

MATH 6260 GEOMETRY OF QUANTUM FIELDS

Fall 2023

Course Instructor: Dr. Markus Pflaum

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Lecture hours and Venue: MWF 02:30 PM - 03:20 PM, ECCR 118

Office Hours:

M 3:30 PM to 4:30 PM, W 10:00 AM to 11:00 AM and by appointment in MATH 255

Targeted Audience and Prerequisites:

The course is intended for graduate students in mathematics or physics with an interdisciplinary interest.

Some basic knowledge of differential geometry and quantum physics is recommended for participation in the course.

Course Literature:

Folland, G.B., *Quantum Field Theory : A Tourist Guide for Mathematicians*, AMS (2008)

Takhtajan, L.A., *Quantum Mechanics for Mathematicians*, AMS (2008)

Streater, R.F. and Wightman, A.S., *PCT, Spin, Statistics, and All That*, Basic Books

Course Page: <http://math.colorado.edu/courses/GeometryQuantumFields>

Course Contents: The course will provide an introduction to the geometric description of quantum field theories. Topics include symplectic mechanics and deformation quantization, classical field theory within the jet bundle formalism, lorentzian geometry, symmetries in quantum mechanics, axioms of a quantum field theory and an outlook to mathematical approaches for rigorous constructions of perturbative and non-perturbative quantum field theories.

Homework and exams: Homework assignments will be given on the course homepage. Every student needs to present some homework problem in class.

Course Project: In addition to the homework, each student has to work on a course project and write a short paper (around 5 pages) which will be presented in class. A selection of possible topics will be provided on the course page, but you can propose your own project.

Course Grading: Your grade will be determined from the talk and the course project.

SYLLABUS STATEMENTS

CLASSROOM BEHAVIOR

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation, or political philosophy.

The use of electronic devices for purposes which are not class-related is strictly prohibited in class. Students may use their tablets or laptop computers to access course materials and write notes.

Beyond adhering to behavioral standards described above, here are some concrete ways in which you can participate to a positive and inclusive classroom environment:

- Be an active listener, listen for understanding.
- Assume positive intentions.
- Share talk time, in your breakout rooms and in the bigger class discussions.
- Be present and aware of your participation: Are you asking questions? Are you pushing the conversation forward? Are you advocating for what you need and your understanding?
- Everyone in the room has expertise.
- Be respectful and kind to others. Also respect and be kind to yourself.

For more information, see the [classroom behavior policy](#), the [Student Code of Conduct](#), and the [Office of Institutional Equity and Compliance](#).

REQUIREMENTS FOR INFECTIOUS DISEASES

Members of the CU Boulder community and visitors to campus must follow university, department, and building health and safety requirements and all public health orders to reduce the risk of spreading infectious diseases.

The CU Boulder campus is currently mask optional. However, if masks are again required in classrooms, students who fail to adhere to masking requirements will be asked to leave class. Students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct & Conflict Resolution. Students who require accommodation because a disability prevents them from fulfilling safety measures related to infectious disease will be asked to follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

For those who feel ill and think you might have COVID-19 or if you have tested positive for COVID-19, please stay home and follow the [further guidance of the Public Health Office](#). For those who have been in close contact with someone who has COVID-19 but do not have any symptoms and have not tested positive for COVID-19, you do not need to stay home.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

[Disability Services](#) determines accommodations based on documented disabilities in the academic environment. If you qualify for accommodations because of a disability, submit your accommodation letter from Disability Services to your faculty member in a timely manner so your needs can be addressed. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance.

If you have a temporary medical condition or required medical isolation for which you require accommodation, contact me within 3 days of the missed assignment via email to make arrangements such as obtaining exemptions or extensions on homework. There will be no make-up tests: In the event that you miss a test for a medical emergency, you may contact me via email within 3 days of the missed evaluation to discuss the recalibrating of your final grade. Also see [Temporary Medical Conditions](#) on the Disability Services website.

PREFERRED STUDENT NAMES AND PRONOUNS

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

HONOR CODE

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the [Honor Code](#). Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud,

submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: honor@colorado.edu, 303-492-5550. Students found responsible for violating the [Honor Code](#) will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit [Honor Code](#) for more information on the academic integrity policy.

I will report any suspected or confirmed honor code violation to the Honor Code office. Academic sanctions for honor code violations are at the discretion of the instructor. Sanctions will vary from a full letter grade drop to an F in the course, depending on the gravity of the offense(s). If you have any doubt about whether or not something is allowed, it is your responsibility to ask me directly. Ignorance is not be an acceptable excuse.

SEXUAL MISCONDUCT, DISCRIMINATION, HARASSMENT AND/OR RELATED RETALIATION

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits [protected-class](#) discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email cureport@colorado.edu. Information about university policies, [reporting options](#), and support resources can be found on the [OIEC website](#).

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of incidents related to these policies regardless of when or where something occurred. This is to ensure that individuals impacted receive an outreach from OIEC about their options for addressing a concern and the support resources available. To learn more about reporting and support resources for a variety of issues, visit [Don't Ignore It](#).

RELIGIOUS HOLIDAYS

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, you must contact me at least seven days before the scheduled due date of planned missed task (assigned work, quiz, test, etc.) to make arrangements.

See the [campus policy regarding religious observances](#) for full details.

MENTAL HEALTH AND WELLNESS

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact [Counseling and Psychiatric Services \(CAPS\)](#) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through [Academic Live Care](#). The Academic Live Care site also provides information about additional wellness services on campus that are available to students.