

Module No.:  
 Credit Points (CP):  
 Category:  
 Semester:

physics61c  
 7  
 Elective  
 1.



## Module: Specialization: Theoretical Physics

### Module Elements:

Nr.	Course Title	Number	CP	Type	Workload	Sem.
<b>Theoretical Physics</b>						
1.	Theoretical Particle Physics	physics615	7	Lect. + ex.	210 hrs	WT
2.	Theoretical Hadron Physics	physics616	7	Lect. + ex.	210 hrs	WT
3.	Theoretical Condensed Matter Physics	physics617	7	Lect. + ex.	210 hrs	WT
4.	Solid State Theory I	TheoSolidSt	6	Lect. + ex.	180 hrs	WT

### Requirements for Participation:

#### Form of Examination:

see with the course

#### Content:

Fundamentals in theoretical physics in Bonn or Cologne

#### Aims/Skills:

Mit den Spezialisierungsvorlesungen wird die Möglichkeit eröffnet, sich in einer bzw. mehreren der in Bonn vertretenen Forschungsrichtungen zu spezialisieren.

The students will get acquainted with modern research topics

#### Course achievement/Criteria for awarding cp's:

see with the course

**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: The student must achieve at least 24 CP out of all 6 Specialization Modules

<b>Module:</b>	<b>Specialization: Theoretical Physics</b>
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Module No.: physics61c

<b>Course:</b>	 universität <b>bonn</b>	<b>Theoretical Particle Physics</b>
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Course No.: physics615

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

**Requirements for Participation:**

**Preparation:**

Advanced quantum theory (physics606)

Quantum field theory (physics755)

Group theory (physics751)

**Form of Testing and Examination:**

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

**Length of Course:**

1 semester

**Aims of the Course:**

Introduction to the standard model of elementary particle physics and its extensions (unified theories)

**Contents of the Course:**

Classical field theory, gauge theories, Higgs mechanism;

Standard model of strong and electroweak interactions;

Supersymmetry and the supersymmetric extension of the standard model;

Grand unified theories (GUTs);

Neutrino physics;

Cosmological aspects of particle physics (dark matter, inflation)

**Recommended Literature:**

T. P. Cheng, L.F. Li: Gauge theories of elementary particle physics (Clarendon Press, Oxford 1984)

M. E. Peskin, D.V. Schroeder; An introduction to quantum field theory (Addison Wesley, 1995)

J. Wess; J. Bagger; Supersymmetry and supergravity (Princeton University Press 1992)

<b>Module:</b>	<b>Specialization: Theoretical Physics</b>
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Module No.: physics61c

<b>Course:</b>	 <b>Theoretical Hadron Physics</b>
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Course No.: physics616

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

**Requirements for Participation:****Preparation:**

Advanced quantum theory (physics606)

Quantum field theory (physics755)

Group theory (physics751)

**Form of Testing and Examination:**

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

**Length of Course:**

1 semester

**Aims of the Course:**

Introduction to the theory of strong interaction, hadron structure and dynamics

**Contents of the Course:**

Meson and Baryon Spectra: Group theoretical Classification, Simple Quark Models

Basics of Quantum Chromodynamics: Results in Perturbation Theory

Effective Field Theory

Bethe-Salpeter Equation

**Recommended Literature:**

F. E. Close, An Introduction to Quarks and Partons (Academic Press 1980)

F. Donoghue, E. Golowich, B.R. Holstein; Dynamics of the Standard Model (Cambridge University Press 1994)

C. Itzykson, J.-B. Zuber; Quantum Field Theory (Dover Publications 2005)

S. Weinberg; The Quantum Theory of Fields (Cambridge University Press 1995)

<b>Module:</b>	<b>Specialization: Theoretical Physics</b>
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Module No.: physics61c

<b>Course:</b>	 universität <b>bonn</b>	<b>Theoretical Condensed Matter Physics</b>
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Course No.: physics617

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

**Requirements for Participation:**

**Preparation:**

Advanced Quantum Theory (physics606)  
 Quantum Field Theory (physics755)  
 Group theory (physics751)

**Form of Testing and Examination:**

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

**Length of Course:**

1 semester

**Aims of the Course:**

Introduction to the theoretical standard methods and understanding important phenomena in the Physics of Condensed Matter

**Contents of the Course:**

Crystalline Solids: Lattice structure, point groups, reciprocal lattice  
 Elementary excitations of a crystal lattice: phonons  
 Electrons in a lattice; Bloch theorem, band structure  
 Fermi liquid theory  
 Magnetism  
 Symmetries and collective excitations in solids  
 Superconductivity  
 Integer and fractional quantum Hall effects

**Recommended Literature:**

N. W. Ashcroft, N.D. Mermin, Solid State Physics (Saunders College 1976)  
 P. M. Chaikin, T.C. Lubensky; Principles of Condensed Matter Physics (Cambridge University Press 1997)  
 W. Nolting; Grundkurs Theoretische Physik Band 7: Vielteilchentheorie (Springer, Heidelberg 2002)  
 Ch. Kittel; Quantentheorie der Festkörper (Oldenburg Verlag, München 3. Aufl. 1989)

<b>Module:</b>	<b>Specialization: Theoretical Physics</b>
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<b>Module No.:</b> physics61c
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<b>Course:</b>		<b>Solid State Theory I</b>
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<b>Course No.:</b>
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Category	Type	Language	Teaching hours	CP	Semester
Elective	Lecture with exercises	English	3+1	6	WT

**Requirements for Participation:****Preparation:**

training in theoretical physics at the B.Sc. level, experimental solid state physics

**Form of Testing and Examination:**

written or oral examination

**Length of Course:**

1 semester

**Aims of the Course:**

this course gives an introduction to the physics of electrons and phonons in solids together with theoretical concepts and techniques as applied to these systems.

**Contents of the Course:**

The lecture investigates basic concepts to describe solids and their excitations. Various applications are discussed with emphasis on experimental and theoretical research directions of the physics department in Cologne.

**Recommended Literature:**

Ashcroft/ Mermin: "Solid State Physics"