Goethe-Universität Frankfurt
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# Nonlinear Wave Equations

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Wave equations are ubiquitous and play a fundamental role in physics and applications. In many models, nonlinearities appear naturally and introduce highly non-trivial dynamics. The aim of this course is to give an introduction into the mathematical analysis of nonlinear wave equations. Central questions concern the existence of solutions to the initial value problem, the description of long-time behaviour, as well as the formation of singularities. The course will basically cover the following chapters:

- The basics: A review of the linear wave equation on $\mathbb{R}^n$
- A first glance on nonlinear problems
- Tempered distributions and Sobolev spaces
- Existence of solutions for nonlinear wave equations (energy methods, Strichartz estimates)
- Formation of singularities in finite time

**Required prerequisites:** Functional analysis

**Course language:** English

**Exam:** Oral examination (about 30 min in English/German)

**Registration:** The main platform for this course is OLAT. Please register for the course here

https://olat-ce.server.uni-frankfurt.de/olat/auth/RepositoryEntry/9670230022

**Modalities of the course:** The course starts on November 4 with a first online meeting (the link will be sent via email to all registered students). After that, the lecture will be given in form of recorded screencasts which you will find on OLAT every week. The corresponding notes will also be provided as pdf files.
In addition, there will be an exercise class in form of online meetings every two weeks (e.g. at the original time of the lecture Wed 12:00 - 14:00). The details and the date will be discussed in the first meeting.

**Some references:**

- C. Sogge, Lectures on Nonlinear Wave Equations
- T. Tao, Nonlinear dispersive equations: local and global analysis
- J. Shatah, M. Struwe: Geometric wave equations