

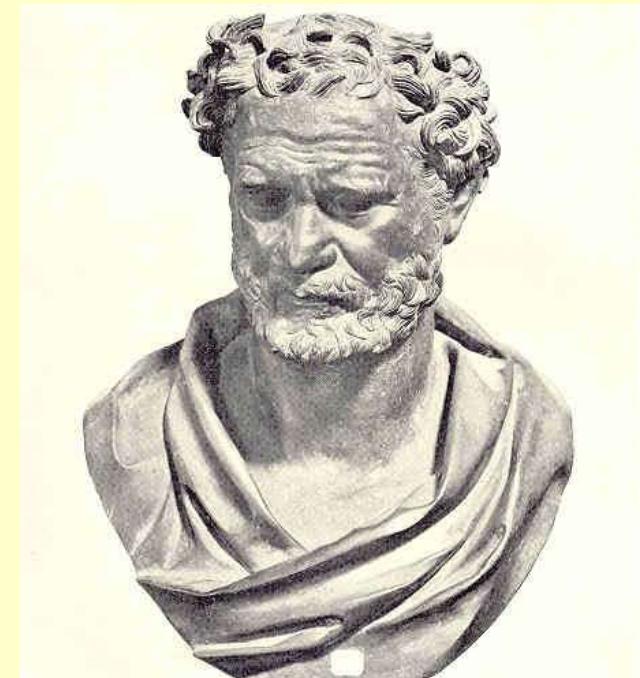
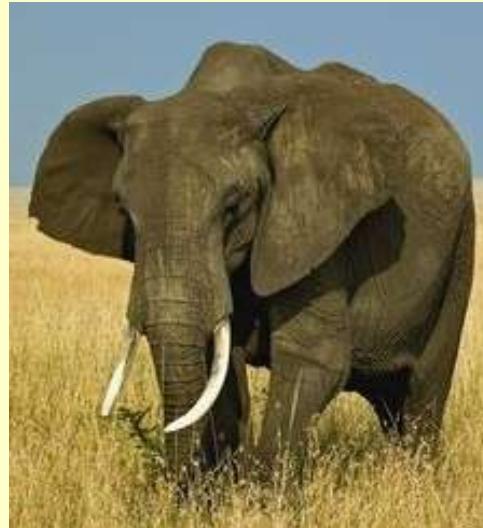
Astročestična fizika jednistveni pogled u svijet velikog i malog

Dario Hrupec
Institut Ruđer Bošković, Zagreb

Gradska knjižnica Samobor
8. siječnja 2013.

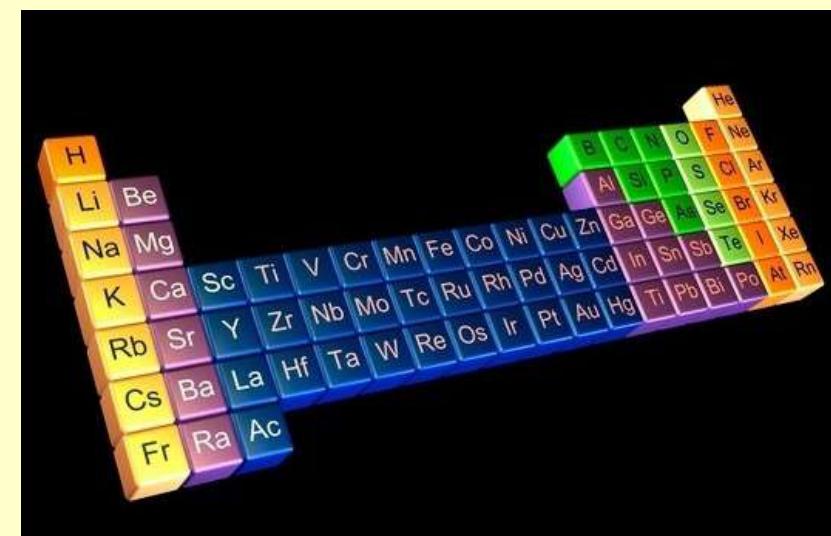
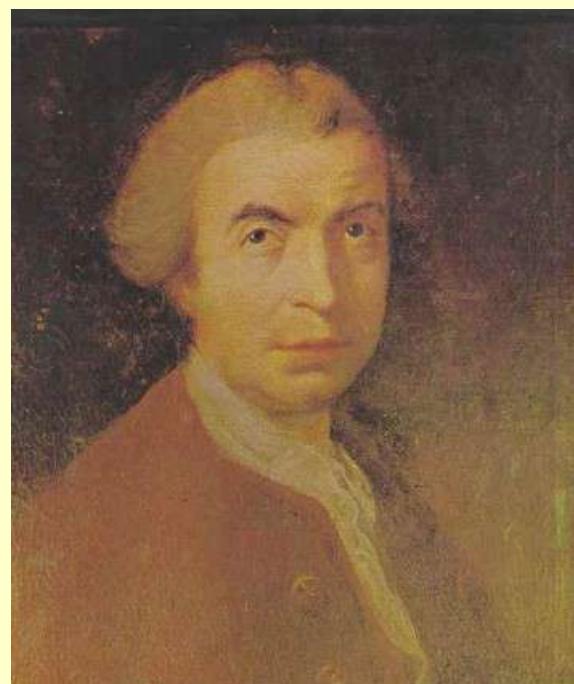
Tvar se sastoji od atoma: ideja atoma

- sitne nedjeljive čestice od kojih se sastoji sva tvar
- jedna je od najplodonosnijih ideja u ljudskoj povijesti
- Grčka (5 stoljeće p.n.e.) ili čak Indija (6 stoljeće p.n.e.)



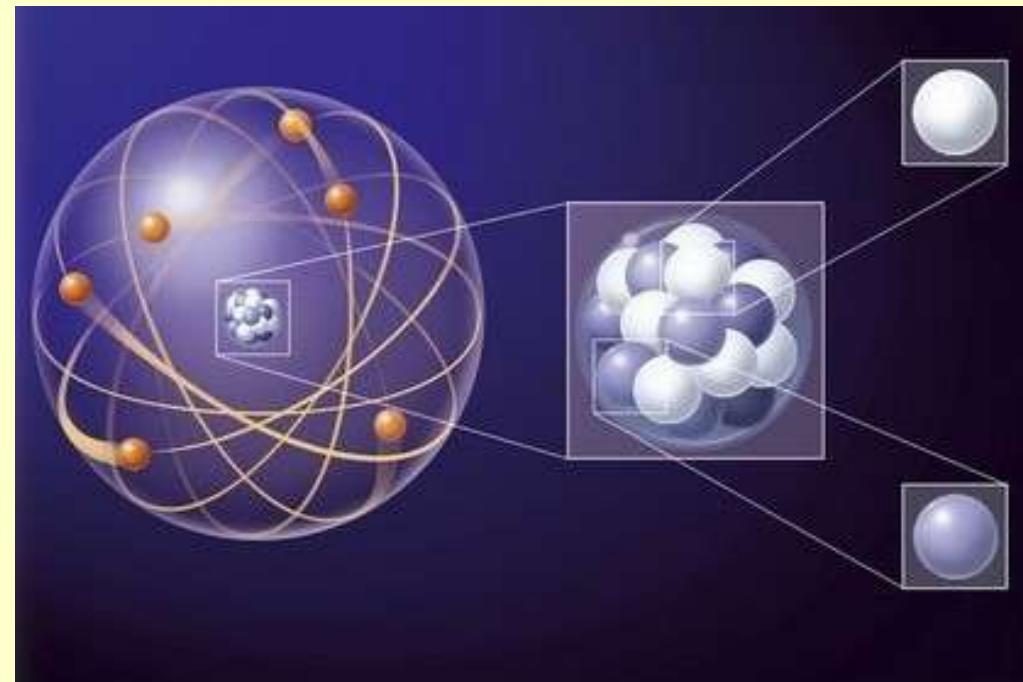
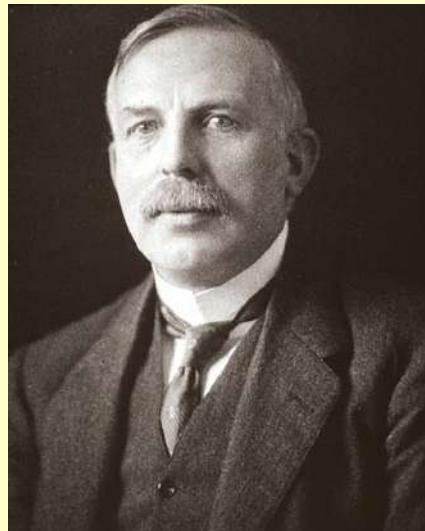
Tvar se sastoji od atoma: teorija atoma

- Robert Boyle (1661.) - prva sustavna primjena u znanosti
- Bošković (1758.) - jedinstvena sila među točkastim česticama
- vrste atoma = kemijski elementi



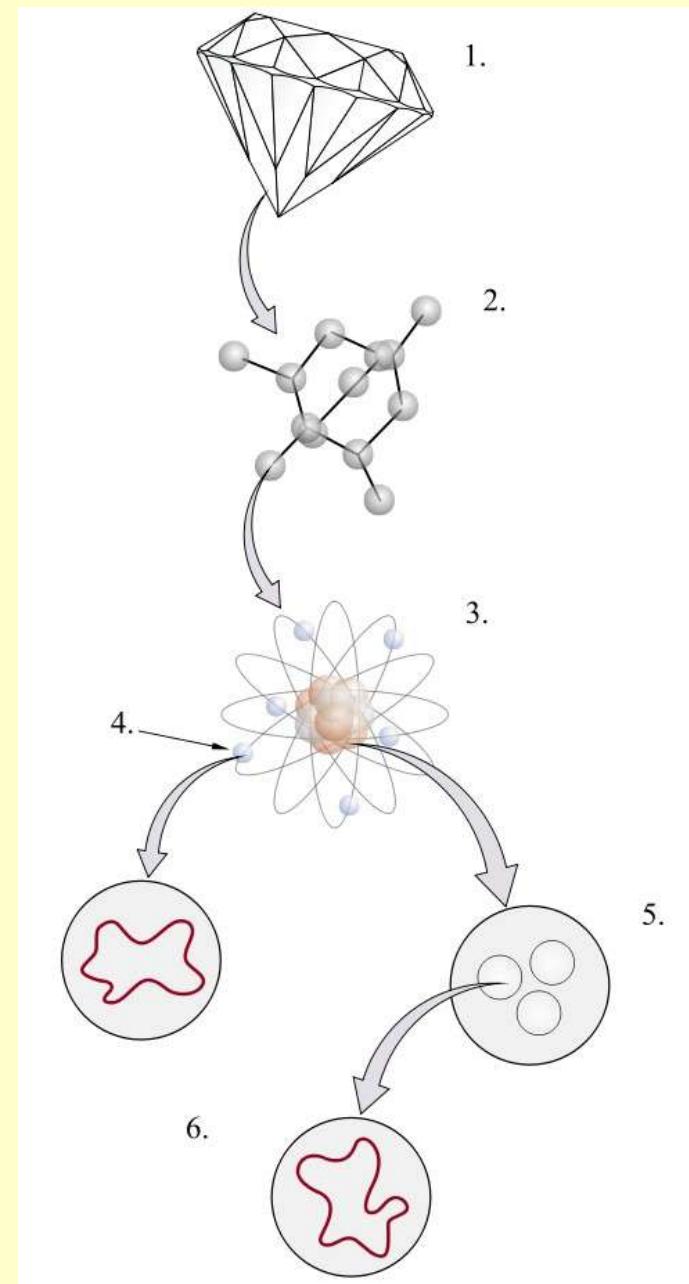
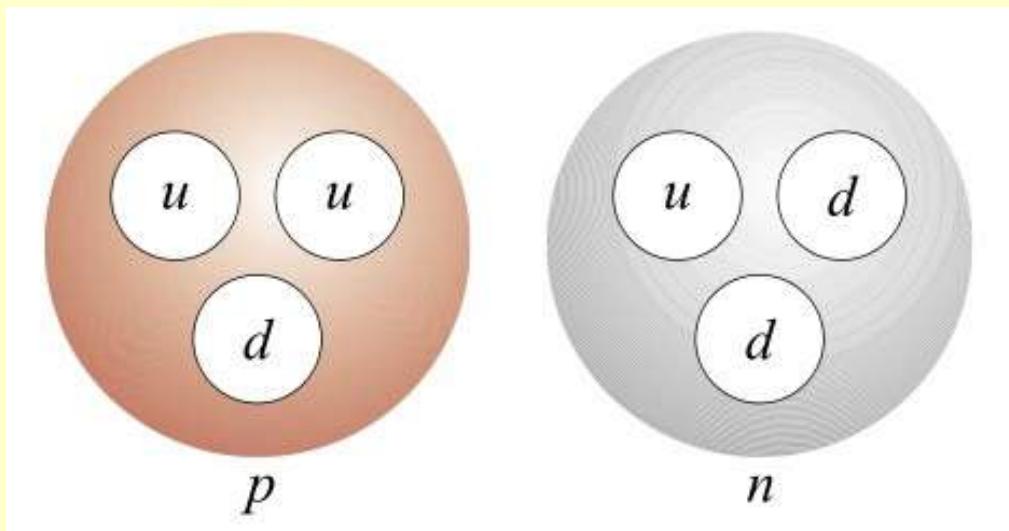
Atom nije nedjeljiv

- Ernest Rutherford (1911.) – “pozivni naboj u sitnoj jezgri”
- kvantna mehanika (sredinom 1920.): potpuni opis atoma
- prema nuklearnoj fizici: Chadwick (1932.), Yukawa (1935.) ...



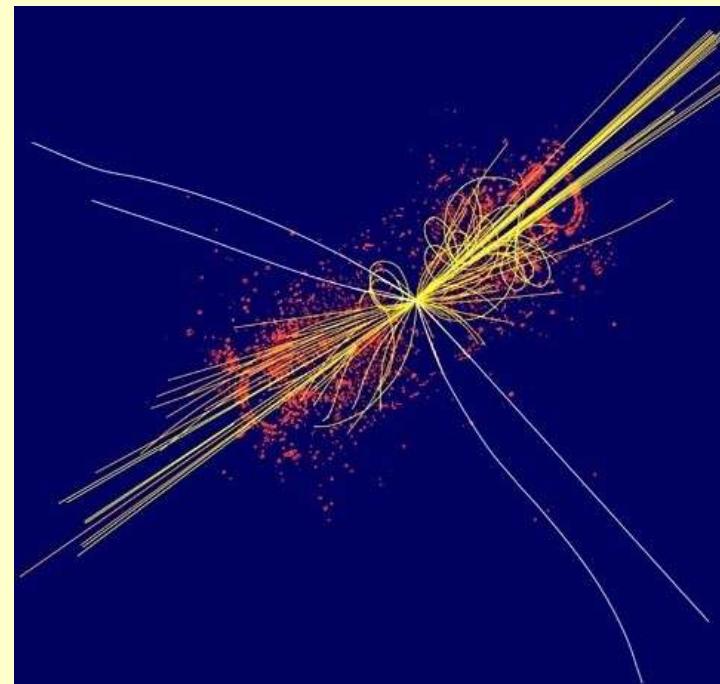
Elementarne čestice

- kvarkovi
- kvantne ljestve



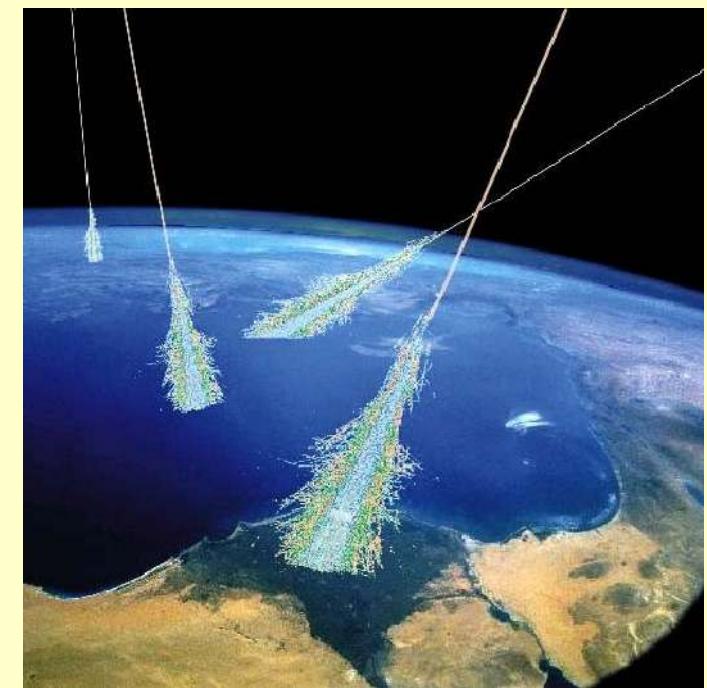
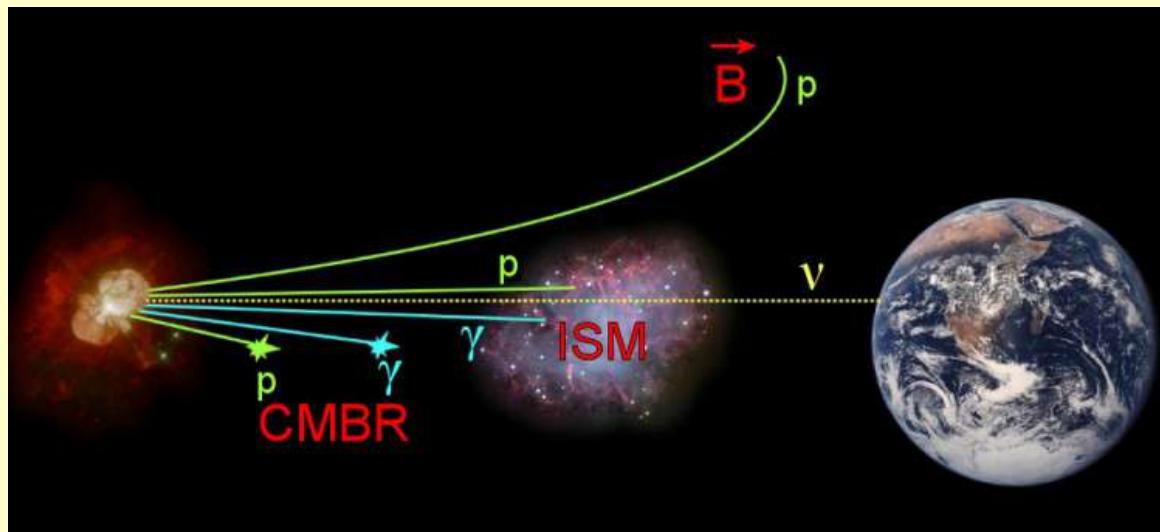
Kako istražujemo elementarne čestice

- LHC (CERN)
- simulacija sudara u kojem nastaje Higgsov bozon



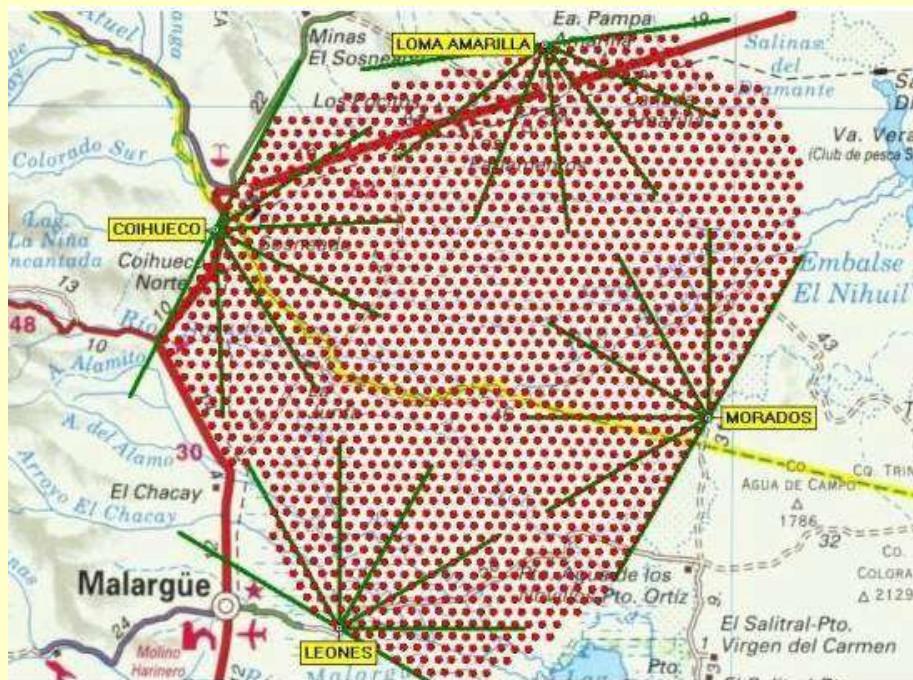
Astročestice - čestice iz svemira

- kozmičke zrake, EM zračenje, astrofizički v, gravitacijski valovi
- veliki pljuskovi sekundarnih čestica u atmosferi



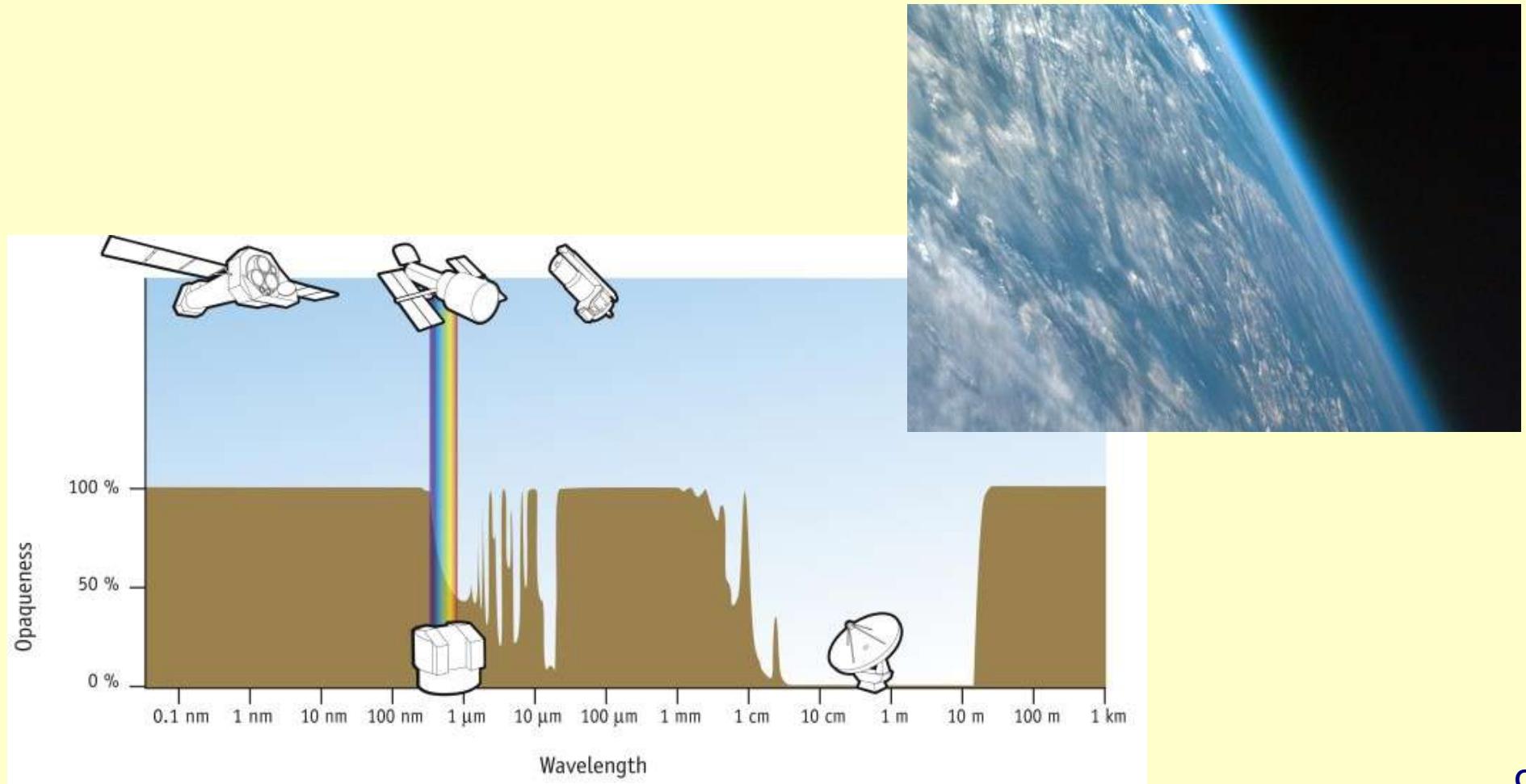
Kozmičko zračenje

- Pierre Auger Observatory
- 1600 rezervoara za vodu na površini od 3000 km^2



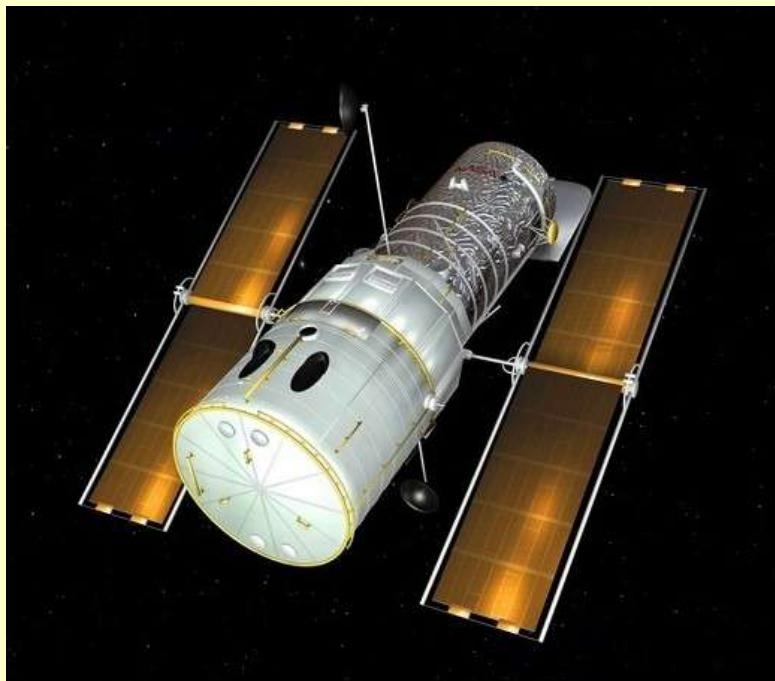
Elektromagnetsko zračenje

- selektivna transparentnost atmosfere
- različiti detektori za različita područja



EM zračenje: vidljiva svjetlost

- početak astronomije = početak znanosti (oko 400 godina)
- HST
- GranTeCan



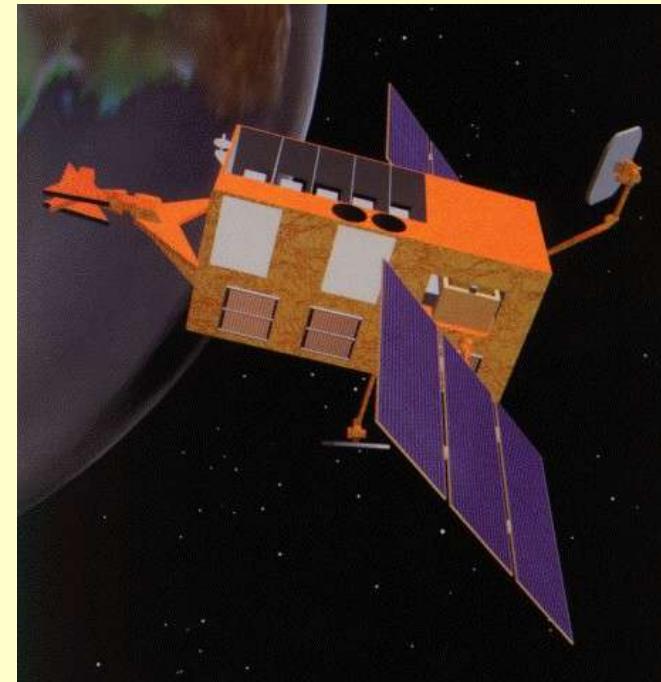
EM zračenje: radiovalovi

- nove astronomije = novi prozori u svemir
- VLA
- LOFAR



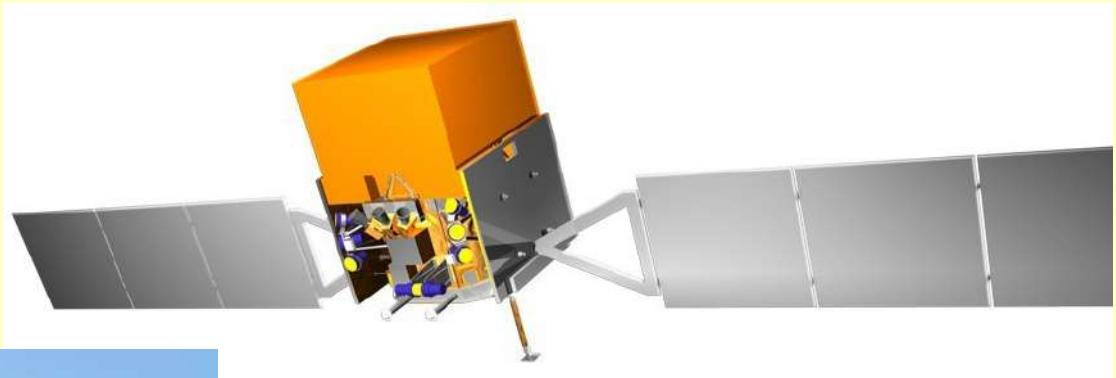
EM zračenje: X-zrake

- Chandra
- RXTE



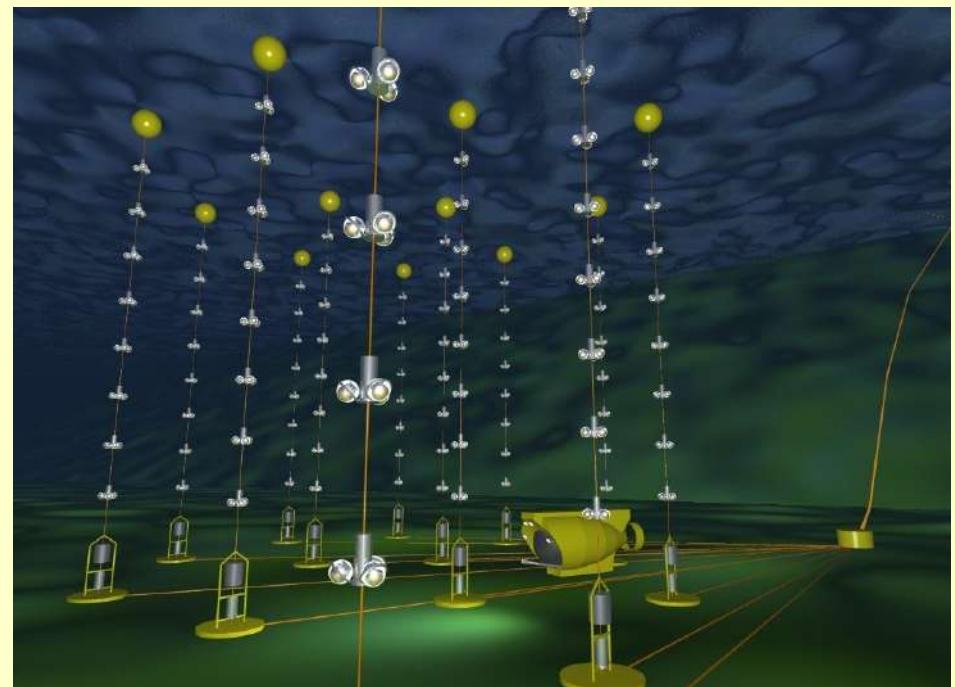
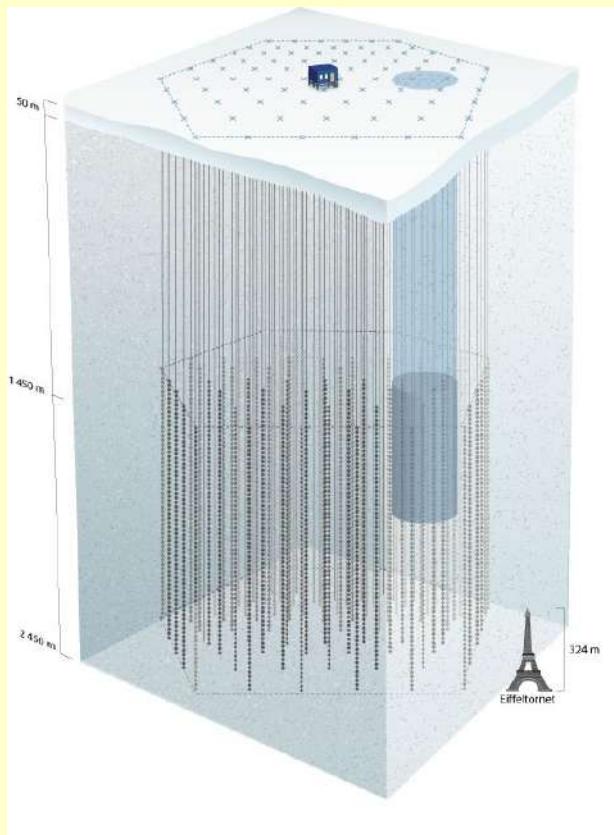
EM zračenje: gama-zrake

- atmosfera kao štit, ali i kao dio detektora
- Fermi (bivši GLAST)
- **MAGIC**



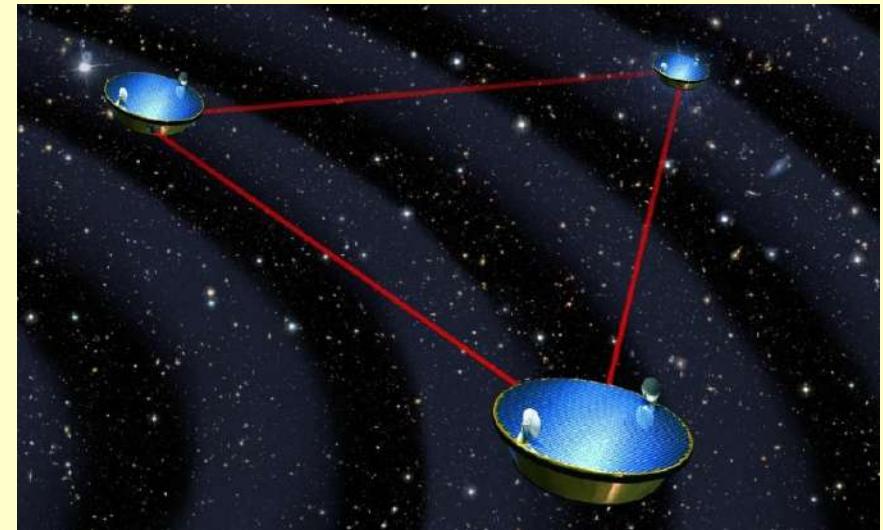
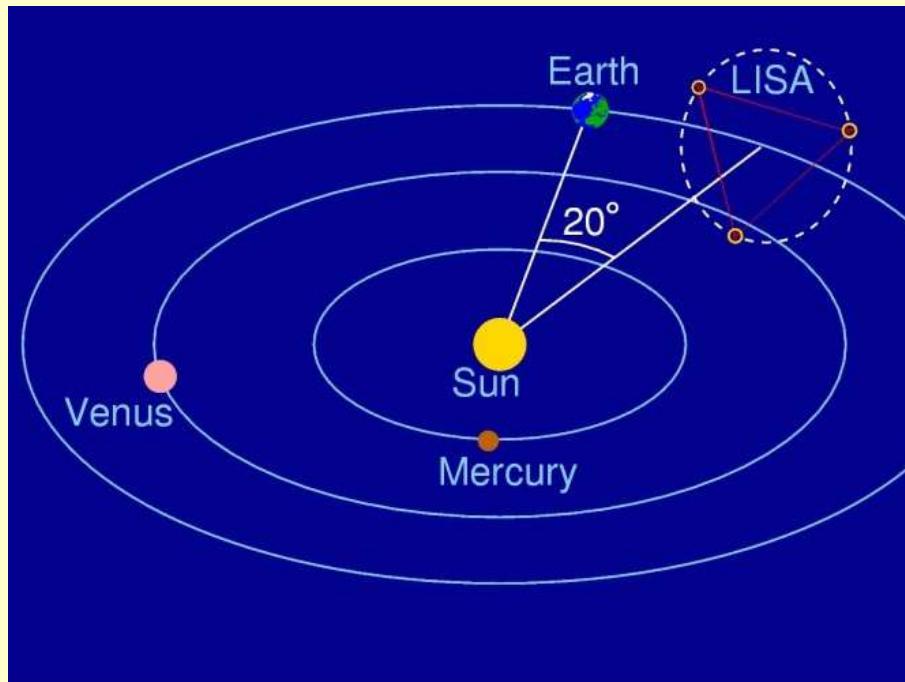
Astrofizički neutrini

- Ice Cube
- Antares



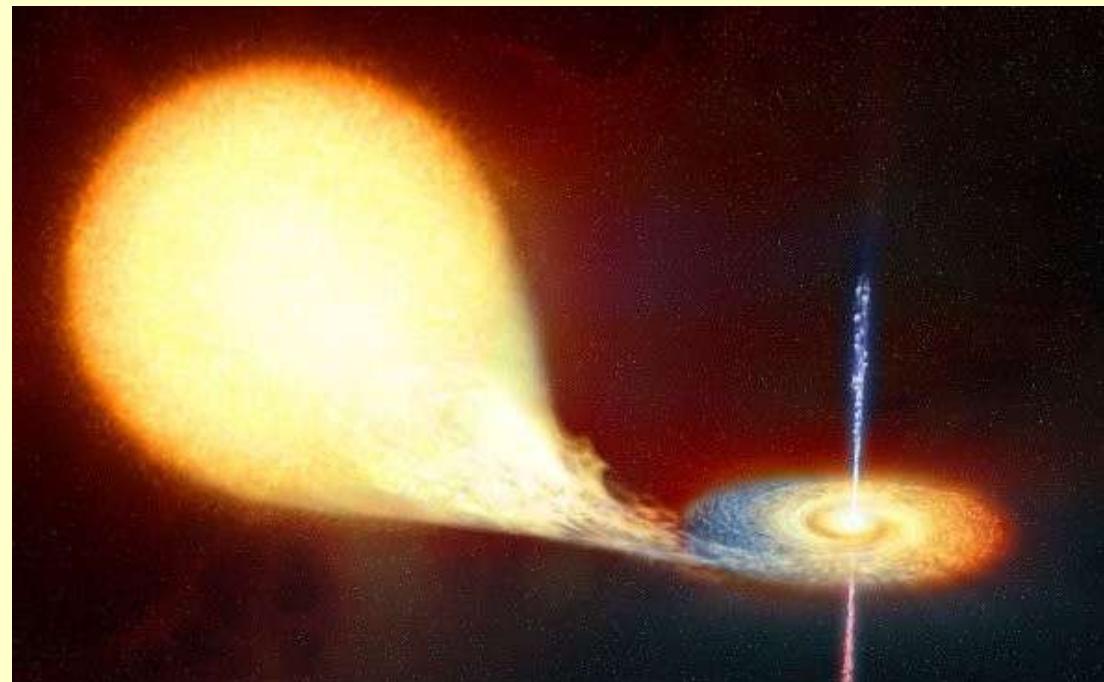
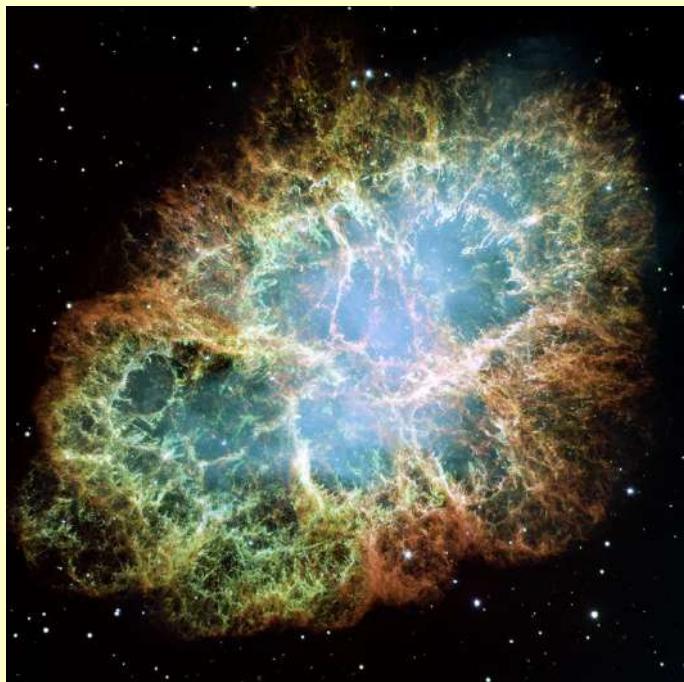
Gravitacijski valovi

- LIGO
- LISA



Odakle astročestice: galaktički izvori

- ostaci supernova
- mikrovazari



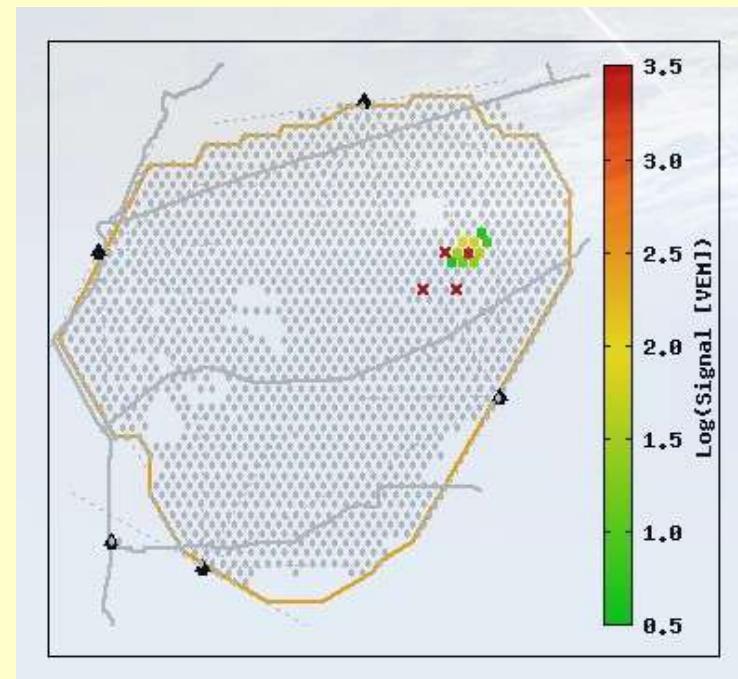
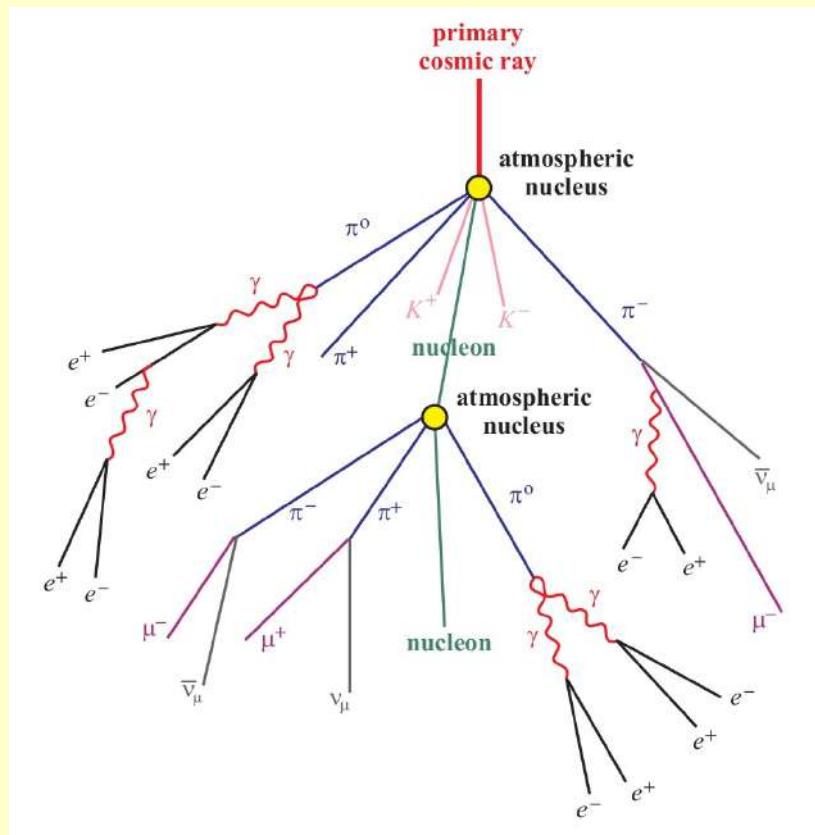
Odakle astročestice: izvangelastički izvori

- AGN (aktivne galaktičke jezgre)
- GRB (provale gama-zraka)



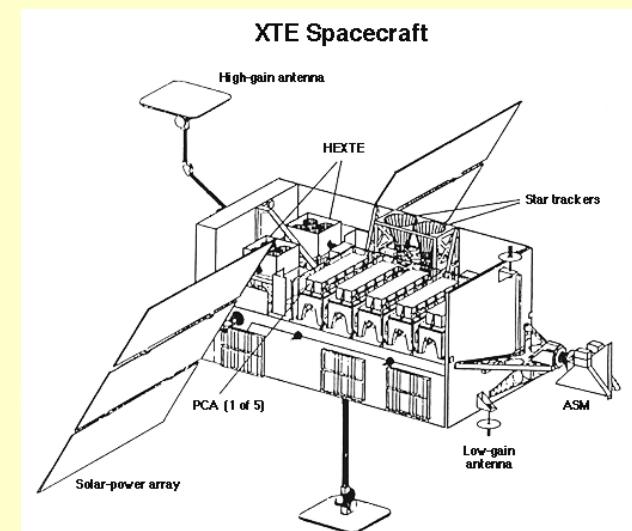
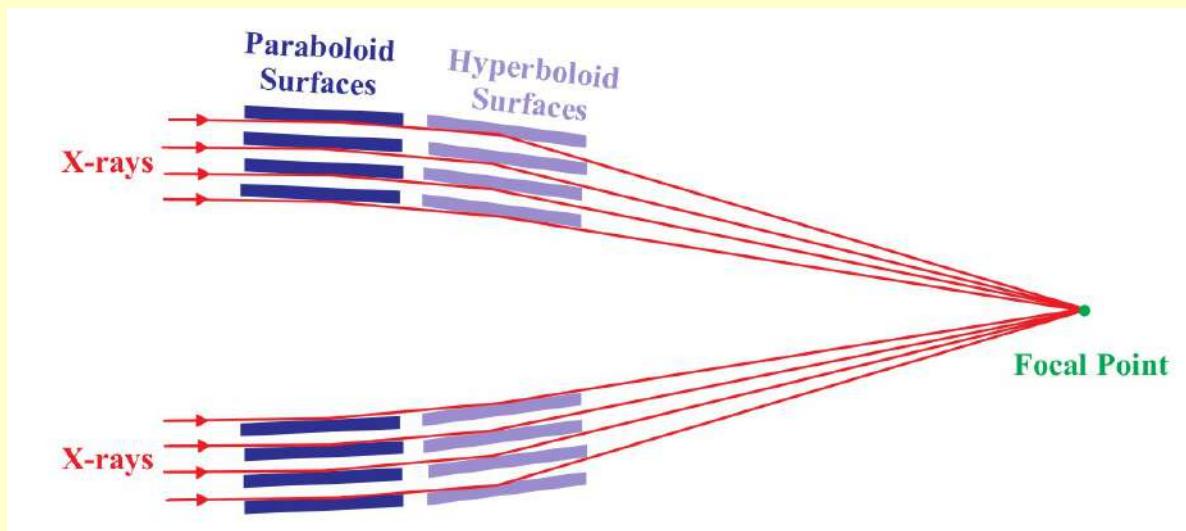
Opažanje astročestica: kozmičko zračenje

- nabijene sekundarne čestice iz pljuska dolaze do tla
- događaj od 14. 7. 2009. (10 stanica, 26 EeV)



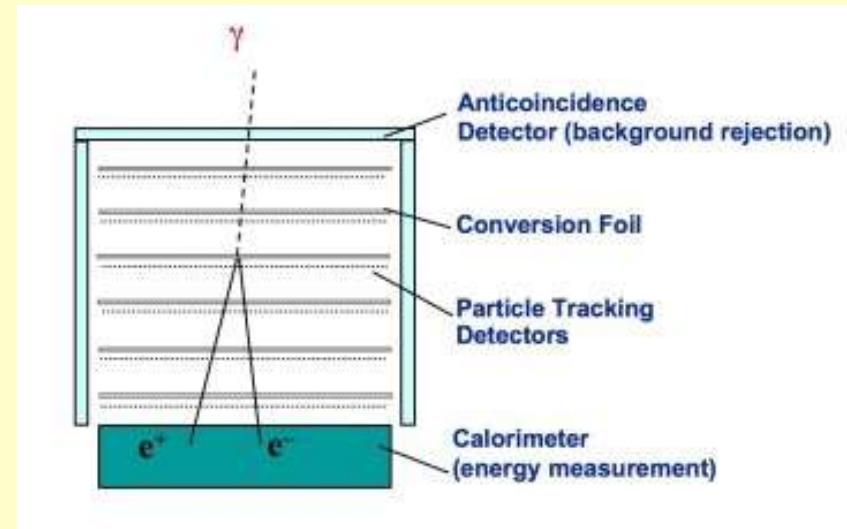
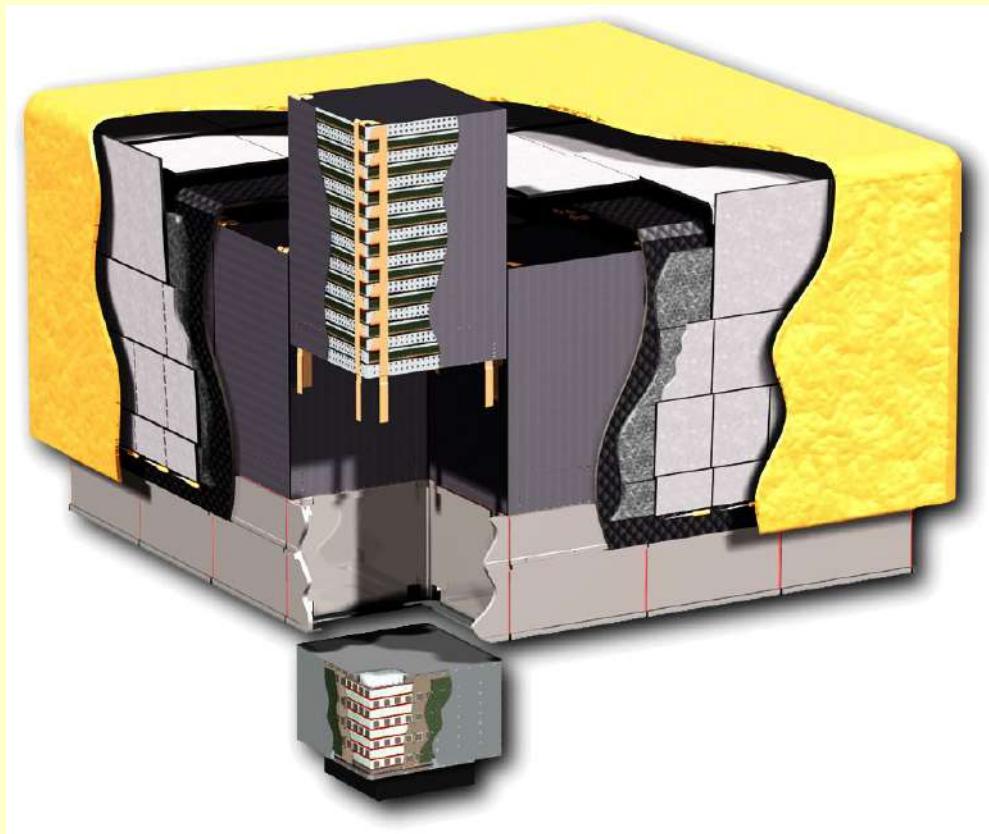
Opažanje astročestica: X-zrake

- Chandra (fokusiranje X-zraka)
- RXTE (ASM, PCA i HEXTE)



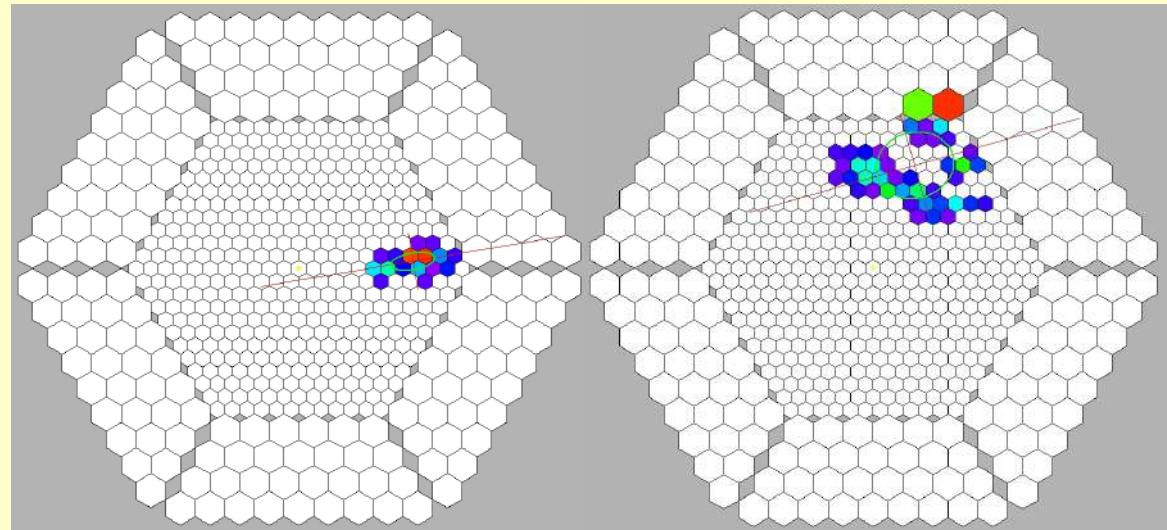
Opažanje astročestica: gama-zrake (LE)

- Fermi LAT (Large Area Telescope)



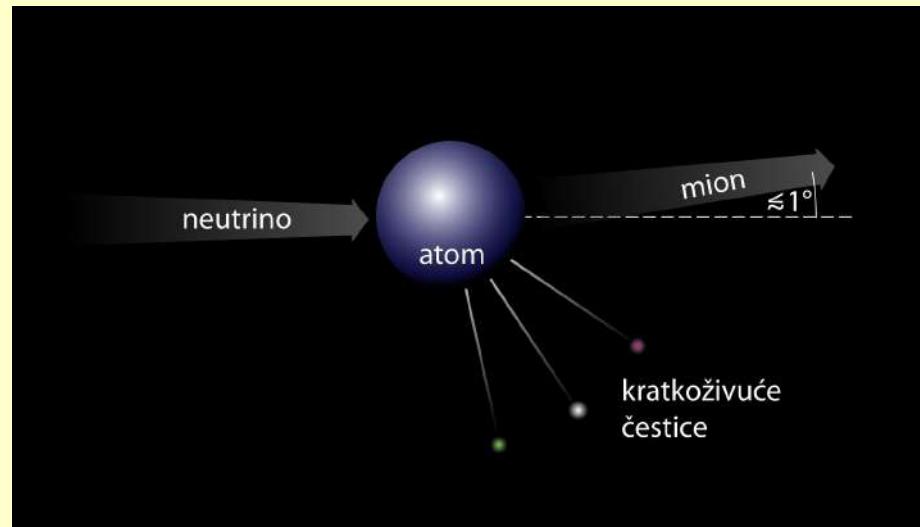
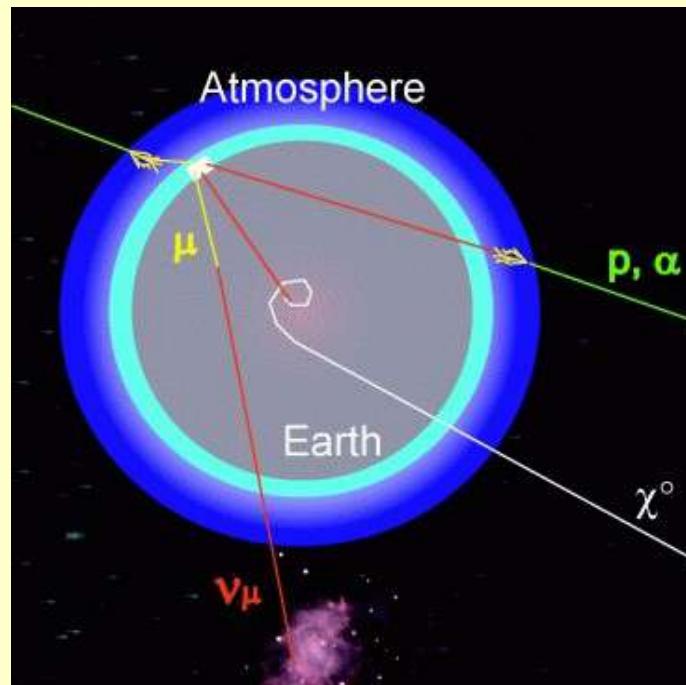
Opažanje astročestica: gama-zrake (HE)

- Čerenkovljevo zračenje
- događaji u kamери teleskopa MAGIC-I



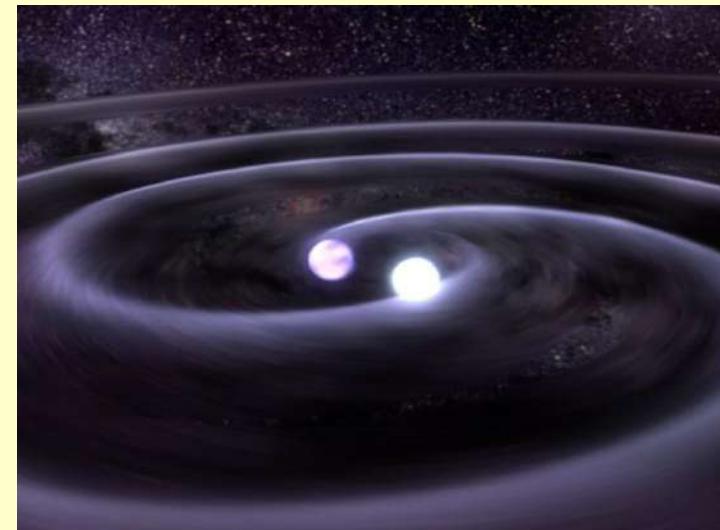
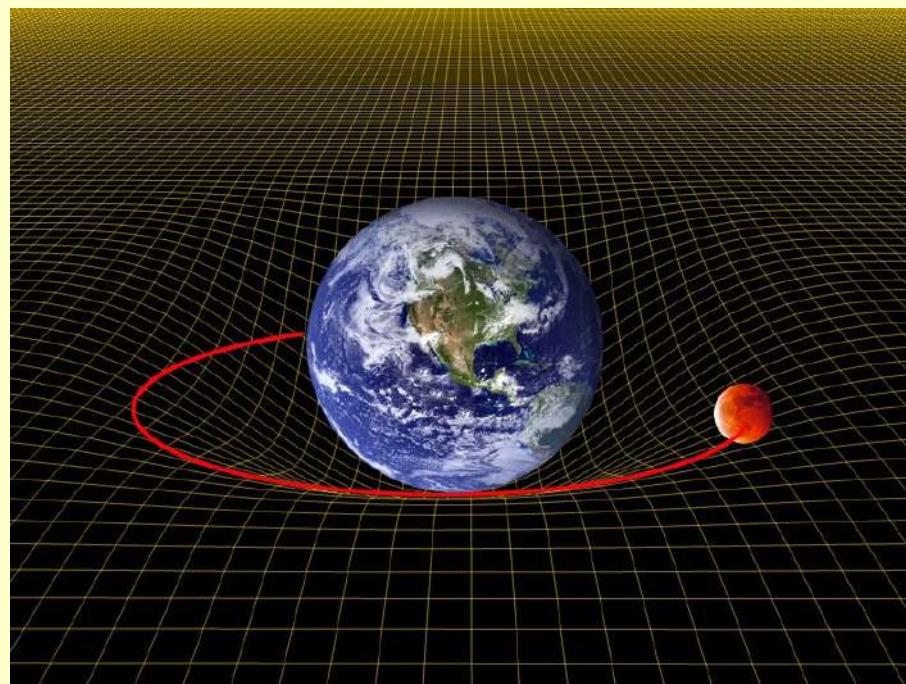
Opažanje astročestica: astrofizički neutrini

- neutrinski teleskop “gleda” kroz Zemlju
- (mionski) neutrino stvara mion



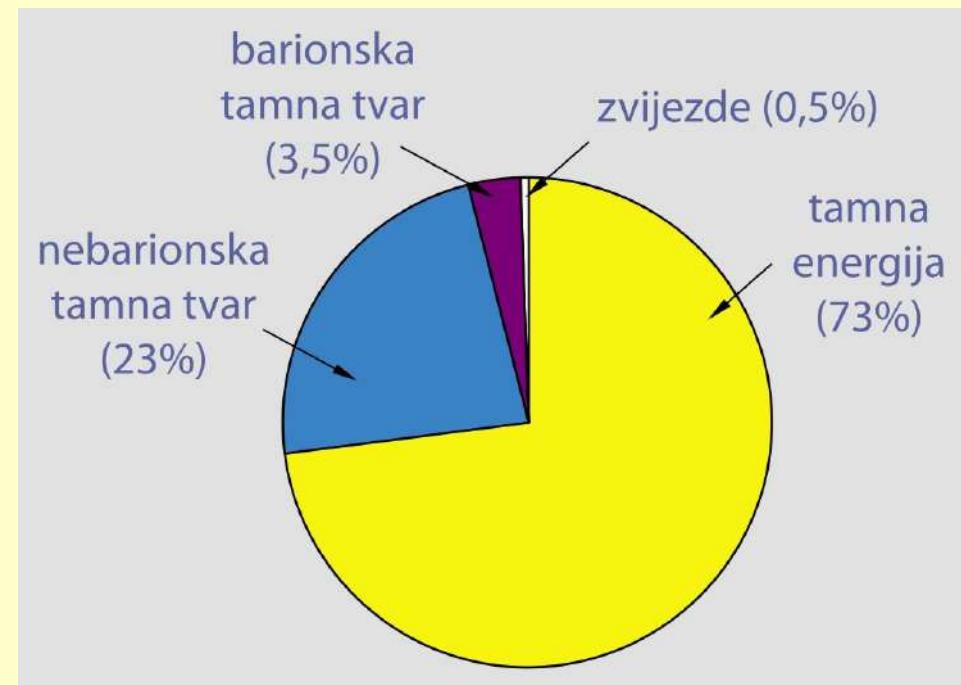
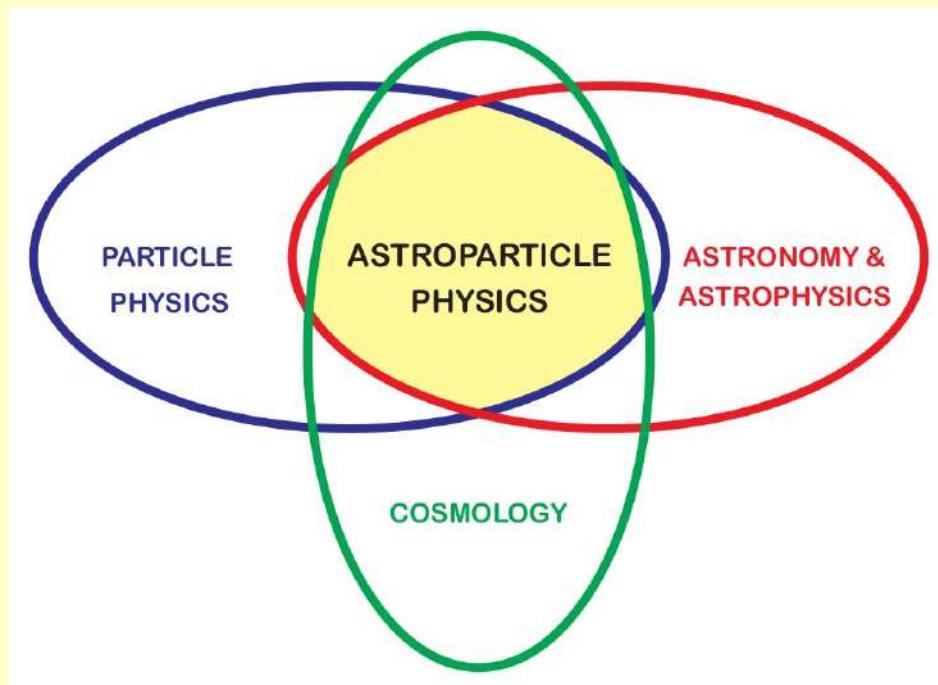
Opažanje astročestica: gravitacijski valovi

- masa-energija zakriviljuje prostor-vrijeme
- dvojni sustav kompaktnih kozmičkih objekata
- gravitacijski valovi: putujući nabori prostor-vremena



Astročestična fizika: rezime i neki rezultati

- astronomija & astrofizika, fizika elementarnih čestica, kozmologija
- svemir nije sve+mir (siloviti procesi, netermički izvori)
- tamna tvar i tamna energija



Svijet velikog i malog: rezime i neki rezultati

- od Planckove duljine do promjera svemira: 60 redova veličine
- Veliki prasak i (ubrzano) širenje svemira

