

Primary Area of Specialization: Molecular Physics

Identification number	Workload	Credits	Term of studying	Frequency of occurrence	Duration
MN-P-SP-Mol	(540 + 90) h	21 CP	1 st to 3 rd semester	Details are provided online in the table "Course Offerings".	3 semesters
1	Type of lessons a) Lecture b) Problem class c) Practical course d) Advanced Seminar e) Exam	Contact times depending on the individual choice 10 h 1 h	Self-study times depending on the individual choice 80 h 24 h	Intended group size 15–20 Students per problem class individual counseling for the seminar	
2	Aims of the module and acquired skills Understanding of the main concepts of molecular physics, use of computer programs for the analysis of molecular spectra (computer aided analysis of scientific data), application of molecular physics concepts to applications of current research in fundamental physics, atmospheric physics and astrophysics including lab courses (advanced experimental skills) and advanced seminars (presentation skills).				
3	Contents of the module The module is subdivided into core courses, specialized courses and the advanced seminar: 1. Core courses <ul style="list-style-type: none"> • Molecular Physics I (3+1 HPW, 6 CP): Basics of Molecular Spectroscopy, Interaction of Radiation with Matter, Chemical Bond, Born- Oppenheimer-Approximation, Rigid Rotor, Harmonic Oscillator, Electronic States, Rotational Spectroscopy, Group Theory • Molecular Physics II (3+1 HPW, 6 CP): Rotational Spectroscopy, Vibrational Spectroscopy, Group Theory, Coupling of Rotation and Vibration, Transitions and Selection Rules, Nuclear Spin Statistics, Coupling of Angular Momenta, Hund's Cases, Fine Structure (FS), HFS 2. Specialized courses <ul style="list-style-type: none"> • Astrochemistry (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • Introduction Atmospheric Physics (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • Measurement Techniques in Atmospheric Physics (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • Experiments in Molecular Physics (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • Methods of Molecular Astrophysics (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • Experimental Methods in Astrophysics (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • Fundamentals of Molecular Symmetry (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • Fourier-Transform and its Applications (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • Star formation (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • The Physics of the Interstellar Medium (2+1 HPW, 4.5 CP) / (2 HPW, 3 CP) • and others, including fitting courses from Bonn University, if approved by the module coordinator 3. Advanced Seminar in Molecular Physics (2 HPW, 3 CP) The contents of the specialized courses can be found in the "kommentiertes Vorlesungsverzeichnis" and in the lecture descriptions online.				

4	<p>Teaching/Learning methods</p> <p>Besides the teaching in lectures, the self-study based on books and lecture notes plays an important role. 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. In the additional lab course the students also gain insight into state-of-the-art instrumentation by conducting experiments independently.</p>
5	<p>Requirements for participation</p> <p>Atomic Physics and Quantum Mechanics at the level of the bachelor courses in physics.</p>
6	<p>Type of module examinations</p> <p>The module is passed by passing an oral examination covering the topics of all attended courses. To be admitted to the exam, students must actively participate in the problem sessions (including the solution of homework problems) and present a scientific talk in the advanced seminar course. The grade given for the module is equal to the grade of the oral examination.</p>
7	<p>Requisites for the allocation of credits</p> <p>The Primary AoS Molecular Physics is composed of:</p> <ol style="list-style-type: none"> 1. Two core courses Molecular Physics I and II (2 x (3+1) HPW) 2. Specialized courses in Molecular Physics, Astrophysics and Atmospheric Physics 3. Optional: advanced practical courses in Molecular Physics, Astrophysics and Atmospheric Physics 4. Advanced Seminar in Molecular Physics, Astrophysics and Atmospheric Physics
8	<p>Compatibility with other Curricula and Soft Skills</p> <p>As elective subject in other M.Sc. programs.</p> <p>Scientific reading and presentation skills, in particular oral presentations. Computer aided analysis of scientific data.</p> <p>This module prepares for topics of current research in molecular physics and astrophysics and provides the basis for the preparation of the master thesis.</p>
9	<p>Significance of the module mark for the overall grade</p> <p>The weight of the module is $21/111 \approx 18.9\%$.</p>
10	<p>Module coordinator</p> <p>S. Schlemmer</p>
11	<p>Additional information</p> <p>Detailed information on the occurrence and the course contents are provided online and in the "kommentiertes Vorlesungsverzeichnis".</p> <p>Version: 23.04.2016 PN</p>