HADRONIC PHYSICS (6 ECTS)

The subject will be taught in 23 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. QCD Lagrangian. Non-perturbative methods.

P2. Effective theories (I).

P3. Effective theories (II).

P4. Lattice QCD.

P5. 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

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

Sergi Gonzalez-Solis de la Fuente

G1. Introduction to the Standard Model (I): fundamental particles and their interactions

G2. Introduction to the Standard Model (II): the quark model (mesons and baryons)

G3. Tutorship S. Gonzalez-Solis

Juan Torres

J1. Deep inelastic scattering. Parton model.

J2. Quark-gluon plasma. QCD Phase Diagram.

J3. Tutorship J. Torres

Vincent Mathieu

V1. Tools for Hadronic Physics: Theoretical review

V2. Tools for Hadronic Physics: Numerical application I

V3. Tools for Hadronic Physics: Numerical application II

Timetable

	Monday, 17-03 (online)	Tuesday, 18-03 (online)	Wednesday, 19-03 (online)	Thursday, 20-03 (online)	Friday, 21-03 (online)
9:30 – 11:00	G1. S. Gonzalez	G2. S. Gonzalez	G3. S. Gonzalez	T1. L. Tolós	T2. L. Tolós
11:30 – 13:00	M1. V. Magas	M2. V. Magas	M3. V. Magas	M4. V. Magas	T3. L. Tolós

	Monday, 24-03 (in person)	Tuesday, 25-03 (in person)	Wednesday, 26-03 (in person)	Thursday, 27-03 (in person)	Friday, 28-04 (in person)
9:30 – 11:00	P1. A. Parreño	P2. A. Parreño	*Visit to ALBA synchrotron*	P4. A. Parreño	J3. J. Torres
11:30 – 13:00	M5. V. Magas	J1. J. Torres		J2. J. Torres	V2. V. Mathieu
15:00-16:30	V1. V. Mathieu	P3. A. Parreño	T4. L. Tolós	P5. A. Parreño	V3. V. Mathieu

Evaluation: the evaluation will be based on a series of exercises to be carried out during the course and a final exam.

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