



Lecture Course in the Integrated Research Training Group (IRTG)  
of the SFB 676 "Particles, Strings and the Early Universe"

Summer Term 2017

# Theoretical Cosmology

T. Konstandin and G. Servant

## Course Description:

The course will cover topics in the following areas:

- **Thermodynamics in the early Universe:** Particle Decoupling, Big Bang Nucleosynthesis, Recombination and Photon Decoupling, Boltzmann Equation, Cold Dark Matter Freeze-Out, hot Dark Matter;
- **Dark Matter:** Evidence and Candidates, WIMP Phenomenology and Constraints, Alternatives to thermal Freeze-Out;
- **Baryogenesis:** Criteria and Mechanisms. Baryon Number Violation in the Standard Model, Sphalerons, Out-of-Equilibrium Decay, Leptogenesis, Electroweak Baryogenesis, Higgs effective Potential at high Temperature, Electroweak Phase Transition, Sources of CP Violation, Calculation of Asymmetry;
- **Axion Cosmology:** Relic Abundance, Signatures, Cosmological Relaxation Mechanism;
- **Inflation:** Motivations and Models;
- **Theory of Perturbations:** Scalar and Metric Fluctuations;
- **Cosmic Microwave Background:** Sachs-Wolfe Effect, Anisotropies, Delayed Recombination, Determination of Cosmological Parameters;
- **Theory of Large Scale Structures:** N-body Simulations, Standard Perturbation Theory and Advanced Techniques;
- **Gravitational Waves:** Theory, Binary Systems, Pulsars & Black Holes, Cosmological Sources.

## Prerequisites:

Basic knowledge in General Relativity and Quantum Field Theory

## Date and Place:

Tue, 9:15 – 10:45, SR 2, Building 2a  
Fri, 9:15 – 10:45, SR 2, Building 2a

Starting on:

4 April 2017

