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University of Tübingen exam regulations for the study program in Mathematical Physics culminating in an examination for a Master of Science (M.Sc.) degree – Special Provisions –

In accordance with §§ 19 (1) sentence 2 nos. 9, and 32, para. (3) LHG of 04.01.2014 (GBl. p. 99), most recently amended by article 1 of the law dated 13 March 2018 (GBl. p. 85), the University of Tübingen Senate on 13.12.2018 passed the Special Provisions of these exam regulations for the study program in Mathematical Physics at the University of Tübingen culminating in an examination for a Master of Science (M.Sc.).

Approved by the President and Vice-Chancellor on 20.12.2018.

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§ 1 Validity of General Provisions

The University of Tübingen exam regulations for the Mathematics and Mathematical Physics degree programs culminating in the academic degree of Master of Science (M.Sc.) – General Provisions – as amended are part of these exam regulations, insofar as no other special provisions have been made.

I. Goals, contents and structure of the program

§ 2 Contents and goals, regular duration of study, scope of program, related programs

(1) ¹The Mathematical Physics Master's program culminating in an examination for a Master of Science (M.Sc.) degree (hereinafter: the Master's program) is a research-oriented academic program following on from the six-semester Bachelor's degree in Mathematics at the University of Tübingen. ²The Master's program allows students to obtain long-term academic qualifications aimed at obtaining and increasing knowledge in a systematic and critical way, and justifying a general scientifically-based occupational qualification for students in the field of Mathematical Physics, building upon a first degree in the field. ³The Mathematical Physics program builds upon the basics and the methodological knowledge

obtained during the relevant Bachelor's degree, teaching advanced skills in the areas of mathematical structure of physical theories and mathematical modelling and mathematical analysis of physical problems. ⁴Students in the Master's program are required to learn how to adequately model, structure, and analyze physical problems mathematically. ⁵The qualification goals to be met are set out in the module handbook.

(2) ¹A prerequisite for enrollment in this Master's program is a Bachelor's degree in the subjects of Mathematics or Physics with a regular duration of study of six semesters and courses worth 180 credit points, with proportions of mathematics and physics in the required scope, or an equivalent degree with a grade of 2.5 or better. ²The examination board will decide on the equivalency of a degree and on whether the prerequisite in sentence 1 above has been met. ³The examination board may transfer the making of this decision revocably to the head of the board. ⁴If there is a set number for admission, the articles may specify that the selection committee formed for the relevant selection process decides instead. ⁵In the case of a degree under sentence 1 with a grade poorer than 2.5 but of 3.0 or better, the applicant's suitability for the Master's program may be gauged via an oral examination of the applicant's level of knowledge lasting 30-45 minutes by two examiners according to § 14 of the General Provisions of these exam regulations, upon application to the examination board. ⁶In that examination, the applicant must prove that he/she has knowledge indicating that he/she would be capable of successfully completing the Master's program. ⁷The examination board decides on admission to the Master's program on the basis of the examiners' recommendation; sentence 3 and sentence 4 apply accordingly. ⁸There can be no repeat examination of an applicant's level of knowledge.

(3) ¹The regular duration of study in the Master's program is set out in § 2 (3) of the General Provisions of these exam regulations. ²A total of 120 credit points must be obtained to successfully complete this Master's degree program. ³If the Bachelor's degree which forms the basis of admission to the Master's program was completed in a program with a regular duration of more than six semesters and which was worth more than 180 ECTS credits, work completed over and above the 180 ECTS credits may, upon application to the examination board, be accredited to the Master's program studies, if there is no significant difference in the skills to be learned.

(4) ¹To take part in the Master's program, applicants must also document knowledge of English at least at the level of B2 of the Common European Framework of Reference for Languages (CEFR). ²For the requirement in sentence 1 above, paragraph (2) sentences 2-4 apply accordingly.

(5) Related degree programs as defined in § 17 (2) sentence 2 of the General Provisions of these exam regulations are (including the corresponding teaching degree programs in their tiered structure) Bachelor of Mathematics, Master of Mathematics, Bachelor of Physics, Master of Physics, teaching-degree programs in Mathematics, teaching-degree programs in Physics, diplomas of Mathematics, diplomas of Physics; the examination board will decide on the relatedness of other degree programs.

§ 3 Structure

(1) ¹The Master's program is structured over two years. ²It concludes with the Master's examination.

(2) ¹Work for the Master's program is carried out in the form of modules. ²These are the final module, along with the following types of module:

1. Compulsory modules: All students must take these modules, without any options regarding the classes taken within the modules; the coursework must be completed and students must pass the respective assessment.
2. Compulsory modules plus option: Students may choose from a list of classes within the module to an extent set out in the module handbook; the students must complete

the respective coursework and pass the corresponding assessment; if a student fails a piece of assessment, the selected class may be replaced by another class belonging to the module, as set out in the module handbook; this counts towards the number of fails which are permissible in the program and is subject to approval by the examination board; and in this case, the respective coursework must be completed again; subject to approval by the examination board, classes other than those set out in the module handbook may be included in the module.

3. Compulsory elective modules: Students may choose freely – usually within a defined module or class catalogue – and may exchange a failed module for another without having the fail count towards the permissible number of fails; switching back is not permitted.

3) ¹Students complete a program of 120 credit points; the program consists of the following modules:

| Recommended semester | Module no. | Module description | Class type | Module type | Course-work | Module completion (type of assessment) | Credit points |
|--|------------|--|------------|-------------|-----------------------------------|--|---------------|
| Section 1: Basics of Mathematical Physics | | | | | | | |
| 1 | MAT-65-11 | Geometry in Physics | V+Ü | PM | ÜN | K or mP | 9 |
| 1 | MAT-65-12 | Mathematical Quantum Theory | V+Ü | PM | ÜN | K or mP | 9 |
| 2 | MAT-65-13 | Mathematical Relativity | V+Ü | PM | ÜN | K or mP | 9 |
| Section 2: Further Knowledge | | | | | | | |
| 1-3 | MAT-40-31 | Advanced Topics in Mathematics | V+Ü | PMW | ÜN | K or mP | 9 |
| 1-3 | MAT-40-32 | Advanced Topics in Theoretical Physics | V+Ü | PMW | ÜN | K or mP | 9 |
| 2-3 | MAT-40-33 | Seminar Knowledge Extension | S | PMW | s.M. | R | 3 |
| Section 3: Required elective modules | | | | | | | |
| 2-3 | | Modules totaling 30 ECTS credits in line with the module handbook. | | WPM | depending on module chosen, s. M. | depending on module chosen, s. M. | 30 |
| Section 4: Academic writing | | | | | | | |
| 3 | MAT-40-41 | Scientific Project | Pr | PM | s. M. | - | 9 |

| | | | | | | | |
|--------------|-----------|---|---|----|-------|----|-----|
| 3-4 | MAT-40-42 | Mathematical Physics Colloquium | C | PM | s. M. | - | 3 |
| 4 | MAT-40-43 | Final module M.Sc. Mathematical Physics | | PM | | MA | 30 |
| Total | | | | | | | 120 |

Glossary:

V=lecture, S=seminar, Ü=exercise, C=colloquium, Pr=Project work, s. M.=see module handbook, PM=compulsory module, PMW=compulsory module with elective option, WPM=compulsory elective module, ÜN=exercise participation certificate, MA=Master's project, mP=oral exam, K=written exam, R=presentation

(4) ¹Prior to registration for their first piece of assessment, students make an individual study and assessment plan which sets out all the modules to be completed as part of the Master's thesis process in accordance with paragraph (3). ²The study and assessment plan must be presented to the head of the examination board or his/her representative for approval.

³Approval of the study and assessment plan is dependent upon the competence goals of the respective study program being achievable on the basis of the modules set out in the study and assessment plan; this evaluation is to be made not schematically but of the plan overall.

⁴Approved study and assessment plans may be amended in justified cases upon application by the student and approval by the head of the examination board or his/her representative.

(5) If elective options exist, and unless otherwise set out in the study and exam regulations, students must make use of the options so that the exact number of ECTS credits specified for the respective modules and in section 1, Basics of Mathematical Physics, in section 2, Further Knowledge, and in section 3, Free Required Electives, is attained.

(6) ¹In section 3, Free Electives, modules to a total of 30 ECTS credits may be included in line with the module handbook. ²Within the framework of changes to the study and assessment plan in accordance with paragraph (4) sentence 4, coursework carried out in Free Electives may replace passed, failed, or not yet completed work in section 2, Further Knowledge, if the work carried out is equivalent to the work it replaces, particularly in regard to the skills to be obtained.

(7) ¹Failed attempts in a class will be counted even if that class is taken again as part of another module. ²Classes which a student has already successfully completed may not be taken again as part of another module.

(8) ¹It is prohibited for students to take, as part of their Master's studies, any module or class which is the same as, or substantially similar to, one they took in their Bachelor's studies; such modules and/or classes may therefore not be selected as part of Master's program studies under these exam regulations, nor be completed under § 3 (3-6). ²In borderline cases and particularly cases in which the content of the modules/ classes overlaps to a large degree, the examination board is to decide on whether the module/ class may be selected/ completed as part of the program. ³The examination board may in individual cases define another appropriate module or class to replace a module or class which is excluded, if otherwise on the basis of these exam regulations and the module handbook there would not be a module yielding the necessary credits for an individual student to complete the program.

(9) The provisions in the module handbook for modules in section 3, Required Electives, may also be valid for that module when it is also used as part of another degree program;

likewise, the Mathematical Physics degree program's module handbook may refer to the module handbook of another degree program for the provisions governing shared modules.

(10) ¹Obtaining additional ECTS points beyond those required under these regulations in line with § 2 (4) sentence 5 of the General Provisions is only permissible if the examination board has specifically approved this for certain modules in the Master's program; beyond that, no further ECTS credits may be obtained. ²For the modules approved by the examination board under sentence 1 above, § 2 (4) sentences 6-7 of the General Provisions apply. ³However, for the modules approved by the examination board under sentence 1 above, § 26 (2) sentences 1 and 3 of the General Provisions do not apply.

II. Teaching of material

§ 4 Types of classes within the modules

Provisions governing the types of classes are set out in § 15 of the General Provisions of these exam regulations.

§ 5 Languages of instruction and examination

¹German and English are the languages of instruction and examination in this degree program. ²Classes and assessment may take place in German or English; students are required to be sufficiently competent in both languages. ³In classes aimed at teaching a language other than German, the teaching and assessment may be conducted in the relevant other language. ⁴The degree may also be obtained by completing the parts of the program offered in English; it is possible to gain enough credit points in the program's English-language classes to complete the degree, with all compulsory classes held in English and in these mandatory and other classes the coursework may be assessed in English.

§ 6 Types of assessment

¹The assessed work required in each of the modules in sections 1-2 and 4 in § 3 (3) is set out in § 3 (3). ²For the modules in section 3 - Free Electives - students should consult the module handbook for details of the required coursework and assessment; in the case of modules originating with a different degree program, students may be required to consult the module handbook of the respective degree program.

§ 7 Multiple-choice procedure

(1) ¹Written assessment in the form of examinations may, in academically justified cases, be wholly or partly completed using a multiple-choice procedure. ²The exam questions must relate to the qualification goals of the respective module and enable reliable results. ³All exam candidates are to receive the same exam questions on the same exam date. ⁴The answers to be recognized as correct must be determined when the exam is compiled; care must be taken to ensure that faulty exam papers are not issued. ⁵Prior to establishing exam results, the person or persons who function as examiners must re-check the exam questions to ensure that they are not faulty by the requirements set out in sentence 2 above. ⁶If this re-checking shows that any exam questions are apparently faulty, or if this becomes otherwise clear, the respective questions may not be included in the calculation of the exam result. ⁷The number of exam questions is reduced accordingly. ⁸During the assessment of the exam in accordance with sentence 1, grades must be calculated on the basis of the reduced number of exam questions. ⁹The reduction in the number of exam questions is not permitted to disadvantage the exam candidate. ¹⁰An exam question is apparently faulty in particular if its wording is unintelligible, contradictory, or ambivalent, or if the answer indicated as correct

according to the answer key is, in fact, wrong. ¹¹Exam instructions must include the number of correct answers for each question.

(2) The questions are required to be approved by a further examiner or to be formulated by two persons authorized to undertake assessment.

(3) ¹Examinations as defined in paragraph (1) sentence 1 in which the questions have only one correct answer have been passed if the exam candidate answered at least 60 percent of the questions asked correctly (absolute pass mark), or if the proportion of questions answered correctly by the candidate is not more than 20 percent below the average achievement of the exam candidates who took the exam for the first time on the exam date (relative pass mark). ²The relative pass mark may only be considered if there is a statistically relevant number of exam candidates. ³If a repeat exam is carried out using a multiple choice procedure, it must be taken within the framework of the scheduled regular exams in the following semester. ⁴Multiple-choice exams are graded as follows: ⁵If the minimum number of points for passing (relative pass mark, if it is a lower value, or the absolute pass mark) has been reached, the following grade is given:

| | | |
|-----|-----------------|--|
| 1.0 | if additionally | at least 90 percent, |
| 1.3 | if additionally | at least 80 percent, but less than 90 percent, |
| 1.7 | if additionally | at least 70 percent, but less than 80 percent, |
| 2.0 | if additionally | at least 60 percent, but less than 70 percent, |
| 2.3 | if additionally | at least 50 percent, but less than 60 percent, |
| 2.7 | if additionally | at least 40 percent, but less than 50 percent, |
| 3.0 | if additionally | at least 30 percent, but less than 40 percent, |
| 3.3 | if additionally | at least 20 percent, but less than 30 percent, |
| 3.7 | if additionally | at least 10 percent, but less than 20 percent, |
| 4.0 | if additionally | less than 10 percent |

is achieved above the minimum number of points for passing. ⁶A grade calculated to a second decimal place will be rounded in favor of the student. ⁷If a student does not obtain the minimum number of points for passing, the grade 5.0 will be given.

(4) ¹The provisions set out in paragraph (3) apply to exams as defined in paragraph (1) sentence 1 which are composed of multiple-choice questions, except that it is not the relationship between the correctly-answered questions and the total number of exam questions which is relevant, but the relationship between the candidate's raw points score to the highest achievable score. ²A value is assigned to each multiple-choice question, corresponding to the number of correct answers; this value may be multiplied by a weighting factor for individual exam questions. ³For each multiple-choice question the exam candidate receives a base number of points, which corresponds to the value if the candidate's answers fully accord with the recognized answers. ⁴For each agreement between an answer respectively selected or not selected by the exam candidate and an answer recognized respectively as correct or incorrect, one point is awarded to the base number of points. ⁵For each failure to select a recognized correct answer, and for each recognized incorrect answer selected by the candidate, one point is deducted from the base number of points; however, the base number of points cannot be lower than zero. ⁶The raw points score is calculated from the base number of points for each question multiplied by its respective weighting factor. ⁷The maximum possible total is calculated from the sum of the products of all values with the respective weighting factors of all of the multiple-choice questions.

(5) If the questions are not all weighted equally, the weighting of each question must be specified on the exam paper.

(6) For exams which are only partly composed of multiple-choice questions, the provisions in paragraphs (1) to (5) apply to the multiple-choice sections only.

(7) If the number of exam questions to be eliminated under paragraph (1) sentence 6 exceeds 15 percent of the total number of multiple-choice questions, the examination as a whole must be repeated; this applies also to exams consisting only partly of multiple-choice questions if that part is weighted with 15 percent or more of the overall value of the examination.

III. Organization of program

§ 8 Scope of studies

The required volume of study is set out in the General Provisions of these exam regulations, the structure of the program and the modules - particularly in § 3 of the Special Provisions of the exam regulations and in the module handbook.

IV. Master's examination and overall grade

§ 9 Nature and procedure of Master's examination

In addition to the prerequisites set out in the General Provisions of these exam regulations, the prerequisites for admission to the final module under § 28 of the General Provisions are:

- the successful completion of the 3 required modules according to § 3(3), in section 1, Basics of Mathematical Physics, and
- the successful completion of modules worth a total of at least 18 ECTS credits from the study areas Further Knowledge and 3 Required Electives (cf. overview in § 3), and
- the successful completion of the Scientific Project module (cf. overview in § 3).

§ 10 Final module

¹Provisions governing the final module are set out in § 28 of the General Provisions of these exam regulations. ²Alongside the Master's thesis, no further oral assessment is required in the final module.

§ 11 Calculation of the Master's overall grade

The overall grade of the Master's examination is calculated on 33% of the grade for the final module and 67% of the average (as weighted by credit points) of the grades of the other graded modules, taking account of the further provisions in § 35 of the General Provisions of these exam regulations.

§ 12 Deadline for completion of degree

¹All coursework and assessment required under the exam regulations for the Master's degree program must be completed by the end of the student's 10th semester in the subject. ²If this time limit is exceeded, the student's right to be examined in the Master's degree program is lost, unless the failure to meet the deadline is beyond the control of the student.

§ 13 Double-degree programs

(1) ¹If the University of Tübingen has, under §6 paragraph (1) LHG, agreed a Double-Degree program between the M.Sc. in Mathematics program and an institution of higher education outside Germany, students in the degree program have the option of participating in the Double-Degree program. ²The requirements for participation and the contents of the program are set out in the respective agreement between the University of Tübingen and the international institution. ³On the Tübingen side, the examination board decides on participation in the program according to the number of available places and the criteria of the degree of suitability and performance (letter of motivation and selection interview), if no other agreement has been reached. ⁴The examination board may transfer this decision revocably to the head of the board or in this case communicate a set number for admission to the selection committee formed for the selection procedure.

(2) ¹Within the framework of a Double-Degree program, participating students must each complete at least 60 credit points at each of the two participating institutions, unless otherwise set out in the Double-Degree agreement; these may be specified in the module handbook for the Tübingen M.Sc. program. ²Work carried out by students at the international institution will be accredited as work done in modules of the M.Sc. of Mathematics degree program at the University of Tübingen, provided the requirements for the accreditation of studies are met. ³To obtain the degree of M.Sc. in Mathematics, all work required under §3 (3) and in the corresponding module handbook must have been completed, unless otherwise proved for in the Double-Degree program agreement.

(3) ¹Upon successful completion of their studies, students will receive their academic degree from their respective university in line with the respective regulations. ²The University of Tübingen confers the Master's degree as set out in § 3 of the General Provisions of these study and exam regulations; the documentation and the degree certificate in particular, may include a reference to the holder's participation in the double-degree program. ³The conferring of an academic degree to students by the international institution is regulated by the international institution.

(4) ¹Students' work at partner institutions is to be completed according to the regulations of the relevant institution. ²Students must in addition fulfill the international institution's requirements regarding the language of instruction and examination. ³Students must carry out coursework at the University of Tübingen in line with the provisions of these study and exam regulations.

(5) ¹Calculation of the overall grade for the Master's examination under these regulations is, for participating students, in accordance with the provisions for the accreditation of coursework and assessment and with the current provisions for calculation of the Master's overall grade in these exam regulations. ²The examination board may determine rules for the conversion of grades given at an institution of higher education outside Germany, if not otherwise specified in the agreement.

V. Closing remarks

§ 14 Effective date and transitional arrangements

¹These exam regulations come into effect on the date of their publication in the University of Tübingen's official bulletin, the Amtliche Bekanntmachungen. ²Their first semester of validity is the winter semester 2019/2020 and they apply only to students who begin their studies in that semester or subsequently. ³Students who commenced their Master's degree studies in Mathematical Physics at the University of Tübingen prior to the semester specified above complete their Master's examination in that program under the previously valid exam regulations.

Tübingen, 20.12.2018

Professor Dr. Bernd Engler
President and Vice-Chancellor