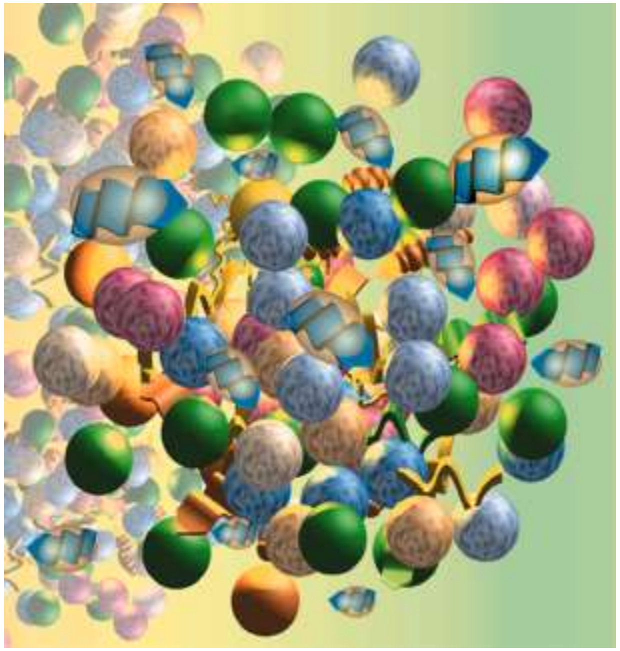
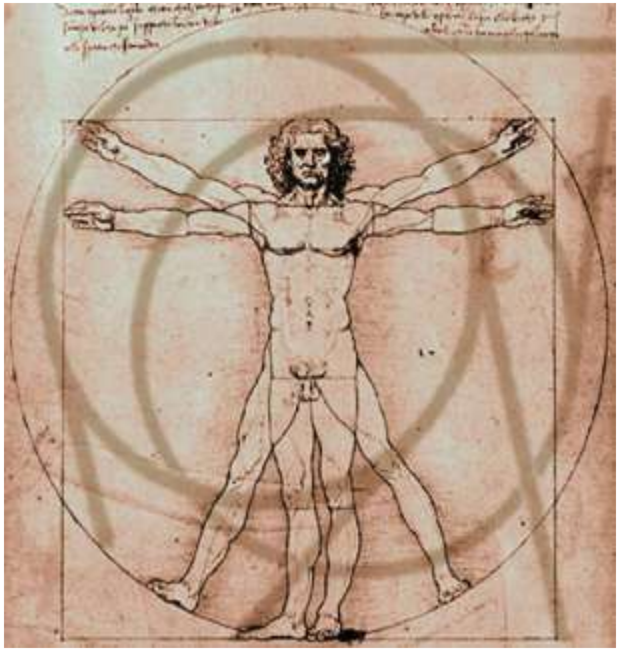
Što [još] ne znamo?





1.dio

Osnovna škola Plokite
Split, 23. travnja 2013.

Ivica Puljak
FESB – Split

Znamo li uopće nešto?

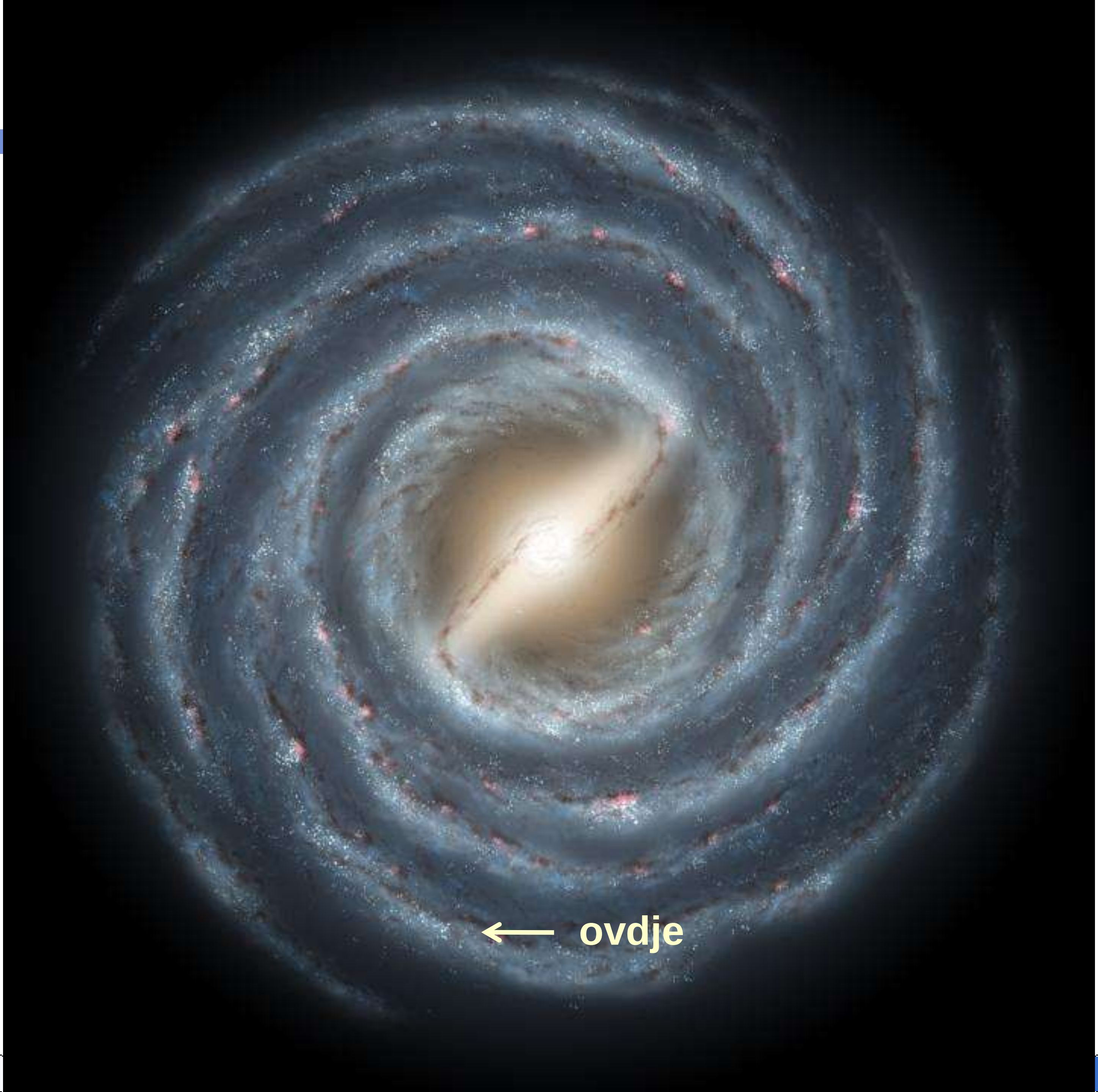
"Nitko ništa ne zna

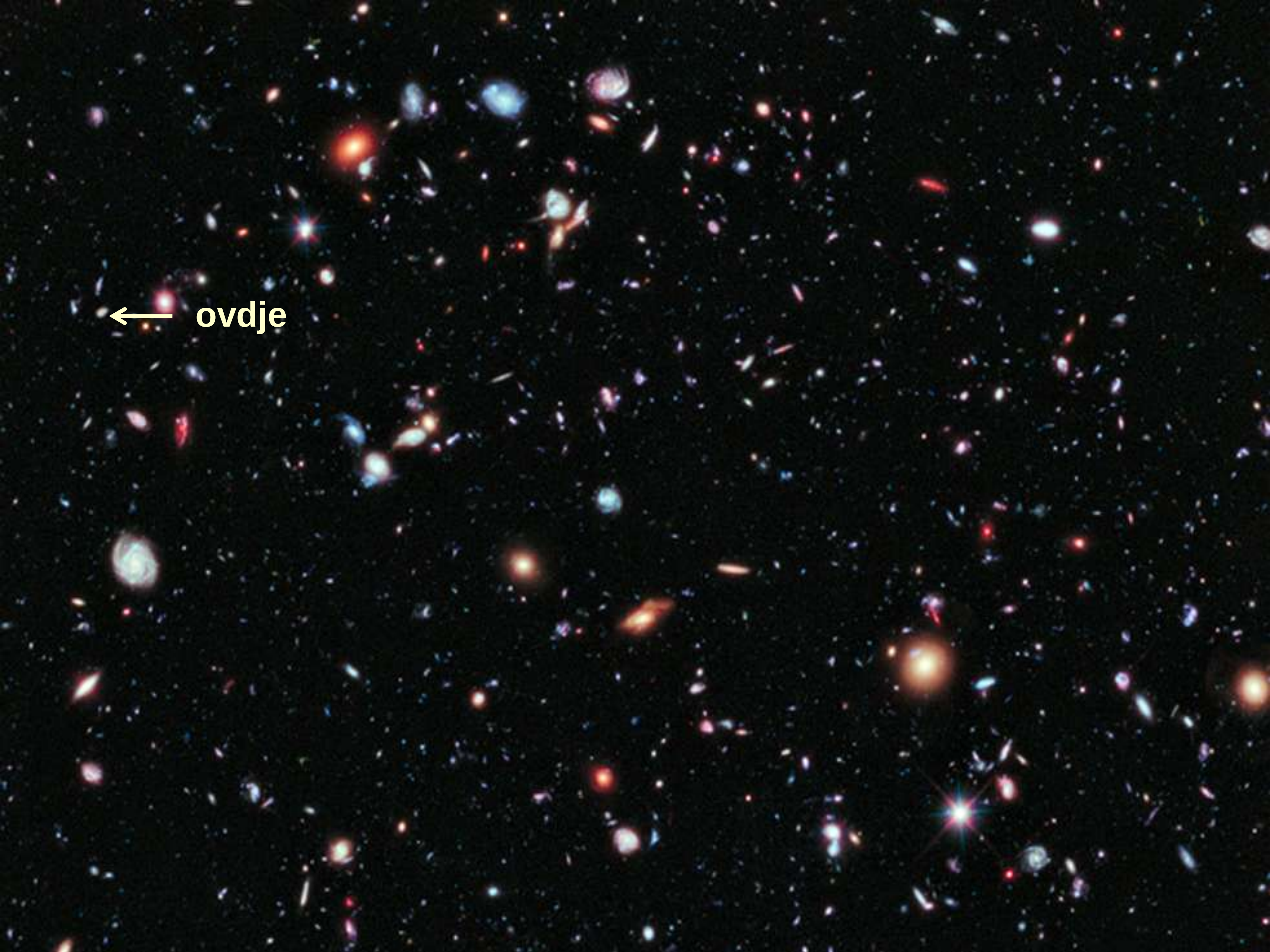
Krhko je znanje "

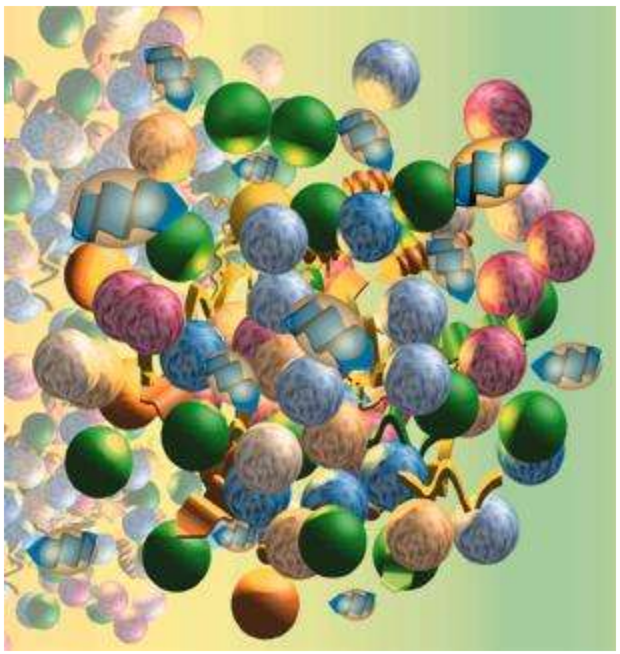
Dobriša Cesarić

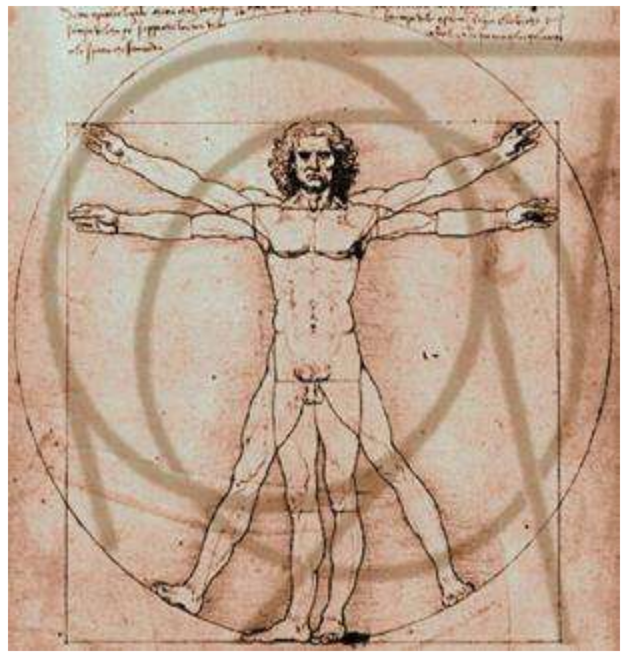
- Je li stvarno tako?


Earth as seen from Mars

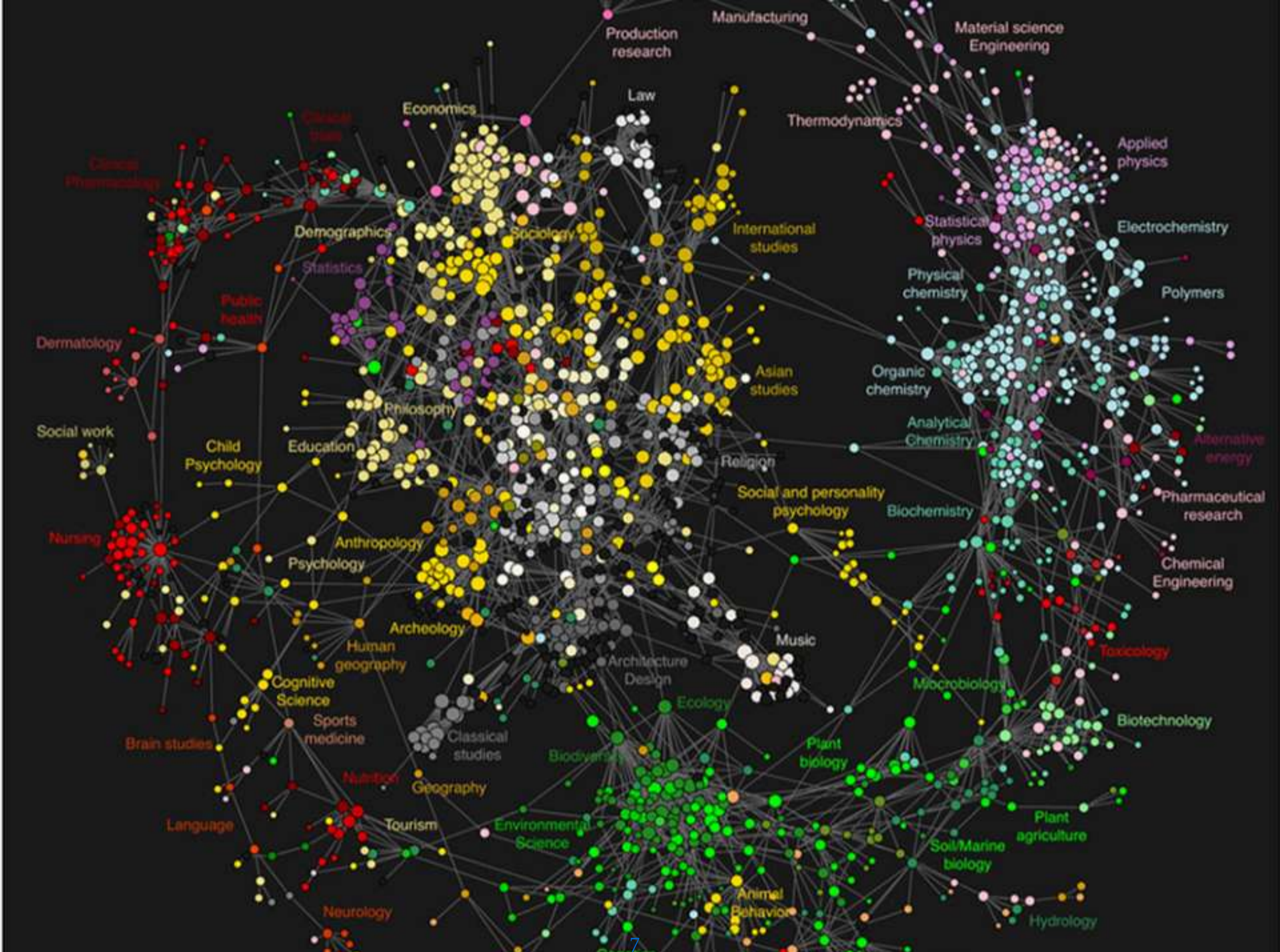

← ovdje


ovdje





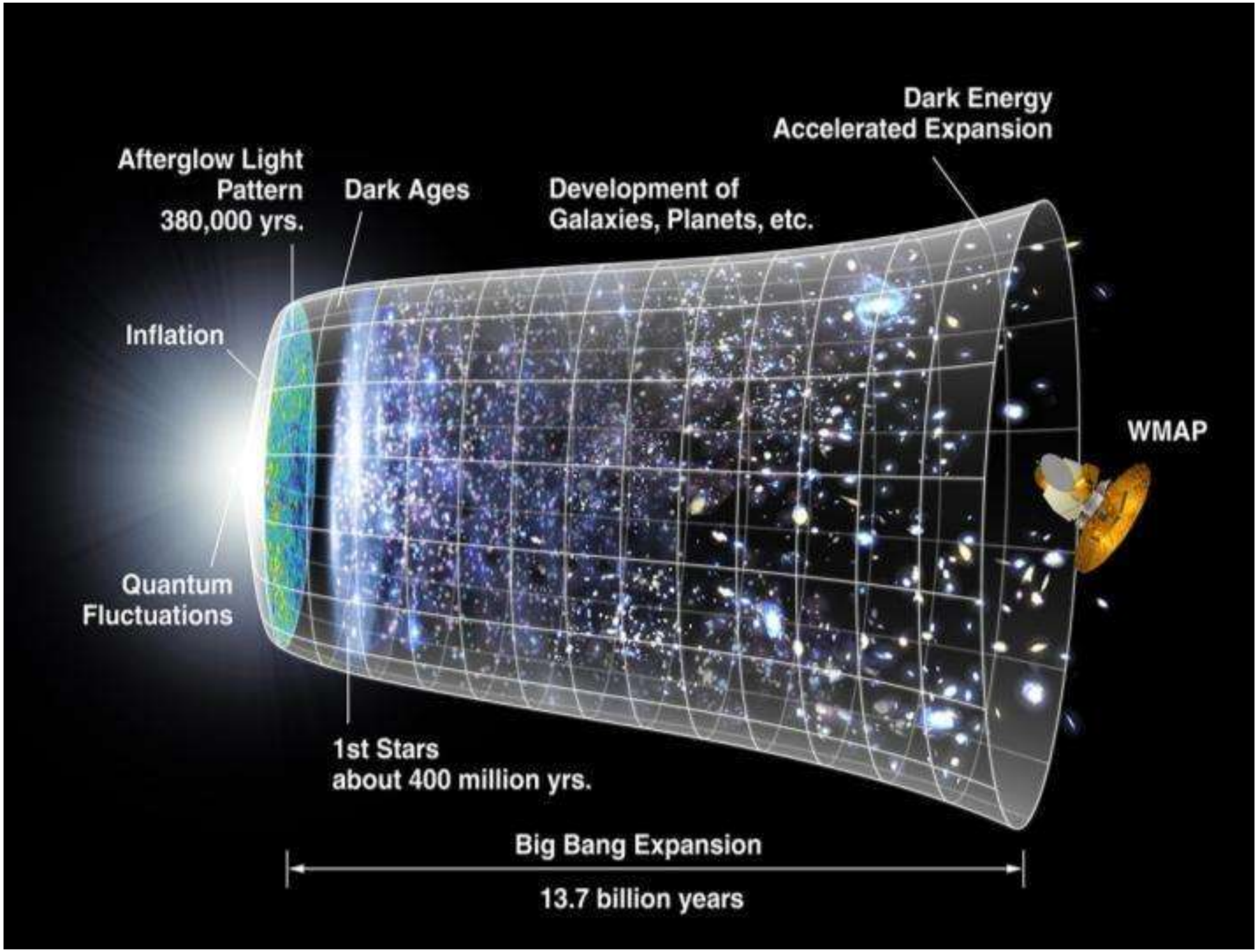

Hubble
Heritage



Production research
Manufacturing
Material science Engineering
Law
Economics
Thermodynamics
Applied physics
Clinical trials
Clinical Pharmacology
Demographics
Sociology
International studies
Statistical physics
Electrochemistry
Statistics
Physical chemistry
Polymers
Public health
Dermatology
Asian studies
Organic chemistry
Philosophy
Analytical Chemistry
Alternative energy
Social work
Child Psychology
Education
Religion
Social and personality psychology
Biochemistry
Pharmaceutical research
Nursing
Anthropology
Psychology
Chemical Engineering
Archeology
Human geography
Music
Toxicology
Architecture Design
Microbiology
Cognitive Science
Ecology
Biotechnology
Sports medicine
Classical studies
Brain studies
Plant biology
Nutrition
Geography
Language
Tourism
Environmental Science
Plant agriculture
Soil/Marine biology
Neurology
Animal Behavior
Hydrology

Što znamo?

- Kako se razvijao svemir



Što znamo?

- Standardni model čestica i njihovih interakcija

Leptoni

Electric Charge


Tau	-1	0	Tau Neutrino
Mion	-1	0	Mion Neutrino
Elektron	-1	0	Elektron Neutrino

Jaka

Gluoni (8)

Kvarkovi

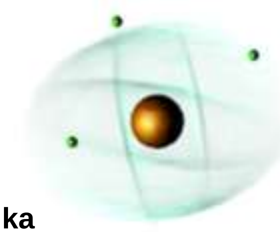
Mezoni
Barioni

Jezgre

Elektromagnetska

Foton

Atomi
Svjetlost
Kemija
Elektronika



Kvarkovi

Električni naboj


Dno	-1/3	2/3	Vrh
Strani	-1/3	2/3	Šarmantni
Dolje	-1/3	2/3	Gore

svaki kvark R, B, G 3 boje

Gravitacija

Graviton ?

Sunčev sustav
Galaksije
Crne rupe

Slaba

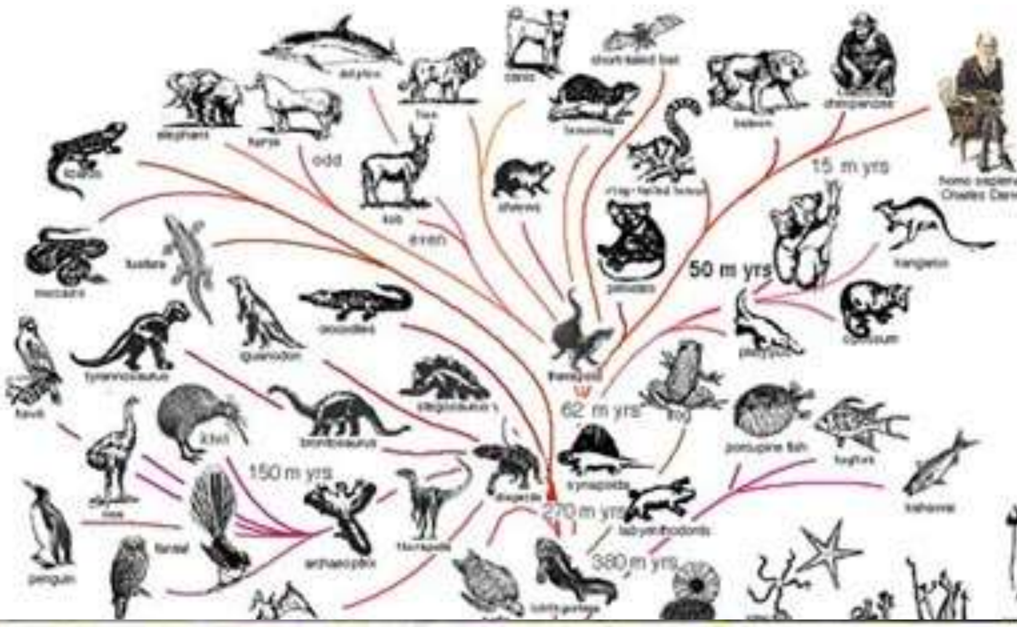
Bozoni
(W,Z)

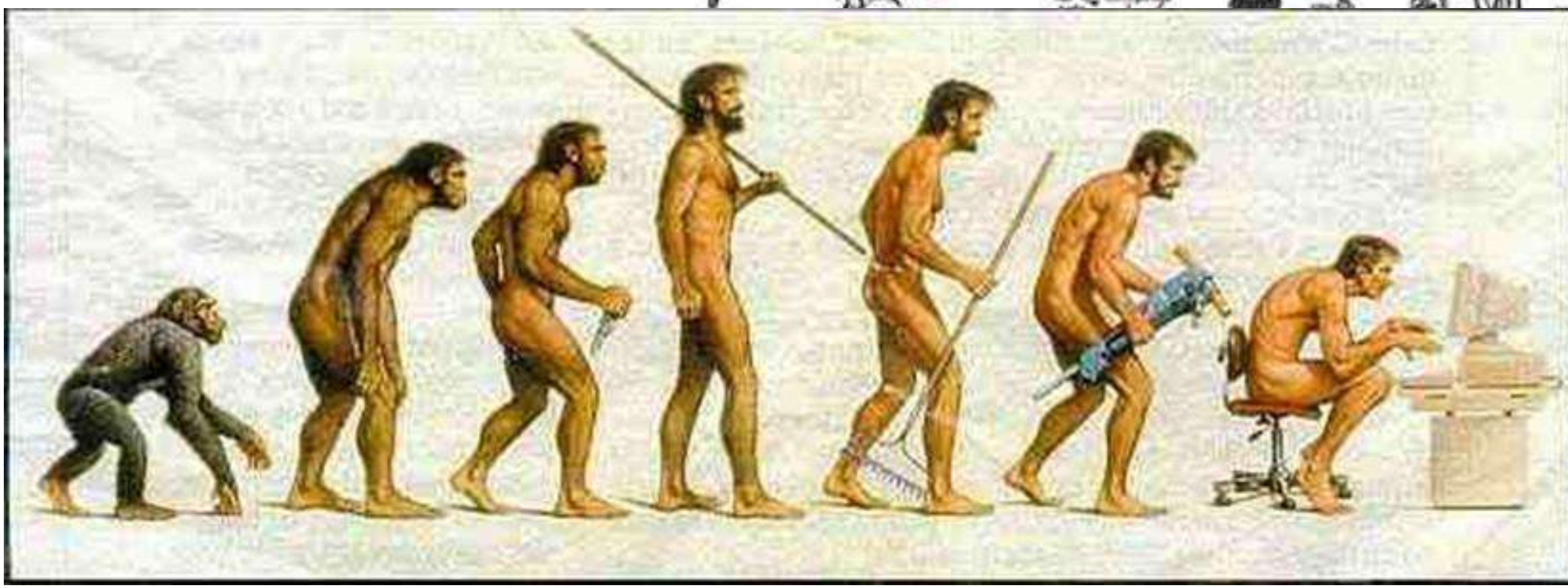
Raspad neutrona
Beta radioaktivnost
Interakcije neutrina
Izgaranja sunca

The particle drawings are simple artistic representations

Što znamo?

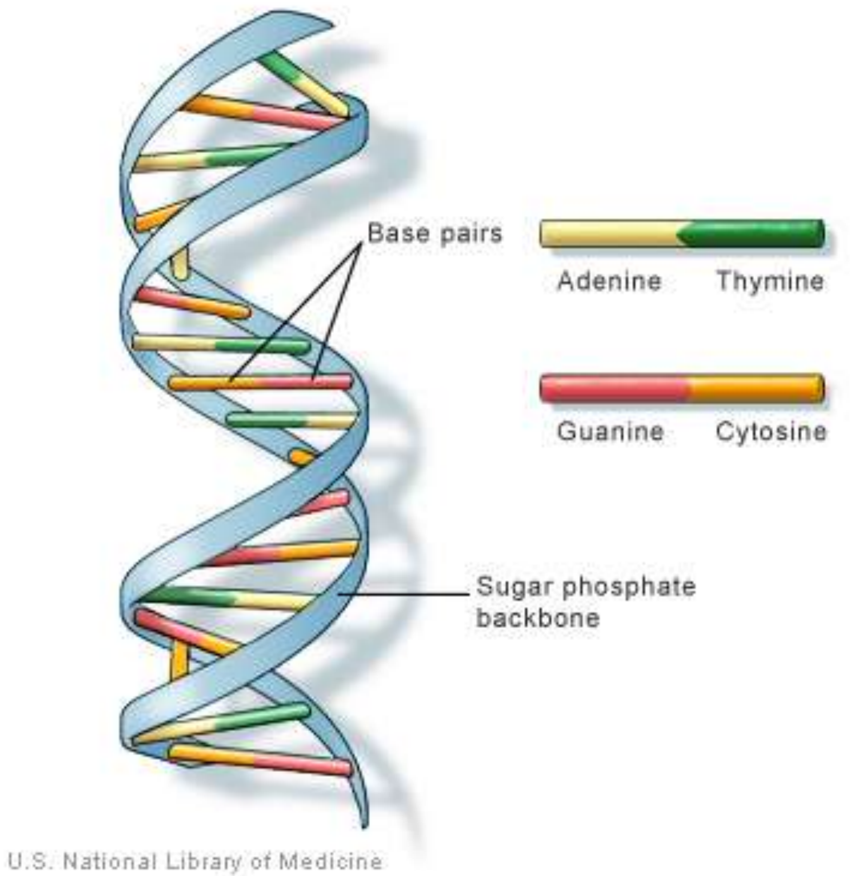
- Darwinova teorija prirodne selekcije

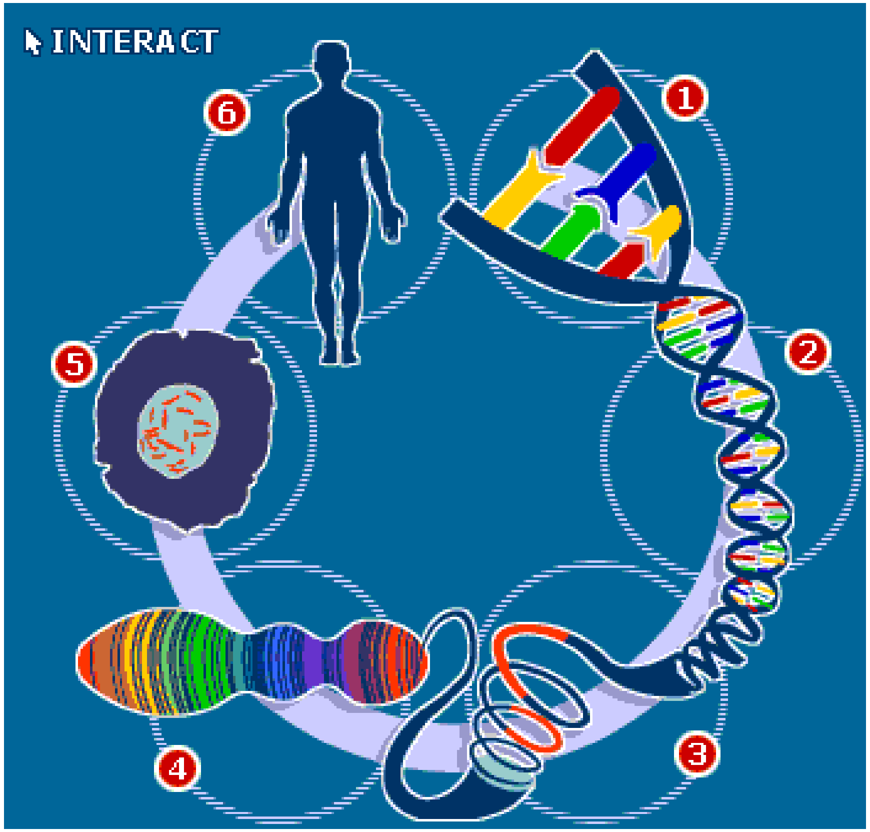




Što znamo?

- DNA





Što još ne znamo?

- Kako je nastao i kako će završiti svemir?
- Od čega je izgrađen svemir?
- Kako mozak proizvodi svijest?
- Zašto ljudi imaju tako malo gena?
- Do koje mjere su povezane genetske varijacije i osobno zdravlje?
- Mogu li se zakoni fizike ujediniti?
- Koliko se može produljiti životni vijek ljudi?
- Kako se regeneriraju organi?
- Kako ćelija iz kože postane ćelija živca?
- Kako se iz oplođene jajne stanice razvije živo biće?
- Kako funkcionira unutrašnjost Zemlje?
- Jesmo li sami u svemiru?
- Kako i kada se pojavio život na zemlji?
- Što određuje raznolikost vrsta?
- Koje genetske promjene su nas učinile ljudima?

Što još ne znamo?

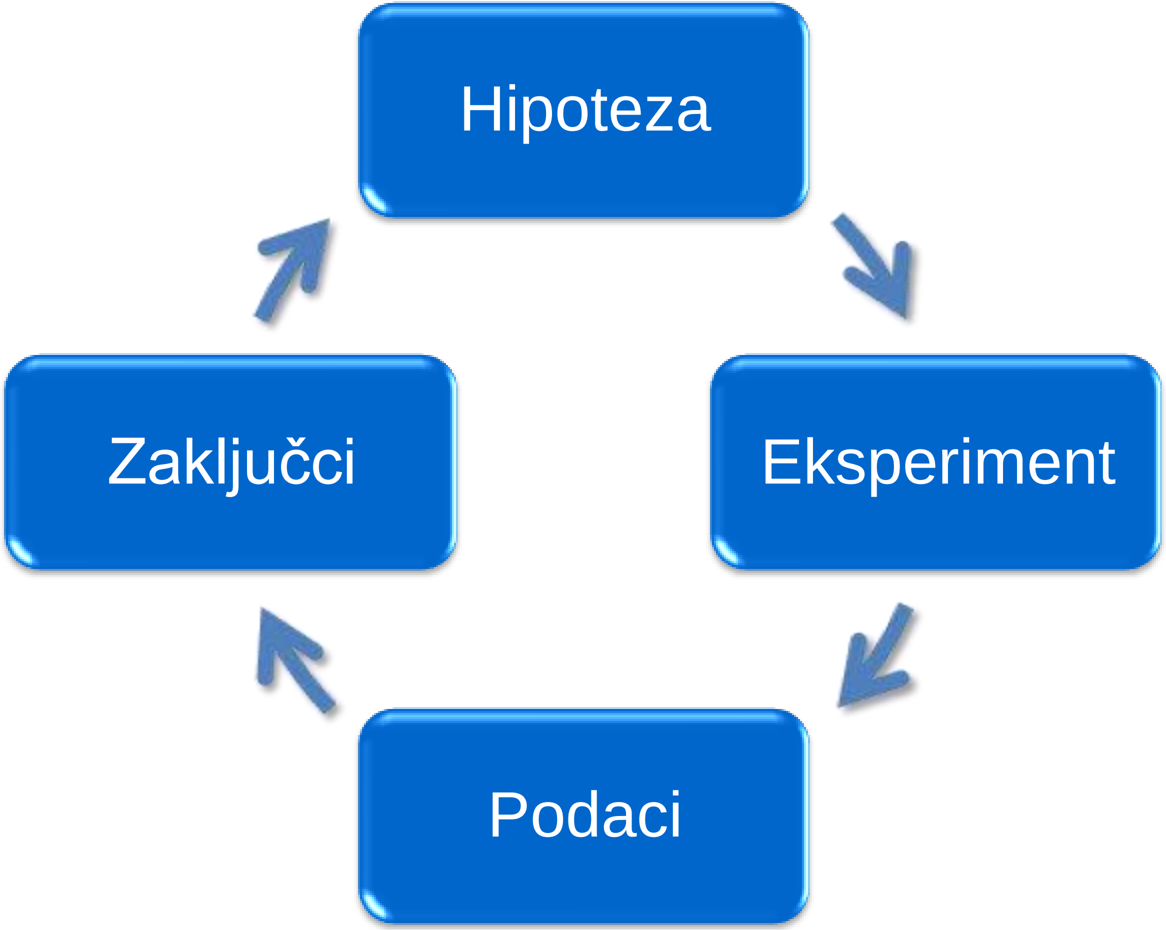
- Kako se pohranjuje i koristi pamćenje?
- Kako je evolurialo kooperativno ponašanje?
- Koliko daleko možemo iskoristiti kemijsko samo-sastavljanje?
- Koje su granice konvencionalnog računanja?
- Možemo li selektivno isključiti imunološke odzive?
- Postoji li dublje razumijevanje kvantne neodređenosti i ne-lokalnosti?
- Je li u principu moguća efikasno cjepivo protiv HIV-a?
- Što može zamijeniti jeftinu naftu? I kada?
- Hoće li Malthus i dalje biti u krivu?
- Je li vrijeme iluzija?
- Zašto spavamo?
- Zašto funkcionira placebo efekt?
- Koja je funkcija ne-kodirajućeg dijela DNA?
- Hoće li šume usporiti globalno zagrijavanje? Ili ga ubrzati?

Što još ne znamo?

- Što se događa s informacijom u crnoj rupi?
- Što uzrokuje ‘ledena doba’?
- Kako mozak računa pokrete?
- Zašto se Zemljini polovi izmjenjuju?
- Kako je evoluirao ljudski jezik?
- Zašto ne možemo predvidjeti vrijeme?
- Zašto ne razumijemo turbulencije?
- Je li svemir u biti izgrađen od informacija?
- Zašto se neke bolesti pretvore u epidemije?
- Zašto umiremo?
- Što uzrokuje gravitaciju?
- Zašto ne mogu ponovo izrasti izgubljeni udovi?
- Zašto čestice imaju masu? I to različitu!

U što smo apsolutno uvjereni?

- Da će se odgovori na ova pitanja, prije ili kasnije, pronaći isključivo **ZNANSTVENOM METODOLOGIJOM**




SO YOU'RE TELLING ME
PEOPLE FROM YOUR COUNTRY THINK THAT FACEBOOK GIVES US FOOD FOR EVERY LIKE?
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Od čega je izgrađen svemir?

Što znamo?

- Standardni model čestica i njihovih interakcija

Leptoni

Electric Charge

Tau	-1	0	Tau Neutrino
Mion	-1	0	Mion Neutrino
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Dolje	-1/3	2/3	Gore

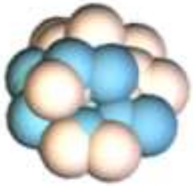
svaki kvark R, B, G 3 boje

Jaka

Gluoni (8)

Kvarkovi

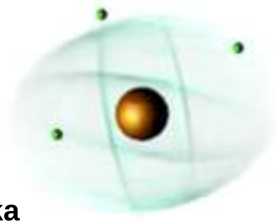
Mezoni
Barioni



Jezgre

Elektromagnetska

Foton



Atomi
Svjetlost
Kemija
Elektronika

Gravitacija

Graviton ?

Sunčev sustav
Galaksije
Crne rupe

Slaba

Bozoni (W,Z)

Raspad neutrona
Beta radioaktivnost
Interakcije neutrina
Izgaranja sunca

The particle drawings are simple artistic representations

Čestice

Leptoni

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Mion	-1	0	Mion Neutrino
Elektron	-1	0	Elektron Neutrino

Kvarkovi

	Električni naboj		
Dno	-1/3	2/3	Vrh
Strani	-1/3	2/3	Šarmantni
Dolje	-1/3	2/3	Gore

svaki kvark: R, B, G 3 boje

Antičestice

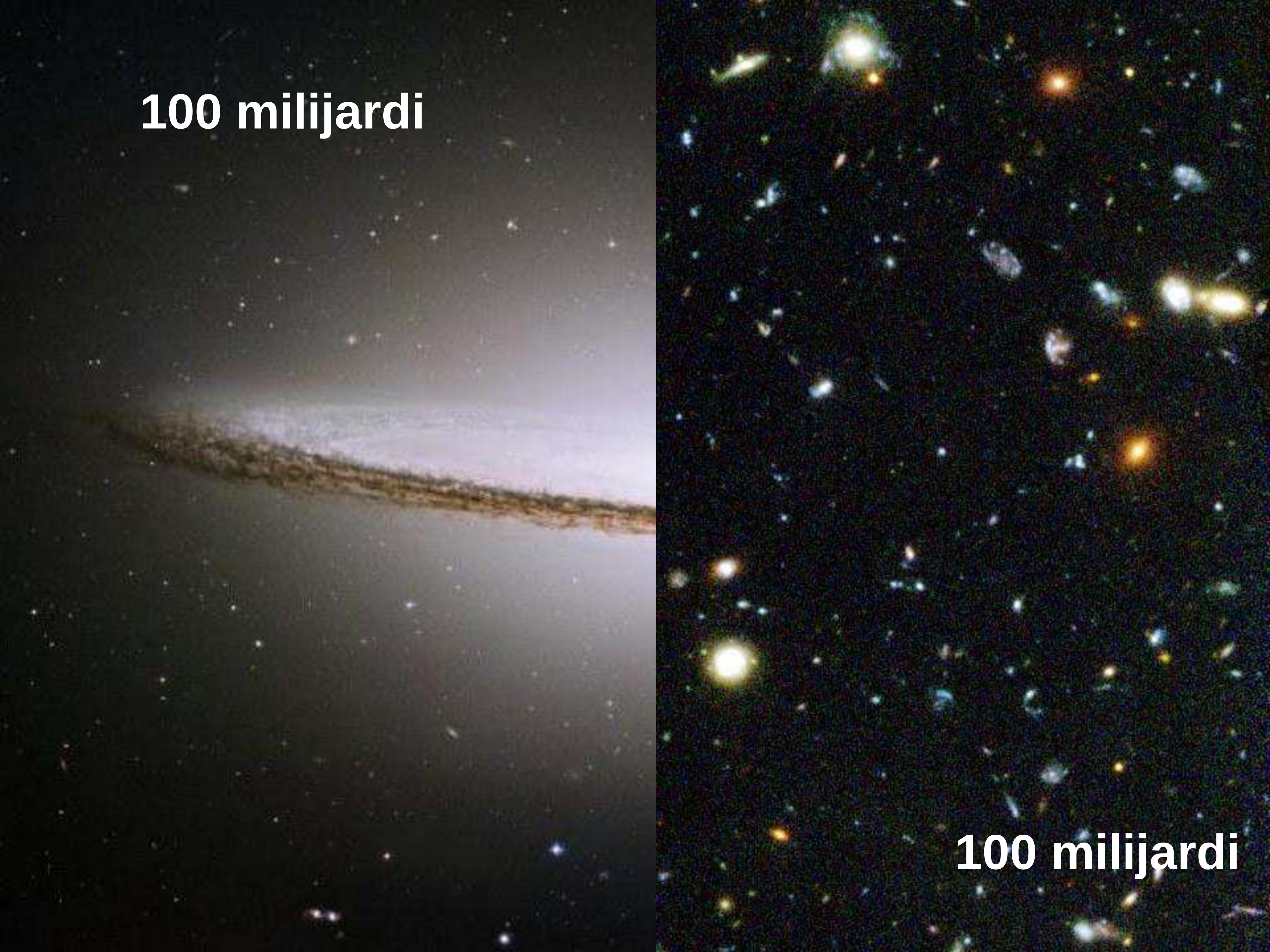
Antileptoni

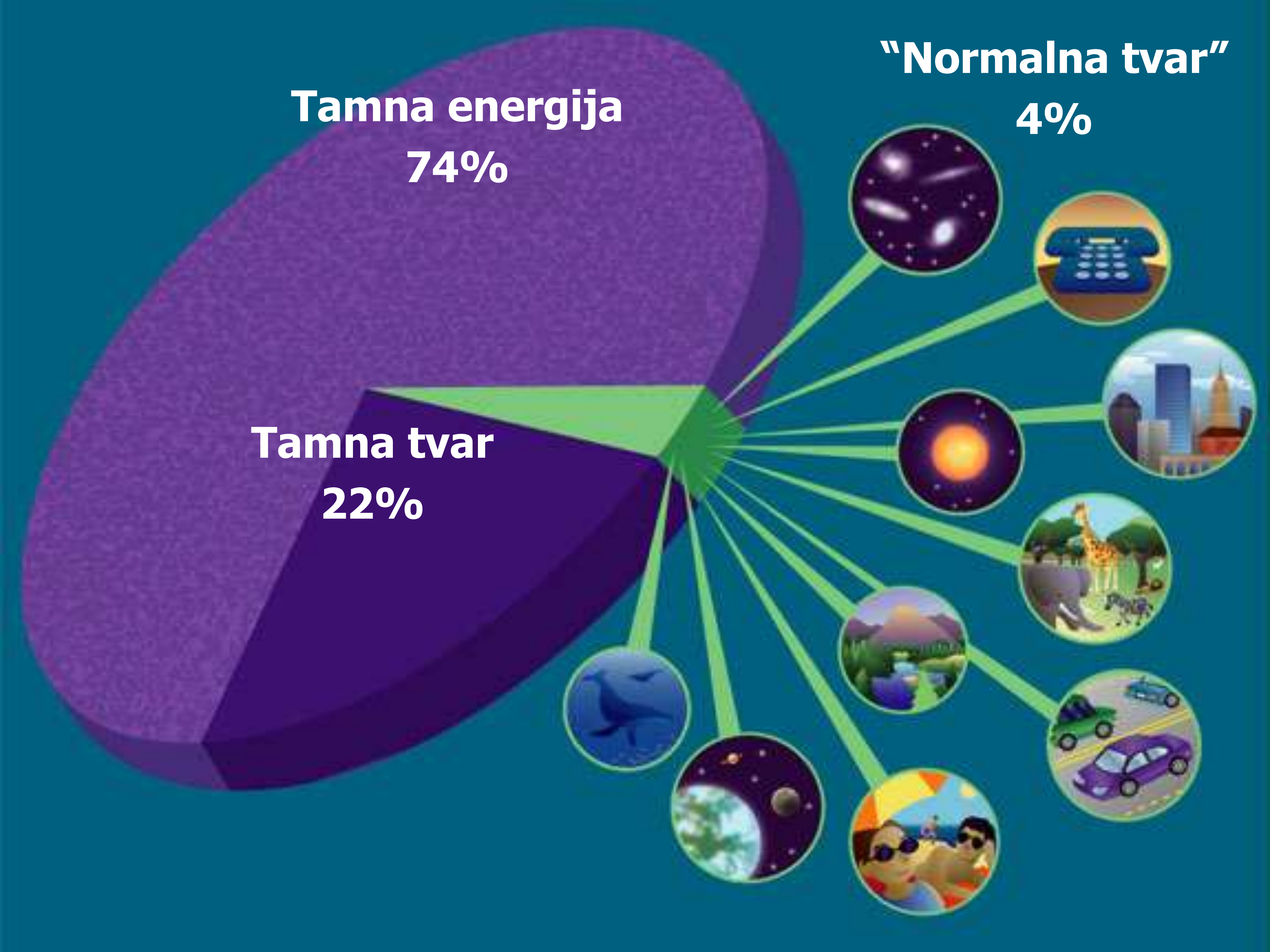
	Electric Charge		
Antitau	1	0	Antitau Neutrino
Antimion	1	0	Antimion Neutrino
Pozitron	1	0	Antielektron Neutrino

Antikvarkovi

	Električni naboj		
Antidno	1/3	-2/3	Antivrh
Antistrani	1/3	-2/3	Antišarmantni
Antidolje	1/3	-2/3	Antigore

svaki antikvark: R, B, G 3 antiboje

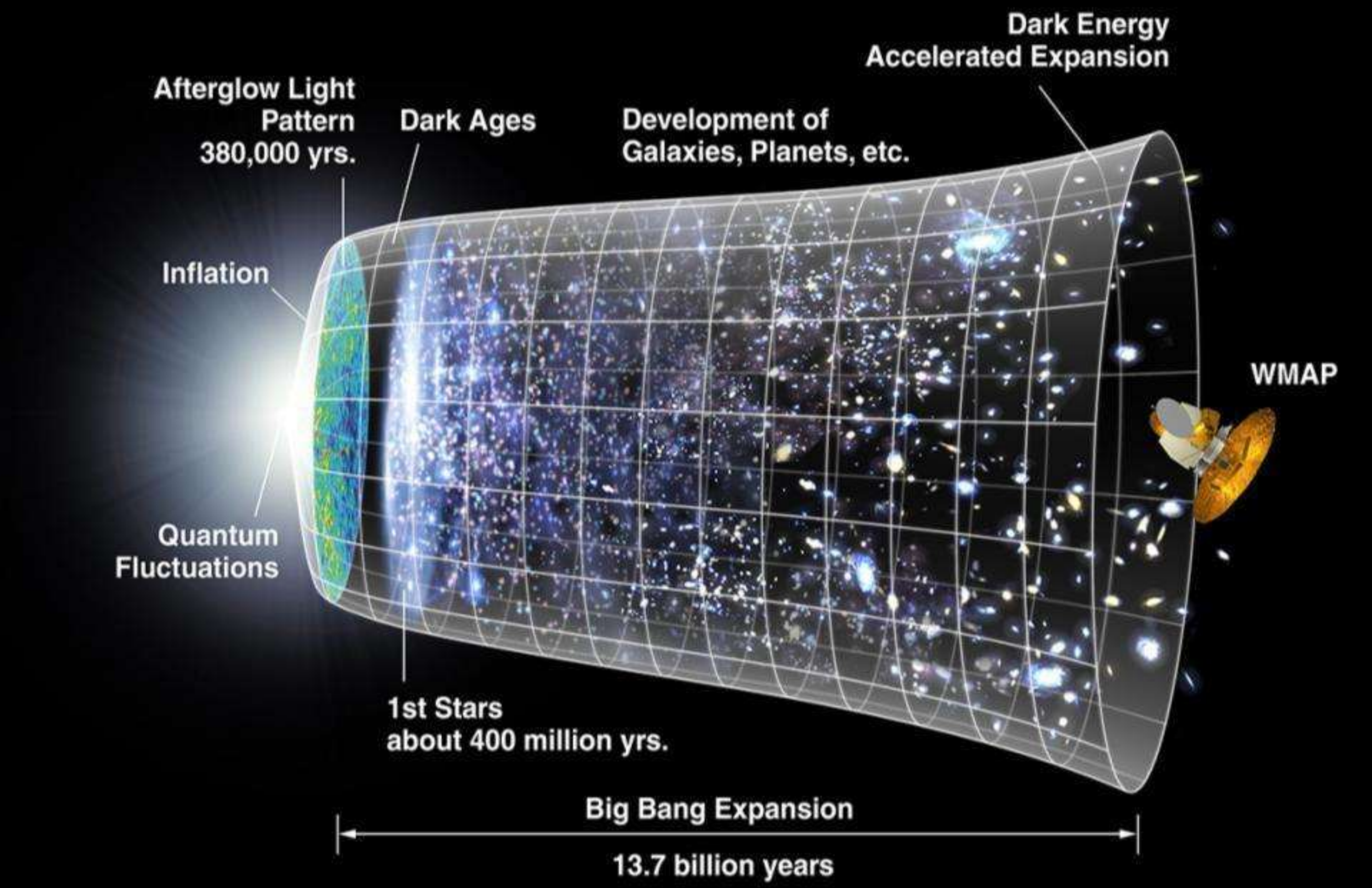

100 milijardi
100 milijardi



Tamna energija
74%
"Normalna tvar"
4%
Tamna tvar
22%

Kako to znamo?

Od Velikog praska do današnjeg dana



10^{-43}s Era kvantne gravitacije

Gravitacije se odvaja kao posebna sila, ostale sile ostaju ujedinjene u jednu (Veliko ujedinjenje)

t < 10^{-43} s : The Big Bang

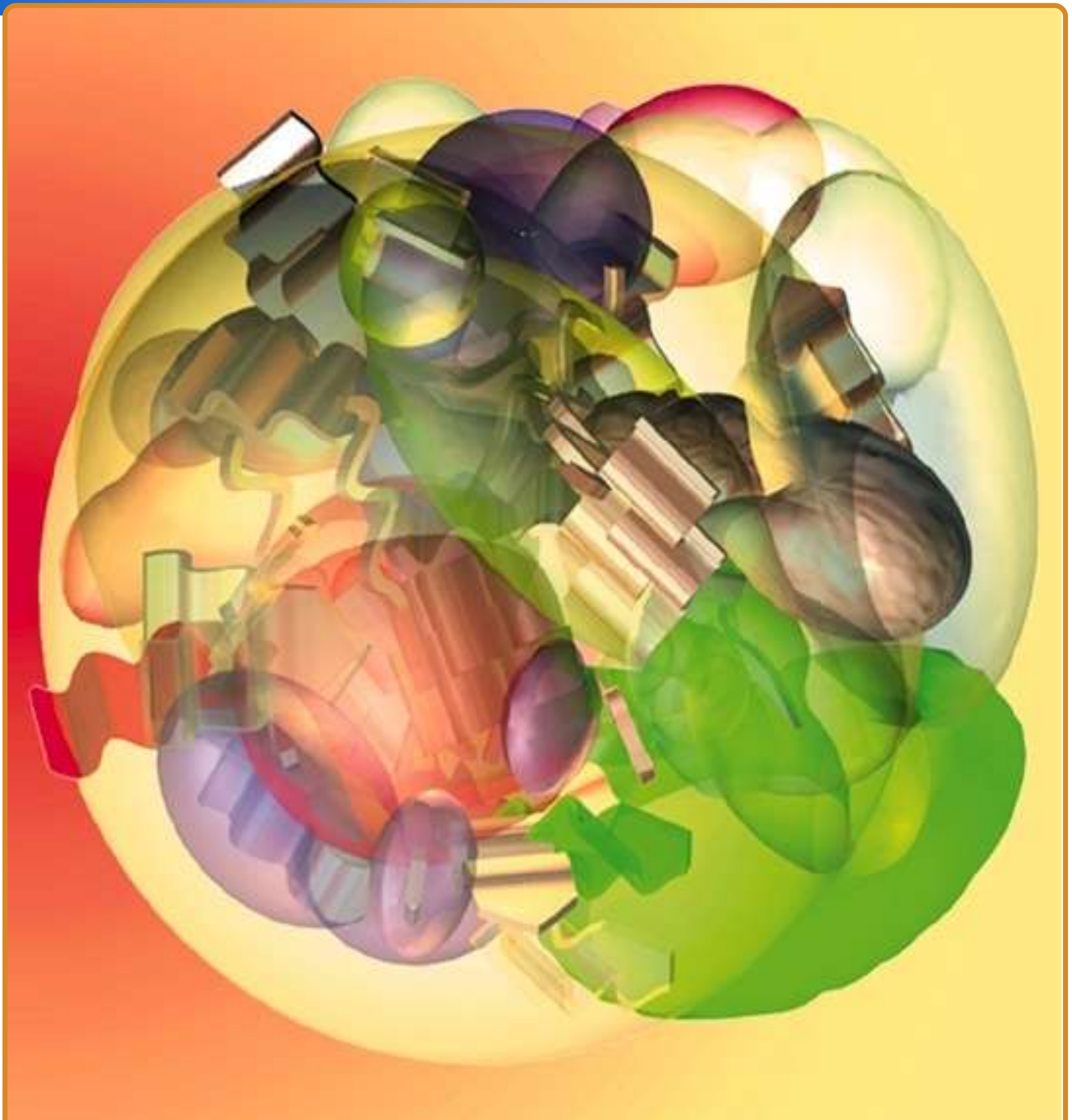
The universe is considered to have expanded from a singl point with an infinitely high energy density (infinite temperature). Is there a meaning to the question what existed before the big bang?

t - 10^{-43} s, 10^{32} K (10^{19} GeV, 10^{-34} m) : Gravity "freezes" out

All particle types (quarks, leptons, gauge bosons, and undiscovered particles e.g.Higgs, sparticles, gravitons) and their anti-particles are in a thermal equilibrium (being created and annihilated at equal rate). These coexist with photons (radiation).

Through a phase transition gravity "froze" out and became distinct in its action from the weak, electromagnetic and strong forces. The other three forces could not be distinguished from one another in their action on quarks and leptons. This is the first instance of the breaking of symmetry amongst the forces.

10^{-35} s Era velikog ujedinjenja



Inflacija prestaje, širenje se nastavlja. Prestaje era velikog ujedinjena. Jaka i elektroslaba sila počinju se razlikovati.

t - 10^{-35} s, 10^{27} K (10^{16} GeV, 10^{-32} m) : Inflation

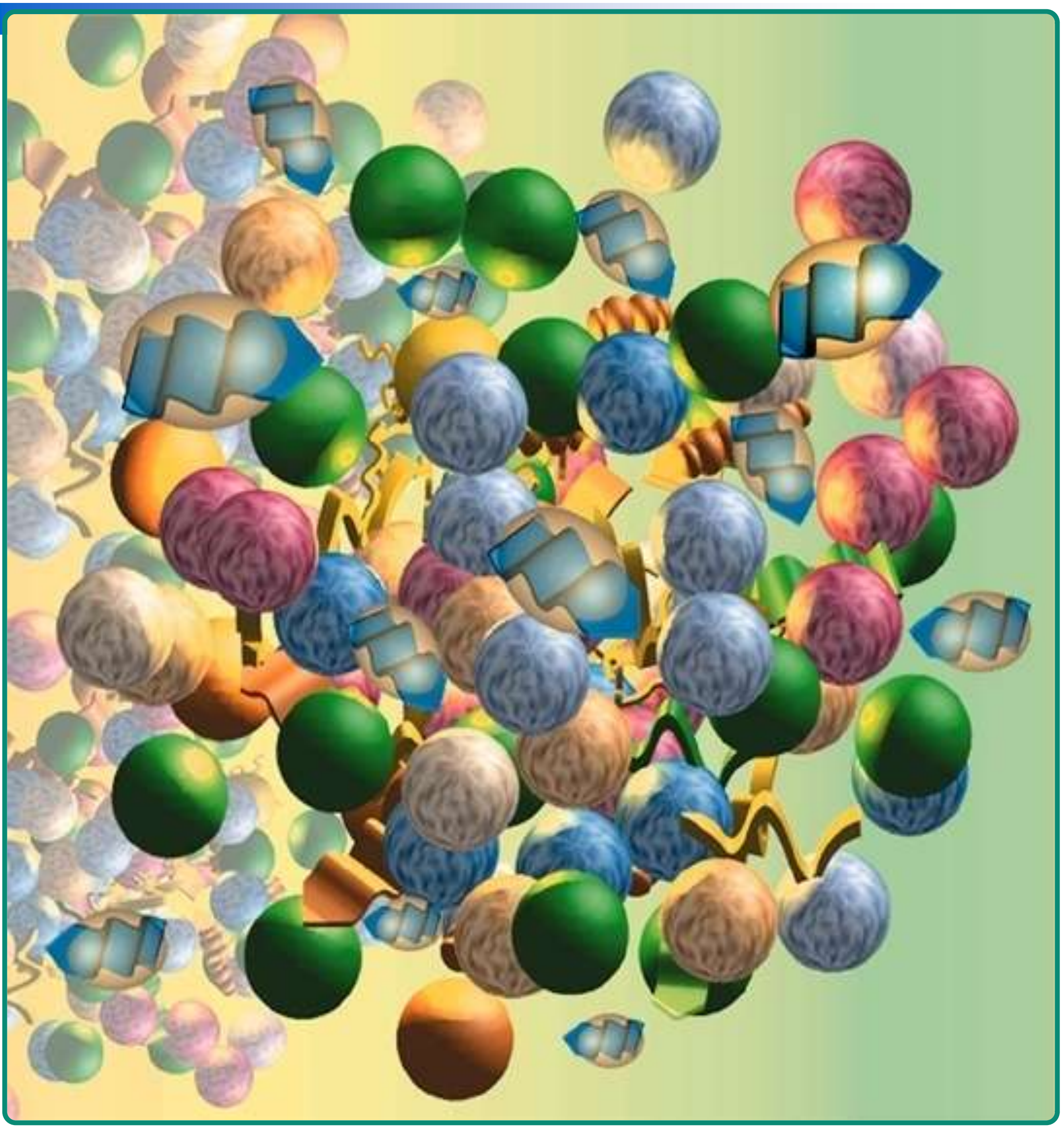
The rate of expansion increases exponentially for a short period. The universe doubled in size every 10^{-34} s. Inflation stopped at around 10^{-32} s. The universe increased in size by a factor of 10^{50}. This is equivalent to an object the size of a proton swelling to 10^{19} light years across.

However the presently visible universe was only 3 m in size after inflation. This solves the problems of 'horizon' (how is it possible for two opposing parts of the present universe to be at the same temperature when they cannot have interacted with each other before recombination) and 'flatness' (density of matter is close to the critical density).

t - 10^{-32} s : Strong forces freezes out

Through another phase transition the strong force "freezes" out and a slight excess of matter over anti-matter develops. This excess, at a level of 1 part in a billion, is sufficient to give the presently observed predominance of matter over anti-matter. The temperature is too high for quarks to remain clumped to form neutrons or protons and so exist in the form of a quark gluon plasma. The LHC can study this by colliding together high energy nuclei.

10^{-10} s Elektroslaba era

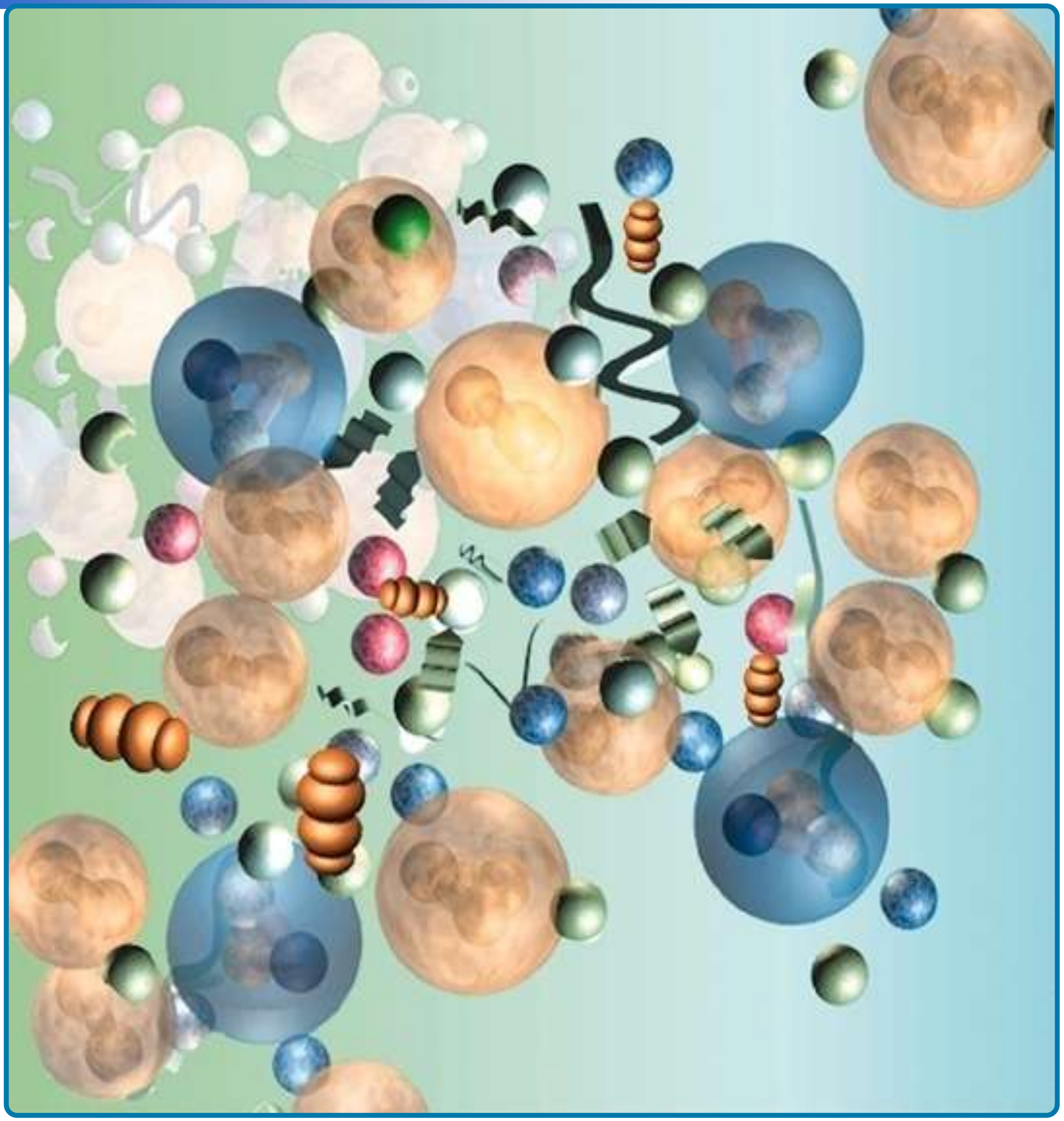


Razdvaja se elektroslaba sila

t - 10^{-10} s, 10^{15} K (100 GeV, 10^{18} m) : Electromagnetic and Weak Forces separate

The energy density corresponds to that at LEP. As the temperature fell the weak force "freezes" out and all four forces become distinct in their actions. The antiquarks annihilate with the quarks leaving a residua excess of matter. W and Z bosons decay. In general unstable massive particles disappear when the temperture falls to a value at which photons from the black-body radiation do not have sufficient energy to create a particle-antiparticle pair.

10^{-4} s Stvaranje protona i neutrona



Kvarkovi se kombiniraju i ujedinjavaju u protone i neutrone

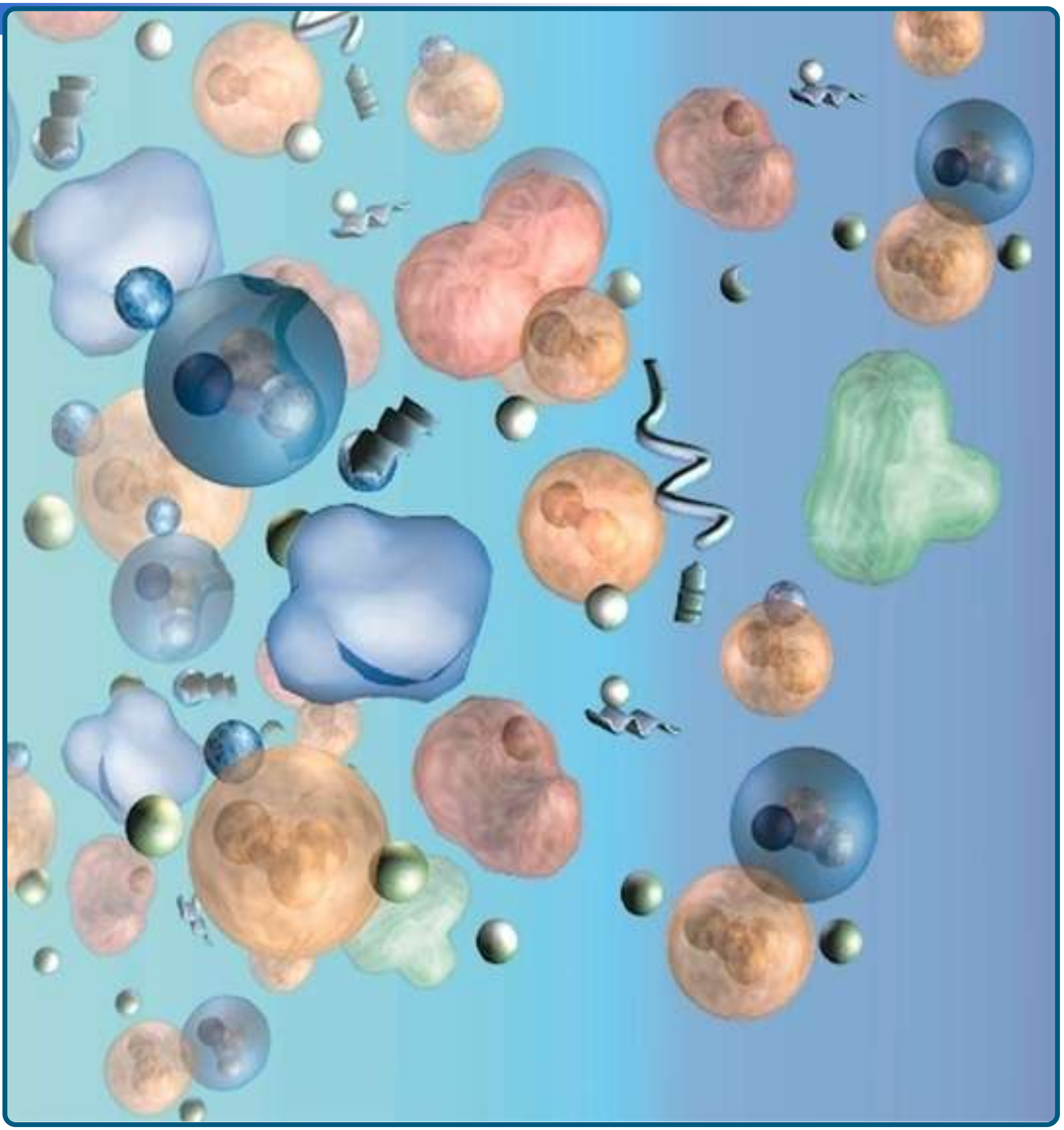
t - 10^{-4} s, 10^{13} K (1 GeV, 10^{-16} m) :
Protons and Neutrons form

The universe has grown to the size of our solar system. As the temperature drops quark-antiquark annihilation stops and the remaining quarks combine to make protons and neutrons.

t = 1 s, 10^{10} K (1 MeV, 10^{-15} m) :
Neutrinos decouple

The neutrinos become inactive (essentially do not participate further in interactions). The electrons and positrons annihilate and are not recreated. An excess of electrons is left. The neutron-proton ratio shifts from 50:50 to 25:75.

100 s

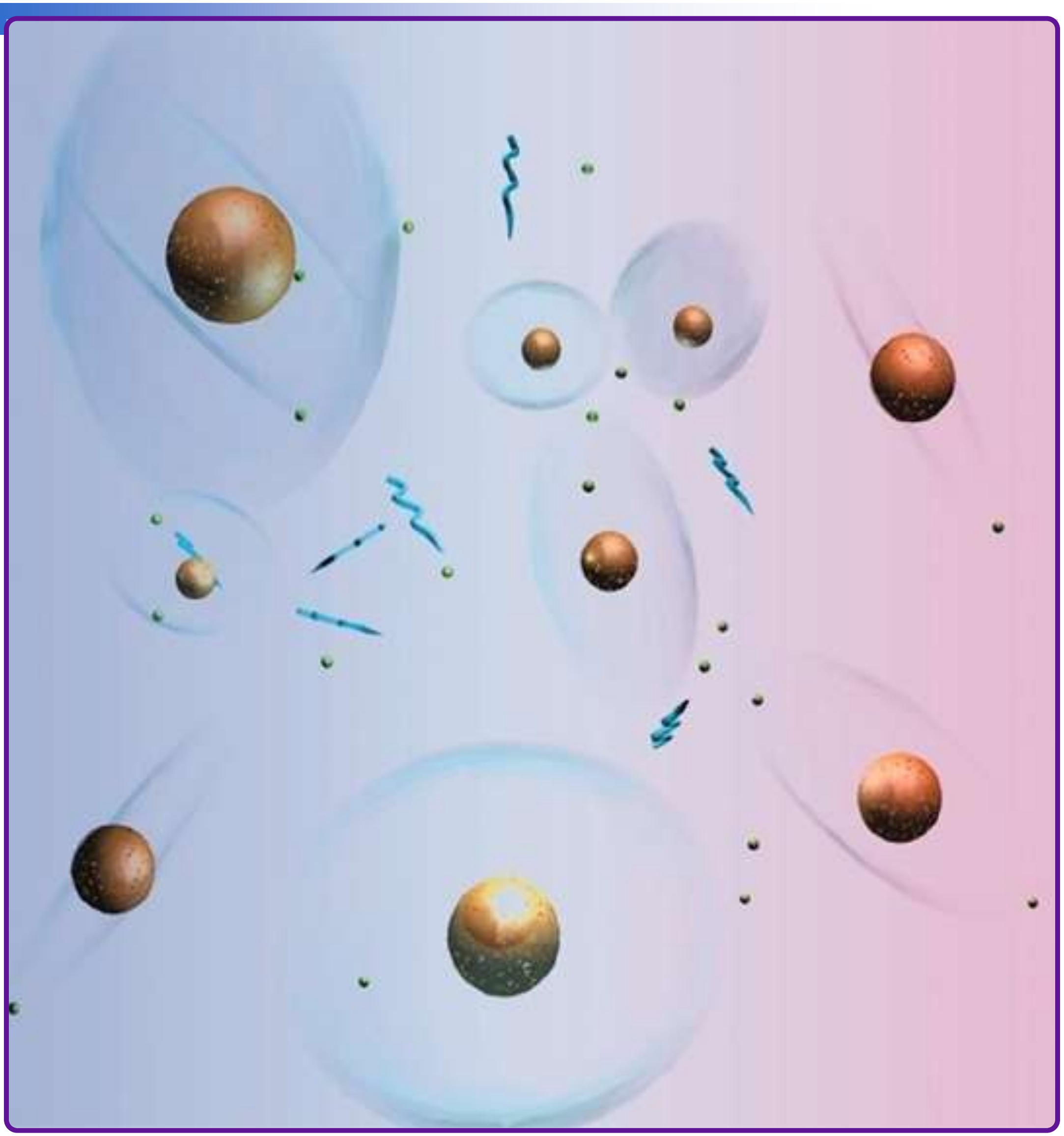


Protoni i neutroni se kombiniraju u jezgru helij

t = 3 minutes, 10^9 K (0.1 MeV, 10^{-12} m) : Nuclei are formed

The temperature is low enough to allow nuclei to be formed. Conditions are similar to those that exist in stars today or in thermonuclear bombs. Heavier nuclei such as deuterium, helium and lithium soak up the neutrons that are present. Any remaining neutrons decay with a time constant of ~ 1000 seconds. The neutron-proton ratio is now 13:87. The bulk constitution of the universe is now in place consisting essentially of protons (75%) and helium nuclei. The temperature is still too high to form any atom and electrons form a gas of free particles.

300000 years Atomi i era svjetla



Svemir postaje proziran i ispunjen svjetlom

t = 300 000 years, 6000 K (0.5 eV, 10^{-10} m) : Atoms are created

Electrons begin to stick to nuclei. Atoms of hydrogen, helium and lithium are created. Radiation is no longer energetic enou to break atoms. The universe becomes transparent. Matter density dominates. Astronomy can study the evolution of the Universe back to this time.

1000 M years

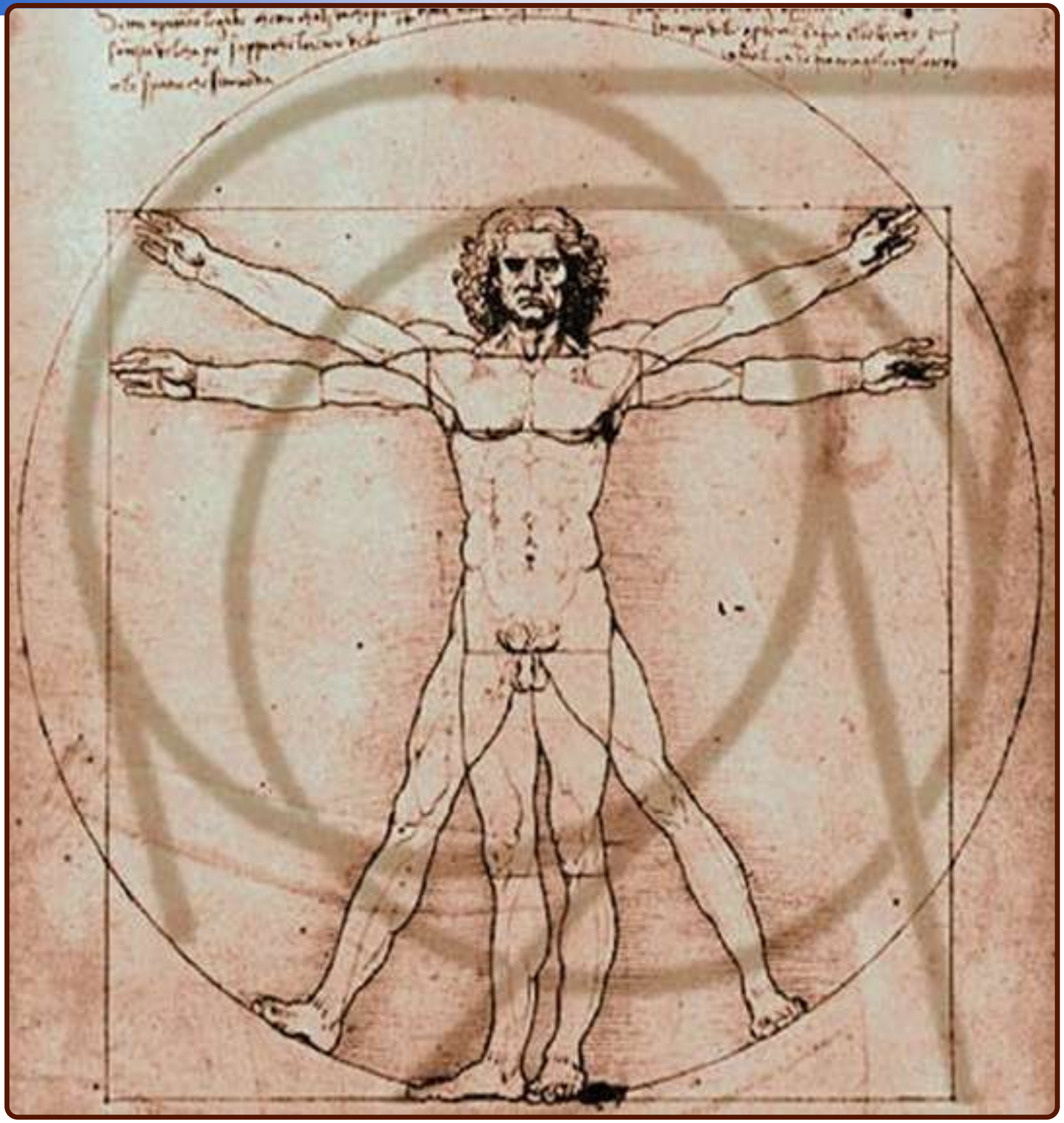
Stvaranje galaksija

Galaksije se počinju stvara

t = 10^9 years, 18 K : Galaxy Formation

Local mass density fluctuations act as seeds for stellar and galaxy formation. The exact mechanisn is still not understood. Nucleosynthesis, synthesis of heavier nuclei such as carbon up to iron, starts occurring in the thermonuclear reactors that are stars. Even heavier elements are synthesized and dispersed in the brief moment during which stellar collapse and supernovae explosions occur.

15000 M years Danas

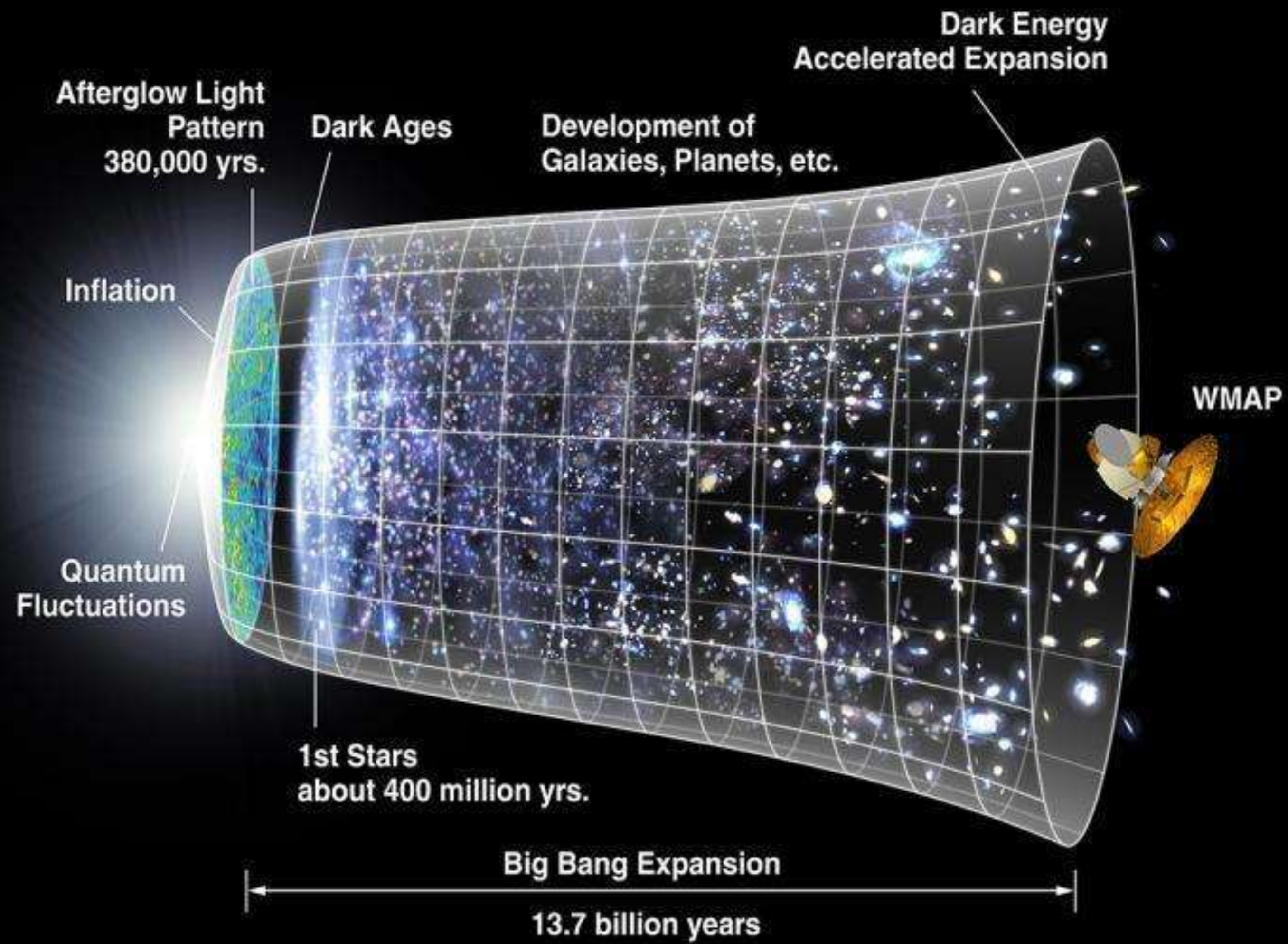


Čovjek se počeo pitati odakle sve ovo!

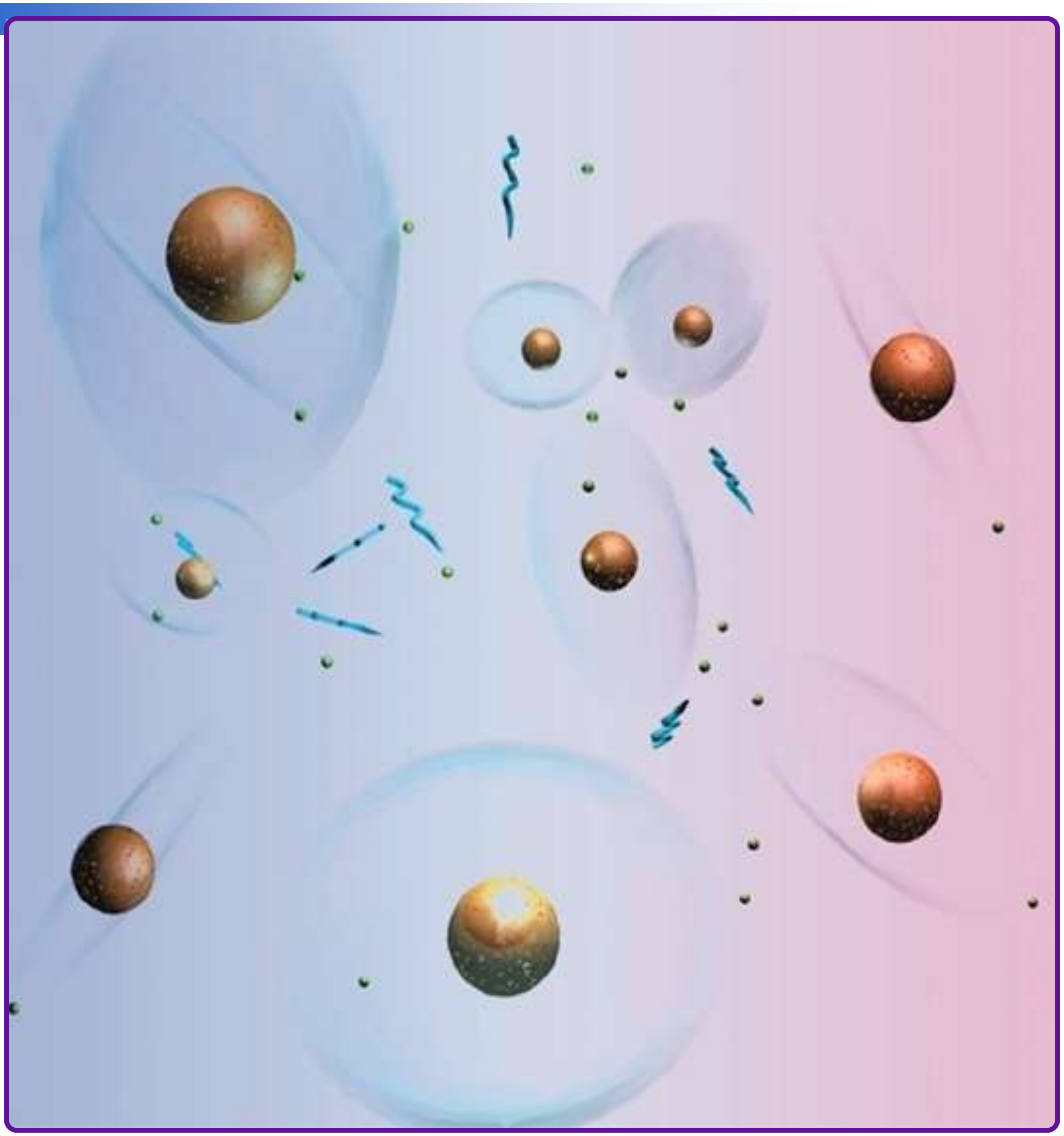
t = 15 x 10^9 years, 3 K : Humans

The present day. Chemical processes have linked atoms to form molecules. From the dust of stars and through coded messages (DNA) humans emerge to observe the universe around them.

Od Velikog praska do današnjeg dana



300000 years Atomi i era svjetla



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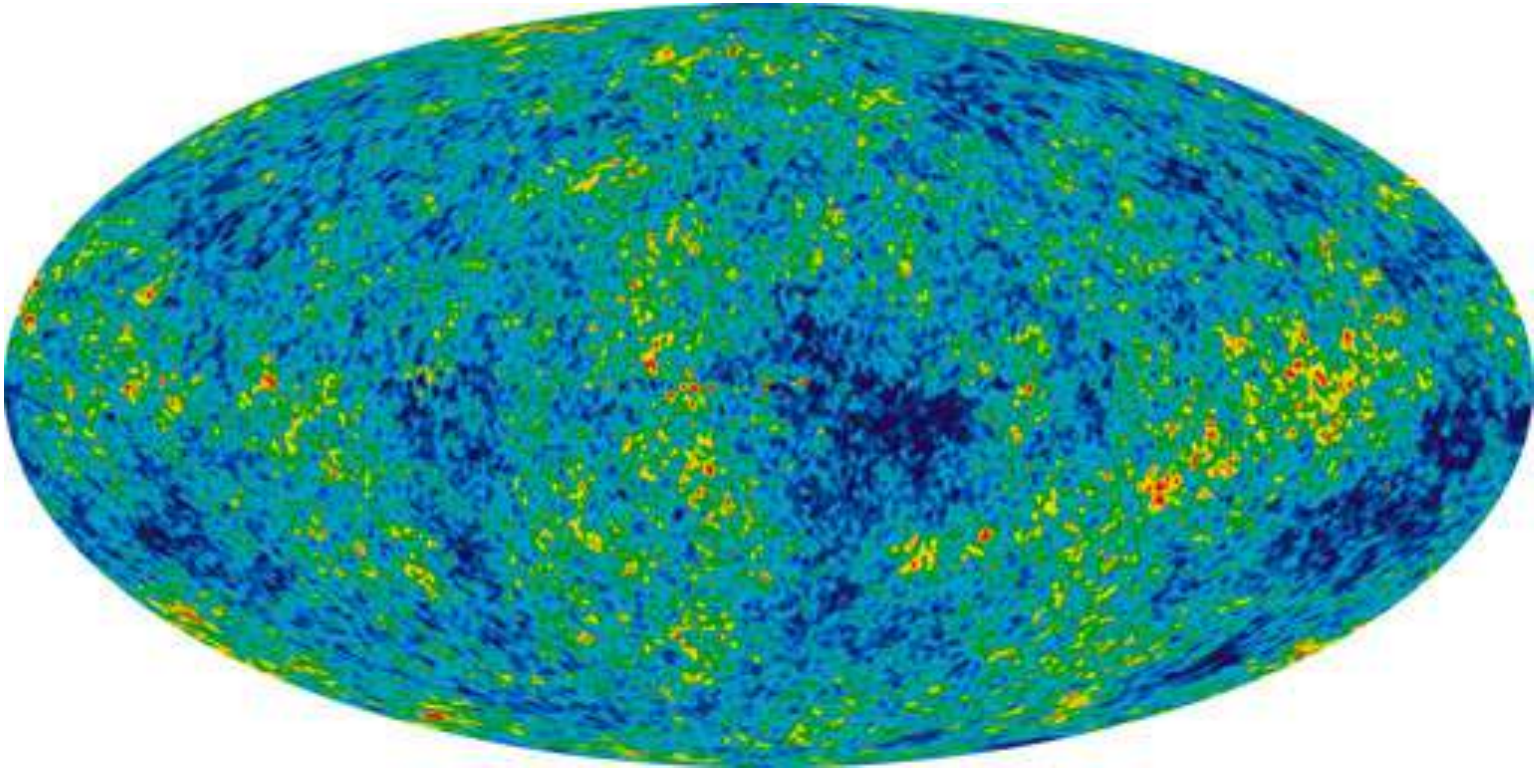
Wilkinson Microwave Anisotropy Probe

WMAP



Čestice

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svaki kvark: R, B, G 3 boje

Antičestice

Antileptoni

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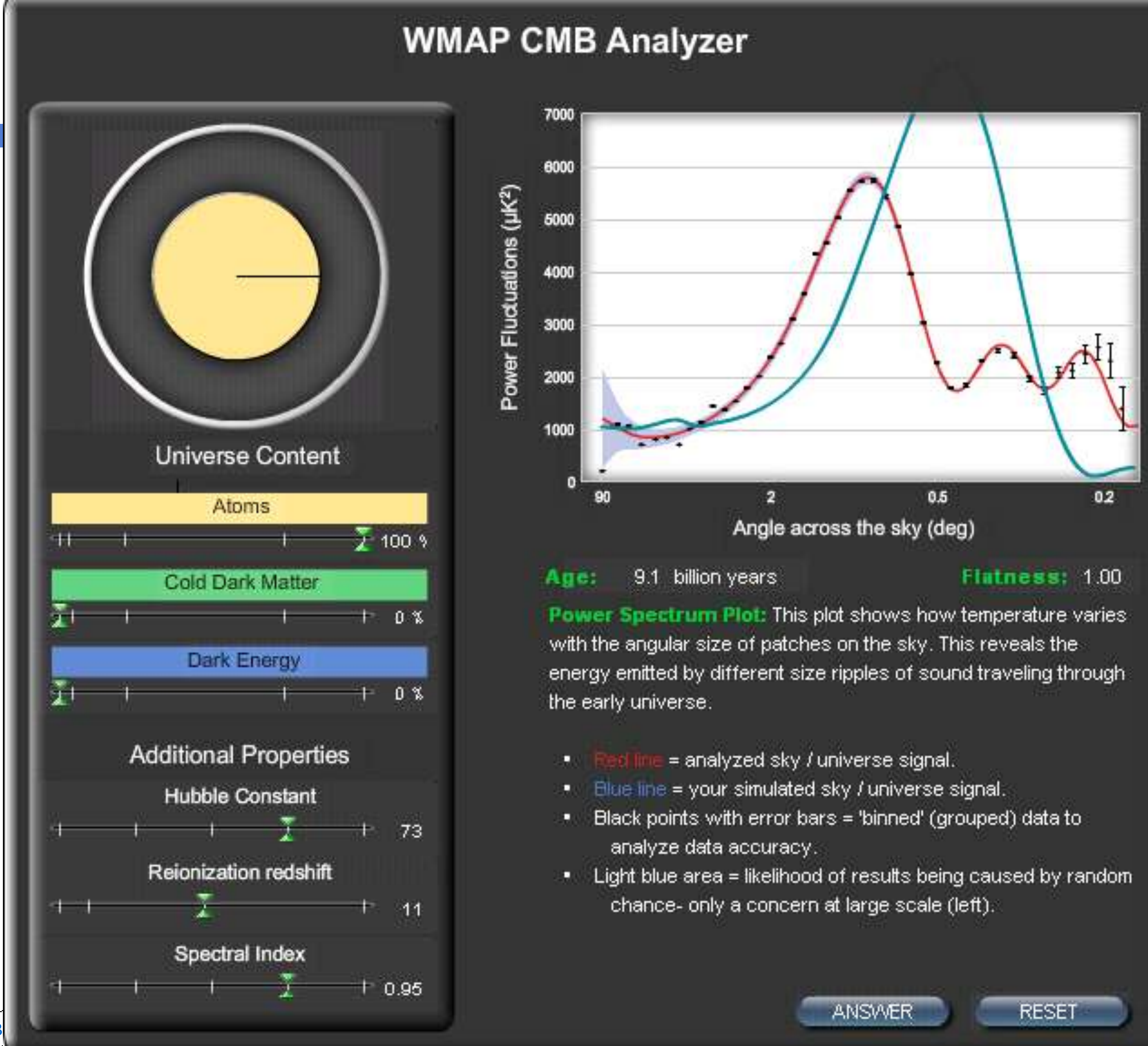
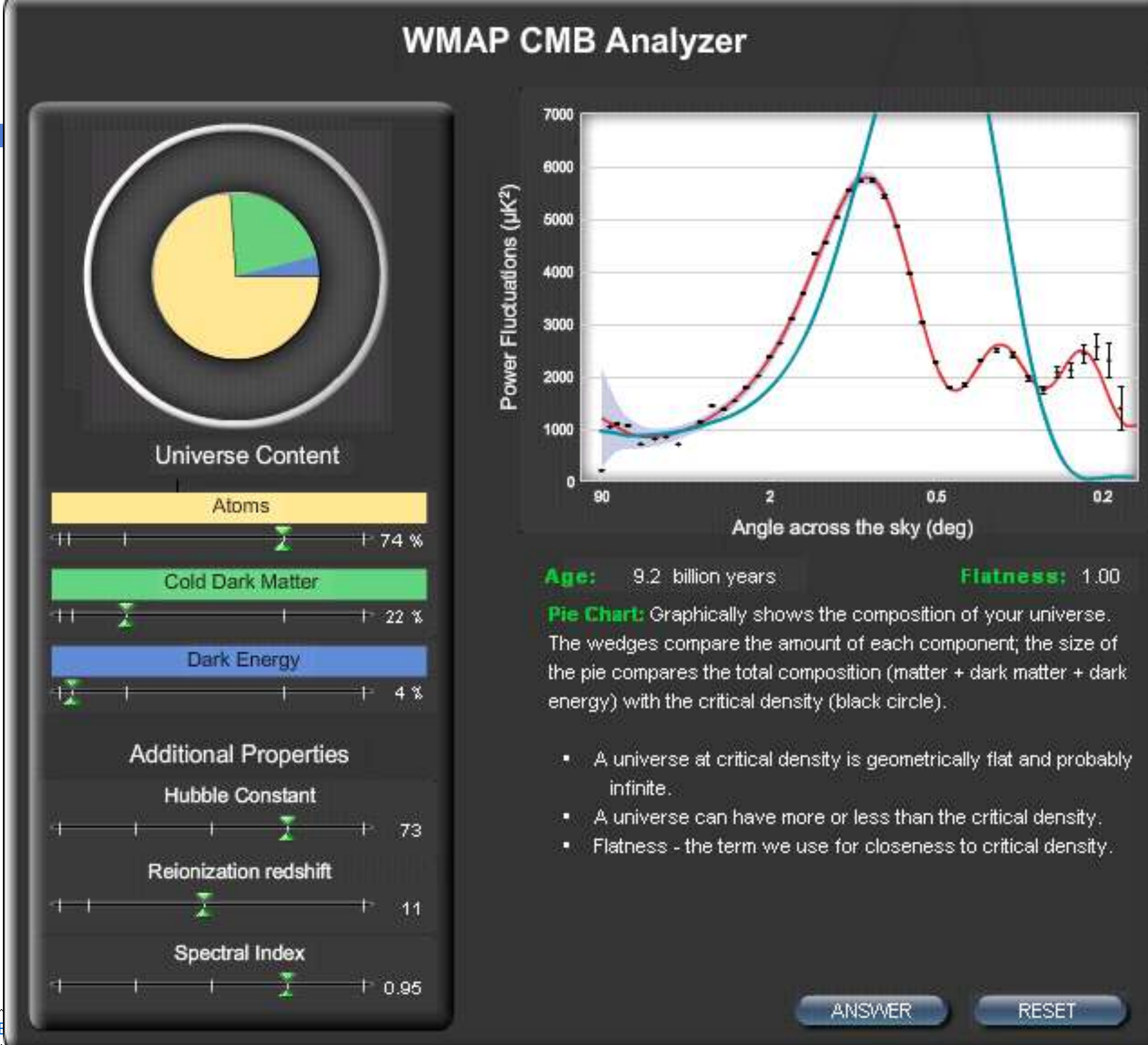
Antikvarkovi

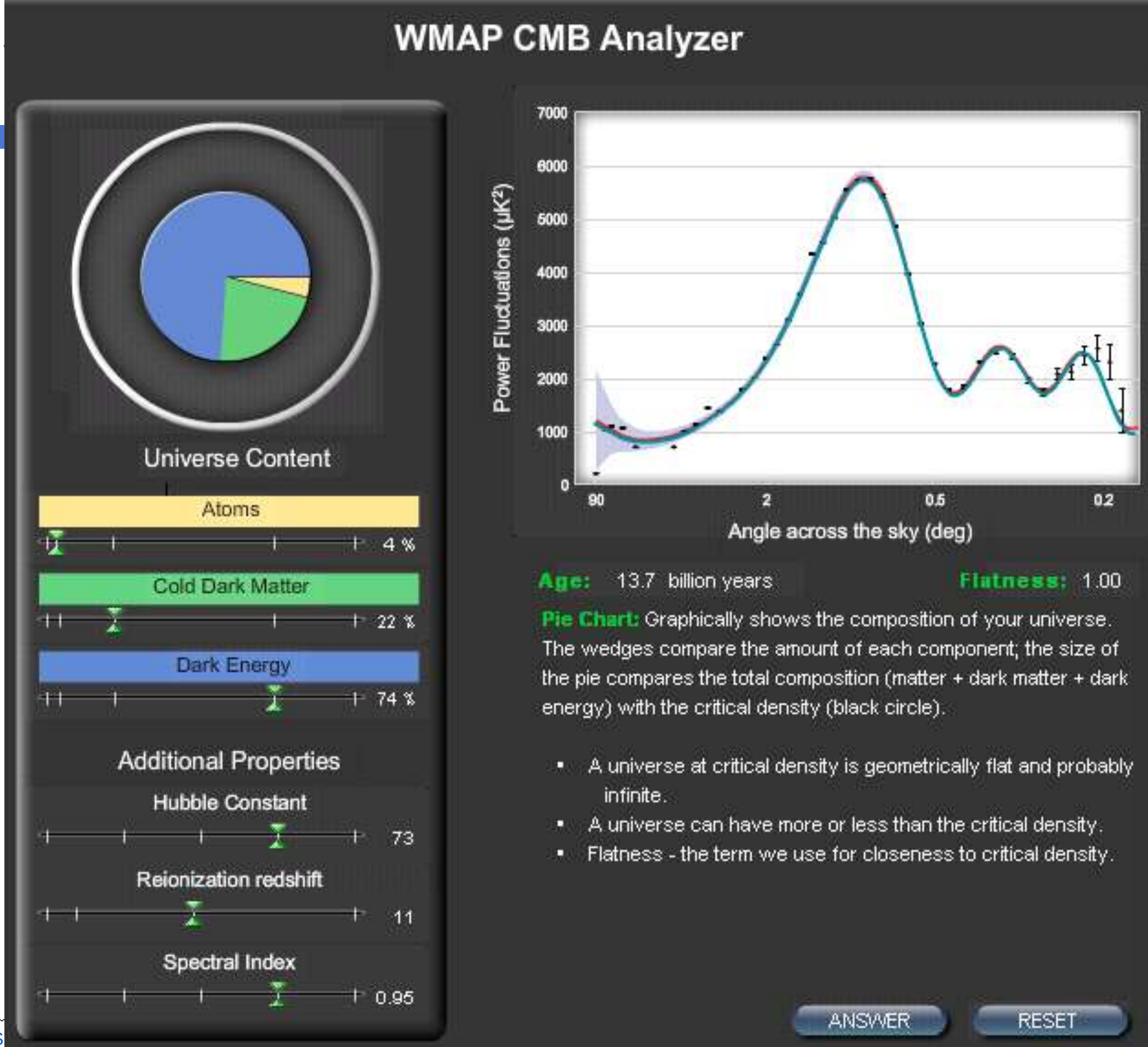
	Električni naboj		
Antidno	1/3	-2/3	Antivrh
Antistrani	1/3	-2/3	Antišarmantni
Antidolje	1/3	-2/3	Antigore

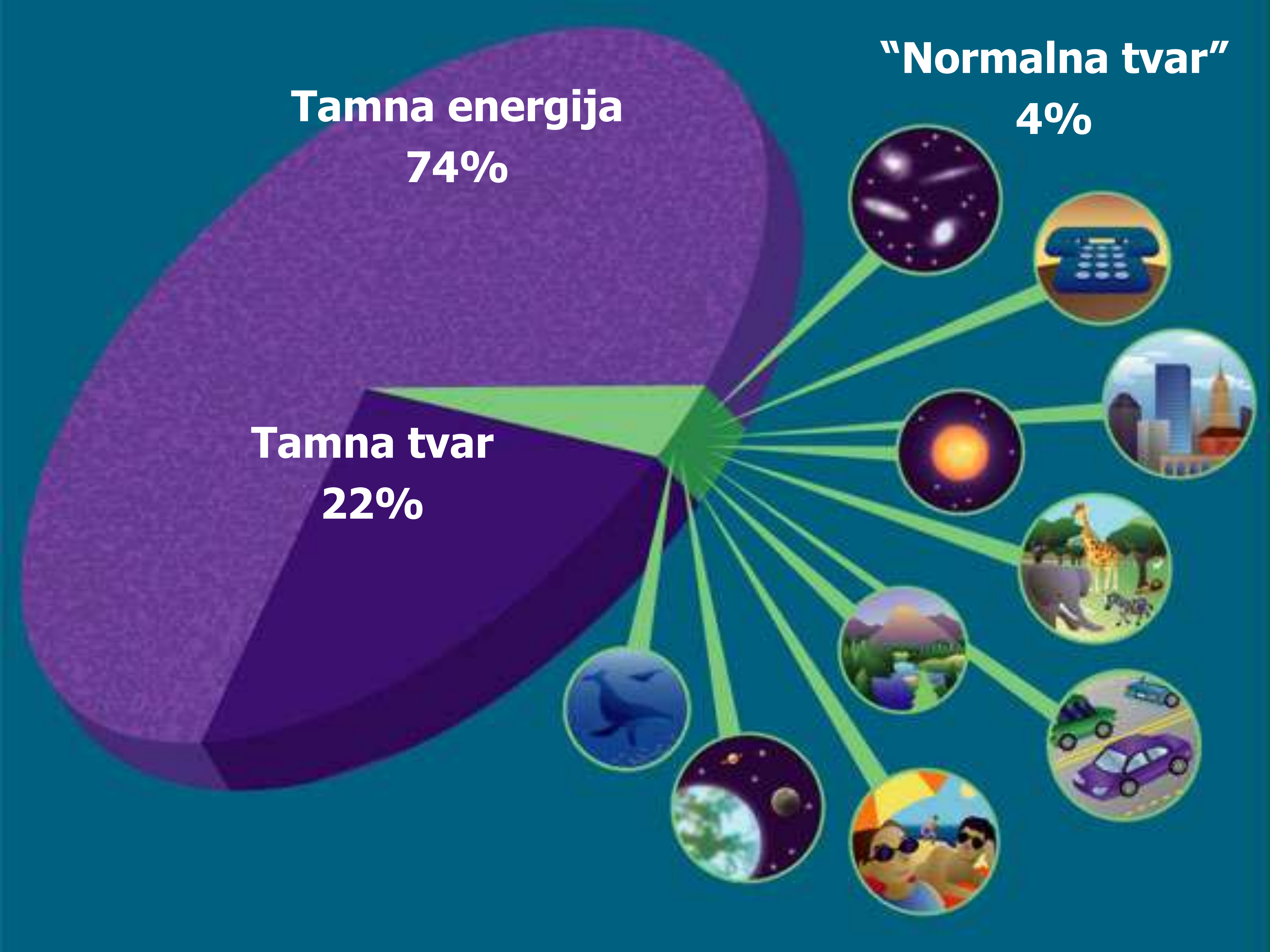
svaki antikvark: R, B, G 3 antiboje



WMAP CMB Analyzer
Universe Content
Atoms
100 %
Cold Dark Matter
0 %
Dark Energy
0 %
Additional Properties
Hubble Constant
73
Reionization redshift
11
Spectral Index
0.95
7000
6000
5000
4000
3000
2000
1000
0
Power Fluctuations (μK²)
90
2
0.5
0.2
Angle across the sky (deg)
Age: 9.1 billion years
Flatness: 1.00
Power Spectrum Plot: This plot shows how temperature varies with the angular size of patches on the sky. This reveals the energy emitted by different size ripples of sound traveling through the early universe.
Red line = analyzed sky / universe signal.
Blue line = your simulated sky / universe signal.
Black points with error bars = 'binned' (grouped) data to analyze data accuracy.
Light blue area = likelihood of results being caused by random chance- only a concern at large scale (left).
ANSWER
RESET


WMAP CMB Analyzer
Universe Content
Atoms
74 %
Cold Dark Matter
22 %
Dark Energy
4 %
Additional Properties
Hubble Constant
73
Reionization redshift
11
Spectral Index
0.95
7000
6000
5000
4000
3000
2000
1000
0
Power Fluctuations (μK²)
90
2
0.5
0.2
Angle across the sky (deg)
Age: 9.2 billion years
Flatness: 1.00
Pie Chart: Graphically shows the composition of your universe. The wedges compare the amount of each component; the size of the pie compares the total composition (matter + dark matter + dark energy) with the critical density (black circle).
A universe at critical density is geometrically flat and probably infinite.
A universe can have more or less than the critical density.
Flatness - the term we use for closeness to critical density.
ANSWER
RESET

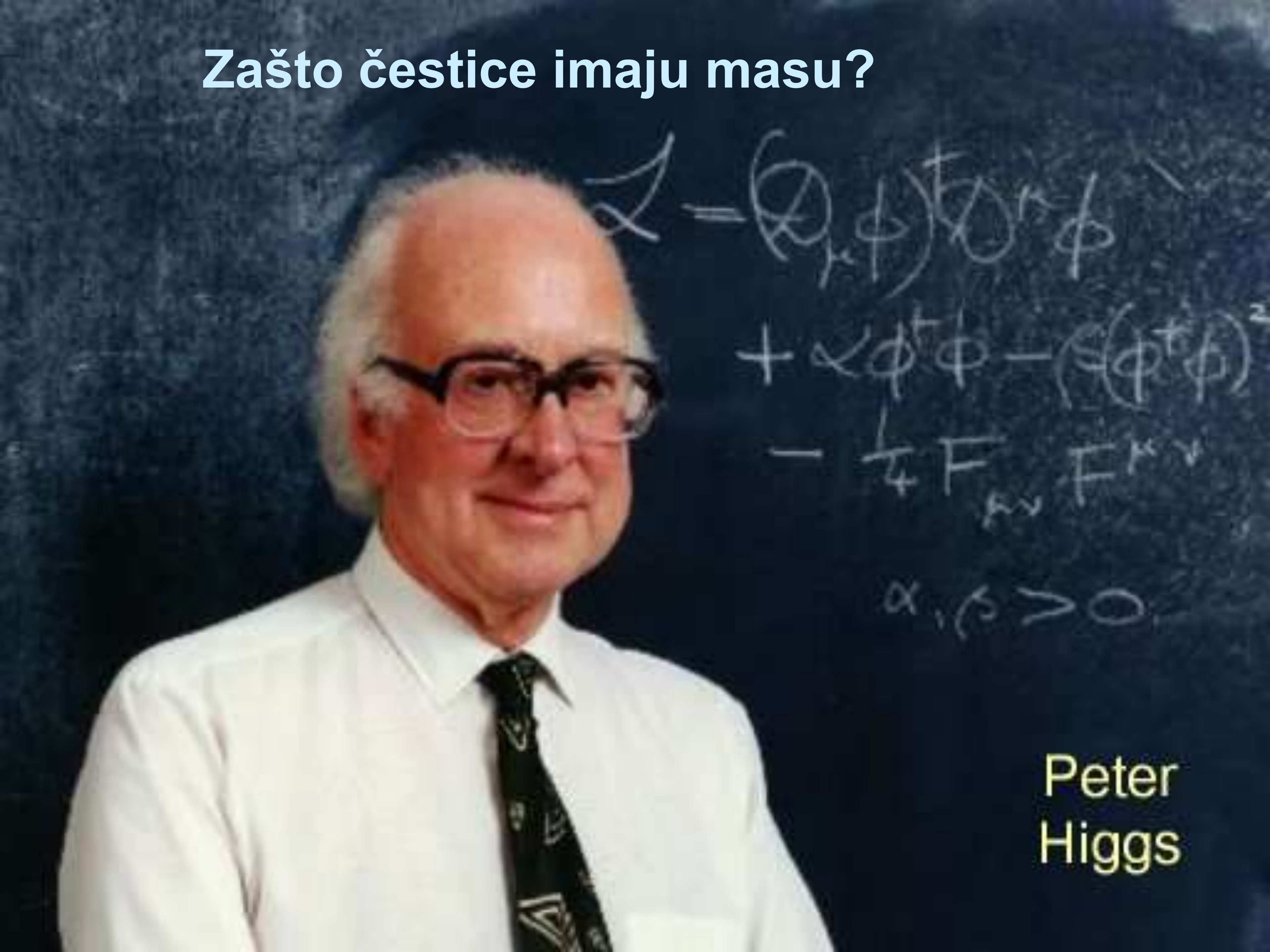

WMAP CMB Analyzer
Universe Content
Atoms
4 %
Cold Dark Matter
22 %
Dark Energy
74 %
Additional Properties
Hubble Constant
73
Reionization redshift
11
Spectral Index
0.95
Power Fluctuations (μK²)
7000
6000
5000
4000
3000
2000
1000
0
90
2
0.5
0.2
Angle across the sky (deg)
Age: 13.7 billion years
Flatness: 1.00
Pie Chart: Graphically shows the composition of your universe. The wedges compare the amount of each component; the size of the pie compares the total composition (matter + dark matter + dark energy) with the critical density (black circle).
A universe at critical density is geometrically flat and probably infinite.
A universe can have more or less than the critical density.
Flatness - the term we use for closeness to critical density.
ANSWER
RESET


Tamna energija
74%
"Normalna tvar"
4%
Tamna tvar
22%


100 milijardi
SVE OVO JE SAMO 4% SVEMIRA!
100 milijardi


I am
the
center
of the
universe

Zašto čestice imaju masu?



Čestice

Leptoni

	Electric Charge		
Tau	-1	0	Tau Neutrino
Mion	-1	0	Mion Neutrino
Elektron	-1	0	Elektron Neutrino

Kvarkovi

	Električni naboj		
Dno	-1/3	2/3	Vrh
Strani	-1/3	2/3	Šarmantni
Dolje	-1/3	2/3	Gore

svaki kvark: R, B, G 3 boje

Antičestice

Antileptoni

	Electric Charge		
Antitau	1	0	Antitau Neutrino
Antimion	1	0	Antimion Neutrino
Pozitron	1	0	Antielektron Neutrino

Antikvarkovi

	Električni naboj		
Antidno	1/3	-2/3	Antivrh
Antistrani	1/3	-2/3	Antišarmantni
Antidolje	1/3	-2/3	Antigore

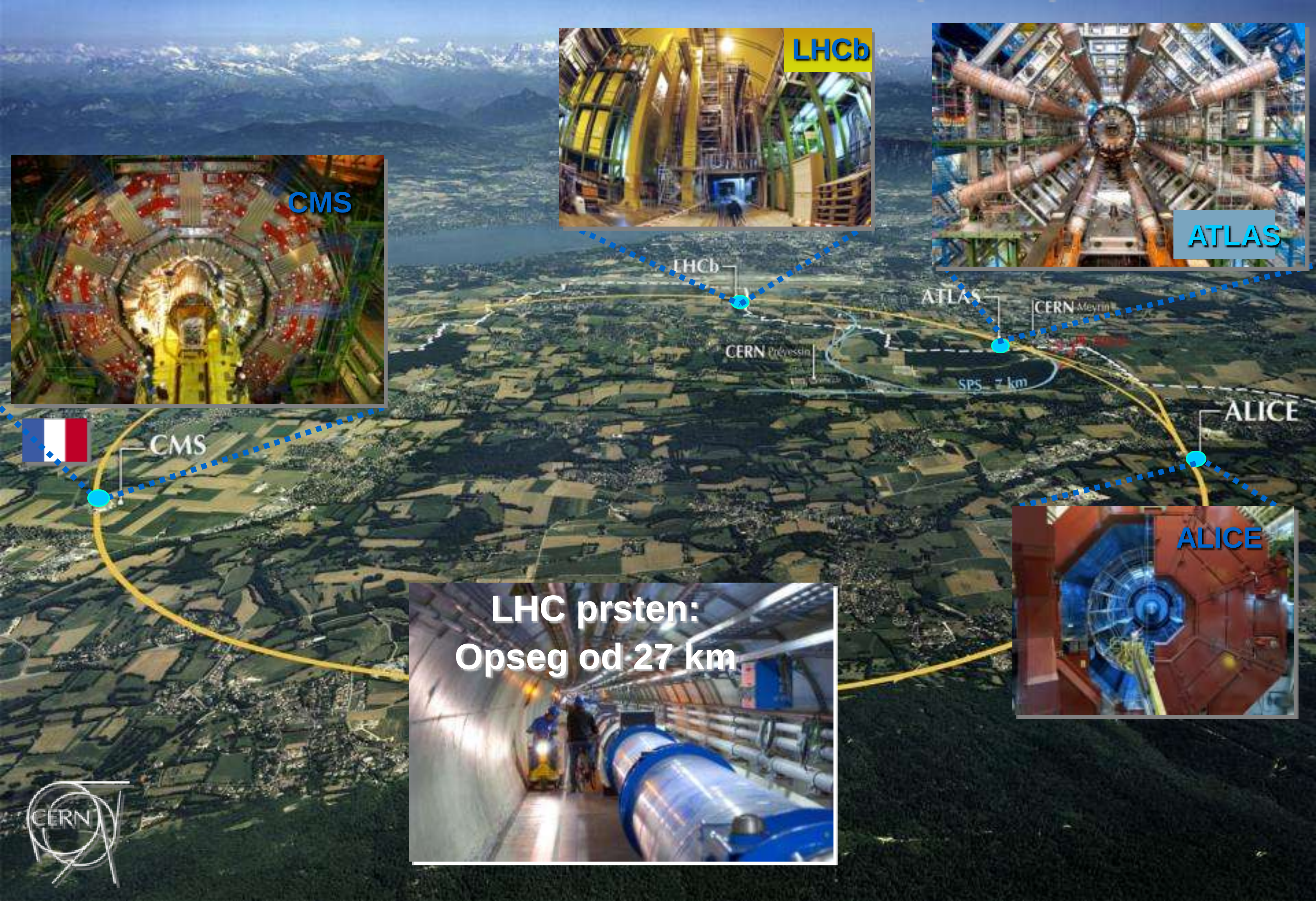
svaki antikvark: R, B, G 3 antiboje

MISTERIJ MASE

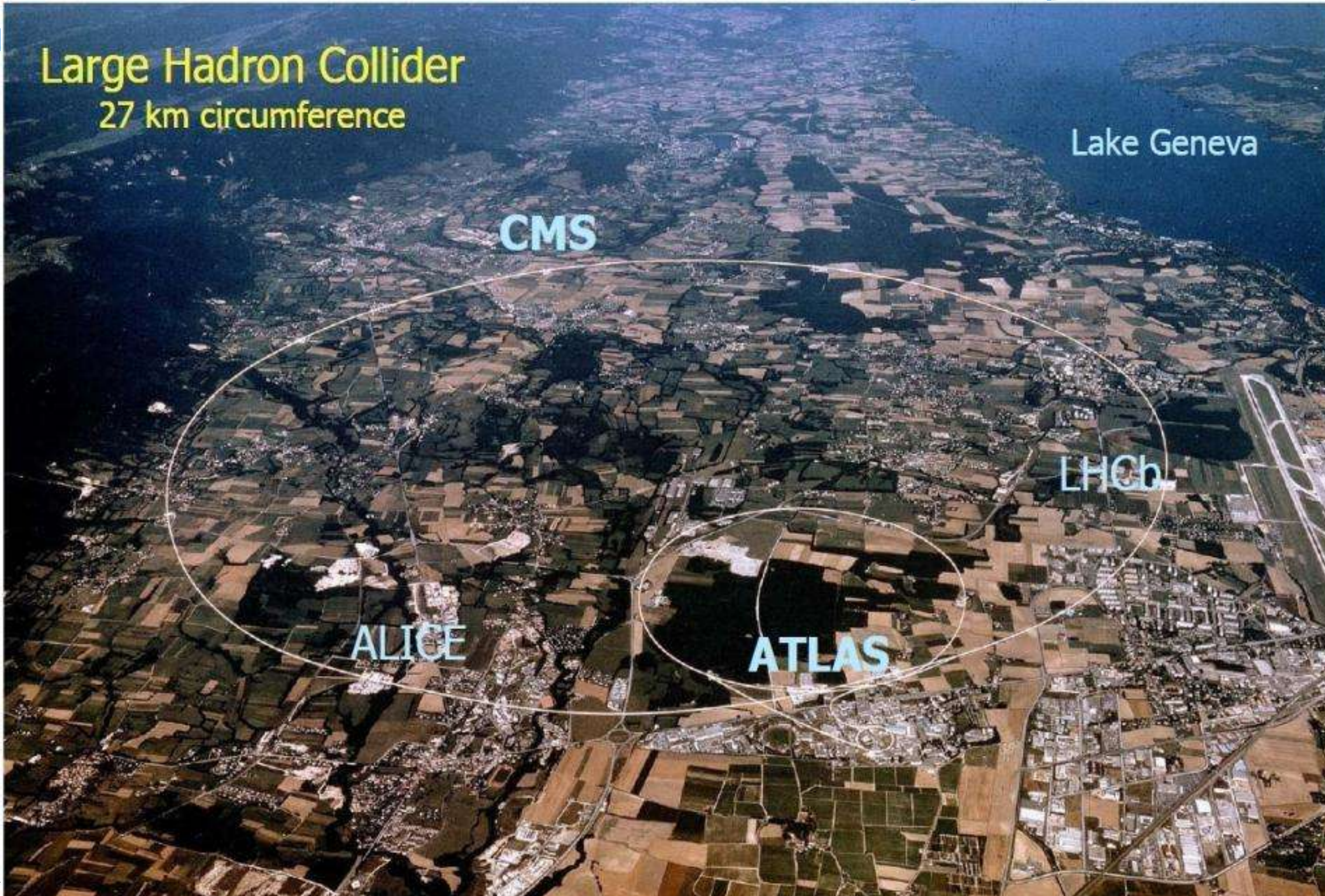
kvarkovi **leptoni**

Razlog “bi moglo biti” postojanje nove čestice, zovemo je “Higgsov boson”

Veliki sudarač hadrona (LHC)

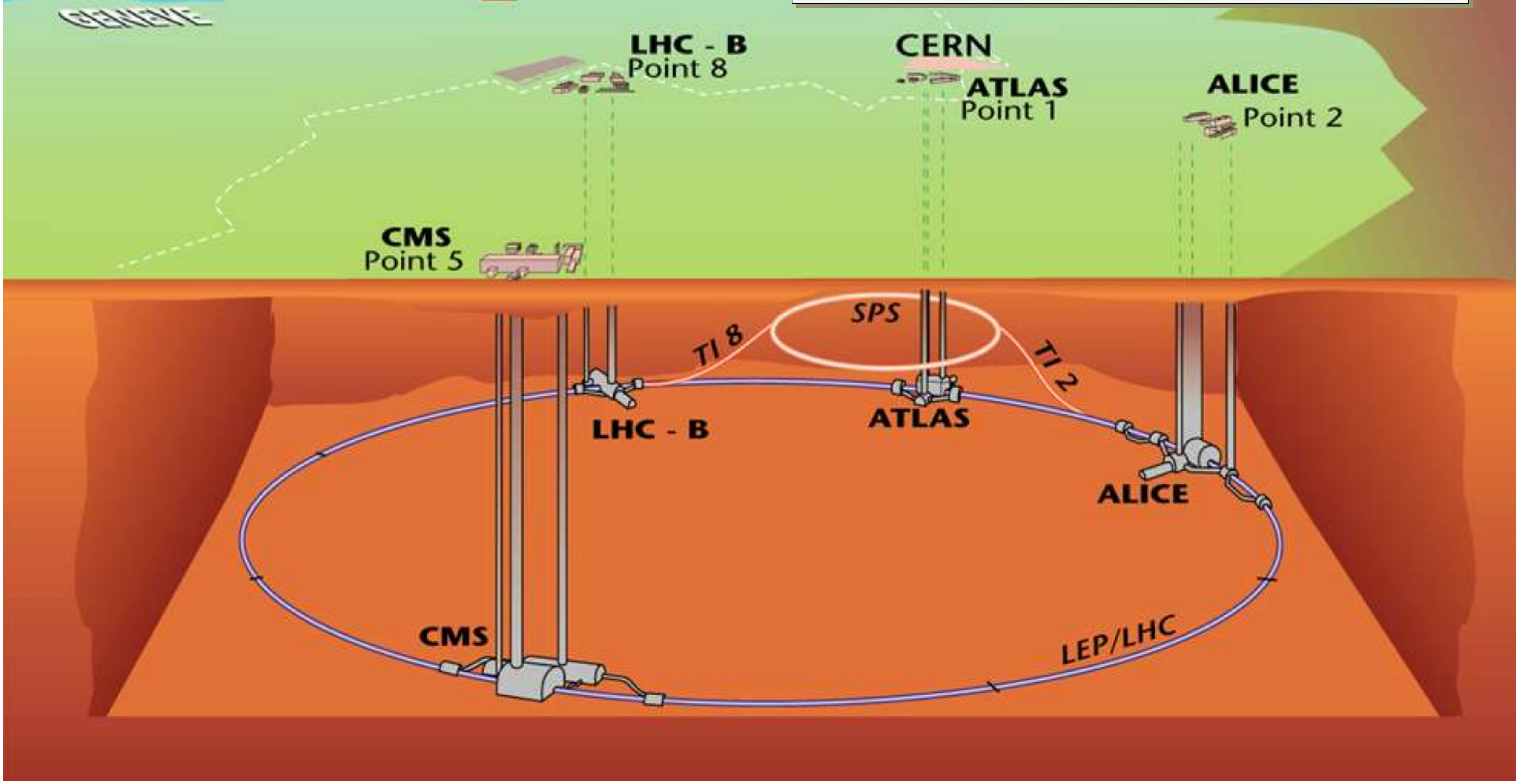


Veliki sudarač hadrona (LHC)

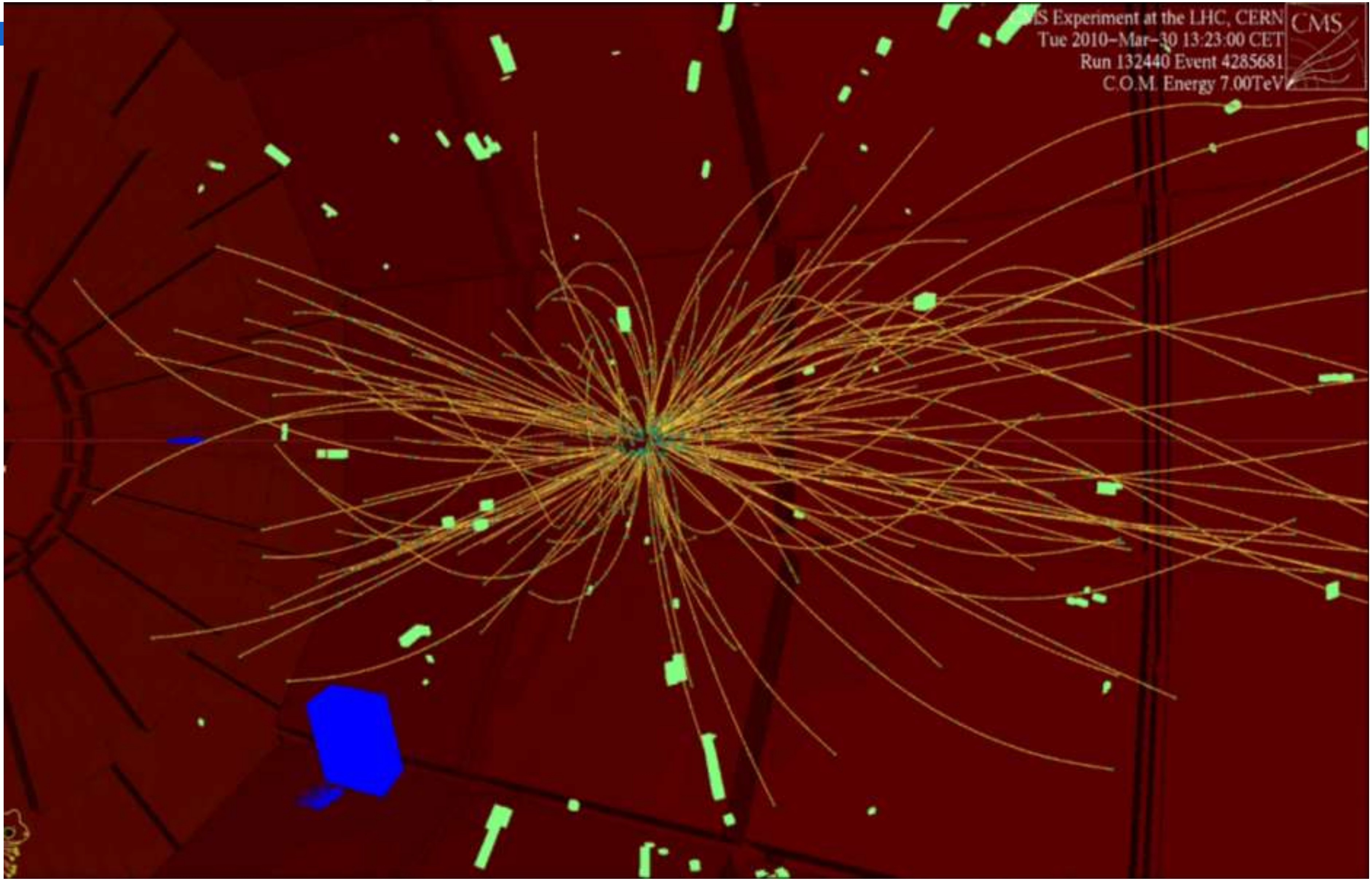


The Large Hadron Collider – Veliki sudarač hadrona

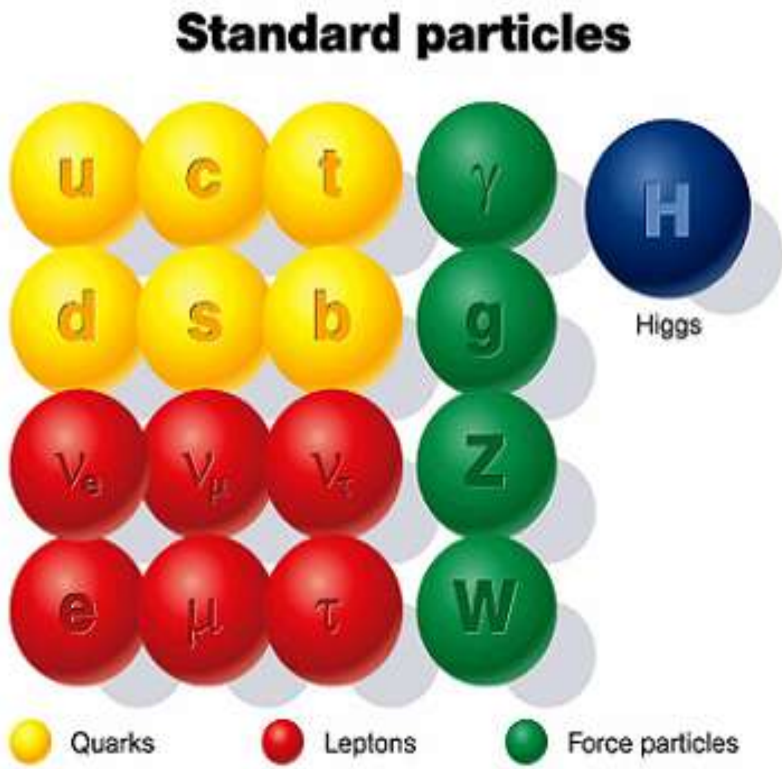
	Beams	Energy	Luminosity	
LEP	$e^+ e^-$	200	GeV	10^{32} $cm^{-2}s^{-1}$
LHC	p p	14	TeV	10^{34}
	P_b P_b	1312	TeV	10^{27}



Prvi sudari protona u CMS detektoru



Standardni Model čestica i sila



$$\mathcal{L}_{GWS} = \sum_f (\bar{\Psi}_f(i\gamma^\mu \partial\mu - m_f)\Psi_f - eQ_f\bar{\Psi}_f\gamma^\mu\Psi_f A_\mu)+$$

$$+\frac{g}{\sqrt{2}}\sum_i(\bar{a}^i_L\gamma^\mu b^i_L W^+_\mu + \bar{b}^i_L\gamma^\mu a^i_L W^-_\mu) + \frac{g}{2c_w}\sum_f \bar{\Psi}_f\gamma^\mu(I^3_f - 2s^2_w Q_f - I^3_f\gamma_5)\Psi_f Z_\mu +$$

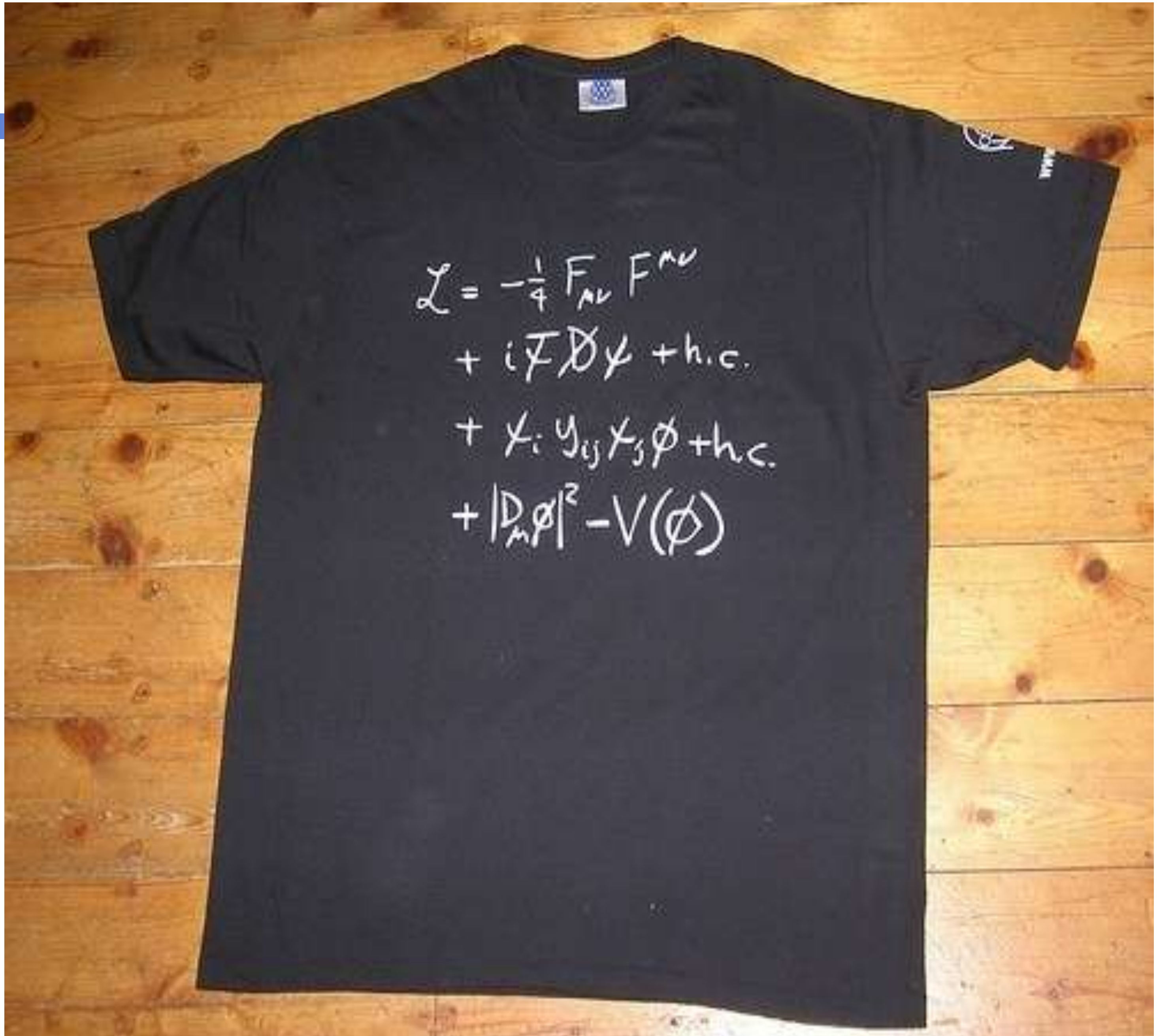
$$-\frac{1}{4}|\partial_\mu A_\nu - \partial_\nu A_\mu - ie(W^-_\mu W^+_\nu - W^+_\mu W^-_\nu)|^2 - \frac{1}{2}|\partial_\mu W^+_\nu - \partial_\nu W^+_\mu +$$

$$-ie(W^+_\mu A_\nu - W^+_\nu A_\mu) + ig'c_w(W^+_\mu Z_\nu - W^+_\nu Z_\mu|^2 +$$

$$-\frac{1}{4}|\partial_\mu Z_\nu - \partial_\nu Z_\mu + ig'c_w(W^-_\mu W^+_\nu - W^+_\mu W^-_\nu)|^2 +$$

$$-\frac{1}{2}M^2_\eta\eta^2 - \frac{gM^2_\eta}{8M_W}\eta^3 - \frac{g'^2M^2_\eta}{32M_W}\eta^4 + |M_W W^+_\mu + \frac{g}{2}\eta W^+_\mu|^2 +$$

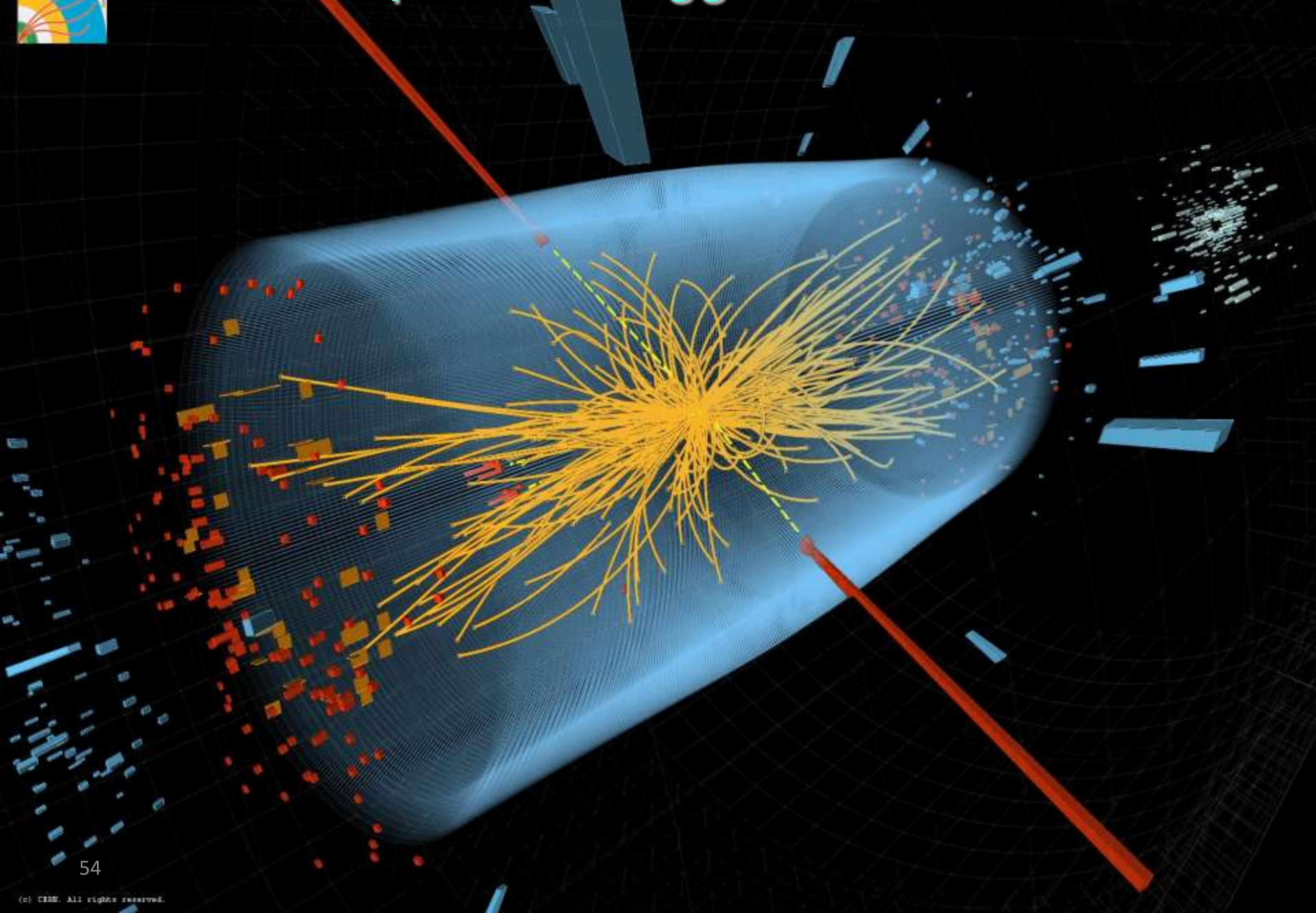
$$+\frac{1}{2}|\partial_\mu\eta + iM_Z Z_\mu + \frac{ig}{2c_w}\eta Z_\mu|^2 - \sum_f \frac{g}{2}\frac{m_f}{M_W}\bar{\Psi}_f\Psi_f\eta$$

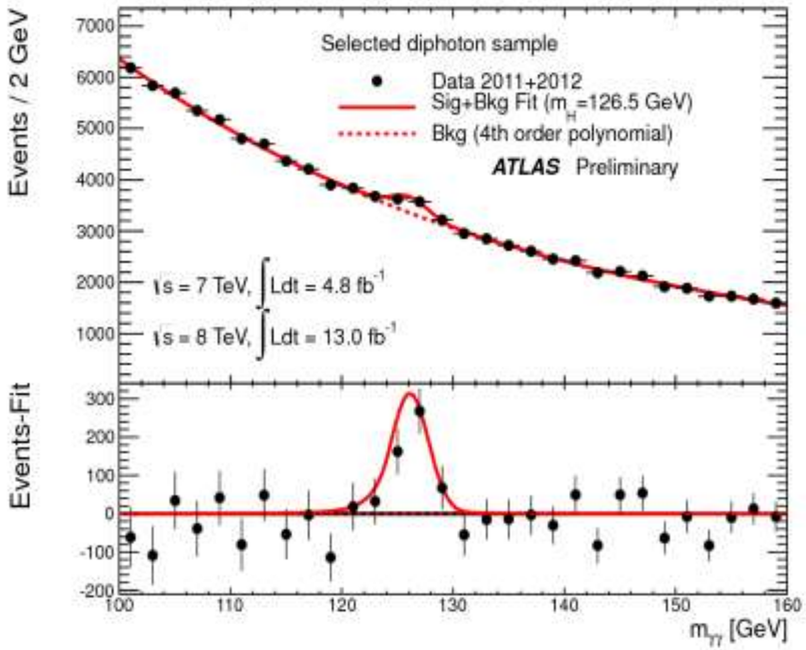

$\mathcal{L} = -\frac{1}{4} F_{\mu\nu} F^{\mu\nu}$
$+ i \bar{\psi} \not{D} \psi + h.c.$
$+ \psi_i y_{ij} \psi_j \phi + h.c.$
$+ |D_\mu \phi|^2 - V(\phi)$

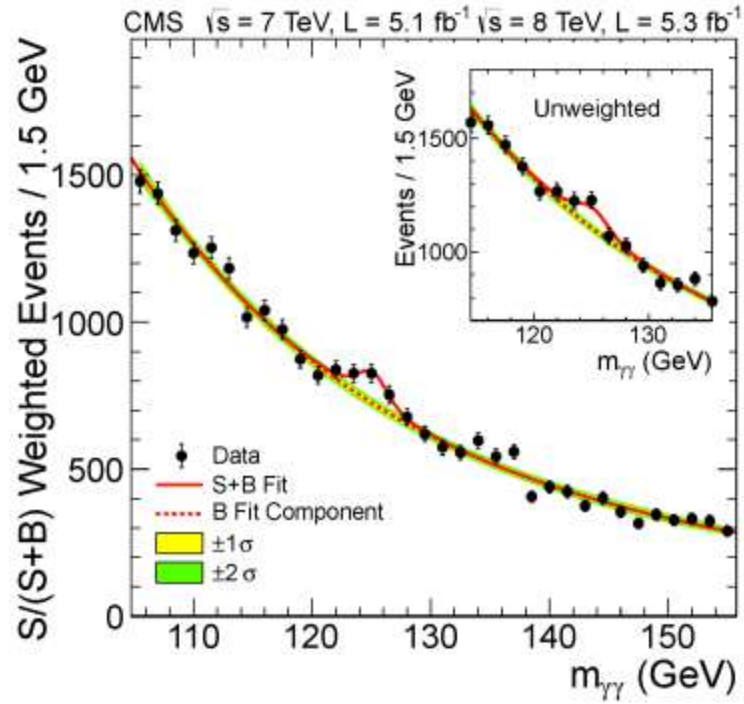
Higgsov mehanizam

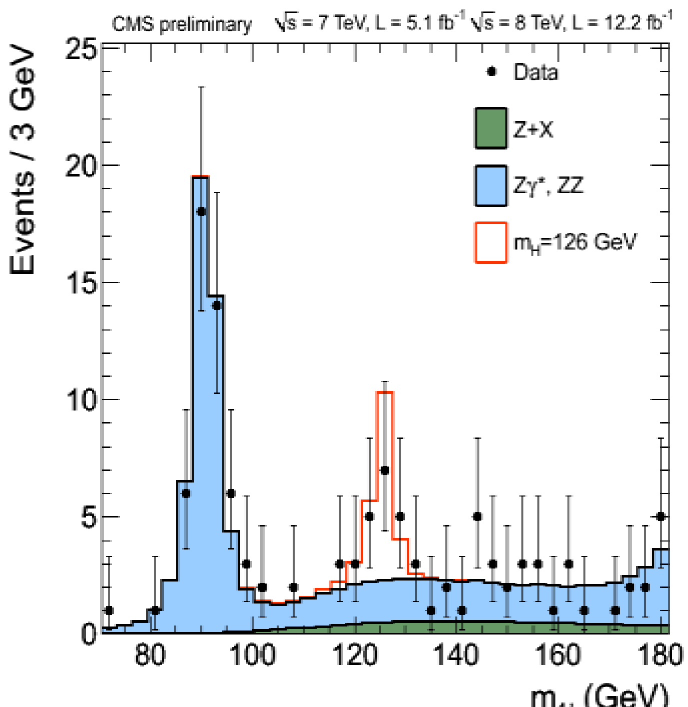
Higgsov bozon

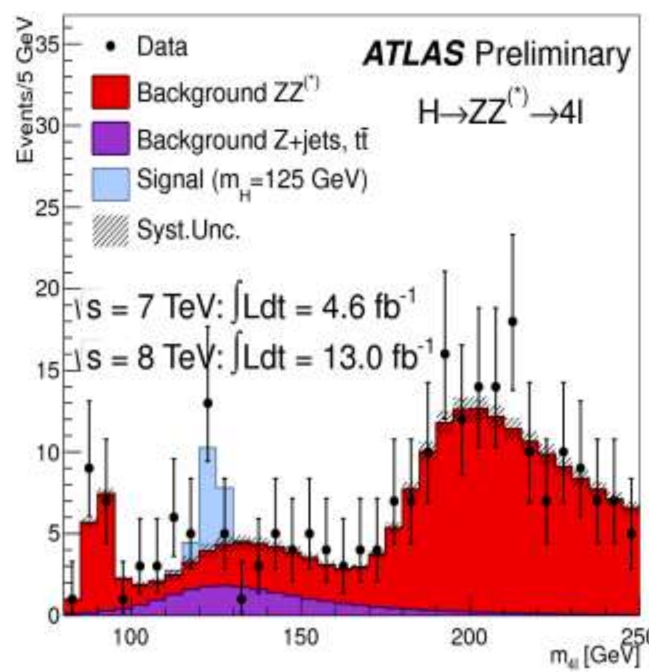
Jesmo li pronašli Higgsov bozon?




Selected diphoton sample
Data 2011+2012
Sig+Bkg Fit (m_H=126.5 GeV)
Bkg (4th order polynomial)
ATLAS Preliminary
√s = 7 TeV, ∫Ldt = 4.8 fb⁻¹
√s = 8 TeV, ∫Ldt = 13.0 fb⁻¹
Events / 2 GeV
Events-Fit
m_γγ [GeV]

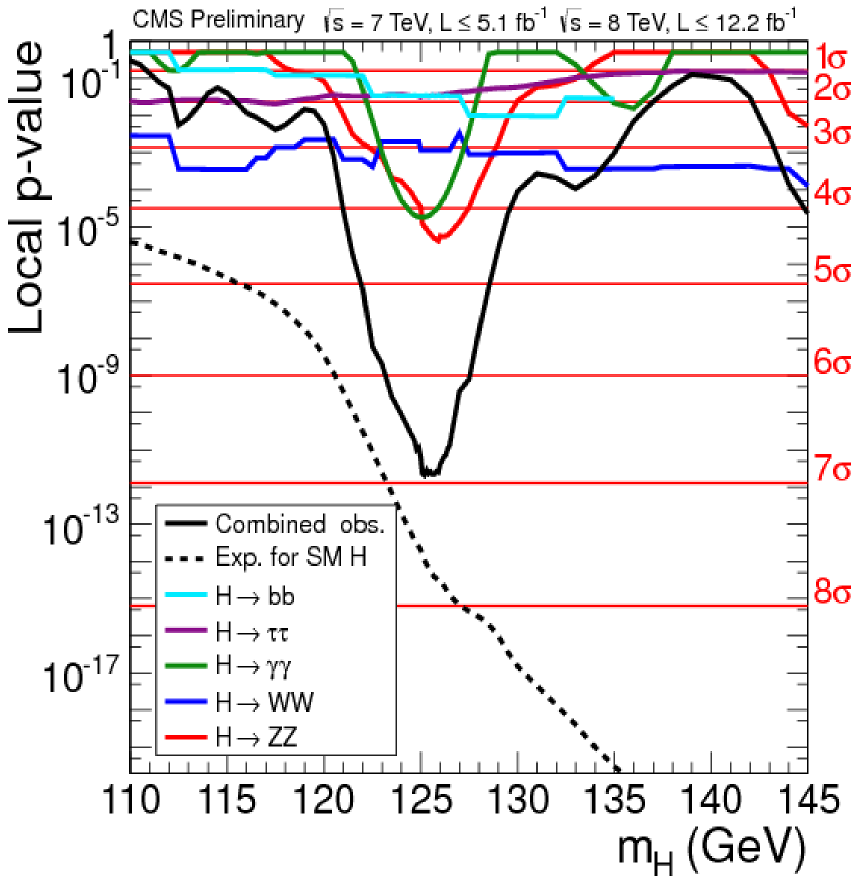

CMS √s = 7 TeV, L = 5.1 fb⁻¹ √s = 8 TeV, L = 5.3 fb⁻¹
Unweighted
Events / 1.5 GeV
m_γγ (GeV)
Data
S+B Fit
B Fit Component
±1σ
±2σ
S/(S+B) Weighted Events / 1.5 GeV
m_γγ (GeV)

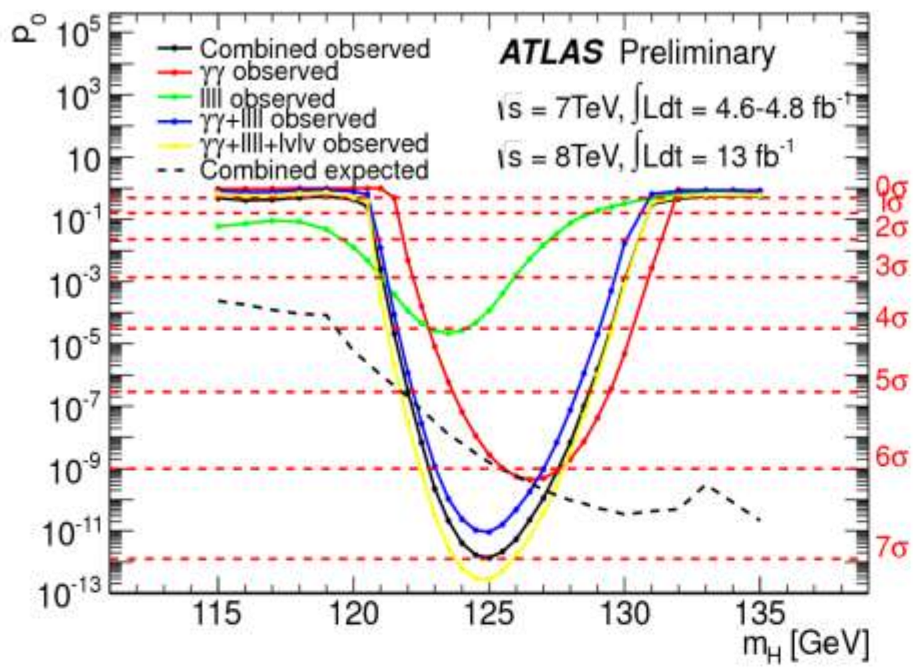

CMS preliminary √s = 7 TeV, L = 5.1 fb⁻¹ √s = 8 TeV, L = 12.2 fb⁻¹
Data
Z+X
Zγ*, ZZ
m_H=126 GeV
Events / 3 GeV
m_4l (GeV)


Data
Background ZZ(*)
Background Z+jets, tt̄
Signal (m_H=125 GeV)
Syst.Unc.
ATLAS Preliminary
H→ZZ(*)→4l
√s = 7 TeV: ∫Ldt = 4.6 fb⁻¹
√s = 8 TeV: ∫Ldt = 13.0 fb⁻¹
Events/5 GeV
m_4l [GeV]

Višak podataka u svima kanalima ...

Na istom mjestu





Vrlo vjerojatno je to Higgsov bozon ...

Je li vrijeme iluzija?