

**Università di Roma Tor Vergata**  
**Program of the course Extragalactic Astrophysics 1**  
**Laurea Magistrale in Fisica - AstroMundus semester S2**  
**academic year 2012-2013 - Prof. Fausto Vagnetti**

- 1** The Milky way and the external galaxies, main data, classifications, catalogs, surface photometry, luminosity function. Distances and velocities, kinematical methods, spectroscopic parallaxes; thick disk, RR Lyrae variables, star clusters; infrared observations, galactic center, differential rotation, Oort constants, rotation curves, dark matter; gravitational microlensing, search for MACHOs. Virial theorem with external force; strong and weak collisions, two-body relaxation, evaporation of open clusters.
- 2** Local Group, Magellanic Clouds, cepheids and cosmic distance ladder, dwarf spheroidal galaxies, spiral galaxies M31 and M33. Formation of the Local Group, chemical evolution. Dwarf ellipticals and dwarf irregulars, future of the Local Group, intra-group medium
- 3** Disk galaxies, surface brightness, exponential profile. Observations of the gas, rotation curves, Tully-Fisher relation; sequence of disk galaxies, spiral structure, bulge, starburst, nuclear cluster, central black hole; environment of the disk galaxies. Elliptical galaxies, photometry, shape of the isophotes, stellar velocities, Faber-Jackson relation, fundamental plane; tensor Virial Theorem, rotation in the elliptical galaxies; spectrum and stellar populations, gas, dark matter.
- 4** Active Galactic Nuclei, discovery of Seyfert galaxies and quasars, radio surveys. SED; radio properties; variability, UV excess, broad lines, redshift. Radio-quiet quasars; AGN taxonomy; Seyfert 1 and 2; composite quasar spectrum; LINERs; blazars, unified schemes; Narrow Line Seyfert 1 galaxies; Seyfert-quasar connection; BH paradigm, Eddington limit, accretion luminosity, angular momentum; tidal disruptions; optical/UV continuum, accretion disk, Big Blue Bump; UV/optical variability; structure function, power spectral density. X-ray/UV ratio; X-ray emission, X-ray spectral components, X-ray variability; gamma-ray emission, IR, radio; superluminal motion, relativistic boosting, blazar continuum.
- 5** Broad Line Region, FWHM and line dispersion; luminosity of the emission lines, filling factor; mass of the BLR, covering factor, ionization parameter, BLR stratification; emission lines profiles; reverberation mapping; R-L relation, single epoch mass measurement. Cloud properties; line-continuum correlations, Baldwin effect; Narrow Line Region, line luminosities, density of the NLR gas; cloud properties; mass and size of the NLR.
- 6** Summary of cosmology, Mattig formula; luminosity distance, case with cosmological constant. Look-back time; quasar surveys; source counts, euclidean case; Eddington effect; K-correction; survey difficulties and problems. COMBO-17 survey; slitless spectroscopy; variability selection, synergic variability surveys; quasar surface density; evolutionary tests:  $\log N$ - $\log S$ ,  $V/V_{\max}$  test; luminosity function and its evolution; cosmic downsizing.
- 7** Intergalactic absorption lines, Ly-alpha forest, Broad Absorption Line QSOs, proximity effect. High redshift galaxies, angular diameter and surface brightness; K-correction, active and passive evolution; bimodality, color-stellar mass diagram, blue cloud, red sequence, green valley.

Textbooks: L.S. Sparke e J.S. Gallagher: Galaxies in the Universe (Cambridge University Press)  
B.M. Peterson: An Introduction to Active Galactic Nuclei (Cambridge University Press)  
On-line lecture notes, <http://www.fisica.uniroma2.it/~vagnetti/lectures/>