Univerza v Mariboru
University of Maribor

Fakulteta za naravoslovje in matematiko / Faculty of Natural Sciences and Mathematics

OPIS PREDMETA / SUBJECT SPECIFICATION	
Predmet:	Uvod v kvantno teorijo polja in fiziko delcev
Subject Title:	Introduction to quantum theory and particle physics

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
FIZIKA PHYSICS		1 ali 2	1 ali 2

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. Vaje Lab. Work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	**20**				**250**	**10**

Nosilec predmeta / Lecturer: Mirjam Cvetič

Jeziki / Languages:
Predavanja / Lecture: slovenski/Slovenian in/and angleški s slovenskim prevodom/English with translation in Slovenian
Vaje / Tutorial:

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

Ni posebnih zahtev.

Prerequisites:

No special prerequisites.

Vsebina:

- Klein-Gordonova enačba, simetrije pripadajočega Lagrangiana in druga kvantizacija delcev spina-O.
- Diracova enačba, njene simetrije in druga kvantizacija delcev s spinom ½.
- Maxwellova enačba, umeritvena simetrija, druga kvantizacija delcev s spinom 1.
- Tipi interakcij: skalarna, Yukaw-ina, umeritveno invariantne interakcije.
- Uvod v perturbativne izračune v kvantni teoriji polja, demonstrirano na delcih s spinom 0:
  a) Izpeljava tri-nivojskega Feynmanovega diagrama za S-matriko,
  b) reakcijski presek in izračun razpadov.
- Perturbativni pristopi v kvantni elektrodinamiki:
  a) izpeljava Feynmanovih pravil s fermioni in polji spinov 1,
  b) izračuni za tipične primere sipalnih procesov in razpadov.
- Vpeljava radiativnih popravkov in renormalizacija:
  a) vertex popravek,
  b) vakuumska polarizacija.
- Aplikacije v sipalnih procesih v pospeševalnikih in sistemih fizike kondenzirane materije.

Contents (Syllabus outline):

- Klein-Gordon equation, symmetries of the Lagrangian and second quantization of the spin-O particles.
- Dirac equation, its symmetries and second quantization of spin ½ particles.
- Maxwellova equation, gauge symmetry, second quantization of spin 1 particles.
- Types of interaction: scalar, Yukawa, gauge invariant interactions.
- Interaction to the perturbative calculations in quantum field theory, demonstrated for spin 0 particles:
  a) Derivation of the three-level Feynman diagram for S-matrix,
  b) reakcijski presek in izračun razpadov.
- Perturbative approaches in quantum electrodynamics:
  a) derivation of Feynman rules for fermions and fields for spin 1,
  b) calculations for typical examples of scattering processes and decays.
- Introduction of radiative corrections and renormalization:
  a) vertex correction,,
  b) vacuum polariztion.
- Applictions in scattering processes in accelerators and condensed matter systems.

Temeljni študijski viri / Textbooks:

M. Peskin, D. V. Schroeder, Introduction to Quantum Field Theory, Westview Press 1995.
Pomembne dodatne reference:
C. Itzykson and J.B. Zuber, Quantum Field Theory, McGraw Hill College 1980.
I. Aitchison and A. Hey, Gauge Theories in Particle Physics 3rd ed., Institute of Physics Publishing 2004.
C. Quigg, Gauge Theories of Strong, Weak and Electromagnetic Interactions, Westview Press 1997.

Cilji:

Objectives:

• Razumeti principe, metode in rezultate kvantne teorije polja • Znati uporabljati metode • Pridobiti si sposobnost nadaljnjega samostojnega študija fizike visokih energij	• Understanding of principles, methods and results of the quantum field theory • Gaining skills to use the methods • Gaining the ability of individual independent frther study of the high energy physics
Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Znanje principov, metod in rezultatov kvantne teorije polja • Razumevanje rezultatov in njihove uporabe Prenesljive/ključne spretnosti in drugi atributi: • Sposobnost samostojnega dela in študija • Uporaba znanj na drugih področjih	Knowledge and Understanding: • Understanding of principles, methods and results of the quantum field theory • Understanding of the results and their applications Transferable/Key Skills and other attributes: • Ability to perform individual work and study • Ability to apply the knowledge in otehr fields
Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar	Lectures, seminar

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
• Ustni izpit • Projektne naloge	50 50	• Oral exam • Projects