HADRONIC PHYSICS (6 ECTS)

The subject will be taught in 20 lectures and tutorships of 1:30 hours. The tutorial sessions will be devoted to discussing questions about the contents of the course, proposed exercises, etc.

Lectures and Teachers:

Assumpta Parreño

P1. Leptons and quarks. Hadrons: baryons and mesons. Elementary interactions. Introduction to gauge theories: symmetries and conservation laws. Hadronic spectroscopy.

P2. QCD Lagrangian. Non-perturbative methods.

P3. Effective theories (I).

P4. Effective theories (II).

P5. Lattice QCD.

P6. Tutorship A. Parreño

Volodymyr Magas

M1. Klein-Gordon and Dirac equations.

M2. Relativistic collisions and Feynman diagrams.

M3. Quantum electrodynamics of particles with spin 0, examples.

M4. Quantum electrodynamics of particles with spin 1/2, examples.

M5. Tutorship V. Magas

M6. Inelastic dispersion of electrons. Partons. Quark-gluon plasma.

Laura Tolós

T1. Phenomenology of the NN interaction. One-meson exchange model.

T2. Bethe-Goldstone equation: interaction in the nuclear medium.

T3. Hadrons in nuclear matter.

T4. Tutorship L. Tolós

T5. Kaon physics

Additional Seminars: Juan Miguel Torres Rincón, Vincent Mathieu

S1. QCD Phase Diagram (J. Torres)

S2. 'Exotic Hadrons and the new challenges in hadron spectroscopy' (V. Mathieu)

S3. Relativistic Heavy-Ion Collisions (J. Torres)

Timetable

	Monday, 08-04 (online)	**Tuesday, 09-04 (online)**	**Wednesday, 10-04 (online)**	**Thursday, 11-04 (online)**	**Friday, 12-04 (online)**
9:30 – 11:00	P1. A. Parreño	P2. A. Parreño	P3. A. Parreño	T2. L. Tolós	T3. L. Tolós
11:30 – 13:00	M1. V. Magas	T1. L. Tolós	M2. V. Magas	M3. V. Magas	M4. V. Magas
	Monday, 15-04 (in person)	**Tuesday, 16-04 (in person)**	**Wednesday, 17-04 (in person)**	**Thursday, 18-04 (in person)**	**Friday, 19-04 (in person)**
9:30 – 11:00		P5. A. Parreño	***Visit to ALBA synchrotron***		S3. J. Torres
11:30 – 13:00		M5. V. Magas			M6. V. Magas
15:00-16:30	P4. A. Parreño		P6. A. Parreño	S1. J. Torres	
17:00-18:30	T4. L. Tolós		T5. L. Tolós	S2. V. Mathieu	

Evaluation: the evaluation will be based on the solution of a few proposed exercises, which should be handed in by the student before a certain date (about 1 month after the finalization of the course).

Basic Bibliography:

1) “Quantum Field Theory”, F. Mandl y G. Shaw, Wiley and Sons Ltd, 1984.

2) “Models of the nucleon: from quarks to solitons”, R.K. Bhaduri, Addison-Wesley, 1988.

3) “Quarks and Leptons: an introductory course in modern particle physics”, F. Halzen and A.D. Martin, Wiley and Sons Ltd., 1984.

4) “Pions and Nuclei”, T.E.O. Ericson, W. Weise. Oxford-Clarendon Press, 1988.

5) “Electroweak and Strong Interactions”, F. Scheck, Springer-Verlag, 3rd edition.

6) “Theoretical Nuclear and Subnuclear Physics”, J.D. Walecka. Oxford University Press, 1995.

7) “Gauge theories in Particle Physic”, I.J.R.Aitchison and A.J.G.Hey

8) “Introduction to the Quark Model of Elementary Particle”, D. Flamm and F. Schöberl. Gordon and Breach, Science Publishers Inc. 1982.

9) “Quantum Theory of Many Particle Systems”, A.L. Fetter y J.D. Walecka, Dover, 2003.

10) “A Guide to Feynman Diagrams in the Many Body Problem”, R.D. Mattuck (Dover, New York, 1992), Second Edition.

11) “The Meson theory of nuclear forces and nuclear structure”, R. Machleidt, Adv. Nucl. Phys. 19 (1989) 189-376.

12) “Production, structure and decay of hypernuclei”, H. Bando, T. Motoba, J. Zofka, Int. J. Mod. Phys. A5 (1990) 4021-4198.

13) “In-medium nuclear interactions of low-energy hadrons”, E. Friedman, A. Gal, Phys. Rept. 452 (2007) 89-153.

14) "Chiral Effective Field Theory and Nuclear Forces", R. Machleidt and D.R. Entem, Phys. Rept. 503, 1-75 (2011); arXiv:1105.2919

15) "Lattice QCD for novices", G. Peter Lepage, Proceedings of HUGS 98, edited by J.L. Goity, World Scientific (2000); arXiv:hep-lat/0506036

16) "Introduction to Lattice QCD", Rajan Gupta, arXiv:hep-lat/9807028