Zvočni zapisi vesoljskih pojavov

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Fakulteta za matematiko in fiziko
Univerza v Ljubljani

Prirodoslovni muzej Slovenije
Portal v vesolje - www.portalvvesolje.si

Sprehod skozi vesolje, 6.2.2014

Zvok

Zvok je longitudinalno (mehansko) valovanje, ki ga lahko zazna človeško uho.

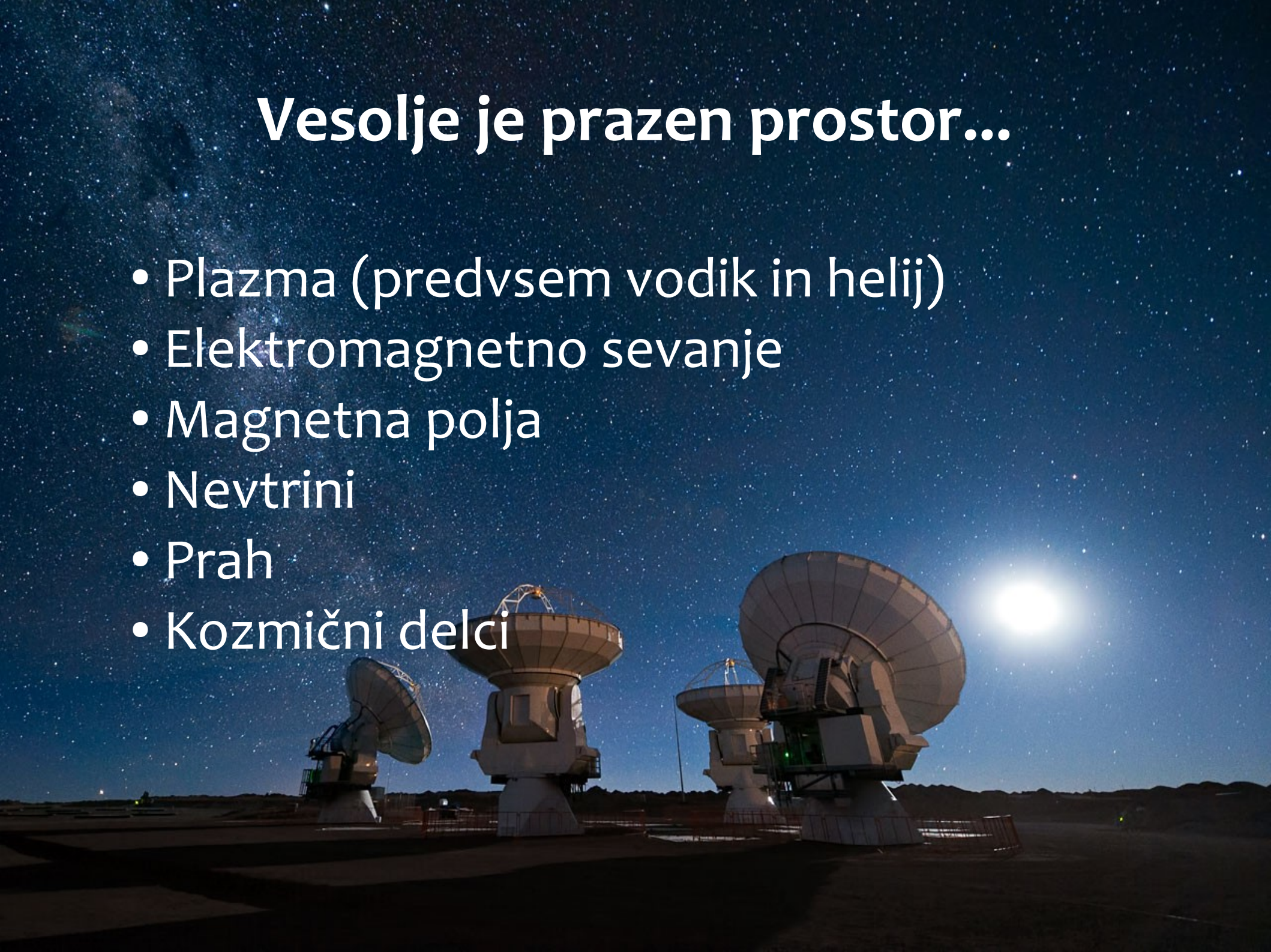
- *Frekvence: 16 do 20000 Hz*

$$c_s = \sqrt{\frac{p}{\rho}}$$

Zrak 320 m/s
Voda 1,5 km/s
Jeklena žica 5 km/s

Vesolje je prazen prostor...

- Plazma (predvsem vodik in helij)
- Elektromagnetno sevanje
- Magnetna polja
- Nevtrini
- Prah
- Kozmični delci

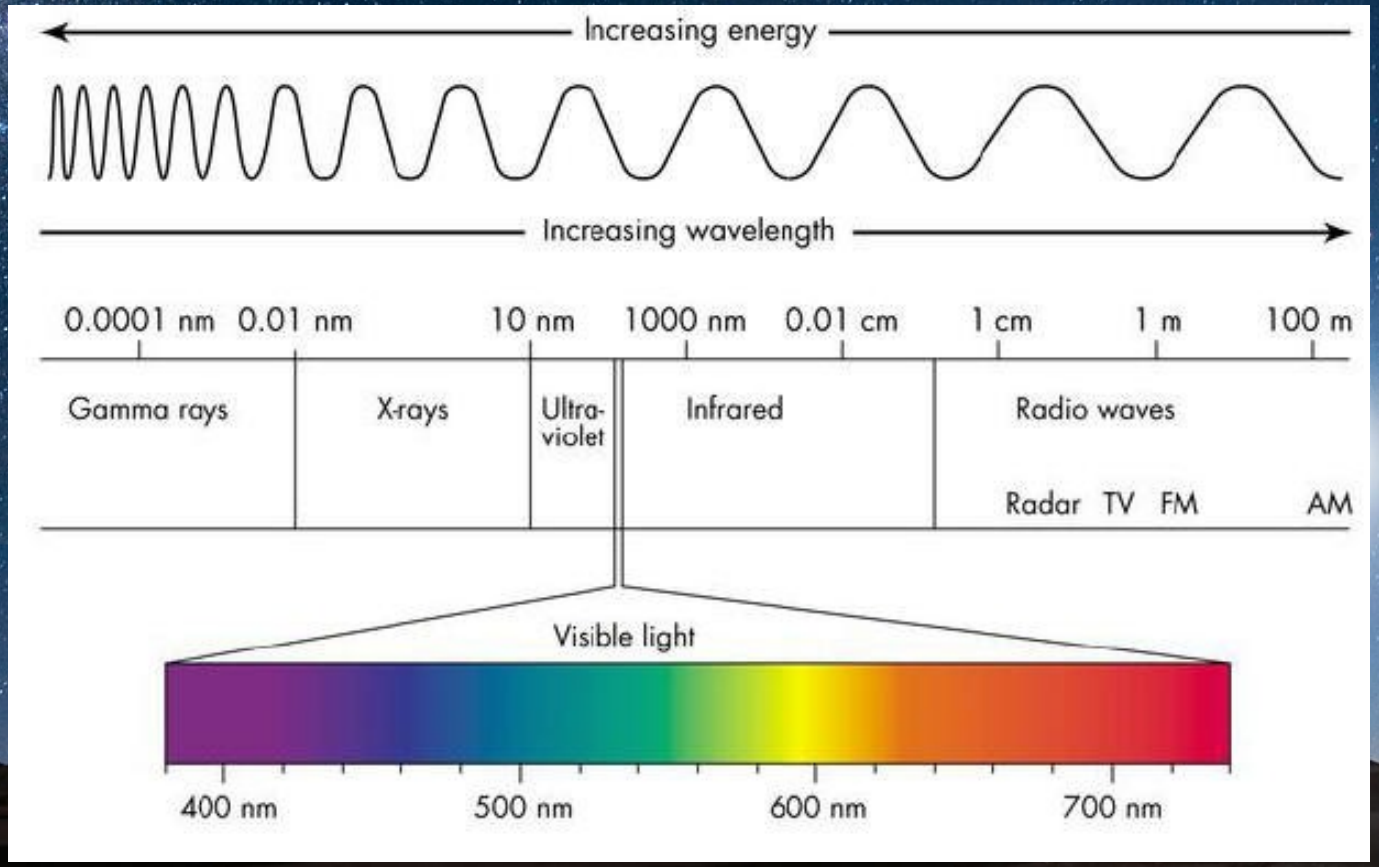


Zvok v vesolju

Star Wars: Empire at War developer Petroglpyh publisher LucasArts

Valovanje v vesolju

Valovanje električnega in magnetnega polja, ki potuje s hitrostjo svetlobe.



Valovanje v vesolju

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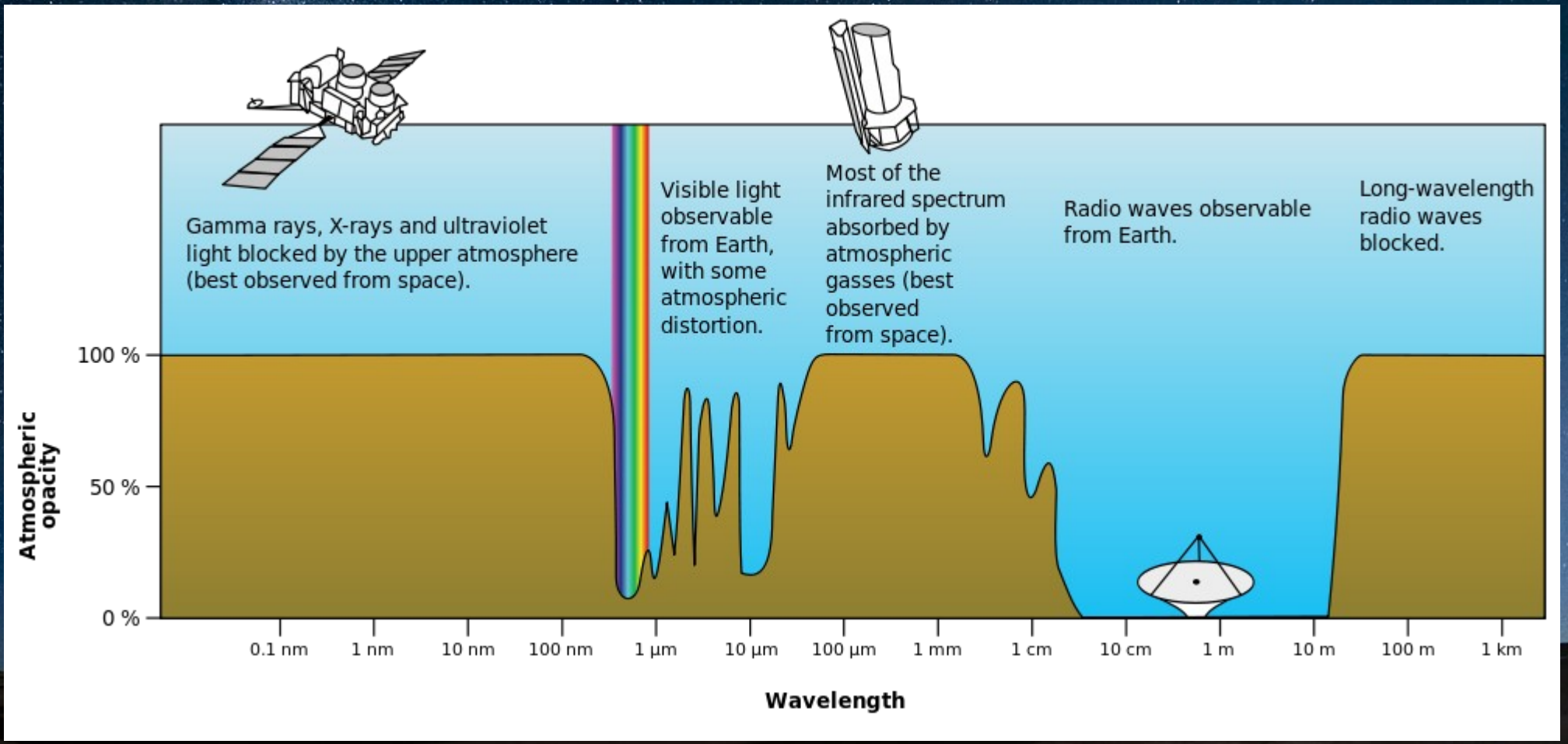


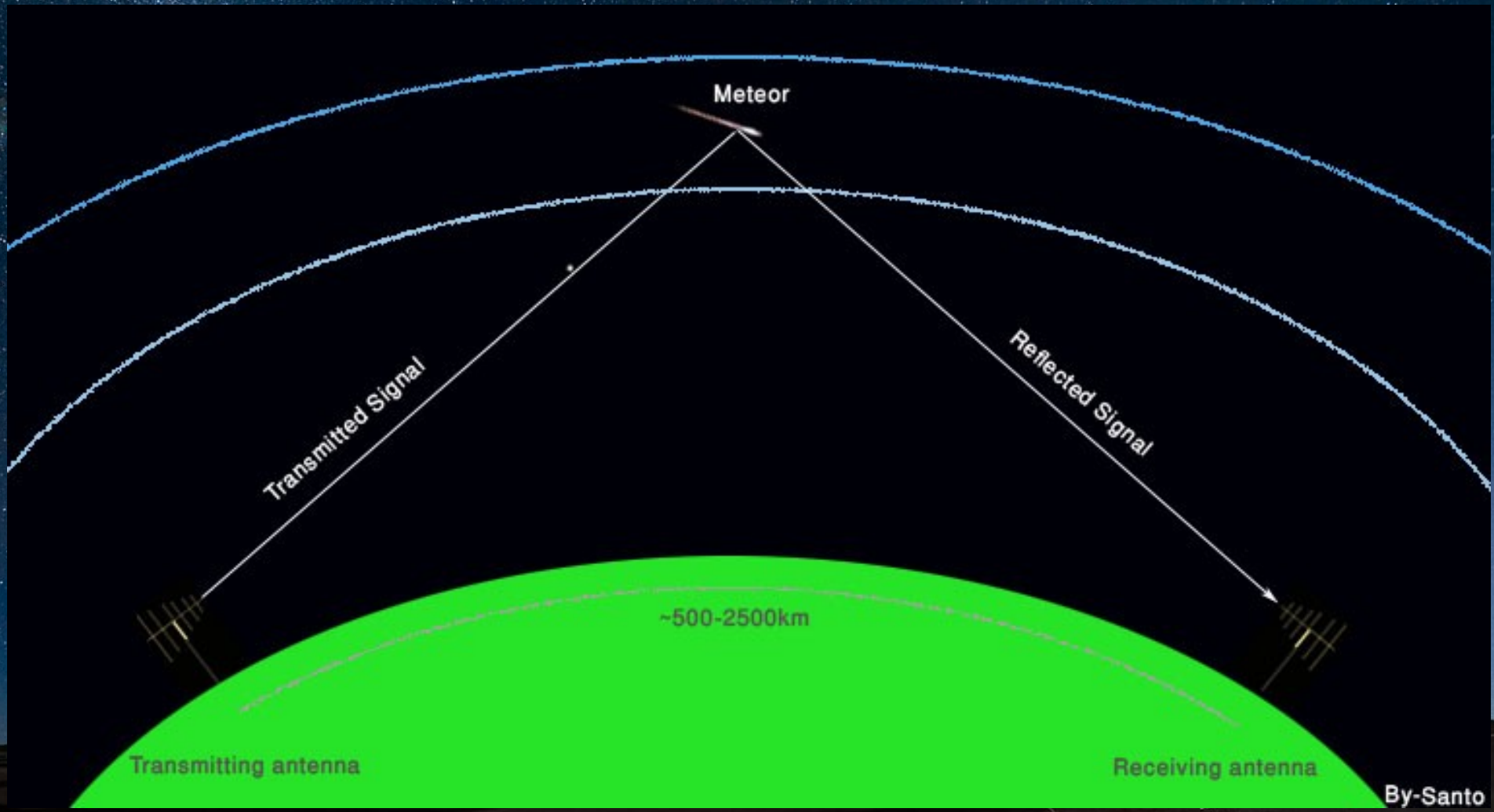
Avtorstvo: NASA

Pojavi v Zemljini atmosferi

Meteorji

Avtor: jeffsmallwood (Flickr)

Meteorji


Meteor
Transmitted Signal
Reflected Signal
~500-2500km
Transmitting antenna
Receiving antenna
By-Santo

Meteorji

- “močnejši” Perzeid
- Geminid
- več Geminidov (67Hz radar, 13.12.2003, Thierry Lombry)

Več o radijskem opazovanju meteorjev: http://www.imo.net/radio

Meteoriti

Avtor: Nikita Plekhanov

Meteoriti

Spletna povezava: http://www.youtube.com/watch?v=H-8ij80vs1E

Animation: Krzysztof Kolasinski; scientific data: Pierrick Mialle

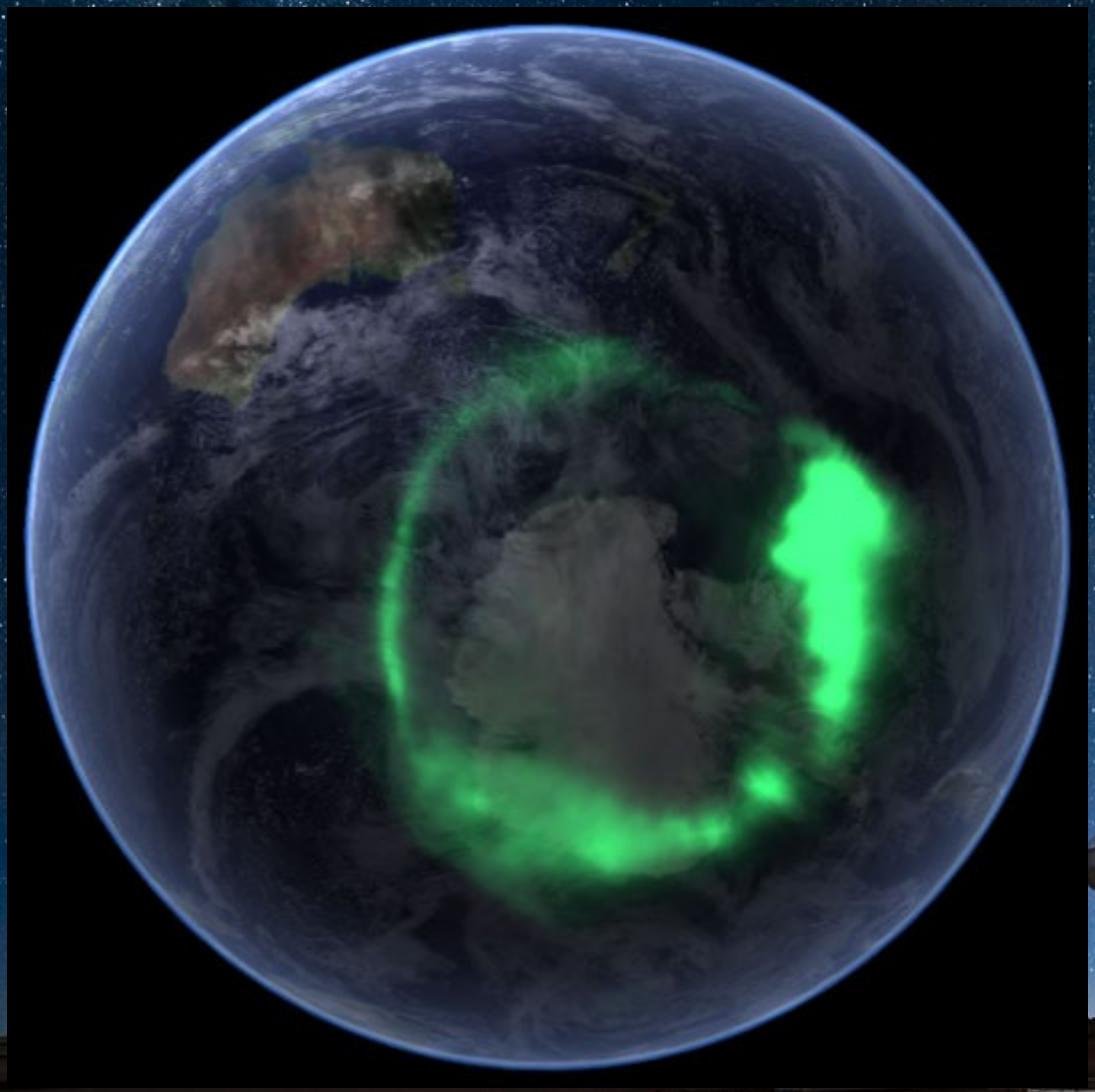
Polarni sij

Avtor: Anthony Clavien

Polarni sij

Avtor:Javor Kac, MBK Team

Polarni sij



- "Auroral whistlers" (0.1-11kHz, 9.9.1995, Stephen P. McGreevy)
- "Auroral chorus" med magnetno nevihto (Stephen P. McGreevy)

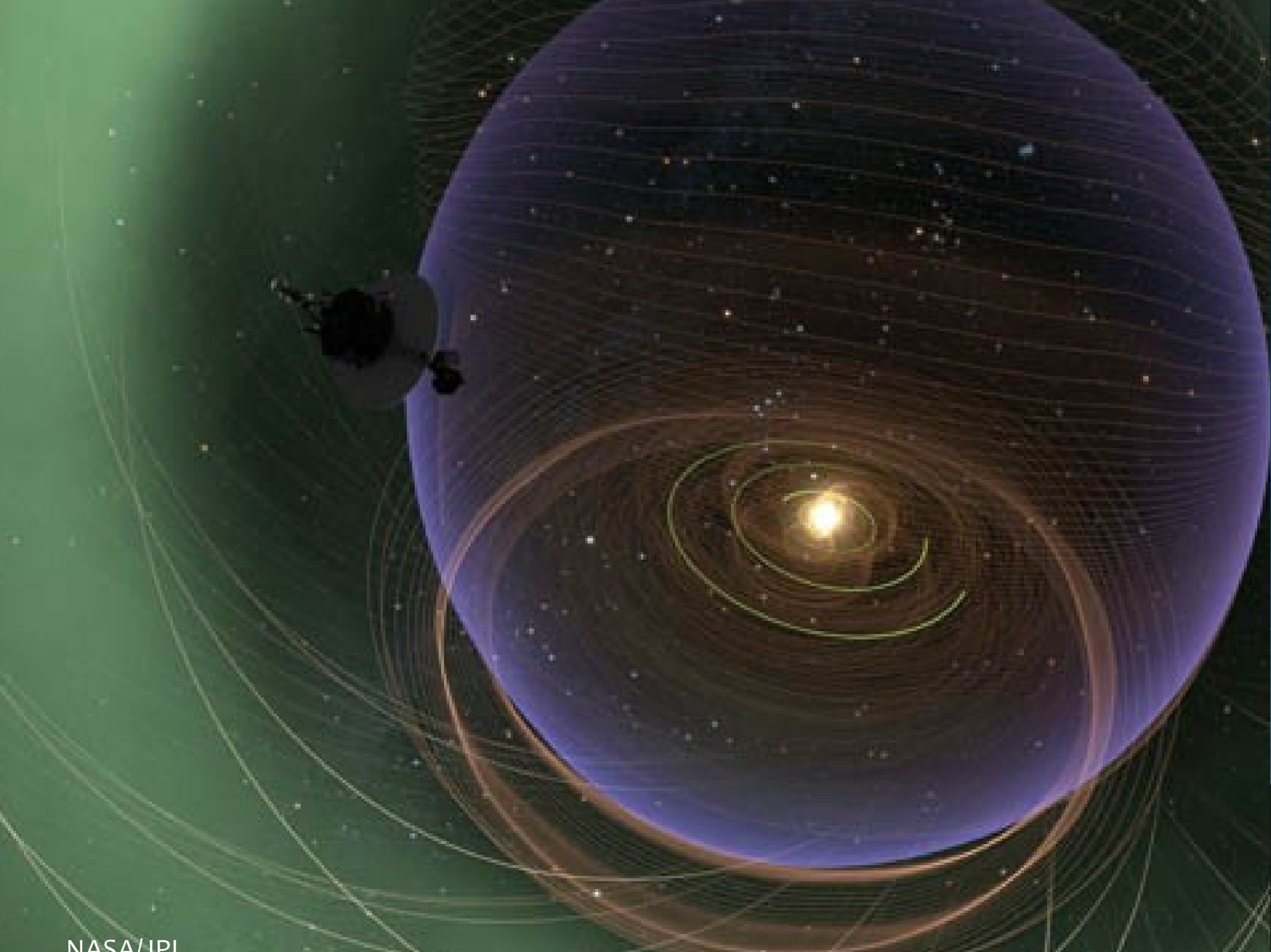
Aurora australis (avtorstvo: NASA)

Sateliti

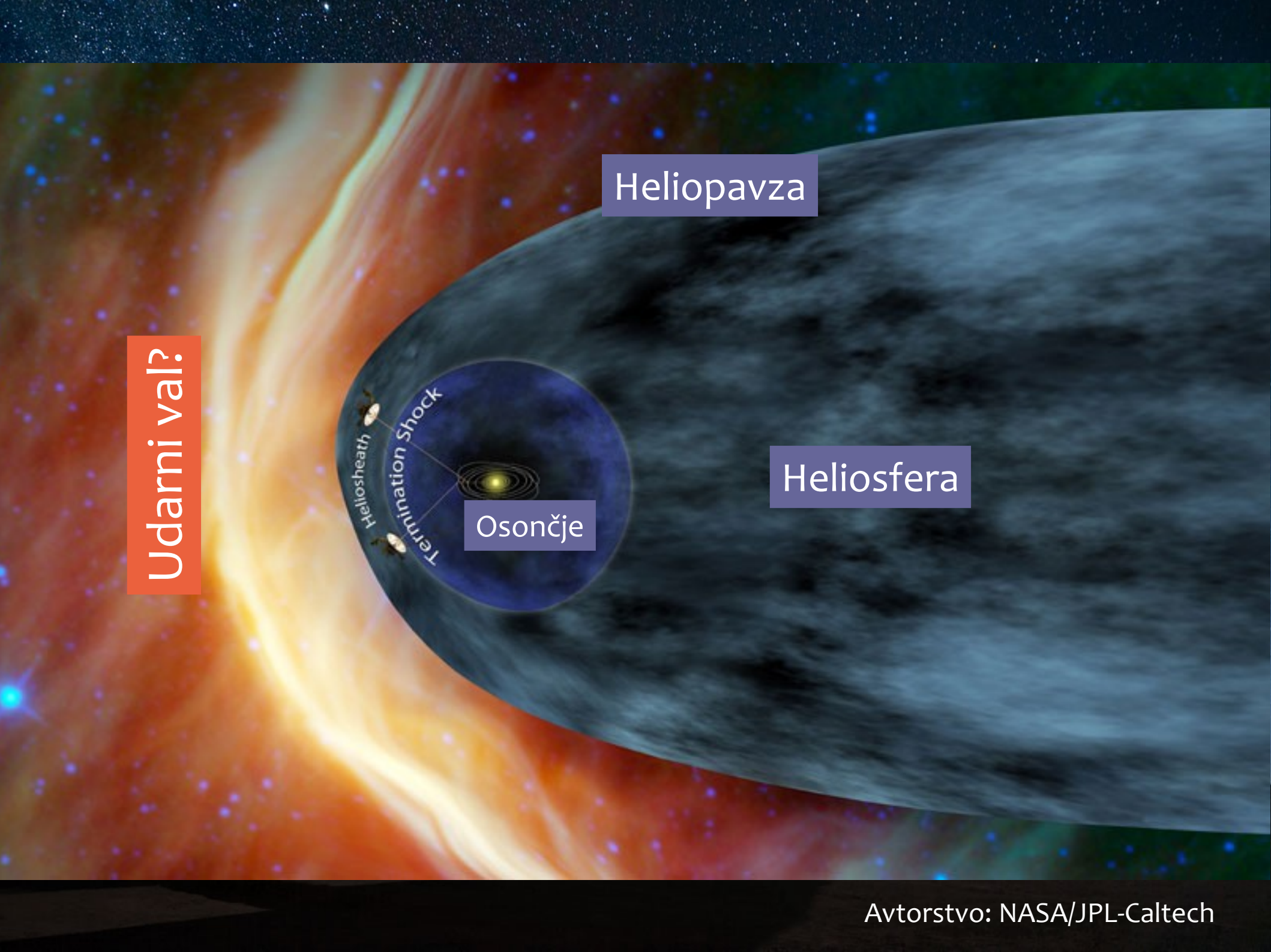
—Dallas News Staff Photo.

SIGNALS FROM THE SATELLITE

Ham operator Roy Welch of Dallas, seated, plays a tape-recorded signal from the Russian space satellite for fellow hams at the State Fair of Texas. Welch recorded the signals on a receiver at his home.

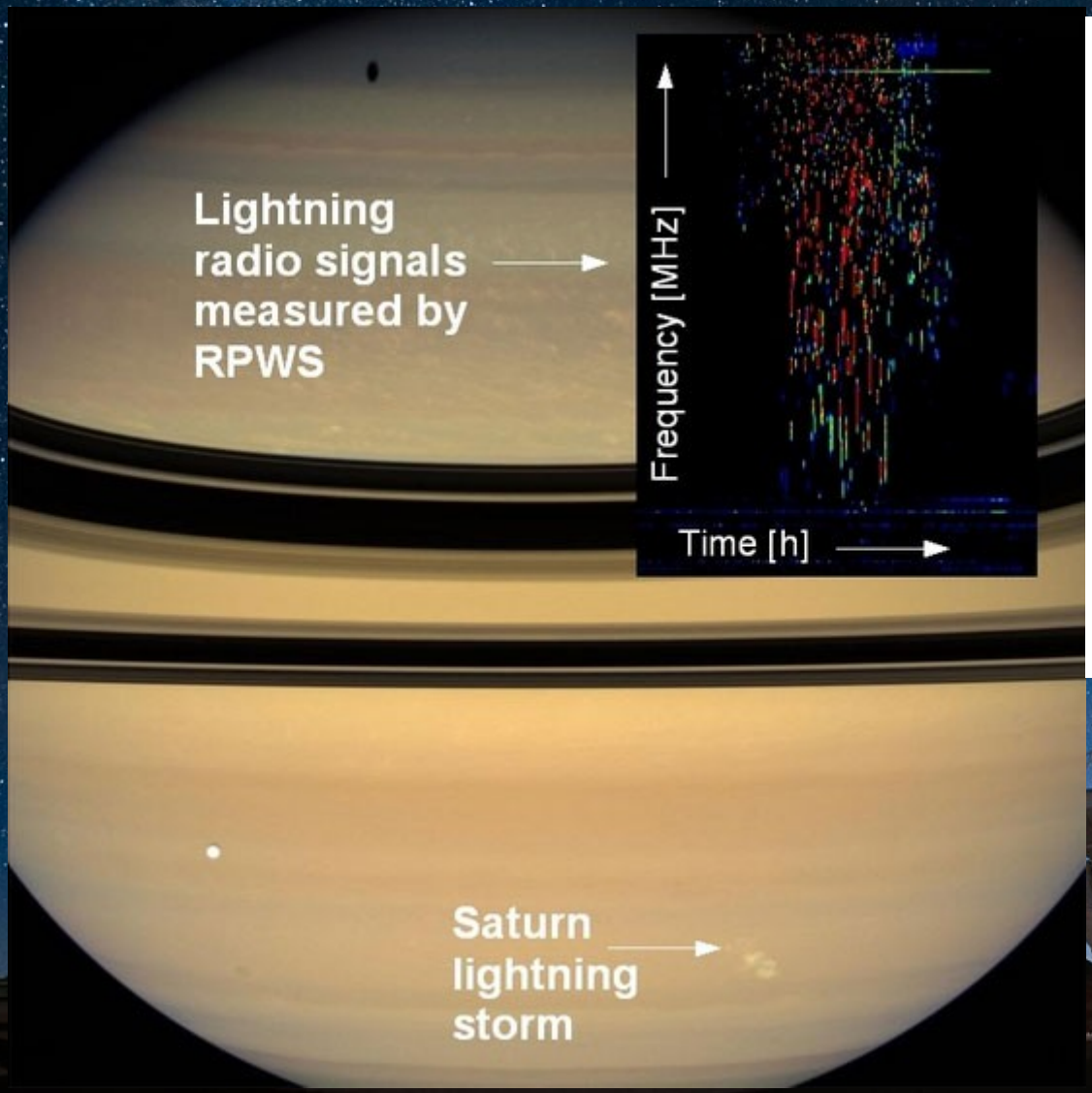

NASA/JPL

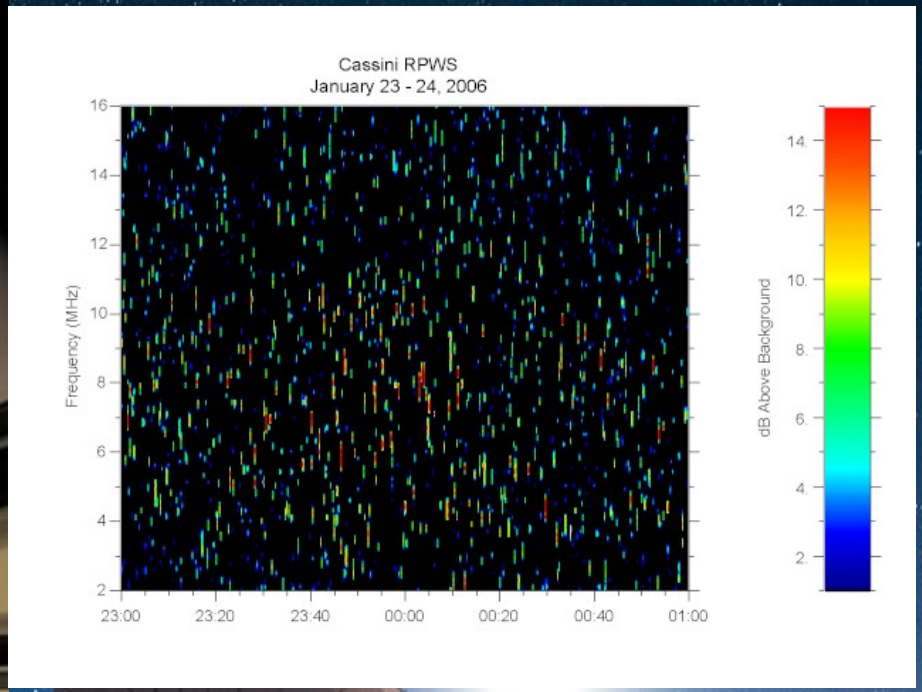
Spletna povezava http://www.youtube.com/watch?v=aNB4FaNh0wQ



Avtorstvo: NASA/JPL-Caltech

Nevihte na Saturnu





Strele na Saturnu

Avtorstvo: NASA/JPL-Cassini

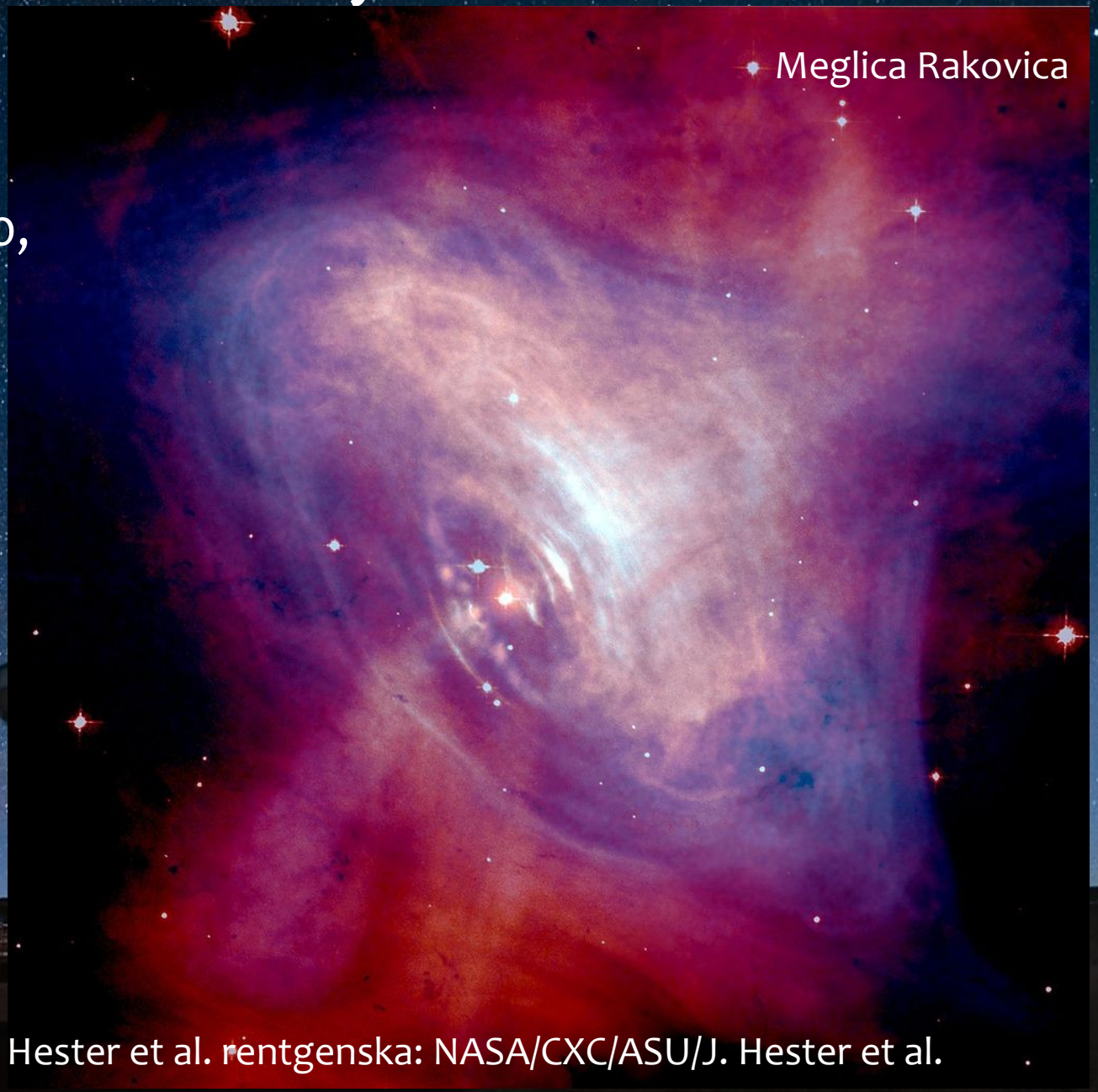
Spust na Titan

- Spuščanje na Titan
- Merjenje površja z odmevi

Huyghensov prvi posnetek s Titanovega površja

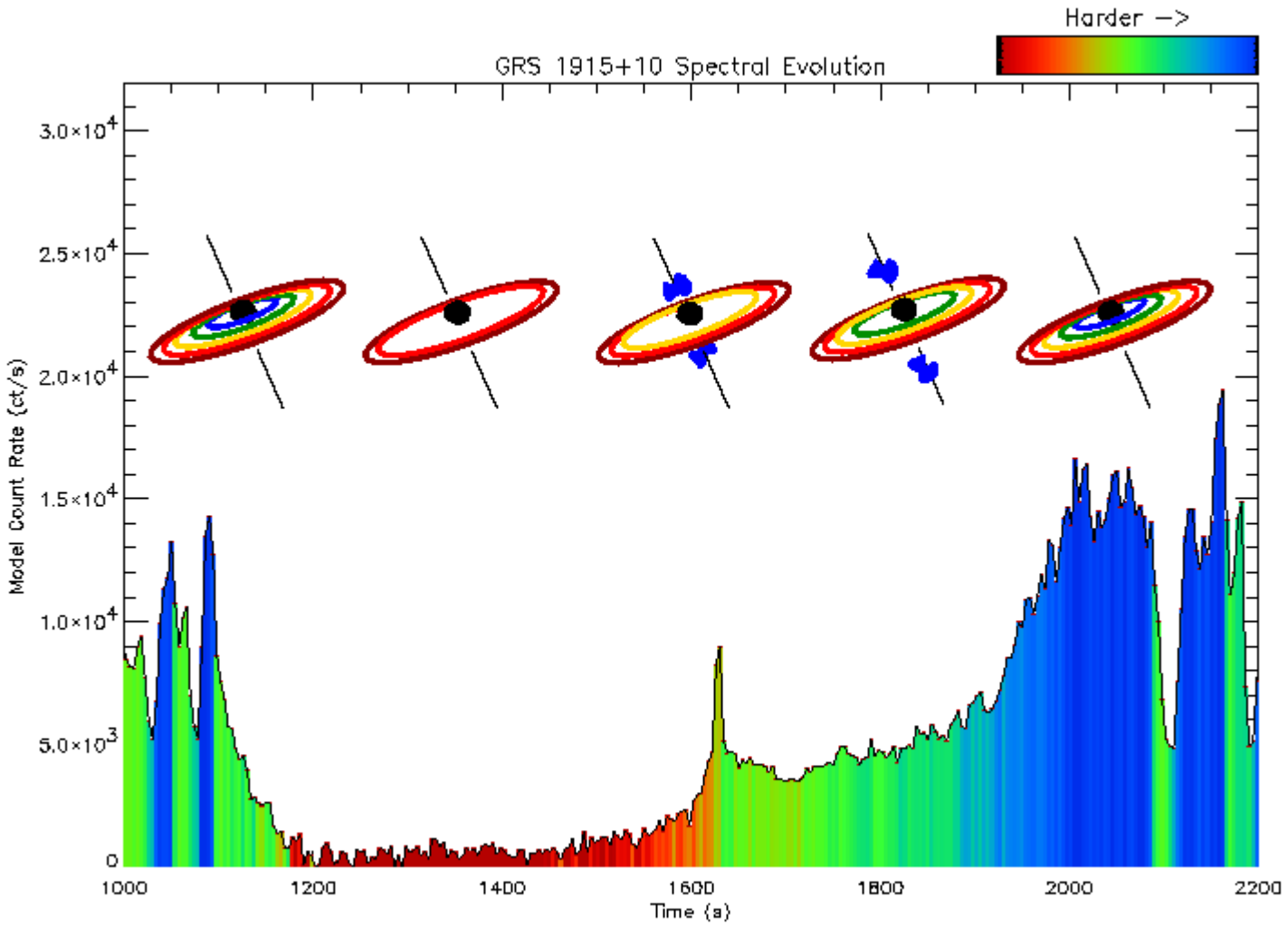
Pulzarji

- pulzar PSR 0950+08-0, Perioda 0.253 sec (NRAO 92-m radijski teleskop @410 MHz)
- pulzar PSR B0531+21 (Rakovica), perioda 1/30 sekunde (Jodrell Bank)



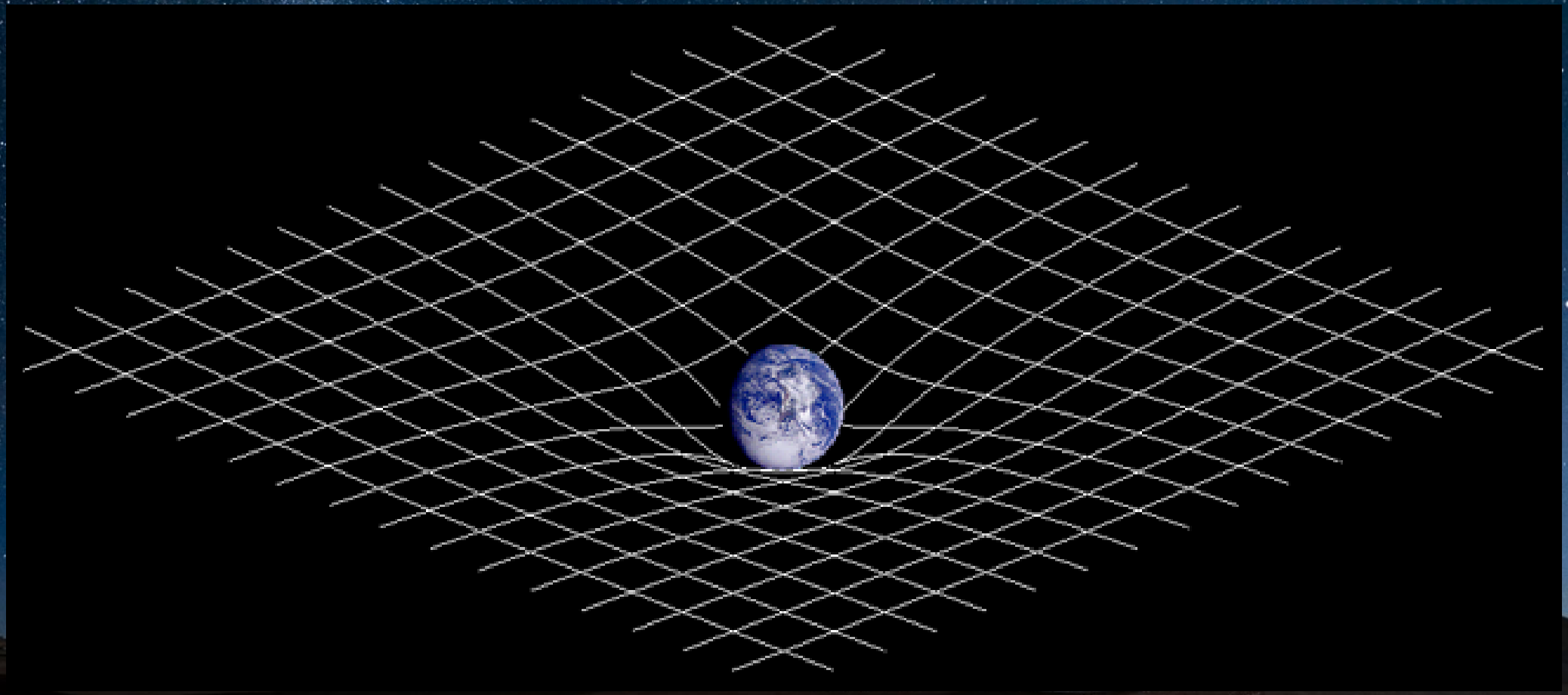
Vidna svetloba: NASA/HST/ASU/J. Hester et al. rentgenska: NASA/CXC/ASU/J. Hester et al.

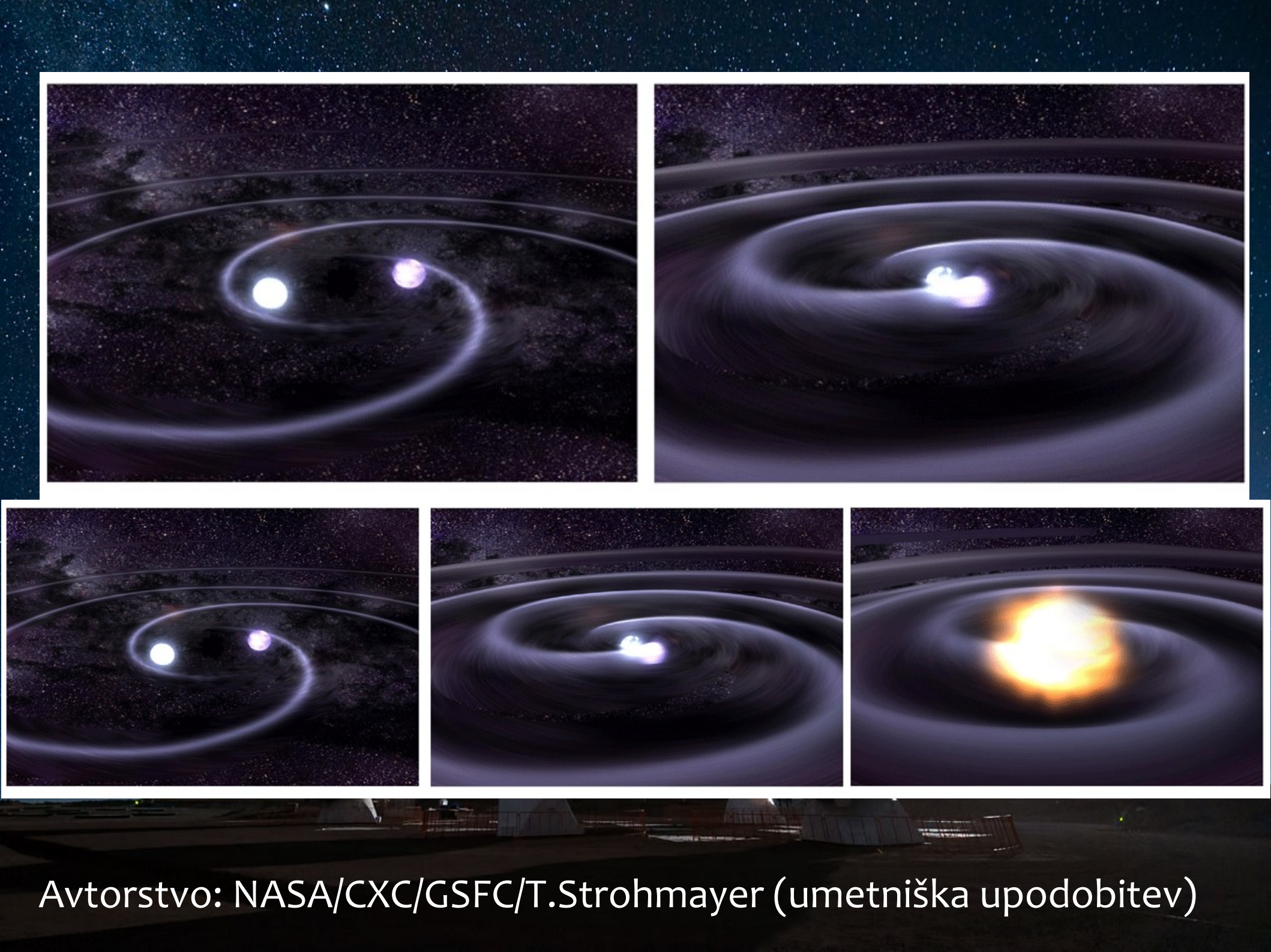
Požrešna črna luknja



Opazovanje rentgenske svetlobe

Pa še drugo valovanje...



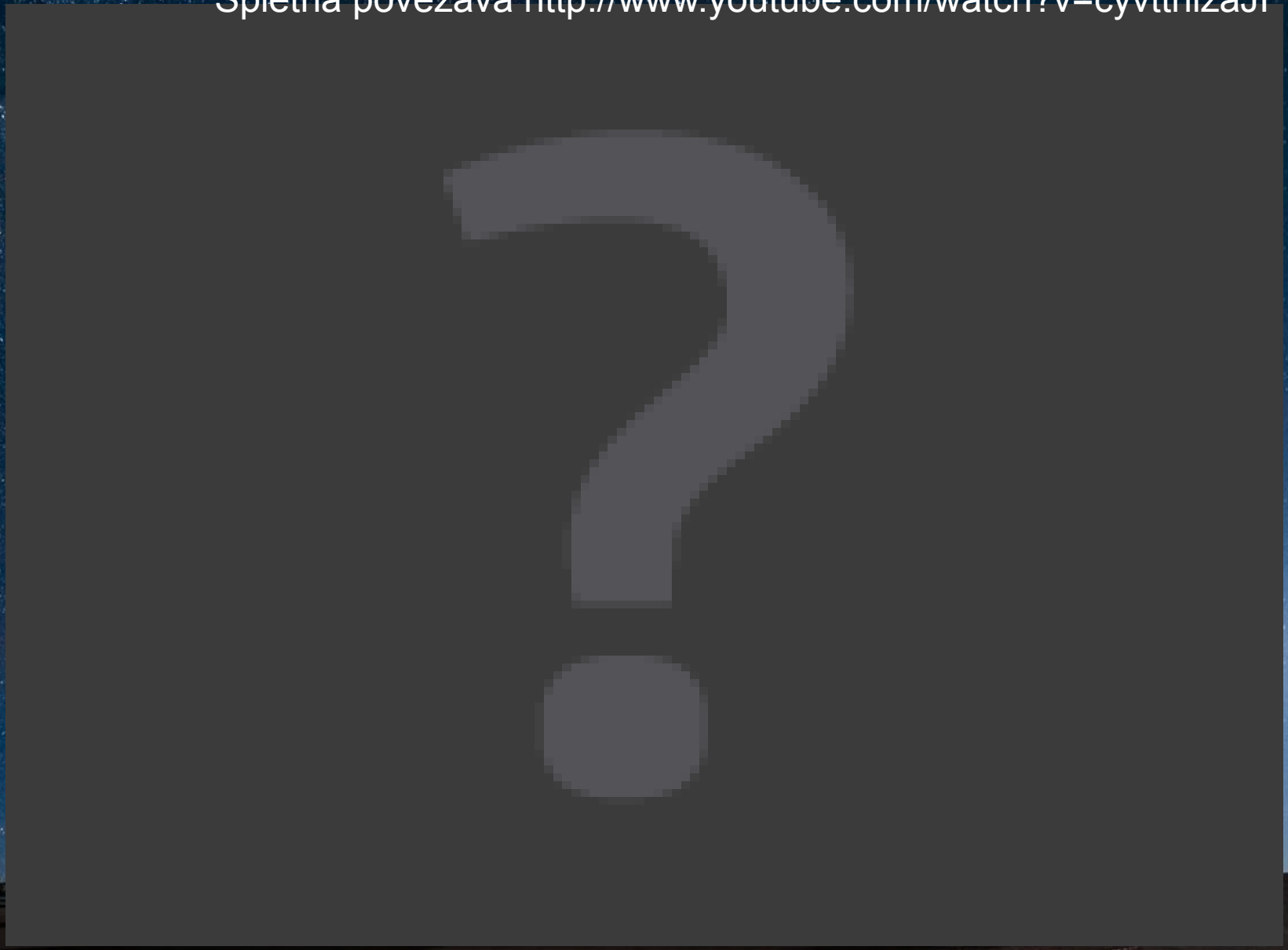


Avtorstvo: NASA/CXC/GSFC/T.Strohmayer (umetniška upodobitev)

Spletna povezava http://www.youtube.com/watch?v=esdzw8XETJM

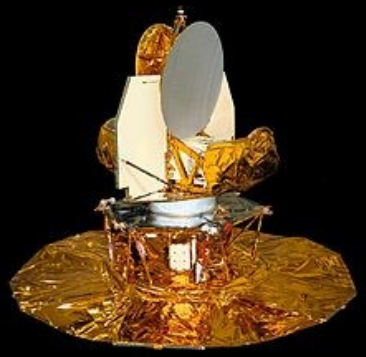
Črni luknji. Avtorja: Aftab Khan in Janna Levin

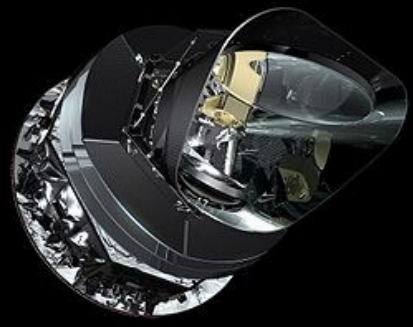
Spletna povezava http://www.youtube.com/watch?v=cyvtthizaJI

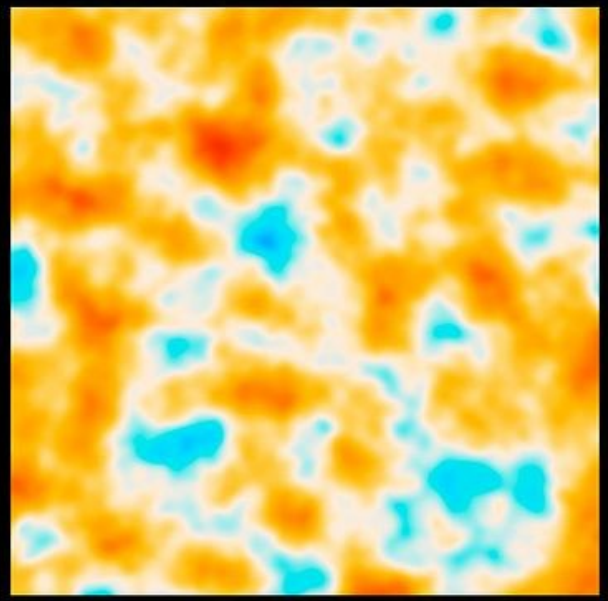


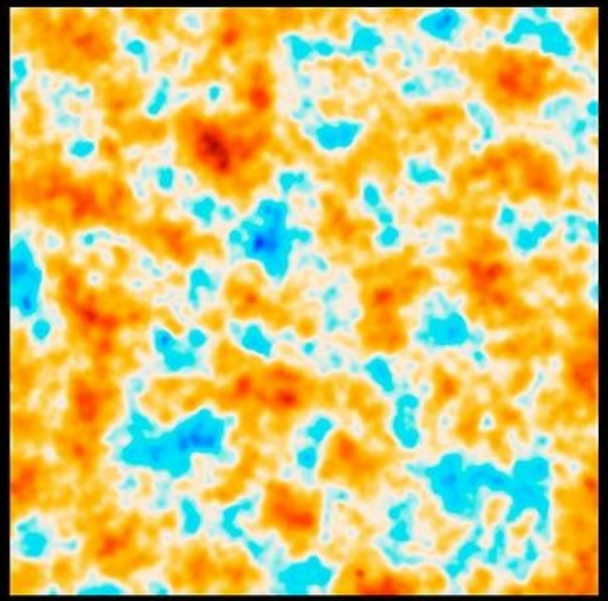
Nevtronska zvezda in črna luknja. Avtorja: Aftab Khan in Janna Levin

Mikrovalovno sevanje ozadja







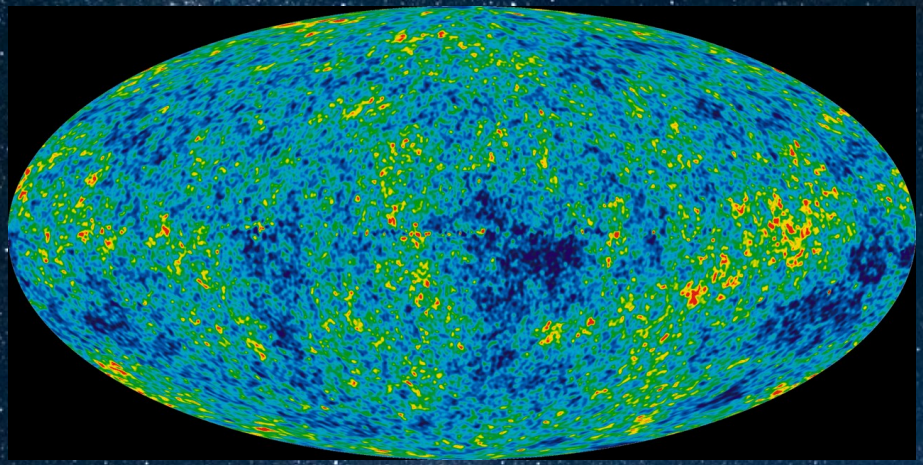


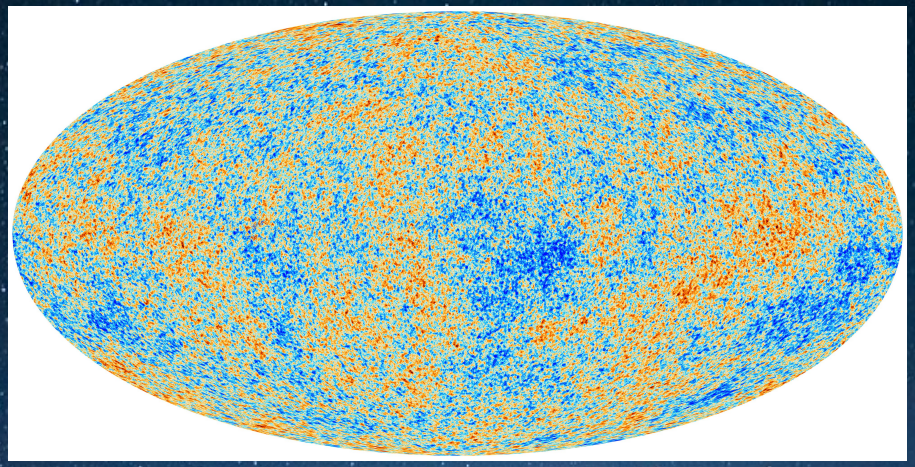
COBE

WMAP

Planck

Prvih 760.000 let vesolja





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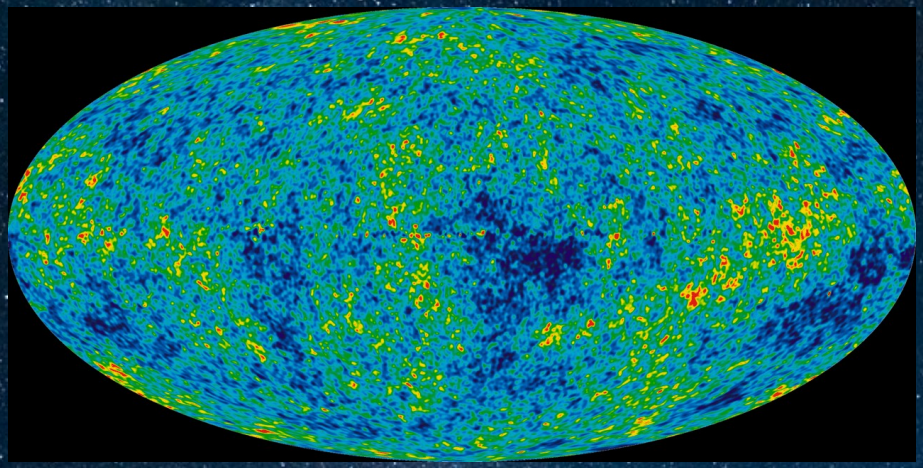
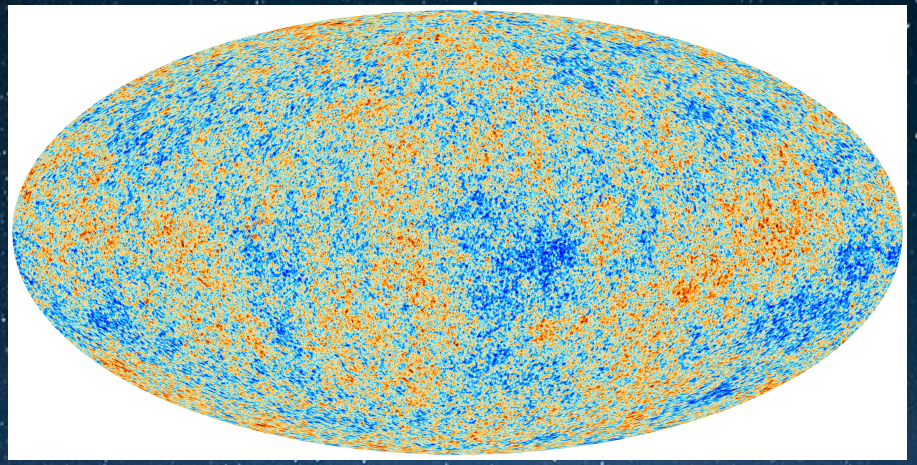
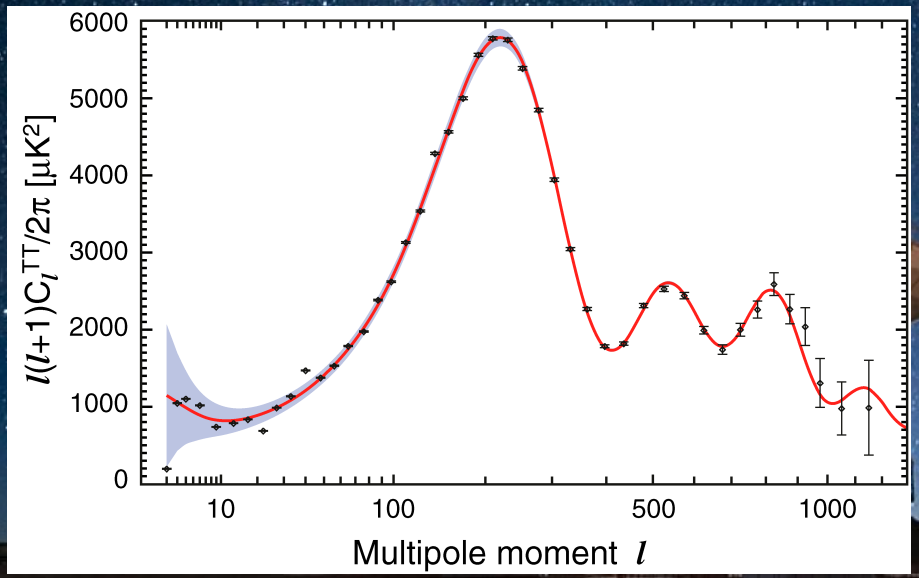
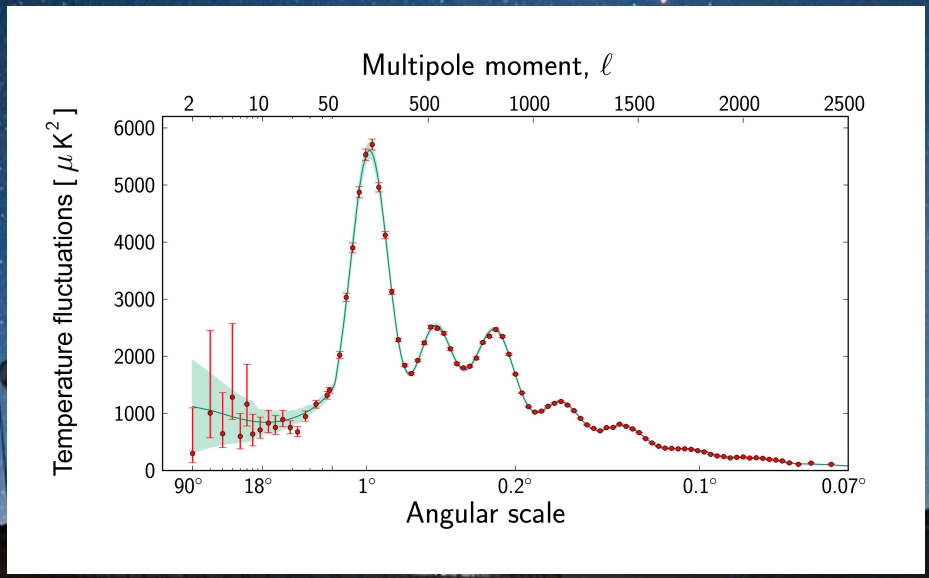
Prvih 760.000 let vesolja

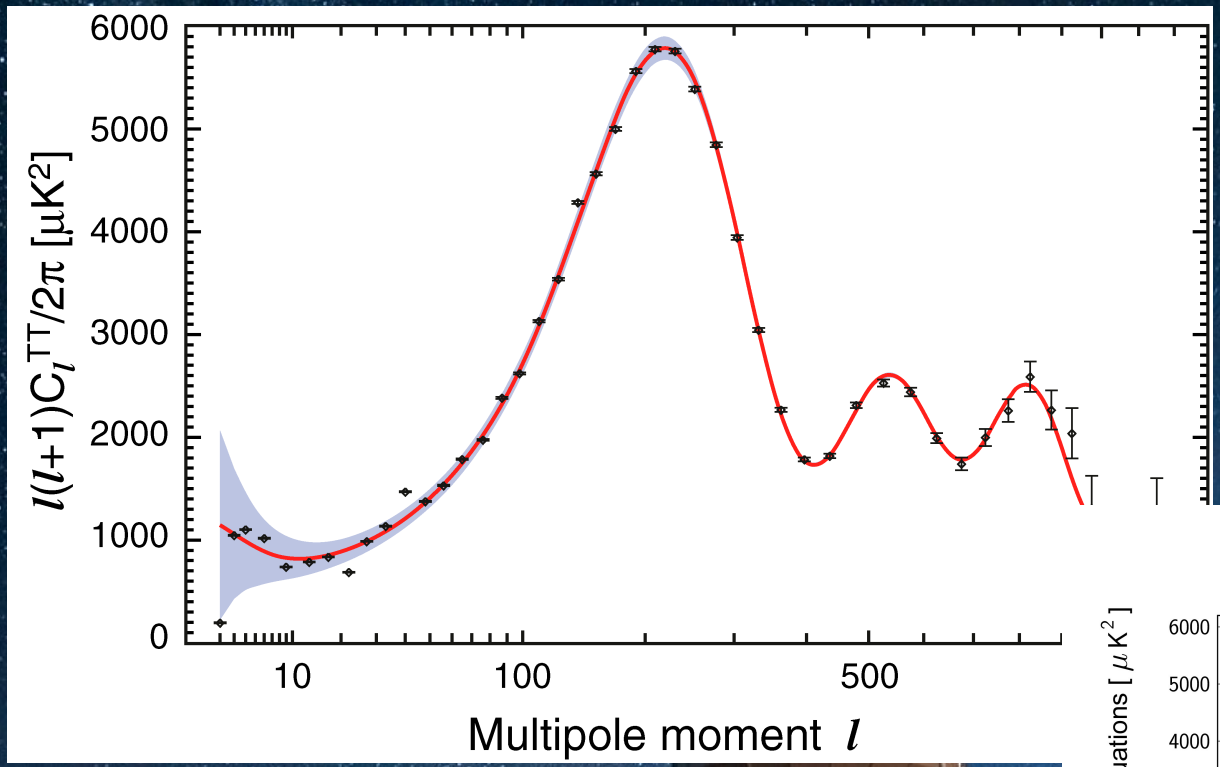




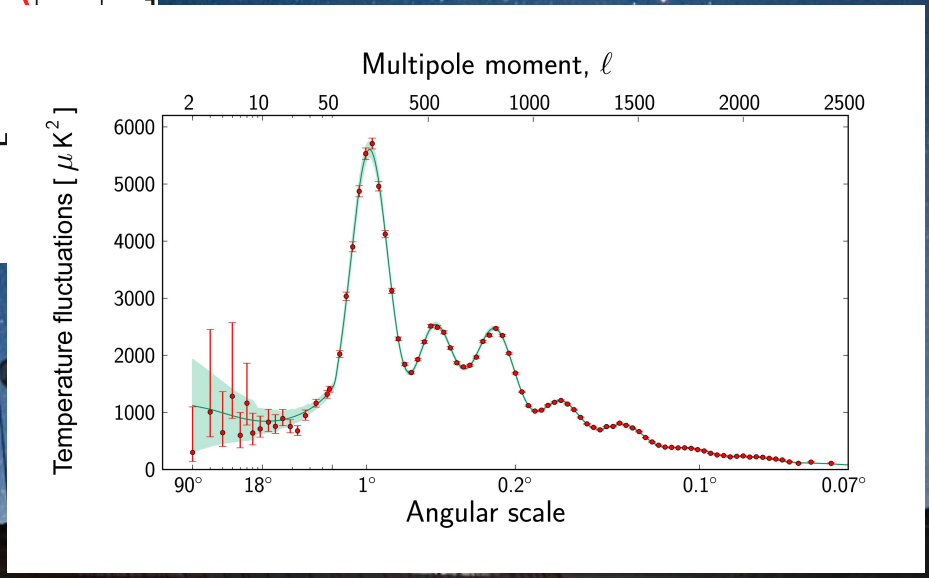




Prvih 760.000 let vesolja



WMAP



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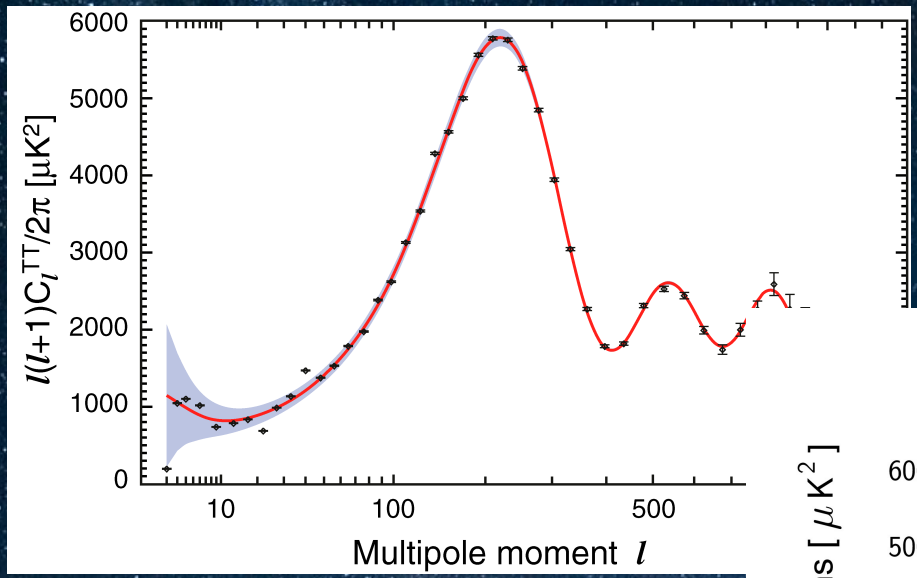
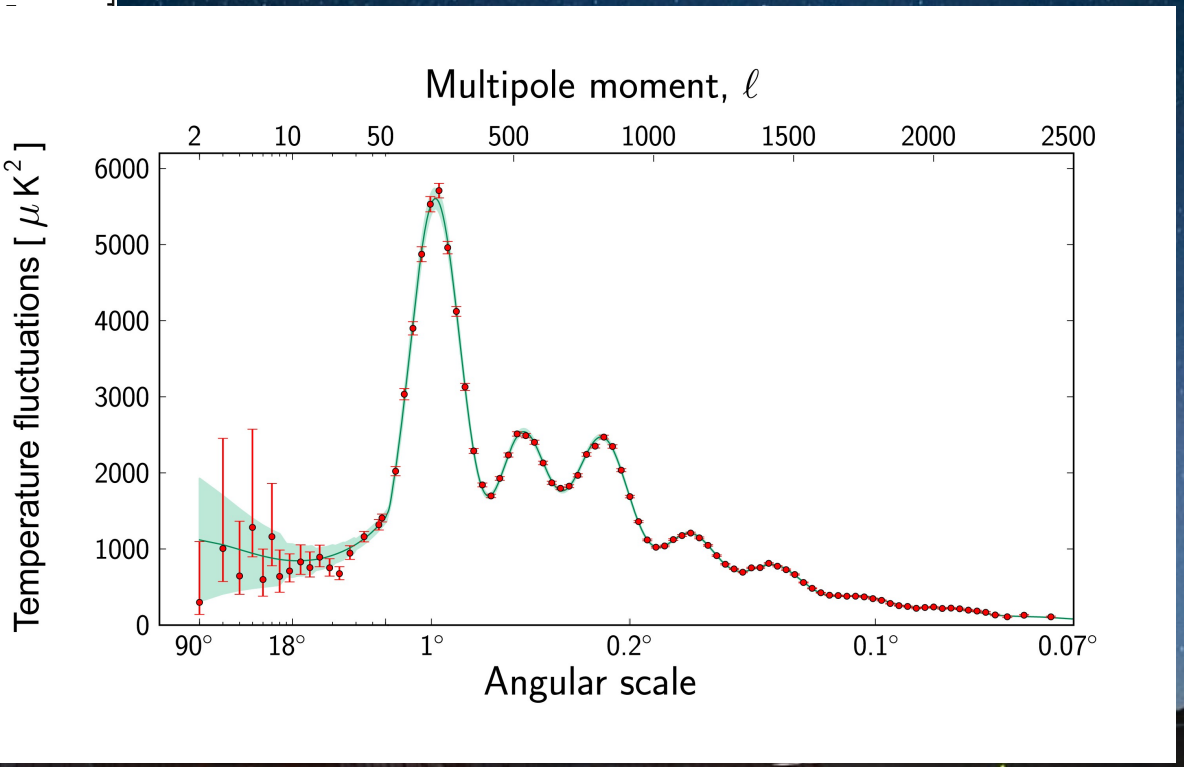
Prvih 760.000 let vesolja





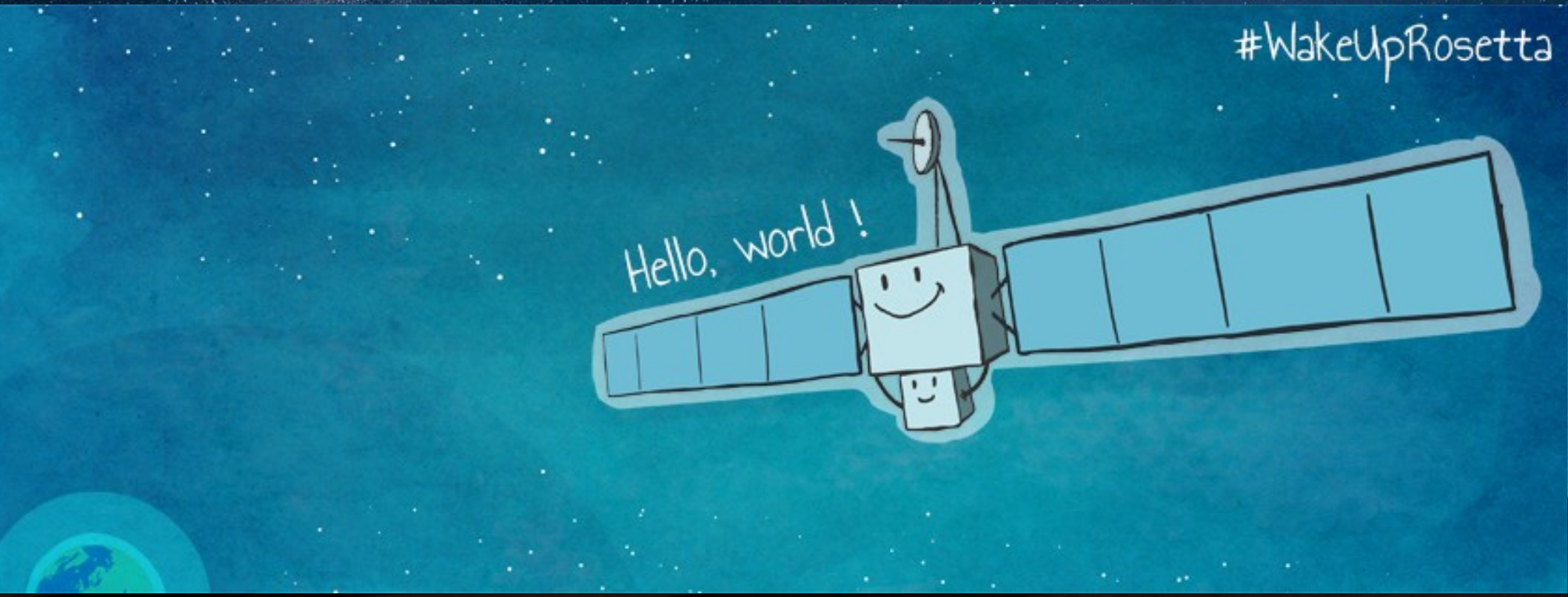
Planck

… ali pa sestavljene frekvence

- Mikrovalovno sevanje ozadja

Se še spomnite Rosette?

Prebudila se je 20. januarja!



Se še spomnite Rosette?

Viri

- Janna Levin: The sound the universe makes, TED2011 in http://www.jannalevin.com/science.html
- John G. Cramer, The Sound of the Big Bang http://faculty.washington.edu/jcramer/BBSound_2003.html http://faculty.washington.edu/jcramer/BBSound_2013.html
- http://www.astrosurf.com/luxorion/audiofiles.htm
- Sounds from the first Satellites, http://www.amsat.org/amsat/features/sounds/firstsat.html
- Sonification, http://spdf.gsfc.nasa.gov//research/sonification/sonification.html

Viri

- Projekt “Sounds of Space”, http://cse.ssl.berkeley.edu/stereo_solarwind/sounds.html
- Spletna stran z zvočnimi efekti http://www.sounddogs.com/
- Zvoki, ki jih je posnela sonda Cassini: http://saturn.jpl.nasa.gov/news/cassinifeatures/feature20060424/
- Sounds of the Universe

  http://www.mso.anu.edu.au/pfrancis/Music/
- Signali s prvih satelitov http://www.amsat.org/amsat/features/sounds/firstsat.html