

Teaching Portfolio

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“Nature is a book written in the language of mathematics. If we cannot understand that language, we will be doomed to wander about as if in a dark labyrinth.”

— Galileo Galilei

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1. Statement of Teaching Philosophy

Galileo's image of nature as a book written in the language of mathematics has always captured why I became a physicist. Physics is not only a body of results; it is a way of learning how to read the world, translate observations into quantitative models, and then test whether those models reveal something true. My goal as an instructor is to help students enter that language. I want them to see the beauty and effectiveness of mathematical descriptions of nature, to use concepts to make quantitative predictions, and to experience scientific understanding as a collective project to which they can contribute.

Earlier in my teaching development, I described my method as a three-step process: transmit knowledge, teach students how to apply concepts, and foster collaboration. Through E110 and the Certificate of Practice in University Teaching, I refined that intuition into a more student-centered philosophy organized around three commitments: **Engage, Collaborate, Include**. I still care deeply about clear explanation, but I no longer think of teaching as transmission alone. My responsibility is to design conditions in which students can actively build understanding, practice applying ideas, receive feedback, and feel entitled to ask questions. I teach this way because students learn physics most deeply when they are not only listening to a derivation, but using it, testing it, and discussing its meaning with others.

1.1. Engage: give students a reason to care and a path into the idea

A key element of my teaching is to make lectures, recitations, and office hours clear and engaging without pretending that difficult ideas are simple. Many concepts in physics are counterintuitive because they describe regimes far from everyday experience: special relativity, quantum phases, gauge invariance, spinor representations, renormalization, baryon number violation, and quantum fields. For this reason, I try to begin each topic by making the central question explicit: what problem are we trying to solve, why should we care, and what would be unsatisfactory about our previous way of thinking?

To do this, I use analogies, physical motivations, historical context, and examples from real physics. I also tell students where the analogy breaks. That last step matters because analogies can help students enter an idea, but they can also generate misconceptions if they are treated as the idea itself. For example, when introducing gauge bosons, I sometimes describe them as carriers of information: if action at a distance is not allowed, then local information about phase conventions must be communicated consistently from one spacetime point to another. Quantum-mechanical phases are locally redundant, and the gauge field becomes the structure that makes local comparisons possible. This is not a substitute for covariant derivatives or gauge transformations, but it gives students a physical reason to care before the formalism appears.

I also like to teach by collecting evidence until a conclusion becomes inevitable. In quantum field theory, one of my most successful explanations has been the canonical quantization of the Dirac field. Students often first encounter the rule “bosons commute, fermions anticommute” as something to memorize. I prefer to show why the rule is forced. If one quantizes the Dirac field with commutators, the Hamiltonian is not bounded below; with anticommutators, the theory has a stable vacuum and a sensible particle interpretation. The result is simple and striking: the algebra

is not an arbitrary convention, but a condition for a consistent quantum theory.

My teaching is shaped by the fact that students arrive with different prior knowledge. In courses I design, I would begin with a short anonymous diagnostic assessment—quizzes, estimates, or brief conceptual exercises—to understand which prerequisites are solid and which need review. In my own TA work, I used office hours, live polls, and feedback forms in the same spirit: as ways to identify where students were getting stuck while there was still time to respond. When I plan a lecture or recitation, I center it around one core topic, make the motivation explicit at the beginning, and try to provide a map of the logic so that students do not become passive note-takers who copy equations without understanding the thread.

In Ph139, *Introduction to Elementary Particle Physics*, students struggled with the group-theoretic foundations behind particle multiplets. I did not try to bypass the difficulty. Instead, I built the necessary representation-theory foundations step by step and then constructed the meson and baryon octets with the students. The goal was for them to see group theory as a language for organizing physical evidence, not as an abstract obstacle between them and particle physics. In Ph205, *Relativistic Quantum Field Theory*, I used similar scaffolding for more advanced material: Faddeev–Popov quantization, spinor representations, Feynman diagram calculations, and renormalization. Advanced physics cannot always be simplified, but it can be made navigable.

I also use historical and philosophical framing whenever appropriate. I want students to see that physics was not born fully formed. Ideas developed in response to problems, failed attempts, and conceptual tensions. Presenting that history encourages students to try, fail, and revise their reasoning. When historically appropriate, I include the work of women and underrepresented scientists, not as an isolated aside, but because students should see that the history of physics has always been broader than the narrow canon they may have inherited.

1.2. Collaborate: make students do the intellectual work of physics

Students learn physics by doing physics. For me, the application stage of learning is not separate from conceptual understanding; it is where understanding becomes real. I use short problems, estimation questions, live polls, collective derivations, and problem sets to move students from recognizing an idea to using it.

During lectures or recitations, I often pause after introducing a concept and give students a short problem or strategic question. I ask them to think first, then compare reasoning with a partner or with the room, and then we work through the solution together on the board. This resembles Think–Pair–Share in spirit, but I adapt it to the context. In office hours, students often arrive with individual questions; when several students are stuck on related points, I reframe the meeting as a collective derivation. Rather than answering isolated questions one by one, I ask the group to identify the first step, compare possible strategies, and reconstruct the solution together. In Ph205, where collaboration on problem sets is part of the culture, I explicitly encouraged students to use office hours as a place to compare reasoning rather than simply check answers.

My use of collaboration has grown in response to feedback. In Ph139, students appreciated my enthusiasm and clarity, but one mid-quarter survey suggested that office hours could become too much like rapid-fire questions. I took this seriously. In later Ph205 office hours, I worked to slow

the pace, reduce question-answer pressure, and give students more room to reason together. I prepared recurring conceptual checkpoints, asked students what they had already tried, and used their partial progress as the starting point for hints. This made office hours less about me providing answers and more about students learning how to move when they are stuck.

As a future instructor, I would make formative assessment a regular part of the course structure. Problem sets should not only test whether students can apply formulas; they should ask students to reason in complex situations, articulate assumptions, and connect formal steps to physical interpretation. In problem sets I design, I would include a baseline conceptual component that checks essential understanding. If fewer than roughly 80% of students answer that component correctly, I would treat it as evidence that the concept needs to be revisited in class with worked examples and a detailed explanation. This is one way I make assessment serve learning rather than merely record performance.

In Winter 2026, I used anonymous live polls in guest lectures on baryogenesis and leptogenesis. I prepared conceptual questions and estimation prompts in advance, collected student responses anonymously, and used the distribution of answers to guide discussion. Students estimated the baryon asymmetry, reasoned through why equilibrium thermodynamics alone cannot explain the observed universe, identified baryon-number-violating operators, and connected proton decay bounds to dimensional analysis. Anonymous polling made student thinking visible while keeping participation low-pressure.

I have also used artificial intelligence as an object of critique. In a Ph205 AI for Physics lecture, we asked AI tools to solve mostly quantum-field-theory problems and then discussed the solutions in class. The goal was not to present AI as a shortcut, but to examine what it did well, where it made mistakes, and why human physical judgment remains essential. Students saw that a fluent derivation can still hide a missing assumption, a wrong sign, a hallucinated theorem, or a failure to check limits. This activity connected a contemporary tool to an old scientific habit: do not trust an answer until you understand the reasoning.

1.3. Include: make physics a place where students can think

As a member of the LGBTQIA+ community, I know that belonging is not peripheral to learning; it shapes whether students feel entitled to ask questions, take intellectual risks, and imagine themselves as physicists. I want every student in my class to feel that they belong there, no matter who they are or what background they bring. Inclusive teaching, for me, is not only a statement of values. It is a set of practices that lower unnecessary barriers while preserving high expectations.

I try to create a classroom climate in which confusion is not shameful. I encourage basic questions, use anonymous feedback surveys, invite students to reach out with concerns, and make myself available by email when they need clarification outside office hours. I use multiple explanations and analogies because students do not all enter a topic through the same door. I also pay attention to prerequisite gaps. In physics, a student can appear confused about a new idea when the real obstacle is an older piece of mathematics or notation that everyone assumes is already automatic.

Peer learning is also part of inclusion. From my recitations and office hours at Caltech, I have often noticed that students learn effectively from one another, especially when the atmosphere is

collaborative rather than competitive. For a course of my own, I would supplement traditional office hours with small-group problem sessions in which students work in groups of two or three on assigned exercises while the TA and I circulate, ask guiding questions, and give feedback. This structure lowers the barrier for students who might be intimidated by traditional office hours and helps build a community of learners.

Equity also requires attention to assessment. Timed, high-stakes exams are not the only way students demonstrate mastery. Whenever possible, I value a mix of problem sets, low-stakes quizzes, collaborative work, oral explanation, and written reflection. Different formats reveal different dimensions of understanding. I would also use mid-course feedback and, in introductory physics, concept inventories or diagnostic assessments to monitor whether students are meeting learning goals and whether some groups are being systematically left behind. Good intentions are not enough; teaching should be adjusted in response to evidence.

1.4. Reflect: use feedback to improve the course and myself

Students' feedback is one of the most important instruments I have for understanding whether my teaching strategies are working. I use formal evaluations, mid-quarter surveys, office-hour conversations, homework performance, and my own reflection after teaching. The point is not simply to collect positive comments, but to identify patterns: what helped students learn, what confused them, and what I should change while I still have the chance.

CPET helped me understand teaching as an iterative practice. Before E110, my teaching was enthusiastic and intuitive, but I had less knowledge of research-based pedagogy. E110 introduced me to goal-directed teaching, backward planning, active learning, class climate, prior knowledge and misconceptions, formative and summative assessment, and inclusive teaching. Those ideas changed how I plan. I now ask not only, "What material should I cover?" but "What should students be able to do, how will they practice it, and what evidence will tell me whether they learned it?"

My Ph139 and Ph205 experiences taught me that complex topics cannot always be simplified, but basic comprehension can be built step by step. They also taught me that some tools work only in the right context. Graphical maps can be powerful, but in advanced QFT they can oversimplify. Preparing office hours in advance is essential, but overpreparing can create pressure to cover too much; sometimes less is more because it leaves room to respond to students' actual needs.

I am still working to improve my communication and participation strategies. In particular, I want to become better at designing activities that invite students to participate without feeling exposed, and at balancing technical rigor with a supportive classroom climate. Teaching itself is an incredible learning opportunity. My long-term goal is to become an instructor who helps students read the mathematical language of nature, apply it with confidence, and join the collective human effort to understand the universe.

2. Teaching Activities

2.1. Summary

My teaching experience spans introductory physics, advanced undergraduate quantum mechanics, graduate quantum field theory, particle physics, outreach, and department-level teaching leadership. I have taught or supported students at multiple levels: high-school visitors in a physics museum, first-year physics students, advanced undergraduates, graduate students, and graduate teaching assistants.

2.2. Teaching activities table

Note on evaluation links. The course-teaching entries below link to the corresponding TQFR/CCEQ excerpts in Appendix A when a TA-specific evaluation excerpt with scores and/or comments is available. Teaching leadership and assessment roles are listed separately so that course TA work, TA Fellow service, outreach, and research-presentation evaluation remain distinct.

Course teaching and guest lecturing

Term/Period	Teaching activity, responsibilities, audience, and evidence
Fall 2019	Teaching Assistant, <i>Computational Methods for Physics</i>, Sapienza University of Rome. Lab tutor for first-year physics majors. Assisted students during computational exercises and helped them connect programming techniques to physics problems.
Winter 2021	Teaching Assistant, <i>Ph1b: Classical Mechanics and Electromagnetism</i>, Caltech. Led two weekly recitations for STEM freshmen, one focused on conceptual development and one on problem-solving strategies. Helped compose and grade the final exam. Approximate enrollment: 100+. Evidence: Appendix A.1.
Fall 2021	Teaching Assistant, <i>Ph125a: Quantum Mechanics</i>, Caltech. Held office hours, graded problem sets, wrote/reviewed solutions, and led review sessions for advanced undergraduate physics students. Approximate enrollment: 50+.
Winter 2022	Teaching Assistant, <i>Ph1b: Classical Mechanics and Electromagnetism</i>, Caltech. Led two weekly recitations, held office hours, prepared and presented five test-review sessions, and collaborated on the composition and grading of four quizzes and the final exam. Approximate enrollment: 100+. Evidence: Appendix A.2.
Spring 2022	Teaching Assistant, <i>Ph205c: Relativistic Quantum Field Theory</i>, Caltech. Held office hours, led recitations, graded problem sets, wrote solutions, and helped prepare problem-set material with Prof. Mark Wise. Approximate enrollment: 10+. Evidence: Appendix A.3.

Term/Period	Teaching activity, responsibilities, audience, and evidence
Fall 2022	Teaching Assistant, <i>Ph125a: Quantum Mechanics</i>, Caltech. Held office hours, graded problem sets, wrote/reviewed solutions, and led review sessions. Approximate enrollment: 50+. Evidence: Appendix A.4.
Winter 2023	Teaching Assistant, <i>Ph139: Introduction to Elementary Particle Physics</i>, Caltech. Reviewed and improved assignment problems and solutions, suggested new problems, graded nine problem sets, held weekly office hours, and advised the instructor on course alignment. Instructor: Prof. Alan Weinstein. Approximate enrollment: 30+. Evidence: Appendix A.5.
Spring 2023	Teaching Assistant, <i>Ph205c: Relativistic Quantum Field Theory</i>, Caltech. Held recitations and office hours, wrote problem sets and solutions with Prof. Mark Wise, graded assignments, and delivered a full lecture on the Faddeev–Popov procedure. Approximate enrollment: 10+. Evidence: Appendix A.6.
Fall 2023	Teaching Assistant, <i>Ph205a: Relativistic Quantum Field Theory</i>, Caltech. Held recitations and office hours, wrote problem sets and solutions with Prof. Mark Wise, graded assignments, and helped students build foundational QFT techniques. Approximate enrollment: 40+. Evidence: Appendix A.7.
Winter 2024	Teaching Assistant, <i>Ph205b: Relativistic Quantum Field Theory</i>, Caltech. Held recitations and office hours, wrote problem sets and solutions with Prof. Mark Wise, graded assignments, and supported students through Feynman diagram calculations and QED. Approximate enrollment: 20+. Evidence: Appendix A.8.
Spring 2024	Teaching Assistant, <i>Ph205c: Relativistic Quantum Field Theory</i>, Caltech. Held recitations and office hours, wrote problem sets and solutions with Prof. Mark Wise, graded assignments, and supported students in non-Abelian gauge theory and the Standard Model. Approximate enrollment: 10+. Evidence: Appendix A.9.
Fall 2025	Teaching Assistant, <i>Ph205a: Relativistic Quantum Field Theory</i>, Caltech. Held recitations and office hours, wrote problem sets and solutions with Prof. Mark Wise, graded assignments, and delivered a full lecture on Lorentz representations, Weyl and Dirac spinors, helicity/chirality, spin sums, and solutions of the Dirac equation. Approximate enrollment: 30+. Evidence: Appendix A.10; lecture notes: Appendix B.1.

Term/Period Teaching activity, responsibilities, audience, and evidence

Winter 2026	Teaching Assistant, <i>Ph205b: Relativistic Quantum Field Theory</i>, Caltech. Held recitations and office hours, wrote problem sets and solutions, graded assignments, and delivered a participatory <i>AI for Physics</i> lecture. In that lecture, students evaluated AI-generated solutions to mostly QFT problems, discussed what the model got right and wrong, and used anonymous polls to reflect on the strengths and limitations of AI tools in advanced physics. Approximate enrollment: 20+. Evidence: Appendix A.11; AI lecture polls: Appendix B.4; representative problem-set excerpt: Appendix B.5.
Winter 2026	Guest Lecturer, Baryogenesis/Leptogenesis. Delivered two full guest lectures on baryogenesis and leptogenesis. Used live-poll questions and estimation prompts to diagnose student understanding and stimulate discussion. Evidence: Appendix B.2 and Appendix B.3.

Teaching leadership, assessment, and outreach

Period Activity, responsibilities, and evidence

Jan. 2018–Jul. 2020	Physics Museum Guide, Sapienza University of Rome. Guided local and international visitors, including high-school students and Physics Department guests, through exhibitions of nineteenth- and twentieth-century physics experiments. Adapted explanations to visitors' backgrounds.
2023–2025	SURF Seminar Day Session Chair and Judge, Caltech. Evaluated undergraduate research presentations, provided feedback on clarity, scientific argumentation, slide design, timing, and audience engagement. This role developed my ability to assess scientific communication and give concise, actionable feedback to undergraduate researchers.
2024–2025	Physics and Astronomy TA Fellow, PMA, Caltech. Supported 122 individual Physics/Astronomy graduate and undergraduate TAs and graders across 231 term-based assignments. Responsibilities included PMA TA orientation; mentoring and troubleshooting for Physics and Astronomy TAs, UTAs, and graders; G1 and first-time TA check-ins; Head TA support; ombuds coordination and reports; recitation observations for newer TAs; TA archive/manual/resource updates; AP and placement-exam support; TA feedback surveys; and department-level teaching improvement recommendations. I also organized three TA-facing events during the year, including Fall and Winter feedback/appreciation events and a Spring teaching-resource/active-learning event. Evidence: Appendix C.1, Appendix C.2, and Appendix C.3.

3. Evidence of Teaching Effectiveness

3.1. Overview

I evaluate my teaching using multiple forms of evidence: student evaluations, anonymous feedback surveys, student comments, course outcomes, instructor feedback, self-reflection, and the evolution of my teaching practices over time. Across my Caltech teaching, students consistently identified several strengths: clarity, preparation, availability, enthusiasm, and the ability to make difficult physics more approachable.

3.2. Clarity, preparation, and availability

Students repeatedly noted that I was well-prepared and clear in instructional settings. In Ph139, my TA ratings were 5.00/5.00 in all categories: helpful comments, clear answers, preparation, clear presentation, and overall teaching effectiveness. Student comments included:

“Thank you Sam! I really enjoyed coming to your office hours and your advice was really helpful.”

“Sam was very helpful in office hours etc. He was very available to ask questions and he made things much clearer. I was grateful for him being able to help the students out when the lectures and homework got misaligned. Thank you thank you thank you so much. You have made a world of a difference.”

In Winter 2024 Ph205b, I received 5.00/5.00 across TA categories. One student wrote:

“Excellent TA. Great balance in OH of giving an overview of problems without going too much into the weeds of the calculation, while also providing interesting insights into the physics we are studying. You’ll make a great lecturer one day.”

In Winter 2026 Ph205b, I again received 5.00/5.00 across all TA categories. A student wrote:

“Sam was an incredible TA! He was able to explain concepts with great knowledge and clarity during office hours, and I appreciated his availability, enthusiasm, and encouraging attitude when helping students.”

These comments reflect the kind of teacher I aim to be: rigorous, clear, available, and emotionally encouraging.

3.3. Helping students in difficult course contexts

Some of my strongest teaching feedback came in courses where students found the material difficult or where lectures and homework were not always aligned. In Ph139, students noted that both the instructor and I worked to bring the course back on track when lecture content and problem sets became misaligned. In Ph125a, where the course was especially challenging and mathematically demanding, students singled out my contributions despite my limited portion of the TA assignment:

“This TA is fantastic, I thought they were immensely helpful. I was disappointed however, that they were not TAing for the whole quarter.”

“Sam was the best TA of the course, he was well prepared, clear, and very knowledgeable about the course content. We all wished he was responsible for more than two homeworks.”

These comments matter to me because they show the impact of TA support in moments when students feel overwhelmed. A TA can help restore structure, confidence, and continuity when a course becomes difficult.

3.4. Responding to critical feedback

Positive feedback is encouraging, but critical feedback is often more useful for growth. In Fall 2023 Ph205a, one student noted that my grading could have provided more explanatory feedback and more transparency about partial credit. I took this seriously. My goal as a grader is not only to evaluate, but also to teach. This feedback reminded me that rigor must be paired with explanation: students should know not only that a step is wrong, but why it is wrong and how to repair the reasoning.

This lesson shaped how I thought about grading in later courses and in my TA Fellow work. In the Physics TA Manual, I emphasized the importance of grading uniformly, explaining point deductions, identifying common mistakes, and giving constructive feedback that helps students understand where their reasoning failed.

3.5. Teaching innovation: AI as an object of critique

A distinctive component of my recent teaching has been my use of AI as an object of critical analysis rather than as an authority. In Ph205c and again in Winter 2026 Ph205b, I used AI-generated solutions as teaching material: students examined solutions to mostly QFT problems, identified mistakes or unjustified steps, and discussed what the model did well, what it hallucinated, and where human physical judgment remained essential.

In the Winter 2026 *AI for Physics* lecture, I began by polling students anonymously about how they used tools such as ChatGPT or Claude in their own work. I then asked them to predict where ChatGPT would fail on QFT tasks and to evaluate actual AI attempts at relatively simple but technically delicate QFT problems. The class discussion focused on concrete advantages and disadvantages: AI can be useful for coding, formatting, summarizing, and generating first-pass explanations, but it can also produce plausible-looking algebra with wrong symmetry factors, missing assumptions, or incorrect physics. This activity helped students practice expert skepticism: checking assumptions, verifying equations, identifying missing factors, and recognizing when fluent derivations conceal conceptual errors.

3.6. Teaching leadership evidence

As Physics and Astronomy TA Fellow, I expanded my teaching work from individual courses to department-level teaching structures. I supported 122 individual Physics/Astronomy graduate and undergraduate TAs and graders across 231 term-based assignments. My responsibilities combined direct TA mentoring, course-feedback infrastructure, teaching-resource development, and department-level assessment. My work included:

- preparing and leading PMA TA orientation and overview materials for graduate TAs, undergraduate TAs, and graders;
- providing mentoring, troubleshooting, and course-specific support for Physics and Astronomy TAs, including G1 and first-time TA check-ins;
- supporting Head TAs through periodic check-ins and clearer expectations for coordination, office hours, grading, and communication with instructors;
- establishing and coordinating course ombuds structures, leading ombuds meetings, taking notes, and sharing anonymized feedback with instructors;
- observing newer TAs in recitations and identifying where additional teaching support was needed;
- maintaining and revising TA resources, including the Physics TA Manual, the PMA TA Resources webpage, and course archives;
- helping with AP and placement-exam support, including reviewing solutions and identifying ambiguities;
- designing a TA feedback survey to gather anonymous suggestions for future TA support;
- organizing three TA-facing events during the academic year: Fall and Winter feedback/appreciation events, and a Spring teaching-resource/active-learning event;
- proposing structural improvements for TA assignments, extension policies, grading workflows, CASS accommodation workflows, Head TA duties, and prerequisite diagnostics.

This role taught me that effective teaching depends not only on the individual instructor, but also on policies, communication channels, course logistics, training structures, and feedback loops. A supportive teaching culture is built deliberately.



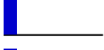
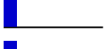

4. Appendix A: Evaluation Evidence

This appendix includes selected evaluation excerpts focused on my scores and comments about my teaching. I intentionally exclude unrelated instructor/course sections where possible and avoid including scores/comments for other TAs except where unavoidable in the original report layout.

A.1 Ph1b Practical, Winter 2021

Teaching Assistant Section: Samuel Patrone

Teaching Assistant Ratings

		Score	Dept.	Div.	Caltech
Provided helpful comments on assignments, papers, exams		5.00 ± 0.00	4.43	4.47	4.73
Answered questions clearly and concisely		5.00 ± 0.00	4.43	4.49	4.71
Was well prepared for section, office hours or lab		5.00 ± 0.00	4.49	4.56	4.74
Presented material clearly in section or lab		5.00 ± 0.00	4.46	4.57	4.77
Overall teaching effectiveness		5.00 ± 0.00	4.45	4.52	4.73

Comments

Please provide any comments you may have regarding the teaching assistant: Samuel Patrone






No comments were entered for this subject.

Figure 1: CCEQ excerpt for Ph1b Practical, Winter 2021: Samuel Patrone TA scores and comment field.

A.2 Ph1b Analytical, Winter 2022

Teaching Assistant Section: Samuel Patrone

Teaching Assistant Ratings

		Score	Dept.	Div.	Caltech
Provided helpful comments on assignments, papers, exams		4.75 ± 0.43	4.57	4.43	4.62
Answered questions clearly and concisely		4.60 ± 0.49	4.42	4.40	4.60
Was well prepared for section, office hours or lab		4.60 ± 0.49	4.56	4.53	4.65
Presented material clearly in section or lab		4.60 ± 0.49	4.51	4.54	4.67
Overall teaching effectiveness		4.60 ± 0.49			

Comments

Please provide any comments you may have regarding the teaching assistant: Samuel Patrone






Amazing TA, I was not officially in the section but easily my favorite to attend and very helpful! Great at explaining and loved the enthusiasm; even through zoom it felt highly engaging

Figure 2: TQFR excerpt for Ph1b Analytical, Winter 2022: Samuel Patrone TA scores and anonymous comment.

A.3 Ph205c, Spring 2022

Teaching Assistant Section: Samuel Patrone

Teaching Assistant Ratings

		Score	Dept.	Div.	Caltech
Provided helpful comments on assignments, papers, exams		4.50 ± 0.50	4.69	4.63	4.62
Answered questions clearly and concisely		4.50 ± 0.50	4.59	4.59	4.59
Was well prepared for section, office hours or lab		4.50 ± 0.50	4.53	4.60	4.60
Presented material clearly in section or lab		4.50 ± 0.50	4.58	4.66	4.67
Overall teaching effectiveness		4.50 ± 0.50	4.54	4.57	4.61

Comments

Please provide any comments you may have regarding the teaching assistant: Samuel Patrone

Sam, you were always very helpful when I asked for help. I could see that you enjoy TAing.

Figure 3: TQFR excerpt for Ph205c, Spring 2022: Samuel Patrone TA scores and comment.

A.4 Ph125a, Fall 2022

Teaching Assistant Section: Samuel Patrone

Teaching Assistant Ratings

Provided helpful comments on assignments, papers, exams		4.50 ± 0.50	4.54	4.48	4.59
Answered questions clearly and concisely		4.50 ± 0.50	4.44	4.42	4.55
Was well prepared for section, office hours or lab		4.50 ± 0.50	4.43	4.43	4.58
Presented material clearly in section or lab		4.60 ± 0.49	4.44	4.44	4.59
Overall teaching effectiveness		4.50 ± 0.50	4.49	4.45	4.58

Comments

Please provide any comments you may have regarding the teaching assistant: Samuel Patrone

This TA is fantastic, I thought they were immensely helpful. I was disappointed however, that they were not TAing for the whole quarter. I would have definitely appreciated their help on some of the harder homework sets later into the quarter.

Sam was the best TA of the course, he was well prepared, clear, and very knowledgeable about the course content. We all wished he was responsible for more than two homeworks.

Figure 4: TQFR excerpt for Ph125a, Fall 2022: Samuel Patrone TA scores and anonymous comments.

A.5 Ph139, Winter 2023

Teaching Assistant Section: Samuel Patrone

Teaching Assistant Ratings

		Score	Dept.	Div.	Caltech
Provided helpful comments on assignments, papers, exams		5.00 ± 0.00	4.59	4.49	4.60
Answered questions clearly and concisely		5.00 ± 0.00	4.57	4.51	4.58
Was well prepared for section, office hours or lab		5.00 ± 0.00	4.62	4.56	4.62
Presented material clearly in section or lab		5.00 ± 0.00	4.66	4.59	4.62
Overall teaching effectiveness		5.00 ± 0.00	4.64	4.57	4.62

Comments

Please provide any comments you may have regarding the teaching assistant: Samuel Patrone

Thank you Sam! I really enjoyed coming to your office hours and your advice was really helpful.
Very good!
Thanks for all the help throughout term!
Sam was very helpful in office hours etc. He was very available to ask questions and he made things much clearer. I was grateful for him being able to help the students out when the lectures and homework got misaligned. Thank you thank you thank you so much. You have made a world of a difference.

Figure 5: TQFR excerpt for Ph139, Winter 2023: Samuel Patrone TA scores and anonymous comments.

A.6 Ph205c, Spring 2023

Teaching Assistant Section: Samuel Patrone

Teaching Assistant Ratings

		Score	Dept.	Div.	Caltech
Provided helpful comments on assignments, papers, exams		5.00 ± 0.00	4.53	4.55	4.59
Answered questions clearly and concisely		5.00 ± 0.00	4.53	4.58	4.58
Was well prepared for section, office hours or lab		5.00 ± 0.00	4.63	4.66	4.61
Presented material clearly in section or lab		5.00 ± 0.00	4.67	4.70	4.65
Overall teaching effectiveness		5.00 ± 0.00	4.53	4.58	4.59

Comments

Please provide any comments you may have regarding the teaching assistant: Samuel Patrone

Sam is awesome! Clearly knows his stuff!
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Figure 6: TQFR excerpt for Ph205c, Spring 2023: Samuel Patrone TA scores and anonymous comment.

A.7 Ph205a, Fall 2023

Teaching Assistant Section: Samuel Patrone

Supplemental TA Questions

		Score	Dept.	Div.	Caltech
My TA provided helpful comments on assignments, papers, and/or exams.		4.00 ± 1.22	4.63	4.67	4.62
My TA answered questions clearly.		4.38 ± 0.48	4.68	4.72	4.66
My TA was well prepared in instructional settings.		4.50 ± 0.50	4.76	4.75	4.69
My TA presented material clearly in instructional settings.		4.43 ± 0.73	4.70	4.74	4.69

Comments

For Samuel Patrone: What aspects of this TA's teaching did you find helpful? What aspects could be improved to help future students in their learning?

Very hard grader and provided little to no partial credit. Additionally, when I got something wrong on a set, he would mark it wrong but not elaborate on how it was wrong.
Office hours were very instructive, and Sam clearly shows great mastery of the material.

Figure 7: TQFR excerpt for Ph205a, Fall 2023: Samuel Patrone TA scores and reflective critical feedback about grading.

A.8 Ph205b, Winter 2024

Teaching Assistant Section: Samuel Patrone

Supplemental TA Questions

		Score	Dept.	Div.	Caltech
My TA provided helpful comments on assignments, papers, and/or exams.		5.00 ± 0.00	4.60	4.68	4.57
My TA answered questions clearly.		5.00 ± 0.00	4.57	4.67	4.57
My TA was well prepared in instructional settings.		5.00 ± 0.00	4.63	4.71	4.60
My TA presented material clearly in instructional settings.		5.00 ± 0.00	4.61	4.71	4.61

Comments

For Samuel Patrone: What aspects of this TA's teaching did you find helpful? What aspects could be improved to help future students in their learning?

Excellent TA. Great balance in OH of giving an overview of problems without going too much into the weeds of the calculation, while also providing interesting insights into the physics we are studying. You'll make a great lecturer one day.
You did very well in the past term! keep on the great work!
Awesome TA, always willing to help outside of OH too!

Figure 8: TQFR excerpt for Ph205b, Winter 2024: Samuel Patrone TA scores and anonymous comments.

A.9 Ph205c, Spring 2024

Teaching Assistant Section: Samuel Patrone

Supplemental TA Questions

		Score	Dept.	Div.	Caltech
My TA provided helpful comments on assignments, papers, and/or exams.		5.00 ± 0.00	4.59	4.50	4.61
My TA answered questions clearly.		5.00 ± 0.00	4.61	4.53	4.62
My TA was well prepared in instructional settings.		5.00 ± 0.00	4.68	4.57	4.63
My TA presented material clearly in instructional settings.		5.00 ± 0.00	4.73	4.60	4.65

Comments

For Samuel Patrone: What aspects of this TA's teaching did you find helpful? What aspects could be improved to help future students in their learning?

No comments were entered for this subject.

Figure 9: TQFR excerpt for Ph205c, Spring 2024: Samuel Patrone TA scores and comment field.

A.10 Ph205a, Fall 2025

Teaching Assistant Section: Samuel Patrone

Supplemental TA Questions

		Score	Dept.	Div.	Caltech
My TA provided helpful comments on assignments, papers, and/or exams.		4.50 ± 0.50	4.39	4.40	4.51
My TA answered questions clearly.		5.00 ± 0.00	4.52	4.47	4.55
My TA was well prepared in instructional settings.		5.00 ± 0.00	4.64	4.52	4.60
My TA presented material clearly in instructional settings.		5.00 ± 0.00	4.49	4.44	4.55

Comments

For Samuel Patrone: What aspects of this TA's teaching did you find helpful? What aspects could be improved to help future students in their learning?

No comments were entered for this subject.

Figure 10: CCEQ excerpt for Ph205a, Fall 2025: Samuel Patrone TA scores and comment field.

A.11 Ph205b, Winter 2026

Teaching Assistant Section: Samuel Patrone

Supplemental TA Questions

		Score	Dept.	Div.	Caltech
My TA provided helpful comments on assignments, papers, and/or exams.		5.00 ± 0.00	4.84	4.66	4.69
My TA answered questions clearly.		5.00 ± 0.00	4.82	4.71	4.71
My TA was well prepared in instructional settings.		5.00 ± 0.00	4.75	4.69	4.73
My TA presented material clearly in instructional settings.		5.00 ± 0.00	4.77	4.67	4.74

Comments

For Samuel Patrone: What aspects of this TA's teaching did you find helpful? What aspects could be improved to help future students in their learning?

Sam was an incredible TA! He was able to explain concepts with great knowledge and clarity during office hours, and I appreciated his availability, enthusiasm, and encouraging attitude when helping students. Thank you Sam!

Figure 11: CCEQ excerpt for Ph205b, Winter 2026: Samuel Patrone TA scores and anonymous comment.

B.2 Baryogenesis and leptogenesis lecture materials

In Winter 2026, I delivered guest lectures on baryogenesis and leptogenesis. The lecture materials articulated learning goals, developed the Sakharov conditions and toy-model baryogenesis, and included clicker questions and short polls.

Lecture 1: The Baryon Asymmetry of the Universe (BAU) and Toy-Model Baryogenesis

Graduate Cosmology / Astroparticle Physics

Learning goals

By the end of this lecture, you should be able to:

- define the observed baryon asymmetry and translate between common normalizations;
- understand why a baryon-symmetric universe would be essentially baryon-free after $N\bar{N}$ annihilation;
- explain (in detail) why each Sakharov condition is necessary under standard assumptions (local QFT, CPT, thermal equilibrium);
- set up and approximately solve the Boltzmann system for baryogenesis from out-of-equilibrium decays of a heavy particle.

Contents

1 What is the baryon asymmetry? What do we observe?	1
1.1 Definitions and useful normalizations	1
1.2 How do we measure it?	2
1.3 What we “see” in the sky	2
2 Why a baryon-symmetric universe would be (almost) empty of baryons	2
2.1 Boltzmann equation for annihilating species in an expanding universe	2
2.2 Approximate freeze-out solution (“cold relics”)	3
2.3 Application 1: A baryon-symmetric universe	3
2.4 Application 2: A baryon-asymmetric universe	4
3 Sakharov conditions (1967)	4
3.1 Why baryon number violation is necessary	5
3.2 Why C and CP violation are necessary	5

Figure 13: Baryogenesis lecture notes, page 1: learning goals and structure.

A Clicker questions and short in-class polls

- 1. BAU normalization.** If $\eta_B \equiv (n_B - n_{\bar{B}})/n_\gamma \simeq 6 \times 10^{-10}$, what is $Y_{\Delta B} \equiv (n_B - n_{\bar{B}})/s$?

Answer. Using Eq. (4), $Y_{\Delta B} = \eta_B/(s/n_\gamma) \simeq \eta_B/7.04$. For $\eta_B \simeq 6 \times 10^{-10}$, this gives $Y_{\Delta B} \simeq 8.5 \times 10^{-11}$.
- 2. Freeze-out intuition.** In a baryon-symmetric universe, would you expect more or fewer relic nucleons than in our universe? Why?

Answer. Fewer, by many orders of magnitude. In a baryon-symmetric universe, $N\bar{N}$ annihilations erase both N and \bar{N} until freeze-out, leaving a tiny symmetric relic $Y_N \sim Y_{\bar{N}} \sim 10^{-19}$ (cf. Eq. (19)). In an asymmetric universe, annihilations remove only the symmetric component and the surviving baryons are set by the primordial asymmetry $Y_{\Delta B} \sim 10^{-10}$.
- 3. Sakharov logic check.** Suppose a theory violates B and CP, but all relevant interactions remain in thermal equilibrium until very late times. Can it generate a net B ?

Answer. No. In thermal equilibrium, detailed balance ensures the collision term vanishes on equilibrium distributions, and efficient inverse processes (washout) drive $\mu_B \rightarrow 0$ and hence $n_B = n_{\bar{B}}$. CP violation can bias individual partial rates, but in equilibrium the forward and inverse reactions cancel, yielding zero net B .
- 4. Out-of-equilibrium parameter.** Consider $K \equiv \Gamma/H|_{T=m_X}$. If $K \ll 1$, which is more suppressed: decays or inverse decays around $T \simeq m_X$?

Answer. For $K \ll 1$, interactions are too slow to maintain equilibrium around $T \simeq m_X$. Inverse decays are more suppressed: producing a heavy X from light particles carries a Boltzmann penalty once $T \lesssim m_X$, and the same small couplings that make Γ small also suppress inverse processes. Thus washout from inverse decays is negligible.
- 5. Interference requirement.** Why does a nonzero CP asymmetry in decays typically require at least two amplitudes (e.g. tree + loop) and an absorptive part?

Answer. Because a CP asymmetry in a rate is an interference effect. One needs (i) a CP-odd phase (complex couplings) and (ii) a CP-even phase (an absorptive/imaginary part of the loop from an on-shell cut). With only one amplitude, $|\mathcal{M}|^2$ is CP-even; with no absorptive part, the relevant interference term cannot generate a rate asymmetry.
- 6. Order-of-magnitude.** If $g_{*s} \sim 100$ and $g_{\text{eff}} = 1$, what order of magnitude is $Y_X^{\text{eq}}(0)$? Given $Y_{\Delta B}^{\text{obs}} \sim 10^{-10}$, what rough size of $\epsilon_X \kappa$ is needed?

Answer. For a relativistic species, $Y_X^{\text{eq}}(0) \simeq 0.278 g_{\text{eff}}/g_{*s} \sim 3 \times 10^{-3}$. Matching $Y_{\Delta B}^{\text{obs}} \sim 10^{-10}$ then requires $\epsilon_X \kappa \sim Y_{\Delta B}^{\text{obs}}/Y_X^{\text{eq}}(0) \sim 10^{-10}/(3 \times 10^{-3}) \sim \text{few} \times 10^{-8}$.

Figure 14: Baryogenesis lecture notes, page 14: clicker questions and short in-class polls.

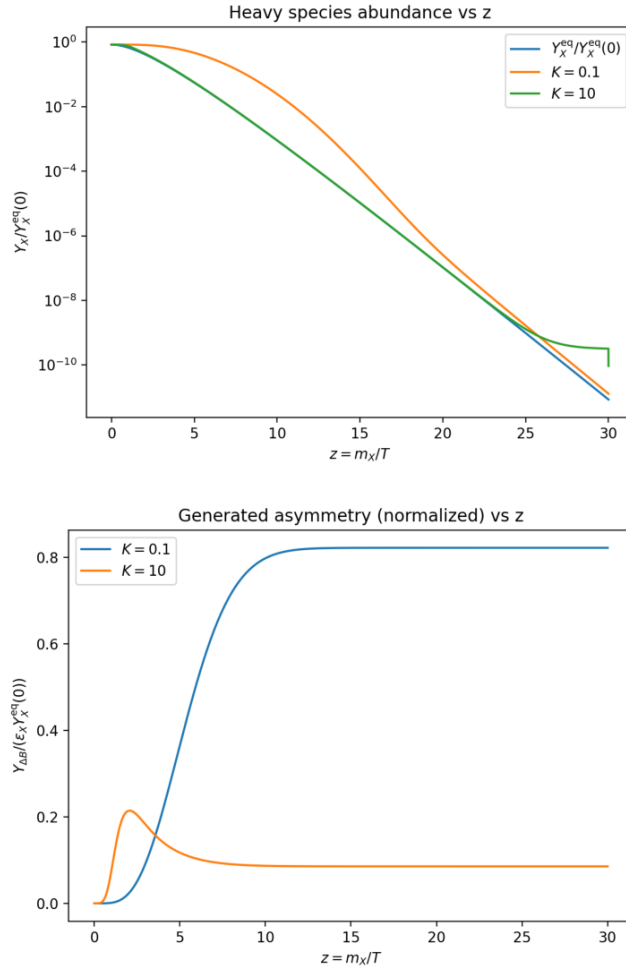


Figure 1: **Weak vs strong washout (illustrative)**. Top: $Y_X(z)$ tracking equilibrium for $K \gg 1$ and departing early for $K \ll 1$. Bottom: normalized asymmetry build-up; in strong washout early production is erased and the final asymmetry comes from the epoch when washout shuts off.

Figure 15: Baryogenesis lecture notes, page 15: illustrative weak- and strong-washout plots.

B.3 Representative live-poll questions

Selected live-poll screenshots from the baryogenesis lecture show how anonymous polling supported estimation, conceptual reasoning, and low-pressure participation before class discussion. The questions moved from the observed baryon asymmetry to the Sakharov conditions, baryon-number-violating operators, proton-decay constraints, out-of-equilibrium dynamics, and the physical origin

of absorptive loop phases.

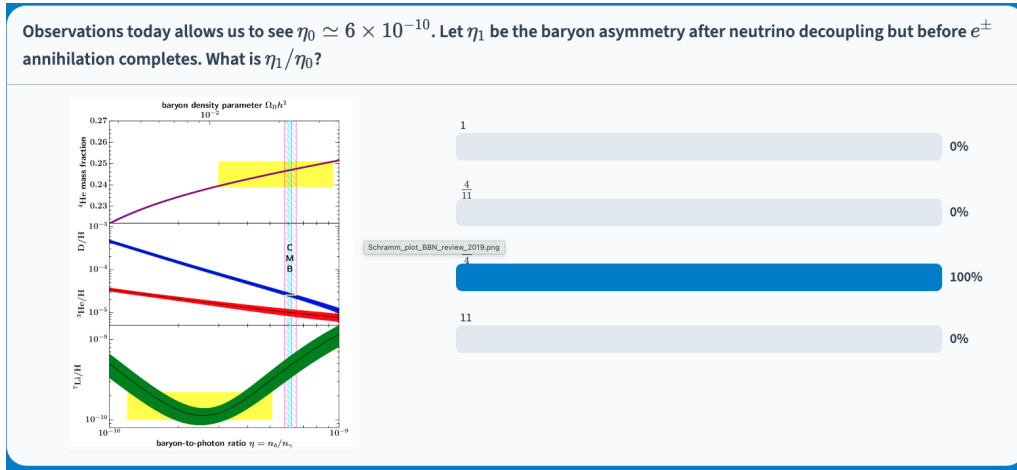


Figure 16: Live-poll excerpt: relating the observed baryon asymmetry to the value before electron–positron annihilation.

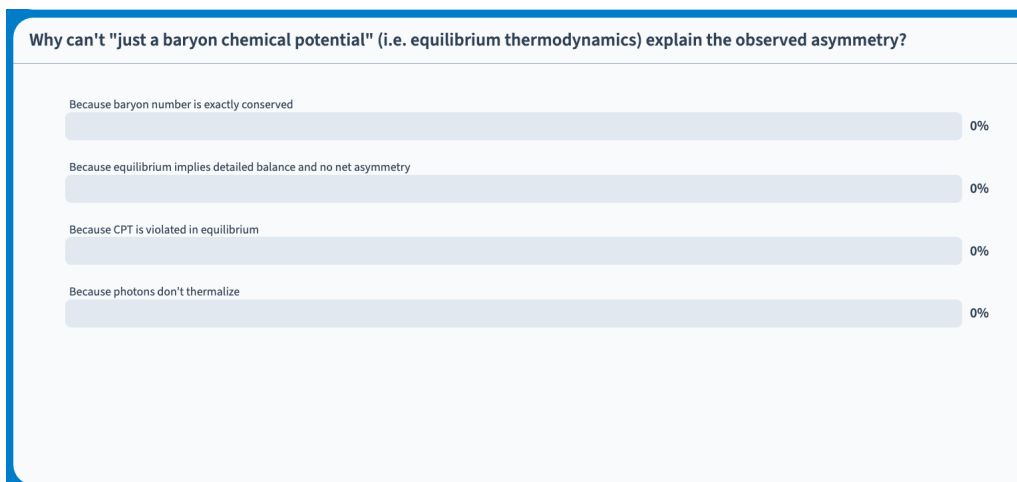


Figure 17: Live-poll excerpt: why equilibrium thermodynamics alone cannot explain the baryon asymmetry.

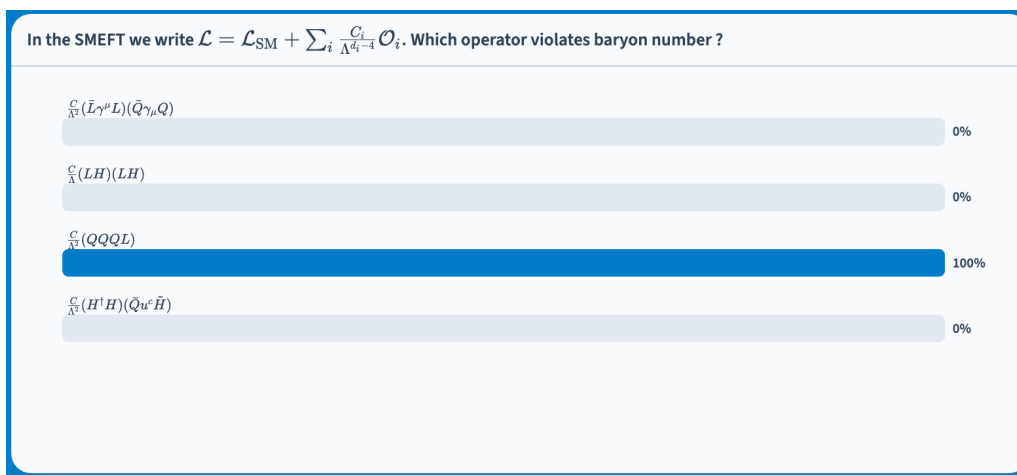


Figure 18: Live-poll excerpt: identifying a baryon-number-violating SMEFT operator.

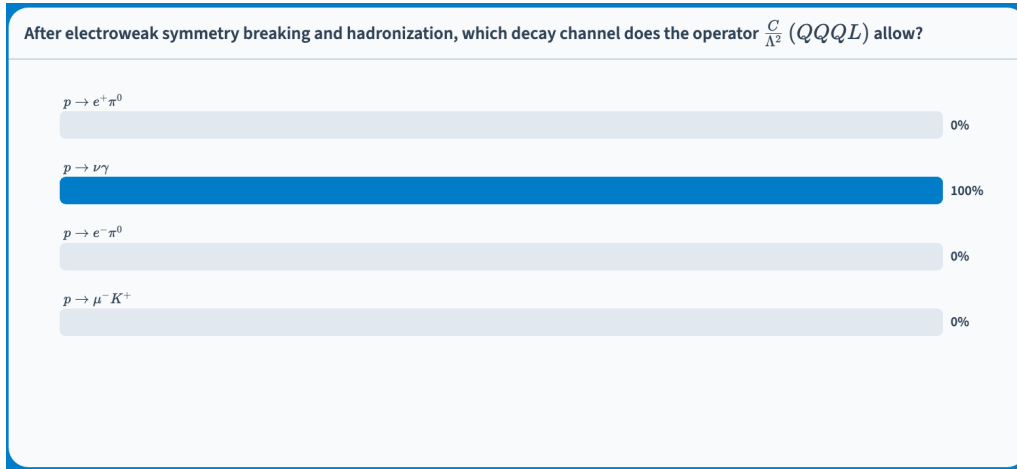


Figure 19: Live-poll excerpt: connecting the baryon-number-violating operator to an allowed proton-decay channel.

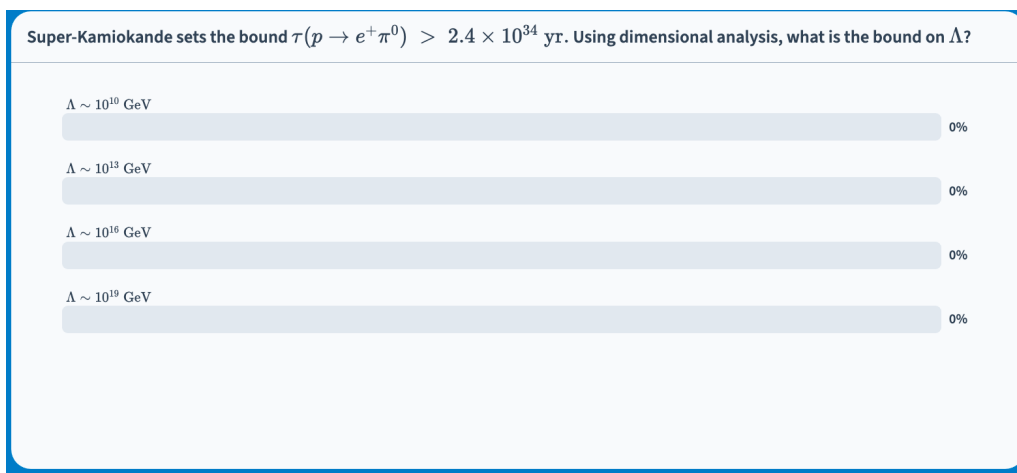


Figure 20: Live-poll excerpt: estimating a new-physics scale from proton-decay bounds.

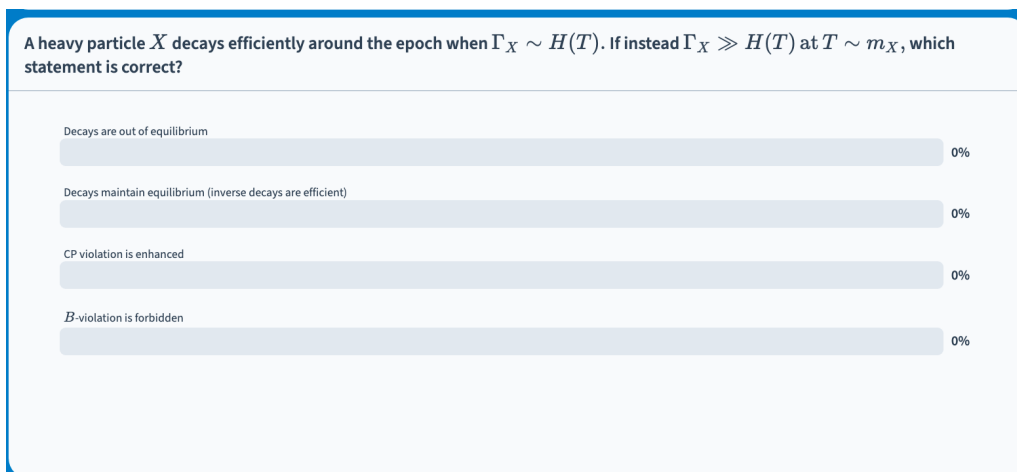


Figure 21: Live-poll excerpt: diagnosing whether heavy-particle decays occur in or out of equilibrium.

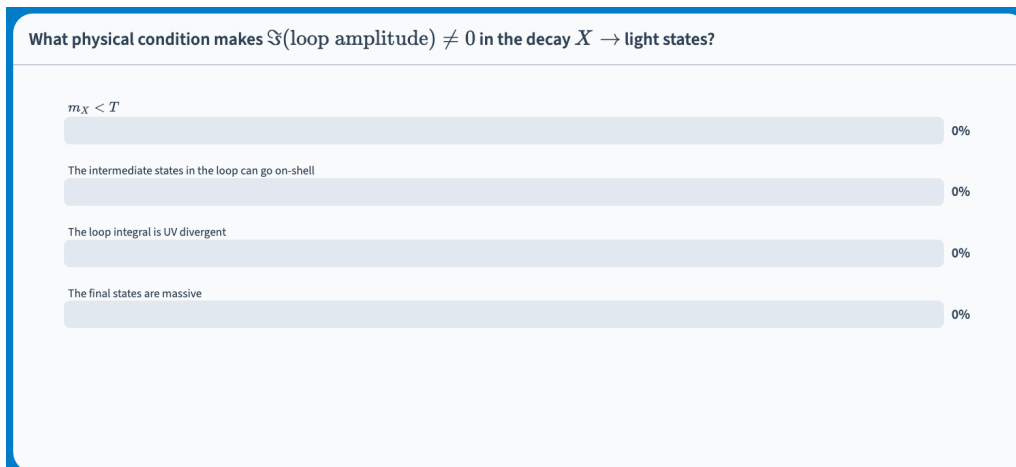


Figure 22: Live-poll excerpt: identifying the physical condition that makes the absorptive part of a loop amplitude nonzero.

B.4 AI for Physics lecture polls

In Winter 2026 Ph205b, I delivered a participatory *AI for Physics* lecture. The lecture used mostly QFT examples: students considered what AI tools could and could not do, predicted likely failure modes, and then discussed AI-generated solutions to physics problems by identifying correct steps, hallucinations, and conceptual or algebraic mistakes. I used anonymous polls to make student assumptions visible before the technical discussion. The selected screenshots show the progression of the activity: students reflected on their own AI use, predicted failure modes on QFT tasks, and summarized their qualitative judgment of AI's advanced-physics performance.

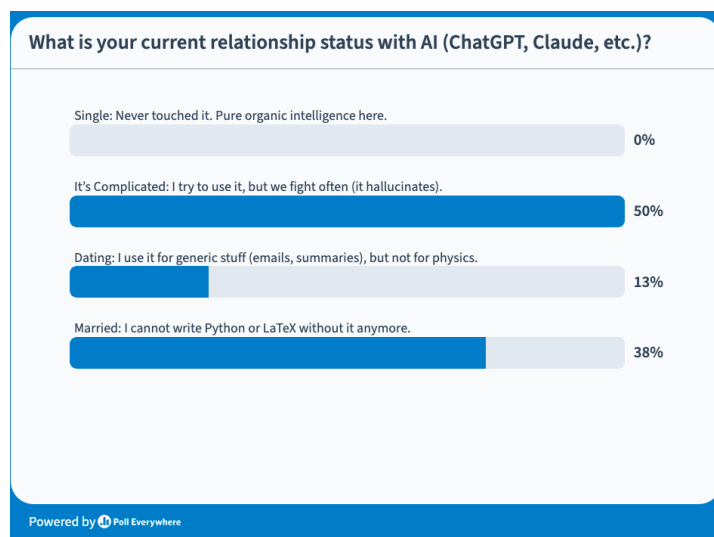


Figure 23: AI for Physics poll: students' current relationship with AI tools.

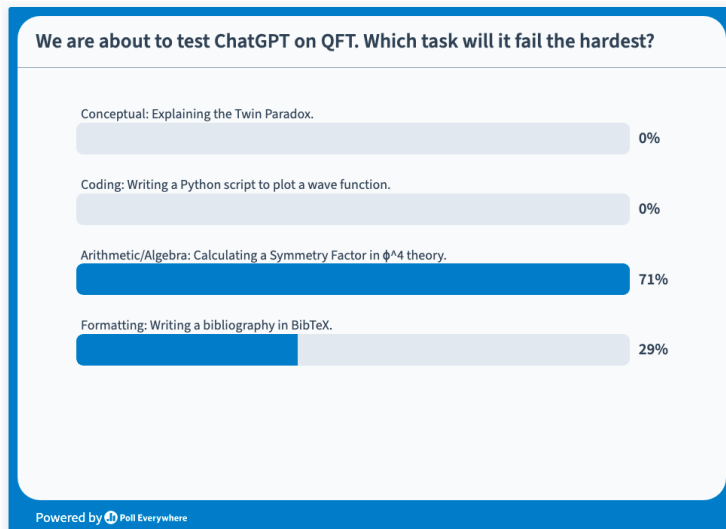


Figure 24: AI for Physics poll: predicting where ChatGPT would fail hardest on QFT-related tasks.

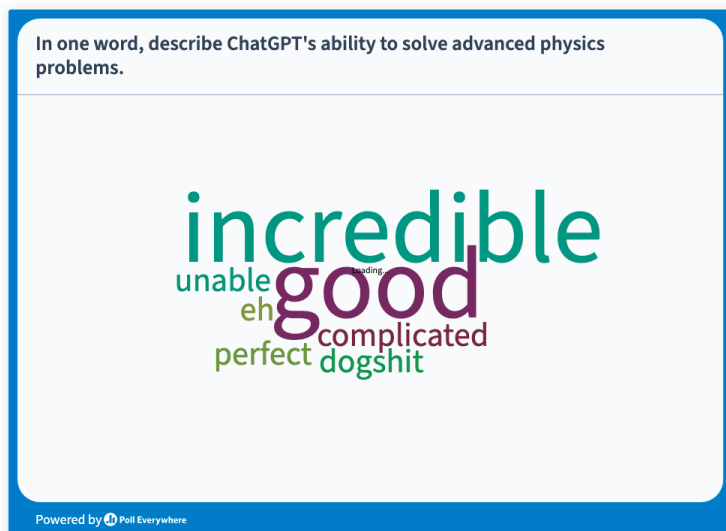


Figure 25: AI for Physics word cloud: students' one-word descriptions of ChatGPT's ability to solve advanced physics problems.

B.5 Representative Ph205 problem-set material

Across the Ph205 sequence, I wrote and revised problem sets and solutions with Prof. Wise. The excerpt below shows the kind of advanced QFT problem-set material I developed, connecting effective operators, loop amplitudes, dimensional regularization, renormalization, and long-range potentials.

Ph205b - Problem Set 5
Due date: February 27th, 2026

Problem 1

Consider a real scalar field ϕ of mass m coupled to electromagnetism through the dimension-six operator

$$\mathcal{L} = \frac{1}{2}(\partial_\mu\phi)(\partial^\mu\phi) - \frac{1}{2}m^2\phi^2 - \frac{1}{4}F_{\mu\nu}F^{\mu\nu} - \frac{g}{4}\phi^2 F_{\mu\nu}F^{\mu\nu}, \quad (1)$$

with $F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu$. Work in dimensional regularization with $n = 4 - \epsilon$ and renormalization scale μ .

- (a) **Power counting / renormalizability.** Determine the mass dimension of g in 4D and decide whether the theory is renormalizable by naive power counting.
- (b) **Feynman rule for $\phi^2 F^2$.** Derive the momentum-space vertex for $\phi(p_1)\phi(p_2)A_\mu(k_1)A_\nu(k_2)$ (all momenta taken incoming). Express your answer in terms of k_1, k_2 and $\eta_{\mu\nu}$.
- (c) **One-loop $\phi\phi \rightarrow \phi\phi$ amplitude.** Compute the one-loop amplitude for elastic scattering $\phi\phi \rightarrow \phi\phi$ from two insertions of the $\phi^2 F^2$ vertex and a photon loop, in Fig. 1. Show that the amplitude of the diagram can be written as

$$i\mathcal{M}^{(1)} = (n-2)g^2 q^4 \mu^{4-n} \int \frac{d^n\ell}{(2\pi)^n} \frac{1}{\ell^2(\ell-q)^2}, \quad (2)$$

In dimensional regularization scaleless integrals $\int d^n\ell/(2\pi)^n 1/(\ell^2)^p$ for any p can be set to zero.

- (d) **DimReg: divergent part and the $\log(-q^2)$ piece.** Evaluate the scalar bubble integral

$$I(q^2) \equiv \mu^{4-n} \int \frac{d^n\ell}{(2\pi)^n} \frac{1}{\ell^2(\ell-q)^2} \quad (3)$$

and extract both the UV pole and the non-analytic $\log(-q^2)$ dependence.

- (e) **Non-relativistic limit and potential.** Then use the Born relation to find the long-range ($r \neq 0$) potential between the ϕ particles.

$$V(r) = -\frac{1}{4m^2} \int \frac{d^3q}{(2\pi)^3} e^{-i\mathbf{q}\cdot\mathbf{r}} \mathcal{M}_{NR}(\mathbf{q}). \quad (4)$$

where $\mathcal{M}_{NR}(\mathbf{q}) = \lim_{q^0 \rightarrow 0} \mathcal{M}^{(1)}(q)$.

Figure 26: Ph205 problem-set excerpt.

6. Appendix C: TA Fellow Leadership Materials

C.1 PMA TA orientation

As Physics and Astronomy TA Fellow, I helped prepare and present PMA TA orientation materials. Topics included TA responsibilities, recitations, office hours, Honor Code issues, fair policies and boundaries, grading, DEI, CASS/CARE/Title IX, and PMA teaching resources.

Recitation Sessions

- Recitation sessions at Caltech actually involve a lot of Teaching. It's not just problem solving. You need to tie up concepts and subtleties backed by problems.
- Keep classrooms interactive and use techniques to engage your students
- Being prepared is key!
- Plan your boardwork.
- Make sure all your equipment works
- Flipped Sections?
- Ask student for feedback – what would be most helpful for them?




Figure 27: PMA TA orientation excerpt: recitation sessions as teaching, not only problem solving.

Office Hours

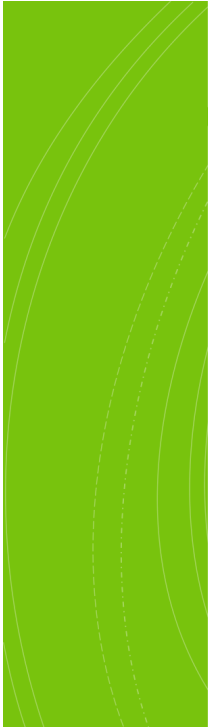
- Style: A casual problem solving assistance and a place to ask questions about course material.
- Have students explain what they've tried before giving hints.
- Try to give subtle hints.
- Do NOT give away solutions
- Follow the student's logic. Try guiding them to a solution which is based on the progress they've made.

Figure 28: PMA TA orientation excerpt: office-hour guidance.

Diversity, Equity and Inclusion (DEI)

- **Be an example:** introduce yourself with your name, pronouns.
- Refer to students with their **preferred name and pronouns**.
- Make your teaching accessible to all students:
 - Challenge your **expert blind spot**
 - Foster a **growth mindset** amongst students
 - Make sure everyone has the opportunity to share ideas or ask questions
 - Student specific accommodation: CASS
- Provide various opportunities for **feedback**
 - Exit tickets
 - Mid-quarter survey
 - TQFR
- Resources:
 - [CTLO](#)
 - [Caltech Center for Inclusion and Diversity](#)
 - [Equity and Title IX office](#)

Figure 29: PMA TA orientation excerpt: DEI practices and feedback opportunities.



CASS, CARE and Title IX

<p><u>CASS</u> <u>C</u>altech <u>A</u>ccessibility <u>S</u>ervices for <u>S</u>tudents</p> <p>Reaches out to TAs before the term starts, with specific accommodation for a given student.</p> <p>cass@caltech.edu</p>	<p><u>CARE Team</u></p> <p>TAs can make referrals if they notice a student is showing signs of distress.</p> <p>careteam@caltech.edu</p>	<p><u>Title IX Office</u></p> <p>Handles sexual misconduct, harassment, discrimination.</p> <p>As a TA, you are required to report such situations to the Title IX Office.</p> <p>Reports: can be done online and anonymously.</p> <p>equity@caltech.edu</p>
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Figure 30: PMA TA orientation excerpt: CASS, CARE, and Title IX resources.

C.2 TA teaching-resource event and active-learning workshop slides

As part of the TA Fellow programming, I helped organize TA-facing events that combined feedback, appreciation, and practical teaching support. The Spring teaching-resource event focused on active learning and guided practice: students learn physics by practicing disciplinary reasoning during class, with feedback, rather than only listening to explanations. I include representative slides below, emphasizing the core rationale, guided-practice model, and the interactive “Your Turn” activities used to help TAs design active-learning moments for recitations and office hours.

Active Learning: Students should take part in constructing their own learning.

Something is better than **nothing**! Some days of AL are better than no days of AL.
 Can be simple or complex—it's a spectrum!

- **The goal:** students are **actively engaging** with the content and 'doing' the learning.
 - We must provide **practice** for our students—they must 'do' the content.
 - The one doing the **work** is the one doing the **learning**.
 - Straight **lectures are passive** learning for our students (just listening).

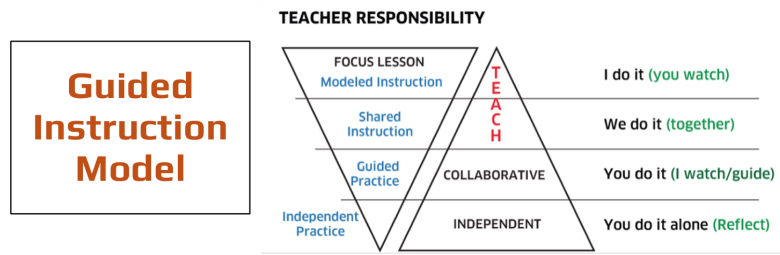


Figure 31: Active Learning workshop excerpts: core principles for active learning and the guided-instruction model.

Guidelines for Active Learning and Guided Practice in the Classroom

- Create the **expectation** that students will have to engage in class sessions.
- Create opportunities to find and correct **misconceptions** (where learning happens!).

When should you utilize Guided Practice in the classroom?

Anticipate what will be most **challenging** for novices!

- **Identify** where some students in a course may **struggle**, get **stuck**, be **unable** to complete required tasks, or move forward in their learning.
- Figure out how **you**, as an expert, accomplish this disciplinary thinking, doing, or knowing.
- **Model** for students the steps/approach/thought process you discovered in step 2.

Figure 32: Active Learning workshop excerpts: classroom guidelines and identifying bottlenecks for novice learners.

Your Turn! Think-Pair-Share

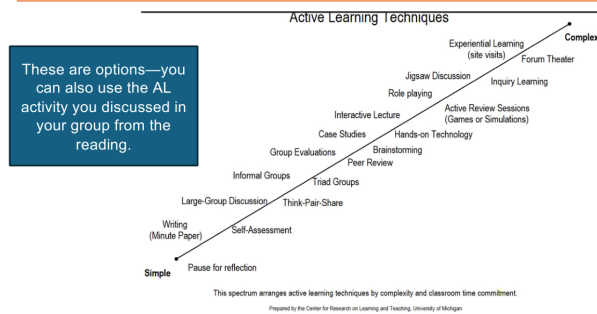
Let's think about some **challenging concepts** and possible **misconceptions** based on the course you're TAing

Your Turn! Brainstorming

Let's think about some possible **active learning activities** you could implement as a TA.

Figure 33: Active Learning workshop “Your Turn” slides: think-pair-share and brainstorming activities.

Active Learning Spectrum and Descriptions



Active Learning Activity	Describe how you would use it	How would this help student mastery? (i.e. get past the bottleneck)	How would you explain the activity to students?	Possible challenges?

Your Turn! Jigsaw Discussion

- Based on the **challenging concept** you identified, **design** with the help of your group an active learning scenario for your next recitation.
- Let's shuffle and share!

Figure 34: Active Learning workshop excerpts: active-learning spectrum and “Your Turn” jigsaw planning activity.

C.3 TA Fellow recommendations

At the end of my TA Fellow term, I prepared recommendations to improve TA coordination, course policies, feedback workflows, and support structures across Physics and Astronomy.

Astro&Physics TA fellow recommendations

Samuel Patrone

June 2025

In the following, I present some of the main suggestions I have for the future. This list is not exhaustive, nor is it arranged in any particular order of priority.

Head TAs

- Have separate head TAs for Ph1 practical and analytical tracks.
- Consider appointing a head TA for Ph12, even with fewer than 30 students enrolled. Since the course uses undergraduate graders, having someone to coordinate (when the professor does not) would be beneficial.
- Provide head TAs with the core class schedule at the start of each term to facilitate effective planning of TA office hours.
- Recommend to the head TA and the professor that they collaboratively draft a written list of duties and expectations at the beginning of the term to clarify roles and responsibilities. Provide them with a template.

UTAs

- Maintain a registry of UTAs to track effective graders. Request that the professor or head TA assign a pass/fail evaluation at the end of each term. UTAs receiving a failing evaluation should not be re-hired.

TAs

- Assign three GTAs to Ph12c—GTAs have reported significant overload due to grading, conducting two recitation sessions, and holding office hours.
- Encourage all professors to hold a TA/head TA meeting at the beginning of the term focused exclusively on logistics.

Courses

- Encourage midnight deadlines for all homework assignments.
- Promote the use of late days or "sleep days" extension policies, along with allowing one dropped homework set (instead of one-week extensions). Late days have the advantage of being automatically tracked by Gradescope, reducing the need for manual intervention by head TAs, TAs, or professors.
- Encourage professors to establish and clearly communicate extension policies from the outset. Automate extension requests where possible (e.g., via Google Forms), reserving manual handling only for exceptional cases.
- Recommend posting a FAQ page on Canvas at the start of the term to clarify extension policies and related procedures.
- Advocate for granting default CASS extensions in advance, so that head TAs and TAs are not burdened with processing repetitive requests. Share the list of students with CASS accommodations with the head TAs (currently only professors are notified).
- Make Quantum Mechanics a strict prerequisite for Ph12c.
- Consider rescheduling Ma1a to the spring term and moving Ma1b to fall and Ma1c to winter to better align with math prerequisites for physics courses.
- Recommend a self-diagnostic assessment on the math prerequisites for each core physics course, to be completed at the start of the term. This helps students identify gaps and avoid falling behind.
- Promote the use of Piazza for student questions and requests to reduce email overload.

TA Fellow

- Hold periodic joint meetings (at least once per term) with PMA staff (Nam & Belen) and CTLO.
- Grant the TA fellow the ability to directly reserve rooms for ombudsperson/head TA lunches, streamlining the process and reducing email correspondence.
- Consider removing AP exam grading from the TA fellow's responsibilities and instead hiring graders from within the department. Ph1 TAs (from the current or previous year) are more familiar with the material being tested and can grade more effectively.

Figure 36: TA Fellow recommendations, page 2: course-policy recommendations, TA Fellow workflow recommendations, and diagnostic/prerequisite suggestions.