

Physics I

Mateusz Krzyzosiak

office hours (in F201)

Tuesday 14.00–15.30

Thursday 10.00–11.30

email

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office

439C (JI building)

TAs and Recitation Classes

Name	Email	Recitation Class	Office Hour
张嘉迪 Zhang, Jiadi	zhangjiadi44@sjtu.edu.cn	Wednesday 18:30~20:00	Wednesday 20:00~22:00
郑静楠 Zheng, Jingnan	sophiezheng@sjtu.edu.cn	Thursday 18:30~20:00	Thursday 20:00~22:00
张皓萌 Zhang, Haomeng	zhanghaomeng@sjtu.edu.cn	Thursday 12:20~13:50	Wednesday 9:00~11:00
黎翰森 Li, Hansen	wilfred_lee@sjtu.edu.cn	Tuesday 18:30~20:00	Tuesday 12:30~14:00
赵伊佳 Zhao, Yijia	zhaoyijia1999@sjtu.edu.cn	Monday 18:20-20:00	Monday 12:10~13:50

Please check Canvas for up-to-date information

Grading Policy

exams

three (25% each)

homework

on-line assignments in Mastering Physics (13%)
course code: **VP140S2019**

paper homework (12%)

expected median grade: “B”

Contents

SUMMER SEMESTER

what is physics?

kinematics

dynamics (equations of motion, periodic motion, work, kinetic and potential energy, conservation laws, rotational motion, rigid body, elasticity)

elements of fluid dynamics

gravitation

mechanical waves

WINTER SEMESTER

electricity and magnetism, electromagnetic waves, elements of optics

Physics

studies

matter and interactions at the most fundamental level (from inside a tiny nucleus of an atom up to the vast expanses of the Universe)

...and tries to find

fundamental laws of nature which underlie physical phenomena

some other branches of science

chemistry (properties of combinations of atoms)

biology (structure and function of organisms)

sociology (behavior of human groups)

psychology (behavior of a human individual)

Models, Laws, and Theories

MODEL

mathematical (abstract) representation of a physical (real) system

e.g. material point (particle), rigid body, point charge, ideal gas

LAW

**mathematical relation between physical quantities
(from experiment or theory)**

e.g. the ideal gas equation, Kepler's laws of planetary motion

THEORY

uses a model and initial assumptions (*postulates*) to deduce specific consequences or laws

e.g. Newton's theory of gravitation explains both: the falling of an apple and motion of planets

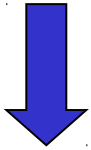
contrary to a common belief, theories do not always follow from experiments (e.g. *the heliocentric model*)

Role of Experiment

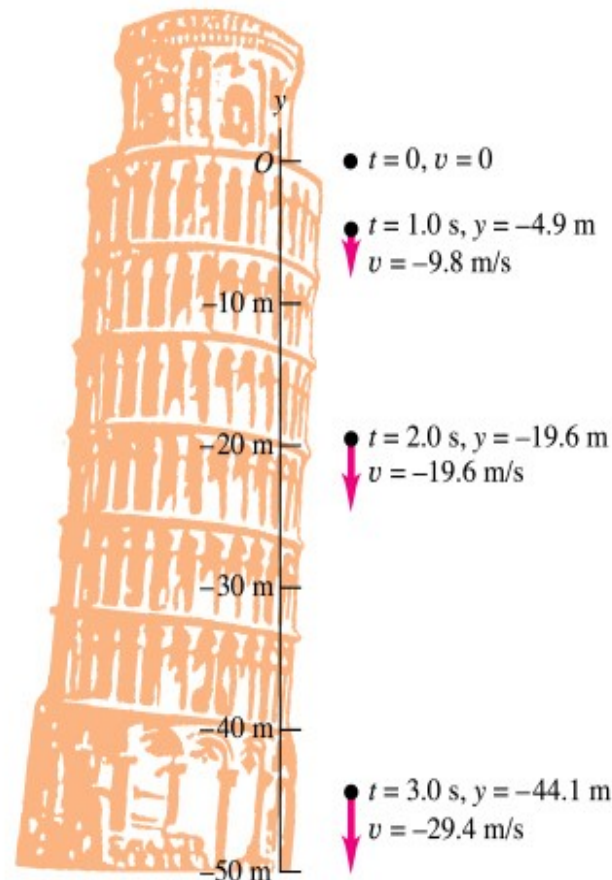
OBSERVATION



EXPERIMENT



MEASUREMENT



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It is said, that Galileo studied the motion of free falling bodies by dropping them from the Leaning Tower in Pisa

Theory and Experiment

An experiment is the ultimate test for all theories!

**No amount of experimentation
can ever prove me right;
a single experiment can prove me wrong.**

Albert Einstein

Physics is **experimental science!**

Development of Physics



Aristotle (ca. 340 BC)

"Since the box eventually stops, it must need something to keep it moving."

Galileo (ca. AD 1600)

"If one could eliminate friction, the box would move on forever."

The latter statement can be regarded as a scientific statement

Development of Physics: Example

deeper understanding of nature \Leftrightarrow simplification of physical rules

ancient times

interactions between charged bodies (rubbed amber attracts pieces of paper)
and between magnetized bodies (magnetite attracting tiny pieces of iron);
qualitative statements

17th century

quantitative approach: Coulomb's Law

19th century

- interaction between electric current and a magnetic needle (Oersted)
- force between current-carrying conductors (Ampere)
- electromagnetic induction (Faraday)
- **unified theory of electromagnetic phenomena (Maxwell's equations)**

Maxwell's Equations (four only!) comprise all laws of electricity and magnetism.

„ToE” theory of everything...?

Classical and Modern Physics

Classical Physics (~ before the 20th century)

Mechanics

Classical Thermodynamics

Electrodynamics

Modern Physics (since the 20th century)

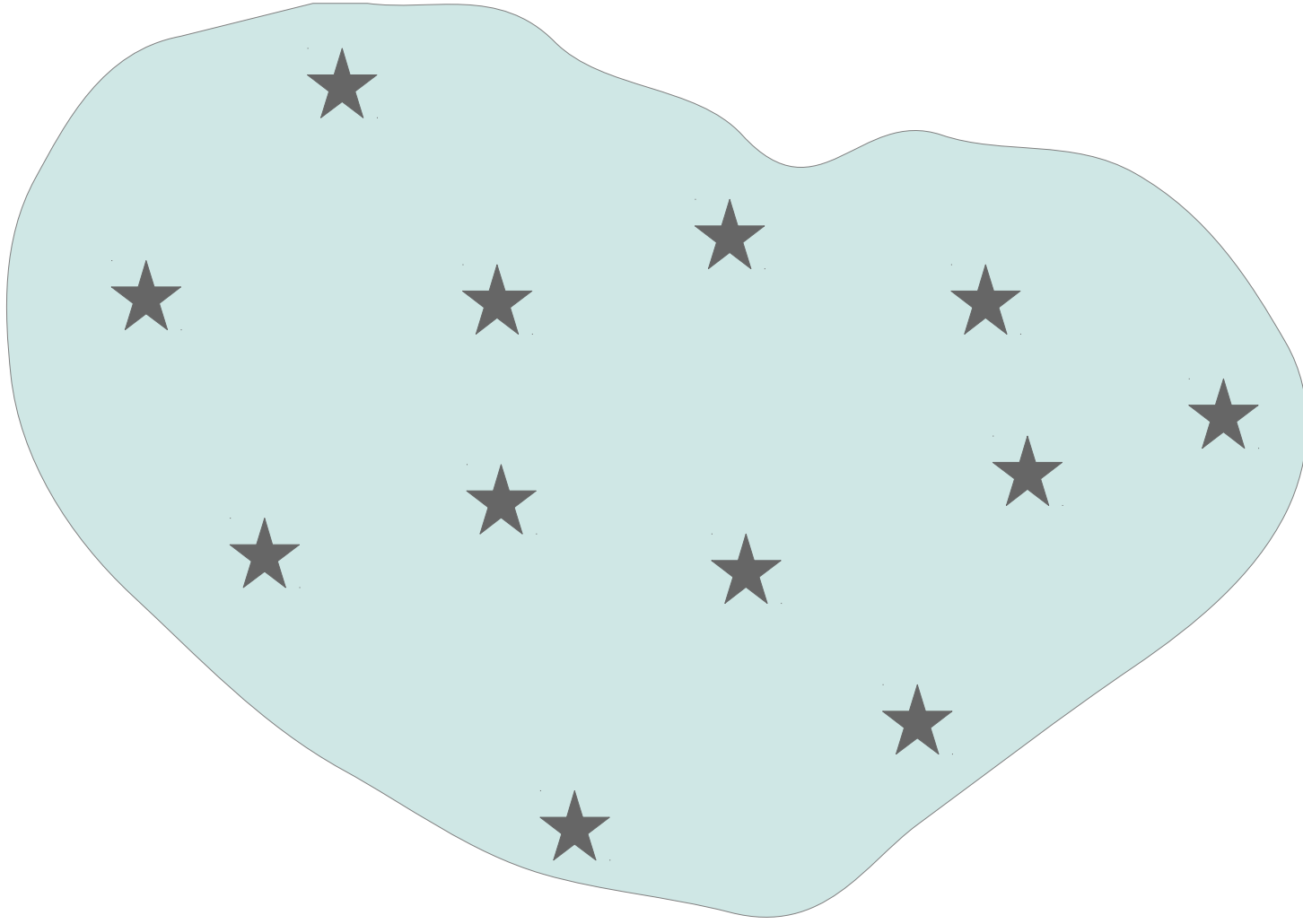
Special Relativity

General Relativity

Quantum Mechanics

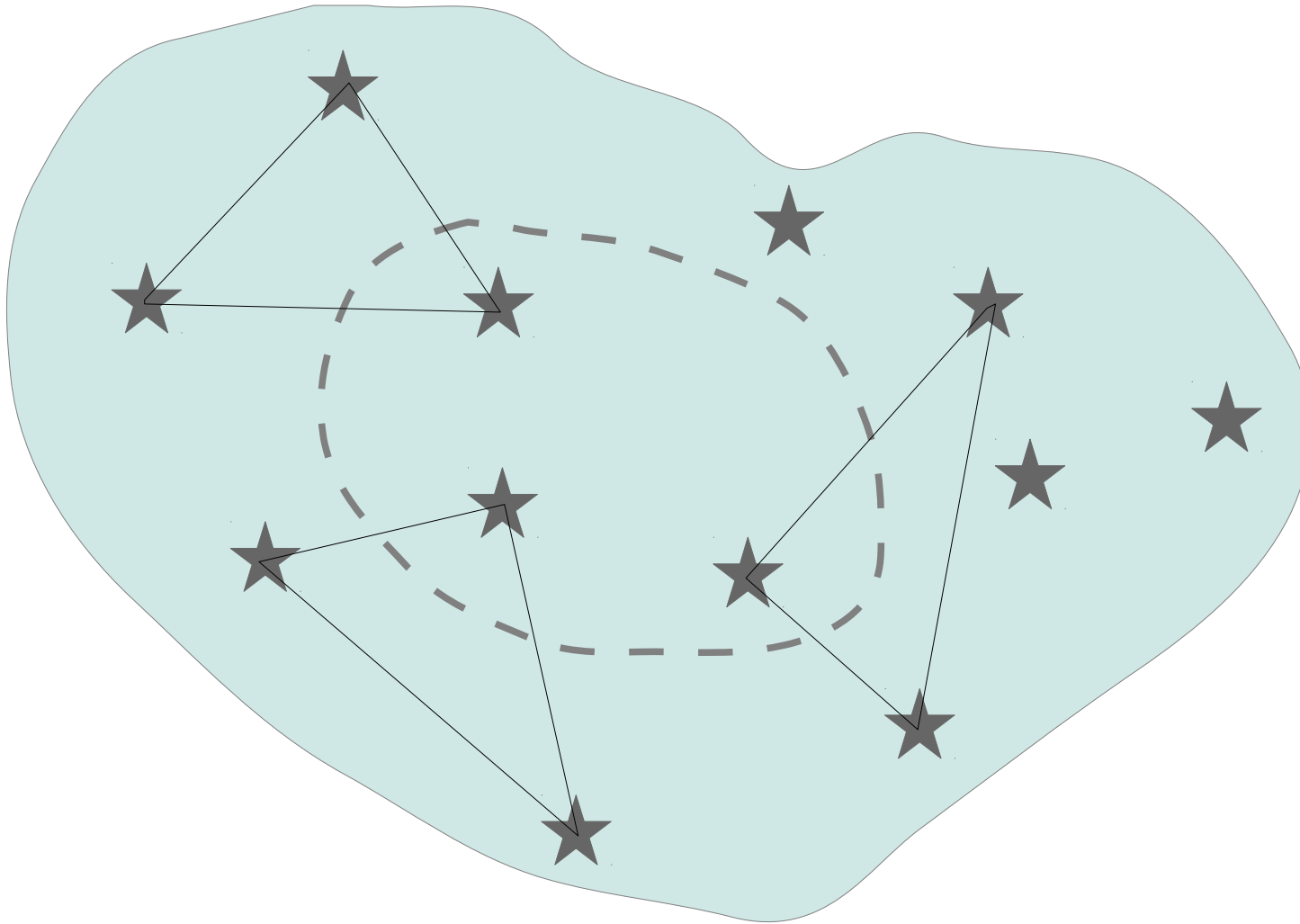
Quantum Electrodynamics

Formulas and “Triangulation”



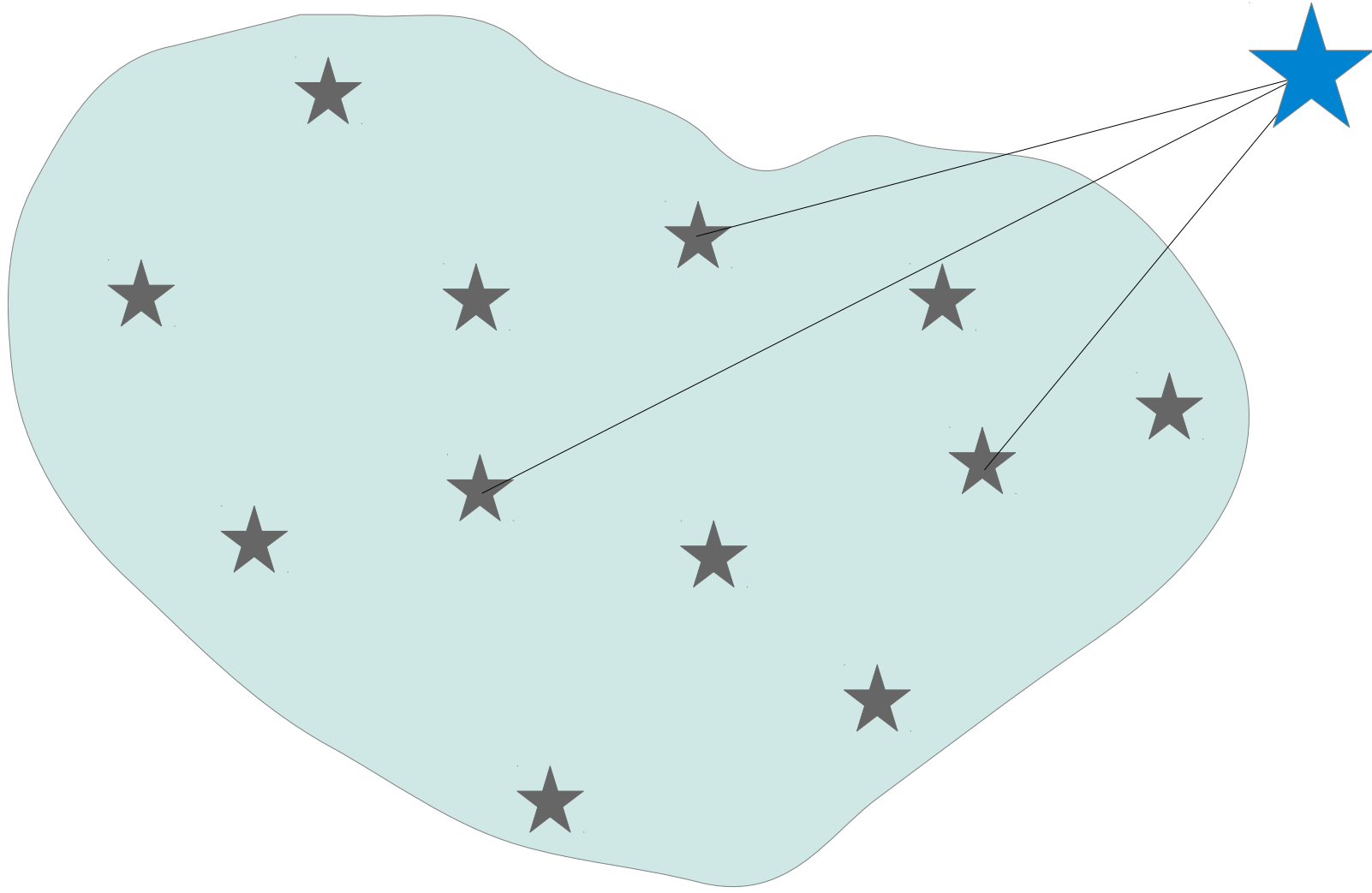
imaginary map of all the physics formulas

Forgotten Facts Re-created



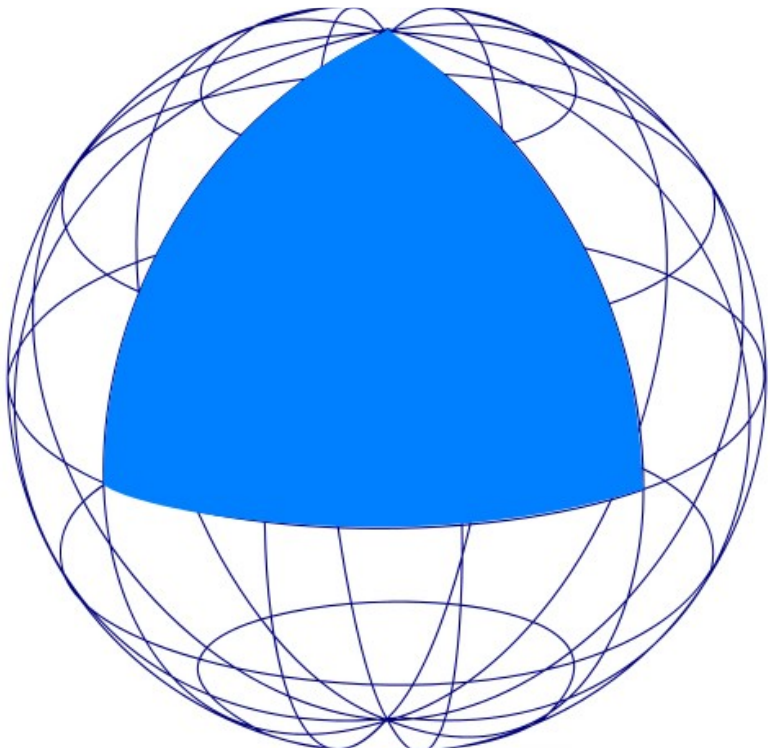
forgotten facts can be recreated by triangulating
from known facts

New Discoveries Made

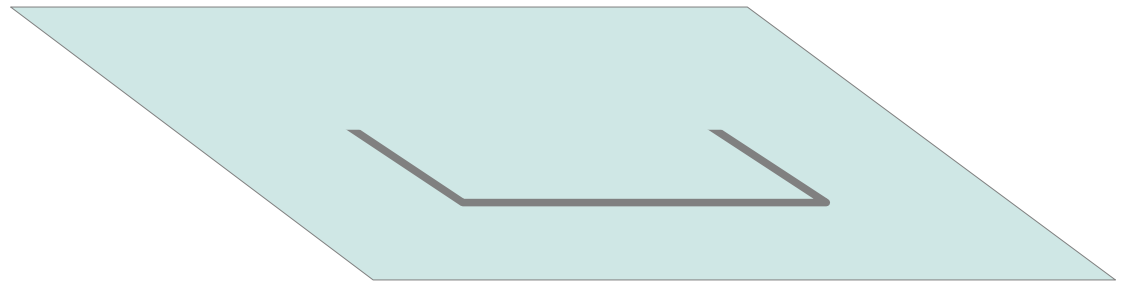


new discoveries are made by physicists triangulating from the known to the previously unknown

Some Properties of Space...

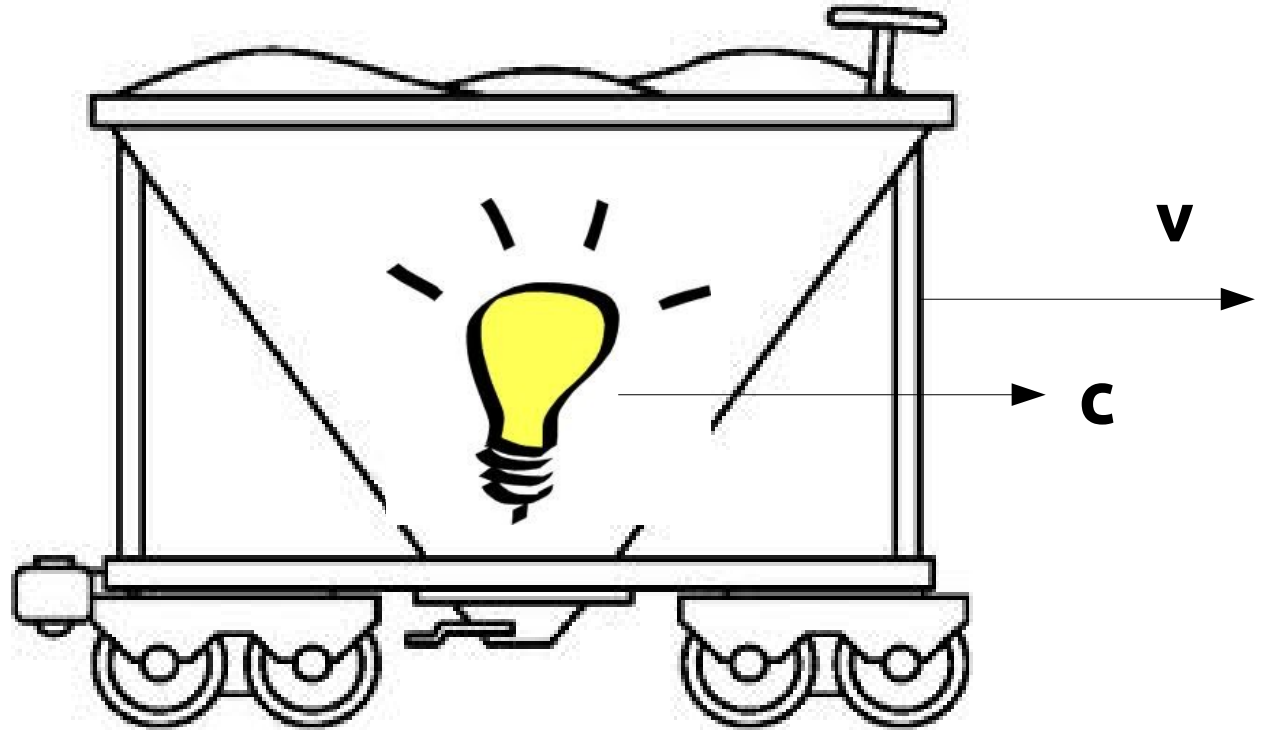


sphere:
non-Euclidean two-dimensional space



plane:
Euclidean two-dimensional space

...and Time



Observation: light still propagates at speed c ;
Implication (one of many): time is relative!

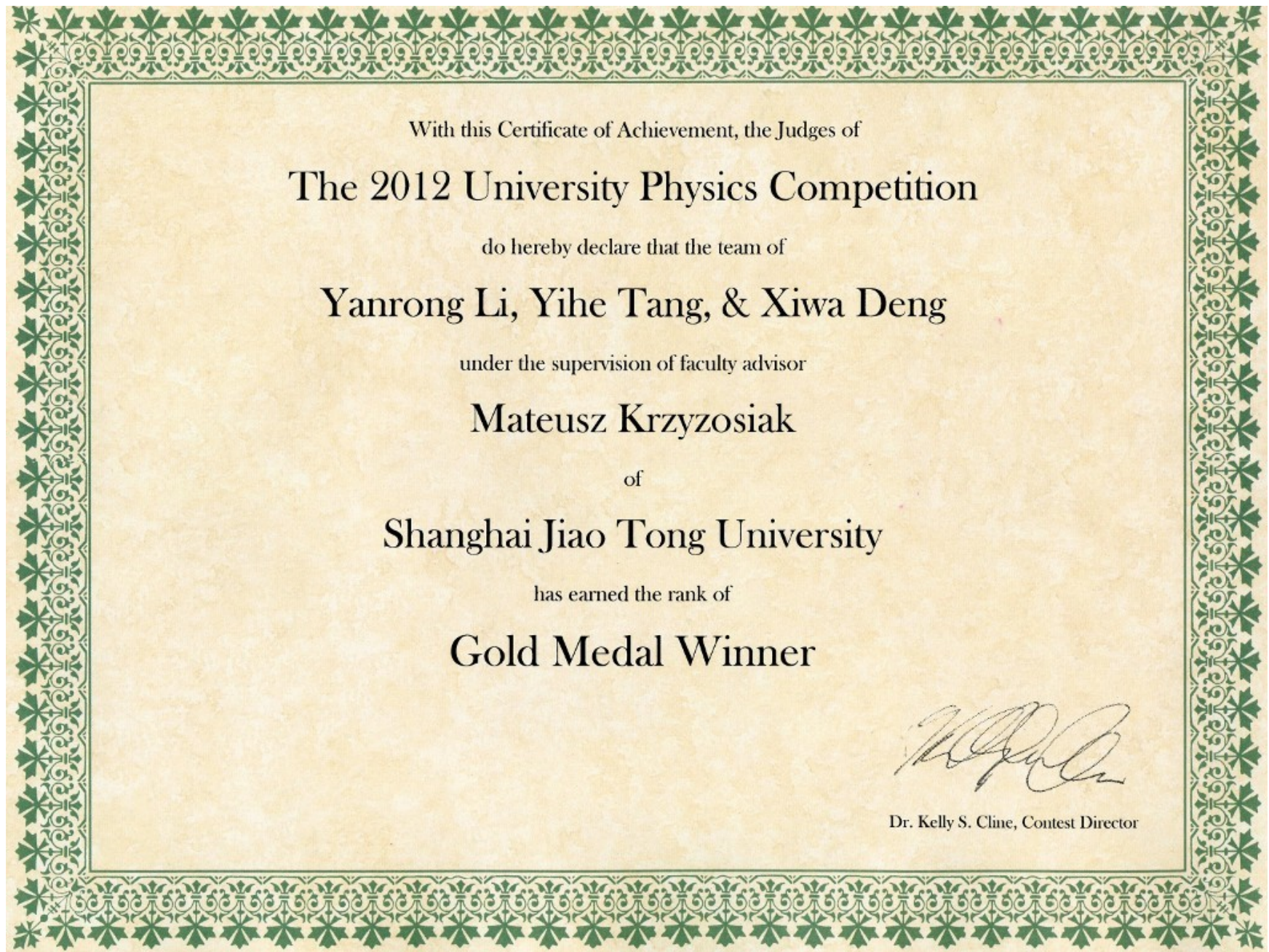
Don't be afraid to think beyond your horizons!

University Physics Competition

The University Physics Competition is an international contest for undergraduate students, who work in teams of three at their home colleges and universities all over the world, and spend a weekend in November (48 hours) analyzing a real-world scenario using the principles of physics, and writing a formal paper describing their work. **The ninth annual University Physics Competition will take place in November 2019.**

www.uphysicsc.com

University Physics Competition



With this Certificate of Achievement, the Judges of

The 2012 University Physics Competition

do hereby declare that the team of

Yanrong Li, Yihe Tang, & Xiwa Deng

under the supervision of faculty advisor

Mateusz Krzyzosiak

of

Shanghai Jiao Tong University

has earned the rank of

Gold Medal Winner

Dr. Kelly S. Cline, Contest Director