Gravitational Waves:

This course will focus on the physics behind the astonishing sensitivities which are required and can be reached with gravitational wave observatories. We will cover the basics of gravitational waves (properties, generation, sources, used interactions to detect them). We will follow up with brief reviews of bar detectors and pulsar timing arrays. The focus of the course will then shift towards ground-based observatories such as Advanced LIGO and Advanced VIRGO. Once we understand their limitations, we will explore how future upgrades and new ground-based detectors (ET, Cosmic Explorer, …) try to improve the sensitivity. During the last third of the semester, we will turn towards space and focus on LISA, the most mature space-based observatory. This will naturally lead to a discussion of potential beyond LISA missions.

LIGO and LISA technologies are used in other fundamental physics experiments such as ALPS, the Holometer, and geodesy missions such as GRACE-Follow on. If time allows, we will also cover these projects.

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Lecture times: TBD

Office hours: TBD

Course objectives and/or goals:
The main objective is to explore together the science behind gravitational wave observatories, identify limiting noise sources and, in parallel, learn how to apply fundamental physics principles to real experimental problems. The improvements of existing and the development of new observatories will be one of the most challenging tasks experimental physics faces over the next decades. This goal of this course is to provide a broad overview of this fast growing field which also finds applications in other areas of physics.

Format:
The course itself will in part be held in the form of classical lectures and in part open discussions. A typical class might start with a 30min lecture followed by a 15min discussion. Or we have one and half lectures followed by a longer discussion. I also plan to assign specific topics to small student teams (3-4 students). The teams have then ~4 weeks to prepare a 20-30min lecture followed by a discussion of their topic.
I will also try to organize a few guest lecturers to present specific topics and lead the discussion.

Grading:
The grading will be based on the constructive participation during the lectures and the discussions as well as on the presentations. Each student will have the opportunity to **improve** her/his grade by taking a 20-30 min individual oral exam during finals week.

Attendance:
Attendance is expected and required to participate in the discussions. In the case of excused absences, I will provide lecture notes. As we don't have exams, we won't have make-up exams.

The oral exam at the end of the semester can be used to improve the grade. We might also schedule a special student presentation if needed.

Students with disabilities:
Students with disabilities should reach out to the lecturer to identify what accommodations are needed.

Material recommended but not required:
There is no single text book that covers all topics we will discuss. However, I am using the following texts as a starting point:

1. Fundamentals of Interferometric Gravitational Wave Detectors by Peter R. Saulson, World Scientific Publishing, ISBN: 981-02-1802-6 (1994)
2. Advanced Interferometric Gravitational-wave Detectors: Essentials of Gravitational Wave Detectors by edited by David Reitze, Peter Saulson and Hartmut Grote, ISBN: 9813146079, World Scientific Publishing Company (2019)

Beyond this, we will use review and other journal articles as well as dissertations which often provide the best discussions of specific topics.

Many of the best dissertations are available at:
https://gwic.ligo.org/thesis-prize.html

Online evaluations:
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

Honor Pledge:
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Conduct Code specifies a number of behaviors that are in violation of this code and the possible sanctions. Click here to read the Conduct Code. If you have any questions or concerns, please consult with the instructor in this class.

In-Class recordings:
Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for

personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. **A class lecture does not include student presentations**, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.