# Relativistic Quantum Electrodynamics

<table>
<thead>
<tr>
<th>Code</th>
<th>76017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction language</td>
<td>English</td>
</tr>
<tr>
<td>ECTS credits</td>
<td>6</td>
</tr>
<tr>
<td>Credit hours</td>
<td>5</td>
</tr>
<tr>
<td>Duration</td>
<td>1 semester</td>
</tr>
<tr>
<td>Cycle</td>
<td>irregular</td>
</tr>
<tr>
<td>Coordinator</td>
<td>Dean of Physics studies</td>
</tr>
<tr>
<td>Lecturer</td>
<td>Prof. Wolfgang Schleich</td>
</tr>
</tbody>
</table>
| Allocation to study programmes | Physics M.Sc., elective module, 1st or 2nd semester  
Wirtschaftsphysik M.Sc., elective module, 1st – 3rd semester |
| Formal prerequisites   |       |
| Recommended prerequisites | Quantum Mechanics course  
Classical Electrodynamics course |
| Learning objectives    | Students who successfully passed this module  
- know the relativistic formulation of quantum mechanics  
- know the formalism of second quantization and can perform elementary calculations for electron/positron and photon fields  
- know how the coupling between electron and photon fields is established  
- understand the theoretical perturbative approach for the electron-photon interaction using Feynman graphs  
- are able to reproduce simple Feynman diagrams  
- are familiar with the conventions and the mathematical methods relevant for this research area (operator algebra, Fourier integrals, covariant formulation, tensors) |
| Syllabus               |  
- Relativistic quantum mechanics (Dirac equation)  
- Second quantization  
- Electron-Photon interaction through the principle of minimal coupling  
- Feynman rules and calculation of simple Feynman diagrams  
- Techniques and problems of Feynman graphs, renormalization |
| Literature             |  
- J.I. Sakurai: Advanced Quantum Mechanics (Addison-Wesley, Redwood, 1987)  
| Teaching and learning methods | Lecture (3 hours per week)  
Exercise (2 hours per week) |
| Workload               | 45 hours lecture (attendance time)  
30 hours exercise (attendance time)  
105 hours self-study and exam preparation |
<table>
<thead>
<tr>
<th>Assessed dedication</th>
<th>Total: 180 hours</th>
</tr>
</thead>
</table>

**Assessment**  
Written or oral examination. Form and scope of the examination is determined and notified by the lecturer at the beginning of the course.

**Examination**  
16017 Relativistic Quantum Electrodynamics  
16517 Relativistic Quantum Electrodynamics (Precourse)

**Grading procedure**  
The module grade is the examination grade.

**Basis for**  
Research in the field of quantum physics