TEACHING GUIDE ON

Cosmology and Galaxies

MASTER MODULE	SEMESTER	CREDITS	COURSE TYPE
Particle Physics and Astrophysics	1	6	Optative

PROFESSOR(S)	CONTACT DETAILS
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	TUTORIALS TIMETABLE
	Mar Bastero Gil: http://www.ugr.es/~fteorica/Docencia/2017-2018/Tutorias.php **Emilio J. Alfaro:** Monday: 10:00-12:00, 15:00-16:00 Tuesday: 10:00-12:00, 15:00-16:00

MASTER DEGREE

University Master in Physics: Radiations, Nanotechnology, Particles and Astrophysics, University of Granada

TEACHING DATES AND TIMES

First semester:
Monday, Tuesday and Wednesday, 19:00-20:00

PRE-REQUISITES FOR REGISTRATION

BRIEF CONTENTS DESCRIPTION

Modern Astrophysics and Cosmology are based nowadays on precise observational data and numerical simulation of physical models against which to test theoretical predictions. We aim to give in this course a modern vision of Astrophysics and Cosmology, starting with the origin of the universe, inflation, primordial nucleosynthesis, large scale structure and star formation, the seeds for the future galaxies. For the galaxies, we will also study the role played by the stars in the chemical evolution of the interstellar medium, focusing on the formation of our own galaxy, the Milky Way, and the universe as a whole.

PROGRAM

1- The expanding universe:
Space-time geometry. Cosmological redshift. Hubble diagram and distances.

2- Friedmann-Robertson-Walker model and dynamics of the expanding universe:
Einstein equations. Cosmological principle and Friedmann equations. Expansion: matter, radiation and cosmological constant dominated universes.

3- Thermal history:
Entropy and equilibrium distributions. Neutrino decoupling. Primordial nucleosynthesis. Matter-antimatter asymmetry. Dark matter and Dark energy.

4. Cosmic microwave background radiation:
Recombination and last scattering. Sach-Wolfe effect. Temperature anisotropy power spectrum and polarization. Observations: COBE, WMAP and PLANCK.

5. Inflation:
Problems of the standard cosmological model. Dynamics of a scalar field in an expanding universe. Primordial spectrum: scalar and tensor components. Reheating of the universe.

6. Large scale structure:
Cosmological gauge invariant linear perturbation theory. Evolution of density perturbations. Cold/hot dark matter. Observations.

7. Galaxies:
Fundamental subsystems. Morphological classification.

8. Galaxies:
Interstellar medium and stellar populations. Main physical variables of the problem.

9. The Milky Way:
Spatial structure and kinematics. On-line numerical models.

10. The Milky Way:
Historical review of the models. Main observational constraints. Present status and model.

11. Galaxy formation:
Cold dark matter. Global scheme. Status of the problem.

BIBLIOGRAPHY

- ”Modern Cosmology’”. S. Dodelson. Academic Press (2003).
- ”The Early Universe”. E.W. Kolb, M.S. Turner. Addison-Wesley (1990).
- ”Physical Foundations of Cosmology”. V. Mukhanov. Cambridge (2005).
- “Cosmological Inflation and Large Scale Structure”, A. Liddle y D. Lyth, Cambridge University Press (2000).
- “Cosmology and astrophysics through problems”, T. Padmanabhan, Cambridge University Press, (1993).
- “The cosmic microwave background”, R. Durrer, Cambridge University Press (2008).
- "Galactic Astronomy", James Binney & Michael Merryfield, Princenton University Press (1998).
- "Galactic Dynamics" Second Edition, James Binney & Scott Tremaine, Princeton University Press (2008).
- "Galactic Astronomy", Dimitri Mihalas, W. Freeman (1968).
- "The Formation of the Milky Way" Emilio J. Alfaro & Antonio J. Delgado, Cambridge University Press (2011).