

Master-Pflichtseminar
Master Mandatory seminar (MVSEM)

Your Passion for Physics:
What are you curious about?

Thomas Pfeifer, MPIK Heidelberg



physics

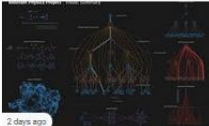


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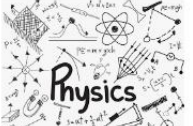
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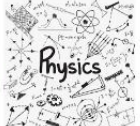
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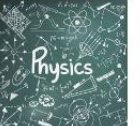
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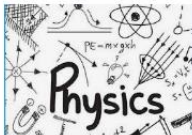
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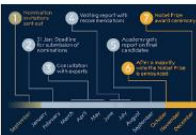
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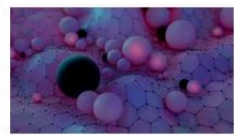
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Nomination and selection of Physics ...
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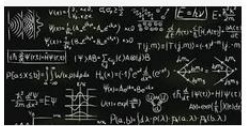
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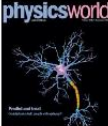
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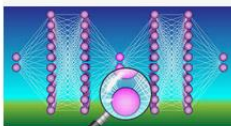
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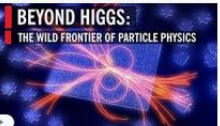
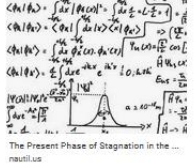
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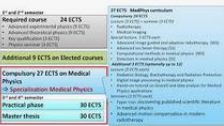
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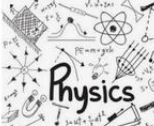
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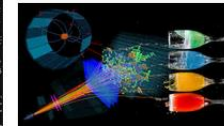
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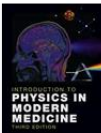
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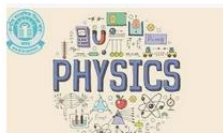
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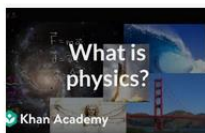
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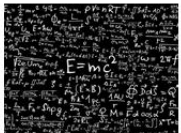
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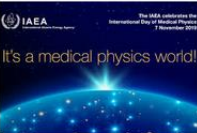
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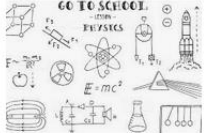
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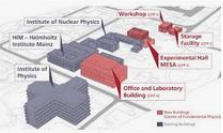
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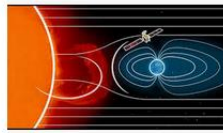
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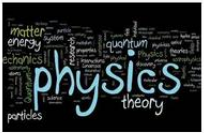
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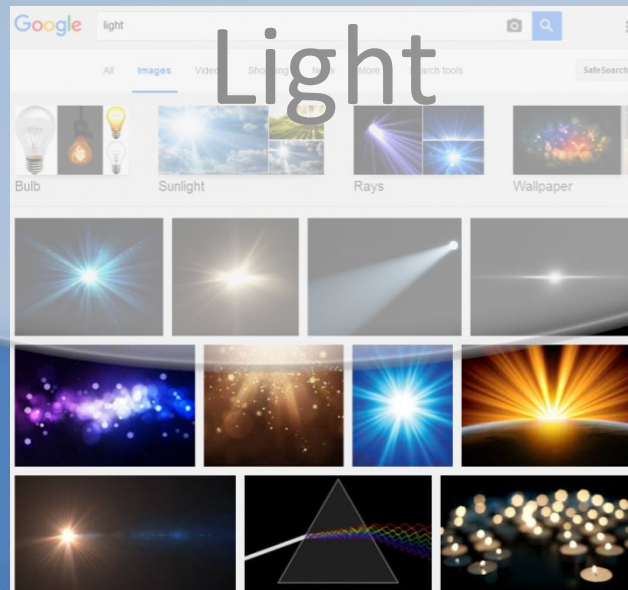
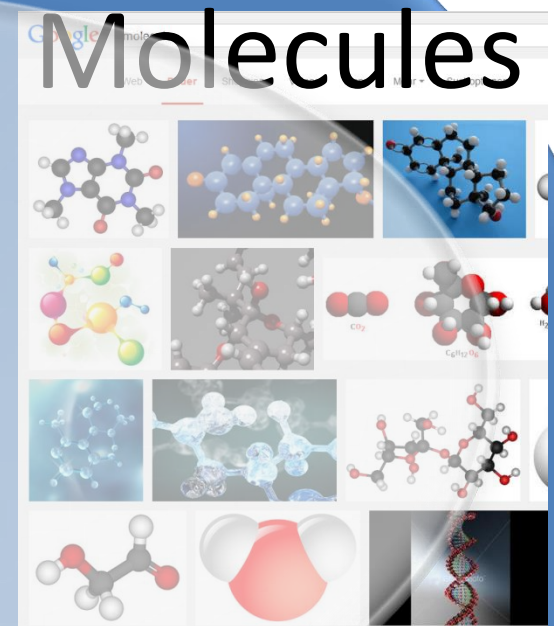
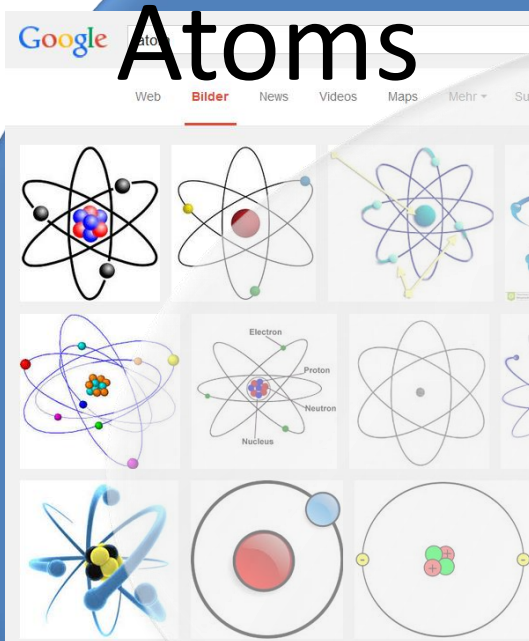


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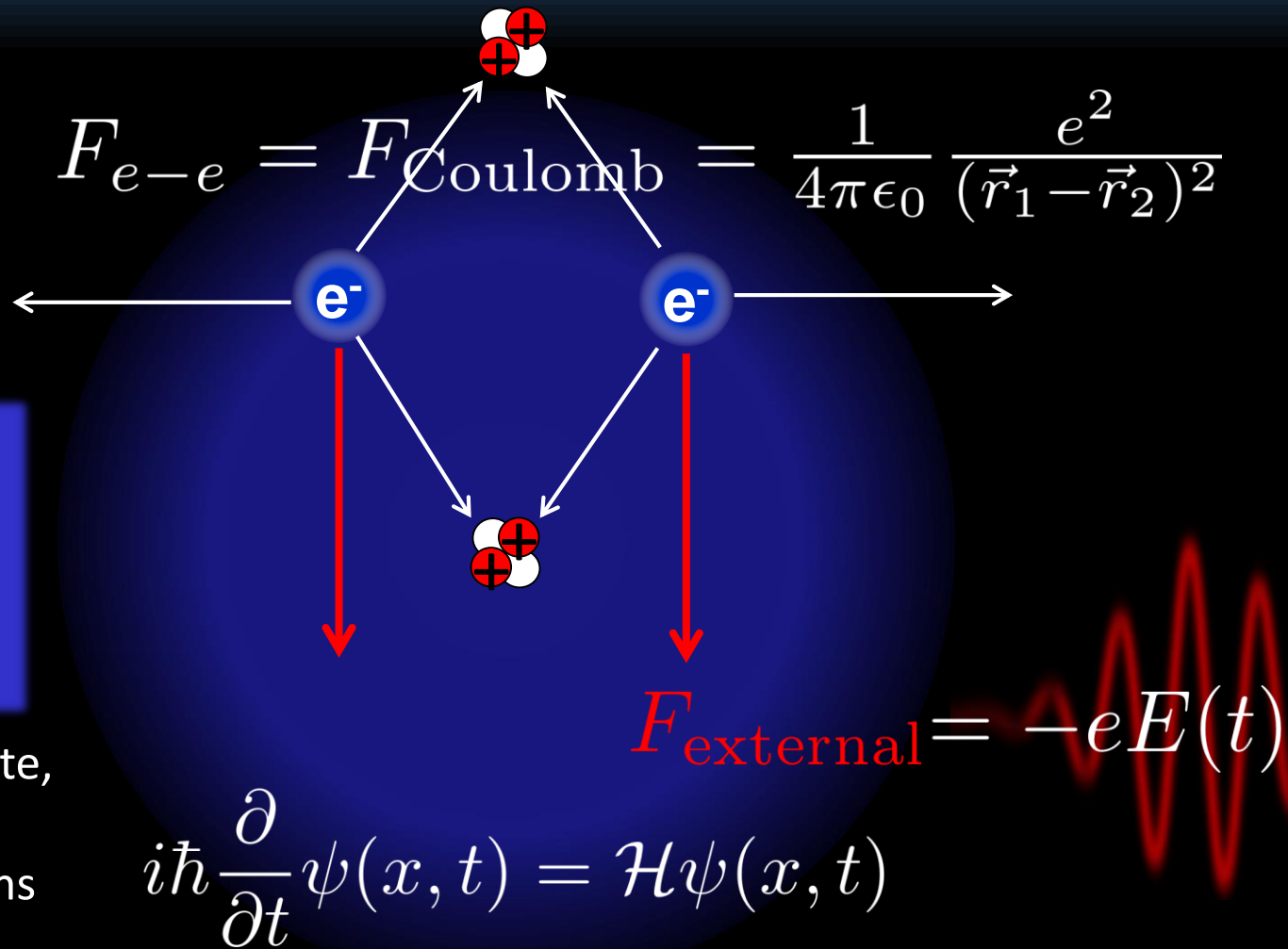
Atomic, Molecular, and Optical Physics (AMO Physics)

What is it?

*Understand
Quantum
Mechanics*



the language electrons speak...



Time-dependent Schrödinger/Dirac equation

atoms and small molecules: well-defined Å-sized quantum "labs"

Some current AMO Focus Topics

Light

(Ultrafast)
Lasers

Femto-/
Attosecond
Physics

Strong-field
Laser Physics

Entanglement&
Quantum
Information

Quantum
Dynamics&
Control

Precision
Physics

Tests of
Fundamental
Theories

Matter

(Ultracold)
Gases or
(Cold) Ions

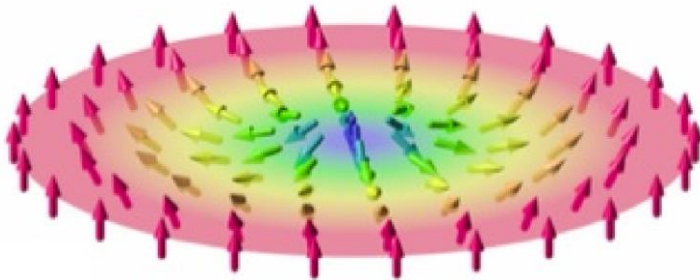
Collision
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Atomic, Molecular, and Optical Physics (AMO Physics)

Is it important?

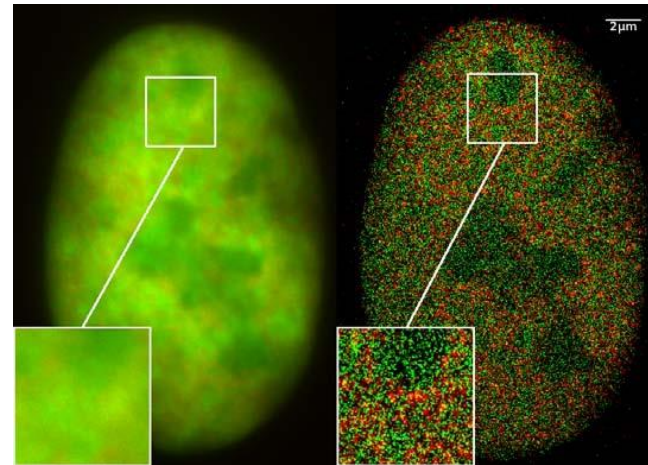
Physics Nobel prize 2016



"for theoretical discoveries of topological phase transitions and topological phases of matter"

David Thouless
Duncan Haldane
Michael Kosterlitz

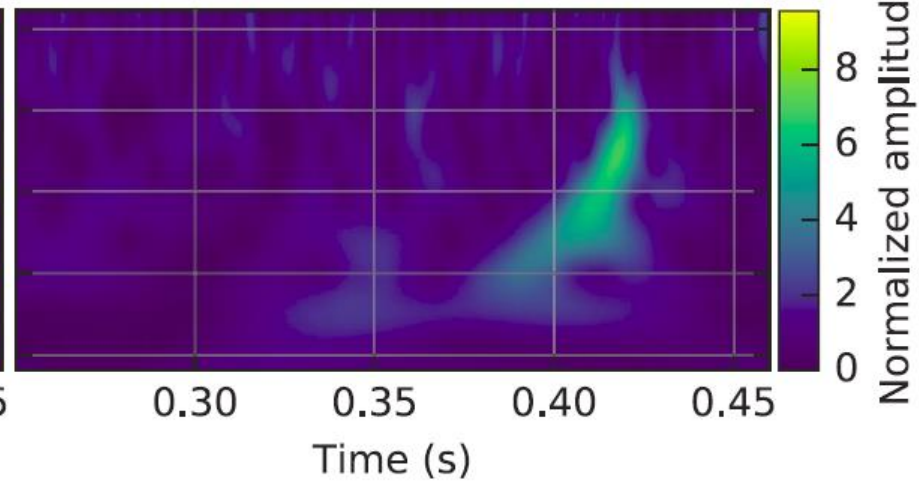
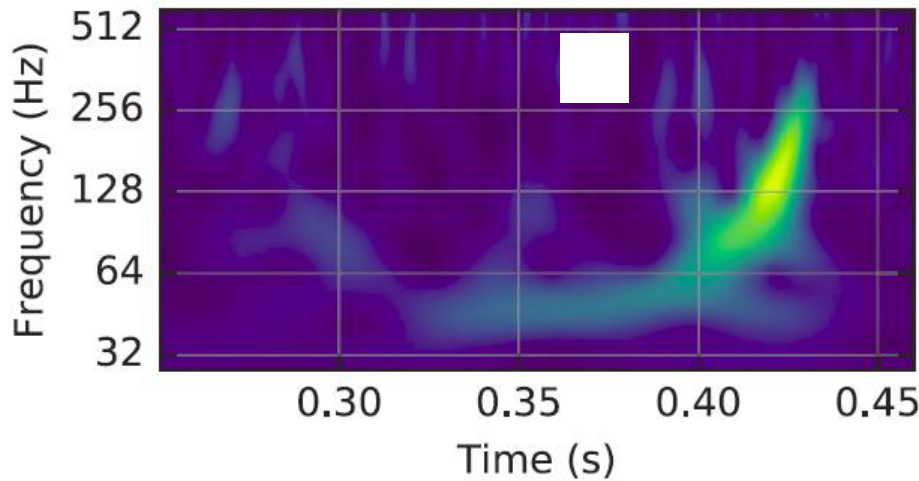
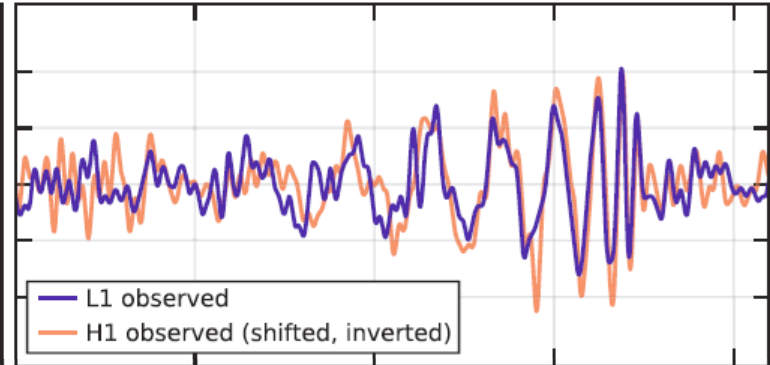
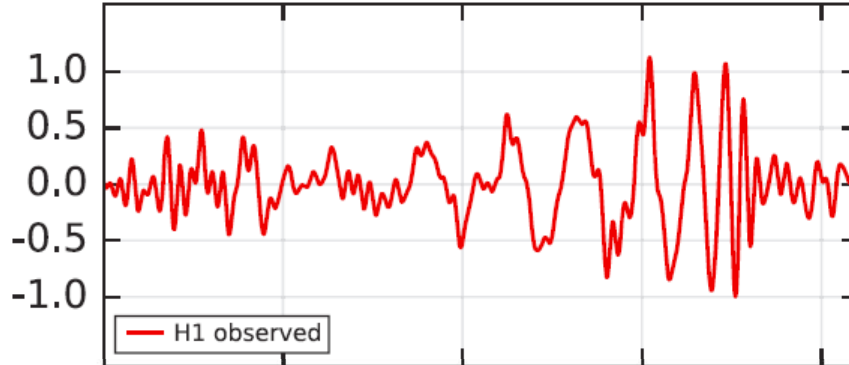
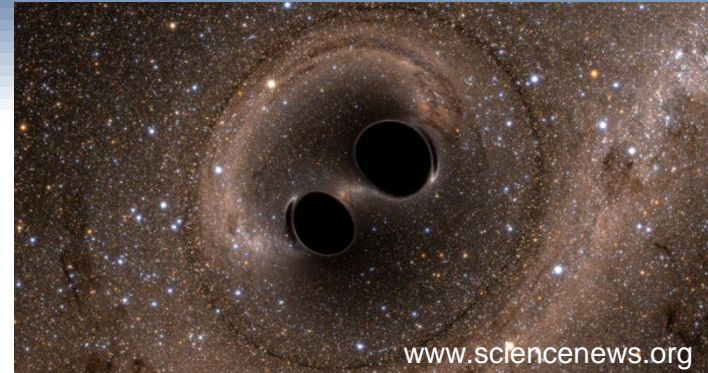
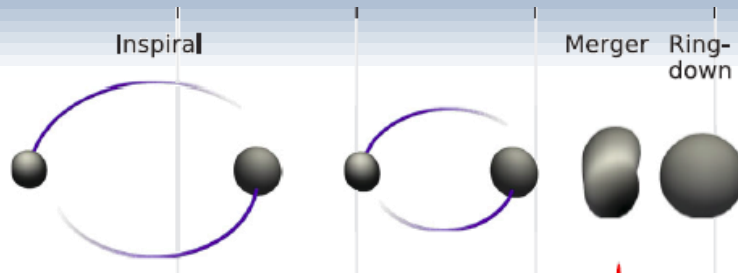
Chemistry Nobel prize 2014




"for the development of super-resolved fluorescence microscopy"

Eric Betzig
Stefan W. Hell
William E. Moerner

Another famous result (based on optics)



Optical-Physics driven Nobel

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► Rainer Weiss






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 **The Nobel Prize in Physics 2017**
Rainer Weiss, Barry C. Barish, Kip S. Thorne

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The Nobel Prize in Physics 2017



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Rainer Weiss
Prize share: 1/2



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Barry C. Barish
Prize share: 1/4



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The Nobel Prize in Physics 2017 was divided, one half awarded to Rainer Weiss, the other half jointly to Barry C. Barish and Kip S. Thorne *"for decisive contributions to the LIGO detector and the observation of gravitational waves"*.

2017 Nobel Laureates

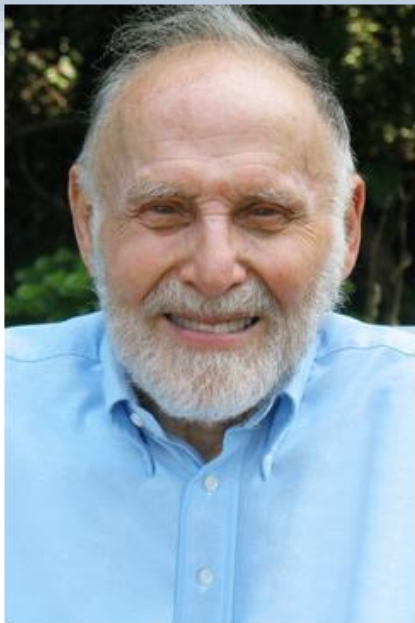
2017 PHYSICS PRIZE QUESTION

Did you know that gravitational waves were predicted by Albert Einstein a hundred years ago?

☐ Yes ☐ No

Nobel Prize Lessons

The Nobel Prize in Physics 2018

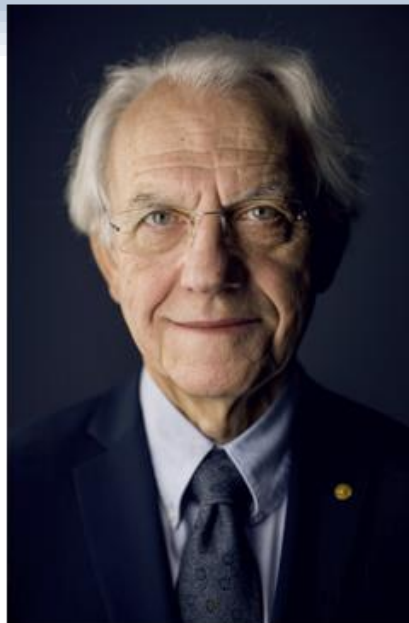


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Prize share: 1/2

Optical tweezers



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Gérard Mourou

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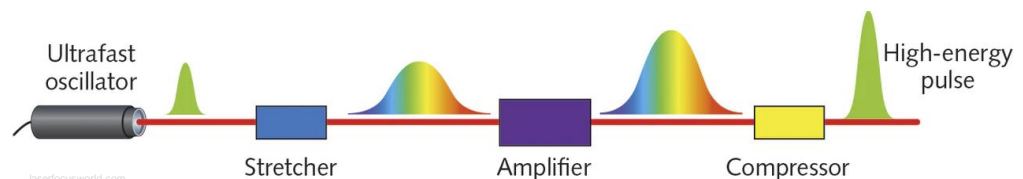


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Donna Strickland

Prize share: 1/4

Chirped Pulse Amplification



Seminar Topics for Presentations

- Generation of short laser pulses
- Frequency combs
- Optical Clocks
- Time-resolved physics in atoms and molecules
- (Low-energy) Electron collisions with atoms and molecules
- Physics in strong laser fields
- (Re-)collision physics
- The Physics of Free-Electron Lasers
- Physics with intense x-ray pulses at Free-Electron Lasers
- Squeezed light for detection of gravitational waves
- Photoionization of Hot Astrophysical Matter
- Ultrafast quantum control with shaped laser pulses
- Optical cooling and trapping
- Laser Cooling of Ions in Coulomb Crystals
- Physics in Rydberg gases
- The g-factor of the electron: Stringent Test of QED, and weighing the electron
- Test of the time variation of fundamental constants using highly-charged ions

Seminar Facts and Requirements

(MVSEM, Master Seminar)

Language: English
ECTS points: 6

Prerequisites: basic knowledge of atomic physics from the bachelor program
Content: your physics topic of interest

Form of testing and examination: ~~45 min~~ ^{→ 30 min} **talk** on agreed topic, submission of presentation and a short **write-up**, participation in **discussions**

Presentation: **Understandable to a Master student with no special prior knowledge**

Material: literature should be searched for independently, seed information can be provided if necessary, please send me **your literature** and a brief **outline** of what you want to talk about **at least 2 weeks before your talk**

Preparation Meeting: **1 week before presentation**
show lineout/structure of presentation, discuss remaining questions

Slides: Please send me your slides at least **2 days before your presentation**

Write-up: ~1 page structured summary of the topic

- What is the goal, why is it important?
- what are the scientific questions?
- what are the methods?
- what has been achieved, recent results?
- what's next?