

Gravitational Waves

Spring 2019

Lectures: Tuesdays in H331, 13:00-15:00

Werkcollege: Tuesdays in H331/H239, 15:00-17:00

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Datanose information: [https://datanose.nl/#course\[68961\]](https://datanose.nl/#course[68961])

OBJECTIVES

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

COURSE CONTENT

The course starts with an introduction to general relativity (GR). The Einstein field equations and properties of black hole solutions are discussed. Next 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.

As part of the course we are going to develop a simple visualization that will aid in understanding various concepts. The visualization could take the form of a brief video, an animated gif, an infographic, or an informative, high-resolution plot.

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
2-4-2019	Overview of the field
9-4-2019	General Relativity Review GW Derivation
16-4-2019	GW Astrophysical Sources Astrophysics with GWs
23-4-2019	GW Data Analysis
30-4-2019	Bayesian Model Selection and Parameter Estimation for GWs
14-5-2019	GW Detectors

ASSESSMENT

Assignment	Percentage of final grade
Weekly exercises	20%
Final exam	70%
Visualization project	10%

EXAM SCHEDULE

Final: 13:00-16:00 Wednesday May 29, 2019 in H331

The final exam will be cumulative with emphasis on the material in the exercises. **There will be no make up of the final exam except in cases of emergency or by prior arrangement.**

POLICIES

Feel free to work on weekly exercises with other students but exams **must be your own work.**

Please feel free to ask questions in class.