, 41(29), 9524-9536.
- M. Trajkovski, M. Webba da Silva, **J. Plavec**, Unique Structural Features of Interconverting Monomeric and Dimeric G-Quadruplexes Adopted by a Sequence from the Intron of the N-myc Gene, *J. Am. Chem. Soc.* 2012, 134 (9), 4132-4141.
- I. Biljan, G. Ilc, G. Giachin, **J. Plavec**, G. Legname, Structural Rearrangements at Physiological pH: NMR insights from the V210I Human Prion Protein Mutant, *Biochemistry* 2012, 51 (38), 7465-7474.