GUIDE OF THE COURSE

RADIATIVE PROCESSES IN ATOMS AND NUCLEI

(updated: 03/06/2019)
Academic year: 2019-20

MODULE	TOPIC	SUBJECT	COURSE	SEMESTER	ECTS	CHARACTER
Radiation Physics and technology	Radiation physics: new developments and applications	Radiative processes in atoms and nuclei	1	1	6	Optional/Compulsory

LECTURERS	CONTACT
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	TUTORING SCHEDULE
	Amaro: M,W,F, 12:00--14:00 Buendia: M,T,W, 10--11 and 12--13 Gálvez: M,T, 9--12
MASTER	
Master in physics: radiation, nanotechnology, particles and astrophysics	

REQUISITES AND/OR RECOMMENDATIONS

BRIEF DESCRIPTION OF CONTENTS

Atomic and molecular structure
Interaction processes with electromagnetic fields.
Gamma and beta decay.

OBJETIVES

The student will know/understand:

The theories on the atomic and nuclear structure beyond the independent particle picture. The quantum theory of electromagnetic field interaction with atoms and nuclei. The Fermi theory of weak interaction.

***The student will be able to*:**

To determine the multipoles contributing to the atomic and nuclear transitions. To evaluate the Fermi and Gamow-Teller transitions in beta decay.

CONTENTS OF THE COURSE

- **1. Atomic structure:** Independent particle models. Making states with angular momentum. Hartree-Fock equations. Optimized effective potential. Multiconfiguration approximation. Dynamic correlations. Electromagnetic field interaction with atoms. Transition probabilities between atomic states. Photoionization.
- **2. Nuclear structure:** State vectors in independent particle models. LS- and jj-couplings and isospin quantum numbers. Models based on generating functions and angular momentum projection. Dynamic correlations. Monte Carlo calculation of expectation values.
- **3. Nuclear radiation:** Quantum theory of the interaction of charged and magnetic particles with the radiation. Gamma radiation. Electromagnetic multipoles. Beta radiation. Fermi theory of weak interaction. Fermi and Gamow-Teller transitions. Neutrinos.
- **4. Some applications:** Electromagnetic transitions: calculation of transition probabilities between bound states in atoms and nuclei. Cross sections for one-electron and one-nucleon knock-out. Alpha decay: calculation of meanlifes as a function of the energy and nuclear effects.

REFERENCES

P. J. Brussaard y P.W.M. Glaudemans, Sell model applications in nuclear spectroscopy, Norh Holland, 1977
E.U. Condon y H. Odabasi, Atomic Stucture, Cambidge Univ. Press, 1980
K.N. Mukhin, Experimental Nuclear Physics, Mir 1987
Emilio Segré, Núcleos y partículas, Reverté 1972
J.M. Eisenberg, W. Greiner, Nuclear Theory 2 Excitation Mechanisms of the Nucleus, North-Holland 1970
R.J. Blin-Stoyle. Fundamental interactions and the nucleus, North-Holland/American Elsevier, 1973
K. Grotz, H.V. Klapdor, The weak interaction in nuclear, particle and astrophysics, Adam Hilger 1990
F. Mandl, G. Shaw, Quantum Field Theory, John Wiley & Sons, 1984
K. Langanke, J.A. Maruhn, S.E. Kooning, Computational Nuclear Physics. (Springer-Verlag, 1991).
J.D. Walecka, Theoretical nuclear and subnuclear physics. (Oxford University Press, 1995)

USEFUL LINKS

http://www.arxiv.org/
http://www.aip.org/

METHODOLOGY

Lectures: To transmit the contents of the subject, motivating the students to reflection, facilitating the discovery of relationships between different concepts and promoting a critical mindset.

Seminars: To develop in the students the cognitive and procedural skills of the subject.

Academic tutoring: To guide the autonomous and team work of students, focusing on different aspects of the subjects and guide the comprehensive academic training of the student.

Study and independent work of students: To foster in the student the ability to self-regulate their learning, by planning, designing, evaluating and adapting it to their particular conditions and interests. **Teamwork**: To encourage students in the generation and exchange of ideas, identification and analysis of different views on a topic, generalization or transfer of knowledge and critical assessment of it.
EVALUATION SYSTEM
1. Final exams: Evaluation of the results of a work proposed by the teacher (50%) 2. Problems and exercices. Written and oral presentation of the solution of the physical problems proposed by the teacher
ADITIONAL INFORMATION