

Physics Independent Study Permission Form

Independent study enables a student to pursue for course credit individual interests under the supervision of a faculty member. Independent study is of two types: Independent Study (non-research) and Research Independent Study.

Students wishing to register for an independent study or research independent study must first make arrangements with a faculty member having expertise in the desired area. The student and instructor should agree on the course title, plan of study, objectives and expectations, as well as on the nature of the final product and evaluation criteria.

The student submits the Independent Study Permission Form to the Director of Undergraduate Studies or Certificate Program Director for final approval before the end of the drop/add period of the term in which the independent study is to be taken. If approved, the student will receive a permission number to register for the course.

Student Information

1. Please provide us with your first and last name: *

Rowan Kelleher

2. Please enter your Student ID (not unique ID)

Available on DukeHub.

2687334

3. Major: *

Undeclared



4. Graduation Date?

example: Dec 2022, May 2023, Aug 2023

May 2025

5. When do you plan to conduct the Independent Study? *

Final product—The student will produce a final academic and/or artistic product to be completed during the semester for which the student is registered for the course.

Fall 2022



Independent Study Information

Course Content / Quality—The independent study must provide a rigorous academic experience equivalent to that of any other undergraduate Duke course. Independent study courses may not duplicate

available course offerings in the semester or summer term in which the independent study is being taken,

nor may independent study be used simply to provide low-level support for other projects or to observe or shadow the work of others.

6. Which independent study are you applying for? *

There are three kinds of independent studies:

1. **PHYSICS 491**, in which a student learns more about an advanced topic through guided reading of research articles or advanced textbooks.
2. **PHYSICS 493**, in which a student does original research. This course carries "R" code.
3. **PHYSICS 495**, a research independent study during which a student writes his or her thesis. (This can also involve completing research while writing a thesis.) 495 is most often taken spring of the senior year, and can be taken more than once. This course carries "R" and "W" codes.

Note that, while students graduating with distinction commonly take one or two semesters of PHYSICS 495, enrolling in PHYSICS 495 is not required in order to do a senior thesis. Conversely, a complete senior thesis is not a required outcome of a semester of PHYSICS 495. However, since PHYSICS 495 is coded with "W", some type of writing product is required of a student signing up for this course for a given semester.

☐ Physics 491: Courses entitled Independent Study are individual non-research directed study in a field of special interest on a previously approved topic taken under the supervision of a faculty member and resulting in an academic and/or artistic product. Such independent study courses do not bear a Research (R) code and do not satisfy any general education requirements.

☒ Physics 493

☐ Physics 495

7. Short Title of Independent Study *

This title can only be 30 characters or less (including spaces) and must be in ALL CAPS. This will be the title listed on your transcript and in DukeHub.

DI-HADRON STUDIES AT CLAS12

Project and Faculty Information

8. Supervising Faculty Member: please provide the name of your supervising faculty member *

Faculty appointment—The instructor of record (supervising faculty member) must hold a regular rank faculty appointment at Duke within the department or program sponsoring the independent study. In some cases, there may be an additional instructor who mentors the bulk of the independent study and holds an appointment outside the sponsoring department or program. If this is the case, the supervising faculty member is responsible for submitting the final grade, and ensuring that the instructor adheres to academic standards, policies, and procedures pertaining to undergraduate students in Trinity College of Arts & Sciences.

Anselm Vossen

9. Supervising Faculty Member's Email Address *

anselm.vossen@duke.edu

10. Supervising Faculty's Department or Program: *

☒ Physics

☐ Biophysics

☐ Other

11. Instructor (if different from Supervising Faculty Member)

Enter your answer

12. Instructor Title and Affiliation

Enter your answer

13. Long Title of Independent Study

This title can be as detailed and long as it needs to be. You can skip this question if there is not a long title for your project and you entered a short title in the previous section.

Di-hadron studies at CLAS12, exploring validity regions of the TMD framework.

14. **Description of Proposed Study:**

Provide a one to two paragraph description of the proposed study, including topic, course goals, research / readings to be conducted. (The instructor and/or department or program may require a more detailed proposal, including a list of sources and bibliography, a rationale for independent study as opposed to regular course work, etc.) *

In deep-inelastic scattering, a point like leptonic probe, e.g. an electron, is scattered off a nucleon at high enough momentum transfers that the underlying quark-gluon structure of the nucleon is resolved.

By measuring hadron pairs produced from the struck quark, properties of the struck quark, like its polarization, can be inferred.

However, to interpret experimental data in a framework where the electron scatters incoherently off a quark, certain approximations have to be made. These approximations are only valid in certain kinematic regimes where higher order corrections are suppressed. Recently, a detailed study of the validity of these approximations has been performed [1]. This study aims to apply the methods developed in Ref. [1] to di-hadron production at the CLAS12 experiment. In particular, the so-called affinity for kinematic points of recent CLAS12 results [2] should be calculated from simulations. As a follow up, a feasibility study for the extraction of di-hadron multiplicities will be started. For this, data-simulation comparisons for key kinematic quantities should be extracted.

15. **Nature of the Final Product:**

Describe the nature and length of the final product (e.g. academic paper, artistic product, research report, etc.) *

The final product will contain a report summarizing the findings of the study as well as a presentation to the group. The report may take the form of a poster. The final product also comprises the analysis code accessible in a github directory.

16. **Scheduled Meetings and Work Expectations:**

Provide information on frequency and length of meetings with instructor, and expected work commitments and/or timetables: *

In addition to the individual effort of the student, which normally entails ~10 hours per week, the student will meet with the instructor of the independent study at least once every two weeks

during the fall or spring semester (at least once a week during the summer).

Meetings are planned to be weekly. Additional meetings will be scheduled as needed. Weekly me

17. **Grade to be based on:**

Provide information on how your work in the course is to be evaluated *

Grading—The instructor will evaluate the work, including the final product, associated with the independent study, and submit a grade by the end of the semester. If the instructor is someone other than the supervising faculty member, the instructor will consult on the final grade with the supervising faculty member from the sponsoring department or program, who will submit the final grade.

Final product and oral presentations to the group.

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