General Theory of Relativity / Quantum Field Theory

Module No.: MN-P-SP-GR-QFT, MN-P-PN-GR-QFT Version: 31.10.2015 CK

Course series: Quantum aspects of gravity

Lecturers: Claus Kiefer
Email: kiefer@thp.uni-koeln.de

Category	Type	Language	Teaching Hours	CP	Semester
Specialized Course	Lecture	English	2	3	

Requirements for participation:

Relativity and Cosmology I, for The Early Universe and Quantum Black Holes also Relativity and Cosmology II

Type of module examinations:

Written or oral examination and one oral examination at the end of the module

Duration of the course:

1 semester

Aims of the courses:

This series of courses presents the material that is needed to work on quantum theories of gravity.

Contents of the courses:

- **Quantum gravity**: general introduction, major approaches, main applications (black holes and cosmology)
- **Quantum field theory in curved spacetime**: general formalism, cosmology, black holes (Hawking effect)
- **The Early Universe**: inflationary universe, quantum origin of structure
- **Foundations of Quantum Theory**: interpretational problems of quantum theory, quantum-to-classical transition, quantum information, quantum gravity
- **Quantum Black Holes**: Black Holes as thermodynamical systems, Hawking effect, information-loss problem, black holes in quantum gravity

Recommended literature:

Quantum gravity: C. Kiefer, Quantum Gravity (3rd edition, Oxford University Press 2012);
Quantum field theory in curved spacetime: L. Parker and D. Toms, Quantum Field Theory in Curved Spacetime (Cambridge University Press 2009);
The Early Universe: V. Mukhanov, Physical Foundations of Cosmology (Cambridge University Press 2005);
Foundations of Quantum Theory: M. Schlosshauer, Decoherence and the quantum-to-classical Transition (Springer-Verlag 2007);
Quantum Black Holes: C. Kiefer, Thermodynamics of Black Holes and Hawking Radiation, in „Classical and Quantum Black Holes“ (ed. By. P. Fré *et al.*), IOP 1999.