I. The physics of galaxies

Lecture 1: Introduction: The world of galaxies (1.5h) R
- MW as a galaxy. Orders of magnitude. Classification. Global properties in the Local Universe
- Census of components in the MW and other galaxies. Stellar populations. BH and AGN.
- The Spectral Energy Distribution of galaxies (basic ideas)
- Dark Mater at galaxy scales.
- Large Scale Structure (basics): from the local universe to LSS. Clusters of galaxies.
- Large surveys and galaxy formation history (basics)

Lecture 2: Evolution of galaxies: Basic equations, analytic and numerical models, chemical evolution (2.5h) R
- Basic Concepts
- Equations, hypothesis and the basics of galaxy (chemical) evolution
- Determination of the IMF
- Analytic approximations for the evolution of galaxies (chemical aspects)
- Building numerical models
- Chemical evolution in the Solar neighborhood
- Chemical evolution of galaxies
- Analytic approximation to the (spectro)photometric evolution of galaxies (and limitations!)

II. Galaxy spectral energy distribution

Lecture 3: How to interpret the observed light received from galaxies ? (3h) O
- Light from stars (single and composite stellar population)
- Emission and absorption lines (links to parameters)
- Dust (loi d'atténuation, Dale, Calzetti, macrospocic views, links with observations
- Deriving statistical functions

Lecture 4 : Inventory of the interstellar medium (2h) P
- the different phases of the interstellar medium

- simple models of the interstellar medium

Lecture 5 : Physics of the interstellar medium (4h) P
- the energy budget, heating and cooling
- nebular emission lines and absorption lines
- dust absorption, scattering and emission

III. Feedback mechanisms

Lecture 6 : Feedbacks at small scales (2h) P
- interstellar medium evolution with super novae and stellar feedback

Lecture 7: Feedback at large scale(2h) O
- Stellar feedback (winds and outflows from supernova)
- AGN feedback (from the accretion disk around supermassive black holes)

IV. Galaxy evolution

Lecture 8: Disk galaxies and their secular evolution (3h) O
- Formation of a stellar disk
- Galaxy Kinematic: observations
- Galaxy Kinematic: some applications
- Dynamical evolution

Lecture 9: Elliptical galaxies and quenching: a violent history (2h) O
- Galaxy properties (morphology, kinematic, scaling relations, supermassive black hole)

- Formation scenario and mergers

V. High-redshift galaxies

Lecture 10: Formation of the first galaxies and Reionization (2h) R
- Present constrains on the Re-ionization epoch & galaxy formation scenarios. Sources of the reionization.
- Theoretical considerations: Hierarchical formation and abundance of CDM halos. Mass profiles. Press-Schechter formalism. Characteristic properties of collapsing halos. Galaxy formation models. Halo mass function. First stars and first galaxies. Reionization process.
- Observational approaches : Identification and characterization of primeval galaxies. Observational signatures & properties. Observational Techniques.
- Present results … and open issues. Discussion. Perspectives

Lecture 11 : the interstellar medium of the first galaxies (2h) P
- evolution of the interstellar medium after reionization
- physics of the interstellar medium before reionization

Lecture 12: Galaxy Assembly and Evolution in DM structures, clustering (2h) R
- The Large Scale Structure (LSS) traced by galaxies. Large samples of galaxies from cosmological surveys.
- Cosmological simulations of Galaxy Formation
- Large Scale Structure and clustering properties: Mapping the density field. 2P correlation function (3D & projected CF). Redshift-space distortions. Galaxy bias. 2PCF in the local universe. 2PCD in the distant universe & redshift evolution. Connecting Galaxies to DM halos (Halo model interpretation, HOD + results)