Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Zlom simetrije**
Course title:	**Symmetry breaking**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA, 3. stopnja		**1. ali 2.**	**1., 2. ali 4.**
PHYSICS, 3rd cycle		**1. or 2.**	**1., 2. or 4.**

Vrsta predmeta / Course type	Izbirni za vse module/ Optional for all modules
Univerzitetna koda predmeta / University course code:	

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15					165	6

Nosilec predmeta / Lecturer:	**Samo Kralj**

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovenian
	Vaje / Tutorial:	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Pogojev ni. Priporočljiva znanja so: predznanje iz klasične in moderne fizike in iz matematične fizike.	None. Recommended is preknowledge of classical physics, modern physics, and mathematical methods in physics.

Vsebina:	**Content (Syllabus outline):**

1) Landau-ova teorija faznih prehodov 2) Značilne razdalje in časovne skale 3) Zlom zvezne simetrije in topološki defekti 4) Statika in dinamiko topoloških defektov 5) Opis narave s polji 6) Interakcija med nanodelci, koloidi in topološkimi defekti; samoorganizacija 7) Topološki defekti v bioloških membranah Topološki defekti kot občutljivi detektorji	1) Landau theory of phase transitions 2) Characteristic lengh and time scales 3) Symmetry breaking and topological defects 4) Statics and dynamics of topological defects 5) Field presentation of nature. 6) Interaction between nanoparticles, colloids, topological defects; selforganisation 7) Toplogical defects in biological membranes Topologica defects as sensitive detectors

Temeljni literatura in viri / Readings:

1. Kléman, M., & Lavrentovich, O. D. (2003). Soft matter physics: an introduction. New York [etc.]: Springer. [COBISS.SI-ID 1580644] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/1580644
2. Chaikin, P. M., & Lubensky, T. C. (2003). Principles of condensed matter physics. Cambridge: Cambridge University Press. [COBISS.SI-ID 2956058] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/2956058
3. Taylor, J. C. (2001). Hidden unity in nature's laws [e-knjiga]. Cambridge: Cambridge University Press. ISBN 0-521-65064-X. Dostopno v EBSCOhost Ebook Academic Collection – World Wide
4. Mesarec, L., Iglič, A., Kralj, S. (2022). Spatial manipulation of topological defects in nematic shells. *The European Physical Journal E: Soft Matter*, 45(7), 62, 1–7. [COBISS.SI-ID 117006851]

Dodatna literatura / Additional readings:

1. Riley, K. F., Hobson, M. P., & Bence, S. J. (2019). Mathematical methods for physics and engineering (3rd ed., 18th printing). Cambridge [etc.]: Cambridge University Press. [COBISS.SI-ID 19736835]
2. Hobson, A. (2013). There are no particles, there are only fields. American journal of physics, 81(3), 211-223. Hobson, A. (2013). There are no particles, there are only fields. American Journal of Physics, 81(3), 211–223. DOI: 10.1119/1.4789885

Cilji in kompetence:	**Objectives and competences:**

Študenti poglobijo znanje s področja zloma simetrije. Spoznajo možnost modeliranja narave s »polji«, kjer »osnovni delci« nastopajo kot topološko stabilizirana lokalizirana stanja polj.	Students acquire advanced knowledge on symmetry breaking. A “field” perspective of nature is presented, where “fields” represent fundamental entity of nature. In this respect “fundamental particles” are emergent.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poglobljeno razumevanje ključnih procesov v naravi, ki so povezani z zlomom simetrije. Spoznanjo uporabnost zloma simetrije za številne aplikacije v nanotehnologiji. Prenesljive/ključne spretnosti in drugi atributi: Rešitev problemov z matematičnimi orodji, numeričnimi metodami, univerzalnosti v fiziki in celosten pristop k reševanju problemov.	Knowledge and understanding: Understanding of key processes in nature based on symmetry breaking. Usefulness of symmetry breaking in emergent nanotechnology is understood. Transferable/Key Skills and other attributes: Solving of problems with mathematical tools, numerical methods, universalities in physics and gained global approach on solving problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in reševanje zastavljenih problemov.	Lectures and solving of defined problems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
~~Seminar.~~	**50 %**	~~Seminar.~~
~~Ustni izpit.~~	**50 %**	~~Oral exam.~~
Seminarska naloga		Seminar paper
Ustni izpit		Oral exam

Reference nosilca / Lecturer's references:

- NATH, Nibedita, CHAKROBORTY, Subhendu, PAL, Kaushik, BARIK, Arundhati, MISHRA, Nilima Priyadarsini, KRALJ, Samo. Recent advances in plasmonic enhanced nanocatalyst for oxidation of alcohol. Topics in catalysis. 2023, 11 str., ilustr. ISSN 1022-5528. DOI: 10.1007/s11244-023-01839-y. [COBISS.SI-ID 163018499]
- MESAREC, Luka, IGLIČ, Aleš, KRALJ, Samo. Spatial manipulation of topological defects in nematic shells. The European physical journal. E, Soft matter. Jul. 2022, iss. 7, art. no. 62, 1-7 str., ilustr. ISSN 1292-8941. https://link.springer.com/article/10.1140/epje/s10189-022-00216-z, DOI: 10.1140/epje/s10189-022-00216-z. [COBISS.SI-ID 117006851]
- POLANŠEK, Juš, HÖLBL, Arbresha, STARZONEK, Szymon, DROZD-RZOSKA, Aleksandra, RZOSKA, Sylwester, KRALJ, Samo. History-dependent phase transition character. The European physical journal. E, Soft matter. Sep. 2022, vol. 45, iss. 9, 1-14 str. ISSN 1292-8941. DOI: 10.1140/epje/s10189-022-00221-2. [COBISS.SI-ID 120603395]