Gravitational Waves

Spring 2020

| Lectures: | Tuesdays on Zoom, 13:00-15:00 |
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| Werkcollege: | Mondays on Zoom, 18:00-19:00 & |
| | Tuesdays on Zoom, 18:00-19:00 |
| Instructor: | Sarah Caudill (physarah@gmail.com) |
| Assistant: | Khun Sang Phukon (k.s.phukon@nikhef.nl) |

Course website: <u>https://www.nikhef.nl/~caudills/teaching.html</u> Datanose information: <u>https://datanose.nl/#course[77627]</u>

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email <u>team@piazza.com</u>.

Find our class page at: https://piazza.com/ university_of_amsterdam/spring2020/5354grwa3y/home

OBJECTIVES

To introduce students to current research topics in gravitationalwave theory, experiment, data science and astrophysics.

COURSE CONTENT

The course starts with an introduction to general relativity (GR). The Einstein field equations are discussed and the linearized Einstein equations are derived, which lead to the prediction of gravitational waves. Interesting sources of gravitational radiation are discussed, such as two black holes spiraling towards each other and colliding. Experimental efforts to gain access to the strong-field regime of GR through direct observation of gravitational waves are explained. We then turn to data analysis of the recent gravitational-wave detections: how they were discovered and how their parameters

were measured. The emphasis throughout is how these observations allow us to address fundamental problems in physics.

The final assessment will take the form of a final project, where the students will have to read and critique a journal article from the field of gravitational-wave physics. Additionally, the students will give a small presentation via Zoom.

There are also required weekly homework assignments.

SCHEDULE

This schedule may be subject to change but the changes will be announced in advance.

| Dates | Topics |
|-----------|--|
| 31-3-2020 | Overview of the Field |
| 7-4-2020 | General Relativity Review GW Derivation |
| 14-4-2020 | GW Astrophysical Sources Astrophysics with GWs |
| 21-4-2020 | GW Detectors |
| 28-4-2020 | GW Data Analysis |
| 12-5-2020 | Bayesian Model Selection and Parameter Estimation for GWs |

ASSESSMENT

| Assignment | Percentage of final grade |
|--------------------------------|---------------------------|
| Weekly exercises | 40% |
| Final project and presentation | 95% and 5% |

FINAL PROJECT SCHEDULE

Final project presentations: 13:00-16:00 Friday May 29, 2020 via Zoom.

In the event that the student cannot be present during this designated time, the student should let me know as soon as possible and I will try to schedule a different time with the student.

POLICIES

Feel free to work on weekly exercises with other students. **Please** feel free to ask questions in class.