Specialization: Advanced Theoretical Physics - physics62c

Module No.	**physics62c**
Category	Elective
Credit Points (CP)	7
Semester	2.

Module: Specialization: Advanced Theoretical Physics

Module Elements:

Nr	Course	Course No.	CP	Type	Teaching hours	Semester
1	Advanced Theoretical Particle Physics	physics636	7	Lect. + ex.	3+2	ST
2	Advanced Theoretical Hadron Physics	physics637	7	Lect. + ex.	3+2	ST
3	Advanced Theoretical Condensed Matter Physics	physics638	7	Lect. + ex.	3+2	ST

Requirements for Participation:

Form of Examination: see with the course

Content: Fundamentals on an advanced level in theoretical physics in Bonn or Cologne

Aims/Skills: 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: Note: The student must achieve at least 24 CP out of all 6 Specialization Modules

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Advanced Theoretical Particle Physics - physics636

Course	**Advanced Theoretical Particle Physics**
Course No.	physics636

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

Requirements for Participation:

Preparation: Theoretical Particle Physics (physics615)

Form of Testing and Examination: Requirements for the examination (written): successful work with the

Length of Course: 1 semester

Aims of the Course: Survey of methods of theoretical high energy physics beyond the standard model, in particular supersymmetry and extra dimensions in regard to current research

Contents of the Course:

Introduction to supersymmetry and supergravity,

Supersymmetric extension of the electroweak standard model,

Supersymmetric grand unification,

Theories of higher dimensional space-time,

Unification in extra dimensions

Recommended Literature:

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

H. P. Nilles, Supersymmetry, Supergravity and Particle Physics, Physics Reports 110 C (1984) 1

D. Bailin; A. Love; Supersymmetric Gauge Field Theory and String Theory (IOP Publishing Ltd. 1994)

M. F. Sohnius; Introducing supersymmtry, (Phys.Res. 128 C (1985) 39)

P. Freund; Introduction to Supersymmetry (Cambridge University Press 1995)

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Advanced Theoretical Hadron Physics - physics637

Course	**Advanced Theoretical Hadron Physics**
Course No.	physics637

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

Requirements for Participation:

Preparation: physics616 (Theoretical Hadron Physics)

Form of Testing and Examination: Requirements for the examination (written): successful work with the exercises

Length of Course: 1 semester

Aims of the Course: Survey of methods of theoretical hadron physics in regard to current research

Contents of the Course:

Quantum Chromodynamics: Nonperturbative Results, Confinement

Lattice Gauge Theory

Chiral Perturbation Theory

Effective Field Theory for Heavy Quarks

Recommended Literature:

F. E. Close; An Introduction 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 2006)

A. V. Manohar, M. B. Wise; Heavy Quark Physics (Cambridge University Press 2000)

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

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Advanced Theoretical Condensed Matter Physics - physics638

Course	**Advanced Theoretical Condensed Matter Physics**
Course No.	physics638

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

Requirements for Participation:

Preparation: physics617 (Theoretical Condensed Matter Physics)

Form of Testing and Examination: Requirements for the examination (written): successful work with the exercises

Length of Course: 1 semester

Aims of the Course: Survey of methods of theoretical condensed matter physics and their application to prominent examples in regard to current research

Contents of the Course:

Bosonic systems:

Bose-Einstein condensation

Photonics

Quantum dynamics of many-electrons systems:

Feynman diagram technique for many-particle systems at finite temperature

Quantum magnetism, Kondo effect, Renormalization group techniques

Disordered systems: Electrons in a random potential

Superconductivity

Recommended Literature:

A. A. Abrikosov, L.P. Gorkov; Methods of Quantum Field Theory in Statistical Physics (Dover, New York 1977)

W. Nolting; Grundkurs Theoretische Physik Band 7: Vielteilchentheorie (Springer, Heidelberg 2002)

A. C. Hewson, The Kondo Problem to Heavy Fermions (Cambridge University Press, 1997)

C. Itzykson, J.-M. Drouffe; Statistical Field Theory (Cambridge University Press 1991)

J. R. Schrieffer; Theory of Superconductivity (Benjamin/Cummings, Reading/Mass, 1983)

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