

The Physics Graduate Student Council is releasing recommended changes to department policies surrounding the General Exams. This Recommendation is endorsed by PhysREFS.

The PGSC wants to acknowledge that many of us have a conflict of interest in even helping to write a recommendation about the Exams. Due to the structure of a PhD program, many graduate students in leadership positions such as PGSC and department committees are in their second or their third year. It would be impossible for us or any future Executive Board to urge much-needed changes, were we to let our position within the program silence our ability to speak on behalf of past, current, and future peers. However, we strongly urge the Department not to grandfather in any current students under new rules, so as to set a precedent where student leaders can speak their minds and represent the student body to the best of their abilities, without any appearance of impropriety in making recommendations.

PGSC Recommendations on Procedures for the General Exam

Dear MIT Physics Education Committee and Physics Council,

The Physics Graduate Student Council are the elected representatives of the 250+ MIT Physics graduate students, and our role is to act in the interest of increasing the welfare of the physics graduate student body. **We write to propose changes to the Department's procedures for the General Exams.** We build upon our [Recommendations to the Community](#) from July 2020, specifically [#12-13](#), which call for improvements to advising and mentoring practices, as well as [#19](#), which calls for changes to language surrounding the exams to mitigate stress and stereotype threat. We recommend that the Department:

1. Stop defaulting to fail a student who does not complete the Core Courses and Oral Exam within a specific period of time or certain number of attempts. **The faculty's mindset and driving goal should be to have all students stay in and complete the Physics Ph.D.** This change (and the removal of all such language from the Doctoral Guidelines) should be immediate and apply to anyone who (a) has any leftover core requirements to fulfill, or (b) enters in fall 2021 or after.
 - The Department must create proactive safety-net measures to catch students who are struggling, provide additional advising, and develop a personalized plan to help them get on track to meet the academic goals of the program.
 - The Department should only consider the option of expulsion in the case that a struggling student seriously deviates from a personalized plan without appropriate justification.
 - The Department should require exit surveys for all students admitted to the doctoral program who leave the Physics Department without a Ph.D., so that the Department can monitor for trends, and understand and mitigate root causes.
2. Provide additional information about the Written Diagnostic and the Oral Exams in order for them to meet their stated purpose. These changes should take place by June 1, 2021.
 - The Written Diagnostic Exam Committee should work with student groups to develop a sheet of all formulas students are expected to know for each exam.
 - The Department should require all remaining Research Areas to post guidelines about oral exam content to the [General Doctoral Exams webpage](#).
3. We reiterate our call for [reframing the Written Exam](#) as **required core courses with the option to test out**. In particular, we request that the Department update the website language within the next couple of weeks, in time for the recruitment cycle of new PhD admitted students.
 - The Department should also consider having core courses rely heavily on alternative methods of assessment, such as projects and presentations, to allow students to demonstrate competency in the core areas in a manner besides exam performance.

Note that these recommendations address only the information provided and the timeline for the General Exams. The PGSC expects to conduct thorough conversations with the student body and the Department administration before releasing further recommendations about the Oral Exam. The following pages explain our recommendations in further detail.

Thank you,

MIT Physics Graduate Student Council 2020-21 || Endorsed by PhysREFS

Physics Community Values

We begin by reminding ourselves of our [Physics Community Values](#):

- We support each other at all times and remember that we are not alone.
- We value the multitude of ways to be a physicist and the many paths through our field and our Department.
- We strive to speak and act in ways that support and include all members of our community.
- Physics is a social endeavor and we proudly collaborate with others to advance the field.
- All physicists are here because of the mentorship we have received and continue to receive, and the mentorship we offer to others.

Background information and rationale

This year, PGSC received an in-depth look into the graduate admissions process through [Grads Advising Grad Admissions](#) (GAGA), its management of the [Physics Graduate Application Assistance Program](#) (PhysGAAP), and our three representatives serving on the Graduate Admissions Committee. This year, about 1600 applicants competed for approximately 100 admissions offers to our doctoral program, a 6% acceptance rate. Many more qualified physicists apply for our program than we could possibly admit, and we have the privilege of being able to choose students who not only have the capability to survive our academic program but also those who will thrive as physicists here.

It is unconscionable that any admitted student should fail our core course requirements or the corresponding diagnostic exams, fail our oral exams, or worse yet, fail out of our program. All students who are admitted have met stringent requirements and passed multiple layers of review with flying colors, and there is no doubt that they are qualified to be here. Given these requirements for admission, a student's poor performance on the General Exams usually indicates either a poor testing experience or external factors, whose ripple effects the PGSC strongly urges the Department to work to mitigate. These include but are not limited to:

A. *Unforeseen obstacles in the external world and the student's personal life.*

The Covid-19 pandemic has laid bare how deeply one's academic progress can be impaired by external factors including but not limited to:

- * Family emergencies or deaths
- * Personal struggles with physical health, mental health, and recuperation and recovery thereafter
- * Political turmoil, social unrest, or traumatic events in one's communities.

Every human being is affected by these circumstances differently, and for many they cause substantial impact on class and research performance.

It is understandable that the Department wants a definite timeline for students to finish their Ph.D. degrees. However, a predefined, one-size-fits-all timeline for completing the qualifying exams—with the threat hanging over a student's head of likely losing their income, health insurance, and career in physics research—is absurd, inequitable, and unjustifiably stressful for students facing

unexpected disruptions in their lives.

B. *Lack of sufficient academic background or preparation.*

This most commonly occurs when we admit promising researchers who attended undergraduate institutions that provided insufficient coursework preparation in one or more subject areas, physicists who took nontraditional educational paths, and/or students who have had a long gap between their most recent physics coursework and when they began their graduate studies at MIT.

It would be inequitable, unjust, and unproductive not to admit the most promising physicists from all walks of life. However, it is equally inequitable and unproductive to leave students from non-feeder schools and non-traditional backgrounds to flounder in our graduate program. We should strive to help these students acquire the physics background, tools, and additional academic guidance needed to succeed and graduate with a doctorate.

C. *Difficulty navigating a graduate program and its requirements.*

(i) Core courses and written diagnostic exams.

Students from underrepresented populations (e.g. students who are URMs, women, LGBTQ+, from lower socioeconomic backgrounds, and/or from non-feeder colleges) may have more limited networks than their peers, and thus less knowledge of norms and expectations in academia. Similarly, students who return to the Ph.D. after a long break often face significant difficulties adjusting to taking classes and exams again.

New students face many changes and challenges in their first August at MIT. Some students are searching for their first-ever apartment in Boston, a notoriously stressful housing market. For the [~30%](#) of American students who commute to college from their parent's house, this may be their first time permanently moving away from home. International students may be arriving in the U.S. for the first time.

All of these factors may lead to lower-than-expected performance on the General Exams, courses, research, or other [metrics of success](#) early in the Ph.D. None of these factors need to be ongoing obstacles if the Department takes proactive steps to help struggling students and institutes simple additional measures to help students navigate the Ph.D. program.

(ii) Oral exams.

Poor performance on the oral exam often reflects a significant mismatch between the student's research niche and the oral exam topics. While some research areas have a clear foundational canon of literature, not all research groups within a single oral exam area in the department have a shared basis of knowledge. Physics research is growing ever more interdisciplinary, particularly in the ABCP division. Many graduate students easily adapt and successfully learn the accepted body of broad, fundamental knowledge required to successfully function in their lab, interact with scientists throughout their field and related areas, grow our body of knowledge, and communicate their findings through presentations and publications to a broad audience. However, this body of literature may not fully overlap with what is considered canonical by senior faculty within a

different part of their Research Area, who determine the scope of and administer their oral exam.

This difficulty can be compounded for graduate students who work in a research group outside of the Physics Department. These students and their advisors have less access to the informal networks upon which many students and advisors rely to learn what material is on the exams — this information is **not** codified by many Research Areas.

Recommendation 1: Proactive intervention to help students

The Department should proactively reach out to students who are facing difficulties getting through the general exams and provide them additional support and structured guidance to help them succeed. Based on comments we have received from current and previous physics graduate students about how they (un)successfully overcame difficulties on the General Exam, PGSC recommends that the Physics Department make the following changes to the doctoral guidelines:

Proposed new text for the General Exams section of the doctoral guidelines¹

The Department traditionally expects graduate students to satisfy all four components of the Core Course requirement by the end of January of their second year and to pass the oral exam by the end of their third year. The Department will proactively reach out to the student and provide additional guidance to help the student complete through the program requirements in the event that one of the following occurs:

- The student receives a grade insufficient for passing a core or specialty course their first fall (below B+/B-)
- The student has not passed two or more Core Courses by the start of their second fall term, or
- The student fails the oral exam on their first attempt

A group consisting of the student's academic advisor, research advisor, the Graduate Student Advocate, and the Associate Department Head will meet with the student to review their progress in the program and to assess any difficulties the student may be facing. This group will agree upon a plan for the student to complete any remaining core course and oral requirements.

This group will also hold a proactive but informal check in with students who do not pass any diagnostic exam during their first August at MIT to offer resources and any needed support and guidance, regardless of whether this is due to the student's scores or their merely opting not to sit exam(s). This group should encourage the option of taking undergraduate courses as review when there is a demonstrated need.

For the core courses, the group will often require the student to take any remaining core courses during the semester they are next offered, as well as attempt any Written Diagnostic Exams in the intervening

¹ **Current text of the [doctoral guidelines](#):** All students must satisfy all four components of the Written Exam requirement by the end of the January of their second year. In the event a student has not passed all parts of the Written Exam by the end of the January of their second year, an ad hoc committee consisting of the student's academic and research advisors, the Associate Department Head, the General Exam Coordinator, and the Chair of the Written Exam Committee will review the student's progress and decide how to proceed. This committee will not give a special oral exam. In most cases, it will confirm that the student must switch to a Masters degree status. In unusual cases, this committee could instead recommend to the Associate Department Head that the student be allowed to continue in the Ph.D. program until the following August, do prescribed further study, and attempt 8.311 in the Spring or attempt the needed component(s) of the Written Exam in August. This decision would be made by the Associate Department Head.

semesters. These diagnostic exams will help assess the degree to which the student is making progress on learning the material, and pinpoint any remaining areas of difficulty. This timeline may need to be extended for students for whom the traditional timeline might pose barriers: for example, if the student needs to review undergraduate subjects, if extra time is needed to prevent the student from bearing too heavy a course load in fall of the second year, or if a student is facing extenuating circumstances. When the timeline diverges from traditional expectations for graduate students, it will usually diverge by 1 or 2 semesters, but in unusual circumstances this timeline can be extended further.

For the oral exam, the committee should first and foremost ensure that the student understands the scope of potential content on their oral exam, as well as the reasons for their failure on the first attempt. When a student fails an oral exam, the Department expects the oral examiners to provide the student clear and detailed reasoning for the failure and guidance for areas the student needs to improve on the next attempt. In the event that the student cannot acquire adequate feedback about their first attempt at the exam, the Associate Department Head and Graduate Student Advocate will speak with the oral examiners. The student should leave the initial meeting with their advisors, Associate Department Head, and Graduate Student Advocate with a list of what material they must learn to pass the oral exam, as well as a clear idea of what aspects of their oral presentation skills they must improve.

The committee should also consider whether half a year (between May and December) is an appropriate time interval between the student's oral exam attempts. Sometimes, a student may benefit from a second exam within a couple months, while the material is still fresh in their mind, and to minimize long-term stress. Other times, the student may desire the full time interval to cement fundamental concepts.

In the event a student's research is of an interdisciplinary nature or based in a different department, every effort should be made to keep the student in the physics doctoral program should they wish to stay in the physics doctoral program. If a student's thesis research is interdisciplinary and a severe mismatch for the topics covered on the oral exam, the committee may occasionally recommend the student pursue an [interdisciplinary doctoral degree](#) home-based in the Physics Department.

The student should email a brief formal progress report to this group at least once per month until they complete their requirements, including any difficulties they may be facing in meeting the plan. In addition, at least one member of this group should hold a formal check-in meeting with the student at minimum once per month for a half hour until the student completes their requirements and is on stable academic footing. The group should connect the student with additional academic resources, information about study strategies, and any other helpful materials as needed.

In the event the student fails to meet the requirements laid out in the agreed-upon plan, a formal ad hoc committee consisting of the student's academic and research advisors, the Associate Department Head, the General Exam Coordinator, the Graduate Student Advocate, and as needed, the Chair of the Written Exam Committee, will review the student's progress reports and academic work, and decide how to proceed. This committee will either recommend to the Associate Department Head that the student be allowed to continue in the Ph.D. program under a modified plan, be allowed an additional attempt at the Oral Exam, or require the student to switch to Master's degree status.

Recommendation 2: Provision of resources for the Written Diagnostic and Oral Exams

Recommendation 2A: Creation of formula sheets for the written diagnostic exam

The [Guidelines for Physics Doctoral Candidates](#) state: "The purpose of the general examination is to assure the Department that its graduates have a broad background in physics and a firm understanding of a particular branch of physics." To achieve this goal, the exams test the students ability to correctly frame and then work through a difficult problem from advanced undergraduate and early graduate material.

Currently, students must know an extensive amount of content and therefore an extensive number of formulas for each subject to ensure success on the Written Diagnostic Exam. Even though it is theoretically possible to derive many of these formulas from a small set of fundamental equations, the 75-minute time limit and the stress of an exam environment do not make this approach feasible. Historically, exams have provided students with some obscure formulas; however, there are no clear guidelines on which formulas the Department will provide. This lack of clarity incentivizes students to spend a large amount of time memorizing formulas at the cost of reviewing concepts and working practice problems to improve their knowledge of the deeper underlying physics. This incentive structure does not match the stated purpose of the written exam.

Students will forget some obscure formulas over time, but they can always look these up in real-life research. It is a student's grasp of the underlying concepts and problem solving methods which endure and distinguish them as a physicist. Having the writers of the Written Diagnostic Exam work with senior students to provide a list of relevant equations for exam takers to commit to memory (or to have access to during the exam), as well as a list of concepts that may be on the exam, would help align students' studying habits with the Department's objectives for student learning and achievement.

Recommendation 2B: Posting Information about Oral Exams on the Department webpage

Department Leadership should require that the Research Areas provide information about their Oral Exams for public posting on the [General Exams webpage](#).

The PGSC is upset and frustrated that after many semesters of formal requests from the graduate student body to make information about the oral exams easily and publicly accessible, only four out of the nine of Research Areas have provided information about their oral exams for our Department website:

- NUPAX and CMT have provided information on the [General Exams webpage](#)
- NUPAT and QI have posted comprehensive graduate student [guidelines](#) on the CTP webpage

It would be fabulous if the Department website manager could add links to the NUPAT and QI guidelines on the general exams webpage as well, to make sure the information is all accessible from one place.