

QUANTUM ASPECTS OF COSMOLOGY AND ASTROPHYSICS

[Alexander Feinstein and Jose J. Blanco-Pillado]

Quantum Fields: Quantum Fields and Vacuum state, Quantum vacuum fluctuations, Particle interpretation of Quantum fields, Examples of particle creation.

Review of Classical and Quantum Theory: Lagrangian formalism, Hamiltonian formalism, Evolution in quantum theory.

Driven Harmonic Oscillator. From Oscillator to Fields, Classical Fields.

Quantum Fields in Expanding universe. Quantum fields in the de Sitter Universe.

Early Universe Cosmology: Problems with the Big Bang Theory.

Cosmological Inflation: Solving the horizon and flatness problem. Scalar Field Inflation. Slow Roll conditions.

Models of Inflation: Chaotic Inflation, Natural Inflation, Multifield Inflation.

Density Perturbations during Inflation: Massless scalar field in de Sitter Space. Vacuum state selection.

Scalar Curvature Perturbations. Power spectrum of perturbations in slow roll. Connection with Cosmic Microwave Background Observations.

Gravitational Waves: Cosmological Tensor perturbations generated during Inflation.