

Exercise to the Lecture: Intro. to Cosmology KIT, Wintersemester 2022/2023

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Lectures	Tues. 11:30-13:00, kl. Hörsaal A
Exercises	Thurs. 14:00-15:30, kl. Hörsaal A
ILIAS	https://ilias.studium.kit.edu/goto.php?target=crs_1945182&client_id=produktiv

General Information

- 6 Tutorials: 17.11., 01.12., 15.12., 11.01., 25.01., 08.02.
- Criteria for exercise ECTS
 - Attendance in the exercise
 - Presentation of a solution to at least one (sub-)problem on the board
 - Solution of at least 60 % of the exercises of each block (two blocks: Sheet 1-3, and 4-6)
- Handout of the sheets will be each Tuesday the week before the exercise *only on IlIAS*.
Please sign up here:
https://ilias.studium.kit.edu/goto.php?target=crs_1945182&client_id=produktiv
- Contact: anton.huber@kit.edu, alexey.elykov@kit.edu, hiu-sze.wu@kit.edu

Sheet 1 – Due 17.11.2022

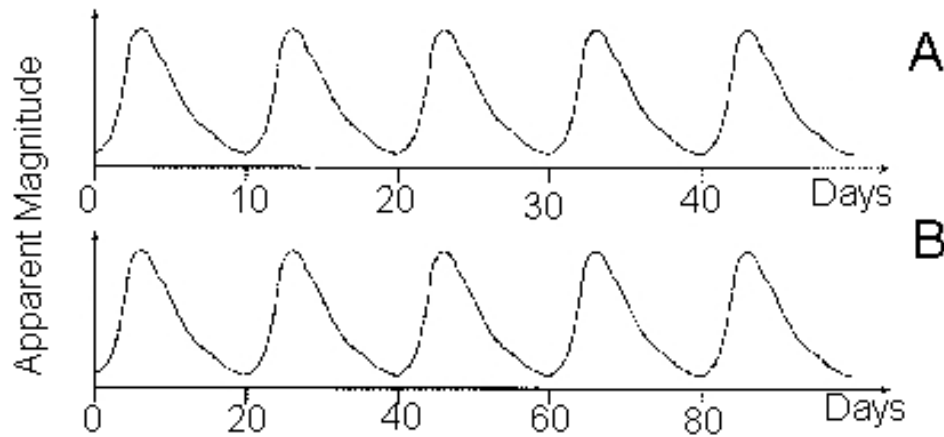
1) Parallax Method

The distance of interstellar objects in the vicinity of the earth can be determined by the trigonometric parallax. On Earth, the observation position changes daily or annually, which also changes the apparent position of a nearby object compared to distant objects such as galaxies.

- (a) Make a sketch of the Earth's position in relation to the Sun over the course of a year, and derive an expression for determining the distance of a nearby object from the change in viewing angle. Approximate the expression for small angles.
- (b) The unit parsec (parallax second) is derived from this method, it corresponds to the distance from which the distance between the Earth and the Sun appears at an angle of 1". The semi-major axis of the earth's orbit is 150 million km long, how many km (ly) are 1 pc? At what distance is the star α -Centauri (parallax 0.724")?
- (c) As part of the Gaia space mission, ESA is currently measuring the distances of nearby objects with an accuracy of $(25 \cdot 10^{-6})''$. At which distance is the relative error in determining the distance 10%?

2) Cepheids

- (a) The diagram below shows the light curve of two Cepheids from the same open cluster. Which Cepheid has greater luminosity? What is the absolute magnitude of a Cepheid with a period of 10 days?



- (b) The Gaia space probe can detect stars with a magnitude of up to 20. How far away can it detect Cepheid A? Up to what distance are both the parallax and brightness methods available?

3) Main Sequence Stars and Distance Ladder

- (a) A main sequence star (Prokyon A) has a parallax of $(286 \cdot 10^{-3})''$ and an apparent magnitude of $m = +0.37$. Take from the diagram below which spectral class the star belongs to.
- (b) Two stars have the same absolute magnitude. Star A has a parallax of $0.15''$ on Earth. Star B is 365 times dimmer than star A. How far is star B from Earth?

