

Text books and notes (in Trieste libraries or ask to the teacher):

FUNDAMENTAL ASTRONOMY, Karttunen, Kroger, Oja, et al. [**K**];

GALACTIC ASTRONOMY, Binney and Merrifield - Princ. Univ. Press, 2nd and 3rd chapters [**BM**];

GALACTIC DYNAMICS, Binney and Tremaine, (1st and 2nd eds.) - Princ. Univ. Press [**BT**] or [**BT2nd**]

Look at <http://moodle2.units.it/course/view.php?id=436> for many notes and slides. A summary is listed in NotesSlides.README.

Suggested, too: CORSO DI ASTRONOMIA M. Hack - Hoepli [**H**]; 1st chapter of [**BM**] is an interesting reading, see <http://press.princeton.edu/titles/6358.html>; 1st chapter of [**BT2nd**] gives a good summary of the phenomenology of “astronomical objects”; Gary Mamon’s course [M] CT2.pdf course complet <http://www2.iap.fr/users/gam/M2/index.html> is useful for the dynamics of galaxy systems; <http://www.wolframalpha.com/> to make computations, integrals and so on.

1 Astronomical Measurements and Quantities

[*K*], [*BM*], *part1.tar*, [*H*] is useful.

Spherical Trigonometry: radiants and steradians; rectangular-spherical coordinates transformations; equations of spherical triangles. **Coordinates on the Earth. Celestial Coordinates:** horizontal system; equatorial systems and the sidereal time; visibility of stars and circumpolar stars; ecliptic system; galactic system; solar and sidereal day; time equation; sidereal and tropical year; exercises: angular separation and cos formula, other exercises. [*K*], [*H*] is useful for some plots.

Perturbations on Coordinates: effects of atmosphere - absorption and optical and radio windows, motion, refraction; aberration; parallax and **parsec (pc) as unit of distance**; precession and nutation. [*K*], [*H*], [*BM*] is useful for refs. to *Hipparcos*.

Motions: proper motion, redshift and radial velocity (= LOS line-of-sight velocity). [*K*], [*BM*].

Photometric concepts, Magnitudes and Colors: intensity, flux density and luminosity; apparent magnitudes and Pogson formula; filters and systems of magnitudes; colors; distance modulus and absolute magnitudes; magnitude corrections; absolute energy distributions and bolometric magnitudes; luminosity in solar units; mass to luminosity ratios; extinction and color excess. Exercises. [*K*], [*BM*].

Radiation Mechanisms and Spectra: radiation of atoms and molecules (concepts); hints to Boltzmann and Saha laws; Spectra - continuum, lines, bands; line profile and equivalent width; 21 cm line as example of forbidden line; blackbody radiation. [*K*].

2 Astronomical Objects

[*K*], [*BM*], *part1.tar* and *part2.tar*, [*H*] is useful only for stars.

Stars: temperatures: temperatures of the star atmosphere - color t., gradient t. effective t., excitation t. ionization t. - meaning and comparison. [*K*],[*H*]. **Stars: spectra and classification:** Harvard classification (O,B,A...types) and discussion of main spectral features (HeII lines, HI Balmer lines; H and K CaII lines, G band); luminosity classes and the MK classification; peculiar spectra; HR and CM diagrams - hints for interpretation; Exercises with slides: 2D and 1D stellar spectra, galaxy spectra, spectra and K-correction; visual inspection of several HR/CM - diagrams. [*K*],[*BM*]. **Binary stars:** visual - astrometric - spectroscopic binaries - photometric

binaries (=eclipsing variables) and the light curve. [K], [BM]. **Stars: properties:** Masses of stars - mass of the Sun, mass of binary stars (visual and spectroscopic); Radii of stars - interferometry and lunar occultations (hints) - eclipsing binaries; Properties from spectra - effective temperature, surface gravity, chemical composition. **Variable stars:** Pulsating variables: Period-density relation, the cause of pulsation, most important types (Classical Cepheids and W-Virginis, RR Lyr); eruptive and cataclysmic variables (Flare stars, T Tauri, Novae, Supernovae). [K]. Exercises.

Stellar luminosity function: luminosity function, star-counts, concepts of limited magnitude limit and magnitude limited samples, fundamental equation of stellar statistics, Malmquist bias, observational results about the luminosity function. [BM].

Stellar systems: Phenomenological properties of Associations, Open Clusters, Globular Clusters [K]. Virial Theorem to estimate Cluster Mass [K] and *virialtheorem.pdf*. Distance from Moving Cluster method. Hints about Secular and statistical parallaxes [BM]. Exercise.

Milky Way: Structure of the Galaxy: stars, stellar clusters and interstellar medium. Dynamics: the Oort constants, the rotation velocity curve and the presence of a DM halo [K].

Galaxies: Morphological classification. Main properties: luminosity and size, colors, spectra. Luminosity function. Tully-Fisher and Faber-Jackson relations. Structure and surface brightness profiles. Dynamics: rotation velocity and pressure supported objects. Galaxy properties and environment: cluster vs field galaxies. [K].

Distance Ladder: The Hubble law (V=HD) and the expansion of the Universe. The Baade-Wesselink method. A brief overview of different methods treated through the course to go from very nearby objects to very distant ones. [K],[BM]

Galaxy Clusters: Morphological classification. Main properties. Clusters as multicomponent objects and their multivavelength observations: optical, X-ray, gravitational lensing. The problem of the galaxy member selection and the projected phase space. X-ray observations and hot intracluster medium. Density profiles of cluster gas and galaxies. Substructure and cluster mergers. Radio observations and halos/relic. *ClustersCap1PhDthesis.pdf* and *others in part3.tar*

3 Galaxy dynamics - a few topics

[BT], *part3.tar*, [M] is an alternative to [BT].

Theory of potential: potential and gravitational field, Poisson eq., Laplace eq., and Gauss theorem in gravitation theory, the potential-energy. Spherical systems: Newton theorems, circular velocity, escape velocity, the potential of simple systems. [BT2nd].

Collisionless Systems: collisionless systems and relaxation time, basis of fluid mechanics. The distribution function and phase space and the collisionless Boltzmann equation. The Jeans equation and the local equilibrium. Jeans equation and its connection with observational quantities. Galaxy orbits. [BT].