

PHYS 6361 Special Topics in Physics - Portals to New Physics: The Higgs Boson and Dark Matter

Instructors:

March 15 - May 4, 2020

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January 19 - March 12, 2020

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Zoom Connection Information:

TBD

Response Time:

Please note that our goal is to respond to student communications within 24 hours during weekdays. If for some reason we are unable to do so, we will follow up as soon as possible. We also always try to let you know ahead of time if we will be unreachable.

Assignment Return Time:

Our goal is to return graded assignments to you within 48 hours. If for some reason we are unable to do so, we will do our best to let you know in advance and will return your graded assignment to you as soon as possible.

Course Description:

Topical course in emergent areas of physics of the Higgs boson and dark matter.

Themes include Higgs in the Standard Model of particle physics, status of experimental verification of its properties, Higgs as a portal to new physics phenomena, evidence for particle dark matter, dark matter candidates including WIMPs, Axions and ALPs and sterile neutrinos, principles of and techniques for dark matter detection.

Learning Outcomes

COURSE LEVEL OUTCOMES (CLOs)

Course Objectives:

The specific learning goals of this course are as follows. Upon successful completion of this course, students will be able to:

1. Analyse the process of electroweak symmetry breaking and explain the origin of mass differences of carriers of electromagnetic and weak forces.
2. Evaluate the requirements for searches for new physics based on precision measurements of Higgs properties.
3. Evaluate the evidence for the particle nature of dark matter.
4. Analyze several viable dark matter candidates.
5. Evaluate and analyze dark matter detection techniques.
6. Synthesize concepts and ideas of a topic (TBD in consultation with instructor) related to dark matter research into a paper.

Grades

Your work and overall performance will be recorded on Canvas. Students can access their current weighted average at any time via [Grades.Links to an external site.](#)

Overview

Activities	Percentage
Homework (Higgs)	20%
Homework (Dark Matter)	20%
Higgs Paper (midterm)	30%
Dark Matter Topic Paper (final)	30%

GRADING SCALE

Range	Letter	Grade
94 - 100	A	Excellent Scholarship

94 - 90	A-	Excellent Scholarship
90 - 87	B+	Good Scholarship
87 - 84	B	Good Scholarship
84 - 80	B-	Good Scholarship
80 - 77	C+	Fair Scholarship
77 - 74	C	Fair Scholarship
74 - 70	C-	Fair Scholarship
70 - 67	D+	Poor Scholarship
67 - 64	D	Poor Scholarship
64 - 61	D-	Poor Scholarship
< 60	F	Fail

Materials

Required: textbook, papers, etc

Higgs Materials: TBD

Dark Matter Papers: TBD

Recommended (NOT REQUIRED): textbook, papers, etc

David Griffith "Introduction to Elementary Particles"

W.N. Cottingham and D.A. Greenwood "An introduction to the Standard Model".

Particle Dark Matter, editor Bertone (ISBN-13: 978-0521763684)

An Introduction to Particle Dark Matter by Profumo (ISBN-13: 978-1786340009)

Technology

To be successful in this course, students should have basic keyboarding and computer skills, and be comfortable navigating the Internet. This fully online course occurs primarily via canvas.smu.edu. [Zoom](#) Web Conferencing is used in this course as well for virtual (i.e., real-time, synchronous) meetings, and YouTube is used for viewing pre-recorded lectures.

IMPORTANT

A **webcam** is required for recording activities and taking exams. If your device does not have a built-in webcam, one can be purchased at a local consumer electronics store or through an online retailer like [Amazon](#).

Your homework will need to be uploaded to Canvas in a specified format. We recommend the free [CamScanner app \(Links to an external site.\)](#) which produces adequate quality documents and has been a favorite of past students. However, you may use any method you would like to digitize your work, so long as the final document is legible as determined by the Course Instructor.

CANVAS

Please be sure that your device or devices meet the **technical requirements** for Canvas. [Technical requirements](#) and [browser requirements](#) for Canvas are located in the [Canvas Student Guide](#). If you need Technical Support with Canvas, click the Help link on the left side [Global Navigation](#). From there you can Search Canvas Guides, Chat with Support, or Submit a Request for assistance. You can also contact the SMU [IT Help Desk](#) for assistance with Canvas.

TECHNICAL SUPPORT

If you run into any technical problems, there are a number of resources available to you. First, you can always check with me; in many cases, I can walk you through technical issues. Also, you can contact the [SMU IT Help Desk](#) for assistance with Canvas and Zoom. Otherwise, here are additional useful resources:

- [Canvas \(Links to an external site.\)](#)
 - Click [HelpLinks to an external site.](#) on the [Global Navigation \(Links to an external site.\)](#) to search the Guides, [Chat \(Links to an external site.\)](#) or contact Instructure Support via email or phone
- Panopto
 - Search the [Panopto Support site \(Links to an external site.\)](#) (Links to an external site.) for forums and documentation, or contact the [SMU IT Help Desk. \(Links to an external site.\)](#)
- Zoom
 - Search their [Knowledge Base \(Links to an external site.\)](#) or [Submit a Request \(Links to an external site.\)](#)

ZOOM

[Zoom \(Links to an external site.\)](#) is used for online synchronous (i.e., real-time) meetings in this course and office hours. Please be sure your devices meet the [technical requirements \(Links to an external site.\)](#) for Zoom.

PRIVACY POLICIES

- [Canvas by Instructure](#)
- [Kaltura Video App in Canvas \(Links to an external site.\)](#)
- [Panopto Privacy \(Links to an external site.\)](#)
- [Respondus LockDown Browser \(Links to an external site.\)](#)
- [SMU OIT Policies and Legislation](#)
- [Zoom \(Links to an external site.\)](#)

ACCESSIBILITY

- Canvas
 - [Accessibility within Canvas](#)
 - [Voluntary Product Accessibility Template](#)
- [Kaltura Video App in Canvas \(Links to an external site.\)](#)
- [Panopto \(Links to an external site.\) \(Links to an external site.\)](#)
- [Zoom](#)

Course Guidelines

As this course will be taught completely online, there are certain expectations that should be adhered to. The following guidelines detail the most important aspects of the online format:

[Netiquette Rules](#) can be here.

EXPECTATIONS

We expect from the students, sincere effort, honesty, punctuality and that their work follows any guidelines we lay out.

Absent questions or requests for assistance, instructors must assume that students understand the material being covered and are able to complete the assignments. It is primarily through your questions that the instructor learns where the students are struggling to understand and on which topics more time needs to be spent for the students' benefit.

WORKLOAD

Students will be responsible for selected readings prior to each class period. In addition, a homework assignment consisting questions or problems will be due each week. **No credit will be given for late homework.** Therefore, it is expected that students will spend between 12 and 15 hours per week on this course inside and outside of class.

ASSESSMENT

Homework problems will be graded with partial credit given at the discretion of the instructor.

Each student will be required to write two papers that are 3000 - 4000 words in length. The first paper will be on a topic related to the Higgs boson and will be due around midterm, date and time TBD. The second paper will be on a topic related to dark matter and will be due on the last day of classes, Tuesday, May 4th at 5:00 pm. These papers will be considered the final project of the class in lieu of a final examination.

A course grade of Incomplete (I) will be given only in the case of extraordinary circumstances that prevent the student from finishing the semester. Students must have completed at least 50% of the course with a passing grade to be eligible for an Incomplete grade.

COMMUNICATION PATTERNS

Direct communications with the instructor should be made in the manner indicated by the instructor. General questions and questions that are relevant to multiple students, that is, questions that are not specific to an individual and involve that individual's private information, should be posted on the course wall.

It is the student's responsibility to ensure that all communications are received or acted upon. All students should be familiar with [Netiquette](#) [Links to an external site.](#) guidelines observed in this course for interactions with the instructor and between classmates.

Student Services

The following services and resources are available to SMU students:

- [Altshuler Learning Enhancement Center](#)
 - ALEC offers study-skill workshops and can help you with learning strategies and test preparation. Their phone number is (214) 768-3648.
- [Altshuler Writing Center](#)
 - The Altshuler Writing Center is open to all undergraduate students who need technical advice on their assigned papers. The writing center is open most afternoons and a few evenings. To work with someone at the writing center you must make an appointment in advance. To contact please call (214) 768-3648.
- [Caring Community Connections \(CCC\) program \(Links to an external site.\)](#)
 - This is a resource for anyone in the SMU community to refer students of concern to the Office of the Dean of Students. Faculty play a critical role in identifying students who are experiencing challenges, as you may be the first to notice a change in behavior such as class attendance or performance. The online referral form can be found at smu.edu/deanofstudentsccc [\(Links to an external site.\)](#). After a referral is submitted, students will be contacted to discuss the concern, strategize options, and be connected to appropriate resources. Additionally, should you have concerns about students and are unclear about what to do,

please see the [CCC Reference Guide \(Links to an external site.\)](#), or contact the Office of the Dean of Students at 214-768-4564.

- [DASS](#)
 - Students needing academic accommodations for a disability must first contact [Disability Accommodations & Success Strategies \(DASS\)](#) at (214) 768-1470 to verify the disability and to establish eligibility for accommodations. They should then schedule an appointment with the professor to make appropriate arrangements. (See an attachment describes the DASS [procedures \(Links to an external site.\)](#) and relocated office.) If you have a disability accommodation you must contact DASS and have a letter of accommodation delivered to the instructor no later than the third day of class. You can email a scanned copy of your letter.
- [my.SMU](#)
 - Online portal for SMU students that allows you to view personal information, emergency contact information, register for AARO (if applicable), view class schedule, enroll in classes, add/drop/swap classes, view grades and view financial aid packages.
- [SMU Bookstore](#)
 - Information on textbooks, events, buyback, promotions and more.
- [SMU Bursar](#)
 - Information on student finances, bill pay and more.
- [SMU Counseling Services](#)
 - College can be a stressful time. There are many transitions and major life events occurring while you are a college student. If you or a friend is going through a difficult time and needs someone to talk to please seek out the resources provided by the counseling center, located in the Health Center and their phone number is (214) 768-2211. For 24 hour help contact (214) 768-2860.
- [SMU Dedman Recreation Center](#)
 - Regular exercise is one of the best things you can do for your mental and physical well-being.
- [SMU Libraries](#)
 - SMU Libraries has reference librarians happy to help with your research needs. Contact a librarian at <http://askalibrarian.smu.edu/> or call (214) 768-2326.
- [SMU OIT](#)
 - OIT provides computing, information processing, and communications resources to satisfy the needs of faculty, students, and staff, and offers comprehensive support services to help them use technology effectively and creatively.
- [SMU Student Affairs](#)
 - SMU Student Affairs is a network of [departments, programs and services](#) focused on supporting students' out-of-classroom experiences and co-curricular learning.

Policies

ACADEMIC INTEGRITY

According to university policy, **cheating or plagiarism** of any kind is strictly prohibited and subject to disciplinary action. Please take the time to read the [SMU Honor Code](#).

POLICY for MISSING TESTS and QUIZZES

Students who miss a test because of illness or other compelling circumstances as determined by the instructor may make arrangements to make up the test. No student has the right to request a make-up test for other reasons, aside for absences for scheduled, officially sanctioned University extracurricular events. Requests for make-up tests will be dealt with on a case-by-case basis. Students who miss a quiz because of illness or other compelling circumstances will have that quiz excused at the discretion of the instructor.

DISABILITY ACCOMMODATIONS

Students needing academic accommodations for a disability must first register with Disability Accommodations & Success Strategies (DASS). Students can call 214-768-1470 or visit <http://www.smu.edu/Provost/SASP/DASS> (Links to an external site.) to begin the process. Once approved and registered, students will submit a DASS Accommodation Letter to faculty through the electronic portal *DASS Link* and then communicate directly with each instructor to make appropriate arrangements. Please note that accommodations are not retroactive and require advance notice to implement.

RELIGIOUSLY OBSERVANT STUDENTS

Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (<https://www.smu.edu/StudentAffairs/Chaplain/ReligiousHolidays> (Links to an external site.)).

EXCUSED ABSENCES for UNIVERSITY EXTRACURRICULAR ACTIVITIES

Students participating in an officially sanctioned, scheduled University extracurricular activity should be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (See [2020-2021 SMU Undergraduate Catalog](#) (Links to an external site.) under “Enrollment and Academic Records/Excused Absences.”)

PREGNANT AND PARENTING STUDENTS

Under Title IX students who are pregnant or parenting may request academic adjustments by contacting Elsie Johnson (elsiej@smu.edu) in the Office of the Dean of Students, or by calling

214-768-4564. Students seeking assistance must schedule an appointment with their professors as early as possible, present a letter from the Office of the Dean of Students, and make appropriate arrangements. Please note that academic adjustments are not retroactive and, when feasible, require advance notice to implement.

COVID-19 ATTENDANCE STATEMENT

Students who are experiencing COVID-19 symptoms or who have been notified through contact tracing of potential exposure and need to self-quarantine or isolate must follow the protocols laid out in [SMU's Contact Tracing Protocol \(Links to an external site.\)](#). To ensure academic continuity, students in these situations will not be penalized and will be provided appropriate modifications to assignments, deadlines, and testing. Please also note that SMUFlex classes might, in rare circumstances, go remote for two-week periods to accommodate COVID-related issues. To ensure these necessary accommodations, affected students must:

- Provide as much advance notification as possible to the instructor about a change in circumstances. Students must notify their instructor about a potential absence as well as plans for a return to class. For cases in which students test positive for COVID-19, they should fill out a [CCC form at this link \(Links to an external site.\)](#).
- Communicate promptly with the instructor to establish, as necessary, alternative assignments and/or changes to deadlines and exams. Students are then responsible for meeting the expectations laid out in these alternative arrangements.
- Continue participation in class via Zoom, as health circumstances permit. Attend class regularly, when not in a situation outlined above, in accordance with safety measures laid out by SMU CAN in the [Pledge to Protect \(Links to an external site.\)](#) (including wearing masks, maintaining social distancing, and cleaning personal space after class). In-person participation in SMUFlex classes is required on students' assigned red/blue rotation days except in cases when students are experiencing illness, are in self-quarantine or in isolation.
- Students facing multiple or extended COVID-19-related absences or illness can work with the Office of the Dean of Students to consider options such as fully remote learning or medical withdrawal.

This policy, aligned with the [SMU Honor Code \(Links to an external site.\)](#) and the SMU [Pledge to Protect \(Links to an external site.\)](#), relies on mutual trust and respect between students and faculty to ensure safety, academic integrity, and instructional continuity.