Master-Pflichtseminar
Master Mandatory seminar (MVSEM)

Your Passion for (AMO-) Physics:
What are you curious about?

Thomas Pfeifer, MPIK Heidelberg

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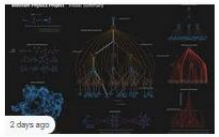
The Backstory of the Wolfram Physics ...
writings.stephenwolfram.com



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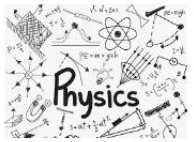

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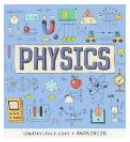

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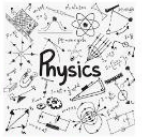

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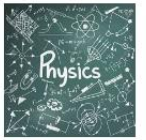

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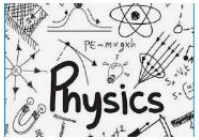

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Physics ex Machina | Lindauer ...
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Nomination and selection of Physics ...
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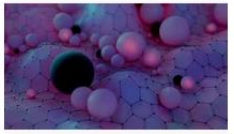
Quanta's Year in Physics (2019 ...
quantamagazine.org


Macomb Community College - Physics
macomb.edu


science physics - Tileco
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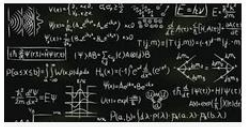
Nobel Predictions: Three Top Contenders ...
astronomy.com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The Coolest Physics You've Ever Heard ...
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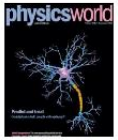

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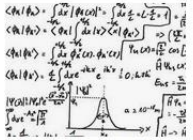
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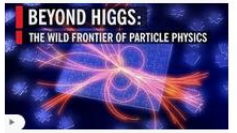

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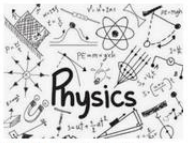

Scope of Physics: What is Physics ...
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TQD
thequantumdaily.com


What can you do with a physics degree ...
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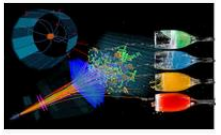
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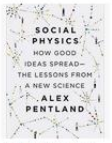

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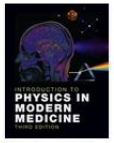

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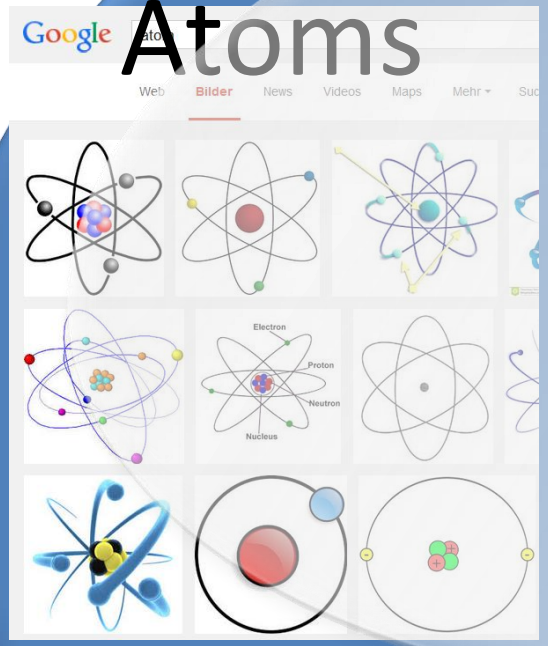
Atomic, Molecular, and Optical Physics (AMO Physics)

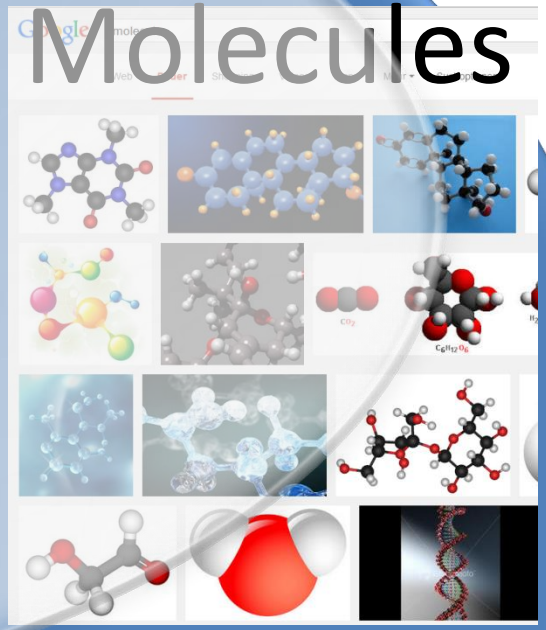
What is it?

Atoms

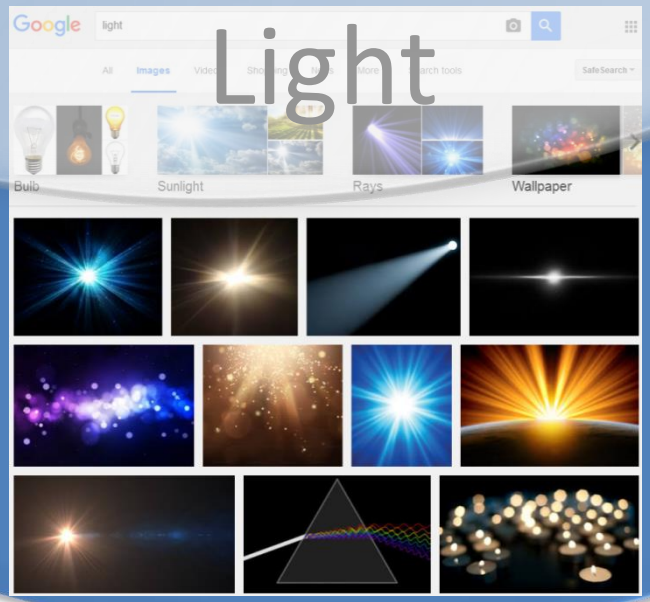


Understand Quantum Mechanics

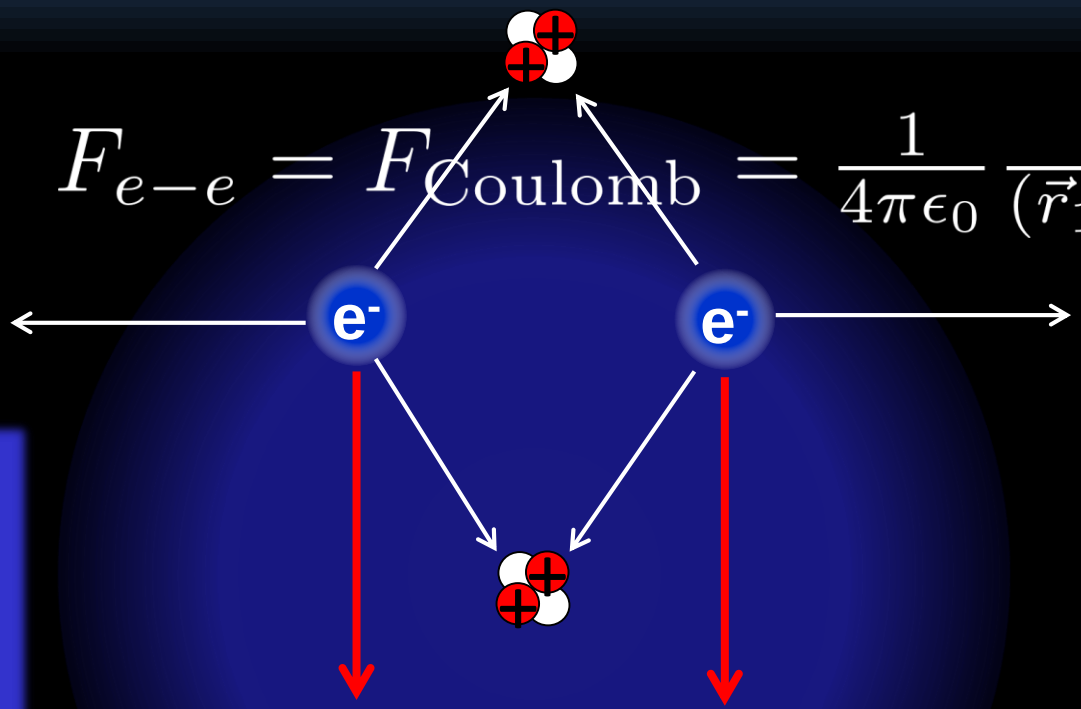
Molecules



Light

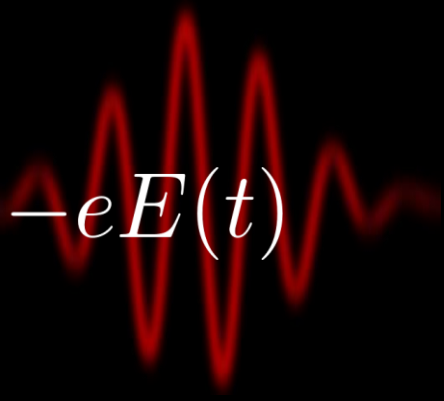


the language electrons speak...



$$F_{e-e} = F_{\text{Coulomb}} = \frac{1}{4\pi\epsilon_0}\frac{e^2}{(\vec{r}_1-\vec{r}_2)^2}$$

$$F_{\text{external}} = -eE(t)$$



$$i\hbar\frac{\partial}{\partial t}\psi(x,t) = \mathcal{H}\psi(x,t)$$

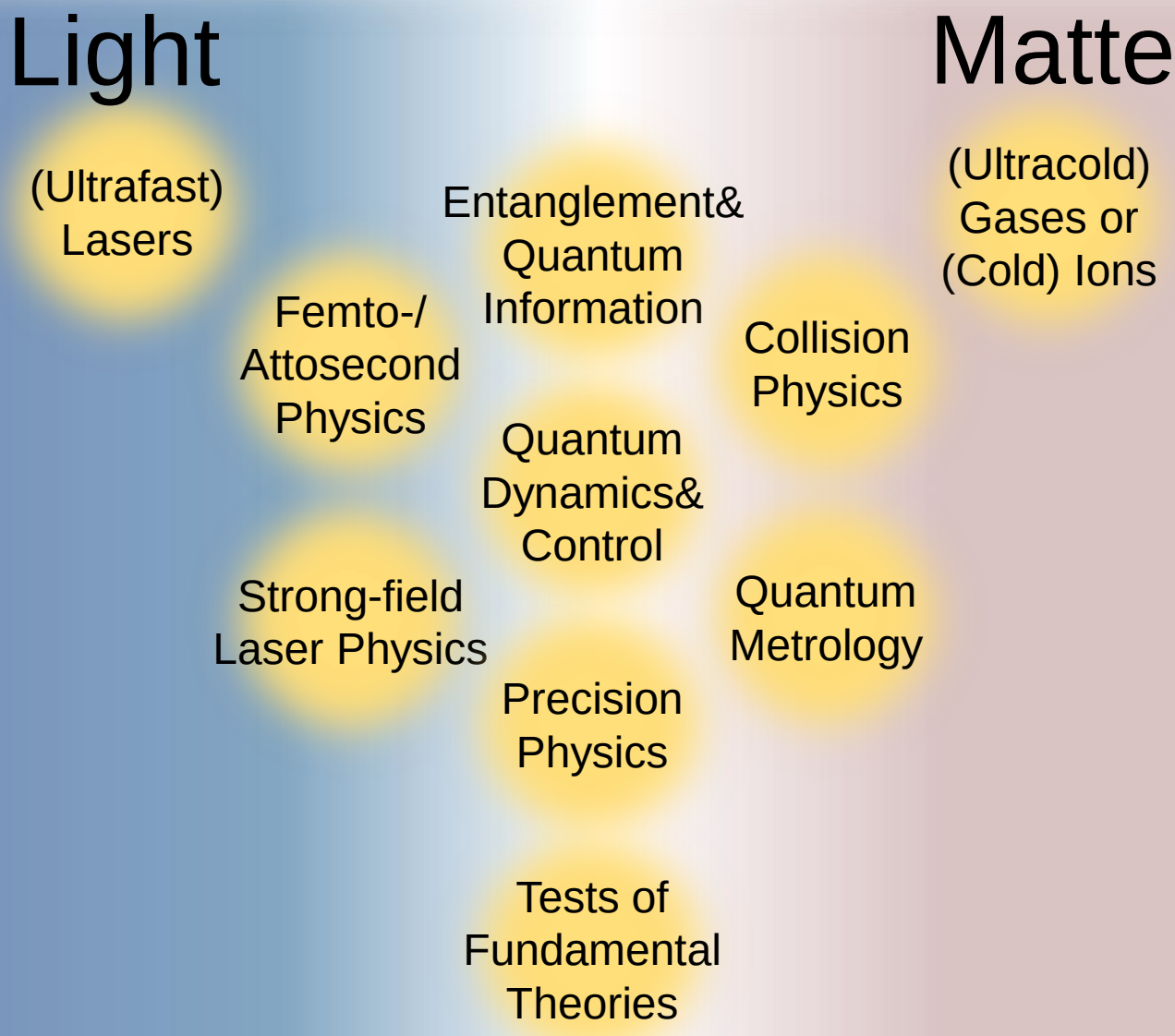
Time-dependent Schrödinger/Dirac equation

The quantum few-body problem

... only approximate, special-case, or numerical solutions

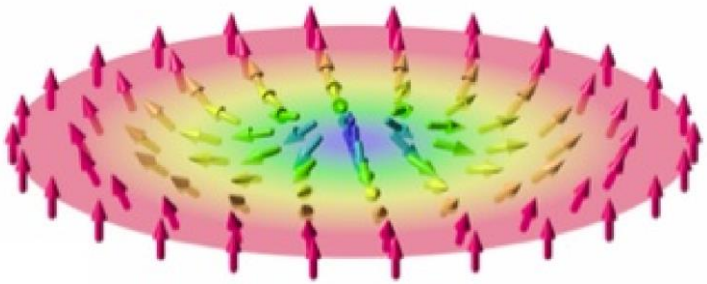
atoms and small molecules: well-defined Å-sized quantum "labs"

Some current AMO Focus Topics



Atomic, Molecular, and Optical Physics (AMO Physics) Is it important?

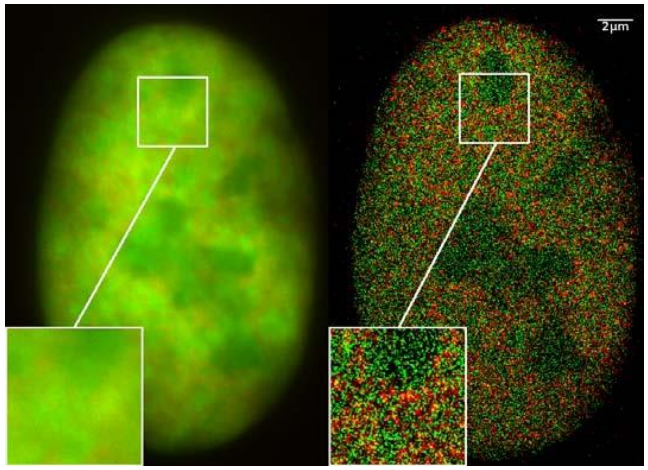
Physics Nobel prize 2016



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

David Thouless
Duncan Haldane
Michael Kosterlitz

Chemistry Nobel prize 2014

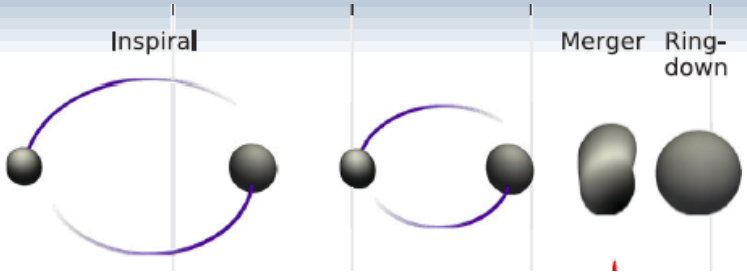


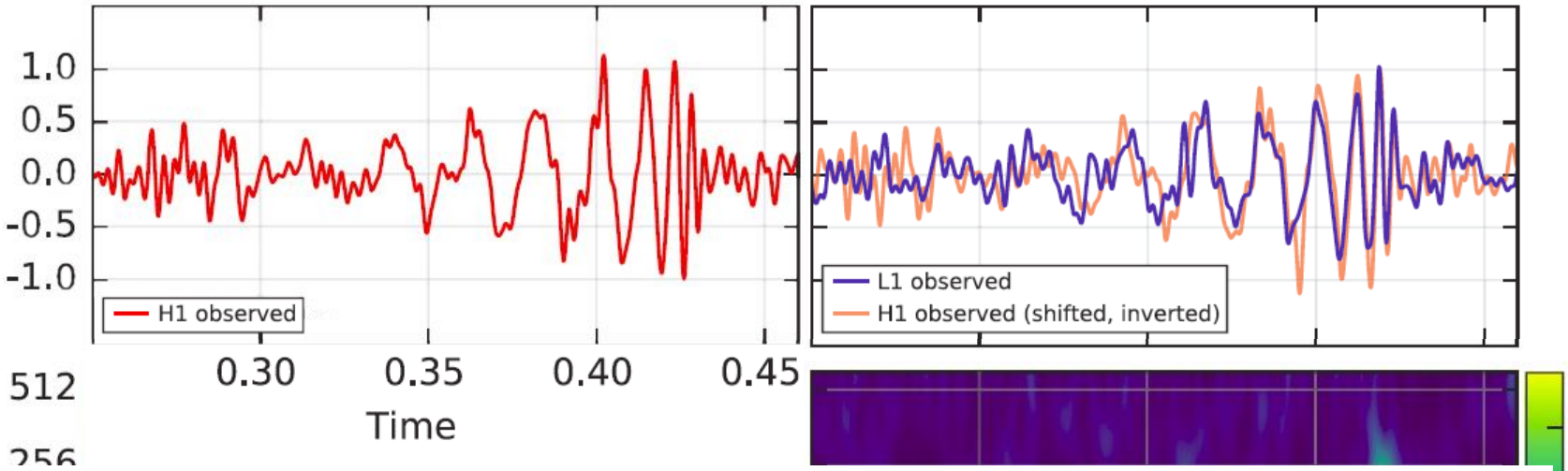
"for the development of super-resolved fluorescence microscopy"

Eric Betzig
Stefan W. Hell
William E. Moerner

Picture source: wikipedia/ nobelprize.org

Another famous result (based on optics)





Selected for a Viewpoint in *Physics*

PRL **116,** 061102 (2016) PHYSICAL REVIEW LETTERS week ending 12 FEBRUARY 2016

Observation of Gravitational Waves from a Binary Black Hole Merger

B. P. Abbott *et al.*[*]
(LIGO Scientific Collaboration and Virgo Collaboration)
(Received 21 January 2016; published 11 February 2016)

Optical-Physics driven Nobel

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- Rainer Weiss
- Barry C. Barish
- Kip S. Thorne

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All Nobel Prizes in 2017

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

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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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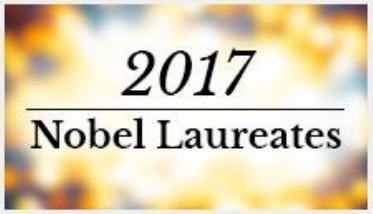
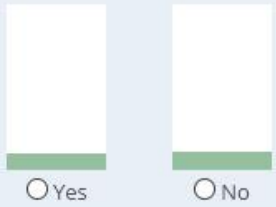
Kip S. Thorne
Prize share: 1/4

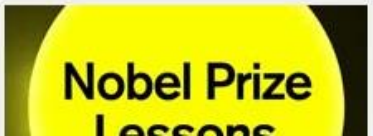
The Nobel Prize in Physics 2017 was divided, one half awarded to Rainer Weiss, the other half jointly to Barry C. Barish and Kip S. Thorne *"for decisive contributions to the LIGO detector and the observation of gravitational waves"*.



2017 PHYSICS PRIZE QUESTION

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





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 **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?