**09/01/2024 EDITION**

**SUNY BUFFALO STATE UNIVERSITY**

**Department of Physics Course Syllabus**

**PHY 525: Nuclear and Particle Physics for HS Teachers CRN3349**

**This course has been reviewed and accepted by SUNY and NYSED as 7-12 Physics Certification content credit.**

**Professor:** Dr. Dan MacIsaac, SAMC162A **E-mail:** macisadl@buffalostate.edu (within 48h)

**Phone:**  (716) 878-3802 (O anytime; leave message); **Brightspace:** [**https://mylearning.suny.edu/d2l/home**](https://mylearning.suny.edu/d2l/home)

**Office hours:** TWR 3:00 -- 4:00pm, plus W after class, and by appointment.

**Course Particulars:** This is a 3 credit-hour course meeting weekly on Wednesdays from 4:30-7:15pm.

**Pre-requisites:** Enrollment in a STEM Masters’ degree program for science teachers, or instructor’s permission.

**Textbook and References:** The required textbooks available both as paper and online for <$20 each are:

Close, F. (2023) (2ed) Particle Physics: A Very Short Introduction. Oxford Univ. 9780192873750

Close, F. (2023) (2ed) Nuclear Physics: A Very Short Introduction. Oxford Univ. 9780198718635

We will also read Ch10 only from:

Arons, A. B. (1997). Teaching introductory physics. New York: Wiley. ISBN 0-471-13707-3.

Y will be submitting online homework and documents by e-mail and/or the BSU LMS BrightSpace. We will follow the textbooks reading both in their entirety, with additional instructor supplied materials.

**Course Description and Objectives:** A survey of the major conceptual ideas underlying the two fields of ***nuclear physics and particle physics*** appropriate for physics and science teachers, extending material from PHY520: Modern Physics for HS Teachers.

This course will be taught using a collection of techniques including some brief standard lecture, activities, and the guided inquiry constructivist inquiry techniques collectively known as reformed teaching methods. We will act as a scientific community to develop introductory understandings of powerful scientific ideas underlying nuclear and particle phenomena, theories, structures, properties of nuclei and their interactions, the standard model, applications including fission and fusion, societal issues regarding nuclear power and nuclear waste and findings from current physics education research in the teaching of nuclear and sub-nuclear physics. Required topics from standard curricula including NYSED Regents Physics, International Baccalaureate Physics, Advanced Placement Physics and relevant NGSS and NYSSLS documents will be examined. Usually, you will have discussions, (short) lectures and problem-solving sessions every day.

**Major Objectives:**

1. Students will develop and apply models describing techniques used to explore nuclear and sub-nuclear structures.
2. Students will develop and apply models describing the properties of nuclei and their interactions.
3. Students will develop and apply models describing the subnuclear structures.
4. Students will research and debate issues dealing with nuclear power and nuclear waste.
5. Students will apply findings from current physics education research in the teaching of nuclear and sub-nuclear physics.

**Course Schedule:** The first ¾ of the course we will roughly complete two chapter every week from the two Close texts, then a chapter of Arons and a final video project. Most weeks you will have a homework assignment and a reading log (expect 2-3 hours of homework and two hours of reading weekly). *Tentative due dates for some homework and exams are set below; I reserve the right to modify topics and pacing to suit needs.*

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| PHY525 Schedule rough draft | | | | |  |
|  | Week | Wednesday |  | Topics | Comments |
|  | 1 | 8/28/24 |  | Intros and Bubble Chambers I | cloud chamber photos activity |
|  | 2 | 9/4/24 |  | Particle Physics Ch1 & 2 RL1 | HW1 -- bubble chamber photo solutions due |
|  | 3 | 9/11/24 |  | Particle Physics Ch3 & 4 RL2 | RL1 due |
|  | 4 | 9/18/24 |  | Particle Physics Ch5 & 6 RL3 | RL2 & HW2 due |
|  | 5 | 9/25/24 |  | Particle Physics Ch7 & 8 RL4 | RL3 due |
|  | 6 | 10/2/24 |  | Particle Physics Ch9 & 10 RL5 | RL4 & HW3 due |
|  | 7 | 10/9/24 |  | Nuclear Physics Ch1 & 2 RL6 | RL5 due |
|  | 8 | 10/16/24 |  | MTX1 Particle Phy (take home) | RL6 due & Final Project Proposals due |
|  | 9 | 10/23/24 |  | Nuclear Physics Ch3 & 4 RL7 | RL7 due |
|  | 10 | 10/30/24 |  | Nuclear Physics Ch5 & 6 RL8 | RL8 & HW4 due |
|  | 11 | 11/6/24 |  | Nuclear Physics Ch7 & 8 RL9 | RL9 & Video Project SB+refs due |
|  | 12 | 11/13/24 |  | Arons Ch10 RL10 | RL10 & HW5 due |
|  | 13 | 11/20/24 |  | Make up/ overrun | Project time |
|  | 14 | 11/27/24 |  | Thanksgiving | Holiday |
|  | 15 | 12/4/24 |  | Final Video Projects | Final Project presentations and posttest |
|  | 16 | 12/11/24 |  | CEP (Exam) Week | Final TH exam + video project report due |

**Grading and Evaluation:** Overview as above, details given below and in class as required. Below is the guaranteed grading scale. I reserve the right to lower grade cutoffs but will not raise them. ≥ 90% A ≥ 80% B ≥ 70% C ≥ 60% D

**Ten Reading Logs (20% of the grade):**  A conscientiously completed one page (two faces) Reading Log for each reading assignment (usually a pair of short chapters for 25-35pages) on the provided paper form is due roughly weekly, submitted as a scanned form. Expect to spend 2 hours per reading through the texts. READ AHEAD!

**Homework (20% of grade):** there will be five homework activities due (plan on 2-4 hours every other week). **While you are strongly encouraged to communicate and work with others, homework is expected to represent your own individual efforts, thoughts and language.** Late homework will not be accepted due to the restrictive nature of the online submission system, and the necessity to post solutions in a timely fashion for class sharing. Some homework may require you to submit recorded video solutions.

**Exams (30% of grade):** there will be one midterm exam and one final exam. Exams will be built from homework, which is built on in-class activity. Midterm exams are not deliberately cumulative, and the final will be only partially cumulative. Some

**Class Activities and Class participation (10% of grade):** You will be part of a working group that depends on every member’s input. You should be present for group discussions, and most discussions will only take place once and really can’t be made up later.

**Final Project and Presentation (20% of grade):** You will be expected to complete a video project related to a course or closely related topic of your choice (but negotiated with the instructor), and present it in class. You must include multiple representations and mathematics, use reviewed literature (journals) and can also use the web as references. You will make a 15 minute presentation upon your project to your peers during the last two weeks of class. More details will be forthcoming.

**Statement On Plagiarism And Cheating:**

I have absolutely no patience with passing off the intellectual work of others as your own. Anyone caught cheating or verbatim copying may receive a failing grade in the course, and/or a recommendation to leave a teacher preparation program if applicable. **Working with other people on homework and in-class activities is not considered cheating, and is in fact encouraged, though your submitted work must reflect your own choice of words and interpretation.**

SUNY Buff State Policies:

My priority as your professor is to ensure a safe, respectful education environment where all students can learn and thrive. The University does not tolerate any form of discrimination or harassment (including sexual assault, dating and domestic violence, stalking) based on protected characteristics (e.g., sex, gender identity, sexual orientation, religion, pregnancy, etc.) or related retaliation. All faculty and teaching assistants are considered mandated reporters by the University, which means that if they observe or learn of sex-based harassment/ discrimination or related retaliation, they are obligated to immediately share that information with the University’s Title IX Coordinator. This obligation, grounded in law and policy, is designed to protect the safety of students and the broader Buffalo State community, as well as ensure that students receive information about available supportive measures and resolution options to enable them to make informed choices. Supportive measures include reasonable academic accommodations available with or without the filing of a formal complaint.

If you need academic accommodations due to sex discrimination, harassment, or related retaliation, you may:

On Campus Resources:

* Contact the TIX Coordinator directly ([titleix@buffalostate.edu](mailto:titleix@buffalostate.edu) or 716-878-5212), without sharing any personal information with me.
* If you would like to speak with a **confidential** counselor about sexual misconduct, [The Counseling Center](https://counseling.buffalostate.edu/) provides 24/7 confidential support for students via the Bengal Support Line (833-823-0260), or by scheduling an appointment at 716-878-4436.
* If you are a student with a disability and require reasonable accommodations to meaningfully participate in this course, please contact the University’s [Student Accessibility Services](https://sas.buffalostate.edu/) at your earliest convenience ([sas@buffalostate.edu](mailto:sas@buffalostate.edu) or 716-878-4500), as SAS is responsible for processing and approving such requests.
* If you are pregnant, have recently experienced childbirth, and/or have medical needs related to childbirth, please contact our Title IX Coordinator for assistance.
* You can file an [anonymous report](https://buffalostate.co1.qualtrics.com/jfe/form/SV_6EdkiALwkGLO0El) with our University Police Department: 716-878-6333, [police@buffalostate.edu](mailto:police@buffalostate.edu)

Off Campus Resources

* Crisis Services: 24/7 hotline, 716-834-3131
* National Suicide Prevention Lifeline: 1-800-273-8255
* Family Justice Center: 716-558-7233, safe@fjcsafe.org