



Portal za analizu familija asteroida

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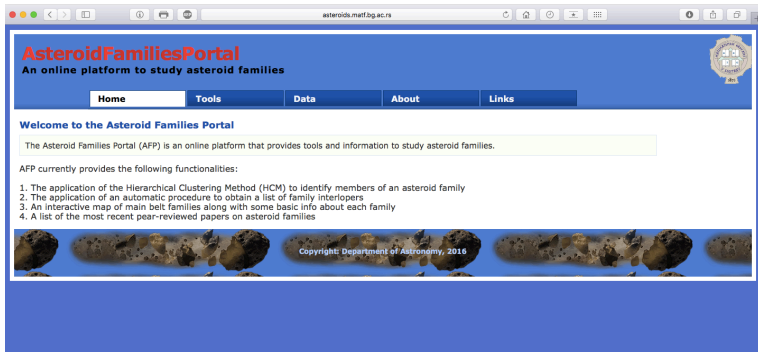
20. mart 2018

Asteroids Family Portal

- Značaj web portala u nauci?
- Asteroids Family Portal (AFP) - portal namenjen analizi familija asteroida
 - Identifikacija - HCM i izbacivanje uljeza
 - Fizički podaci
 - Metod integracije unazad
 - Katalog sopstvenih elemenata za GAP i MBC
 - Naučni radovi iz oblasti

Asteroids Family Portal - AFP

<http://asteroids.matf.bg.ac.rs/fam/>



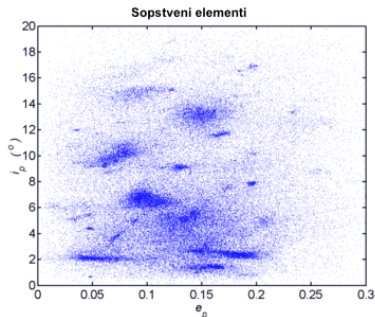
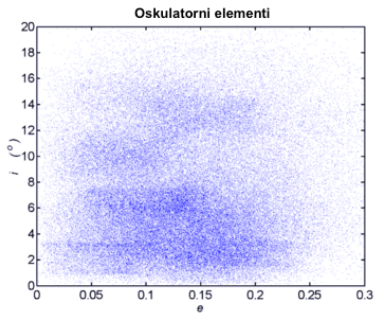
The screenshot shows a web browser window displaying the Asteroid Families Portal. The browser's address bar shows the URL `asteroids.matf.bg.ac.rs`. The website has a blue header with the title "AsteroidFamiliesPortal" and the subtitle "An online platform to study asteroid families". A navigation menu includes "Home", "Tools", "Data", "About", and "Links". A welcome message states: "Welcome to the Asteroid Families Portal" and "The Asteroid Families Portal (AFP) is an online platform that provides tools and information to study asteroid families." Below this, it lists the functionalities provided by AFP:

1. The application of the Hierarchical Clustering Method (HCM) to identify members of an asteroid family
2. The application of an automatic procedure to obtain a list of family interlopers
3. An interactive map of main belt families along with some basic info about each family
4. A list of the most recent peer-reviewed papers on asteroid families

At the bottom of the page, there is a banner image showing several asteroids of different sizes and colors (grey, brown, black) against a blue background. The text "Copyright: Department of Astronomy, 2016" is overlaid on the image.

Familije asteroida

- Oskulatorni (a, e, i) i sopstveni elementi asteroida (a_p, e_p, i_p)
- Hirayama, 1918




Sopstveni elementi

- Dinamički model: 7 planeta
- 10 miliona godina unapred
- Ista verzija softvera
- Šest meseci!
- <http://asteroids.matf.bg.ac.rs/fam/properelements.php>

AFP: Sopstveni elementi

AsteroidFamiliesPortal

An online platform to study asteroid families



Home Tools **Data** About Links

Proper Elements Catalogs

The catalogs contain proper orbital elements of numbered asteroids and main-belt comets computed numerically by means of a synthetic theory by Knežević & Milani (2000,2003).

There are however some differences between the procedure proposed by aforementioned authors and the one used to produce the catalogs available here:

- Orbits of all asteroids are numerically propagated for 10 Myr
- All numerical integrations are made within the same dynamical model
- All proper elements calculations are performed using the same version of the software

Asteroid proper orbital elements:

- `afp.pro` (file size: ~50MB)
- `afp.sig` (file size: ~40MB)

Proper orbital elements for main-belt comets:

- `mbc.pro`
- `mbc.sig`

Information on the format of the catalogs:

The format of files containing proper elements:

- Column 1: Asteroid number
- Column 2: Absolute magnitude
- Column 3: Proper semi-major axis [au]
- Column 4: Proper eccentricity

Familije asteroida: Identifikacija

- Metoda hijerarhijskog grupisanja (MHG, Zappalá et al., 1990)

$$d = na_p \sqrt{C_a(\delta a_p/a_p)^2 + C_e(\delta e_p)^2 + C_i(\delta \sin(i_p))^2}$$

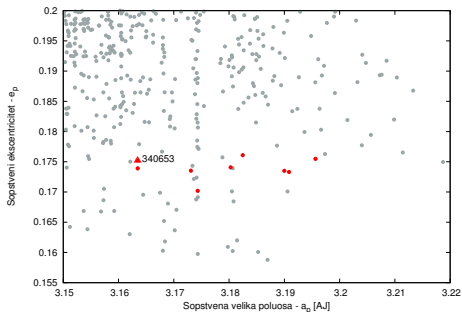
Nominalno rastojanje d_{nom}

Rastojanje koje u prostoru sopstvenih elemenata najbolje opisuje familiju.

Familije asteroida: Identifikacija

Problemi

- ✗ Uljezi i lančano vezivanje (eng. chaining effect)
- ✗ Određivanje d_{nom}



AFP: Identifikacija familija

The screenshot shows the Asteroid Families Portal website. The header is blue with the text "AsteroidFamiliesPortal" in red and "An online platform to study asteroid families" in white. A navigation bar below the header contains buttons for "Home", "Tools", "Data", "About", and "Links". The "Tools" button is highlighted. On the right side of the header, there is a circular logo with the text "AFIP" and "Portal".

The main content area has a blue "Toolbar" header with the text "No started HCM task!". Below this, there is a text box with instructions: "This page allows to employ the Hierarchical Clustering Method (HCM) to generate a list of potential members of an asteroid family. In the fields **Ast id** and **Cut-off** a number of an asteroid around which the HCM should perform a search, and a distance threshold in m/s should be entered, respectively." A tooltip "Select a family from the list" is visible over a dropdown menu. Below the text box, it says: "It is also possible to generate membership at different cut-offs. In this case **Multiple** box should be checked, and the other fields below should be filled. For additional instructions move the mouse over the corresponding field."

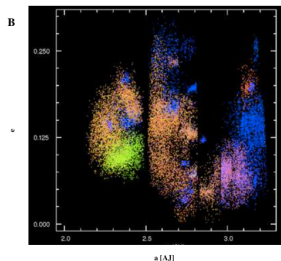
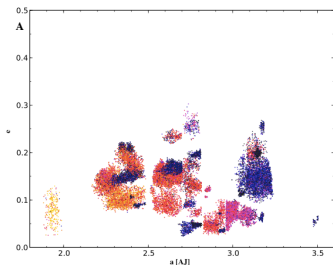
The form fields include:

- Family:
- Advanced options:
- Ast id:
- Cut-off: m/s
- Multiple:
- Max cut-off: m/s
- Step: m/s
- Max num:

A "Generate" button is located at the bottom of the form.

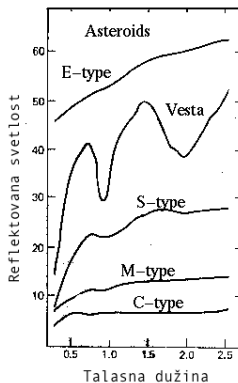
Familije asteroida: Fizičke karakteristike

- Spektro-fotometrijske karakteristike
- Homogen vs. heterogen sastav familije



Taksonomija asteroida

- Taksonomija asteroida - podela u grupe na osnovu spektro-fotometrijskog sastava površi asteroida
 - C, S kompleksi
- Spektar
- Boje - SDSS
- Albedo - WISE, AKARI, IRAS



AFP: Fizički podaci

The screenshot shows the Asteroid Families Portal website. At the top, the title "Asteroid Families Portal" is displayed in red, with the subtitle "An online platform to study asteroid families" below it. A navigation menu includes "Home", "Tools", "Data", "About", and "Links". A "Toolbar" on the left contains a search box, a "Family" dropdown menu set to "(27) Euterpe", an "Advanced options" checkbox, an "Ast id" input field with "27", a "Cut-off" input field with "65 m/s", and a "Generate" button. A table in the center lists data files with their names and descriptions:

File name	#Description
sdssa27v065.list	Asteroid colors
albedoa27v065.list	Asteroid albedos and diameters
taxonomya27v065.list	Asteroid taxonomy

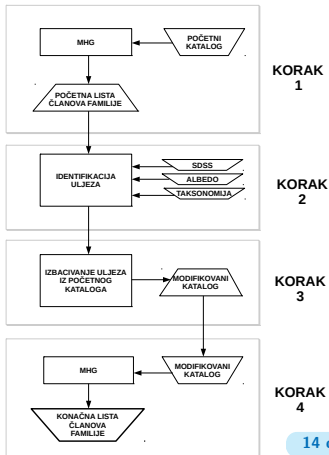
At the bottom of the page, there is a banner image of various asteroids with the text "Copyright: Department of Astronomy, 2016".

Familije asteroida: Identifikacija uljeza

- Migliorini et al., 1995
- Proširenje metrike MHG raspoloživim fizičkim podacima
 - ✓ Pouzdanije određena familija \Rightarrow manje uljeza (Parker et al., 2008, Carruba et al., 2013)
 - ✗ Mali broj raspoloživih fizičkih podataka
 - ✗ Tačnost fizičkih podataka
- Izbacivanje uljeza direktno iz liste identifikovanih članova familije (Novaković et al., 2011, Milani et al., 2014, 2016)
 - ✓ Ne koristi si se smanjen skup podataka
 - ✗ Različiti kriterijumi za izbacivanje asteroida
 - ✗ Lančani efekat

Algoritam za izbacivanje uljeza

- **KORAK 1:** MHG se primenjuje na katalog sopstvenih elemenata (Knežević & Milani, 2000).
- **KORAK 2:** Identifikacija uljeza → SDSS boje, geometrijski albedo (WISE, AKARI, IRAS) i spektralni podaci.
- **KORAK 3:** Izbacivanje uljeza iz početnog kataloga.
- **KORAK 4:** MHG se primenjuje na modifikovanom katalogu.



Rezultati (Radović et al, 2017)

Familija	d_{cut}	# STEP1	# SDSS	# ALBEDO	# TAX.	# STEP2	Vezivanje	# STEP 4	%
(5) Astraea	55	7482	92	295	2	361	234	6887	7.9
(10) Hygiea	70	5904	24	15	3	38	86	5780	2.1
(15) Eunomia	60	11889	411	1421	12	1595	316	9978	16.1
(20) Massalia	30	4663	7	8	0	13	2	4648	0.3
(24) Themis	70	5499	20	39	0	59	31	5409	1.6
(93) Minerva	75	7015	352	845	39	1057	-	-	-
(135) Herta	45	22849	465	1138	10	1358	1363	20128	11.9
(145) Adeona	45	1994	45	21	0	62	78	1854	7.0
(158) Koronis	65	7743	28	81	1	101	38	7604	1.8
(170) Maria	60	2939	20	28	0	45	44	2850	3.0
(221) Eos	70	24155	555	1706	39	2089	757	21309	11.8
(490) Veritas	30	1295	6	7	0	13	0	1282	1.0
(668) Dora	60	1401	9	3	1	13	0	1388	0.9
(847) Agnia	45	3054	14	52	0	61	84	2909	4.7
(1040) Klumpkea	80	2794	56	435	3	452	227	2115	24.5
(1726) Hoffmeister	40	1763	6	3	1	9	0	1754	0.5
(2076) Levin	45	2500	52	30	2	83	71	2346	6.2

Diskusija

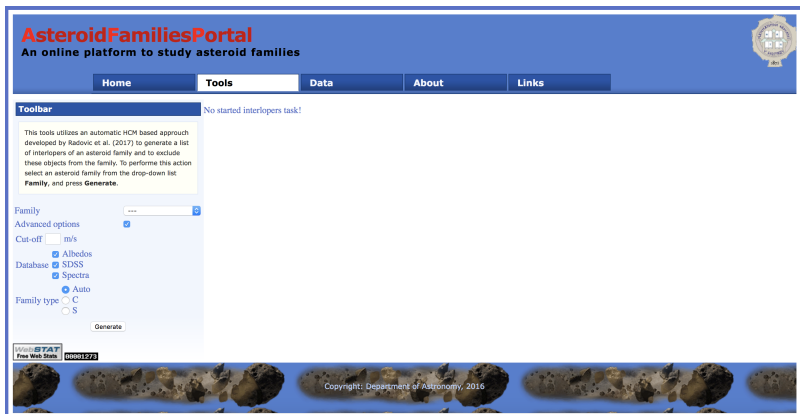
Prednosti

- ✓ Jasni i strogi kriterijumi za identifikaciju uljeza
- ✓ Uvođenjem novog koraka povećan je broj identifikovanih uljeza
- ✓ Redukovanje lančanog efekta ($> 10\%$)
- ✓ Pouzdanija lista članova familije
- ✓ Razdvajanje familija različitog tipa

Ograničenja

- ✗ Brojnost i kvalitet fizičkih podataka
- ✗ Preklapanje familija istog ili sličnog tipa

AFP: Izbacivanje uljeza



AsteroidFamiliesPortal
An online platform to study asteroid families

Home Tools Data About Links

Toolbar No started interlopers task!

This tool utilizes an automatic HCM based approach developed by Radović et al. (2017) to generate a list of interlopers of an asteroid family and to exclude these objects from the family. To perform this action select an asteroid family from the drop-down list **Family**, and press **Generate**.

Family:

Advanced options:

Cut-off: m/s

Database: SDSS Spectra

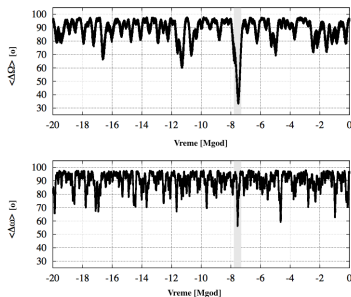
Family type: Auto C S

WebSTAT
Free Web Stats 00001273

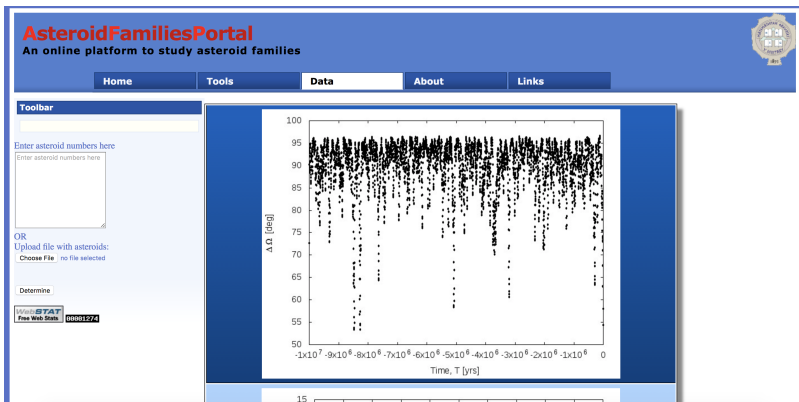
Copyright: Department of Astronomy, 2016

Familije asteroida: Metoda integracije unazad

- Trenutak formiranja familije → bliskost orbitalnih uglova
- Longituda uzlaznog čvora Ω i longituda perihela ϖ
- Dosadašnje procene? Najviše do 20 Mgod (Nesvorný et al., 2003; Novaković et al., 2010, Radović, 2017))



AFP: MIU



AFP: Papers

AsteroidFamiliesPortal

An online platform to study asteroid families



Home Tools **Data** About Links

Toolbar

Peer reviewed journal papers on asteroid families:

- 2018
- 2017
- 2016
- 2015
- 2014
- 2013
- 2012
- 2011
- 2010

Peer reviewed journal papers on asteroid families:

Year 2018:

- Hsieh, H.H., Novakovic, B., Kim, Y., Brassier, R.:
Asteroid Family Associations of Active Asteroids
2018, *The Astronomical Journal*, **155**, 96
- Pravec, P., and 18 colleagues:
Asteroid clusters similar to asteroid pairs
2018, *Icarus*, **304**, 110-126
- Henych, T., Holsapple, K.A.:
Interpretations of family size distributions: The Datura example
2018, *Icarus*, **304**, 127-134
- Rosaeu A., Plávalová E.:
On relative velocity in very young asteroid families
2018, *Icarus*, **304**, 135-142
- Benavidez, P.G., Durda, D.D., Enke, B., CampoBagatin, A., Richardson, D.C., Asphaug, E., Bottke, W.F.:
Impact simulation in the gravity regime: Exploring the effects of parent body size and internal structure
2018, *Icarus*, **304**, 143-161
- Bolin, B.T., Walsh, K.J., Morbidelli, A., Delbo, M.:
Initial velocity V-shapes of young asteroid families
2018, *Mon. Not. R. Astron. Soc.*, **473**, 3949-3968
- Hanus, J., and 36 colleagues:
Spin states of asteroids in the Eos collisional family

Budući rad

- Nove baze podataka: MOVIS-VISTA, GAIA, LSST
- Magnitude Size Distribution (V. Đošović)
- Izmena korisničkog interfejsa
- Sumarni podaci o familijama asteroida

HVALA NA PAŽNJI!