

Introduction to Cosmology

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Program

- *Introduction*: short historical introduction - census of the Universe - isotropy and homogeneity - cosmic expansion - observational evidence for a hot big-band [NR, 1x3h]
- *From GR to the Friedmann equations*: Metrics - FLRW metric - comoving coordinates - geodesics - GR survival kit - energy-momentum tensor - Einstein tensor - Einstein equation - from the Einstein equation to the Friedmann equations [NR, 1x3h]
- *Friedmannology*: Classical solutions of the Friedmann equations - evolution of the energy densities - equation of state - cosmological parameters - age of the Universe - distances and volumes - (neo-)classical cosmological probes [NR, 2x3h]
- *Case study I*: from supernova fluxes to cosmological parameters [NR, 1x3h]
- *Thermal history of the Universe*: Equilibrium distributions - Boltzmann equation - Electrons and positrons - neutrinos - decoupling - relic densities - primordial nucleosynthesis - recombination - re-ionization [NR, 2x3h]
- *Structure formation*: spherical collapse - linear theory - sound waves - [JR, 2x3h]
- *CMB basics*: [JR, 1x3h]
- *Inflation*: Motivation for inflation (horizon, flatness and other problems) - definition of inflationary phase and difference with late time acceleration - realisations of inflation - attractor solutions - definition of slow-roll parameters - calculation of primordial scalar and tensor power spectra generated by inflation [DS, 1x3h]
- *Modified gravity*: motivation for modifying gravity on large scales as an alternative to dark energy - different models of modified gravity (massive gravity, galileons...) [DS, 1x3h]

Summer Reading

- S. Serjeant, [*Observational Cosmology*](#), Cambridge University Press, 2010.

References

- S. Dodelson, [*Modern Cosmology*](#), Academic Press, 2003.
- J. A. Peacock, [*Cosmological Physics*](#), Cambridge University Press, 1998.
- J. Rich, [*Fundamentals of cosmology*](#), Springer, 2010, ISBN:978-3-642-07461-5.
- B. Ryden, [*Introduction to cosmology*](#), Addison-Wesley, 2002.