Quantum Field Theory A (Physics 215A)
Fall 2026

Lecturer: John McGreevy
Office Hours: After lecture or by appointment.

Use of the Web: The course web page is

http://mcgreevy.physics.ucsd.edu/f26/ .

Problem sets, solutions, lecture notes, handouts, announcements, *etc* will be distributed via this page. You should check it regularly (*e.g.* before each lecture) for new material. It will help to look at the relevant lecture notes before the lecture happens.
Problem set hand-in and return will happen through Canvas.

Content: This course will be an introduction to perturbative quantum field theory, mostly relativistic. We'll see how much of the content of Part I of the book by Peskin and Schroeder we can get our heads around in a quarter. I will try to emphasize connections with many-body physics. The table of contents of the lecture notes is a good outline of the plan.

Texts: I do not plan to follow any textbook very closely. My posted lecture notes will be the main text. The textbook by Zee is wonderful and you should all keep it by your bedside. I will sometimes refer you to some relevant sections of the following books.

Quantum Field Theory in a Nutshell, by Anthony Zee (Princeton) (electronic version through UCSD library here).

An Introduction to Quantum Field Theory, by Michael Peskin and Daniel Schroeder (Wiley).

Quantum Field Theory: an integrated approach, by Eduardo Fradkin (Princeton).

Quantum Field Theory and the Standard Model, by Matthew D. Schwartz (Cambridge).

A Modern Introduction to Quantum Field Theory, by Michele Maggiore (Oxford).

The quantum theory of fields, vol. 1: foundations by Steven Weinberg (Cambridge) (electronic version through UCSD library here).

Finally, a great and freely-available resource is David Tong's lecture notes.

Grading: Grades will be determined by problem sets, class participation, and problem set de-briefs.

Problem sets: Problem sets will be posted on the course web page

http://mcgreevy.physics.ucsd.edu/f26/hw.html .

They will be approximately weekly and generally be due at the beginning of lecture.

Comments on outside help: Problem sets are a very important part of this course. Sitting down yourself and trying to reason your way through problems not only helps you learn the material deeply, but also develops analytical tools fundamental to a successful career in science. Students also learn a great deal from talking to and working with each other. Students can also learn a great deal by interacting with LLMs.

Well-posed, doable, instructive problems in QFT are precious. I encourage you to make your own attempt on every problem and then, having done so, to discuss the problems with other intelligent agents and collaborate on understanding them more fully. Such collaboration adds most to the understanding of those who have done the most by themselves first. The solutions you write up after any discussion and then submit must reflect your own work. They must not be transcriptions or reproductions of other people's work.

Relatedly, it may be possible to find solutions to some of the problems on the internet. I very strongly encourage you to resist the temptation to look for such solutions, for the reasons given in the previous paragraph. The solutions I have written for past years' problem sets have very specific errors sprinkled throughout that identify them uniquely.

In doing the problems, you should feel free to use whatever computational software (*e.g. Mathematica*) you find useful; please make a note in your write-up when you do so.

Problem Set Debriefs: As an experiment in aligning the goals of students and instructor, this quarter we are going to conduct what I have decided to call "Problem Set Debriefs". Each week, n students will be asked to sign up for a 20-minute time slot (on the day the problem set is due) to talk to me. (n is to be determined.) We'll talk about quantum field theory, by default focusing on topics related to the problem set you just submitted. It's a chance for you to ask me where you got stuck, and for me to see how you're thinking about the physics.

I assume that you are taking this class because you want to learn quantum field theory. Happily, my goal in teaching the class is also for you to learn quantum field theory. Exactly why you want to learn quantum field theory I will not presume to know yet (I hope to find out more), but probably it is because you want to do scientific research of some kind in a related area. The way scientific research is done is rapidly changing, but already it is the case that we often use powerful tools like computer algebra software and LLMs and AI agents, and we often talk to each other. So I don't mind if you use these tools, or if you work extensively with your peers.

However, both as a researcher and in this class, you must take absolute ownership of your work. If you put your name on a calculation, you must be able to explain it to someone else at the blackboard.

Therefore, instead of high-stakes exams, which are unhelpful and unpleasant exercises that focus attention on the least interesting parts of the subject, we will be doing these 'Problem Set Debriefs.' I hope they will be fun and instructive.

Homework hand-in procedure: Homework will be handed in electronically. The preferred option is to typeset your homework. It is easy to do and anyway as a practicing scientist you will need to be comfortable quickly producing readable documents. A LaTeX template file with some examples is provided here. I will also provide the tex file for each problem set. If you need help getting set up or have any other questions please email me.

To hand in your homework, please submit a pdf file through the course's canvas website (at canvas.ucsd.edu) under the appropriate assignment, hwnm (where *nm* are the decimal digits of the assignment number).

Thanks in advance for following these guidelines. Please ask me if you have any trouble.

Miscellaneous unsolicited advice about how to do well in this class:

Participate in lecture! I will post my lecture notes, but they are intended as a supplement to what is presented in lecture, not a substitute.

Keep up with the material. Review the lecture notes from previous lectures before the next one. The relevant reading from other sources always appears at the beginning of a section of the lecture notes; read ahead.

Start the homework problems as early as possible. Give yourself some time to think about them, and keep them in mind when you are reading and in lecture.

Ask lots of questions (during lecture, by email, during office hours). I particularly encourage and enjoy questions by email and will do my best to answer them promptly. The fact that you can ask questions is the point of having classes and not just having everyone go learn on their own.