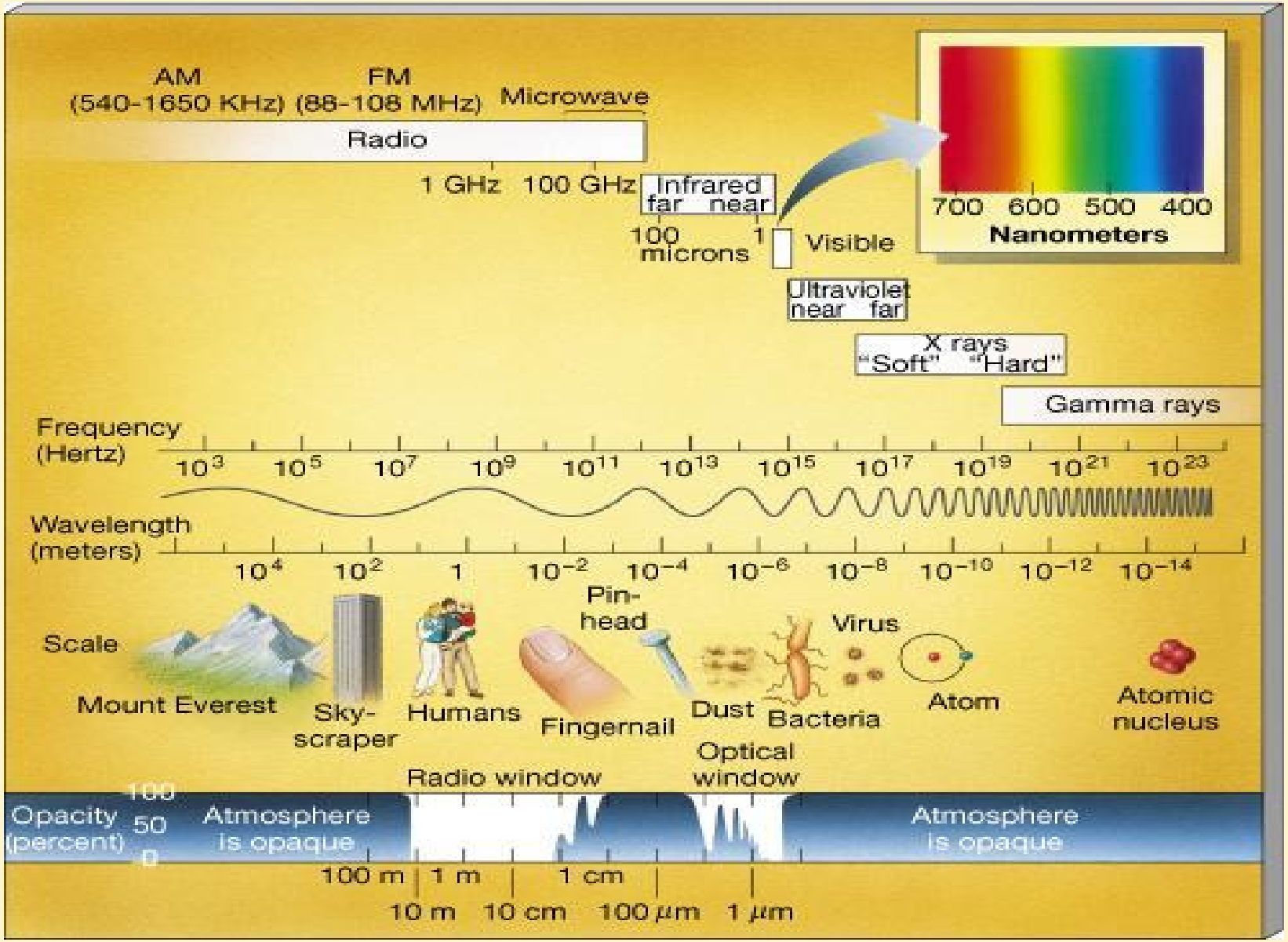
O jei pasakoti apie mokslinių tyrimų rezultatus, tai verta parodyti ir įrangą, kuri buvo bei yra reikalinga tiems tyrimams atlikti. (“Virtualios ekskursijos”)

- Kartais ta įranga aiški,
- Kartais tai prietaisų “tumulas”
- Tačiau gana dažnai jų vaizdas parodo, kiek ja gaunamos žinios kainuoja (neskaičiuojant žmogiškojo faktoriaus)

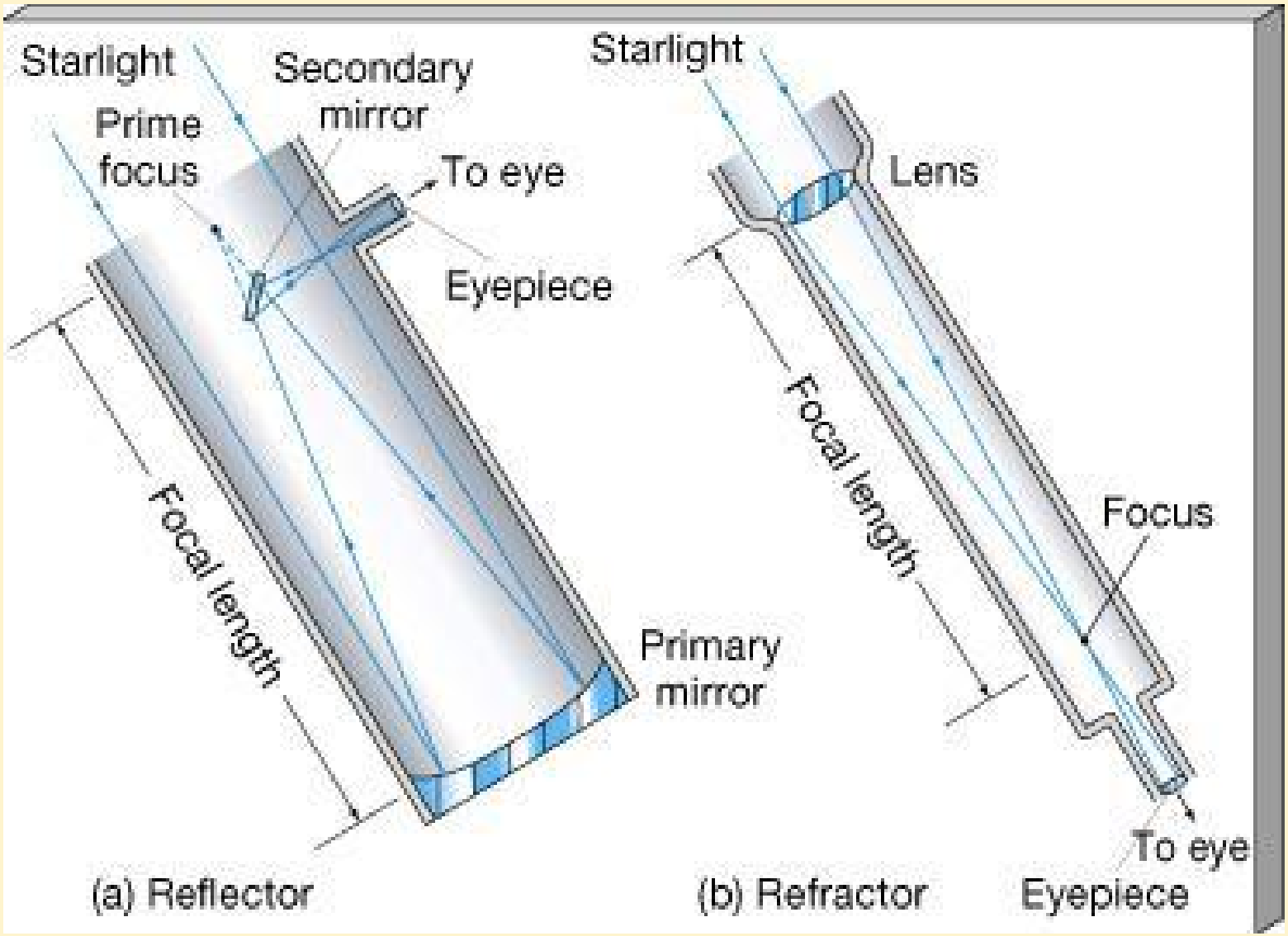
Žmonija žvelgia į megapasaulį

Teleskopai

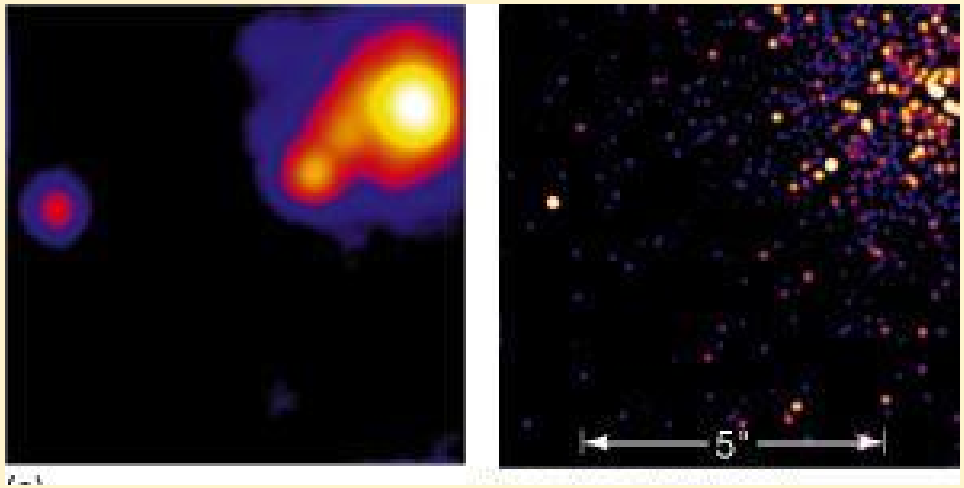
Elektromagnetinių bangų skalė

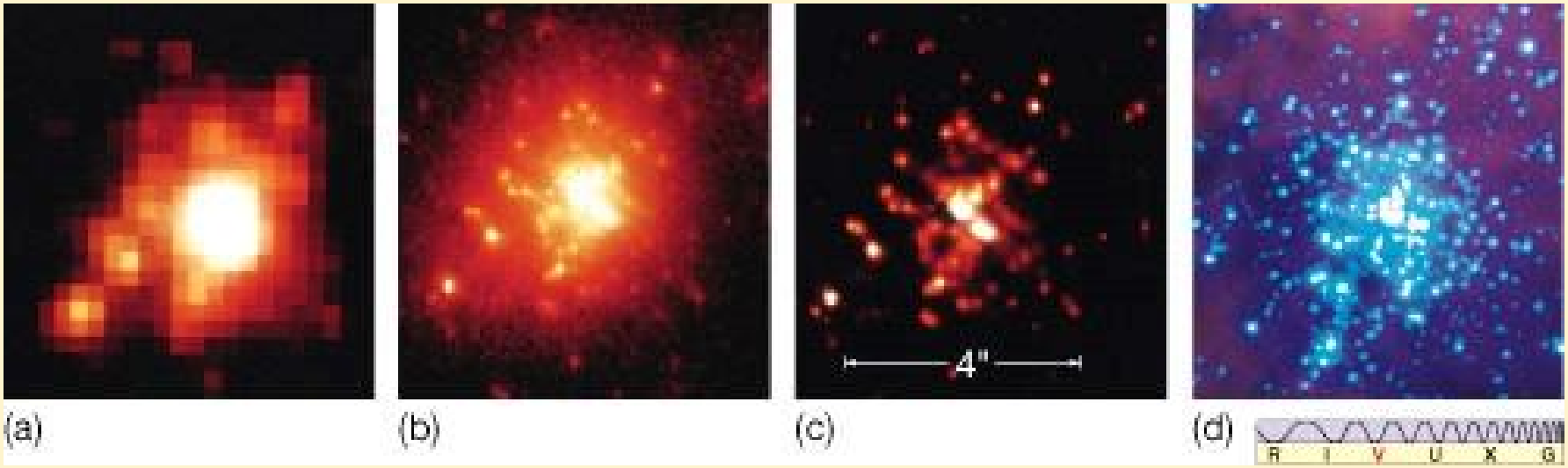


Teleskopų principinės schemos

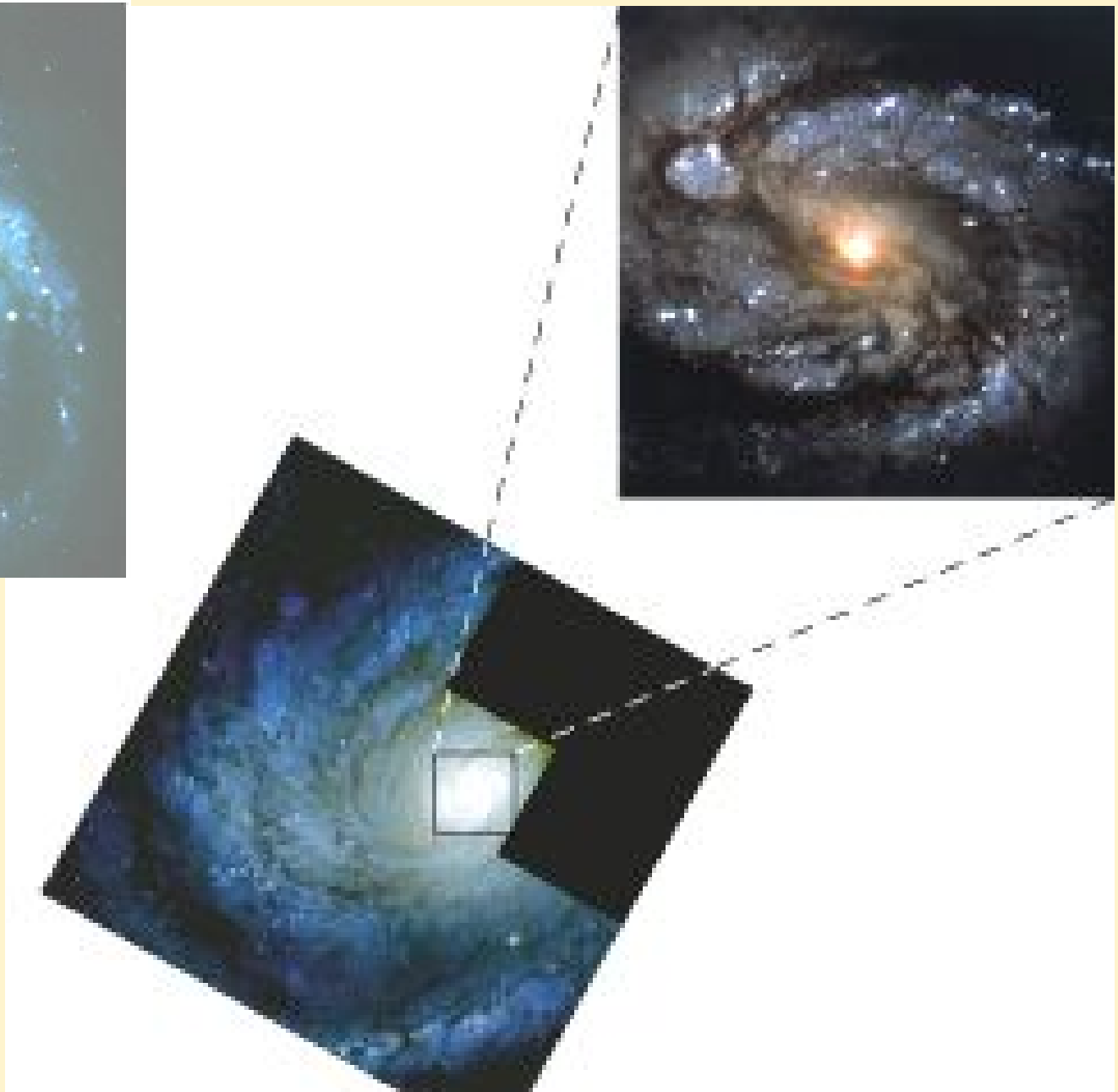


Teleskopų skiriamosios gebos reikšmė

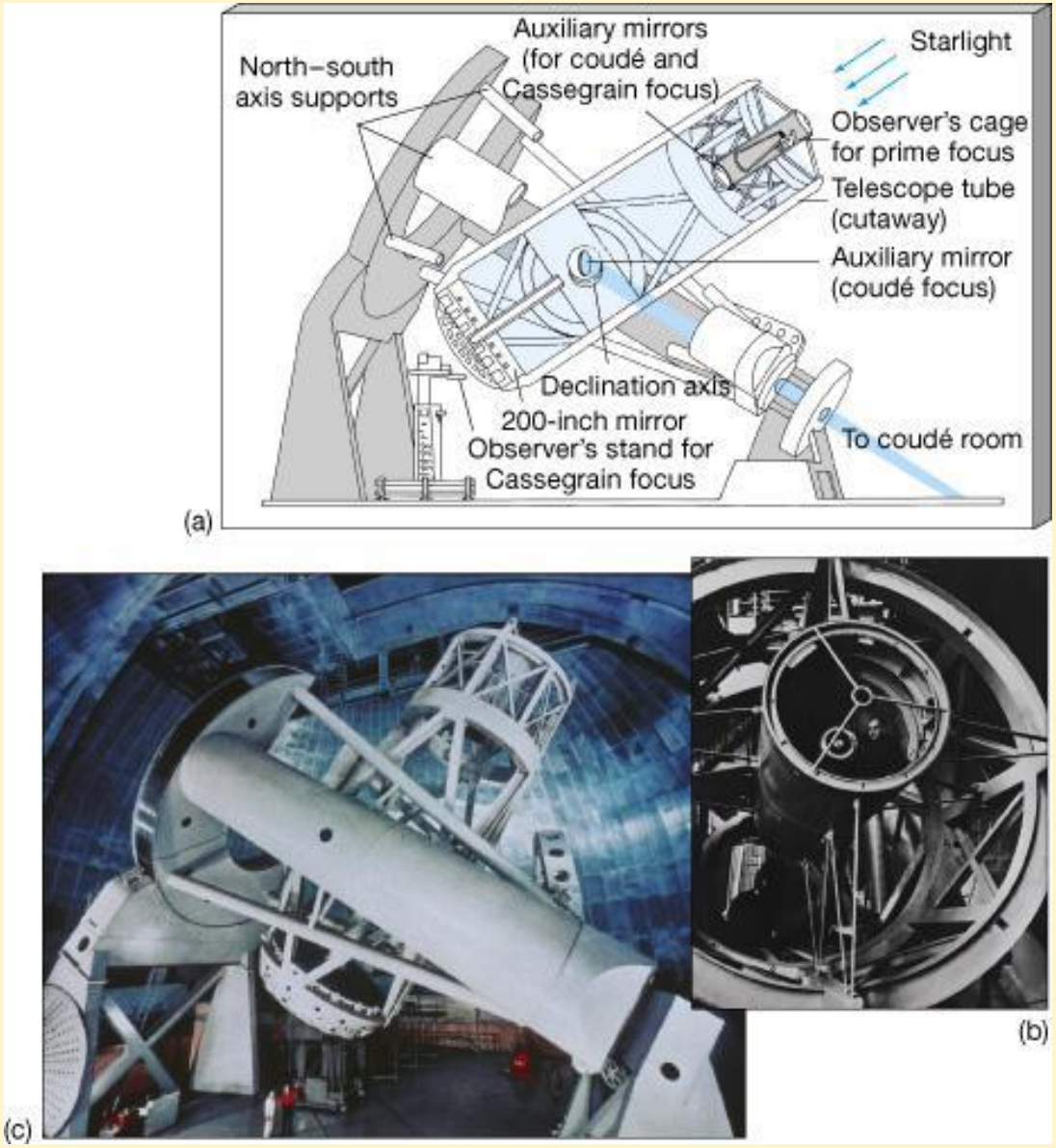




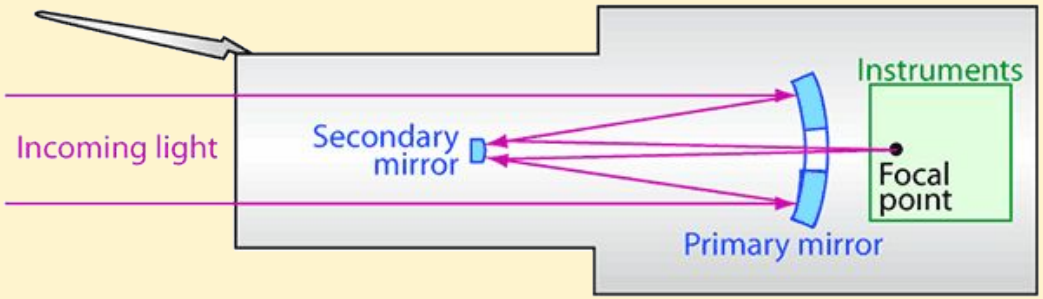
Teleskopų kokybės reikšmė

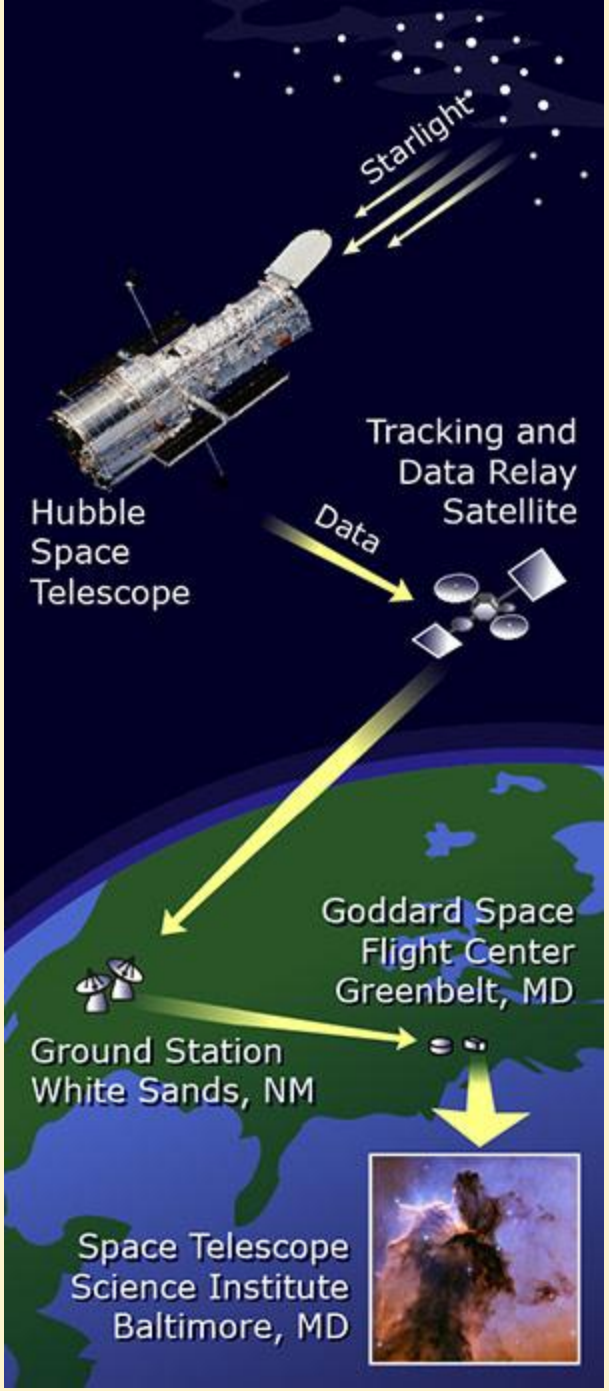


Palomaro teleskopas



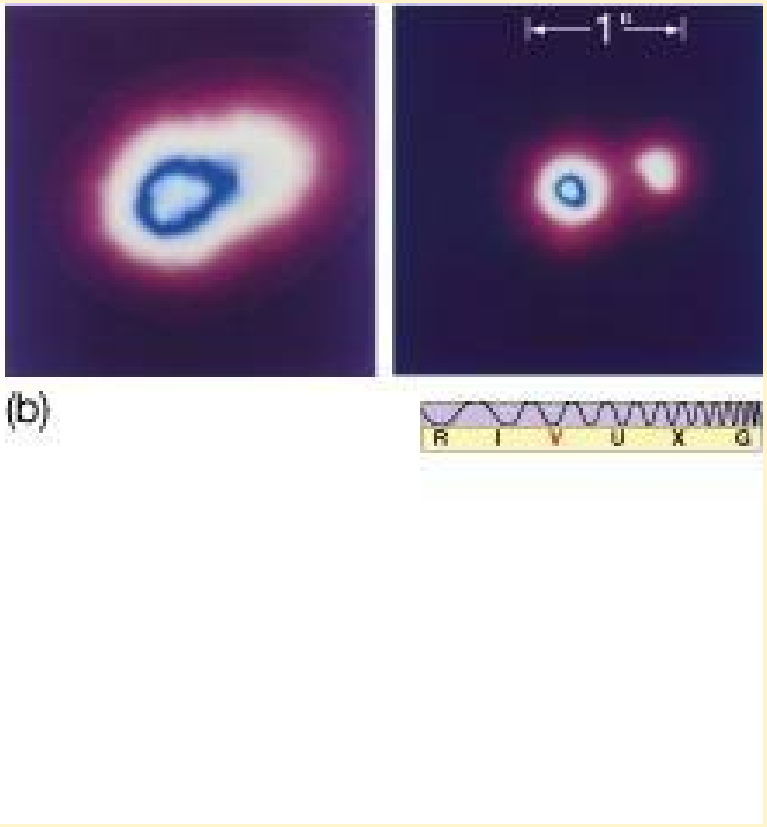
Hablo teleskopas kosmose





Adaptyvioji optika

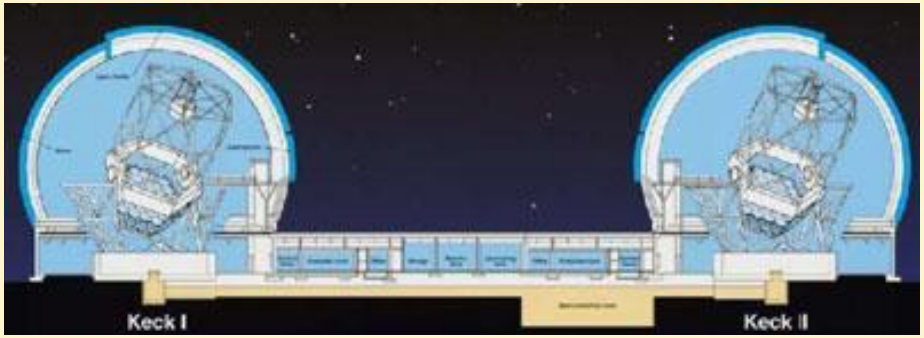
(a)

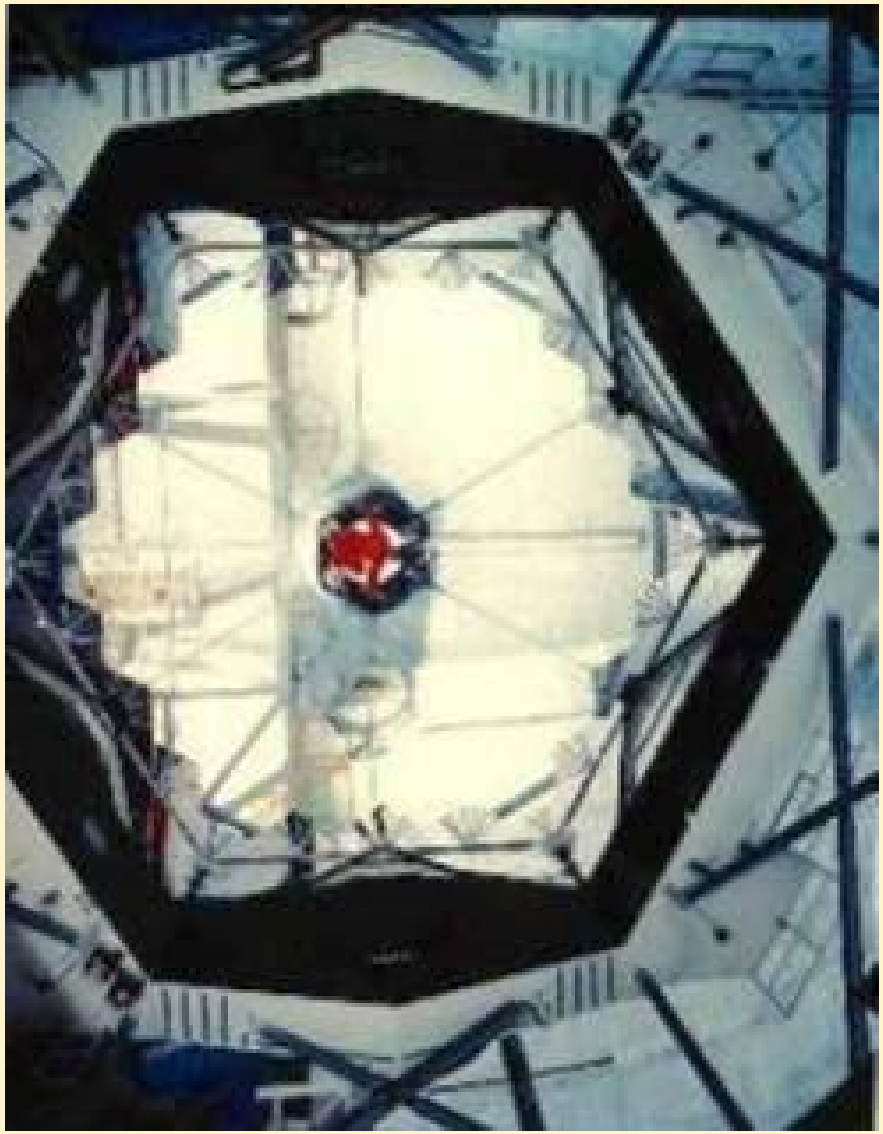


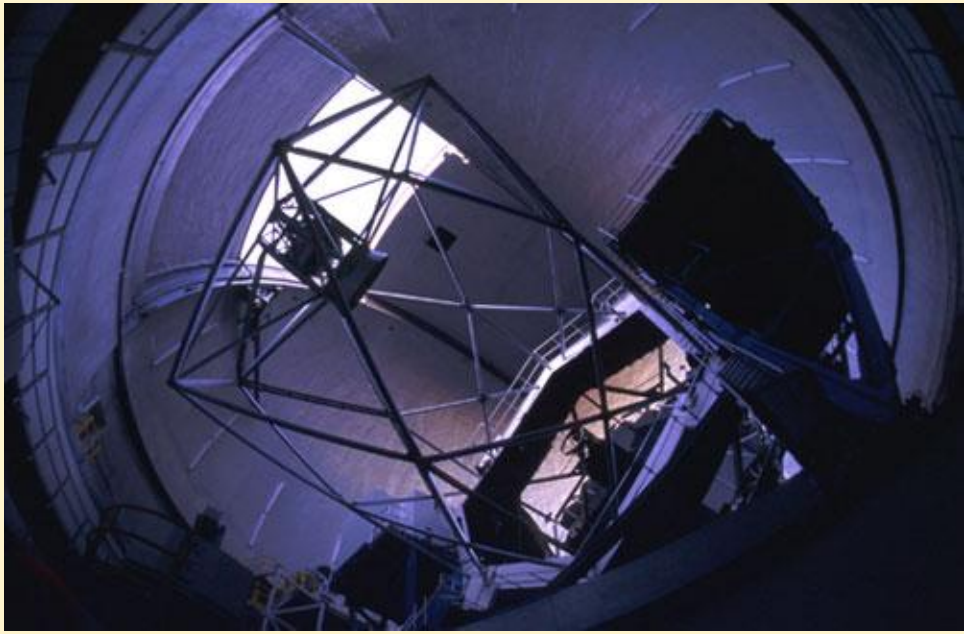
(b)

Kuriant metodiką dalyvavo JAV lietuvis mokslininkas Petras V.Avižonis, dabar jau tapęs LMA užsienio nariu (už bendradarbiavimą su Lietuvos “lazeristais”)

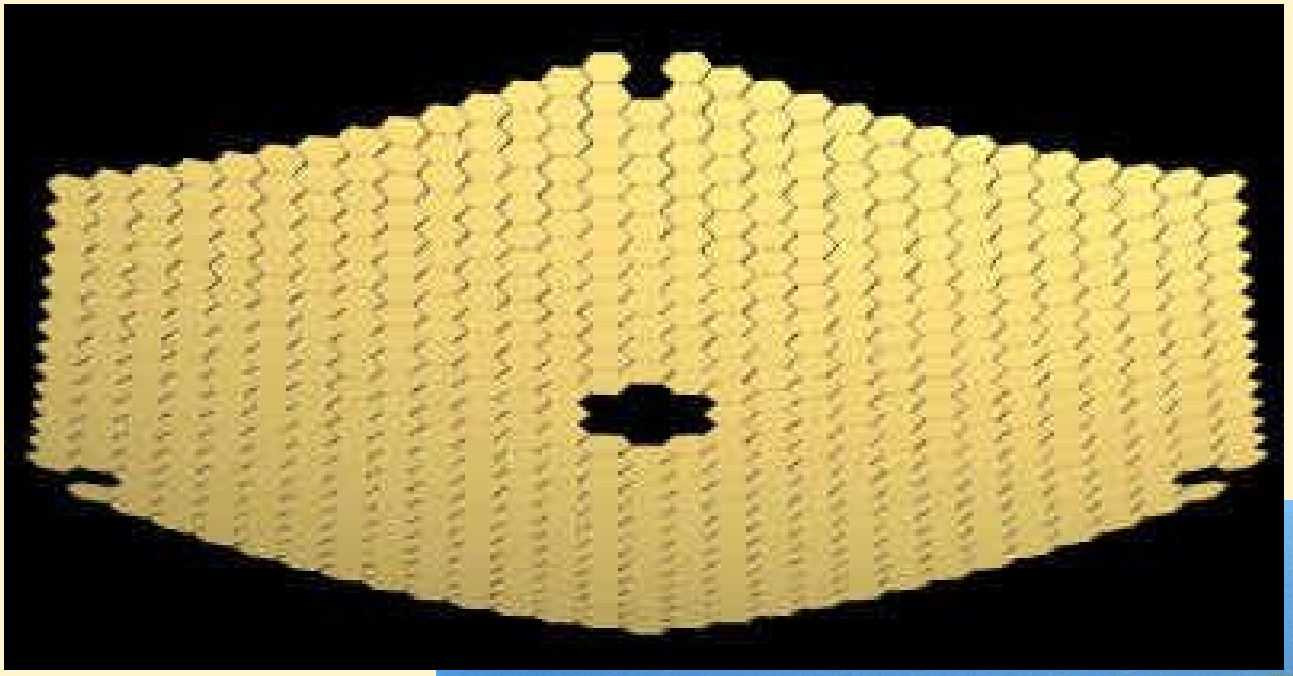
Mauna-Kea observatorija

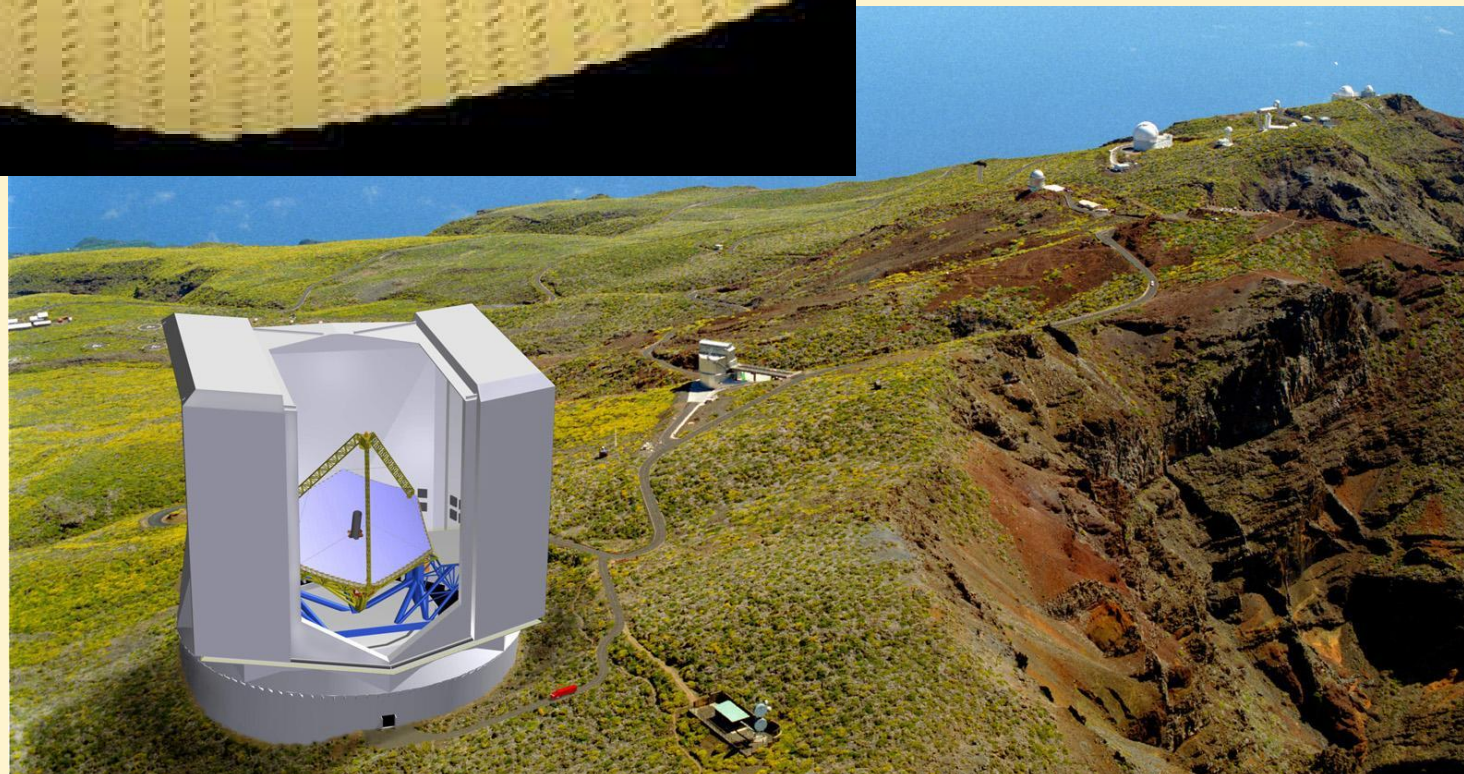






Nauja iniciatyva – Lundo U





- Segmentinis veidrodis Euro50 teleskopui.
- Kiekvienas segmentas - 2 m pločio


May 20, 2002

Lietuvos astronomų indėlis ir dalyvavimas astronomijoje matomos šviesos diapazone

Akad. Paulius Slavėnas – žvaigždžių fotometrija, jo mokinys -

Akad. Vytautas Straižys pasiūlė žvaigždžių fotometrijos metodą (žinomą Vilniaus-Ciuricho metodu)

Daug astronomų dalyvauja tarptautiniuose projektuose, tame tarpe Europos Gaja teleskopo kūrime.

VU TFAI direktorė G.Tautvaišienė IUPAP Astrofizikos komisijos narė

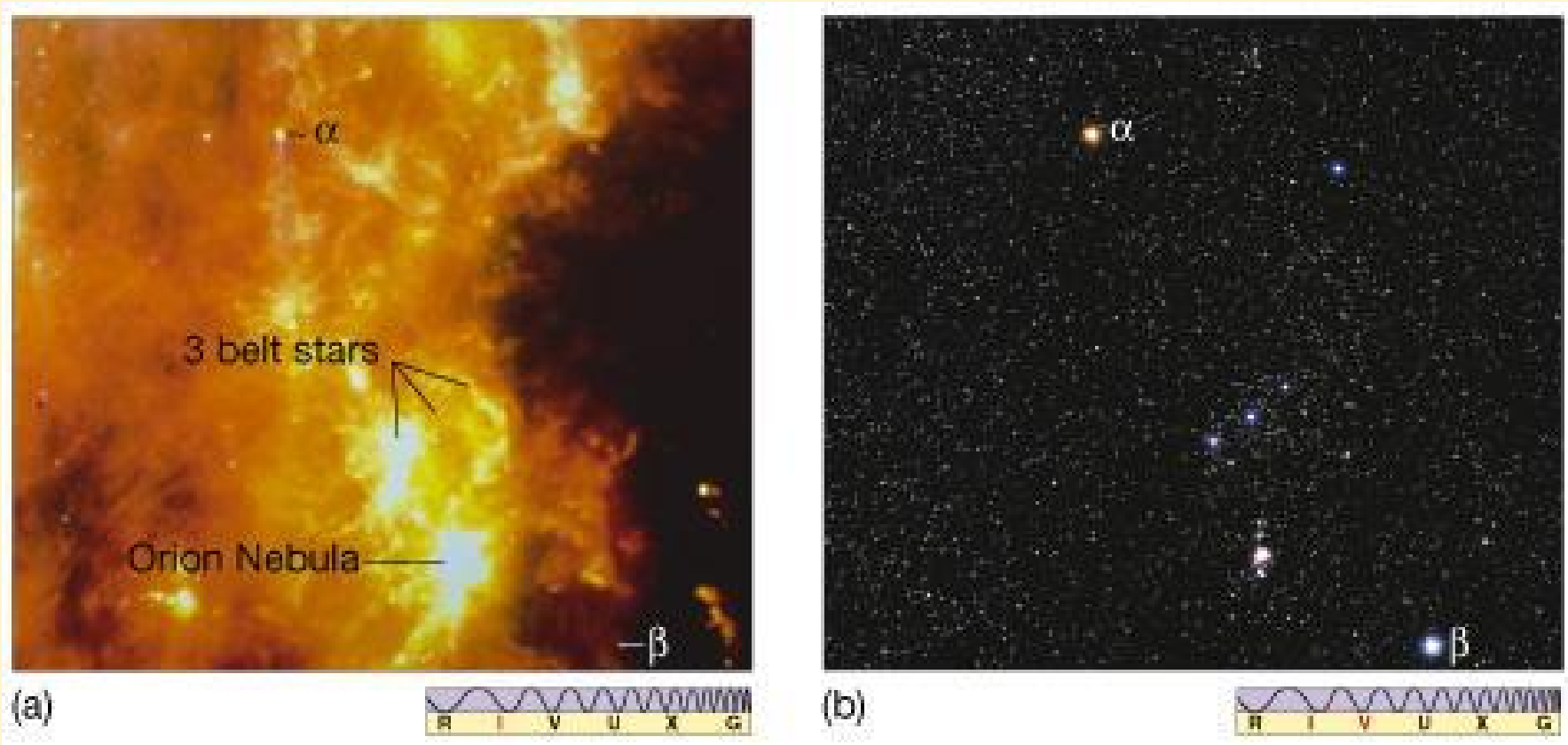
Žvaigždžių drebėjimo tyrimai
(VU TMI, FF AO ir TFAI)
WET (Whole Earth Telescope) programa.
Sukurtas fotometras,
Dalyvauta tyrimuose - ekspedicijose

IR teleskopai

(a)

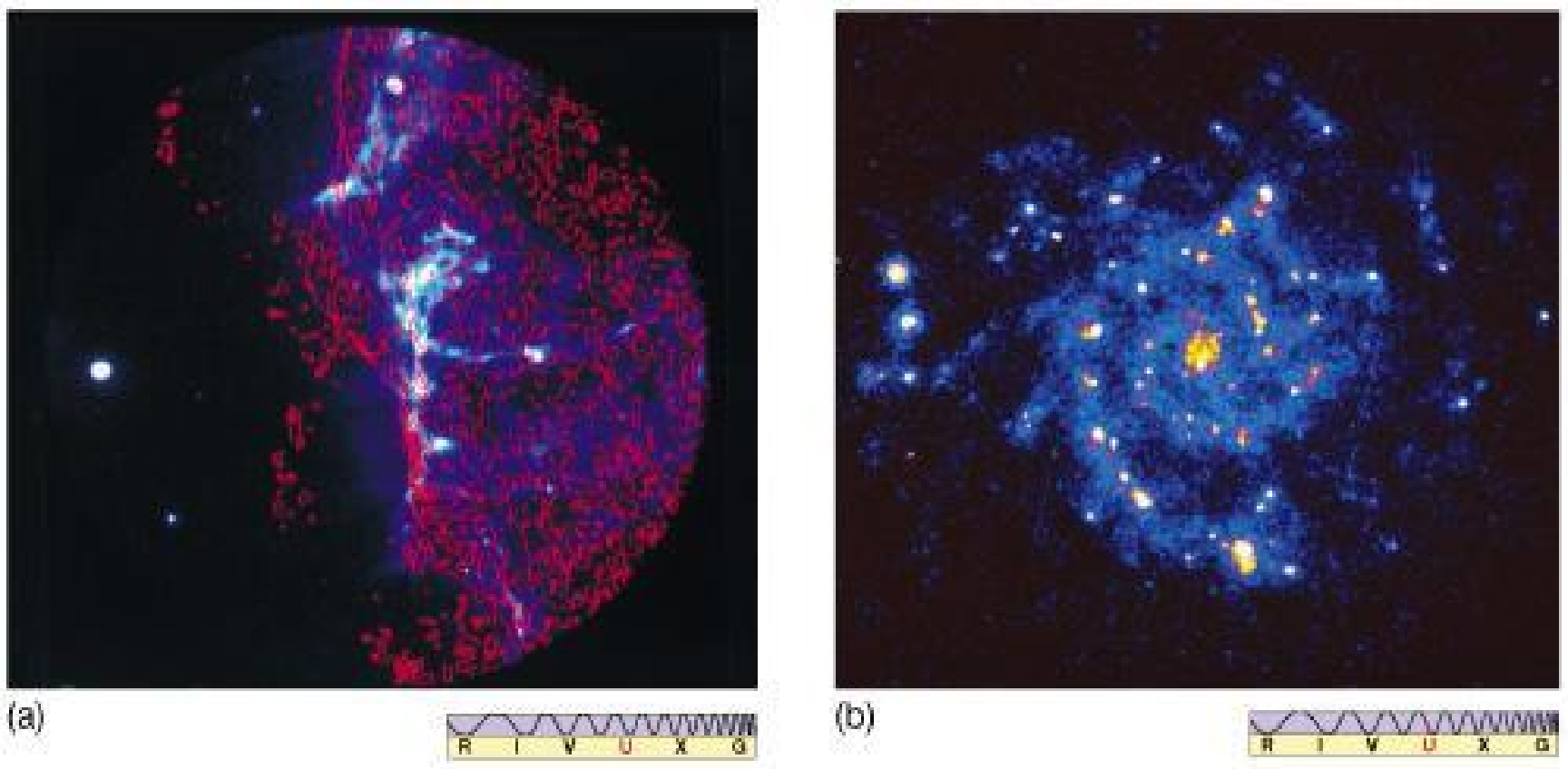
(b)

IR ir optinis vaizdas



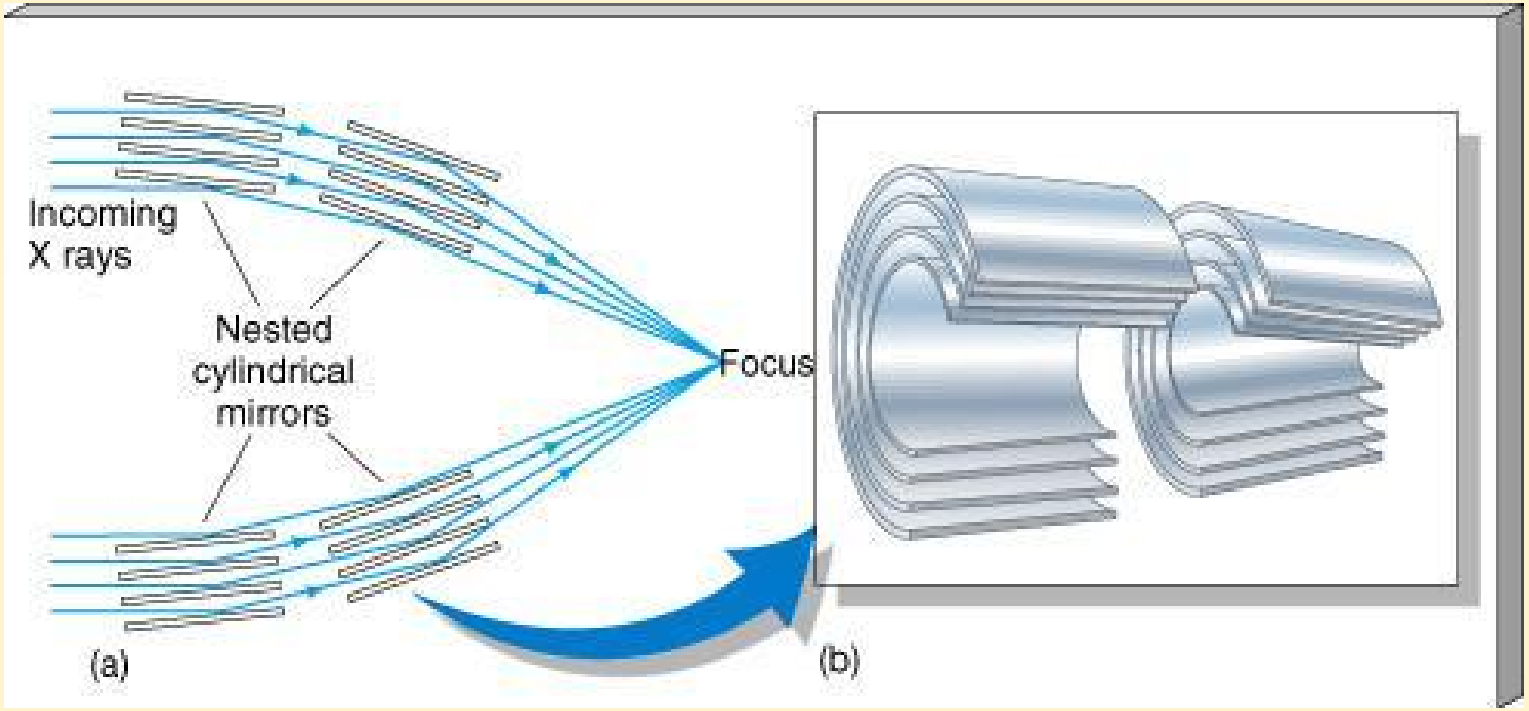
Atrasti nauji stambiagabaritiniai astronominiai objektai

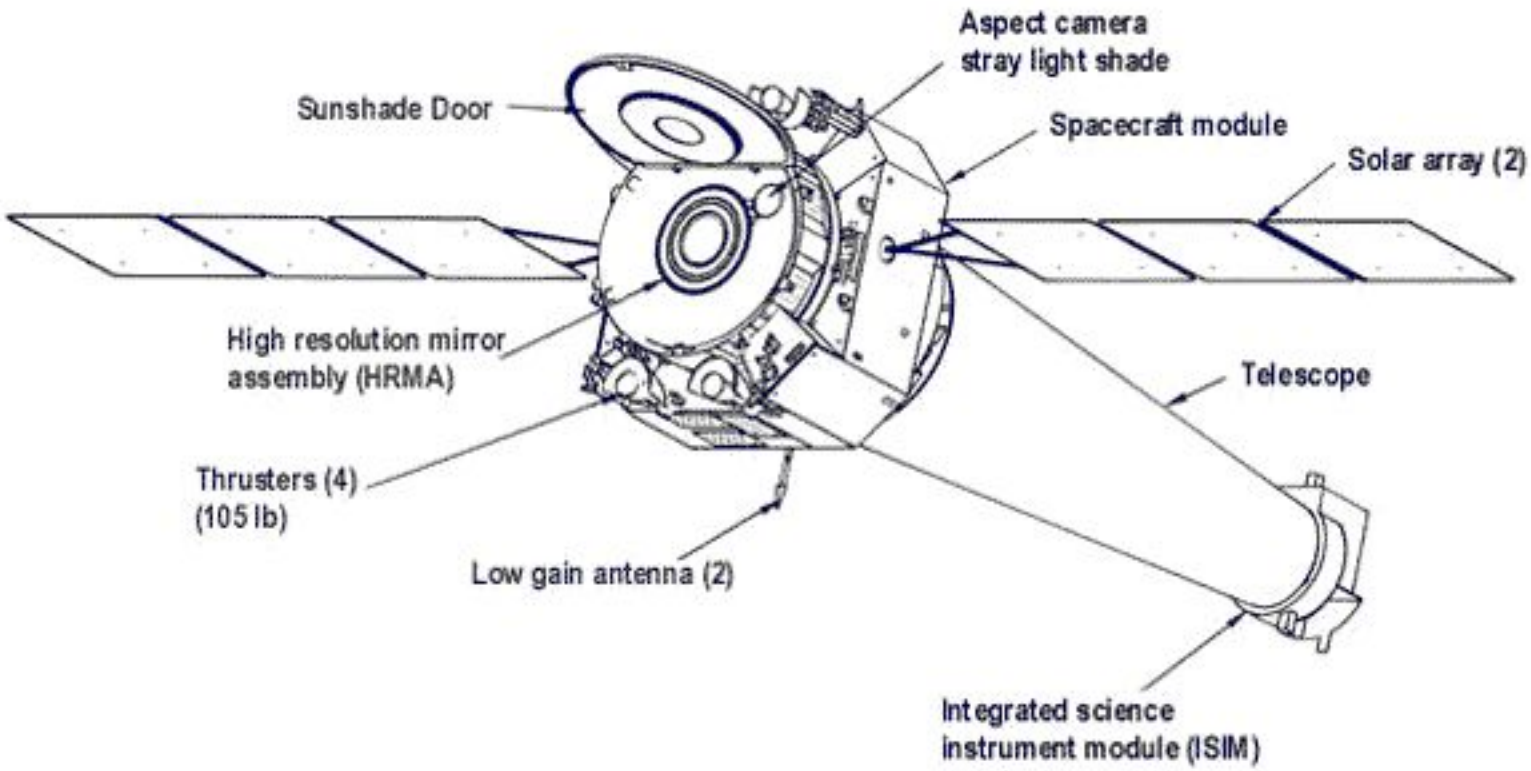
UV vaizdai



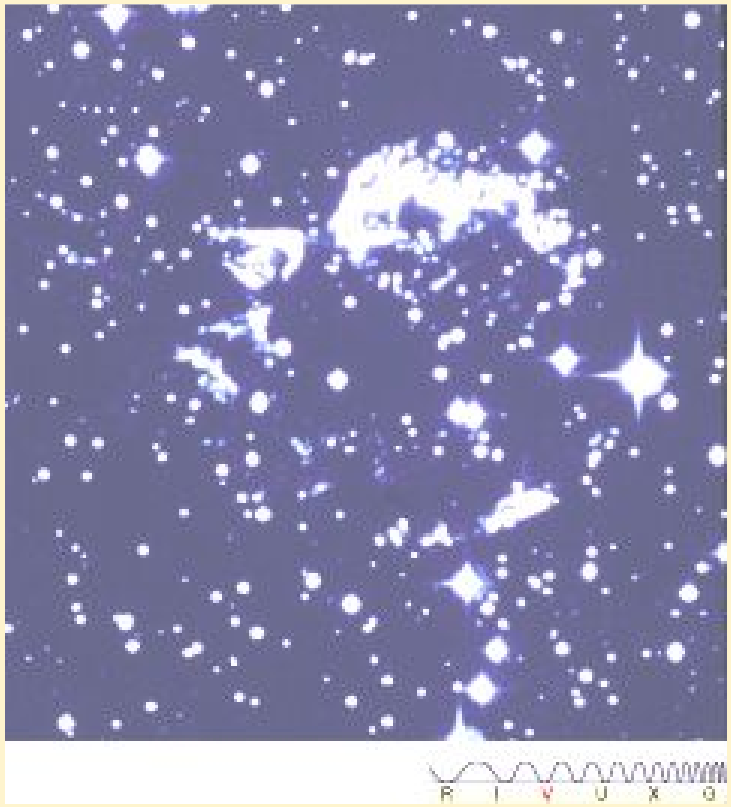
Atrasti spinduliai, kurių negali spinduliuoti atomai: išsiaiškinta, kad juos spinduliuoja įelektrintos dalelės skriedamos orbitomis galaktiniame magnetiname lauke

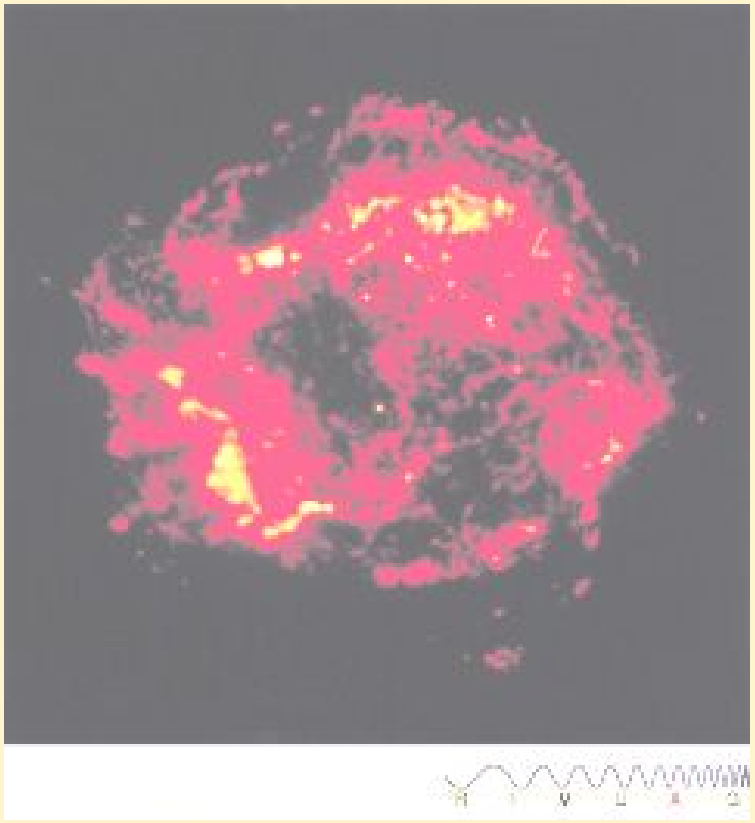
Rentgeno spindulių teleskopas




Aspect camera
stray light shade
Sunshade Door
Spacecraft module
Solar array (2)
High resolution mirror
assembly (HRMA)
Telescope
Thrusters (4)
(105 lb)
Low gain antenna (2)
Integrated science
instrument module (ISIM)

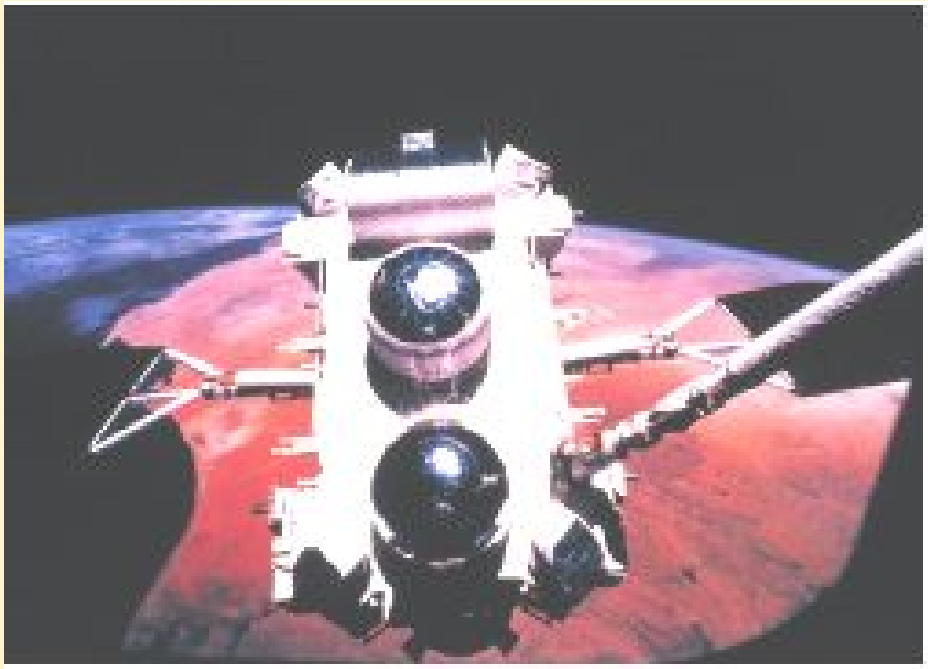
Šviesos ir Rentgeno spinduliuose



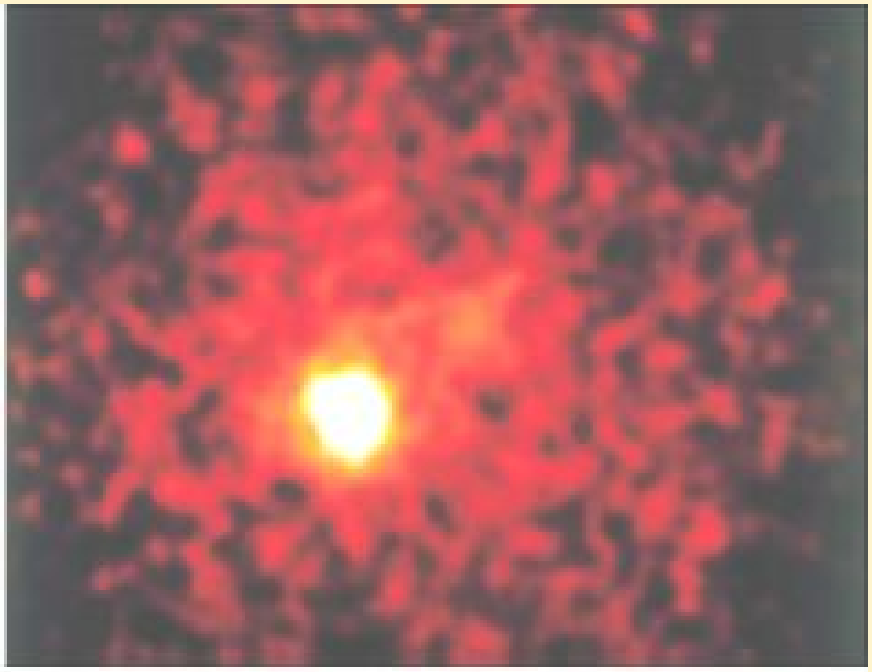


Atrasti stambūs labai įkaitintų atomų telkiniai

Gama teleskopas ir vaizdas

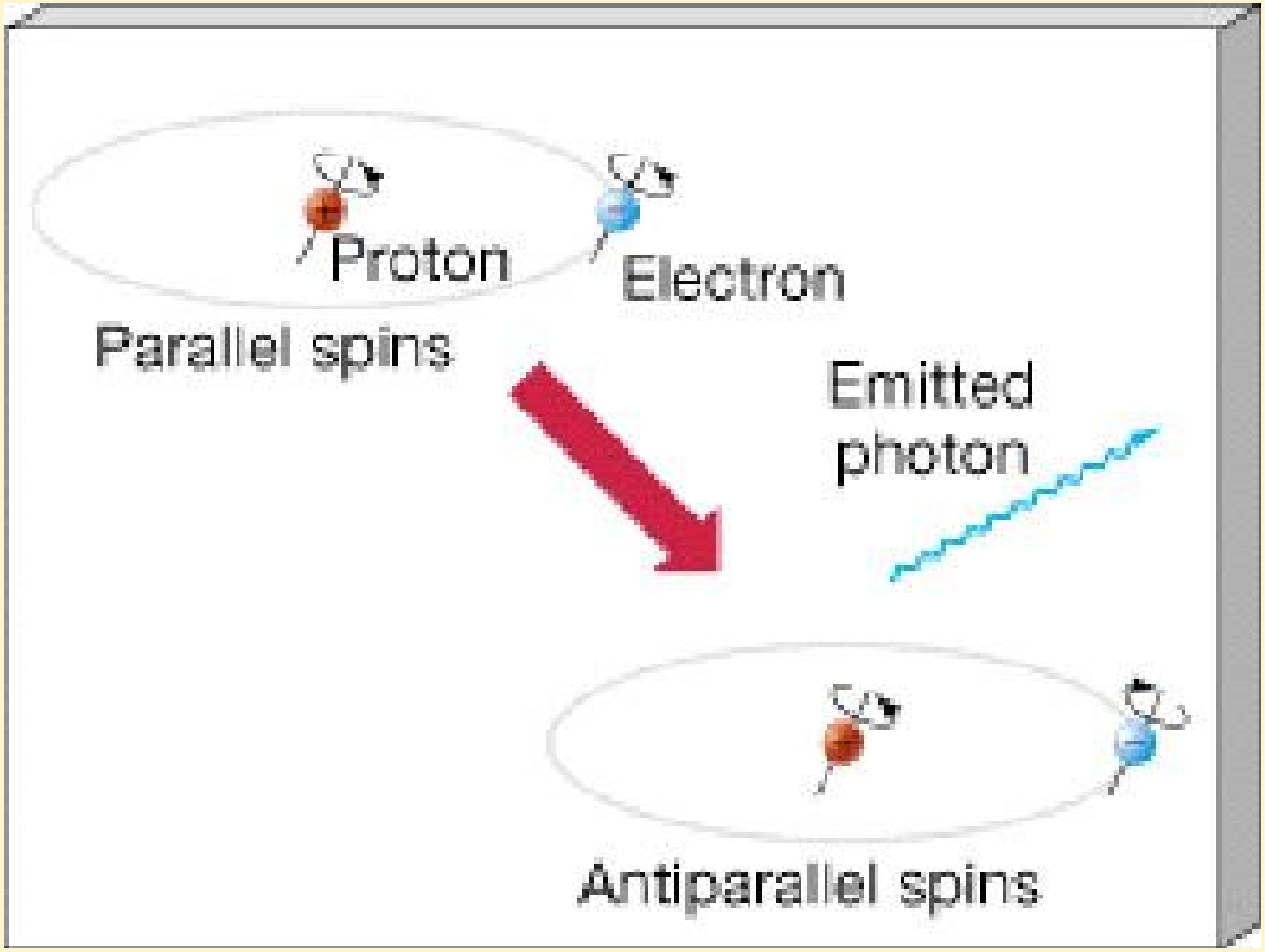


(a)



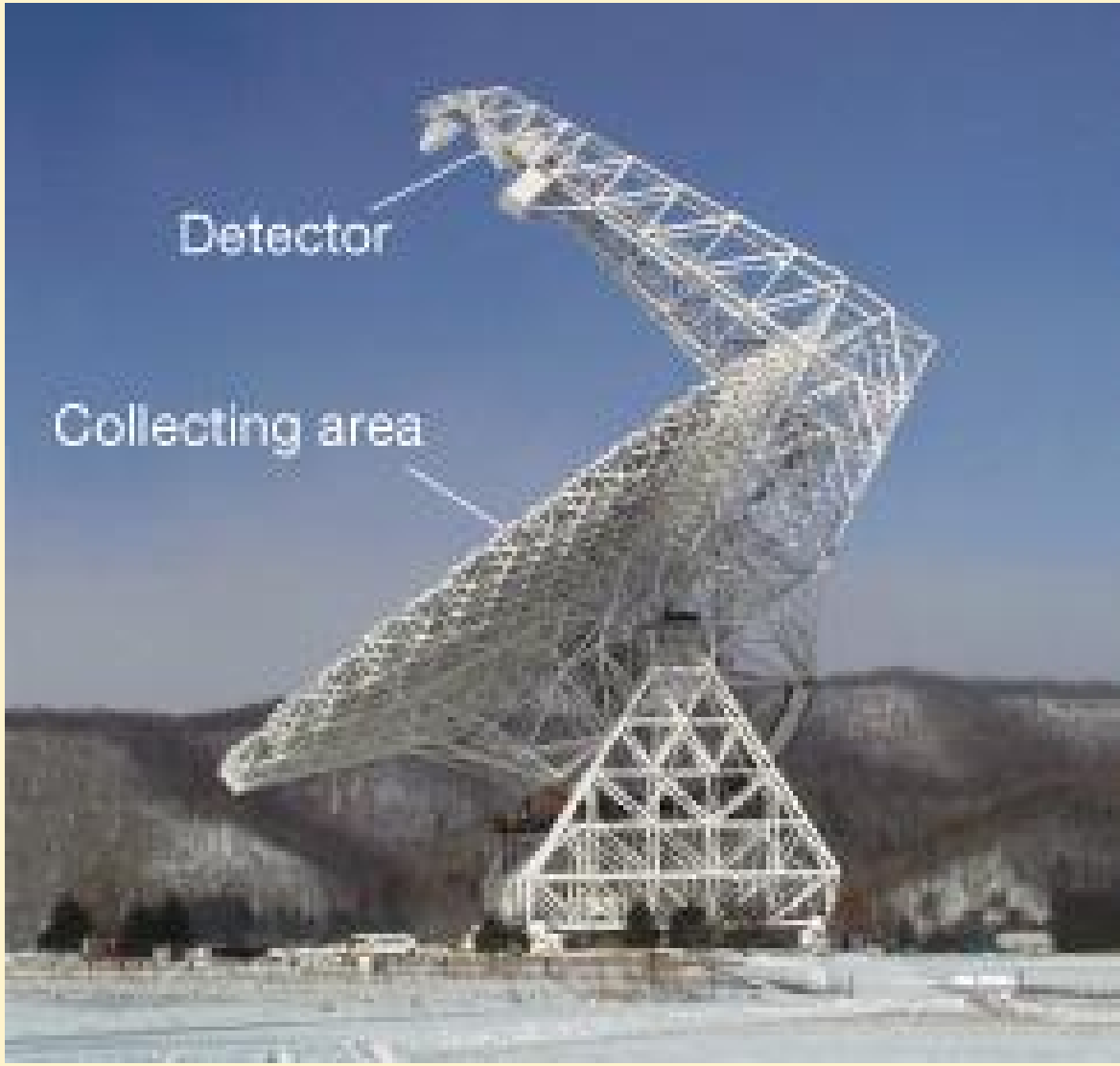
(b)

Mikrobangos iš atomo



Radioteleskopas

Onsala 25 m. teleskopas

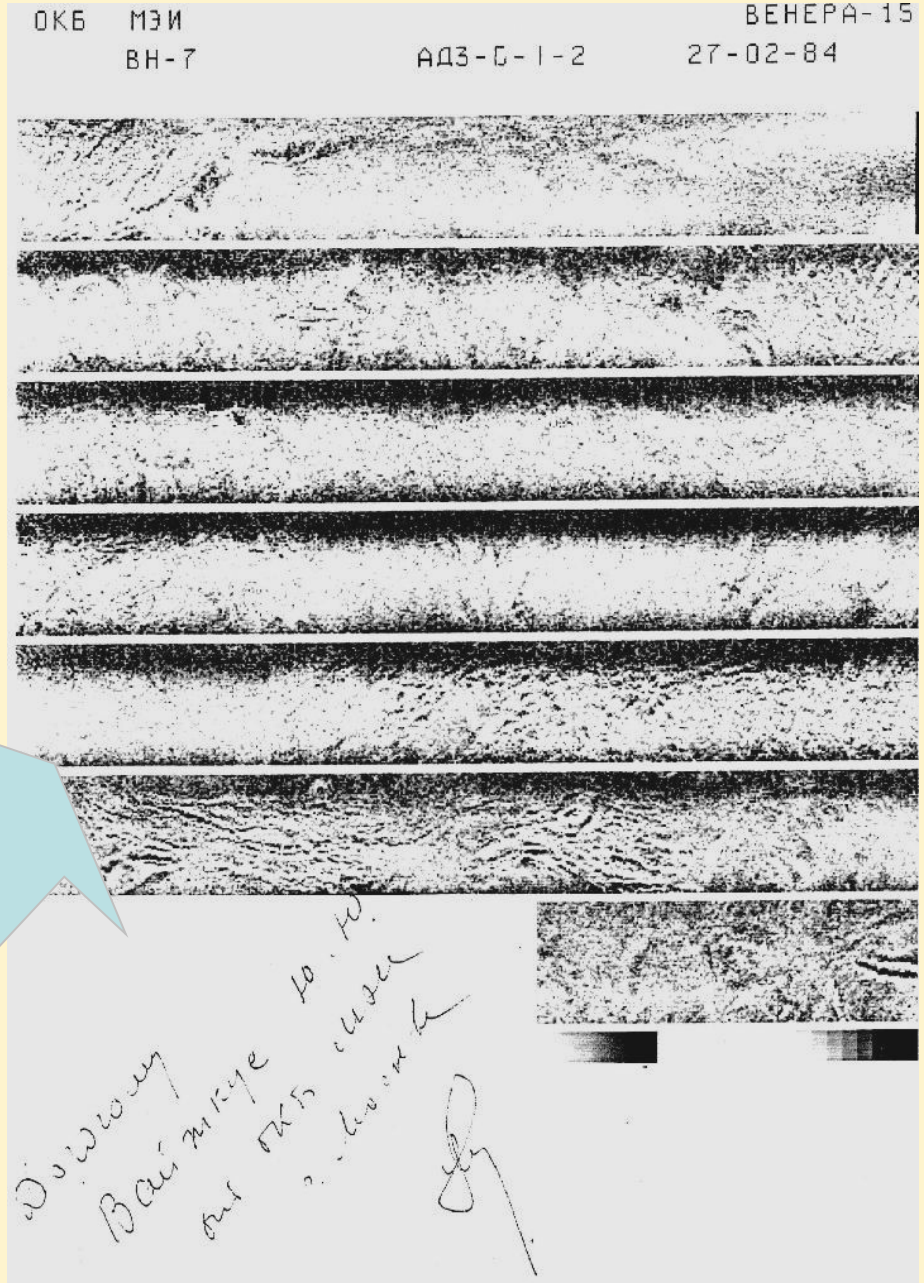


Veneros palydovas

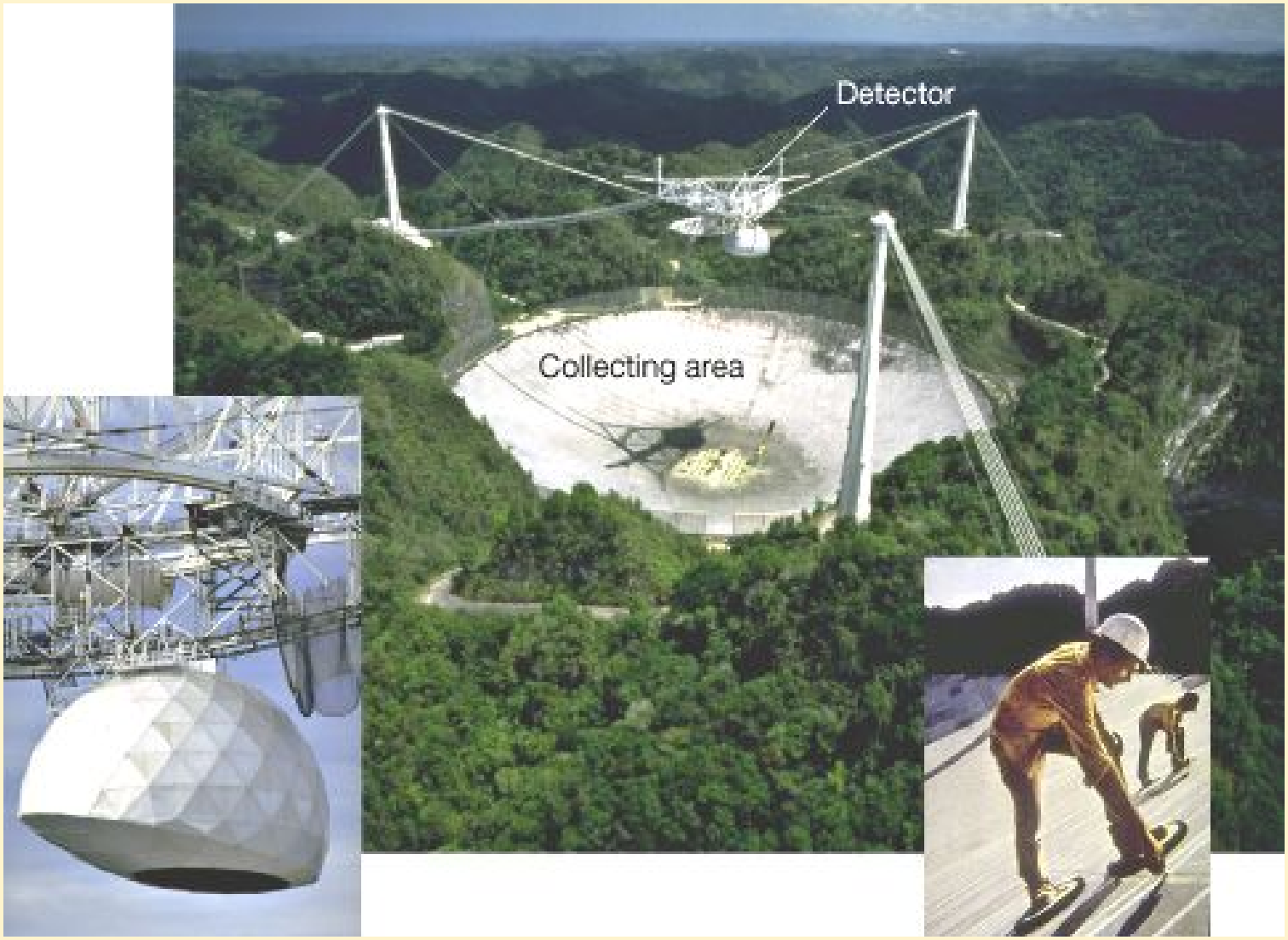
Buvo galimybė žvilgtelėti į unikalius eksperimentus:

a) pamatyti “neparodinius” Žemės palydovų ir į Venerą skridusių laivų “vidurius”,

b) dalyvauti tiesioginiame eksperimente, kai Veneros palydovas fotografavo jos paviršių



Radioteleskopas



Radioteleskopas-interferometras

(a)

(b)

Tiems tinklams valdyti reikalinga programinė įranga, nes būtina, kad visos antenos stebėtų tą patį objektą tuo pačiu metu.

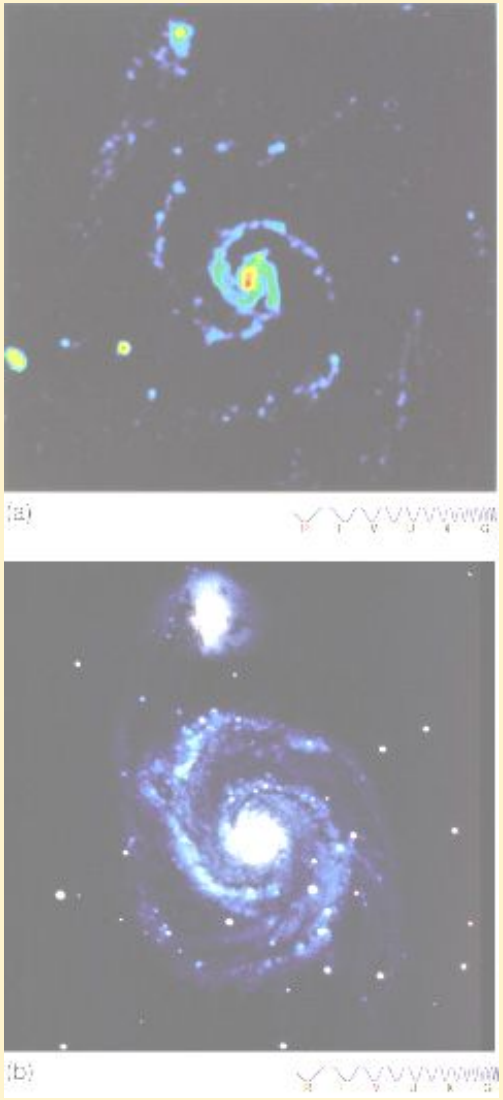
John O'Sullivan
1970 pradadėjo spręsti problemą,
1988 sukūrė ir įdiegė "chip'ą"

Dabar šis metodas vadinamas **Wi-Fi** technologija ir yra įdiegtas: **in "many personal computers, video game consoles, printers, smartphones, and virtually all laptop or palm-sized computers**

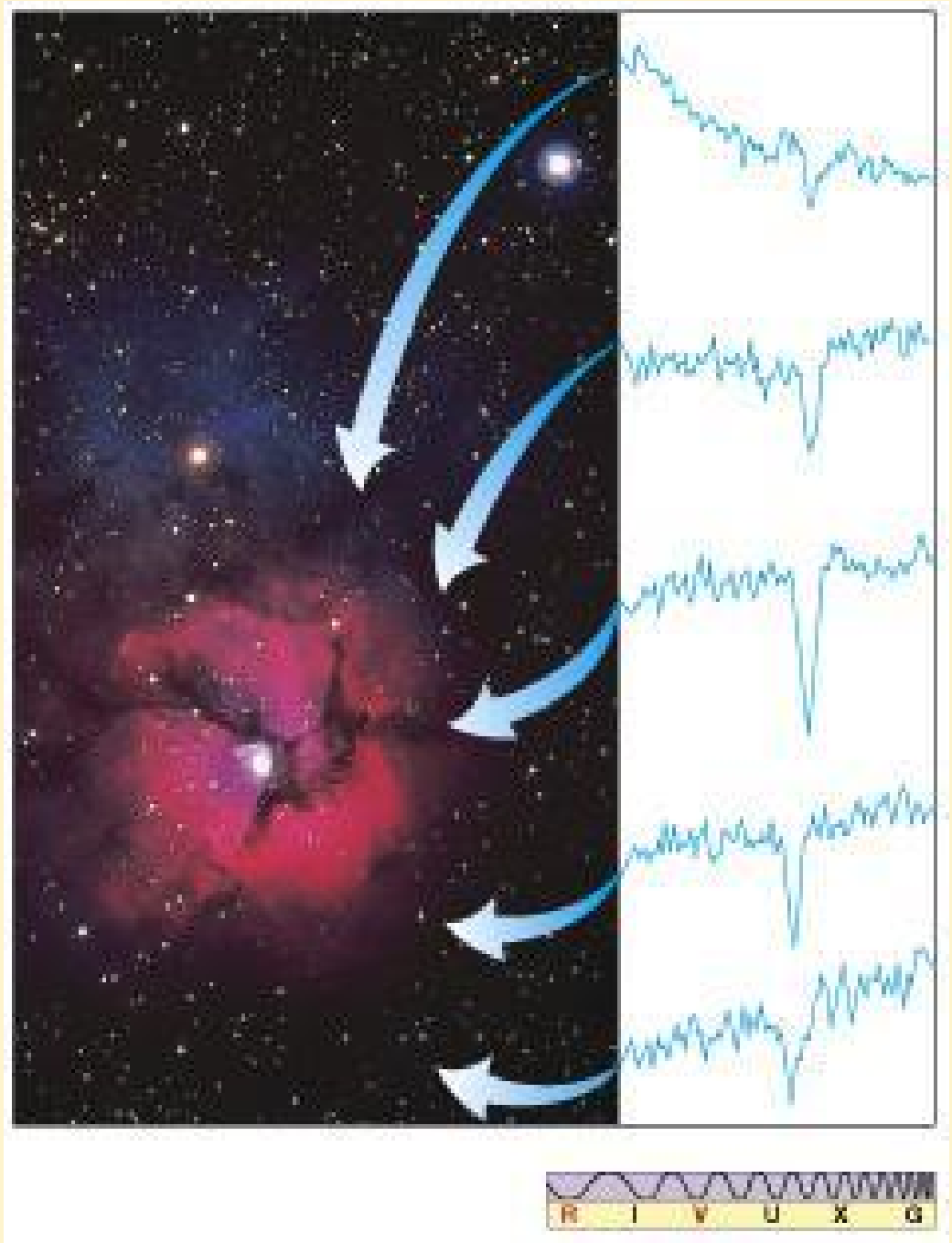
Tur būt tai yra akivaizdus fundamentinio mokslo indėlis į verslą?

O astronomai kuria tokį radioteleskopą (apimantį visą Australiją ir N.Zelandiją):

Radijo ir optinis vaizdai

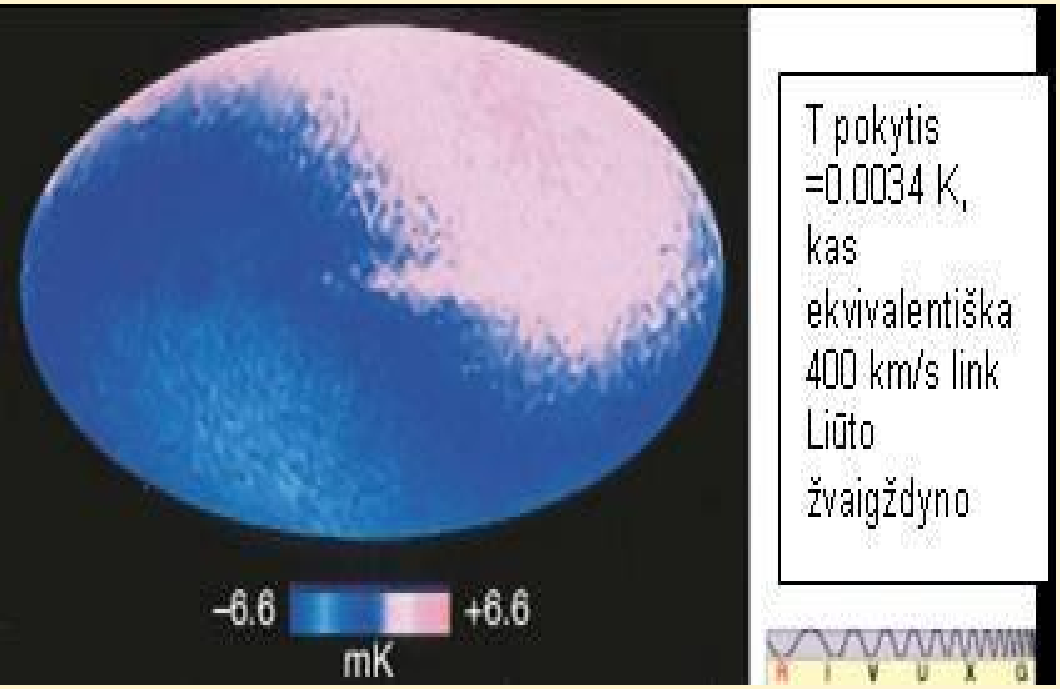


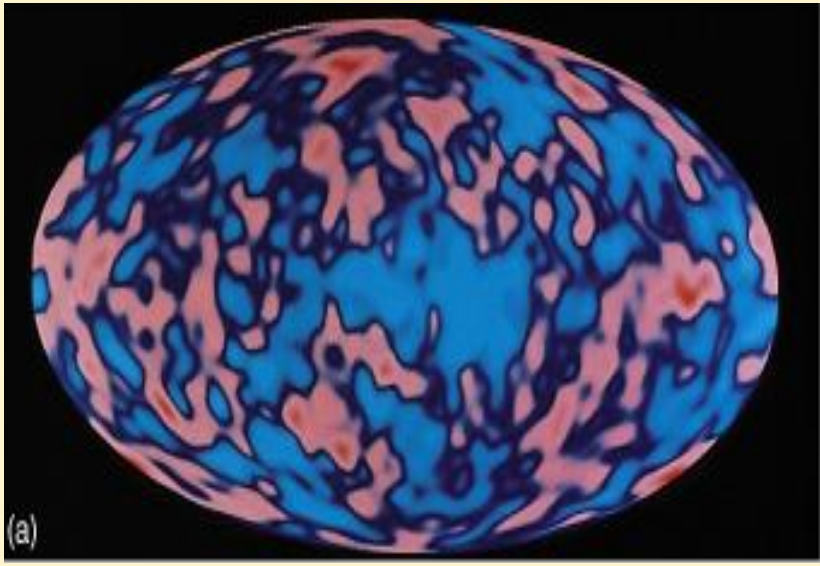
Nustatyti vandenilio ir kitų molekulių telkiniai, jų srautai


R
I
V
U
X
G

Mikrobangė spinduliuotė

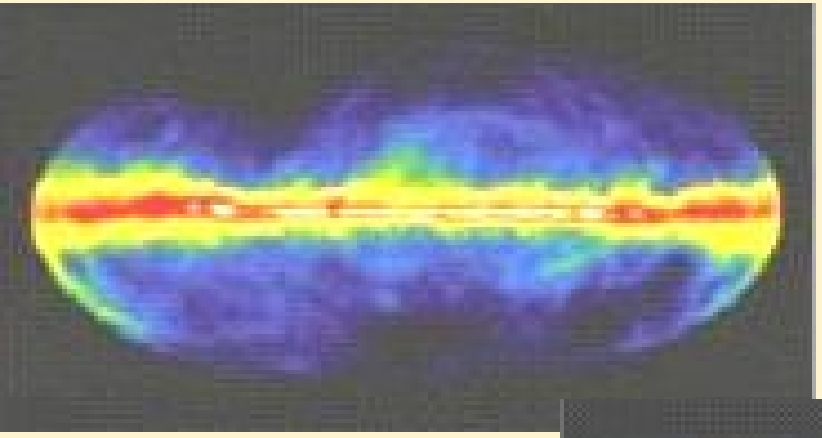
Mikrobangė spinduliuotė



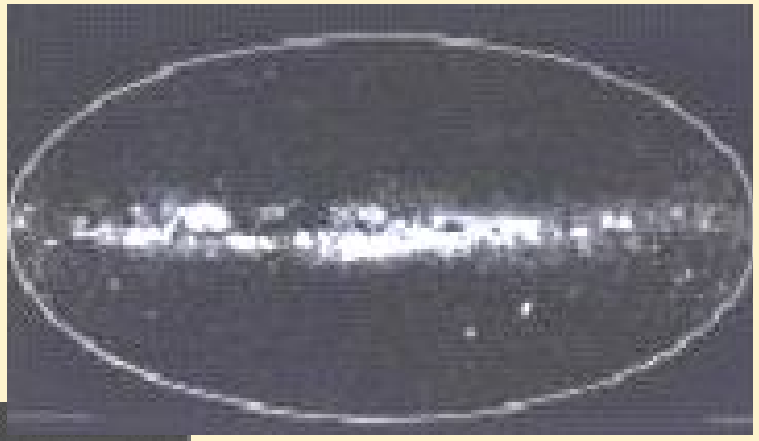


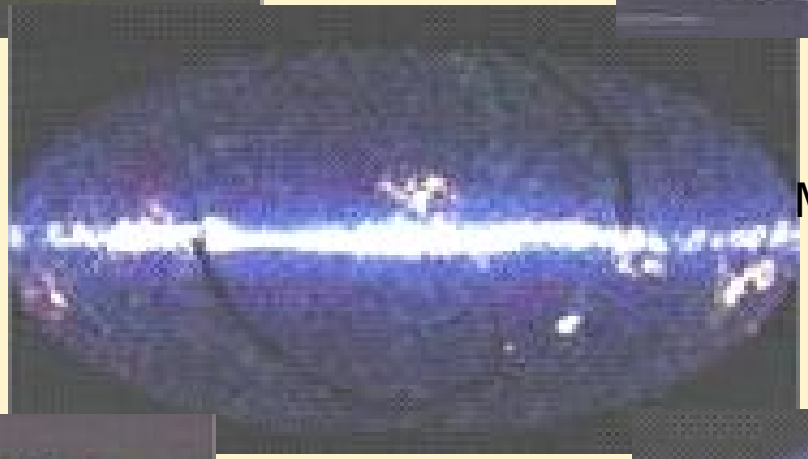
0.1 mK skirtumuose

Visata įvairiose bangose

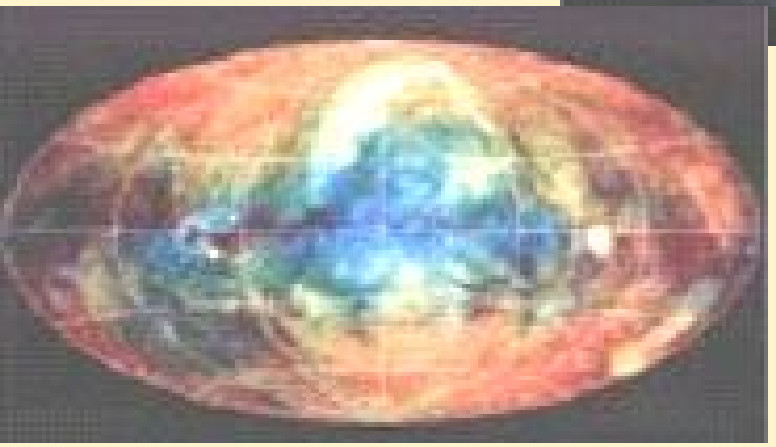


Radijo bangose



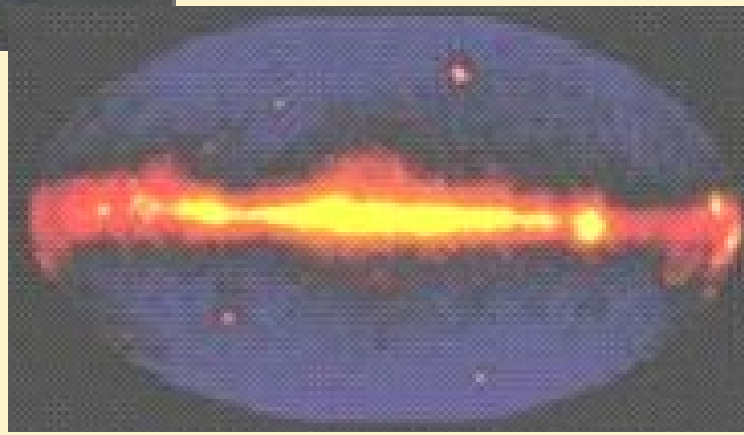


Matomoje šviesoje



Rentgeno spinduliuose

Infraraudonoje šviesoje

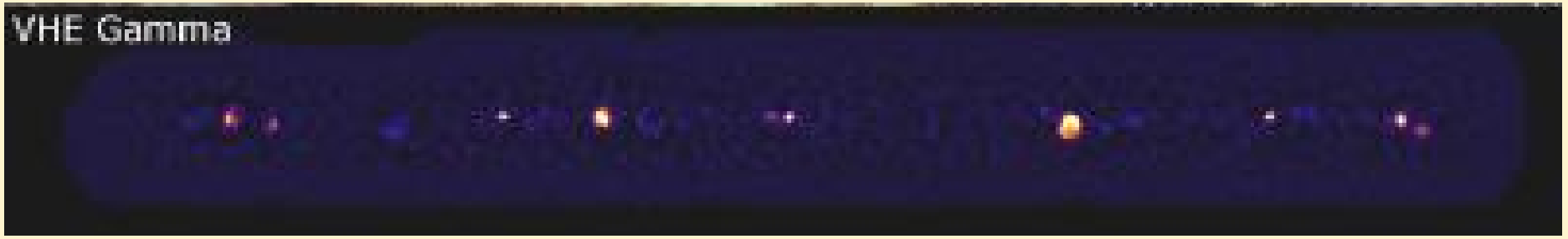


Gamma spinduliuose

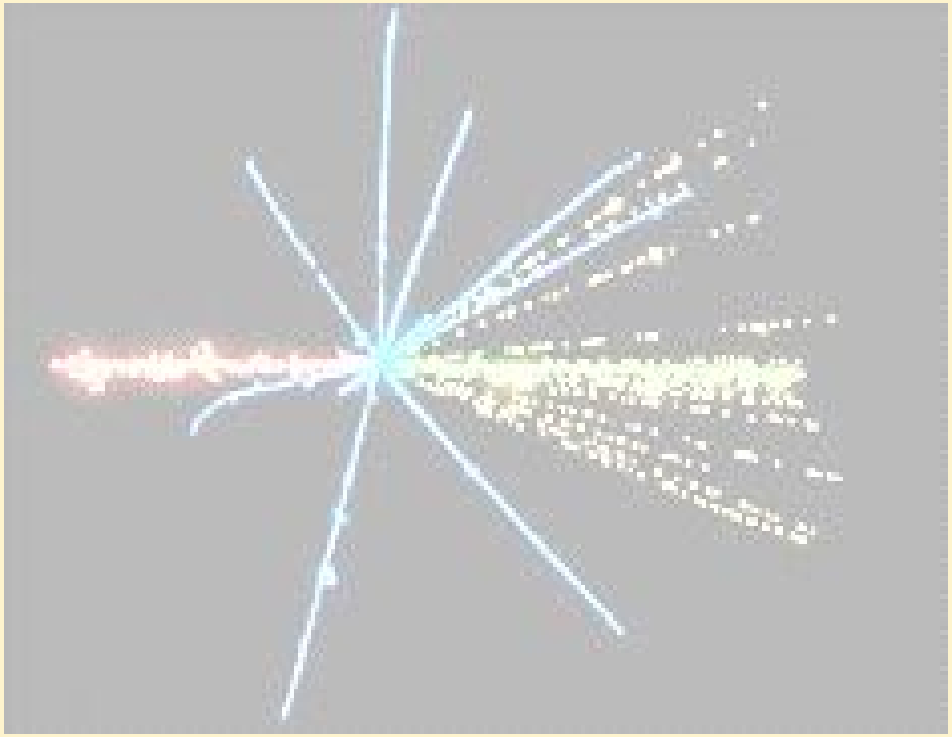
Žmonija žvelgia į megapasaulį

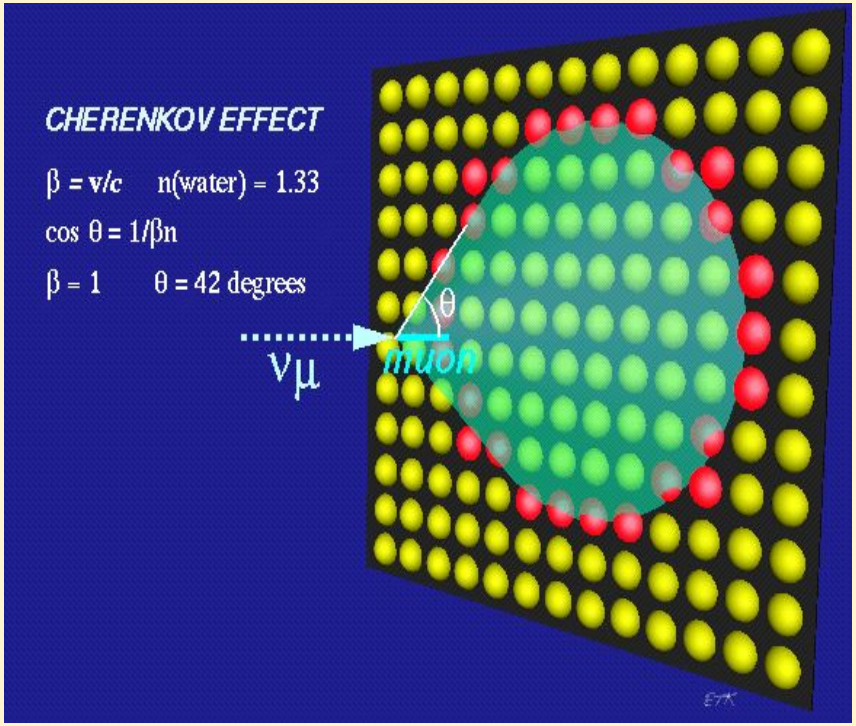
ir ne teleskopais

Gamma spinduliuose “normalios” ir labai didelės energijos

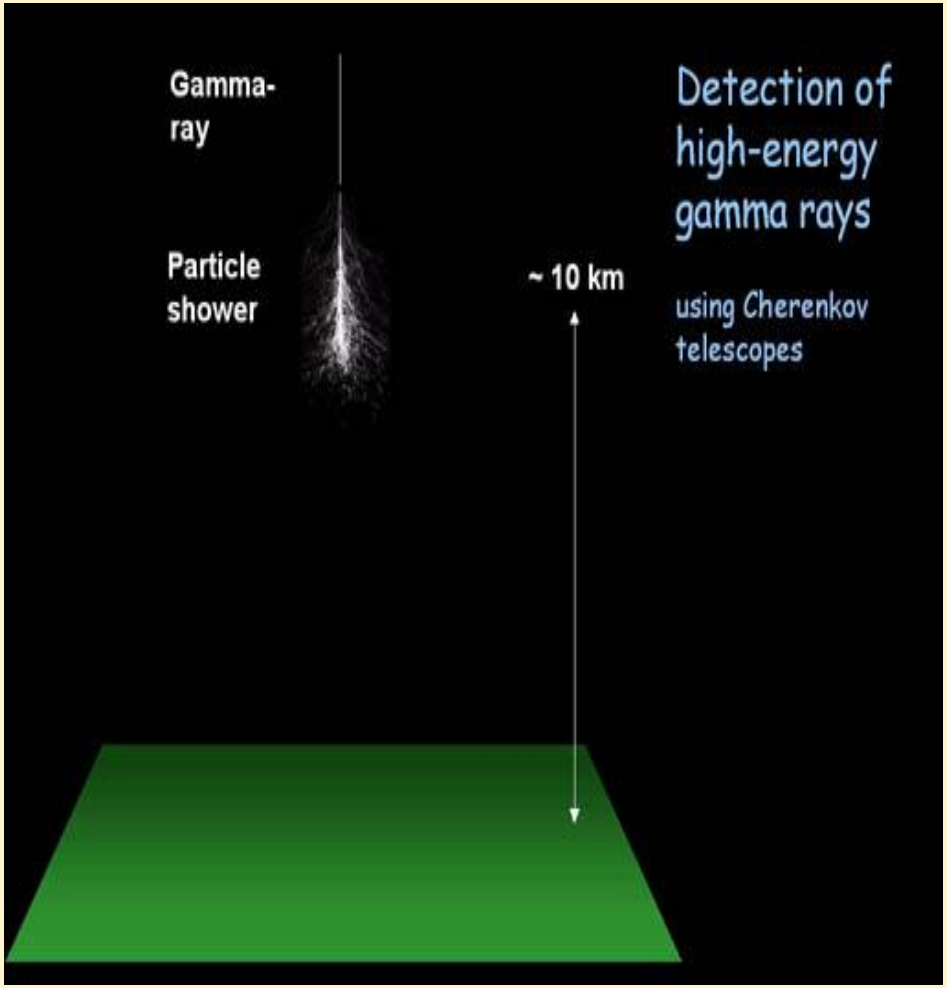


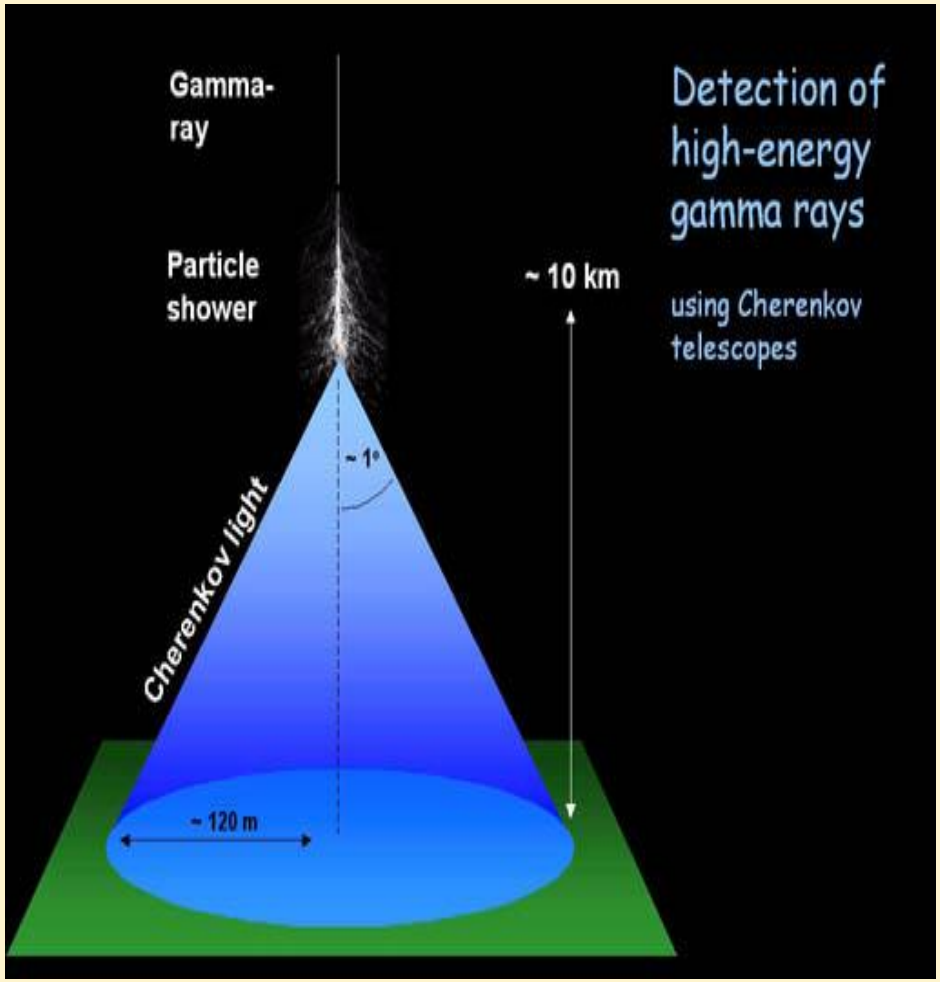
Pradėta įsiskverbti į “Terra-inkognita”: Dalelių astronomija!

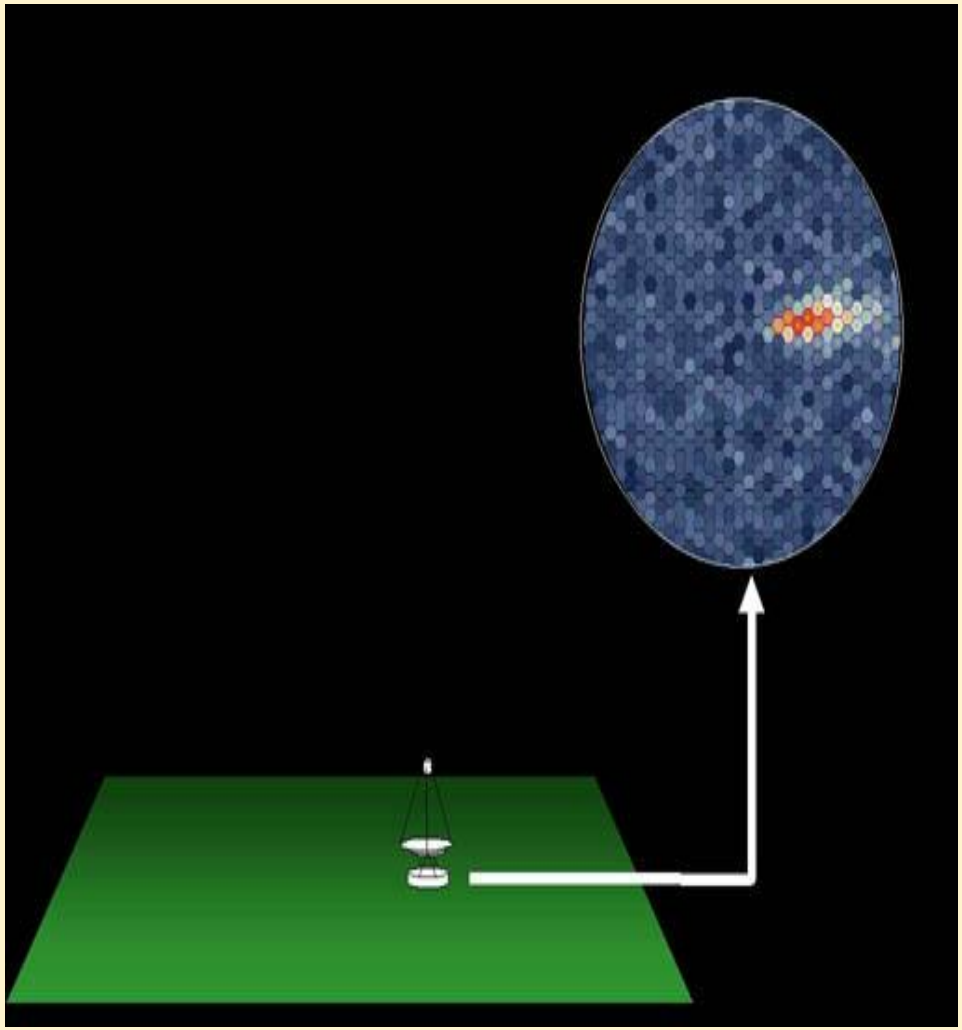


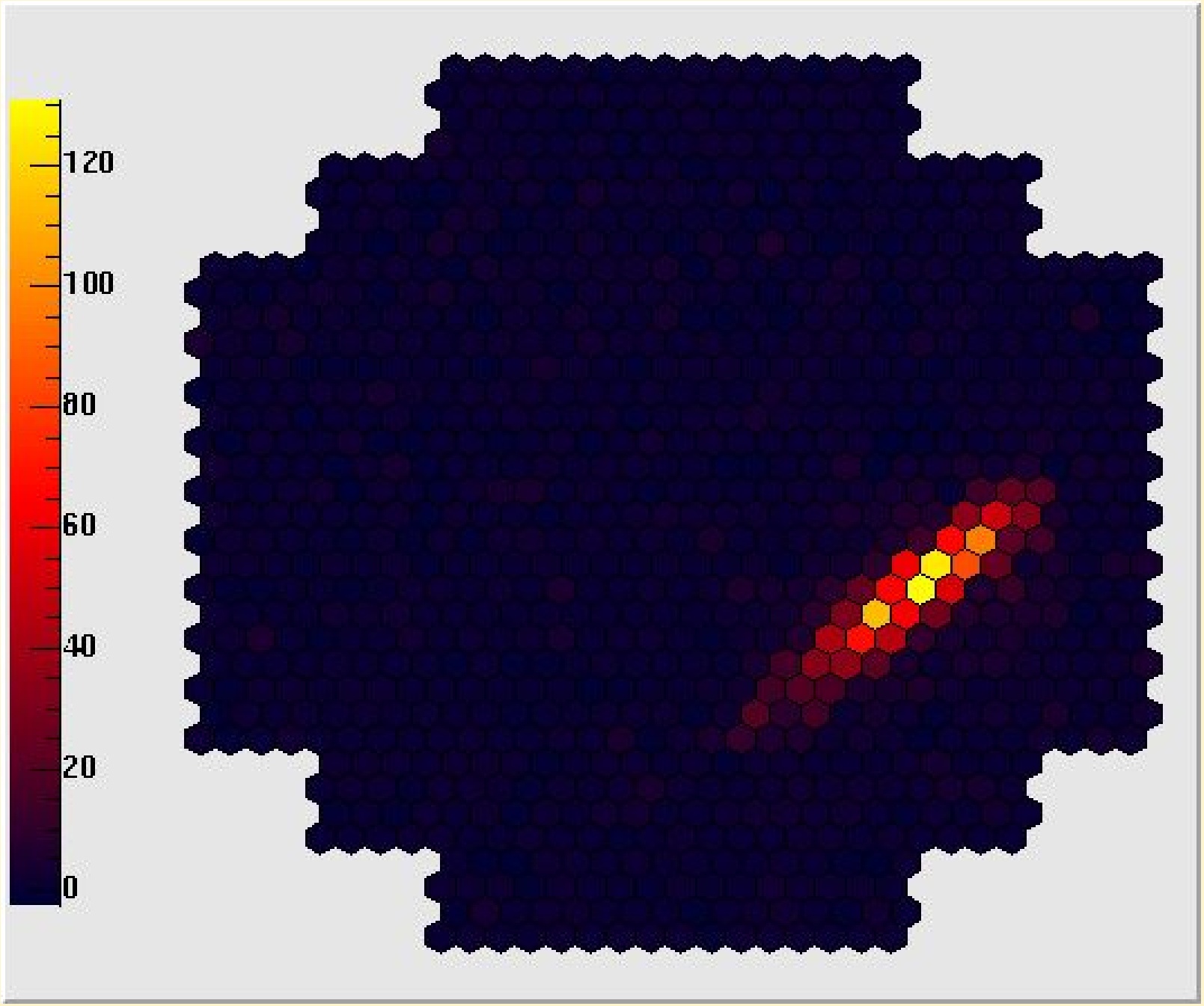


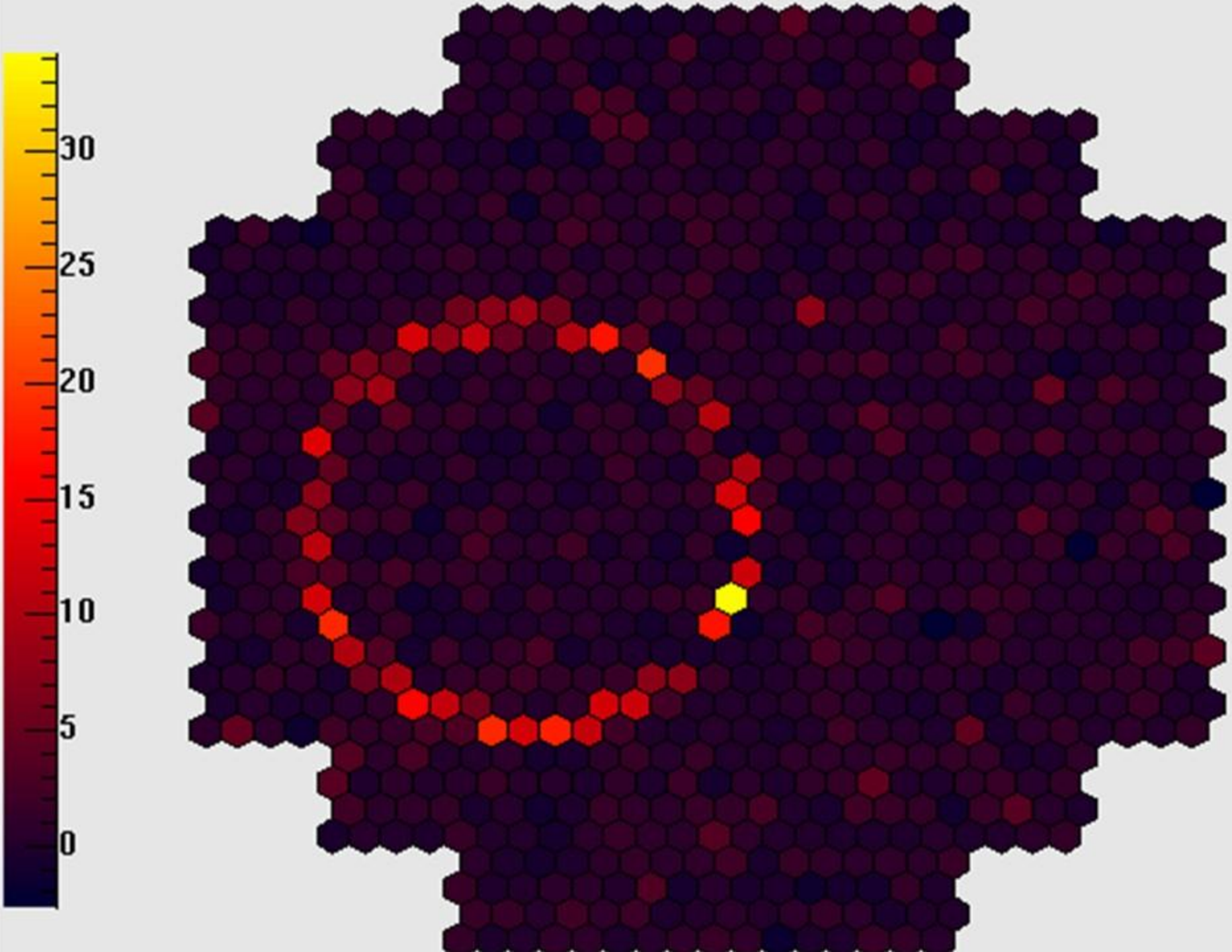
Bet apie tai jau mikropasaulio temoje ...


Gamma-ray
Particle shower
~ 10 km
Detection of high-energy gamma rays
using Cherenkov telescopes


Gamma-ray
Particle shower
~ 10 km
Detection of high-energy gamma rays
using Cherenkov telescopes
~ 1°
Cherenkov light
~ 120 m

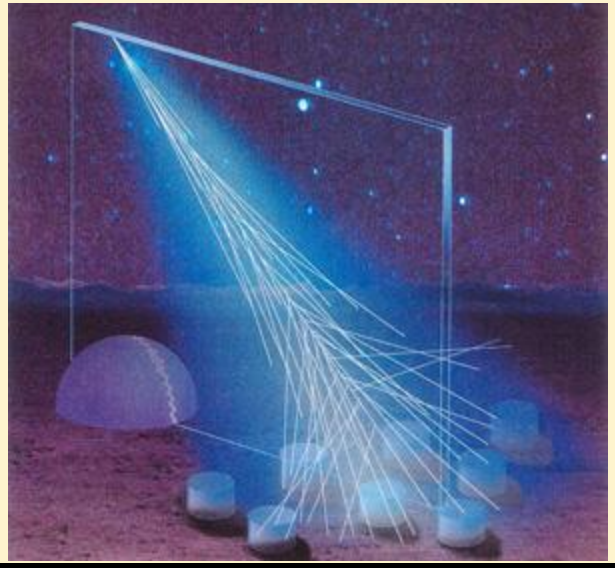


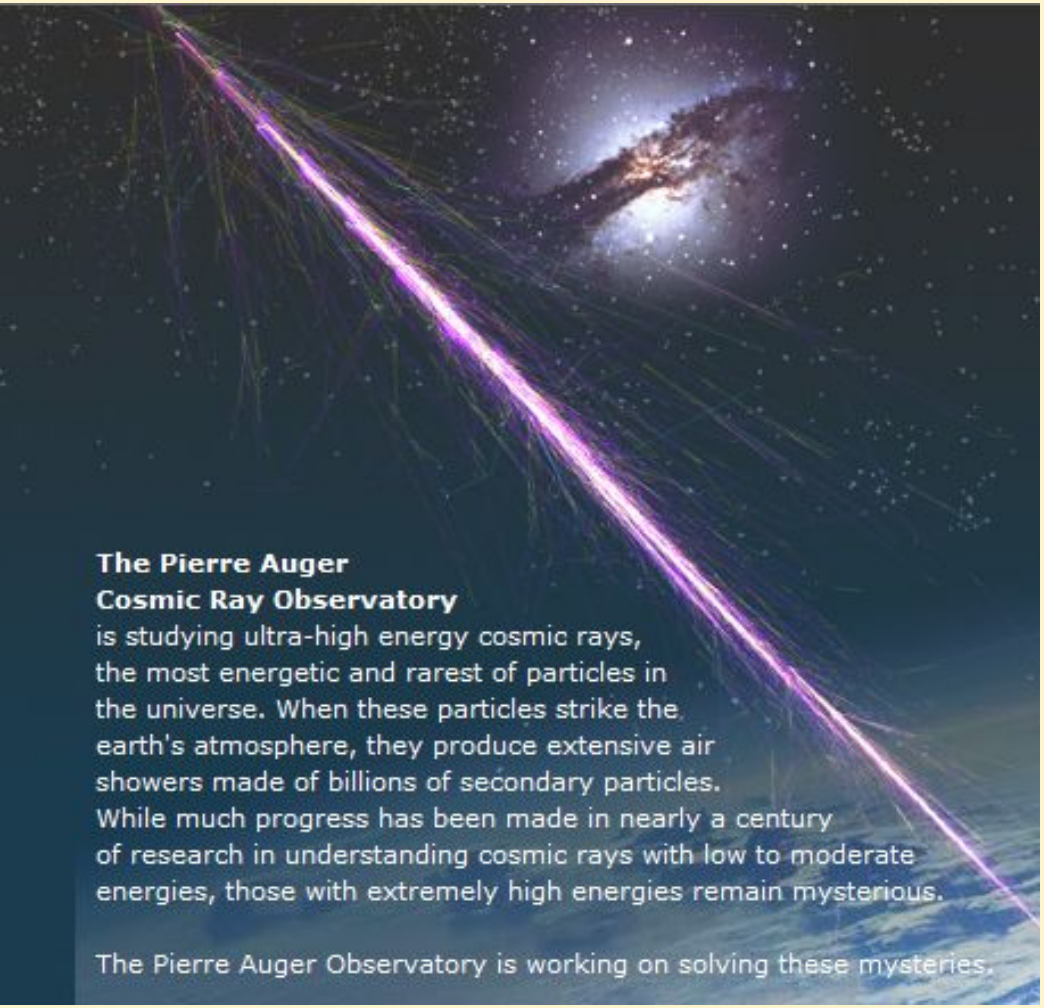

120
100
80
60
40
20
0

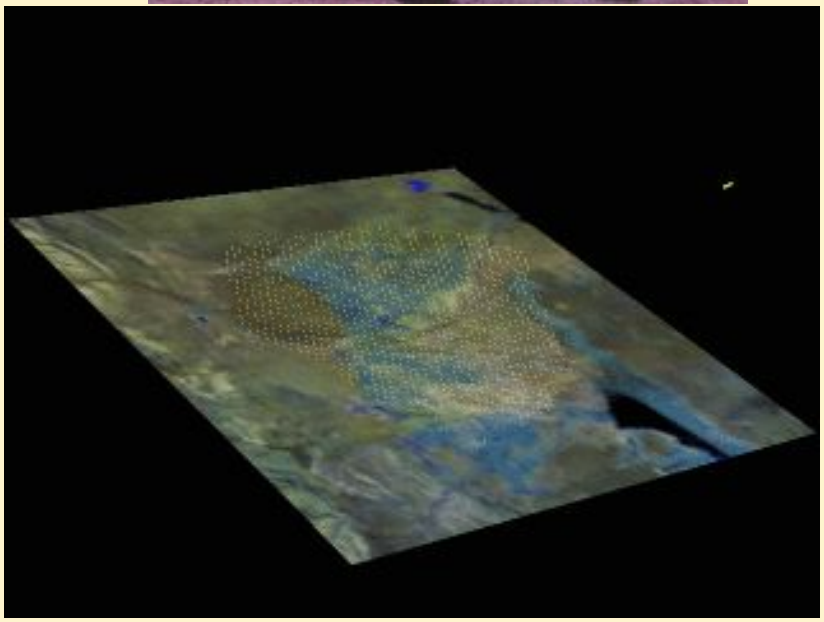

30
25
20
15
10
5
0

Ultra-didelių energijų dalelių registravimas:

ne tik Čerenkovo spinduliuotė, bet ir dalelių sužadintų oro molekulių fluorescencija

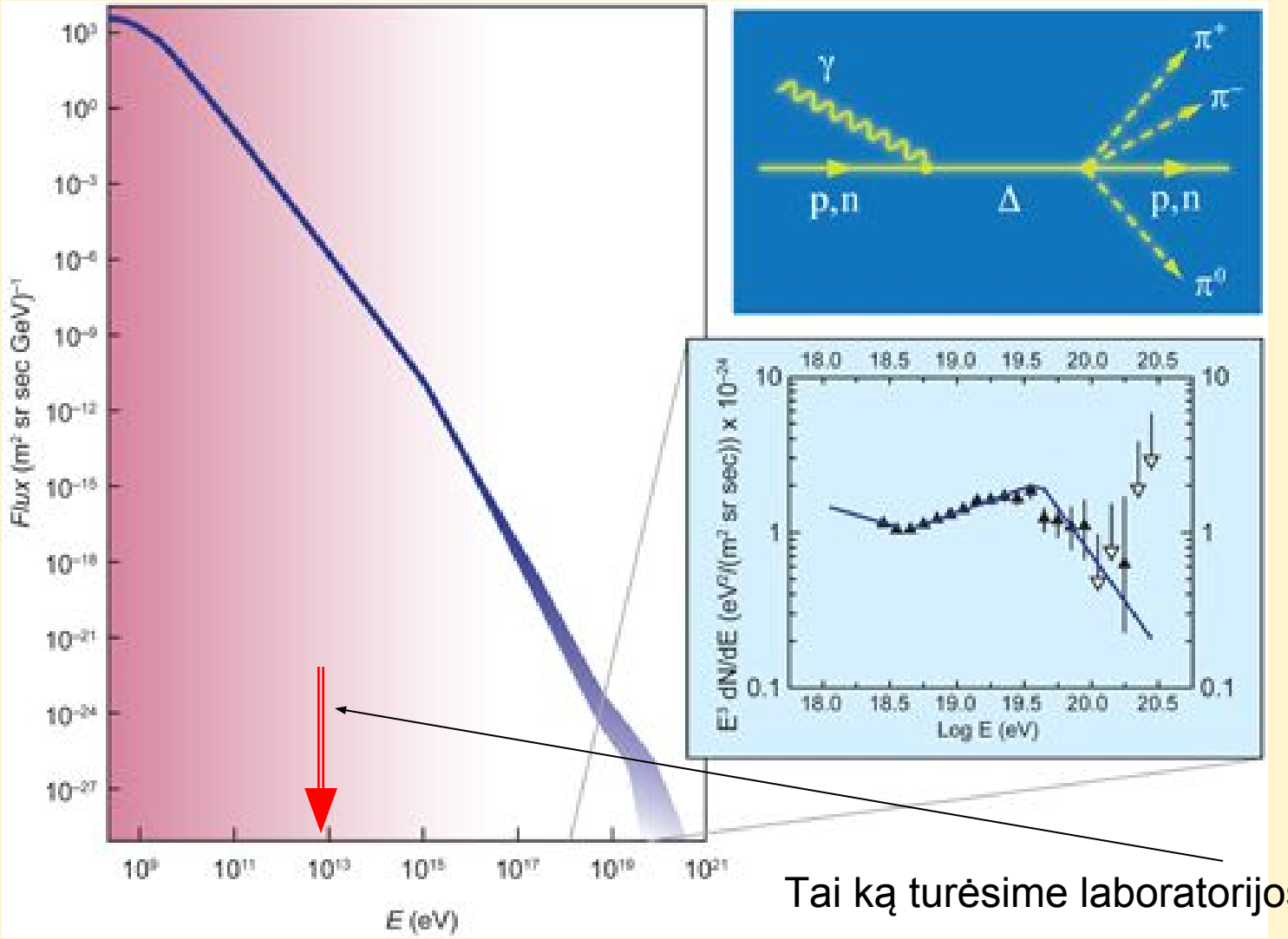






Mokslinės mįslės:

kodėl tokių energijų dalelės egzistuoja?
Kodėl šioje priklausomybėje yra struktūra

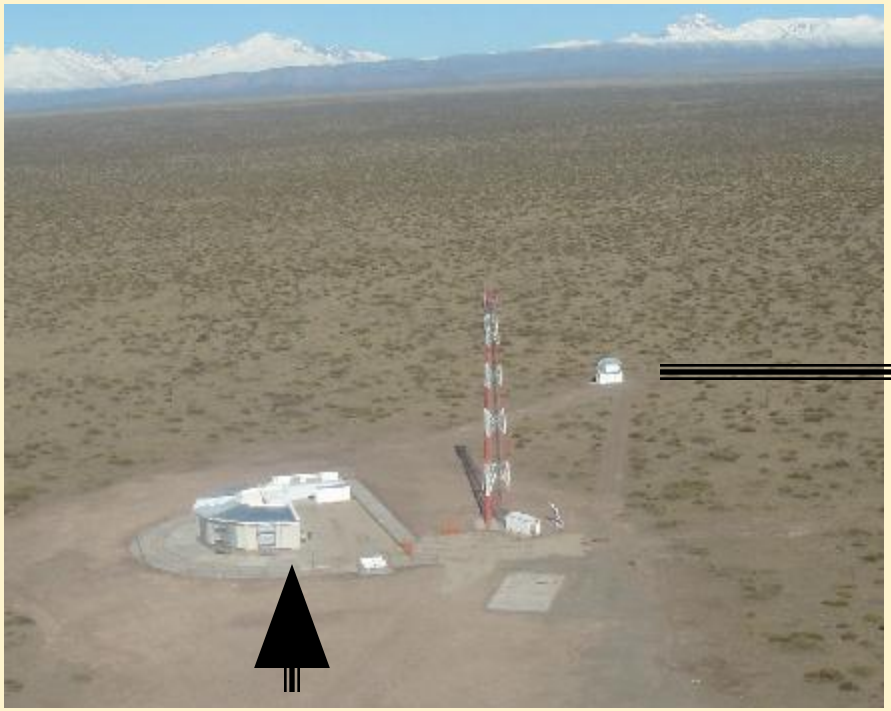


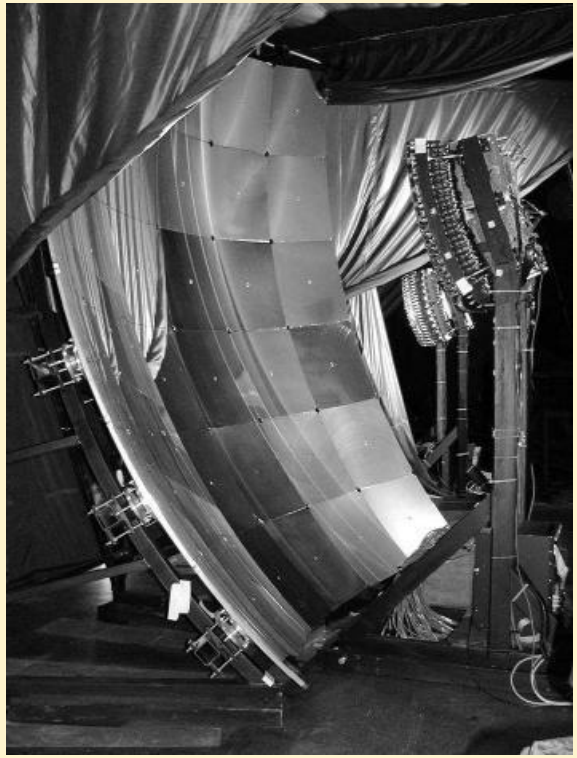
Tyrėjų problema:

At 1 GeV, the intensity per unit solid angle per GeV is roughly 1000 particles per second over 1 m^2, but at energies near 10^{20} eV, the probability that a particle hits an area of 1000 km^2 is only about once per century!

Tai ką turėsime laboratorijose 2010 metais!

Pierre Auger Southern Observatory

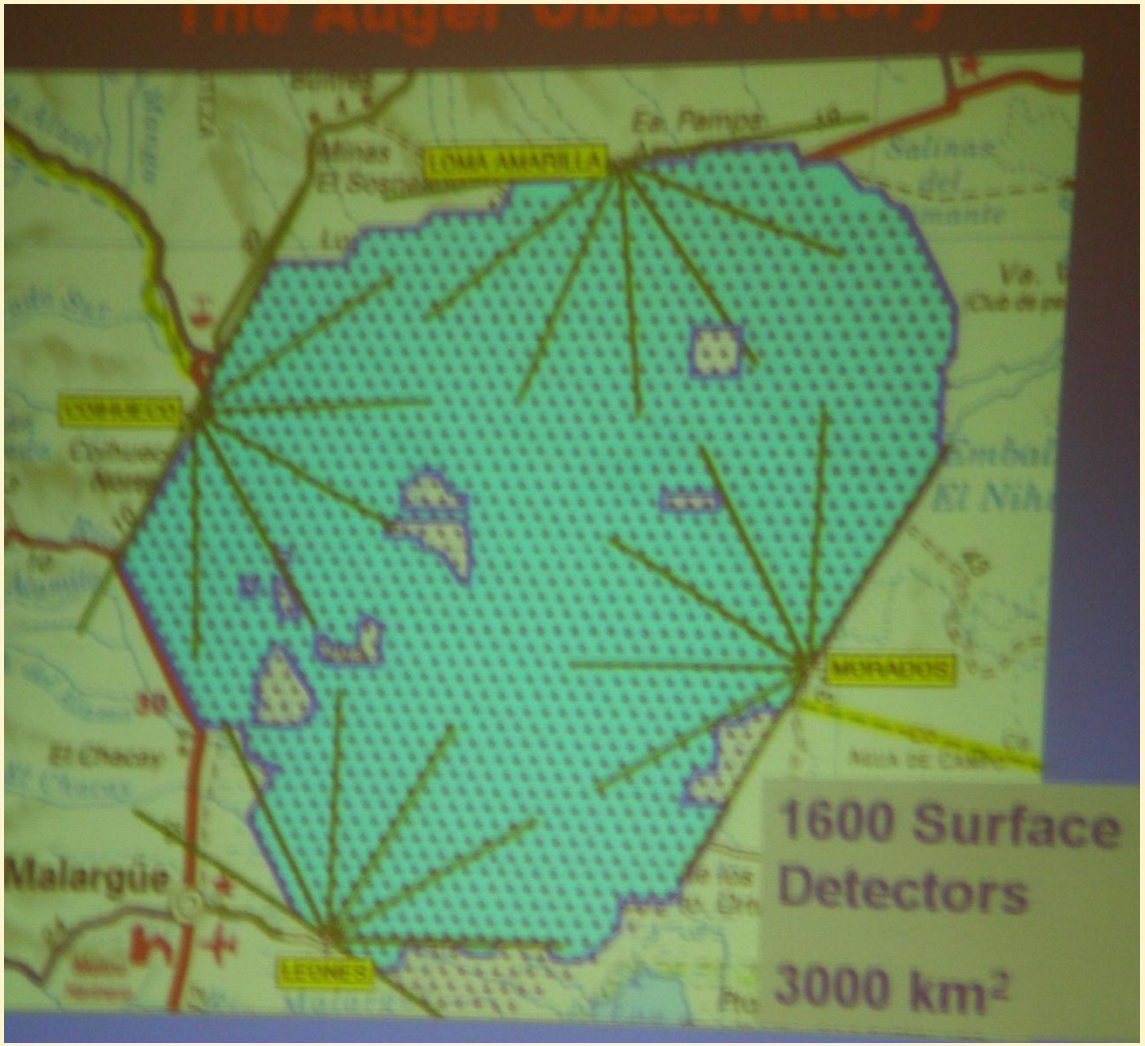


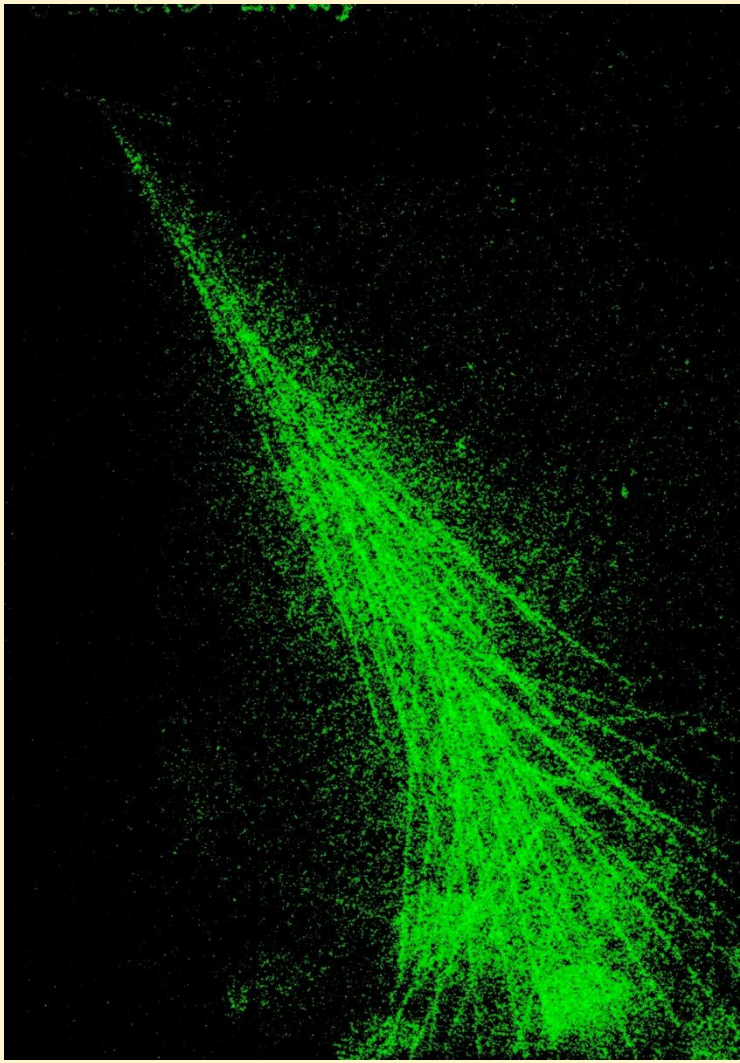


Fluorescencijos detektoriaus pastatas

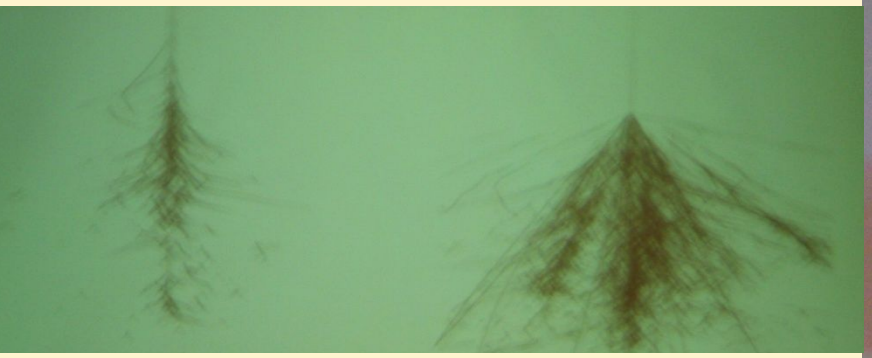
- 1600 detektorių tinklas apimantis virš 3000 km^2 Argentinos Mendoza provincijoje, netoli Andų kalnagūbrio.
- Tinklą apsupa 24 fluorescenciniai teleskopai, kurie mato kosminių spindulių kaskadų sužadintą UV spinduliuotė atmosferoje.

Pjero Ože observatorija





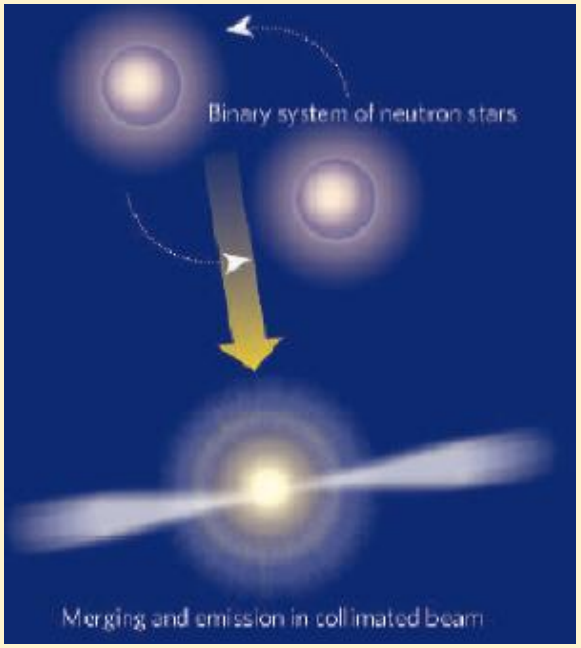
Dalelių ir gamma spindulių generuotų šuorų išsiskleidimo kampai skiriasi.

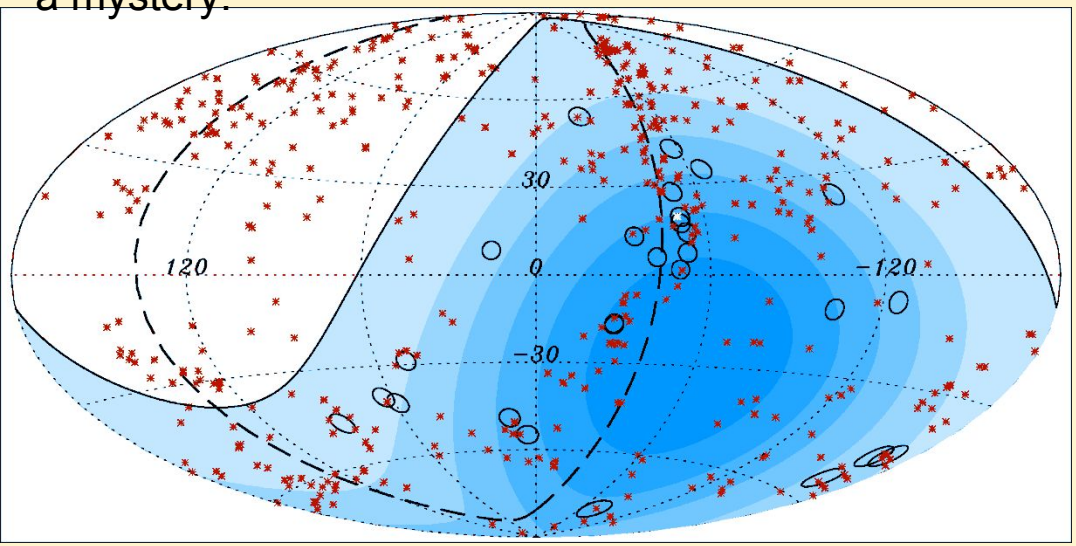


Gamma kvantas Hadronas

Didelių energijų ir gama spindulių šuorai

Active Galactic Nuclei (AGN) are thought to be powered by supermassive black holes that are devouring large amounts of matter. They have long been considered sites where high-energy particle production might take place. They swallow gas, dust and other matter from their host galaxies and spew out particles and energy. While most galaxies have black holes at their center, only a fraction of all galaxies have an AGN. The exact mechanism of how AGNs can accelerate particles to energies 100 million times higher than the most powerful particle accelerator on Earth is still a mystery.





The celestial sphere in galactic coordinates (Aitoff projection) showing the arrival directions of the 27 highest energy cosmic rays detected by Auger. The energies are greater than 57 x 10^{18} eV (57 EeV). These are shown as circles of radius 3.1°. The positions of 472 AGN within 75 megaparsecs are shown as red *'s.

The blue region defines the field of view of Auger; deeper blue indicates larger exposure. The solid curve marks the boundary of the field of view, where the zenith angle equals 60°. The closest AGN, Centaurus A, is marked as a white *. Two of the 27 cosmic rays have arrival directions within 3° of this galaxy. The supergalactic plane is indicated by the dashed curve. This plane delineates a region where large numbers of nearby galaxies, including AGNs, are concentrated.

Siunčiant kosminius zondus:

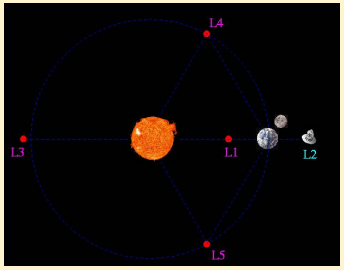
Mariner 1-2 to Venus: Mariner 2 was the world's first successful interplanetary spacecraft. Launched Aug. 27, 1962, on an Atlas-Agena rocket, Mariner 2 passed within about 34,000 kilometers of Venus, sending back valuable new information about interplanetary space and the Venusian atmosphere. Mariner 2 recorded the planet's temperature for the first time, revealing the its very hot atmosphere of about 500 ^{0}C. The spacecraft's solar wind experiment was the first to measure the density, velocity, composition and variation over time of the solar wind.

Scanning the planet with infrared and microwave radiometers, revealing that Venus has cool clouds and an extremely hot surface.

Science instruments: Microwave radiometer, IR radiometer, flux-gate magnetometer, ion chamber and Geiger-Mueller counters, cosmic dust detector, solar plasma detector.

Tyrimuose dalyvavo JAV lietuvis dabartinis LMA užsienio narys Arvydas Kliorė, įtaiso konstravime dalyvavo kitas JAV lietuvis J. Jodelė.

Galima eksploatuoti visuotinės traukos dėsnį: Lagranžo taškai



L1

In 1978, the International Sun-Earth Explorer-3 (ISEE-3) was launched towards L1, where it conducted such observations for several years. Now the ESA/NASA SOHO solar watchdog is positioned there.

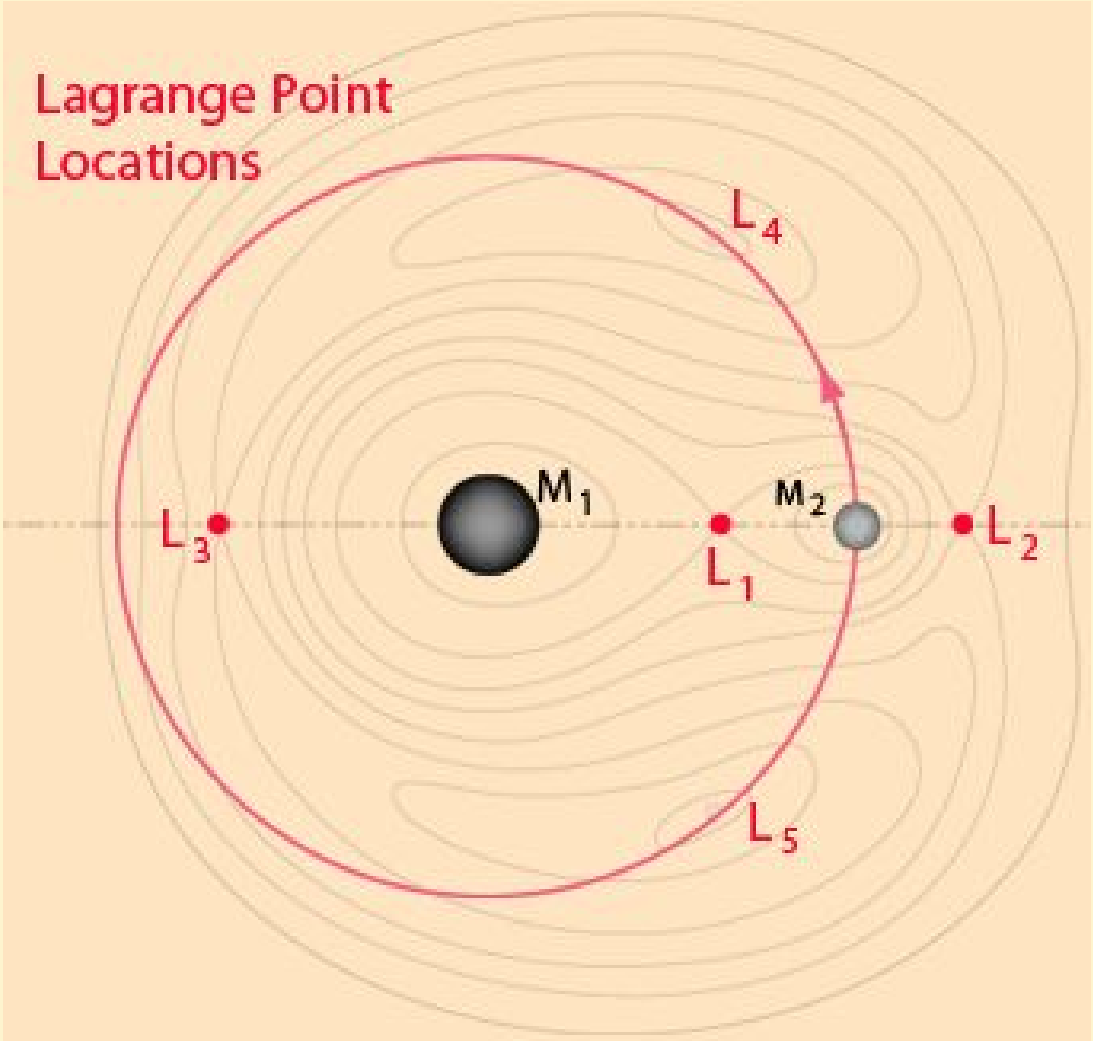
L3

L2

ESA has a number of missions that will make use of this spot in the coming years. L2 will become home to ESA missions such as Herschel, Planck, Gaia and the James Webb Space Telescope.

Iš ESA – Space science puslapio

Lagranžo taškai Žemė-Mėnulis sistemoje



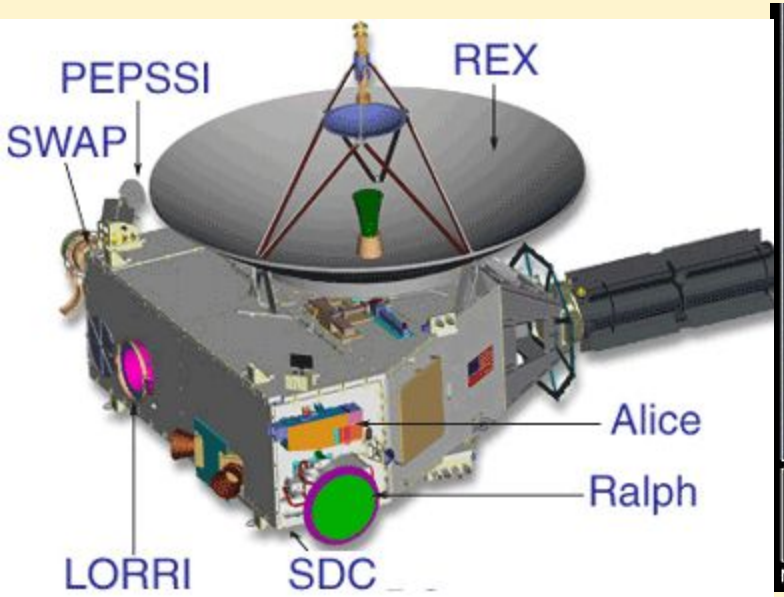
Joseph Louis Lagrange and Leonhard Euler were 18th century mathematicians who tackled the famous "three-body problem" in the late 1700s. The problem cannot be solved exactly, but he found that in the case where the third body is very small compared to the other two, some useful approximate solutions could be found.

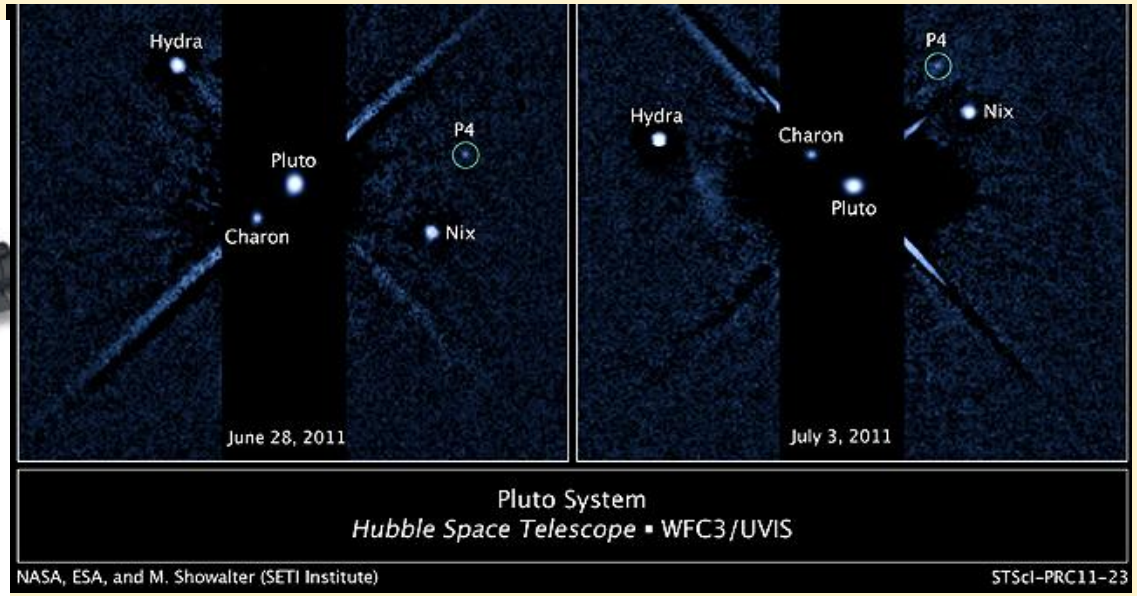
http://hyperphysics.phy-astr.gsu.edu/hbase/mechanics/lagpt.html

Pioneer 10 was managed by NASA Ames Research Center, Launched on March 2,1972, It was the first spacecraft to travel through the Asteroid belt, and the first spacecraft to make direct observations and obtain close-up images of Jupiter.
Famed as the most remote object ever made through most of its mission, Pioneer 10 traveled more than 8 billion miles through space in 25 years. (On Feb. 17, 1998, Voyager 1's heliocentric radial distance equaled Pioneer 10 at 69.4 AU and thereafter exceeded Pioneer 10 at the rate of 1.02 AU per year.) Pioneer 10, on its 40th anniversary, is now 11 billion miles into deep space.

- The venerable Pioneer 10 spacecraft sent its last, very weak signal to Earth received Jan. 23, 2003. The power source on Pioneer 10 finally degraded to the point where its signal to Earth dropped below the threshold for detection.
- Pioneer 10 will continue to coast silently as a ghost ship through deep space into interstellar space, heading generally for the red star Aldebaran, which forms the eye of Taurus (The Bull). Aldebaran is about 68 light years away and it will take Pioneer more than 2 million years to reach it.
  http://www.nasa.gov/centers/ames/missions/archive/pioneer.html

New Horizons erdvėlaivis paleistas 2006.01.19, 2007.02 praskries Jupiterį, kad jis jį pagreitintų, ir pasiekęs Plutoną 2015.07, ir pradės tirti šią ledinę planetą ir jos mėnulius.





Ralph: Visible and infrared imager/spectrometer; provides color, composition and thermal maps.

Alice: Ultraviolet imaging spectrometer; analyzes composition and structure of Pluto's atmosphere and looks for atmospheres around Charon and Kuiper Belt Objects (KBOs).

REX: (Radio Science EXperiment) Measures atmospheric composition and temperature; passive radiometer.

LORRI: (Long Range Reconnaissance Imager) telescopic camera; obtains encounter data at long distances, maps Pluto's farside and provides high resolution geologic data.

SWAP: (Solar Wind Around Pluto) Solar wind and plasma spectrometer; measures atmospheric "escape rate" and observes Pluto's interaction with solar wind.

PEPSSI: (Pluto Energetic Particle Spectrometer Science Investigation) Energetic particle spectrometer; measures the composition and density of plasma (ions) escaping from Pluto's atmosphere.

SDC: (Student Dust Counter) Built and operated by students; measures the space dust peppering New Horizons during its voyage across the solar system.

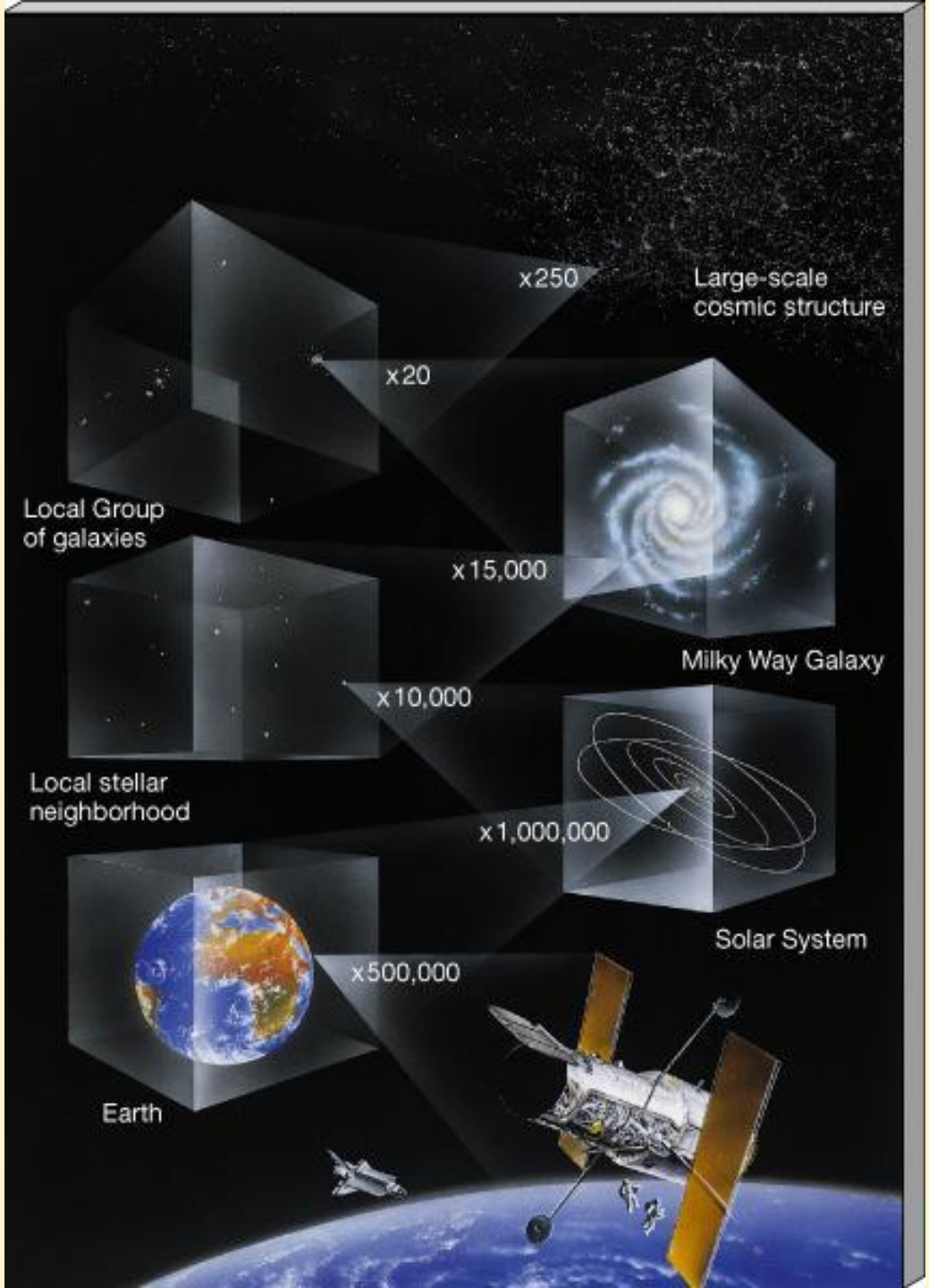
Ir tai dar ne viskas

Kai kas bus pateikiama rodant dangaus kūnų stebėjimo ir analizės rezultatus

Visatos

(megapasaulio)

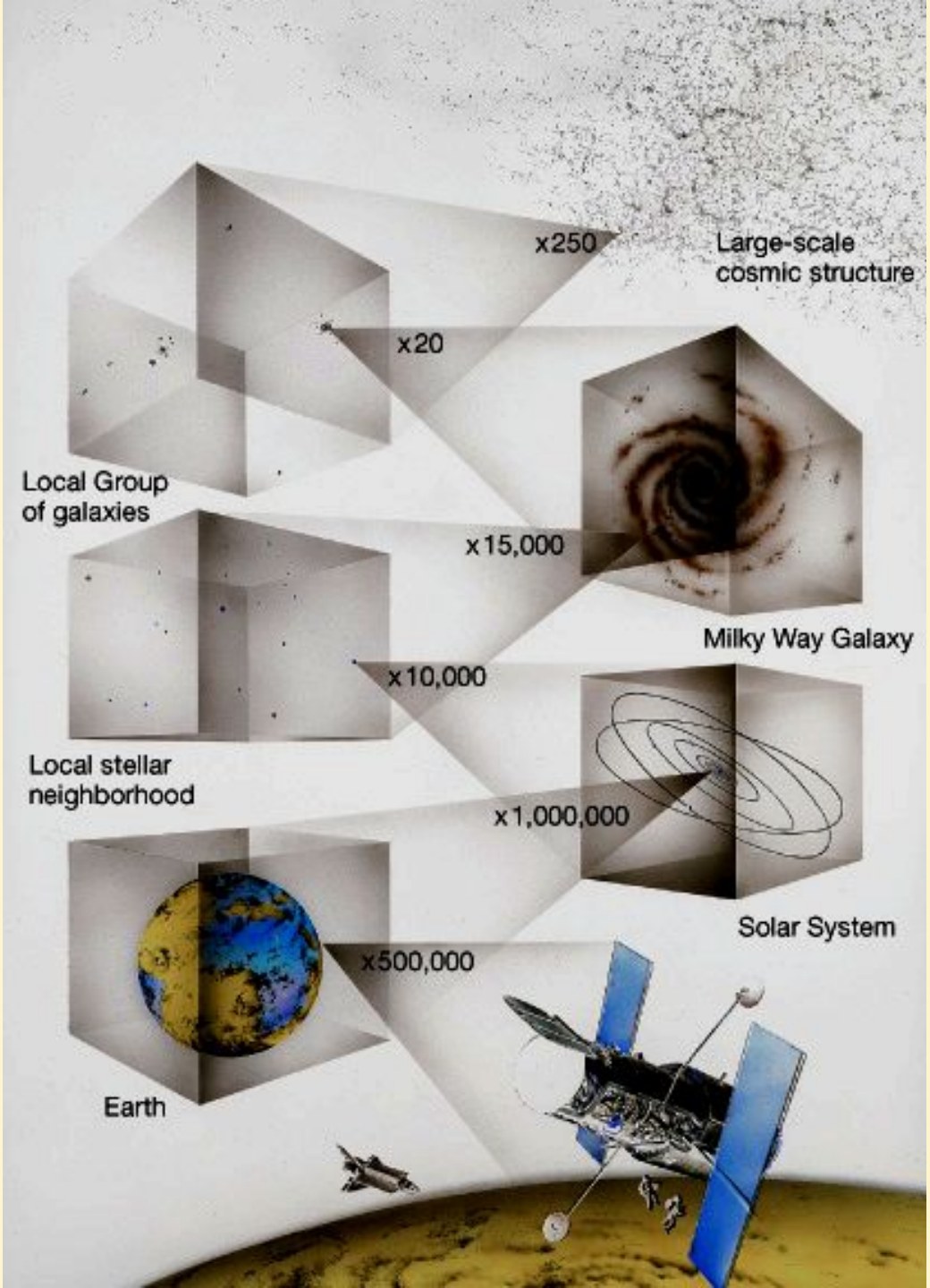
skalės



Visatos

(megapasaulio)

skalės



Kodėl reikia tirti megapasaulį?

- Žemė – kosminis kūnas. Kas nutiko kitiems, gali nutikti ir Žemei.
  - Iš kur atlekia kūnai išmušantys meteoritinius kraterius?
- Kiek ir kaip toliau degs Saulė?
  - Kaip žmonija turi ruoštis pokyčiams?
  - Kokia visų tų procesų laiko skalė?
- O visa tam reikia suprasti dangaus sferoje veikiančius procesus.