The 37th European Symposium on Occultation Projects, Czech Republic, August 25th , 2018

FACULTY OF EDUCATION
UNIVERSITY
OF WEST BOHEMIA

Astronomia
ASTRONOMIE PRO KAŽDÉHO

How to use Real data from Catalogues of Astronomical objects (not only) in Education

Ota Kéhar

kehar@kmt.zcu.cz

Faculty of Education, University of West Bohemia, Plzen, Czech Republic

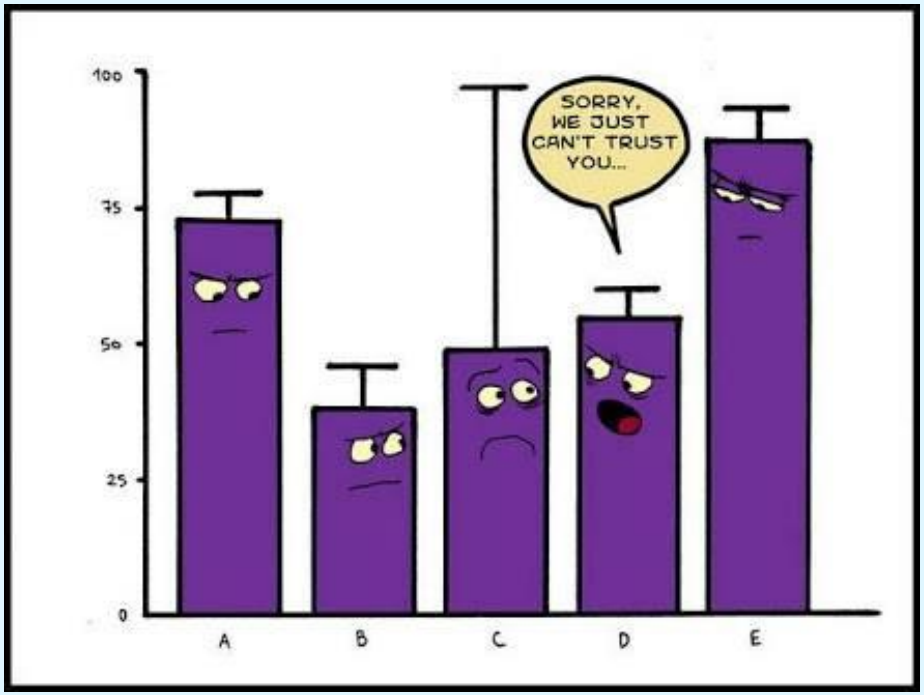
Ota Kéhar / Plzeň / Česká republika

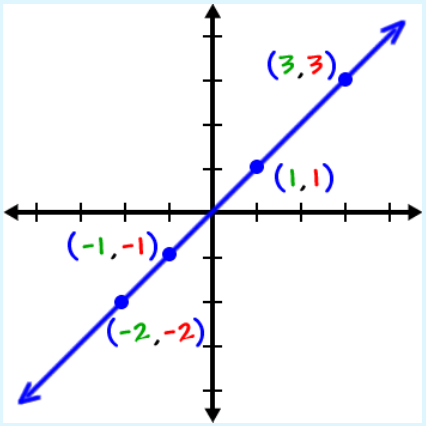
- **RAM/LCC Manager at ŠKODA ELECTRIC, Plzen** …job…
  (RAM = Reliability, Availability, Maintainability; LCC = Life-cycle cost)
- **Eng study at Faculty of Electrical Engineering UWB, Plzen**

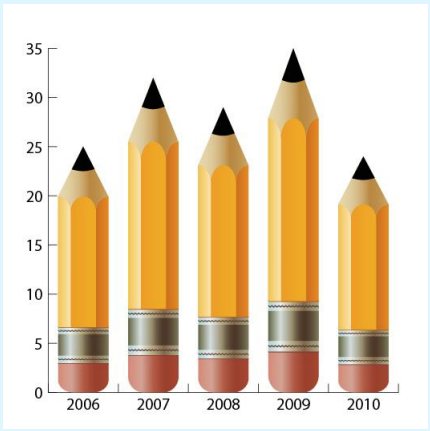
…hobby…

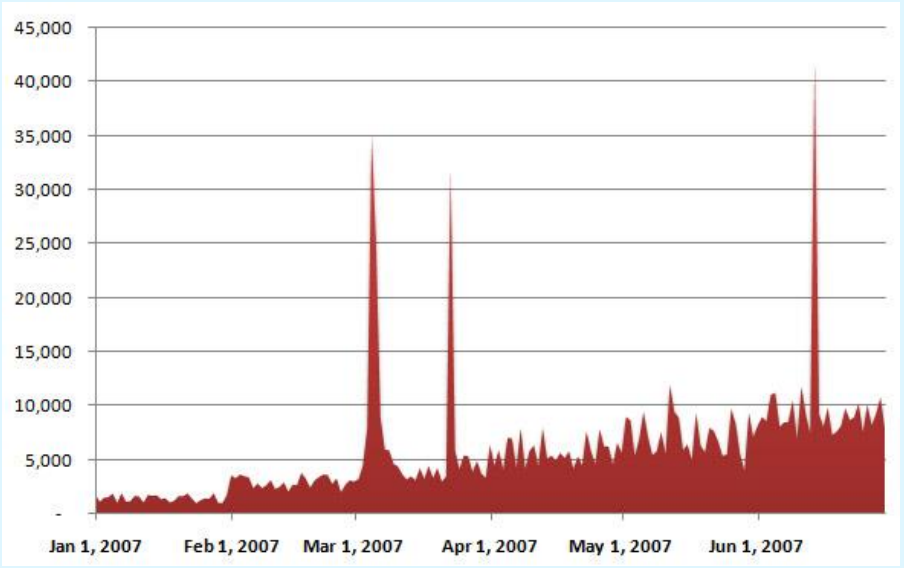
- **PhD study and now partly job as Assistant Professor at Faculty of Education, University of West Bohemia, Plzen**
- **Cooperation with Observatory at Rokycany and Plzen**
- Cooperation with Czech and European Astronomical Societies, with Union of Czech Mathematicians and Physicists
- Reviewer of Astronomy Olympiad
- Website creation

Graphs / plots / diagrams are everywhere…



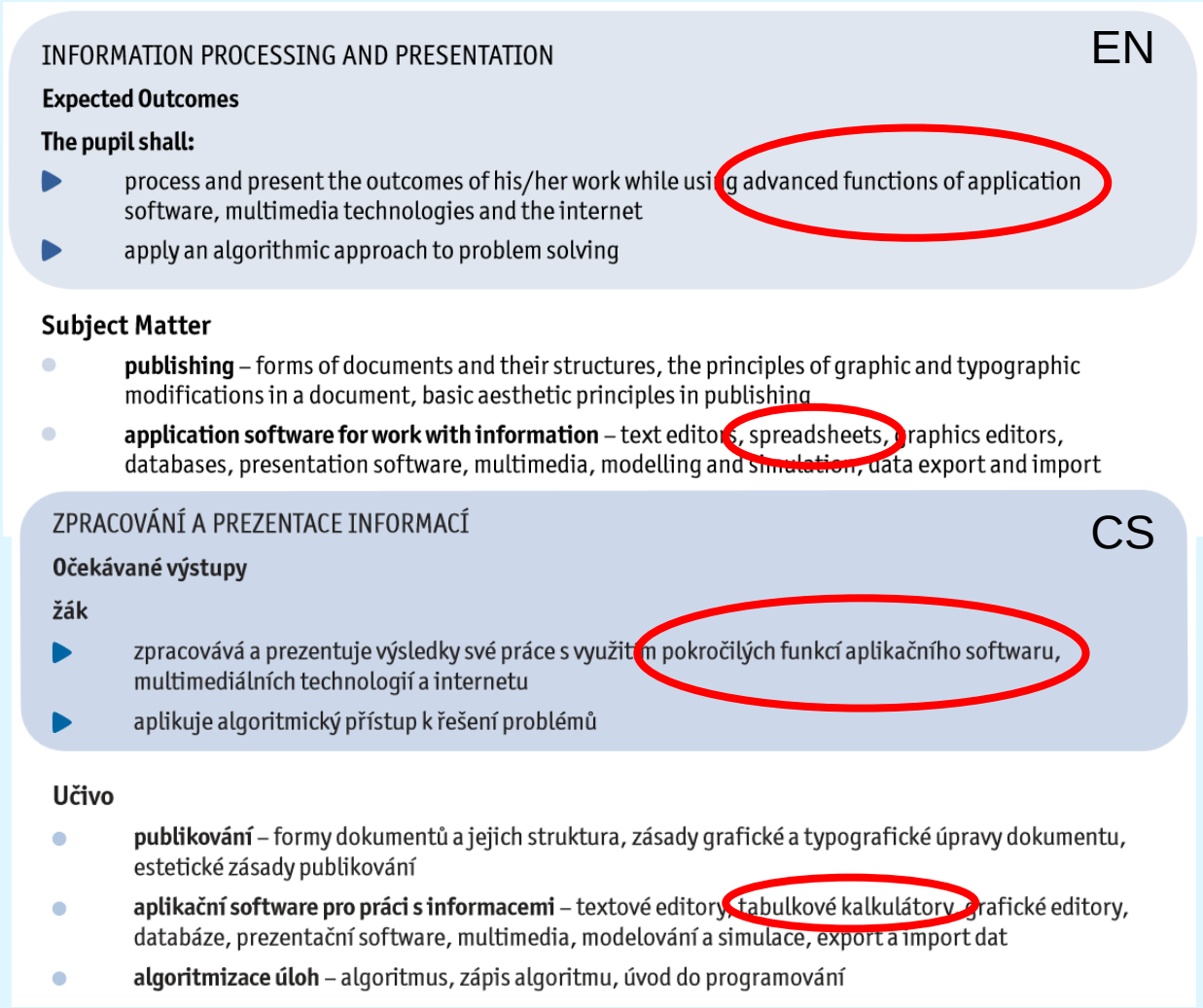






What students should know about it?

Educational Framework Programme for High Schools



INFORMATION PROCESSING AND PRESENTATION — EN

Expected Outcomes

The pupil shall:

- process and present the outcomes of his/her work while using advanced functions of application software, multimedia technologies and the internet
- apply an algorithmic approach to problem solving

Subject Matter

- **publishing** – forms of documents and their structures, the principles of graphic and typographic modifications in a document, basic aesthetic principles in publishing
- **application software for work with information** – text editors, spreadsheets, graphics editors, databases, presentation software, multimedia, modelling and simulation, data export and import

ZPRACOVÁNÍ A PREZENTACE INFORMACÍ — CS

Očekávané výstupy

žák

- zpracovává a prezentuje výsledky své práce s využitím pokročilých funkcí aplikačního softwaru, multimediálních technologií a internetu
- aplikuje algoritmický přístup k řešení problémů

Učivo

- **publikování** – formy dokumentů a jejich struktura, zásady grafické a typografické úpravy dokumentu, estetické zásady publikování
- **aplikační software pro práci s informacemi** – textové editory, tabulkové kalkulátory, grafické editory, databáze, prezentační software, multimedia, modelování a simulace, export a import dat
- **algoritmizace úloh** – algoritmus, zápis algoritmu, úvod do programování

What are advanced functions of application software?

…, macros, pivot tables, databases, …

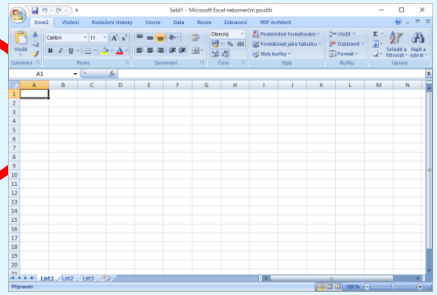
…, functions, adding columns, using formulas, creating graphs, data sorting, …

Students' Activities

Real Data

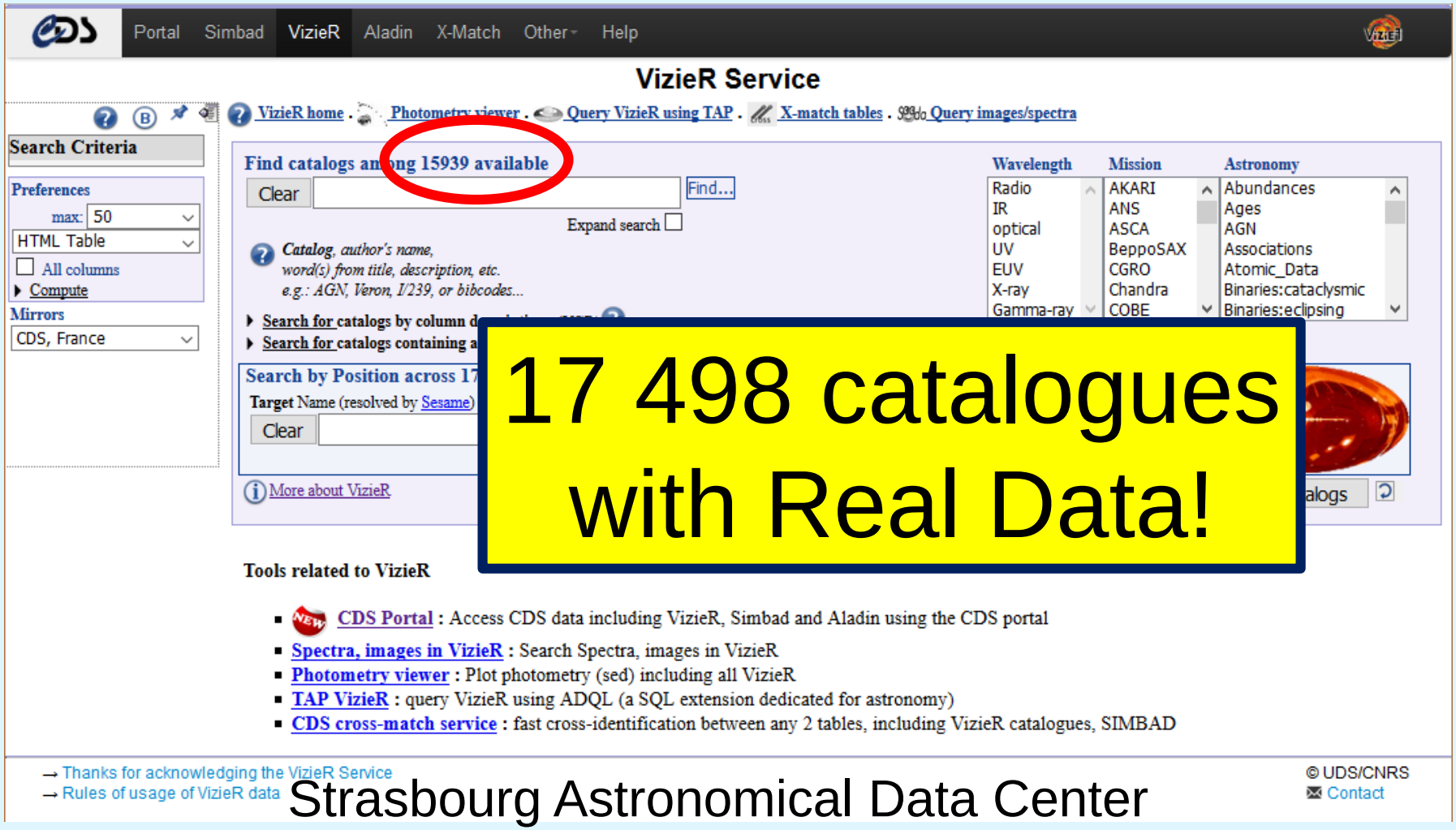
Students

Application software



Graphs Visualization

Where to easily get Real Data?



Strasbourg Astronomical Data Center

vizier.u-strasbg.fr/viz-bin/VizieR

Multimedia Textbook Astronomia

Catalogues

Astronomia.zcu.cz

ASTRONOMICKÝ SERVER FAKULTY PEDAGOGICKÉ ZČU V PLZNI

Planety | Galaxie | Hvězdy

Planets | Galaxies | Stars

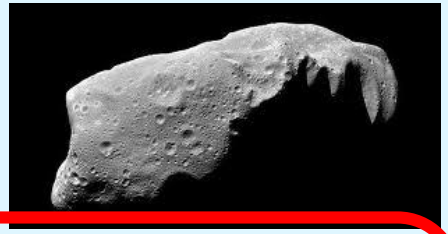
Astronomical photos

Astronomers

Spacecrafts

Catalogues on Astronomia web pages

- **MPC** = 523 584 minor planets
  www.minorplanetcenter.net (135 MiB, **monthly update, semi-auto**)

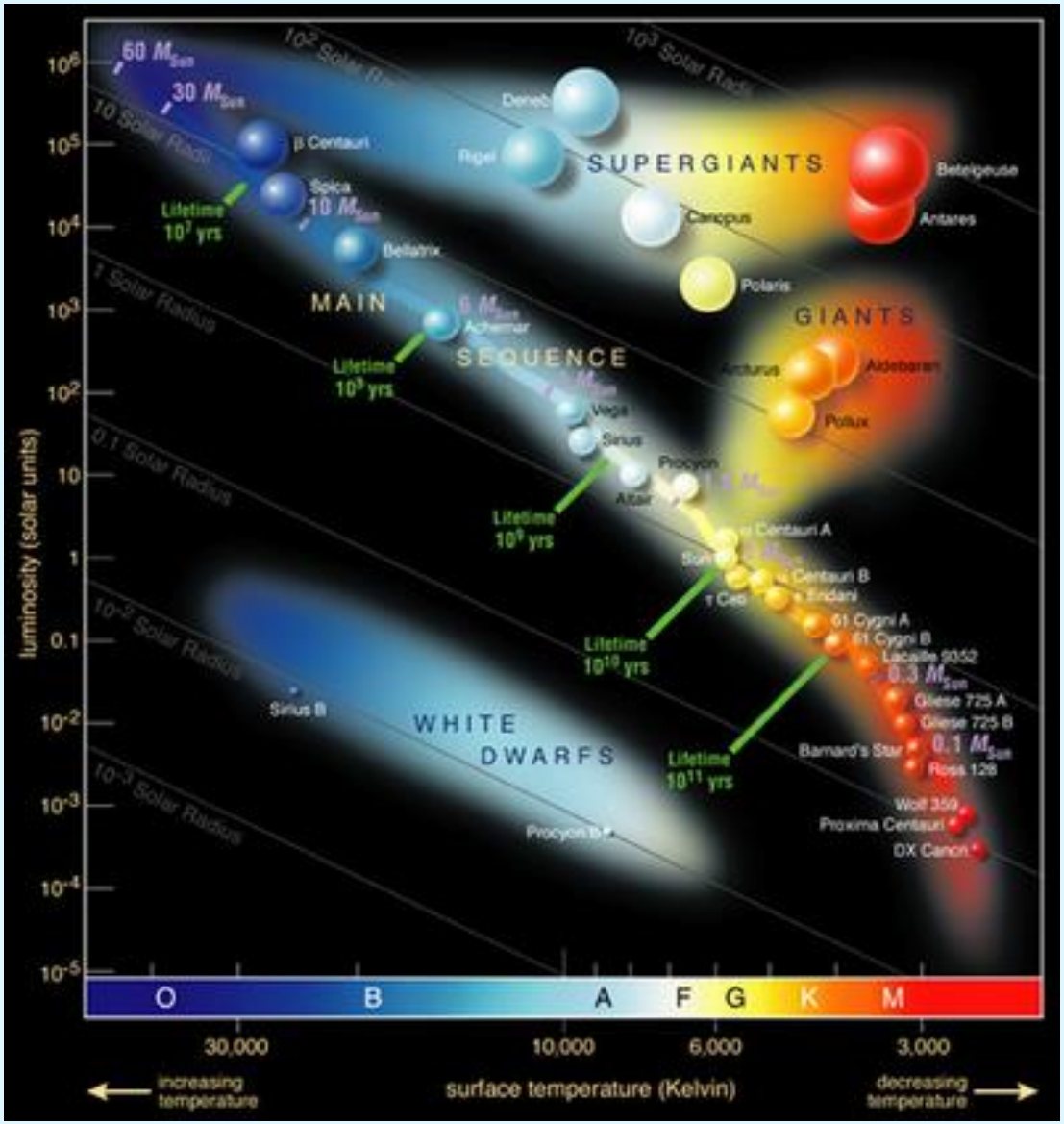


- **HIPPARCOS** = 118 218 stars
  (60 MiB, static)
- **SIMBAD** (*) = 118 195 stars
  simbad.u-strasbg.fr/simbad/ (36 MiB, **weekly update, automatic**)

- **NGC** = 7 840 deep-sky objects
  (2 MiB, 400 MiB pics, weekly update)
- **Messier** = 110 deep-sky objects
  simbad.u-strasbg.fr/simbad/ (615 MiB pics, weekly update)

Hertzsprung-Russell diagram

Vertical axis:
Absolute magnitude *M*



Horizontal axis:
Colour index *B–V*

Meteor over China and Czech news

Přihlásit se | Seznam

Novinky.cz 8. 10. 2017 Hledej

Hlavní stránka » Koktejl

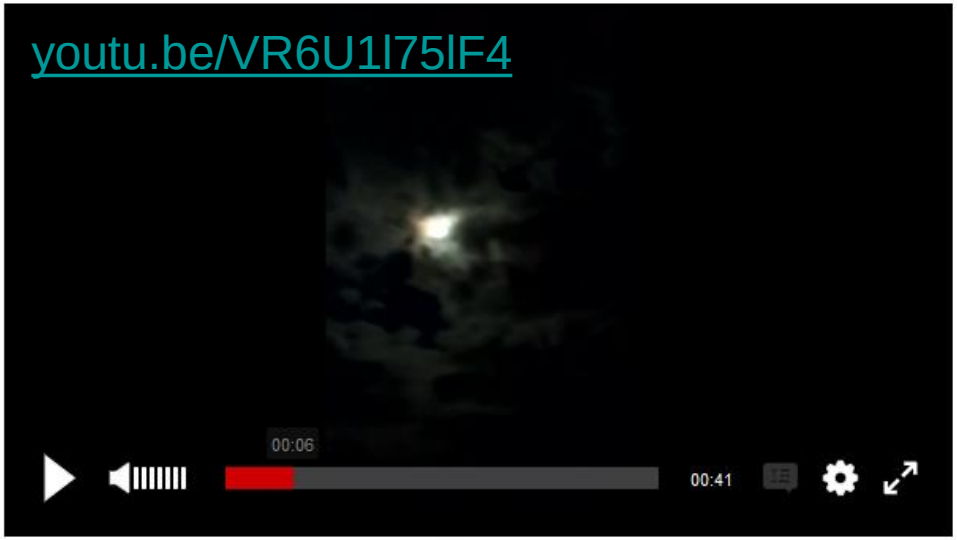
There was a bright meteor over China.
It was like an earthquake, local people say

Nad Čínou se prohnal jasný meteor. Bylo to jako zemětřesení, tvrdí místní

Záběry jasné ohnivé koule ve středu zachytilo hned několik svědků v čínské oblasti Šangri-La v provincii Jün-nan na jihozápadě Číny. Spatření meteoru potvrdila i americká vesmírná agentura NASA, podle které meteor dosáhl jasnosti 2,1 magnitudy a uvolněné energie rovnající se 540 tunám TNT. Video poskytla agentura Reuters.

…NASA says, meteor reached brightness 2.1 mag and…

youtu.be/VR6U1l75lF4



www.novinky.cz/koktejl/451264-nad-cinou-se-prohnal-jasny-meteor-bylo-to-jako-zemetreseni-tvrdi-mistni.html

Meteor over China and original news

ejinsight
on the pulse

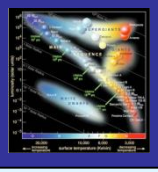
HOME BUSINESS STARTUPS HONG KONG WORLD COLUMNISTS LIVING

In this sequence shot, a meteorite lights up the night sky as it falls into the mountains. It landed about 40 km northwest of Shangri-la county in Yunnan province. Photo: Internet

Home > World > Greater China

Oct 6, 2017 4:30pm

www.ejinsight.com/20171006-meteor-shower-lights-up-yunnan-sky-during-mid-autumn-festival/



Meteor over China and original news

Meteor shower lights up Yunnan sky during Mid-Autumn Festival

Like 32 people like this. Be the first of your friends.

Some people in Yunnan province were stunned by the rare sight of three meteors exploding in the night sky over Shangri-la county as they were watching the full moon during the Mid-Autumn Festival.

The phenomenon occurred at about 8 p.m. on Oct. 4, with witnesses saying they saw fireballs exploding in the air some 37 kilometers above the ground. Experts said the explosion had a force equivalent to 540 tons of TNT, Apple Daily reports.

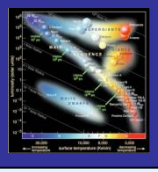
It is believed the meteors landed in a small village around 40 km. northwest of Shangri-la.

A netizen who filmed the event said the "sky lit up like day" and felt intense vibrations on doors and window panes.

In many of the clips, a flash of intense light could be seen as a meteorite fell from the sky and into the mountains.

The National Aeronautics and Space Administration (NASA) was the first to detect the astronomical event. It clocked the meteorite's speed at 14.6 km. per second and said it likely landed in a ball of fire.

www.ejinsight.com/20171006-meteor-shower-lights-up-yunnan-sky-during-mid-autumn-festival/



Meteor over China and original news

Local authorities have yet to report any casualties or damage and are searching for the meteorite for research purposes.

A local villager told the paper that he heard a loud bang and felt the ground shake. His pigs were so scared they ran out of the pigsty.

The China Earthquake Network Center said the power of the explosion would be equivalent to a 2.1 magnitude earthquake on the Richter scale.

Local sources said it is possible that the meteorite landed in Dêqên county in Diqing Tibetan autonomous prefecture.

Astronomer Ye Quanzhi from the California Institute of Technology said the hilly terrain woud make it very difficult to locate the meteorite.

However, as the meteor had fallen at a relatively slow speed, there is a higher chance of obtaining bigger samples.

The last meteor shower in China occurred on Nov. 5, 2014 when a meteor exploded over Xilingol in Mongolia with a power equivalent to 450 tons of TNT.

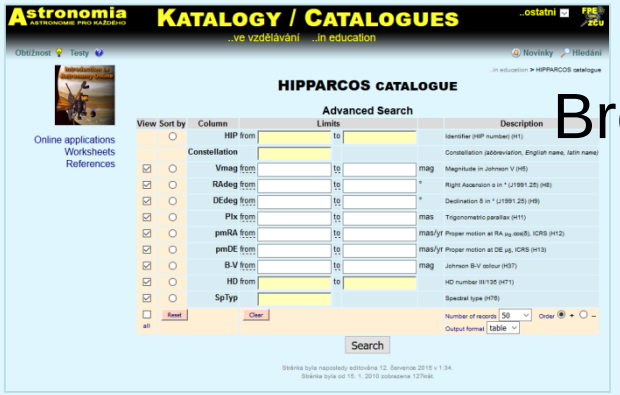
Meteorite hunters rushed to the scene in the hope of finding fragments which could fetch up to 100,000 yuan each. They ended up empty-handed.

– Contact us at english@hkej.com

www.ejinsight.com/20171006-meteor-shower-lights-up-yunnan-sky-during-mid-autumn-festival/

Raw Real Data Usage and Processing

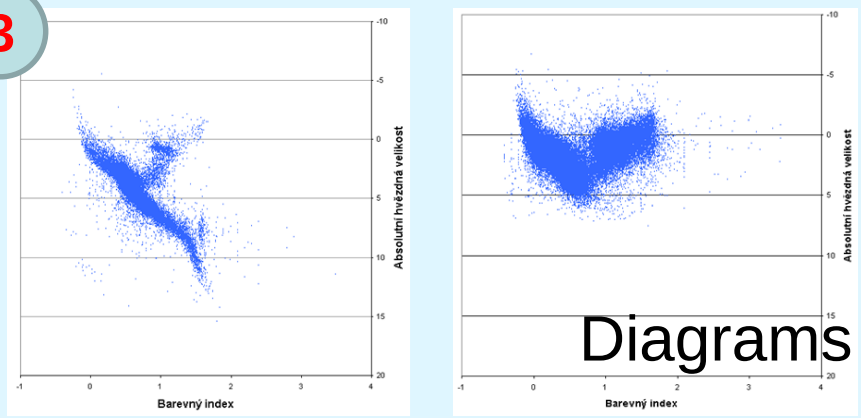
1

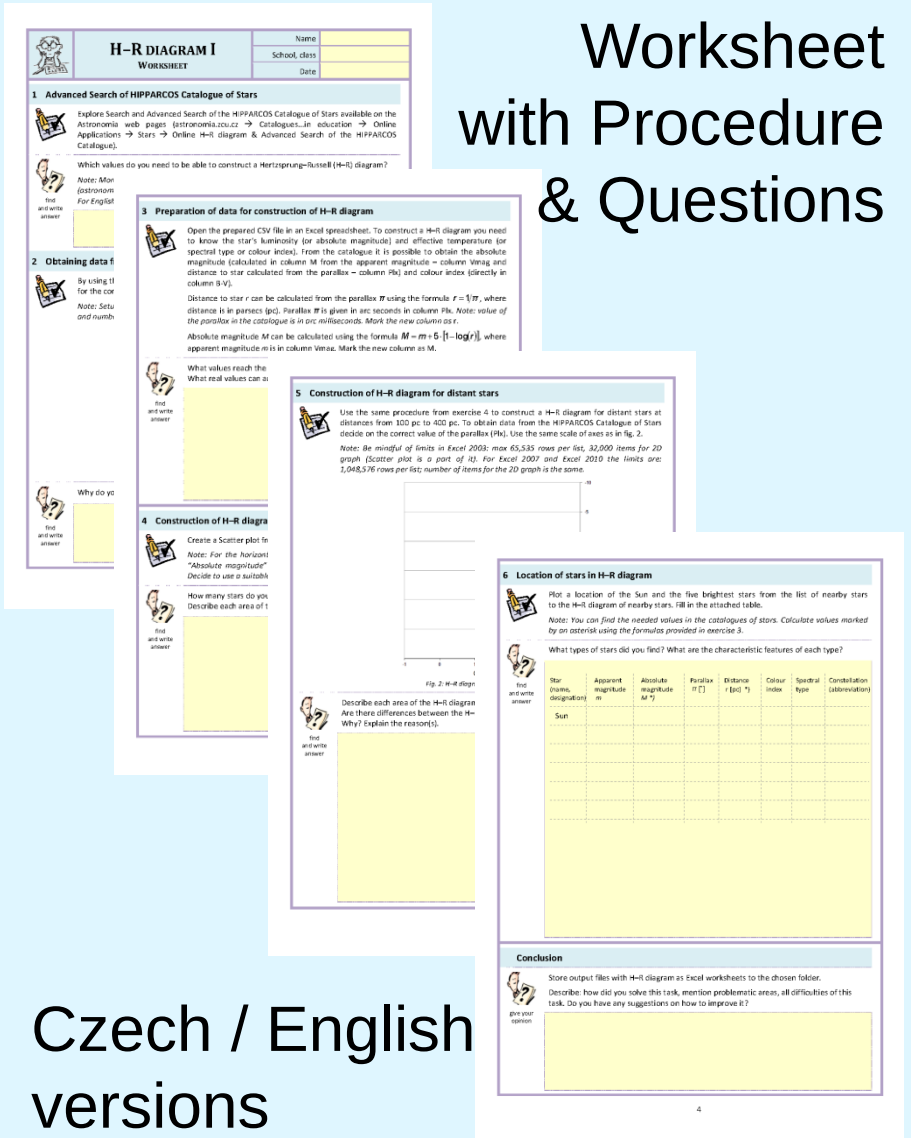


Browser

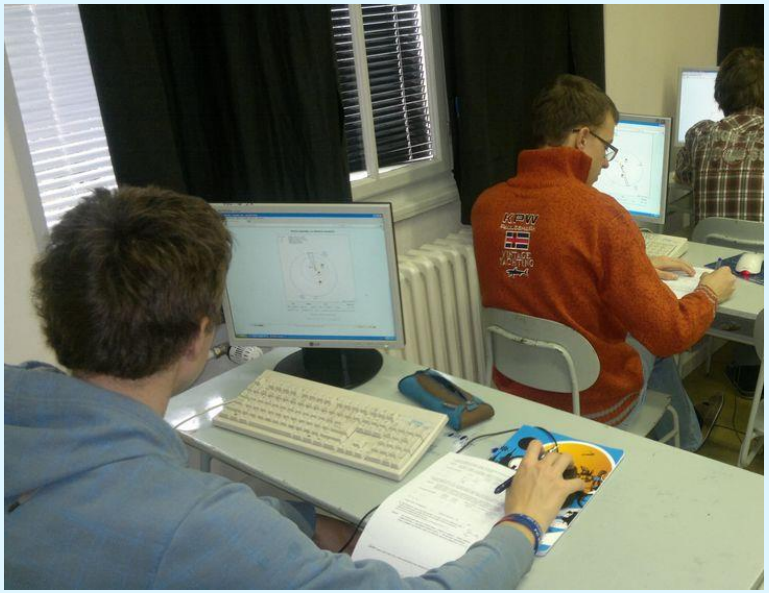
2

3



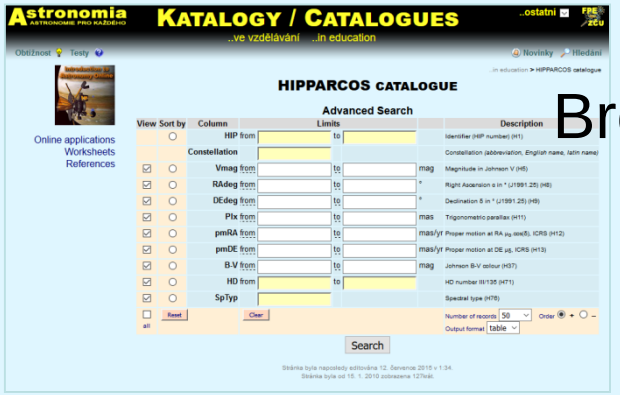


Physics and Informatics lessons



Raw Real Data Usage and Processing

1

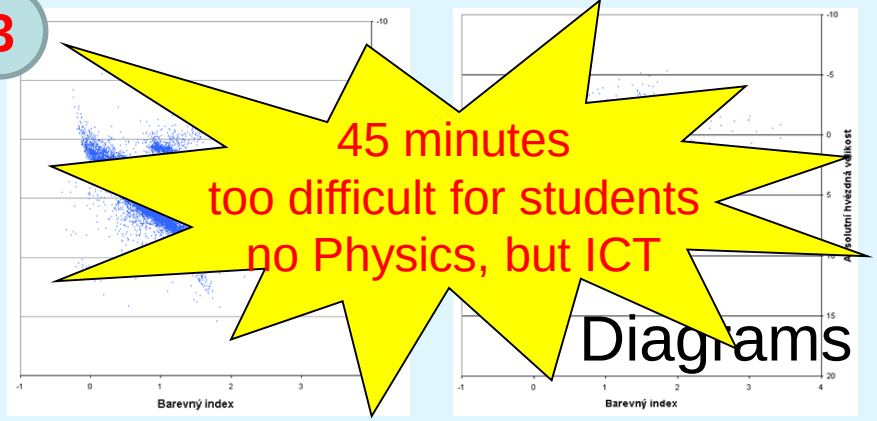


Browser

2

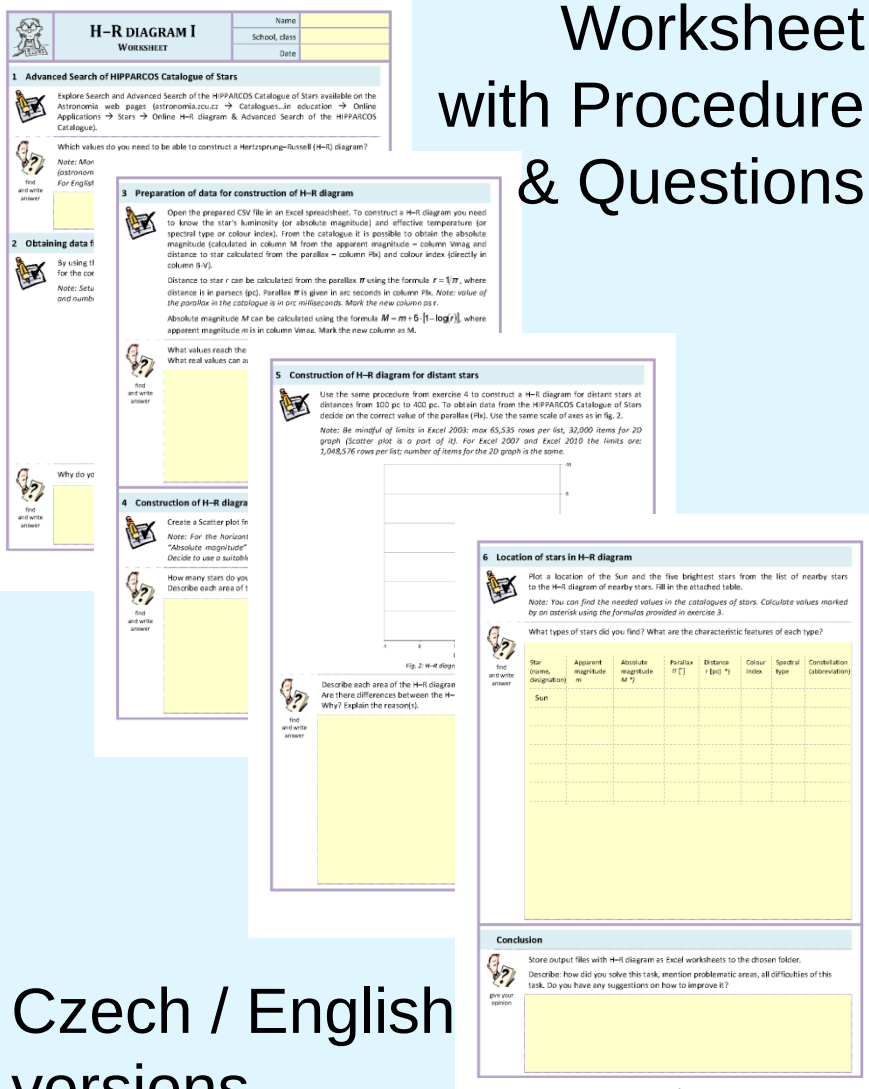
Excel Spreadsheet

3



45 minutes
too difficult for students
no Physics, but ICT

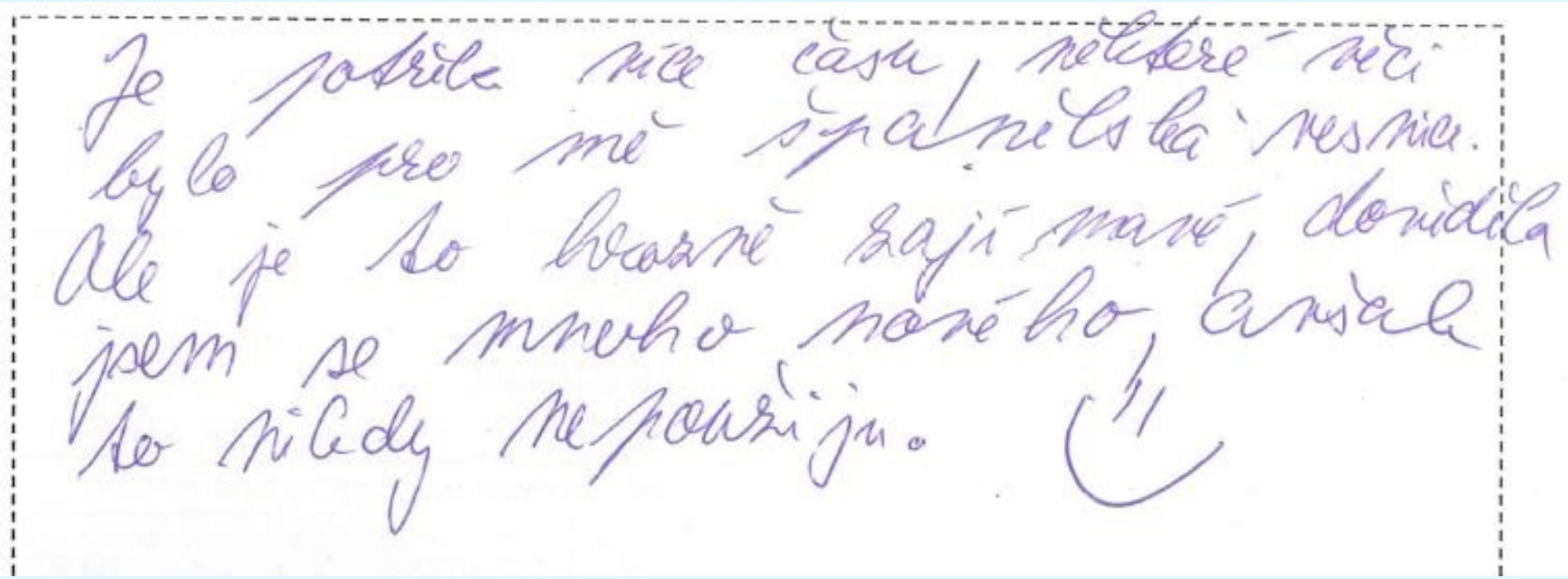
Diagrams



Worksheet
with Procedure
& Questions

Czech / English
versions

Comment from students

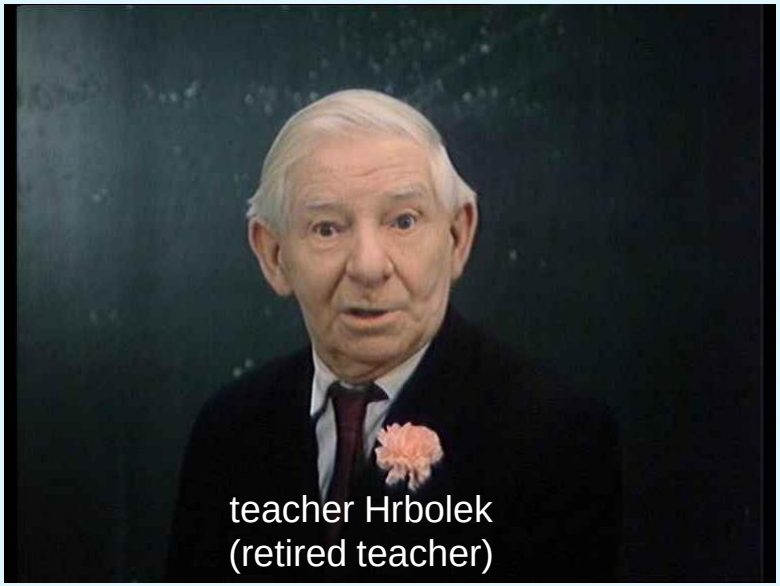

Je potřeba více času, některé věci
bylo pro mě úplně španělská vesnice.
Ale je to hodně zajímavé, dozvěděla
jsem se mnoho nového, určitě
to nikdy nepoužiju. :)

"More time is needed, some things were all Greek to me. But it is very interesting. I learned many of new things, but I will never use it..."

Student from Faculty of Philosophy and Arts

Czech comedy

From Czech comedy “Marecek, Pass Me the Pen!“, teacher Hrbolek: “No, i skladník ve šroubárně si může přečísti Vergilia v originále.”



Pupil Plha: "I have a question − will I use Latin in my field of activity?“

Teacher Hrbolek: "Which field of activity do you want to dedicate?“

Pupil Plha: "I work as a warehouse operator in screw factory."

Teacher Hrbolek: "**Well, even warehouse operator in screw factory can read Virgil in the original!** I am writing you on the list.“

Pupil Plha: "I still have not decided."

Teacher Hrbolek: "You will come every Wednesday at 2 pm, Mlha (fog)!"

My comment

Original message from comedy:

“Well, even warehouse operator in screw factory can read Virgil in the original!”

My message:

“Well, even student from Faculty of Philosophy and Arts can create Hertzsprung-Russell diagram from Real Data from catalogue of stars HIPPARCOS or SIMBAD…”

Right way how to use catalogues?

Portal | Simbad | VizieR | Aladin | X-Match | Other | Help

SIMBAD basic query result

other query modes : Identifier query | Coordinate query | Criteria query | Reference query | Basic query | Script submission | Output options | Help

Object query : polaris

C.D.S. - SIMBAD4 rel 1.207 - 2013.08.08CEST04:07:42

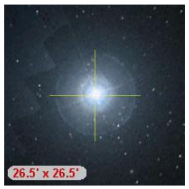
Available data : Basic data • Identifiers • Plot & images • Bibliography • Measurements • External archives • Notes • Annotations

Basic data :

V* alf UMi -- Classical Cepheid (delta Cep type)

query around with radius 2 arcmin

Other object types:	cC* () , * (*,AG,BD,CSI,FK5,GC,GCRV,GEN#,GSC,HD,HIC,HIP,HR,JP11,N30,PLX,PMC,PPM,ROT,SAO,SKY#,TYC,UBV) , ** (ADS,CCDM,IDS,WDS) , SB* (SBC7,SBC9) , V* (V*,AAVSO) , IR (IRAS) , UV (TD1)
ICRS coord. (ep=J2000) :	02 31 49.09456 +89 15 50.7923 (Optical) [1.14 0.97 90] A 2007A&A...474..653V
FK5 coord. (ep=J2000 eq=2000) :	02 31 49.095 +89 15 50.79 (Optical) [1.14 0.97 0] A 2007A&A...474..653V
FK4 coord. (ep=B1950 eq=1950) :	01 48 47.78 +89 01 43.6 (Optical) [6.60 5.58 0] A 2007A&A...474..653V
Gal coord. (ep=J2000) :	123.2805 +26.4614 (Optical) [1.14 0.97 0] A 2007A&A...474..653V
Proper motions *mas/yr* [error ellipse]:	44.48 -11.85 [0.11 0.13 0] A 2007A&A...474..653V
Radial velocity / Redshift / cz :	V(km/s) -17.4 [0.9] / z(~) -0.000058 [0.000003] / cz -17.40 [0.90] (~) A 1953GCRV..C.....0W
Parallaxes *mas*:	7.54 [0.11] A 2007A&A...474..653V
Spectral type:	F7:Ib-IIv C ~
Fluxes (2) :	B 2.591 [~] C ~ V 2.005 [~] C ~



essential notes:
- see also NAME POLARIS CIRRUS CLOUD
- see also NAME POLARIS FLARE

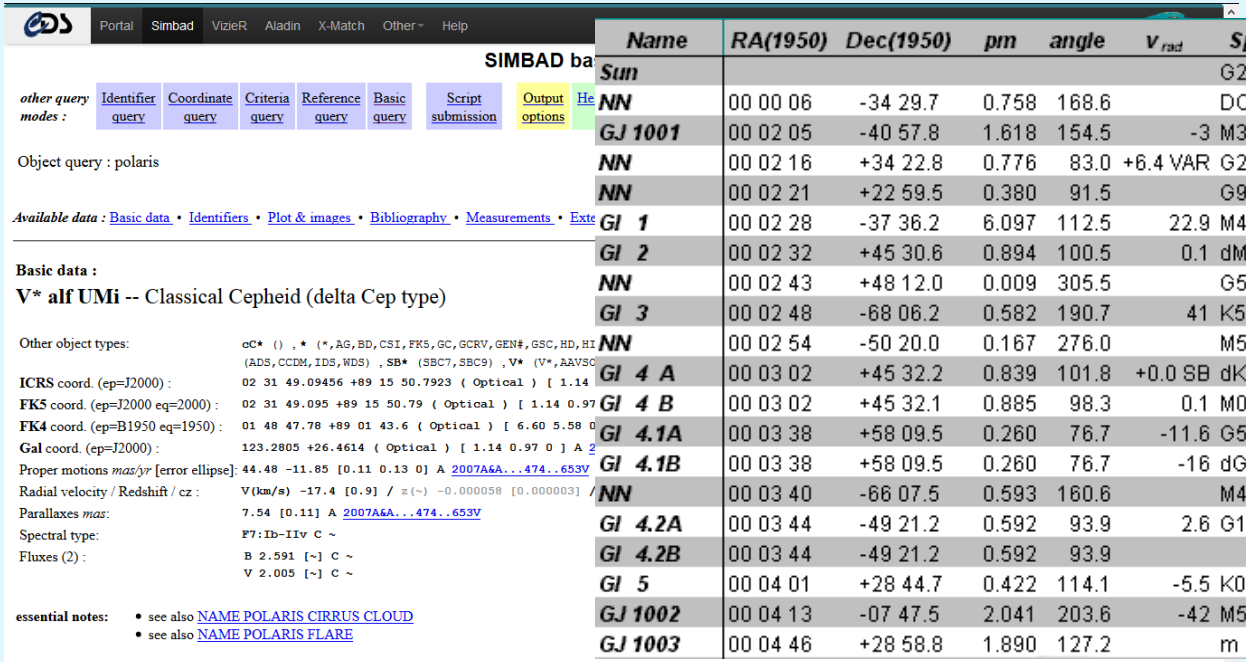
Lister - [z:\data1.csv]

Soubor Upravit Možnosti Kódování Nápověda 100 %

```
Astronomia, katalog HIPPARCOS, 13:22:28, 21. 2. 2011
Vyhledáno dle DEdeg(≥ 40, ≤ 90); seřazeno podle Vmag vzestupně; nalezeno 22 072 záznamů, výpis omezen na 10 záznamů

HIP;označení;jméno hvězdy;RAhms;DEdms;Vmag;RAdeg;DEdeg;Plx;pmRA;pmDE;`B-V`;HD;SpType;souhvězdí;
24608;α Aur, 13 Aur;Capella;05 16 41,30;+45 59 56,5;0,08;79,17206517;45,99902927;77,29;75,52;-427,13;0,795;34029;M1: comp;Aur
102098;α Cyg, 50 Cyg;Deneb;20 41 25,91;+45 16 49,2;1,25;310,35797270;45,28033423;1,01;1,56;1,55;0,092;197345;A2Ia;Cyg
62956;ε UMa, 77 UMa;Alioth;12 54 01,63;+55 57 35,4;1,76;193,50680410;55,95984301;40,30;111,74;-8,99;-0,022;112185;A0p;UMa
15863;α Per, 33 Per;Mirfa;03 24 19,35;+49 51 40,5;1,79;51,08061889;49,86124281;5,51;24,11;-26,01;0,481;20902;F5Ib;Per
54061;α UMa, 50 UMa;Dubhe;11 03 43,84;+61 45 04,0;1,81;165,93265365;61,75111888;26,38;-136,46;-35,25;1,061;95689;F7V comp;UMa
67301;η UMa, 85 UMa;Alkaid;13 47 32,55;+49 18 47,9;1,85;206,88560880;49,31330288;32,39;-121,23;-15,56;-0,099;120315;B3V SB;UMa
28360;β Aur, 34 Aur;Menkalinan;05 59 31,77;+44 56 50,8;1,90;89,88237261;44,94743492;39,72;-56,41;-0,88;0,077;40183;A2V;Aur
11767;α UMi, 1 UMi;Polárka;02 31 47,08;+89 15 50,9;1,97;37,94614689;89,26413805;7,56;44,22;-11,74;0,636;8890;F7:Ib-IIv SB;UMi
72607;β UMi, 7 UMi;Kocab;14 50 42,40;+74 09 19,7;2,07;222,67664751;74,15547596;25,79;-32,29;11,91;1,465;131873;K4IIIvar;UMi
14576;β Per, 26 Per;Algol;03 08 10,13;+40 57 20,3;2,09;47,04220716;40,95565120;35,14;2,39;-1,44;-0,003;19356;B8V;Per
```

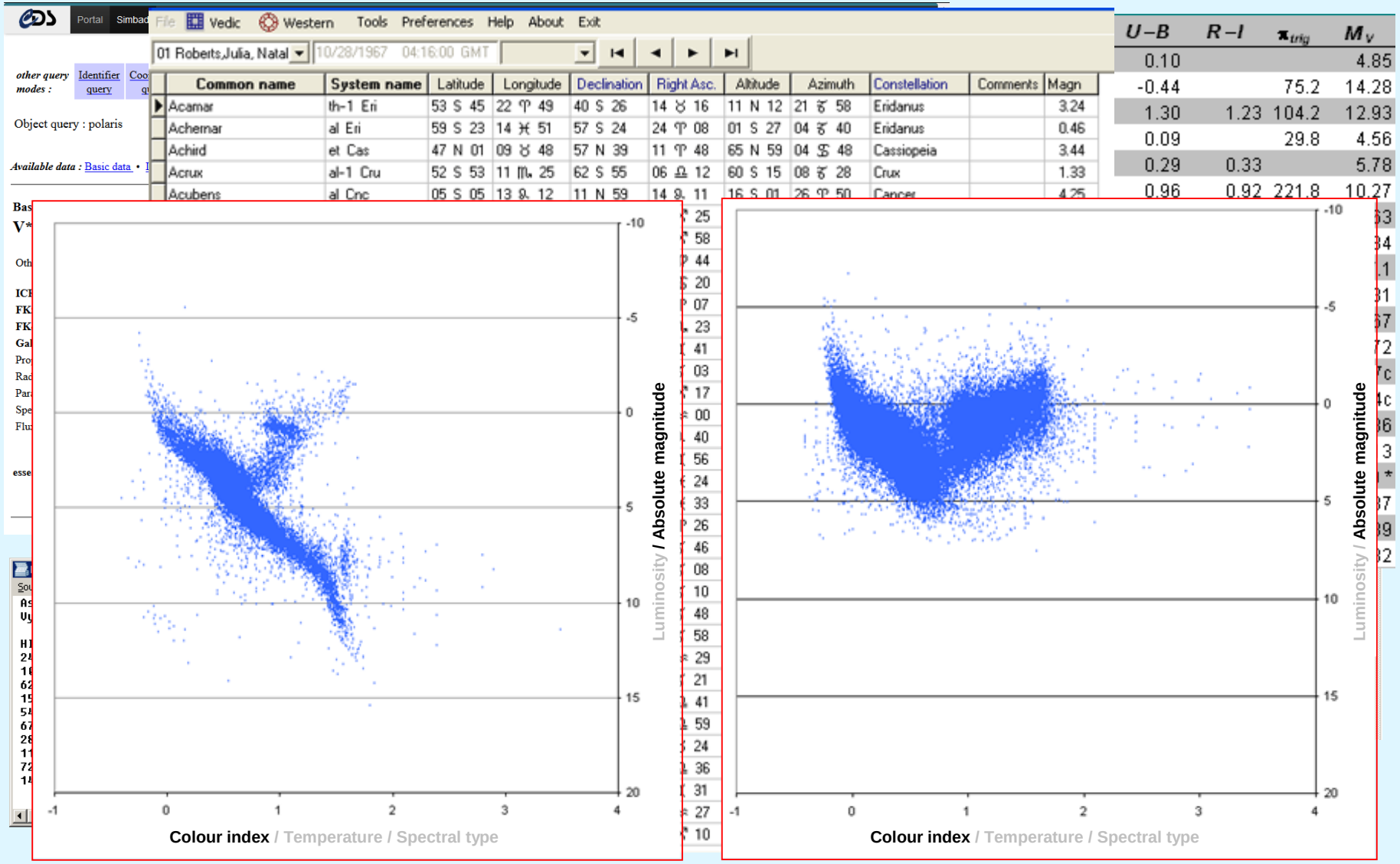
Right way how to use catalogues?



Name	RA(1950)	Dec(1950)	pm	angle	v_{rad}	Sp Type	m_v	B–V	U–B	R–I	π_{trig}	M_v
Sun						G2 V	-26.72	0.65	0.10			4.85
NN	00 00 06	-34 29.7	0.758	168.6		DC9	14.90	0.46	-0.44		75.2	14.28
GJ 1001	00 02 05	-40 57.8	1.618	154.5	-3	M3.5	12.84	1.63	1.30	1.23	104.2	12.93
NN	00 02 16	+34 22.8	0.776	83.0	+6.4 VAR	G2 V	6.11	0.62	0.09		29.8	4.56
NN	00 02 21	+22 59.5	0.380	91.5		G9 V	7.82	0.74	0.29	0.33		5.78
Gl 1	00 02 28	-37 36.2	6.097	112.5	22.9	M4 V	8.54	1.46	0.96	0.92	221.8	10.27
Gl 2	00 02 32	+45 30.6	0.894	100.5	0.1	dM2 e	9.93	1.49	1.18	0.85	87.0	9.63
NN	00 02 43	+48 12.0	0.009	305.5		G5	8.30					6.84
Gl 3	00 02 48	-68 06.2	0.582	190.7	41	K5 V	8.48	1.06	1.03	0.42	72.5	7.1
NN	00 02 54	-50 20.0	0.167	276.0		M5	11.95	1.50		+0.95t		10.31
Gl 4 A	00 03 02	+45 32.2	0.839	101.8	+0.0 SB	dK6 e	8.97	1.44	1.21	+0.71 J	87.0	8.67
Gl 4 B	00 03 02	+45 32.1	0.885	98.3	0.1	M0.5 V	9.02	1.45	1.20		87.0	8.72
Gl 4.1A	00 03 38	+58 09.5	0.260	76.7	-11.6	G5 V	6.43c	+0.64c	+0.11c		46.5	4.77c
Gl 4.1B	00 03 38	+58 09.5	0.260	76.7	-16	dG8	7.20c	+0.78c	+0.33c		46.5	5.54c
NN	00 03 40	-66 07.5	0.593	160.6		M4	12.16	1.55		1.04		10.86
Gl 4.2A	00 03 44	-49 21.2	0.592	93.9	2.6	G1 IV	5.71	0.52	0.03	0.17	48.3	4.13
Gl 4.2B	00 03 44	-49 21.2	0.592	93.9			11.50				48.3	9.9 *
Gl 5	00 04 01	+28 44.7	0.422	114.1	-5.5	K0 Ve	6.14	0.75	0.33		70.2	5.37
GJ 1002	00 04 13	-07 47.5	2.041	203.6	-42	M5-5.5	13.75	1.98	+1.60:	1.63	212.8	15.39
GJ 1003	00 04 46	+28 58.8	1.890	127.2		m	14.18	1.49	1.40	1.14	53.5	12.82

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Astronomia, katalog HIPPARCOS, 12:53:56, 23. 2. 2011															
2	Vyhledáno nalezeno 22 982 záznamů															
3																
4	HIP	označení	jméno hvě	RAhms	DEdms	Vmag	RAdeg	DEdeg	Plx	pmRA	pmDE	`B-V`	HD	SpType	souhvězdí	
5	2			00 00 00,91	-19 29 55,8	9,27	0,0038	-19,499	21,9	181,21	-0,93	0,999	224690	K3V		
6	6			00 00 04,35	+03 56 47,4	12,31	0,0181	3,94649	18,8	226,29	-12,84	1,336		M0V:		
7	7			00 00 05,41	+20 02 11,8	9,64	0,0225	20,0366	17,74	-208,12	-200,79	0,74		G0		
8	10			00 00 08,70	-50 52 01,5	8,59	0,0363	-50,867	10,76	42,23	40,02	0,489	224717	F6V		
9	18			00 00 12,75	-04 03 13,5	11,03	0,0531	-4,0537	19,93	-127,22	23,78	1,567		K5		
10	20			00 00 15,11	+23 31 45,4	8,51	0,063	23,5293	10,76	36	-22,98	0,516	224723	G0		
11	23			00 00 17,86	+13 18 44,0	7,57	0,0744	13,3122	12,21	54,15	9,65	0,456	224742	F2V		
12	25			00 00 19,05	-44 17 25,1	6,28	0,0794	-44,29	13,74	58,36	-108,64	0,763	224750	G3IV		
13	34			00 00 23,87	+26 55 05,7	6,43	0,0995	26,9182	12,71	42,2	-53,47	0,514	224758	F7,5IV-V		
14	38			00 00 26,65	-79 03 42,6	8,65	0,111	-79,062	23,84	162,3	-62,4	0,778	224752	G6V		
15	39			00 00 26,85	-16 41 48,9	7,46	0,1119	-16,697	10,98	169,72	-32,54	0,475	224763	F3V		
16	45			00 00 32,21	-72 12 09,8	9,59	0,1342	-72,203	15,1	-37,2	-2,78		224766	G6/G8V:		

Right way how to use catalogues?



Probably not…

What about another way?

EN version:

astronomia.zcu.cz/catalogues

CS version:

astronomia.zcu.cz/katalogy

Astronomia
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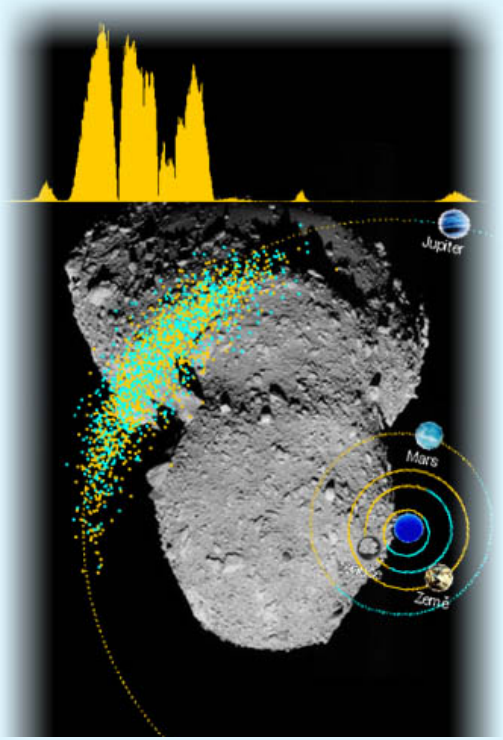
..in education > Online applications using data from catalogues

ONLINE APPLICATIONS USING DATA FROM CATALOGUES

Minor planets

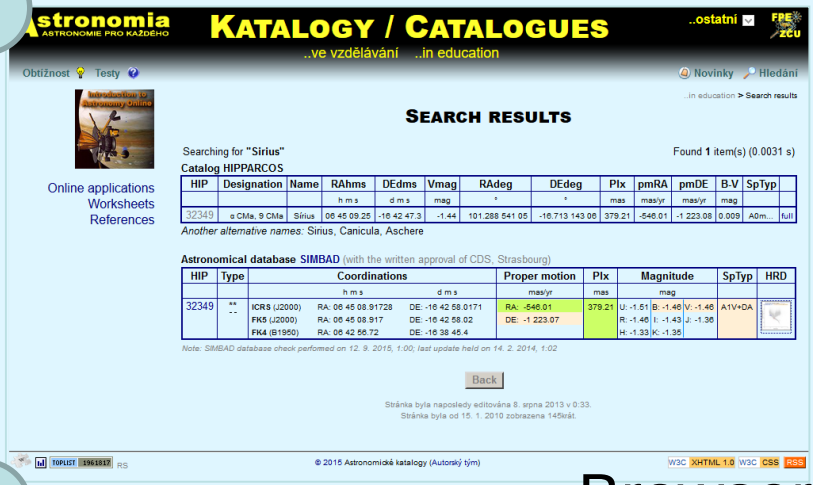
Hundreds of thousands of numbered Minor planets whose parameters are periodically (monthly) updates can be used for demonstration of Kepler's laws or display (in different point of view) interesting group of Minor planets.

- **Analysis of Minor planets parameters**
  Change of one slider of any parameter, the other sliders adjusts to match intervals of Minor planet. You can choose from different groups of Minor planets, e.g. Trojans. For selected (even inhomogeneous) group of Minor planets; parameters can be saved to the file or to use special Data Export.
- **Kirkwood gaps**
  This is a part of Analysis of Minor planets parameters as a special Data Export. It shows graph of semimajor axes on quantity of minor planets. It can be found several gaps. They correspond to the location of orbital resonances with Jupiter.
- **Historical development**
  This is a part of Analysis of Minor planets parameters as a special Data Export. It shows graph of year of discovery on quantity of minor planets.
- **Current location in the Solar system**
  This is a part of Analysis of Minor planets parameters as a special Data Export. It shows location of selected group of minor planet, it is also possible to animate this one by increasing/decreasing of date.
- **Kepler's laws demonstration**
  It is possible to view current (or for selected date) location in the Solar system for any Minor planet. On this image it is possible to demonstrate all Kepler's laws, including the location of focuses and the center of the ellipse, perihelion, aphelion, mainly the law of equal areas (using the interactive behavior with area calcultion), and more.
- **Apparent magnitude of Minor planet calculation**
  The image with location of Minor planet in Solar system shows calculated



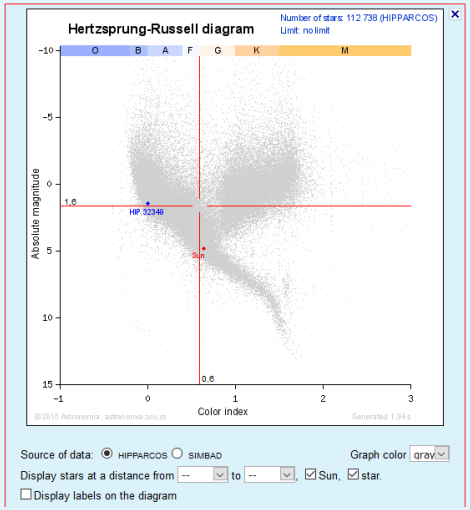
Online Application Real Data Usage

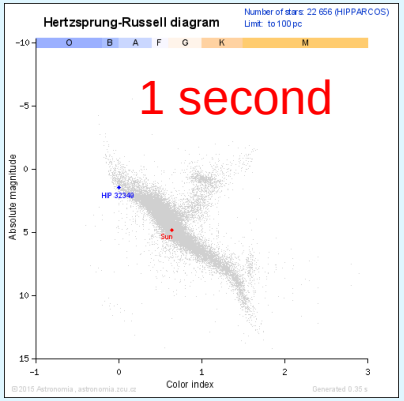
1



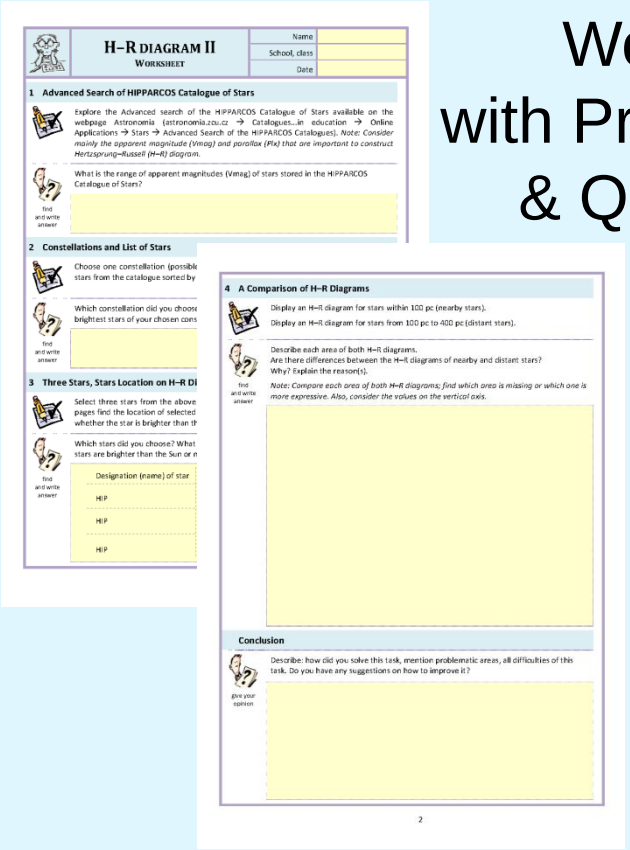
2

Browser





Diagrams in Browser



Worksheet with Procedure & Questions

Czech / English versions

Catalogues on Astronomia web pages

- **MPC** = 523 584 minor planets
  www.minorplanetcenter.net (135 MiB, **monthly update**)

- **HIPPARCOS** = 118 218 stars
  (60 MiB, static)
- **SIMBAD** (*) = 118 195 stars
  simbad.u-strasbg.fr/simbad/ (36 MiB, **weekly update**)

- **NGC** = 7 840 deep-sky objects
  (2 MiB, 400 MiB pics, static)
- **Messier** = 110 deep-sky objects
  (615 MiB pics, static)

- **Exoplanets** = 3 824 exoplanets
  exoplanet.eu (3 MiB, **daily update**)

Number of (numbered) minor planets increase

1st	– 1801
1st thousand	– 1921
2nd thousand	– 1942
3rd thousand	– 1960
ten thousand	– 1981
hunderd thousand	– 2000
milion	– ?
two hunderd thousand	– 2002
three hunderd thousand	– 2005
four hunderd thousand	– 2014
five hunderd thousand	– 2017

(1000) Piazzia

523 584 numbered minor planets

Minor planets parameters analysis

Astronomia
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..in education > Minor planets analysis

MINOR PLANETS ANALYSIS

Number: 1 – 523 584

Min: 1 Max: 523 584

Year of discovery: 1801 – 2016

Min: 1801 Max: 2016

Semimajor axis *a*: 0.6 au – 817.4 au

817.4 au

Min: 0.6 au Max: 817.4 au Max: 817.4 au

Orbital eccentricity *ε*: 0.0 – 1.0

Min: 0.0 Max: 1.0

Inclination to the ecliptic *i*: 0.0° – 172.9°

Min: 0.0 Max: 172.9

Absolute magnitude *H*: −1.1 mag – 25.5 mag

Min: −1.1 mag Max: 25.5 mag

Type of Minor planet.. ..expand..

Data Export.. ..expand..

523 584

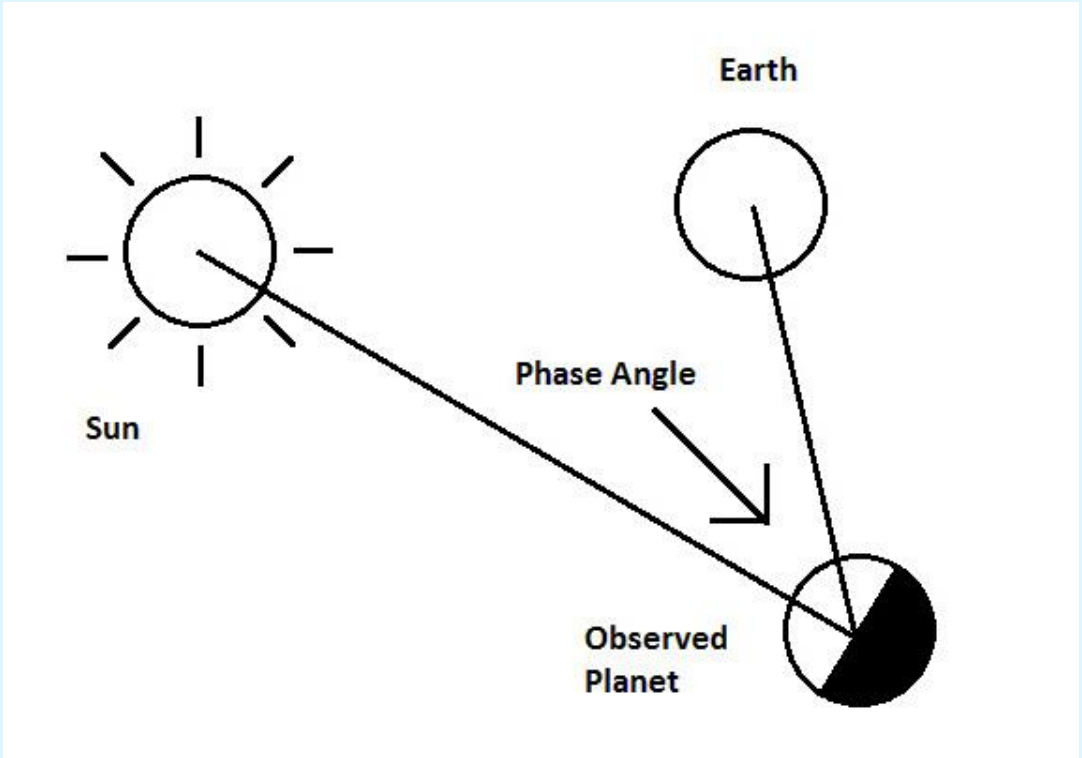
(number of found minor planets)

Absolute magnitude *H*

The apparent magnitude that the object would have if it were one astronomical unit (au) from both the Sun and the observer, and in conditions of ideal solar opposition.

Where is the observer?

$$m = H + 5\log\Delta + 5\log r$$

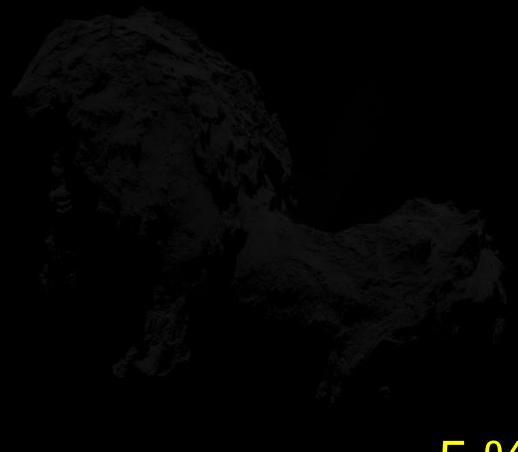


$$D = \frac{1329}{\sqrt{p}} 10^{-0.2H}$$

Albedo *p*

100 %

31 %



12 %

5 %

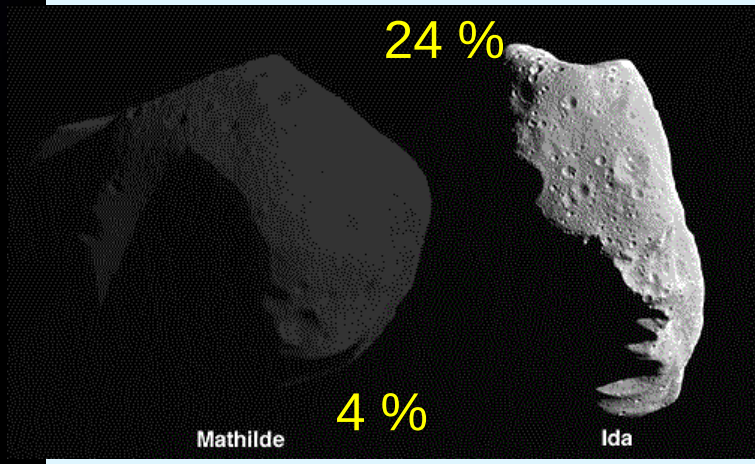
reflectivity

p = 5%

p = 25%

p = 50%

24 %



4 %

Historical development of minor planets discovery

Astronomia
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MINOR PLANETS ANALYSIS

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Min: 1801 Max: 2016

Semimajor axis *a*: 0.6 au – 817.4 au

Min: 0.6 au Max: 817.4 au 817.4 au Max: 817.4 au

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Min: 0.0° Max: 172.9°

Absolute magnitude *H*: −1.1 mag – 25.5 mag

Min: −1.1 mag Max: 25.5 mag

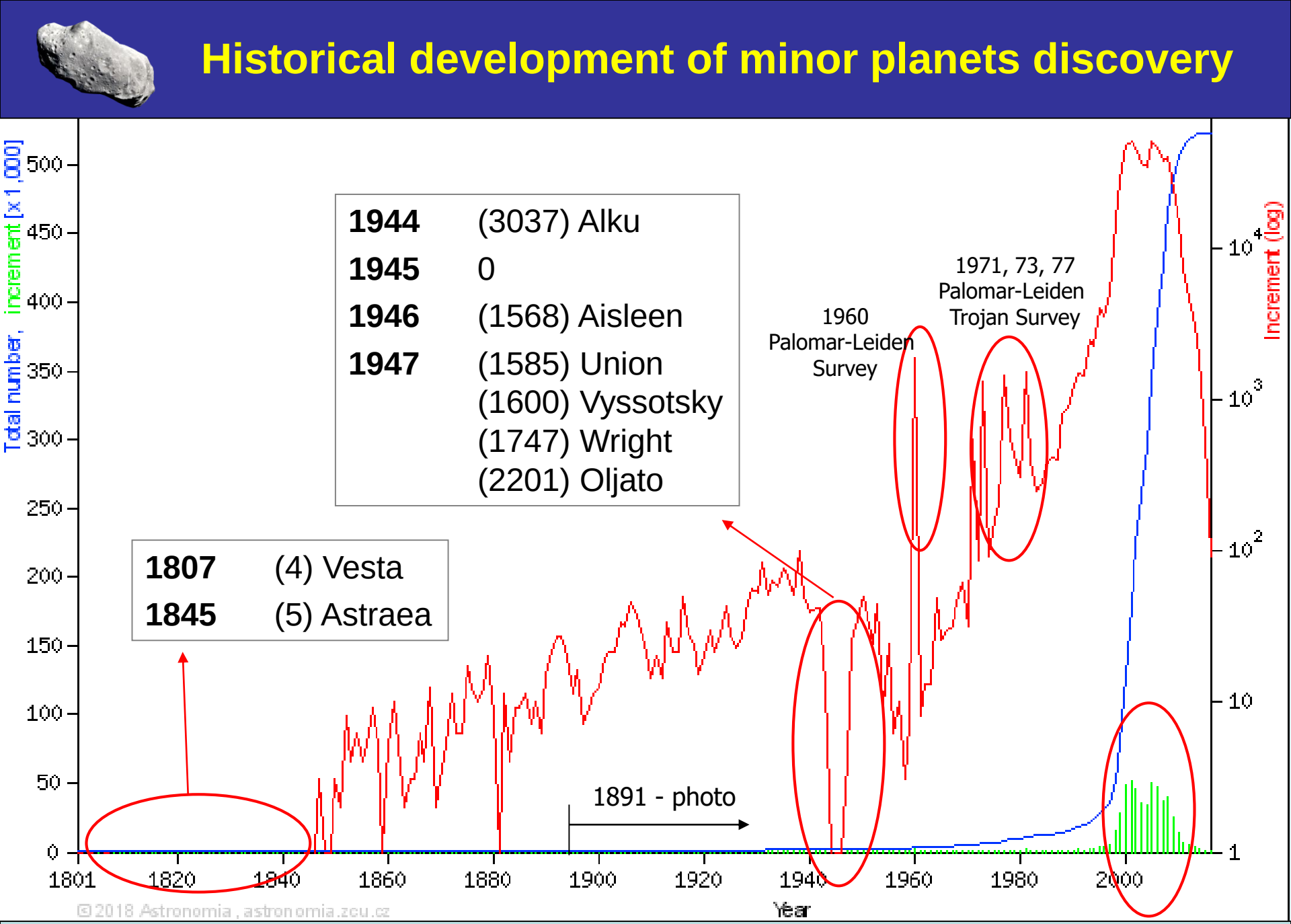
Type of Minor planet.. ..expand..

Data Export.. ..expand..

523 584

(number of found minor planets)

Historical development of minor planets discovery



Number of minor planets per semi-major axis

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..in education > Minor planets analysis

MINOR PLANETS ANALYSIS

Number: 1 – 523 584

Min: 1 Max: 523 584

Year of discovery: 1801 – 2016

Semimajor axis *a*: 0.6 au – 817.4 au

817.4 au

Min: 0.6 au Max: 817.4 au Max: 817.4 au

Orbital eccentricity *ε*: 0.0 – 1.0

Min: 0.0 Max: 1.0

Inclination to the ecliptic *i*: 0.0° – 172.9°

Min: 0.0° Max: 172.9°

Absolute magnitude *H*: −1.1 mag – 25.5 mag

Min: −1.1 mag Max: 25.5 mag

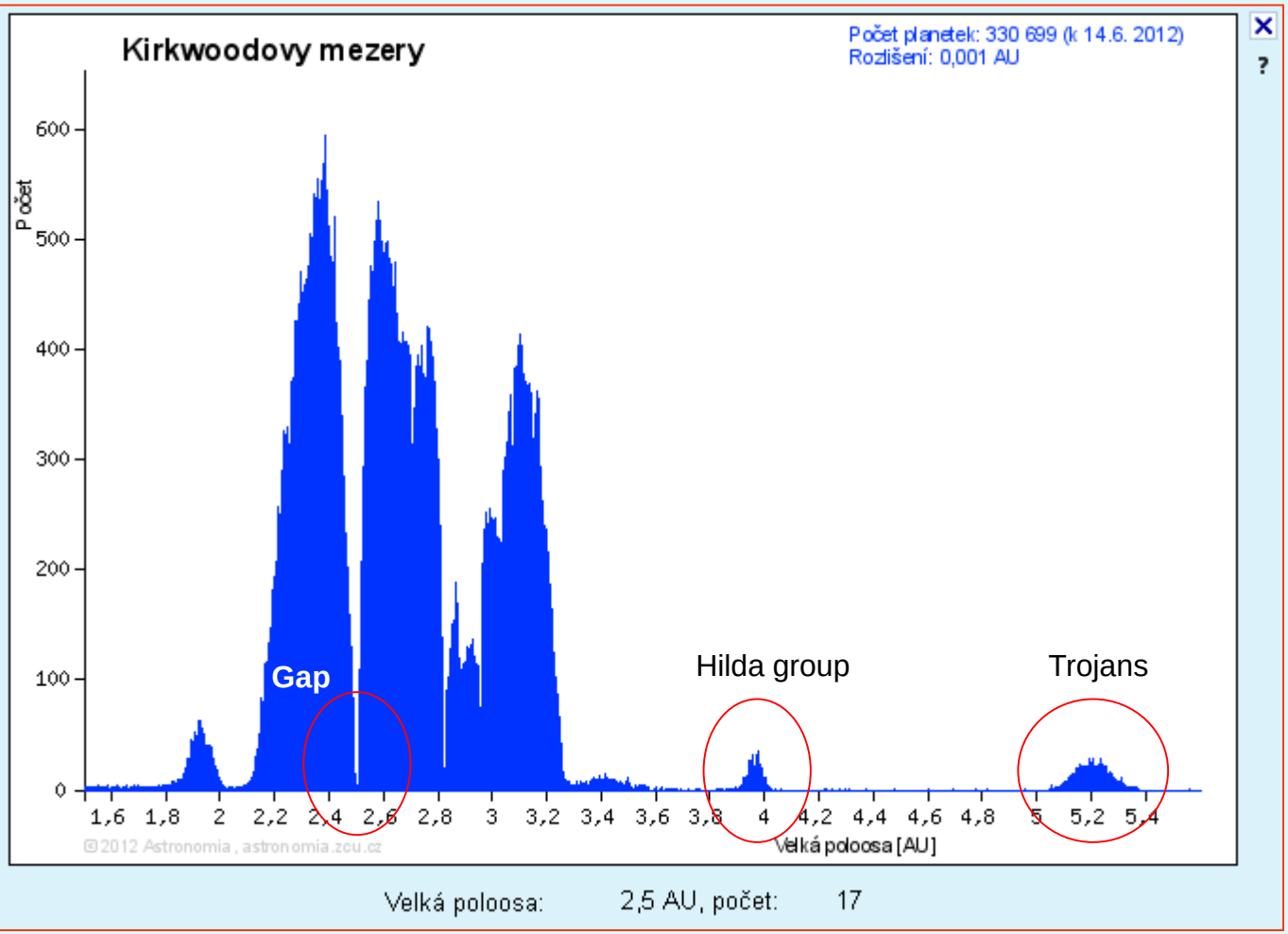
Type of Minor planet.. ..expand..

Data Export.. ..expand..

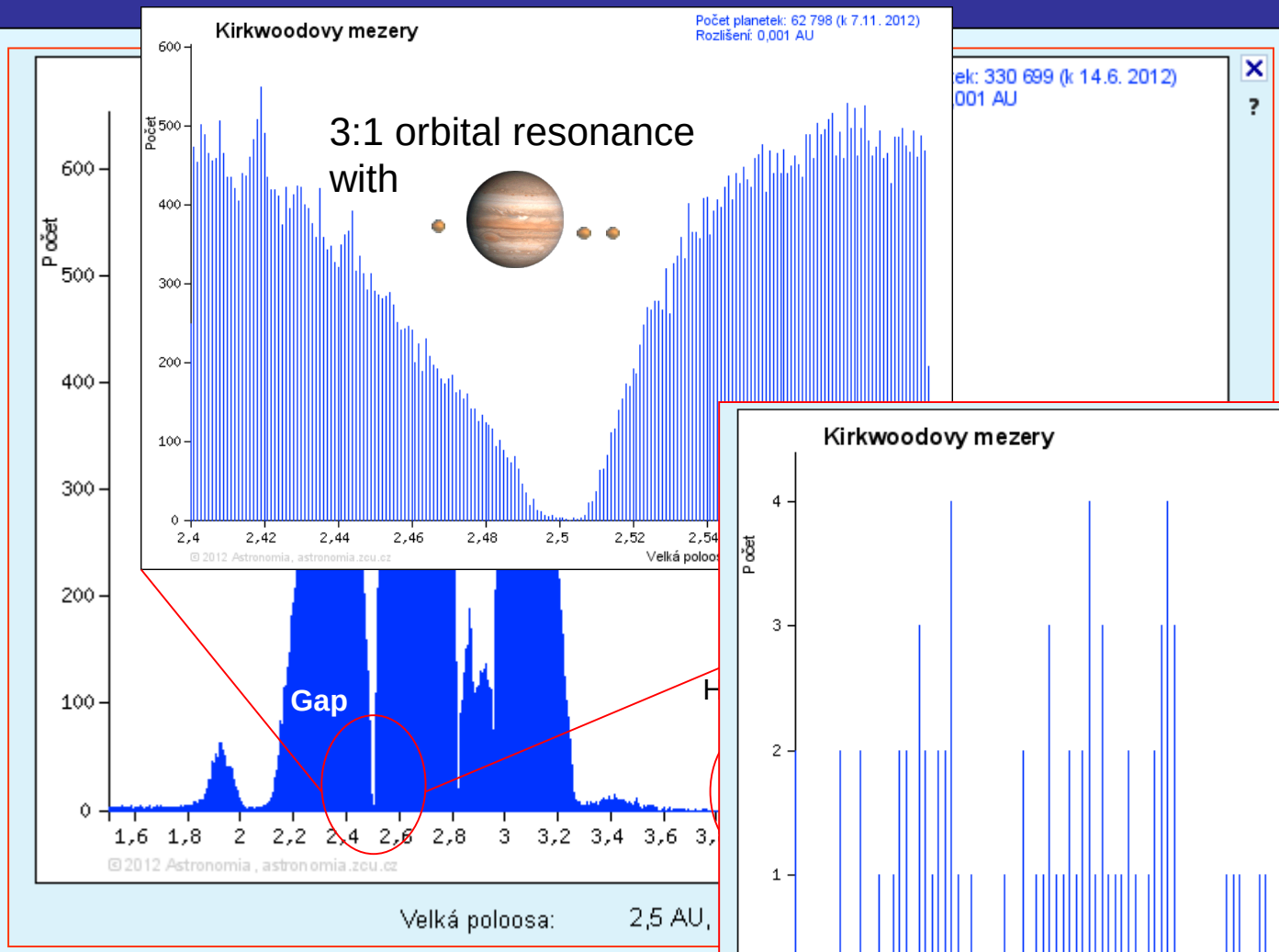
523 584

(number of found minor planets)

Kirkwood gaps



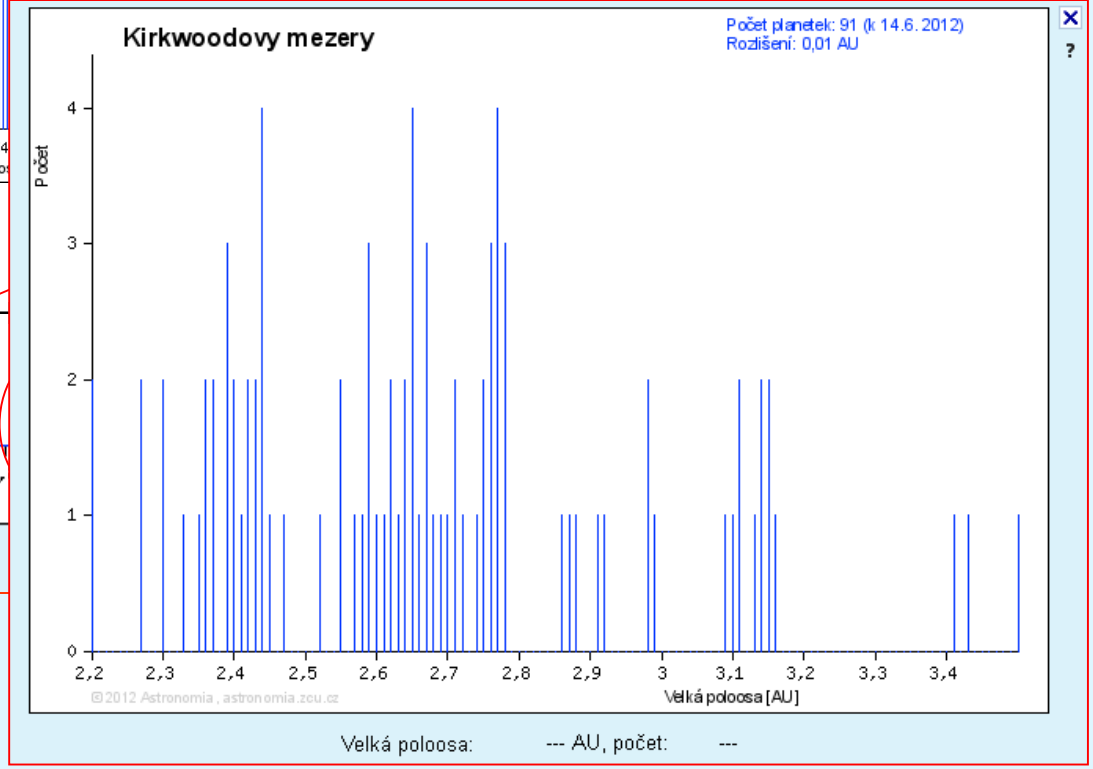
Kirkwood gaps



1857
(50)

1866
(91)

Kirkwood



a = 2,5 au → T = 3,95 years

a = 5,2 au → T = 11,86 years

Interesting „group“ of minor planets

Near-Earth Asteroids/Minor planets (NEA)

Interesting „group“ of minor planets

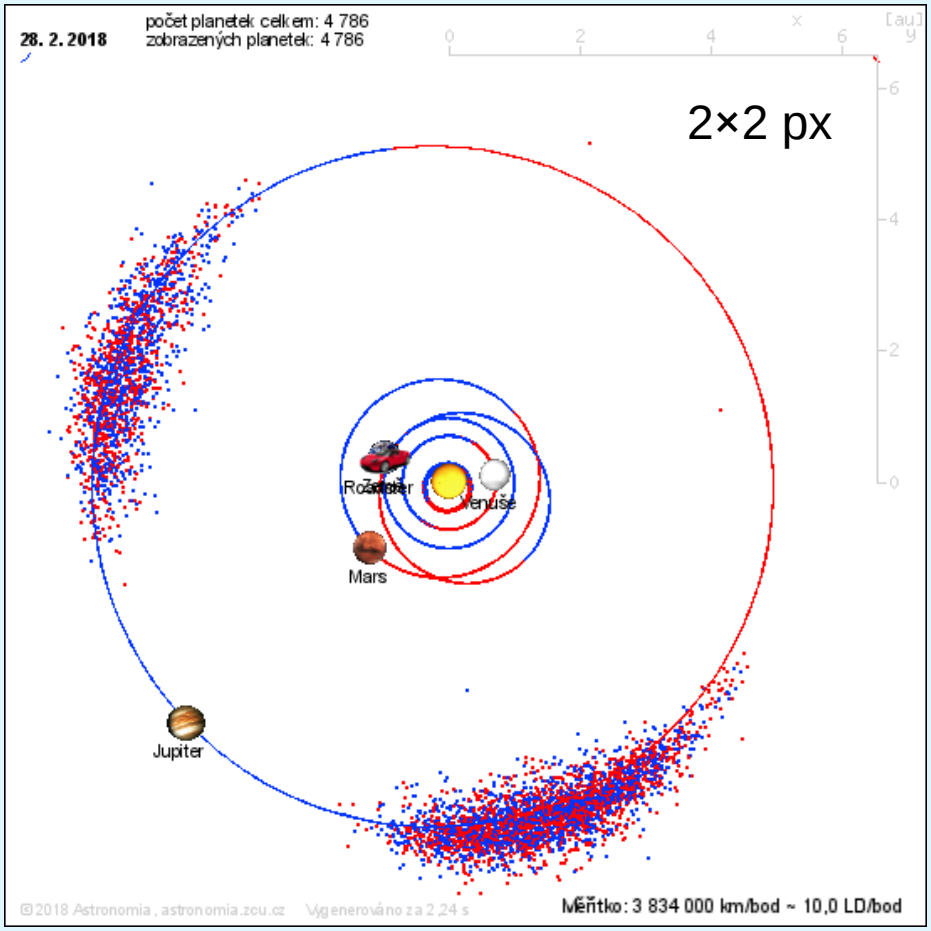
(object dimensions and distances are not in scale)

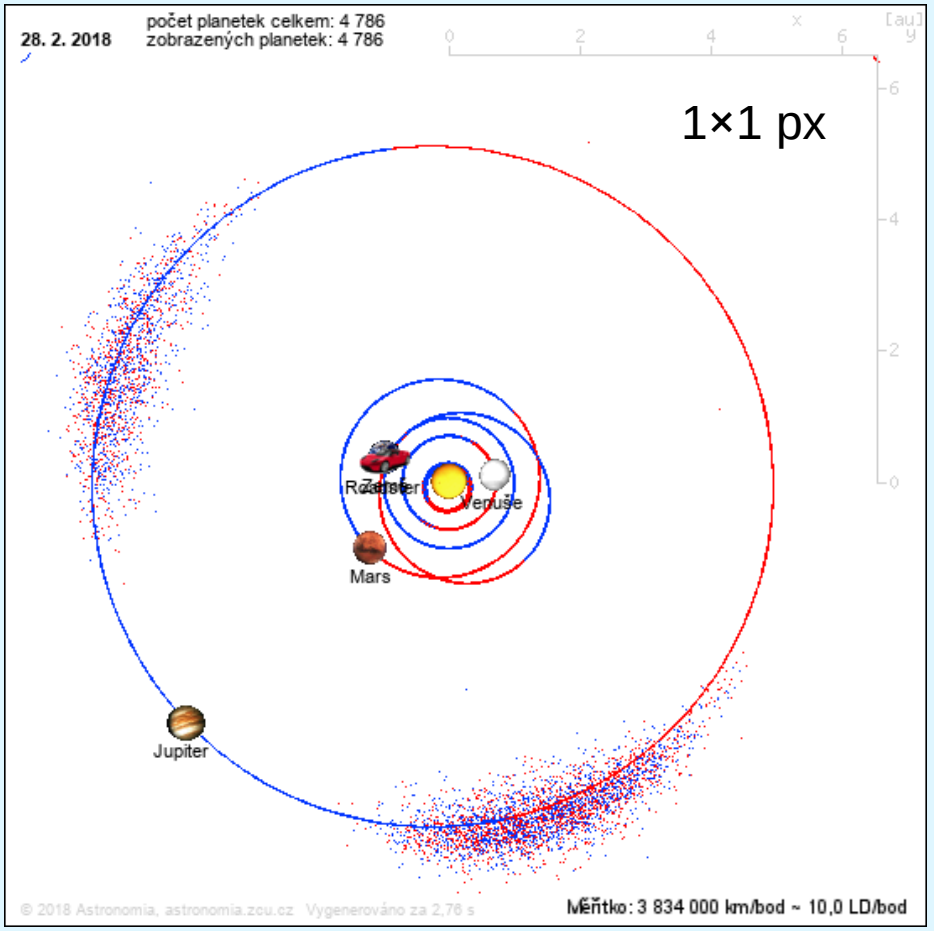
150 000 000 km

1 au

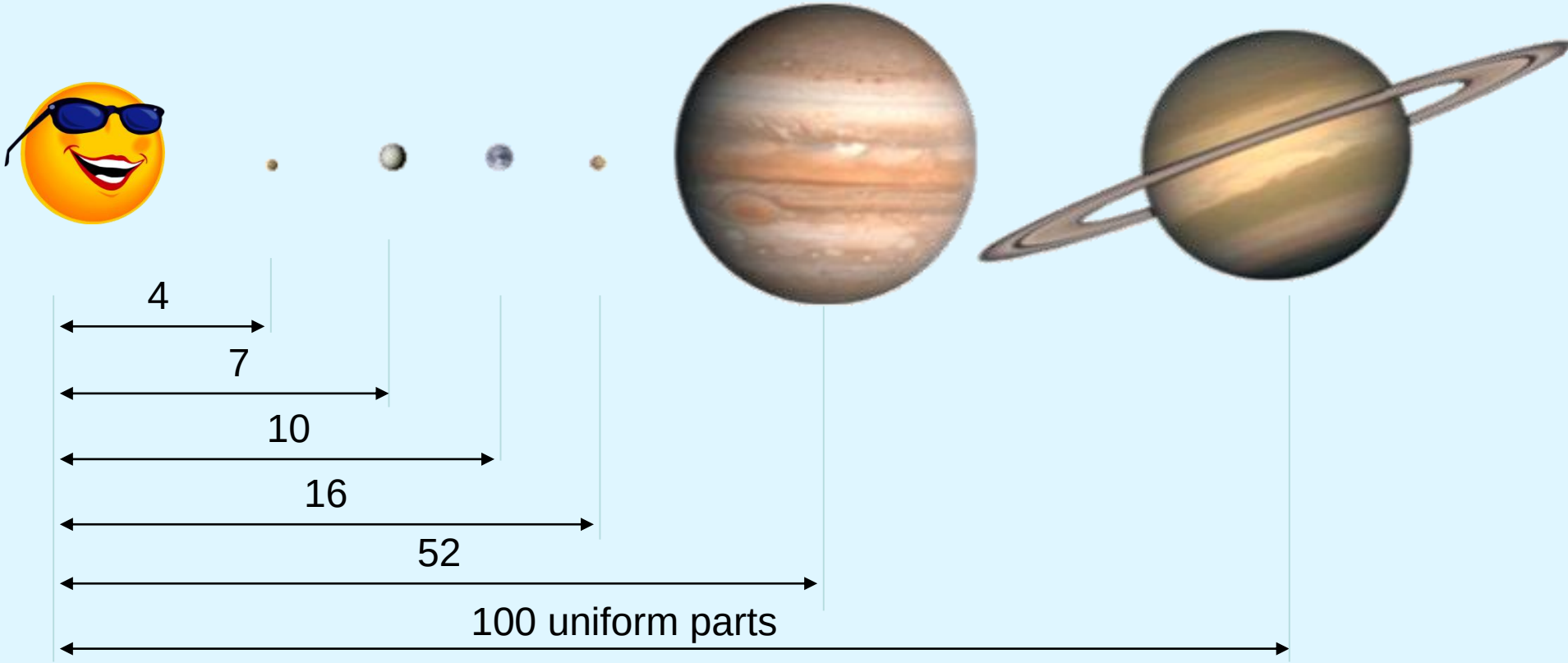
Sun Earth

Group of Jupiter Trojans

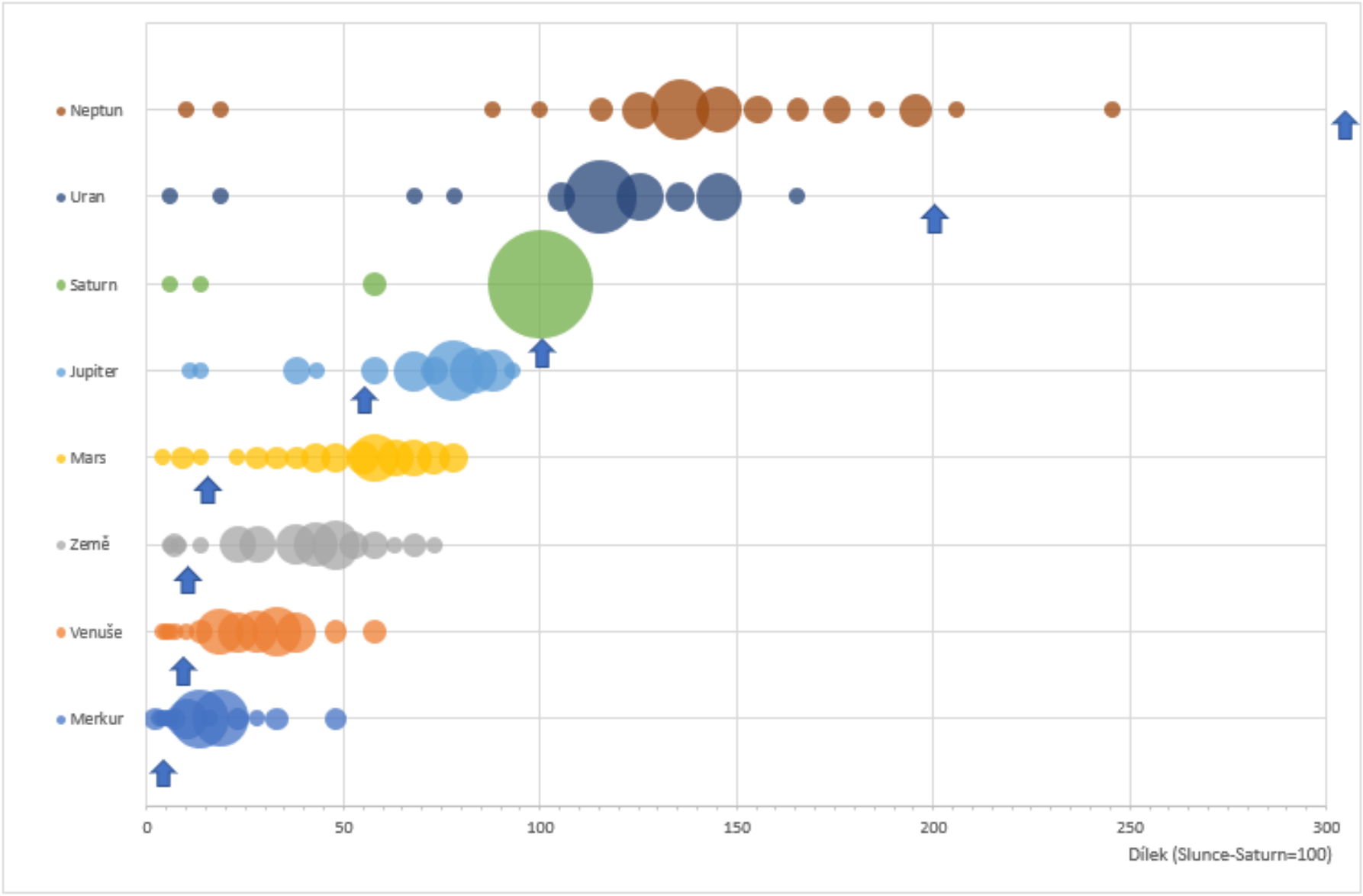




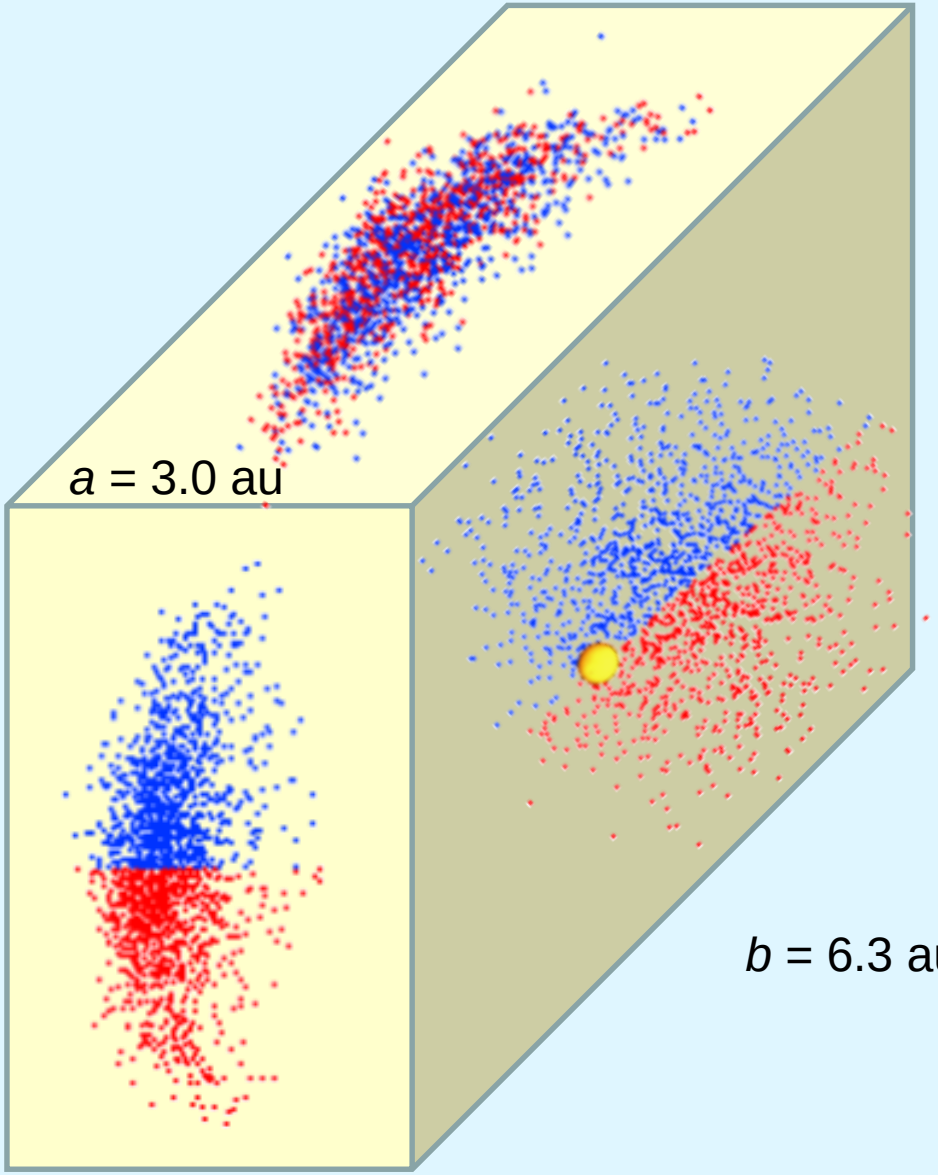
Perceptions about distances of planets



Perceptions about distances of planets



Mutual distances of Jupiter Trojans



$n \sim 1700$ $V = abc$

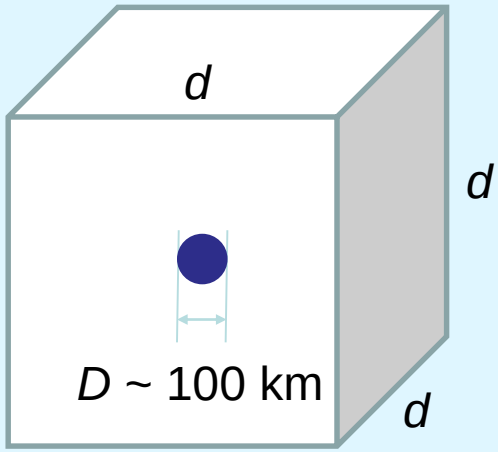
$V \sim 120$ au^3 $V_k = V / n$

$V_k \sim 0.07$ au^3

~ 166 thousand of Sun

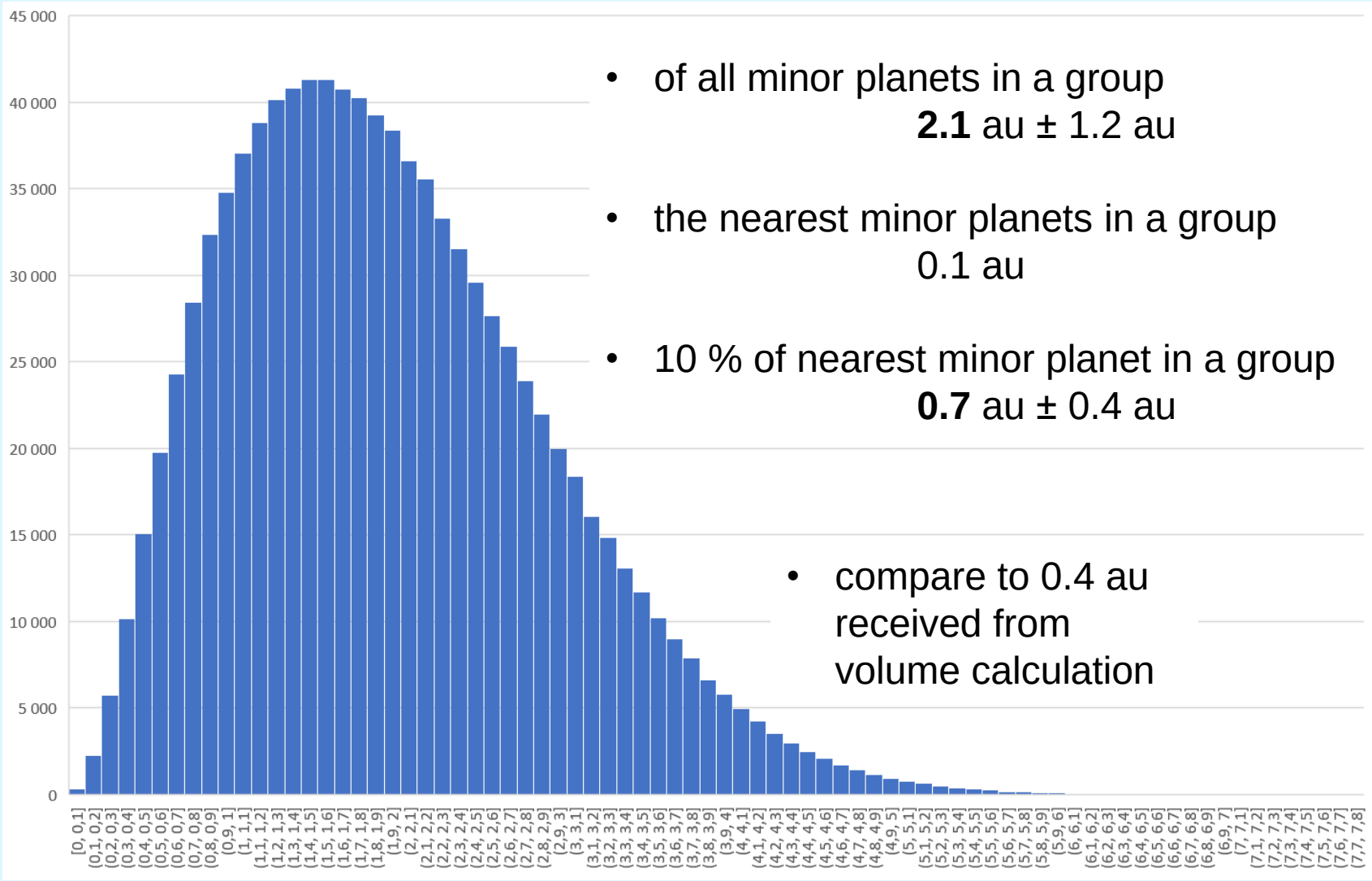
$d \sim 0.4$ au

~ Sun–Mercury



(object dimensions and distances are not in scale)

Mutual distances of Jupiter Trojans



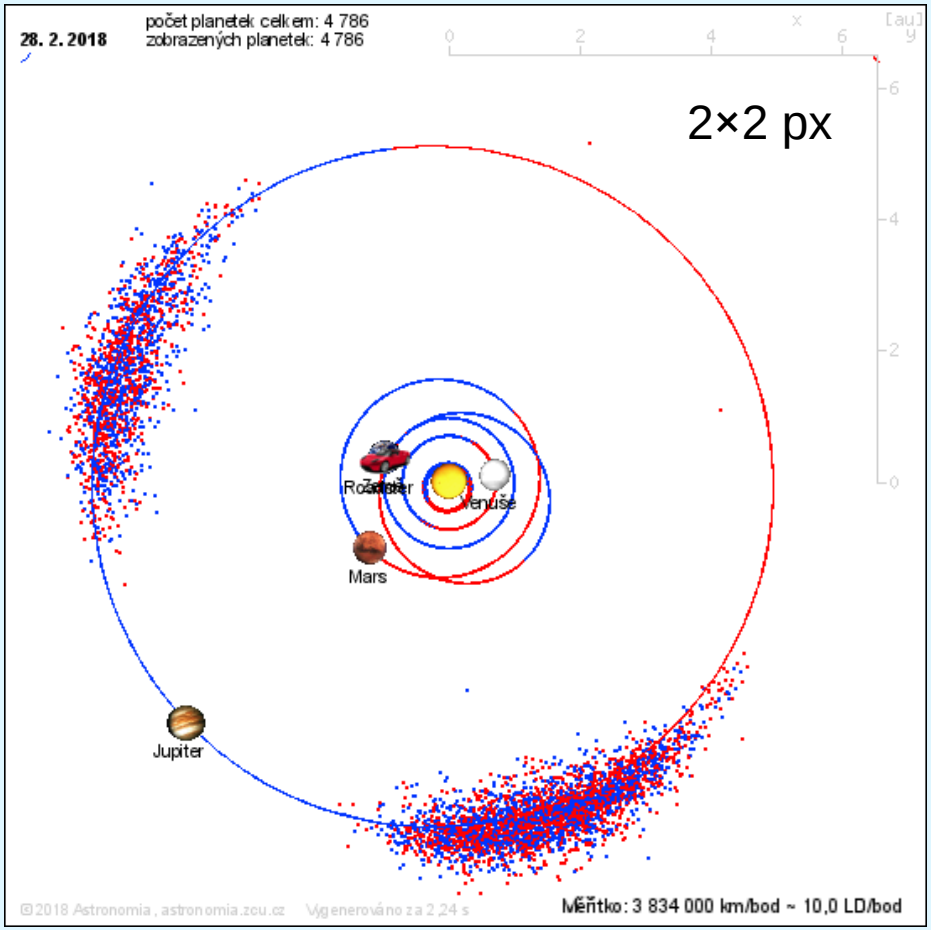
- of all minor planets in a group
  2.1 au ± 1.2 au
- the nearest minor planets in a group
  0.1 au
- 10 % of nearest minor planet in a group
  0.7 au ± 0.4 au
- compare to 0.4 au received from volume calculation

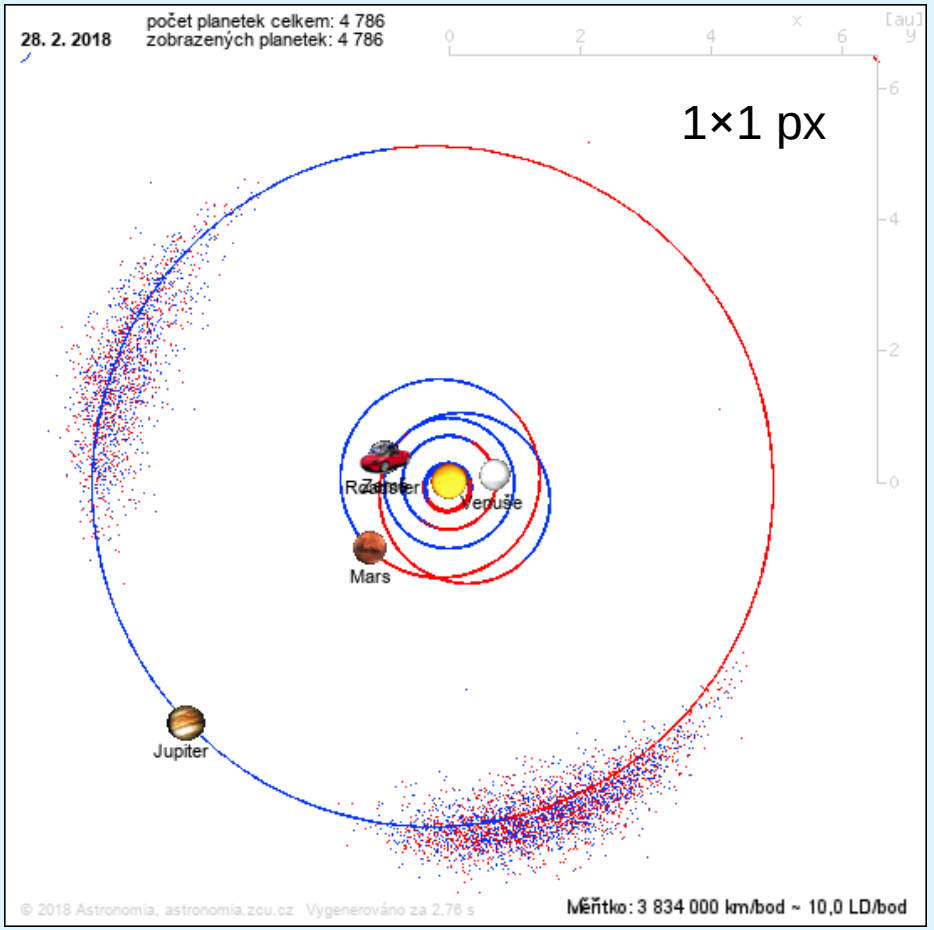
Mutual distances of Jupiter Trojans

150,000,000 km
1 au
Sun — Earth

300,000,000 km
2 au
Earth, Jan — Earth, Jul

100,000,000 km
0.7 au
Sun — Venus





(object dimensions and distances are not in scale)

Interesting „group“ of minor planets

Hilda group
Hungaria group
Phocaea group

Location of minor planet

- actual location, date change
- animation forward, back
- estimation of minor planet temperature
- estimation of minor planet apparent magnitude
- trajectory colour
  (above – blue/below – red ecliptic)
- **perihelion, aphelion passages**
- **closest approach to Earth, far approach to Earth**
- **highest, lowest brightness from Earth**
- **Kepler‘s laws**

Open question…

- **Which Deep-sky Objects / Bright stars / Constellations are Above Horizon?**

Catalogues on Astronomia web pages

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www.minorplanetcenter.net (135 MiB, **monthly update**)

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(60 MiB, static)

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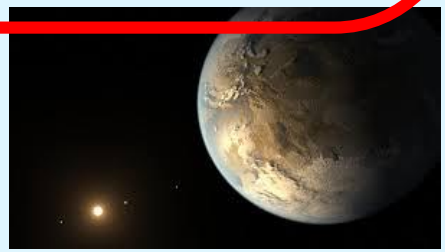
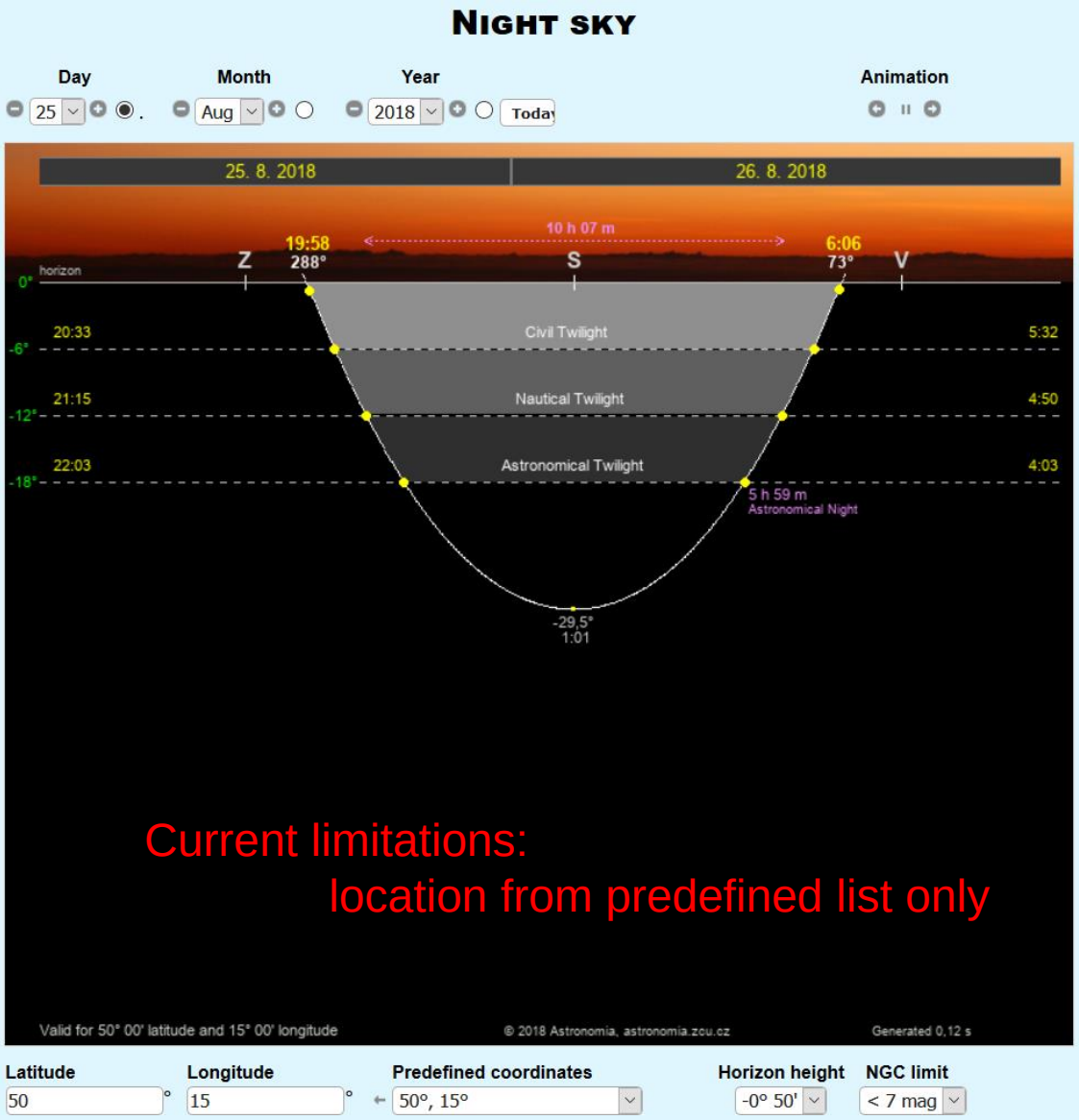


„Night sky“ Online application



The 37th European Symposium on Occultation Projects, Czech Republic, August 25th , 2018

FACULTY OF EDUCATION
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Astronomia
ASTRONOMIE PRO KAŽDÉHO

How to use Real data from Catalogues of Astronomical objects (not only) in Education

Ota Kéhar

kehar@kmt.zcu.cz

Faculty of Education, University of West Bohemia, Plzen, Czech Republic