Primary Area of Specialization: General Theory of Relativity / Quantum Field Theory					
Identification number MN-P-SP-GR-QFT	Workload (540 + 90) h	Credits 21 CP	Terms of study 1st to 3rd semester	Frequency of occurrence Details are provided online in the table "Course Offerings".	Duration 3 semesters

1	Types of lesson	Contact times	Self-study times	Intended group size
	a) Lecture courses	These depend on the	These depend on the	15–20 students per problem class
	b) Problem classes	specific choices made	specific choices made	Individual tutoring for the seminar
	c) Advanced seminar	10 h	80 h	
	d) Exam	1 h	24 h	

2 Aims of the module and acquired skills

The aim of the core courses to master the fundamental concepts of general relativity and/or quantum field theory, to an extent where students are able to read and comprehend original research articles in these areas. The specialized courses introduce students to an expanded range of subjects including related topics in nearby areas such as astrophysics, particle physics and physics-related mathematics. Presentation skills are acquired through the participation in an advanced student seminar. Ultimately, the goal is to prepare the candidate to do the research for a master thesis.

3 Contents of the module

The module is subdivided into core courses, specialized courses and the advanced seminar:

1. Core courses

- Relativity and Cosmology I (4+2 HPW, 9 CP): gravity as a geometric theory, Einstein field equations, Schwarzschild solution, experimental tests, gravitational waves
- Relativity and Cosmology II (4+2 HPW, 9 CP): black holes, introduction to cosmology, the early universe
- Quantum Field Theory I (4+2 HPW, 9 CP): second quantization and applications, functional integrals, perturbation theory, mean-field methods
- Quantum Field Theory II (4+2 HPW, 9 CP): the role of correlation functions, spontaneous symmetry breaking, lattice gauge theory, topological aspects of QFT, renormalization

2. Specialized courses

- Misc. courses: Quantum Aspects of Gravity (X HPW, X CP – cf. table 'course offerings')
- Misc. courses: Particle– and Astrophysics (X HPW, X CP – cf. table 'course offerings')
- Misc. courses: Mathematics (X HPW, X CP – cf. Table 'course offerings')
- and others, including fitting courses from Bonn University, if approved by the module coordinator

The contents of the specialized courses can be found in the "kommentiertes Vorlesungsverzeichnis" and in the course descriptions online.

3. Advanced student seminar (2 HPW, 3 CP)

- Seminar on current topics in Quantum Mechanics, General Relativity, or Quantum Field Theory

4	Teaching/Learning methods Besides the teaching in lectures, the self-study based on books and lecture notes plays an important role. The students work individually on problem sets. In discussions with others and in the problem classes, they learn to solve challenging problems in a team and to present their approaches and results. By preparing an advanced seminar, they become acquainted with a current topic of research, scientific methods and literature. They also learn to communicate in a pedagogical way on an advanced topic.
5	Requirements for participation The theoretical physics curriculum at the level of the bachelor courses in physics
6	Type of module examinations The module is passed by passing an oral examination covering the topics of all attended courses. To be admitted to the examination, students must actively participate in the problem sessions (including the solution of homework problems) and give a talk in the advanced seminar. The grade given for the module is the grade of the oral examination.
7	Requisites for the allocation of credits The Primary AoS GR-QFT is composed of: 1. One of the core courses GR I-II or QFT I-II (lectures and exercises) 2. A second core course or specialized courses from the list above 3. Advanced student seminar
8	Compatibility with other Curricula and Soft Skills May be taken as an elective subject in other M.Sc. programs. Promotes scientific reading and presentation skills, in particular those for oral presentations.
9	Significance of the module grade for the overall grade The weight of the module is 21/111 ≈ 18.9 %.
10	Module coordinator C. Kiefer
11	Additional information Details of the course offerings and contents are given online and in the “kommentiertes Vorlesungsverzeichnis”. Version: 28.08.2015 PN