H–R DIAGRAM I
WORKSHEET

Name	
School, class	
Date	

1 Advanced Search of HIPPARCOS Catalogue of Stars

Explore Search and Advanced Search of the HIPPARCOS Catalogue of Stars available on the Astronomia web pages (astronomia.zcu.cz → Catalogues...in education → Online Applications → Stars → Online H–R diagram & Advanced Search of the HIPPARCOS Catalogue).

find and write answer

Which values do you need to be able to construct a Hertzsprung–Russell (H–R) diagram?

Note: More information about H–R diagram in Czech can be found on Astronomia (astronomia.zcu.cz → Hvězdy → Charakteristiky → HR diagram).
For English version use e.g. English Wikipedia pages.

2 Obtaining data from HIPPARCOS Catalogue of Stars for stars within 100 pc

By using the Advanced Search of the HIPPARCOS Catalogue of Stars, choose suitable stars for the construction of a H–R diagram of nearby stars (within 100 pc).

Note: Setup items "from" to value 10 for trigonometric parallax (Plx), output format "CSV" and number of records to "all". Store output data as a CSV file to the selected folder.

HIPPARCOS CATALOGUE

Advanced Search

View	Sort by	Column	Limits			Description
	○	HIP	from	to		Identifier (HIP number) (H1)
		Constellation				Constellation *(abbreviation, English name, latin name)*
☑	○	Vmag	from	to	mag	Magnitude in Johnson V (H5)
☑	○	RAdeg	from	to	°	Right Ascension α in ° (J1991.25) (H8)
☑	○	DEdeg	from	to	°	Declination δ in ° (J1991.25) (H9)
☑	○	Plx	from 10	to	mas	Trigonometric parallax (H11)
☑	○	pmRA	from	to	mas/yr	Proper motion at RA $\mu_{\alpha}.\cos(\delta)$, ICRS (H12)
☑	○	pmDE	from	to	mas/yr	Proper motion at DE μ_{δ}, ICRS (H13)
☑	○	B-V	from	to	mag	Johnson B-V colour (H37)
☑	○	HD	from	to		HD number III/135 (H71)
☑	○	SpTyp				Spectral type (H76)
☐ all		Reset	Clear			Number of records all, Order + –, Output format CSV

Search

Fig. 1: Advanced Search on HIPPARCOS Catalogue of Stars with highlighted areas.

find and write answer

Why do you setup item "from" for trigonometric parallax to value 10? Please explain.

Next page…

3 Preparation of data for construction of H–R diagram

Open the prepared CSV file in an Excel spreadsheet. To construct a H–R diagram you need to know the star's luminosity (or absolute magnitude) and effective temperature (or spectral type or colour index). From the catalogue it is possible to obtain the absolute magnitude (calculated in column M from the apparent magnitude – column Vmag and distance to star calculated from the parallax – column Plx) and colour index (directly in column B-V).

Distance to star *r* can be calculated from the parallax π using the formula $r = 1/\pi$, where distance is in parsecs (pc). Parallax π is given in arc seconds in column Plx. *Note: value of the parallax in the catalogue is in arc milliseconds. Mark the new column as* r.

Absolute magnitude *M* can be calculated using the formula $M = m + 5 \cdot [1 - \log(r)]$, where apparent magnitude *m* is in column Vmag. Mark the new column as M.

find and write answer

What values reach the parallax π (column Plx) in the HIPPARCOS Catalogue of Stars? What real values can acquire a parallax? Please explain.

4 Construction of H–R diagram for nearby stars

Create a Scatter plot from data in Excel (Insert → Scatter → Scatter with only Markers).

Note: For the horizontal axis use "Colour index" (column B-V), for the vertical axis use "Absolute magnitude" (calculated in column M). Scales for axes adjust based on fig. 2. Decide to use a suitable colour, shape and size of markers.

find and write answer

How many stars do you use for the construction of a H–R diagram of nearby stars? Describe each area of the H–R diagram of nearby stars.

5 Construction of H–R diagram for distant stars

Use the same procedure from exercise 4 to construct a H–R diagram for distant stars at distances from 100 pc to 400 pc. To obtain data from the HIPPARCOS Catalogue of Stars decide on the correct value of the parallax (Plx). Use the same scale of axes as in fig. 2.

Note: Be mindful of limits in Excel 2003: max 65,535 rows per list, 32,000 items for 2D graph (Scatter plot is a part of it). For Excel 2007 and Excel 2010 the limits are: 1,048,576 rows per list; number of items for the 2D graph is the same.

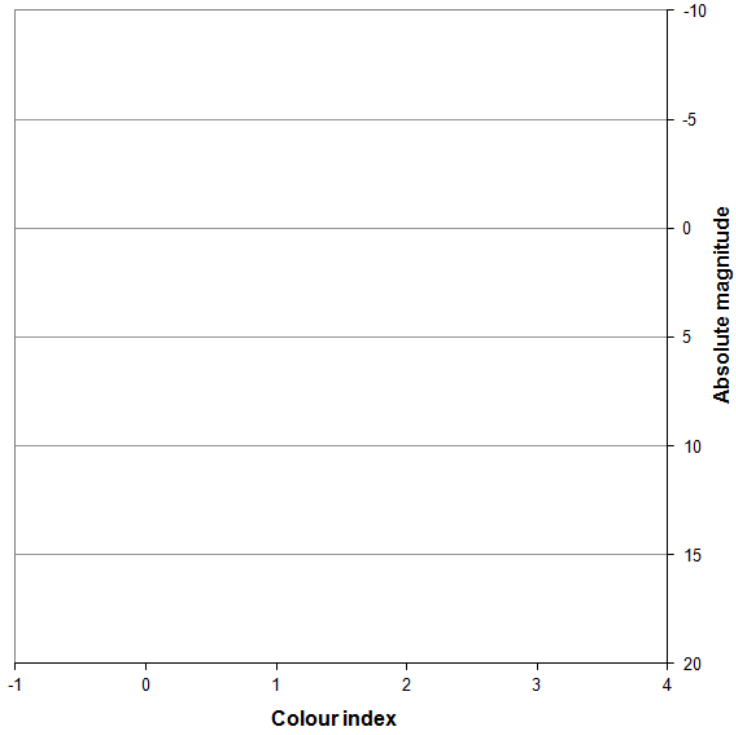

Fig. 2: H–R diagram – description and scale of axes.

find
and write
answer

Describe each area of the H–R diagram of distant stars.
Are there differences between the H–R diagrams of nearby and distant stars?
Why? Explain the reason(s).

Next page…

6 Location of stars in H–R diagram

Plot a location of the Sun and the five brightest stars from the list of nearby stars to the H–R diagram of nearby stars. Fill in the attached table.

Note: You can find the needed values in the catalogues of stars. Calculate values marked by an asterisk using the formulas provided in exercise 3.

find and write answer

What types of stars did you find? What are the characteristic features of each type?

Star (name, designation)	Apparent magnitude *m*	Absolute magnitude *M *)*	Parallax π ["]	Distance r [pc] *)	Colour index	Spectral type	Constellation (abbreviation)
Sun							

Conclusion

give your opinion

Store output files with H–R diagram as Excel worksheets to the chosen folder.

Describe: how did you solve this task, mention problematic areas, all difficulties of this task. Do you have any suggestions on how to improve it?