

**Università di Roma Tor Vergata**  
**Program of the course Extragalactic Astrophysics**  
**Laurea Magistrale in Fisica - AstroMundus semester S3**  
**academic year 2016-2017 - Prof. Fausto Vagnetti**

- 1** The Milky way and the external galaxies, main data, classifications, catalogs. Surface photometry, luminosity function. Galactic center. Differential rotation, Oort constants. Rotation curve of the Milky Way, dark matter, WIMPs; gravitational microlensing, search for MACHOs. 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. 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.
- 2** 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; Broad Absorption Line Quasars; Seyfert-quasar connection; BH paradigm, Eddington limit, accretion luminosity, angular momentum; optical/UV continuum, accretion disk, Big Blue Bump; tidal disruptions; 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.
- 3** Broad Line Region; broad lines, FWHM and line dispersion; temperature and density in the BLR; luminosity of the emission lines, filling factor; mass of the BLR, covering factor, ionization parameter, BLR stratification; emission lines profiles; cloud properties. Reverberation mapping; estimate of the black hole mass; virial theorem with external force; size-luminosity relation, single epoch mass measurement. line-continuum correlations, Baldwin effect; Narrow Line Region, line luminosities, density of the NLR gas; cloud properties; mass of the NLR; size-luminosity relation.
- 4** Summary of cosmological formulae, Mattig formula; luminosity distance. Look-back time; quasar surveys; source counts, euclidean case; Eddington effect; K-correction; survey difficulties and problems. Color selection; COMBO-17 survey; effect of the emission lines; slitless spectroscopy; variability selection, synergic variability surveys; quasar surface density; V/Vmax test; luminosity function and its evolution; cosmic downsizing. Black Hole-galaxy relations. fossil BHs and Soltan argument. Quasar-galaxy coevolution. Black hole growth by accretion and merging.
- 5** Intergalactic absorption lines, Ly-alpha forest, 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/>