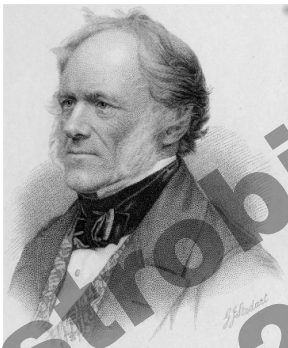


Modeling Galactic habitability

Biblioteka AO, Astrobiologija petkom

31.05.2013.

Pogodite misteriozne ličnosti

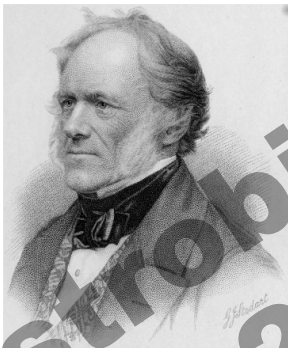


???????????? (1797 – 1875)



???????????? (1769 – 1832)

Gradualizam vs. Katastrofizam

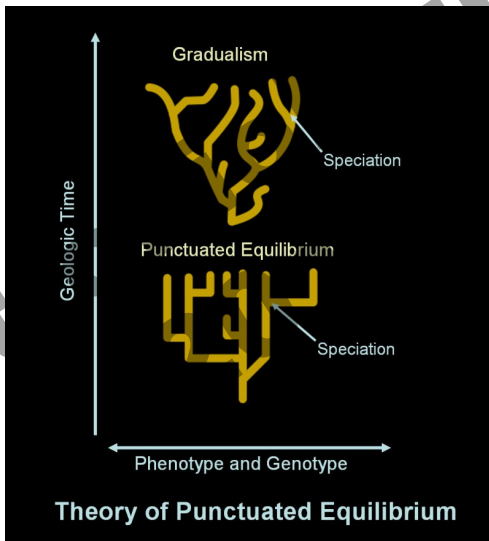


Charles Lyell (1797 – 1875)

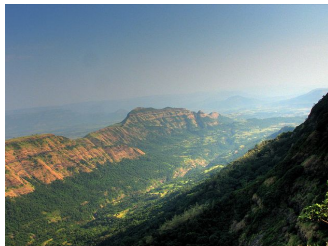
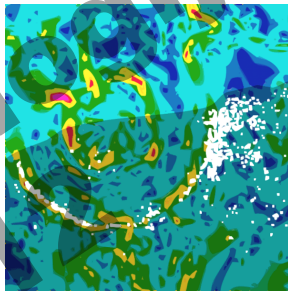


Georges Cuvier (1769 – 1832)

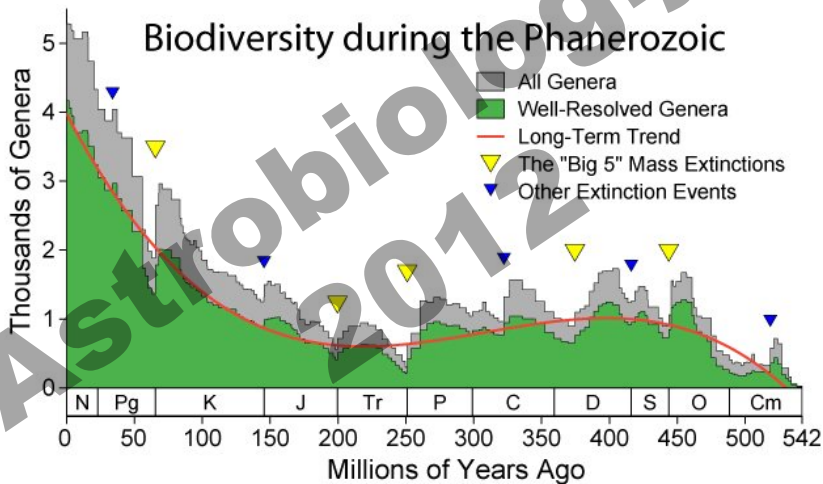
Punctuated equilibrium



Šta se dogodilo pre ~ 65 Myr?

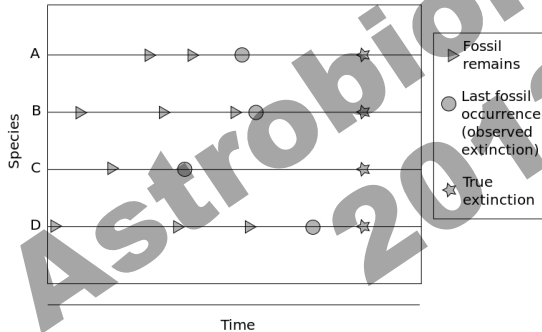


Velikih Pet

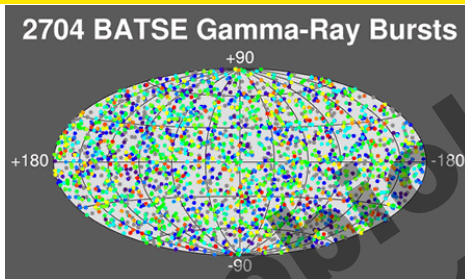


Postepena ekstinkcija?

Signor-Lipps Effect



Katastrofični dogadjaji na galaktičkoj skali

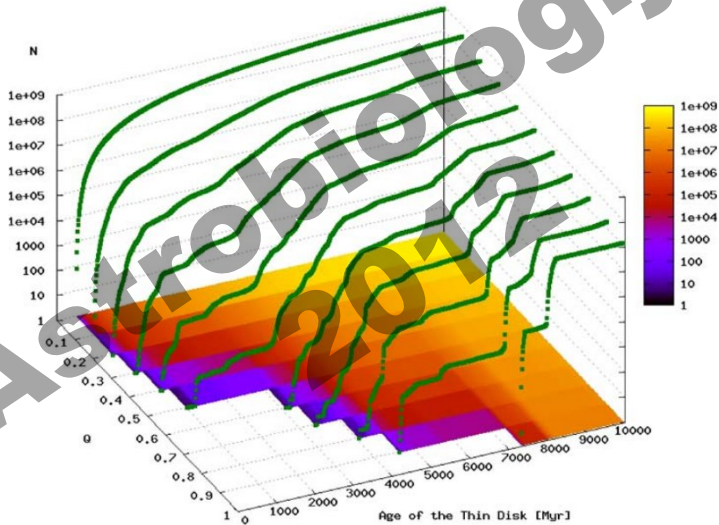


- γ -bleskovi:
 - Annis J, 1999, JBIS, 52, 19.
 - Scalo, J., Wheeler, J.C., 2002, ApJ, 566, 723.
 - Thomas, B.C. et al, 2005, ApJ, 634, 509.
- Supernove
- Sudari zvezda

Bitno za naseljivost

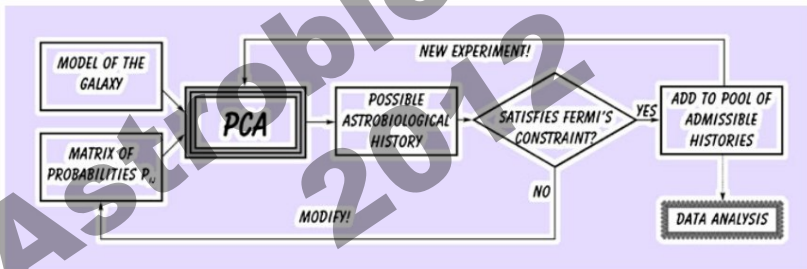
- Preduslovi: Masa zvezde ($M?$), Metaličnost. Statistika misija kao što je Kepler je veoma važna za bolje razumevanje, takođe modeli formiranja planetskih sistema, itd.
- Funkcija rizika (po prirodi rizika)
 - Globalne: ...
 - Lokalne: ...
 - Unutrašnje: ...

Primer korelisanja vremenske skale



Način modeliranja

Napraviti modele koji uključuju što više parametara i ispitati parametarski prostor...



Veoma kraaaaaaatak uvod u EČA

Uređena četvorka: $\{G, S, N, F\}$

$$f : S^{2r+1} \rightarrow S,$$

$$|F| = m^{m^{2r+1}}.$$

$$s_i^{(t)} = F(s_{i-r}^{(t-1)}, s_{i-r+1}^{(t-1)}, \dots, s_{i+r-1}^{(t-1)}, s_{i+r}^{(t-1)}).$$

$$s_i^{(t)} = F(s_{i-r}^{(t-1)}, s_{i-r+1}^{(t-1)}, \dots, s_{i+r-1}^{(t-1)}, s_{i+r}^{(t-1)},$$

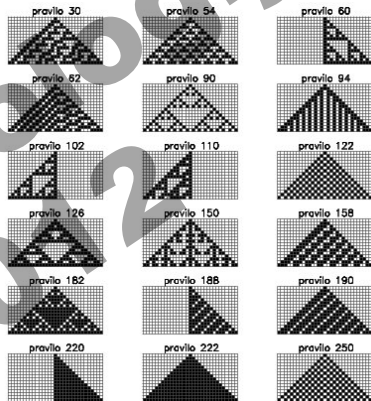
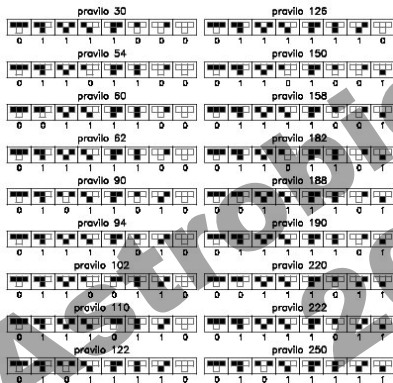
$$s_{i-r}^{(t-2)}, s_{i-r+1}^{(t-2)}, \dots, s_{i+r-1}^{(t-2)}, s_{i+r}^{(t-2)},$$

$$\vdots$$

$$s_{i-r}^{(t-n+1)}, s_{i-r+1}^{(t-n+1)}, \dots, s_{i+r-1}^{(t-n+1)}, s_{i+r}^{(t-n+1)},$$

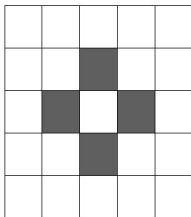
$$s_{i-r}^{(t-n)}, s_{i-r+1}^{(t-n)}, \dots, s_{i+r-1}^{(t-n)}, s_{i+r}^{(t-n)})$$

Neki EĆA

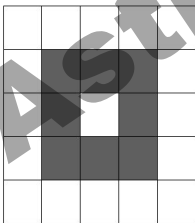


Conus textile

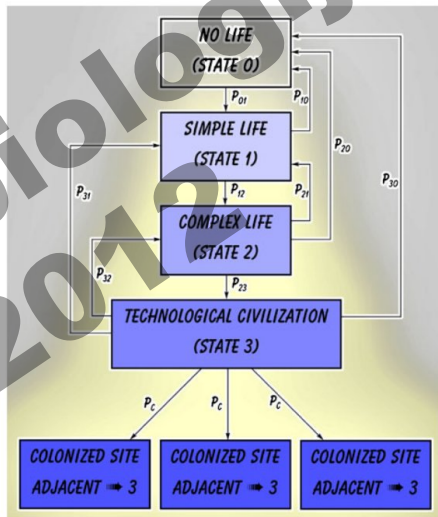
2D ČA i PČA



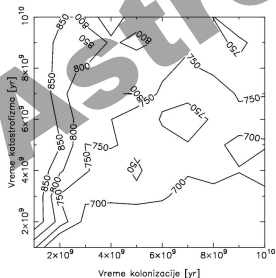
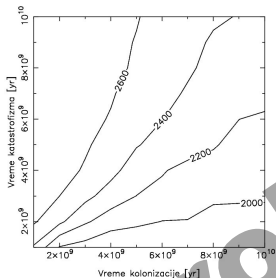
von Neumann



Moore



Ispitivanje parametarskog prostora

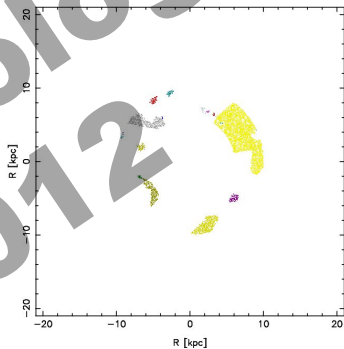
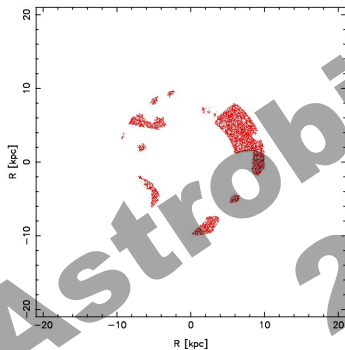


$$P_{ijk}(t_s) = a_{ijk} \frac{t_s}{t_p^{ijk}}$$

...	t_p^{ijk} [Gyr]	a_{ijk}
P_{010}	3	1.0
P_{120}	0.6	1.0
P_{230}	0.1	1.0
P_{034}	~ 1	1.0
P_{134}	~ 1	1.0
P_{234}	~ 1	1.0
P_{305}	~ 1	0.01
P_{315}	$\sim 1(0.6)$	0.1 (1.0)
P_{325}	$\sim 1(0.1)$	1.0 (1.0)

Analiziranje klastera

Mapiranje klastera



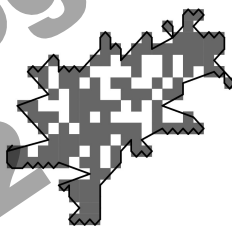
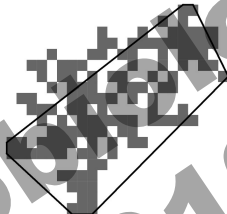
Analiziranje klastera



Analiziranje klastera



Analiziranje klastera



No.	i	j	k	τ_{ijk} [yr]	$\delta\tau_{ijk}$ [yr]	Comment
1	0	1	0	1.0×10^9	1.0×10^9	"Copernican" hypothesis on biogenesis
2	1	2	0	3.0×10^9	1.0×10^8	"Cambrian explosion" timescale
3	2	3	0	6.0×10^8	1.0×10^8	Noogenesis timescale
4	2	3	4	1.1×10^8	1.0×10^7	Expansion timescales
5	1	3	4	1.1×10^8	1.0×10^7	
6	3	1	0	2.0×10^7	1.0×10^7	

Neki rezultati

Vukotic B., Cirkovic, M.M., 2012, OLEB, 42, 347-371.

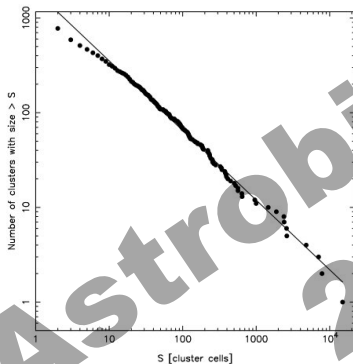
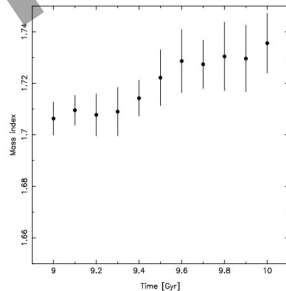
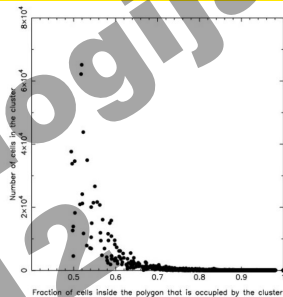


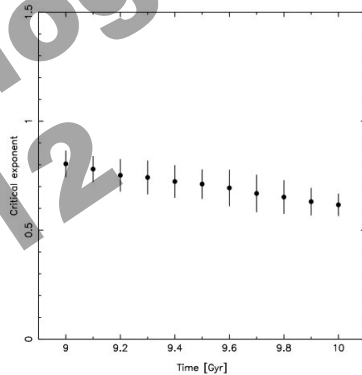
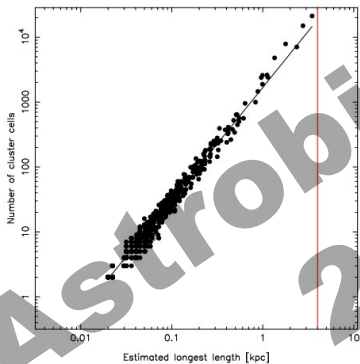
Figure 7. Mass index $\alpha = 1.72 \pm 0.01$ of the same set of clusters as in Fig. 6.

$$N(> S) \propto S^{-\alpha}$$



Neki rezultati

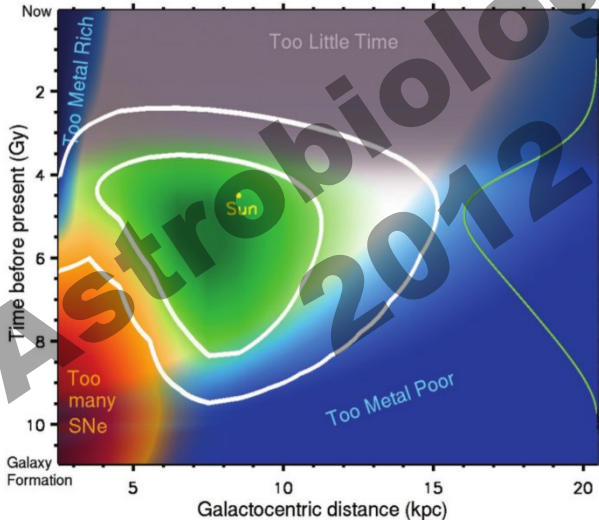
Vukotic B., Cirkovic, M.M., 2012, OLEB, 42, 347-371.



$$M \propto L^\tau$$

Opseg GNZ

Lineweaver, C. H., Fenner, Y., & Gibson, B. K.: 2004, Science, 303, 59.



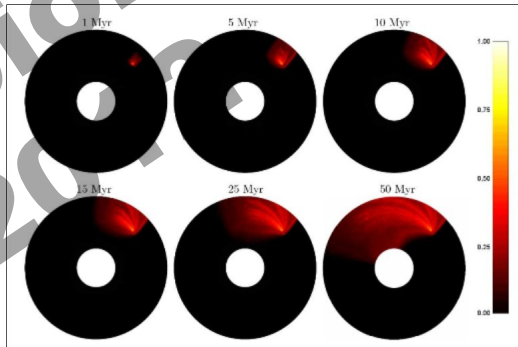
Još radova o granicama GNZ

R_{inn} [kpc]	R_{out} [kpc]	Reference
4	17.5	Peña-Cabrera, G.V.Y., Durand-Manetrola, H.J. 2004, AdSR, 33, 114.
1.3	13.5	Čirković, M.M. 2005, IAU Colloquium 197, 113.
—	—	Prantzos, N. 2008, Space Sci. Rev., 135, 313.
inner Gal.	inner Gal.	Gowanlock, M.G., Patton, D.R., McConnell, S.M. 2011, Astrobiology, 11, 855.

SETI orijentisane simulacije

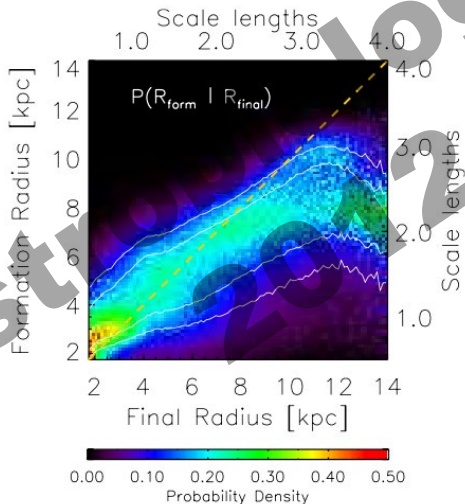
Left: Forgan, D., 2009, IJAsB, 8, 121.

Right: Cotta, C., Morales, A., 2009, JBIS, 62, 82.



Mešanje populacija

Roškar, R., et al., 2011, ASPC, 448, 371.

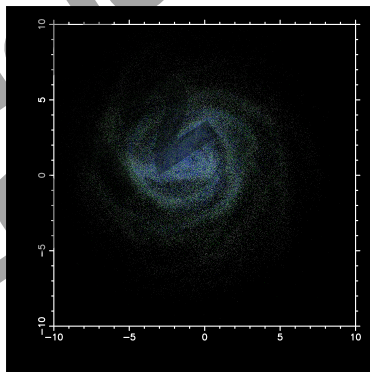
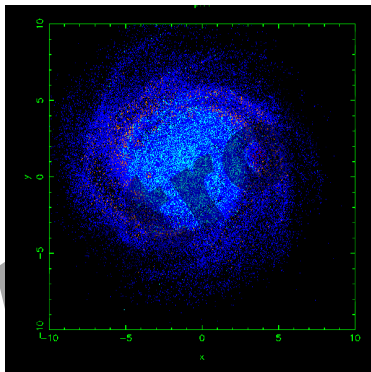


Tajni plan...

- Podesiti i izvršiti GADGET simulacije za galaksiju nalik Mlečnom Putu.
- Učitavanje međustanja.
- Izračunati bitne podatke o česticama (unutrašnji faktori nastanjivosti) i prostorne faktore (spoljašnji faktori nastanjivosti).
- Praćenje čestica kroz grid i izračunavanje nastanjivosti čestica.
- Prikaz rezultata.

"Preliminarni" rezultati

Martinez Aviles, G., Steinhauer, D., Vukotić, B., Čirković, M.M., Schindler, S., 2013, in prep.



Mapiranje arhipelaga...

Doline i planine parametarskog
prostora čekaju na otkriće!

HVALA NA PAŽNJI!!!