

Module No.: physics605  
 Credit Points (CP): 7  
 Category: Required  
 Semester: 7.



## Module: Base Module Theoretical Physics

### Module Elements:

Nr.	Course Title	Number	CP	Type	Workload	Sem.
1.	Advanced Quantum Theory	physics606	7	Lect. + ex.	210 hrs	WT
2.	Advanced Theoretical Physics	physics607	7	Lect. + ex.	210 hrs	WT

### Requirements:

### Preparation:

### Content:

The course provides fundamental knowledge needed for theoretical lectures in the Master course

### Aims/Skills:

The M.Sc. Physics programme includes one obligatory module for all students. It includes a theoretical unit to extend the B.Sc. in Physics knowledge

### Form of Testing and Examination:

Requirements for the module examination (written examination): successful work with exercises

**Length of Module:** 1 semester

**Maximum Number of Participants:** ca. 100

### Registration Procedure:

s. <https://basis.uni-bonn.de> u. <http://bamawww.physik.uni-bonn.de>

Note: When the student has (upon admission) demonstrated satisfactory knowledge of Advanced Quantum Theory already, the class Advanced Theoretical Physics may be taken instead

**Module: Base Module Theoretical Physics**

Module No.: physics605

**Course:**  **Advanced Quantum Theory**

Course No.: physics606

Category	Type	Language	Teaching hours	CP	Semester
Required	Lecture with exercises	English	3+2	7	WT

**Requirements:****Preparation:**

Theoretical courses at the Bachelor degree level

**Form of Testing and Examination:**

Requirements for the module examination (written examination): successful work with exercises

**Length of Course:**

1 semester

**Aims of the Course:**

Ability to solve problems in relativistic quantum mechanics, scattering theory and many-particle theory

**Contents of the Course:**

Born approximation, partial waves, resonances  
 advanced scattering theory: S-matrix, Lippman-Schwinger equation  
 relativistic wave equations: Klein-Gordon equation, Dirac equation  
 representations of the Lorentz group  
 many body theory  
 second quantization  
 basics of quantum field theory  
 path integral formalism  
 Greens functions, propagator theory

**Recommended Literature:**

L. D. Landau, E.M. Lifschitz; Course of Theoretical Physics Vol.3 Quantum Mechanics (Butterworth-Heinemann 1997)  
 J. J. Sakurai, Modern Quantum Mechanics (Addison-Wesley 1995)  
 F. Schwabl, Advanced Quantum Mechanics. (Springer, Heidelberg 3rd Ed. 2005)

**Module: Base Module Theoretical Physics**

Module No.: physics605

**Course:**  **Advanced Theoretical Physics**

Course No.: physics607

Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture with exercises	English	3+2	7	WT

**Requirements:****Preparation:**

3-year theoretical physics course with extended interest in theoretical physics and mathematics

**Form of Testing and Examination:**

Requirements for the module examination (written examination): successful work with exercises

**Length of Course:**

1 semester

**Aims of the Course:**

Introduction to modern methods and developments in Theoretical Physics in regard to current research

**Contents of the Course:**

Selected Topics in Modern Theoretical Physics for example:

Anomalies

Solitons and Instantons

Quantum Fluids

Bosonization

Renormalization Group

Bethe Ansatz

Elementary Supersymmetry

Gauge Theories and Differential Forms

Applications of Group Theory

**Recommended Literature:**

M. Nakahara; Geometry, Topology and Physics (Institute of Physics Publishing, London 2nd Ed. 2003)

R. Rajaraman; Solitons and Instantons, An Introduction to Solitons and Instantons in Quantum Field Theory (North Holland Personal Library, Amsterdam 3rd reprint 2003)

A. M. Tsvelik; Quantum Field Theory in Condensed Matter Physics (Cambridge University Press 2nd Ed. 2003)

A. Zee; Quantum Field Theory in a Nutshell (Princeton University Press 2003)