Programs of courses - semester S2 - Roma Tor Vergata

compulsory courses

Observational Solar Physics

Theory of image formation: Fourier optics, diffraction, PSF. Atmosphere: image degradation, limits of short and long exposure, Fried Parameter. Solar and night adaptive optics: measurement and reconstruction of the wave front, deformable mirrors. Reconstruction of post-acquisition images with special reference to extended objects: Wiener Filter, Blind Deconvolution, Phase Diversity. Fundamentals of image processing: punctual operators, filters, transforms, operators and morphologic descriptors. Focal plane instrumentation for solar astrophysics applications. Laboratory practice: introduction to IDL; dynamical atmosphere: numerical simulation of a turbulent atmosphere; processing of solar datasets.

Stellar Astrophysics

The Galaxy. Stellar Structures. Thermodynamics of stellar interiors. Hydrogen Burning Phases. Helium Burning Phases. Stellar Variability. Stellar Observables with a Cosmological impact. Nucleosynthesis.

Extragalactic Astrophysics I

The Galaxy and the galaxies, main data, classification, catalogs, surface photometry, luminosity function. Distances and velocities in the Galaxy. The Local Group, measures of distances, dwarf galaxies, chemical evolution. Disk galaxies, photometry, rotation curves, Tully-Fisher relation. Elliptical galaxies, photometry, stellar velocities, Faber-Jackson relation, fundamental plane. Active galactic nuclei, black hole paradigm, accretion disk. Continuous emission and variability. Broad line region and narrow line region, cloud properties, line-continuous correlations, Baldwin effect. Cosmology review, luminosity distance. Surveys, Eddington effect, K-correction. Selection criteria. logN-logS and V/Vmax test. Luminosity function and its evolution. Cosmic Downsizing. High redshift galaxies, Active and passive evolution. Color bimodality, blue cloud, red sequence.

Relativity and Cosmology I

Fundamentals of general relativity and gravitational physics. Schwarzschild solution. Gravitational collapse. Black holes. Gravitational waves. Cosmic geometry, kinematics and dynamics, FRW models. Black body and thermodynamic equilibrium. Cosmic radiation background. Primordial

nucleosynthesis.

optional courses

Theoretical Solar Physics

Internal structure of quiet Sun, nuclear reactions and the problem of neutrinos. Heliosismology, tachoclines and solar dynamo. Turbulent convection in the Sun: new paradigm. The solar surface: quiet and active Sun. The solar spectrum: formation of spectral lines. photospheric and chromospheric dynamics. From chromosphere to solar corona: the problem of coronal heating. Flares and coronal mass emissions (CME). Solar irradiance, its spectral and temporal variability and the Earth climate.

Stellar Populations

The Discovery Of Stellar Populations: Baade and the discovery of Galactic stellar populations; Kinematic and spectroscopic evidence; Oort,Äôs Constants, and the Rotation of the Galaxy. Formation And Evolution Of The Galaxy: Galaxy formation: semi-analytic models; Galaxy formation: numerical simulations; Dark matter and baryonic components. The Cosmological Abundances Of The Elements: The Big Bang nucleosynthesis; Primordial helium content; Primordial lithium content. Star Formation: Theory and observations; Population III stars; Initial mass function; Mass luminosity relation.
Galactic Components: The halo; The thin and the thick disk; The bulge; The center. Stellar Systems: Open clusters and associations; Globular clusters; Abundance patterns and anticorrelations. Stellar Populations In Local Group Galaxies: Andromeda group; Dwarf irregulars; Dwarf spheroidals. Stellar Populations In Local Volume Galaxies: Virgo cluster; Ultra compact dwarfs; Dwarf ellipticals; Ellipticals; Galaxy bulges. Unresolved Stellar Populations: Population synthesis; Integrated spectra and colours. Galactic Chemical Evolution: Star Formation rate and SN rate; Stellar abundance gradients; Gas abundance gradients; alpha-element abundances; s and r-process elements; neutron capture elements. TEXT BOOKS: James Binney & Michael Merrifield, Galactic Astronomy, Princeton University Press; James Binney & Scott Tremaine, Galactic Dynamics, Princeton University Press; Maurizio Salaris, Santi Cassisi, Evolution of Stars and Stellar Populations, Wiley