Detailed contents of the Dynamics of Galaxies course

Year 2012-2013

- Generalities (Sec 1.2)
  - Collisionless systems, relaxation time (Sec.1; collisionless systems)
- Potential theory (Sec. 2.1, 2.2, 2.3)
  - general results, gravitational force, Poisson's equation, potential energy.
  - Spherical systems: Newton's 1st and 2nd theorems, circular velocity, escape velocity, computation of the gravitational force and potential. Examples: point mass, homogeneous sphere, Plummer, isochrone, power-law densities (Sec.2.1)
  - Flattened systems: spheroidal, relation between iso-density and iso-potential surfaces, disks
- Orbits of stars (Sec. 3.1, 3.2, 3.3)
  - Spherical potentials: equations of motion, bound vs unbound orbits, apocentre, pericentre distances, radial and azimuthal periods and relations, examples.
  - Integrals of motion
  - Axisymmetric potentials: equations of motion, meridional plane, effective potential, surface of section, zero velocity curve, epicycles
  - Non-axisymmetric potentials: 2D non-rotating potential, box and loop orbits, 2D rotating potential, Jacobi integral, resonances and weak bars
  - Numerical integration of orbits: algorithms, requirements

- Equilibrium of collisionless systems and distribution functions (Sec. 4.1, 4.2, 4.3, 4.8)
  - Phase-space, Collisionless Boltzmann Equation
  - Relation between DF and observables: density, velocity DF, velocity moments, velocity ellipsoid
  - Jeans theorems: integrals of motion. Ergodic f(E) and anisotropic DF f(E, L), f(E,Lz) and characteristics of the velocity ellipsoid
  - DF for spherical systems. Ergodic DF and relation between density and DF. Anisotropic DF and velocity anisotropy. Examples.
  - Jeans equations. Spherical symmetry. Applications. Axisymmetric case. Asymmetric drift. Virial equations.
- Collisions (Sec. 8.3.1, 8.3.3)
  - Tides: restricted 3-body problem. Tidal radius
  - Evolution of debris streams and action angle variables
- Numerical studies of the evolution of a satellite galaxy orbiting a spherical host
  - Generation of initial conditions from DF: configuration and velocity space
  - Choice of suitable parameters
  - Analysis of the results