

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Analize interakcij med molekulami s površinsko plazmonsko resonanco
Course title:	The analysis of interactions between molecules using surface plasmon resonance
Članica nosilka/UL Member:	UL BF

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Bioznanosti, tretja stopnja, doktorski (v postopku)	Ni členitve (študijski program)		Celoletni

Univerzitetna koda predmeta/University course code: 0643127

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
0	0	25	0	0	100	5

Nosilec predmeta/Lecturer: Matej Butala

Izvajalci predavanj:

Izvajalci seminarjev:

Izvajalci vaj:

Izvajalci kliničnih vaj:

Izvajalci drugih oblik:

Izvajalci praktičnega usposabljanja:

Matej Butala, Kristina Sepčič

Vrsta predmeta/Course type: individualno raziskovalni /individual research course

Jeziki/Languages:

Predavanja/Lectures:

Angleščina, Slovenščina

Vaje/Tutorial:

Angleščina, Slovenščina

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

Splošni pogoji za vpis na doktorski študij.

Prerequisites:

General requirements for the enrolment in PhD program.

Vsebina:

Metoda, ki temelji na površinski plazmonski resonanci (ang. surface plasmon resonance, SPR) je sodobna biofizikalna analitska metoda za analizo interakcij med molekulami. Z metodo lahko analiziramo ali pride do interakcije in v realnem času okarakteriziramo kinetiko interakcij npr. med proteini, proteini in membranami, proteini in nukleinskimi kislinami, proteini in malimi molekulami (večjimi od 100 Da) in celo med proteini in virusi oziroma celimi celicami.

Content (Syllabus outline):

The method based on the surface plasmon resonance (SPR) is a modern biophysical analytical method for the analysis of interactions between molecules. Using the method we can analyze in the real time whether an interaction among selected (macro)molecules occurs and characterize the kinetics of interaction e.g. between proteins, proteins and membranes, proteins and nucleic acids, proteins and small molecules (bigger than 100 Da) and even among proteins and viruses or whole cells.

<p>V okviru <i>teoretičnega</i> dela predmeta študent spozna:</p> <ol style="list-style-type: none"> 1. Osnovne dele in princip delovanja aparata za merjenje interakcij na osnovi SPR 2. Osnovne parametre SPR analize: K_a, K_d, R_{max}, KD, χ^2. 3. Nabor in kemijo SPR čipov za imobilizacijo makromolekul 4. Kako zasnovati poskus za analizo interakcij med molekulami 5. Načine imobilizacije molekule liganda na izbrani čip 6. Načine injiciranja analita preko liganda in sledenje interakciji v realnem času 7. Načine kako regenerirati površino čipa in zagotoviti ponovljivost rezultatov 8. Analiza podatkov – ugotoviti ali je prišlo do vezave med ligandom in analitom, analiza kinetike vezave. <p>Študent <i>praktično</i> izvede zasnovo, izvedbo in analizo eksperimenta interakcije med izbranimi molekulami.</p>	<p>Within the <i>theoretical</i> part of the course the student learns:</p> <ol style="list-style-type: none"> (i) Basic parts and principle of operation of the SPR apparatus (ii) Basic parameters of SPR analysis: K_a, K_d, R_{max}, KD, χ^2. (iii) Set and chemistry of SPR chips used for the immobilization of molecules (iv) How to design an experiment to analyse interactions between molecules (v) Methods of immobilizing the ligand molecule on the selected SPR chip (vi) Methods of injecting the analyte over the ligand and tracking the interactions in real-time (vii) How to regenerate the chip surface and ensure repeatability of results (viii) Data analysis - to determine whether ligand-analyte binding has occurred, analysis of binding kinetics of the interacting molecules. <p>The student practically designs and carries out the experiment and analyses the data of interaction between selected molecules.</p>
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Temeljna literatura in viri/Readings:

<p>Pregledni in izvirni članki iz področja.</p> <p>Review and original articles from the field.</p>

Cilji in kompetence:

<p>Pridobitev znanja o zmožnosti analiz interakcij med (makro)molekulami z aparatom na osnovi SPR.</p> <p>Zmožnost zasnove, izvedbe interakcij protein-protein, protein-membrana, protein-DNA, protein-RNA, protein-male učinkovine, celični lizat- protein ali virus-protein.</p> <p>Študent se nauči kritične analize izmerjenih lastnosti interakcij.</p>	<p>Objectives and competences:</p> <p>Acquisition of knowledge about the ability to analyse interactions between (macro)molecules with an apparatus based on SPR.</p> <p>Ability to conceive, perform protein-protein, protein-membrane, protein-DNA, protein-RNA, low-protein, cell lysate-protein or virus-protein interactions.</p> <p>The student learns how to critically analyse and characterize properties of the interactions.</p>
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Predvideni študijski rezultati:

<p>Študent izvede individualno raziskovalno nalogo in na primeru spozna lastnosti aparata, ki deluje na principu površinske plazmonske resonance.</p> <p>Študent spozna kako zasnovati in analizirati</p>	<p>Intended learning outcomes:</p> <p>The student performs an individual research task and »hands on« experiences the properties of the SPR apparatus. The student learns how to design and analyse the obtained measurements - the expected</p>
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<p>pridobljene meritve – predvideni študijski rezultat je uspešna analiza izbrane interakcije med molekulami. Rezultati analiz študentu omogočijo zasnovo nadaljnjih poskusov, ki bi <i>in vivo</i> potrdili izsledke SPR analiz.</p>	<p>study result is a successful analysis of the selected interaction between molecules. The results of the analyses enable the student to design further experiments that would confirm the results of SPR analyses <i>in vivo</i>.</p>
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Metode poučevanja in učenja:

<p>Konzultacije in pomoč pri zasnovi, izvedbi in analizi SPR eksperimenta izbrane interakcije med molekulami. V dogovoru z mentorjem kandidata je mogoča izvedba dela raziskav v sklopu kandidatove doktorske naloge študenta v infrastrukturnem centru za merjenje molekularnih interakcij.</p>	<p>Learning and teaching methods:</p> <p>Consultations and assistance in the design, implementation and analysis of the SPR experiment of the interaction between selected molecules. In agreement with the candidate's mentor, it is possible to carry out a part of the research work of the student's doctoral dissertation in the SPR infrastructure center for measuring the molecular interactions.</p>
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Načini ocenjevanja:

Načini ocenjevanja:	Delež/Weight	Assessment:
<p>Ocenjuje se izvedba problemsko orientiranega individualnega raziskovalnega dela, ki ga kandidat odda v pisni obliki glede na tri sklope: zasnova eksperimenta, izvedba analize in interpretacija pridobljenih meritev.</p>	<p>100,00 %</p>	<p>The implementation of problem-oriented individual research work is evaluated, which the candidate submits in writing according to three parts: the design of the experiment, the implementation of the analysis and the interpretation of the obtained measurements.</p>

Reference nosilca/Lecturer's references:

<p>Matej Butala</p> <ol style="list-style-type: none"> 1. BAHUN, Miha, JUKIČ, Marko, OBLAK, Domen, KRANJČ, Luka, BAJC, Gregor, BUTALA, Matej, BOZOVIČAR, Krištof, BRATKOVIČ, Tomaž, PODLIPNIK, Črtomir, POKLAR ULRIH, Nataša. Inhibition of the SARS-CoV-2 3CLpro main protease by plant polyphenols. <i>Food chemistry</i>, 2022, vol. 373, št. članka 131594, doi: 10.1016/j.foodchem.2021.131594. [COBISS.SI-ID 84899331]. 2. MRAVINEC, Martina, BAJC, Gregor, BUTALA, Matej. Surface plasmon resonance approach to study drug interactions with SARS-CoV-2 RNA-dependent RNA polymerase highlights treatment potential of suramin. <i>Journal of virological methods</i>, 2021, vol. 298, št. članka 114283, , doi: 10.1016/j.jviromet.2021.114283. [COBISS.SI-ID 76436739]. 3. KOČAR, Eva, LENARČIČ, Tea, HODNIK, Vesna, PANEVSKA, Anastasija, HUANG, Yunjie, BAJC, Gregor, KOSTANJŠEK, Rok, NAREN, Anjaparavanda P., MAČEK, Peter, ANDERLUH, Gregor, SEPČIČ, Kristina, PODOBNIK, Marjetka, BUTALA, Matej. Crystal structure of RahU, an aegerolysin protein from the human pathogen <i>Pseudomonas aeruginosa</i>, and its interaction with membrane ceramide phosphorylethanolamine. <i>Scientific reports</i>, 2021, vol. 11, article no. 6572, doi: 10.1038/s41598-021-85956-2. [COBISS.SI-ID 56737283]. 4. MOLAN, Katja, PODLESEK, Zdravko, HODNIK, Vesna, BUTALA, Matej, OSWALD, Eric, ŽGUR-BERTOK, Darja. The <i>Escherichia coli</i> colibactin resistance protein ClbS is a novel DNA binding protein that protects DNA from nucleolytic degradation. <i>DNA Repair</i>, 2019, vol. 79, str. 50-54. doi: 10.1016/j.dnarep.2019.05.003. [COBISS.SI-ID 5079119]. 5. CAVENEY, Nathanael A., PAVLIN, Anja, CABALLERO, Guillermo, BAHUN, Miha, HODNIK, Vesna, CASTRO, Liza de, FORNELOS, Nadine, BUTALA, Matej, STRYNADKA, Natalie C.J. Structural insights into bacteriophage GIL01 gp7 inhibition of host LexA repressor. <i>Structure</i>, 2019, vol. 27, str. 1094-1102.e4, doi: 10.1016/j.str.2019.03.019. [COBISS.SI-ID 5060431].
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6. FORNELOS, Nadine, BROWNING, Douglas F., PAVLIN, Anja, PODLESEK, Zdravko, HODNIK, Vesna, SALAS, Margarita, BUTALA, Matej. Lytic gene expression in the temperate bacteriophage GIL01 is activated by a phage-encoded LexA homologue. *Nucleic acids research*, 2018, vol. 12, str. 9432-9443, doi: [10.1093/nar/gky646](https://doi.org/10.1093/nar/gky646). [COBISS.SI-ID [4764239](https://www.cobiss.si/id/4764239)].

Kristina Sepčić

1. KOČAR, Eva, LENARČIČ, Tea, HODNIK, Vesna, PANEVSKA, Anastasija, HUANG, Yunjie, BAJC, Gregor, KOSTANJŠEK, Rok, NAREN, Anjaparavanda P., MAČEK, Peter, ANDERLUH, Gregor, SEPČIĆ, Kristina, PODOBNIK, Marjetka, BUTALA, Matej. Crystal structure of RahU, an aegerolysin protein from the human pathogen *Pseudomonas aeruginosa*, and its interaction with membrane ceramide phosphorylethanolamine. *Scientific reports*, ISSN 2045-2322, 2021, vol. 11, article no. 6572, str. 1-12, <https://www.nature.com/articles/s41598-021-85956-2.pdf>, <https://www.nature.com/articles/s41598-021-85956-2>, doi: [10.1038/s41598-021-85956-2](https://doi.org/10.1038/s41598-021-85956-2). [COBISS.SI-ID [56737283](https://www.cobiss.si/id/56737283)].
2. MILIJAŠ JOTIĆ, Matej, PANEVSKA, Anastasija, IACOVACHE, Ioan, KOSTANJŠEK, Rok, MRVINEC, Martina, SKOČAJ, Matej, ZUBER, Benoît, PAVŠIČ, Ana, RAZINGER, Jaka, MODIC, Špela, TRENTI, Francesco, GUELLA, Graziano, SEPČIĆ, Kristina. Dissecting out the molecular mechanism of insecticidal activity of ostreolysin A6/pleurotolysin B complexes on western corn rootworm. *Toxins : Elektronski vir*, ISSN 2072-6651, 2021, vol. 13, no. 7, str. 1-16. <https://www.mdpi.com/2072-6651/13/7/455>, doi: [10.3390/toxins13070455](https://doi.org/10.3390/toxins13070455). [COBISS.SI-ID [68691203](https://www.cobiss.si/id/68691203)].
3. NOVAK, Maruša, KR PAN, Teja, PANEVSKA, Anastasija, SHEWELL, Lucy K., DAY, Christopher J., JENNINGS, Michael P., GUELLA, Graziano, SEPČIĆ, Kristina. Binding specificity of ostreolysin A6 towards Sf9 insect cell lipids. *Biochimica et biophysica acta, Biomembranes*, ISSN 0005-2736. [Print ed.], 1 Sep. 2020, vol. 1862, iss. 9, str. 1-10, doi: [10.1016/j.bbmem.2020.183307](https://doi.org/10.1016/j.bbmem.2020.183307). [COBISS.SI-ID [13431555](https://www.cobiss.si/id/13431555)].
4. NOVAK, Maruša, ČEPIN, Urška, HODNIK, Vesna, NARAT, Mojca, JAMNIK, Maja, KRAŠEVEC, Nada, SEPČIĆ, Kristina, ANDERLUH, Gregor. Functional studies of aegerolysin and MACPF-like proteins in *Aspergillus niger*. *Molecular microbiology*, ISSN 0950-382X, Oct. 2019, vol. 112, iss. 4, str. 1253-1269. <https://onlinelibrary.wiley.com/doi/full/10.1111/mmi.14360>, doi: [10.1111/mmi.14360](https://doi.org/10.1111/mmi.14360). [COBISS.SI-ID [4280456](https://www.cobiss.si/id/4280456)].ž
5. PANEVSKA, Anastasija, HODNIK, Vesna, SKOČAJ, Matej, NOVAK, Maruša, MODIC, Špela, PAVLIC, Ivana, PODRŽAJ, Sara, ZARIĆ, Miki, RESNIK, Nataša, MAČEK, Peter, VERANIČ, Peter, RAZINGER, Jaka, SEPČIĆ, Kristina. Pore-forming protein complexes from *Pleurotus* mushrooms kill western corn rootworm and Colorado potato beetle through targeting membrane ceramide phosphoethanolamine. *Scientific reports*, ISSN 2045-2322, 2019, vol. 9, str. 1-14. <https://doi.org/10.1038/s41598-019-41450-4>, doi: [10.1038/s41598-019-41450-4](https://doi.org/10.1038/s41598-019-41450-4). [COBISS.SI-ID [5013839](https://www.cobiss.si/id/5013839)].
6. VEZOČNIK, Valerija, HODNIK, Vesna, SITAR, Simona, OKUR, Halil I., TUŠEK-ŽNIDARIČ, Magda, LÜTGEBAUCKS, Cornelis, SEPČIĆ, Kristina, KOGEJ, Ksenija, ROKE, Sylvie, ŽAGAR, Ema, MAČEK, Peter. Kinetically stable triglyceride-based nanodroplets and their interactions with lipid-specific proteins. *Langmuir*, ISSN 0743-7463, 2018, vol. 34, no. 30, str. 8983-8993, doi: [10.1021/acs.langmuir.8b02180](https://doi.org/10.1021/acs.langmuir.8b02180). [COBISS.SI-ID [4754255](https://www.cobiss.si/id/4754255)].