

Zašto opšta relativnost?

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Ciklus predavanja u saradnji sa projektom "Kvantna gravitacija iz viših gejdž teorija"
(QGHC-2021), broj 7745968 programa IDEJE Fonda za nauku Republike Srbije



Фонд за науку
Републике Србије

Fizika na kraju 19. veka



Isak Njutn (1643 - 1727)



Ludvig Bolcman (1844 - 1906)

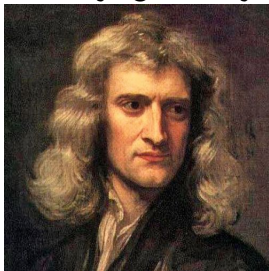


Džejms Klerk Maksvel (1831 - 1879)

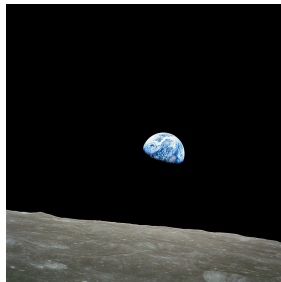
"Nema više ništa novo da se otkrije u fizici"

Lord Kelvin

Njutnova teorija gravitacije (1687)

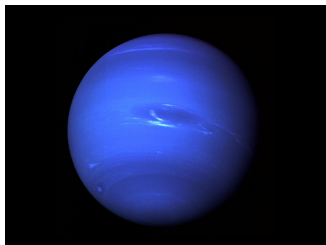


Isak Njutn (1643 - 1727)

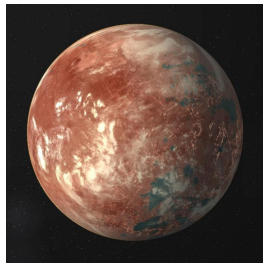




Urbain Leverijer (1811 - 1877)



Otkriće Neptuna (1846)

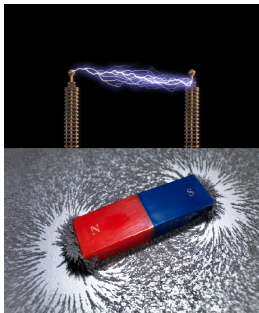


Otkriće Vulkana (?)

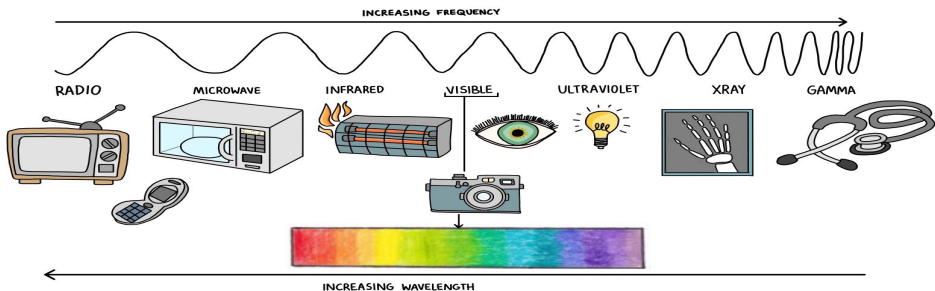
Elektrodinamika (1873)



Džejs Klerk Maksvel (1831 - 1879)



Svetlost je elektromagnetno zračenje



Elektromagnetno zračenje ima konačnu brzinu (299 792 458 m/s)

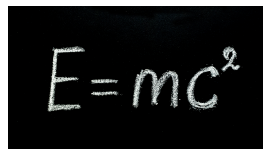
Inkompatibilnost Njutnove mehanike i elektrodinamike

Apsolutan prostor i vreme + Brzina svetlosti
= dva moguća rešenja problema

Svetlonosni etar



Specijalna teorija relativnosti

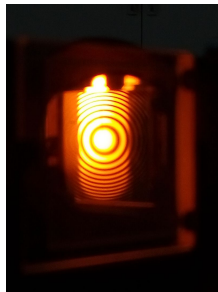

$$E=mc^2$$



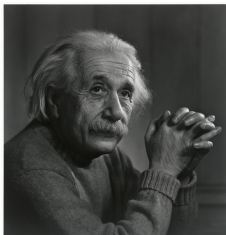
Albert Michelson (1852 - 1931)



Edward Morley (1838 - 1923)



Specijalna teorija relativnosti (1905)



Albert Ajnštajn (1879 - 1955)

Brzina svetlosti je ista za sve posmatrače

Nemamo privilegovane inercijalne referentne sisteme

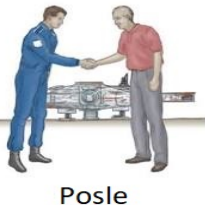
Zakoni fizike su isti u svim inercijalnim sistemima

Posledice specijalne teorije relativnosti

Dilatacija vremena



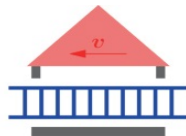
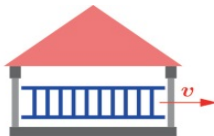
Paradoks blizanaca



Kontrakcija dužine



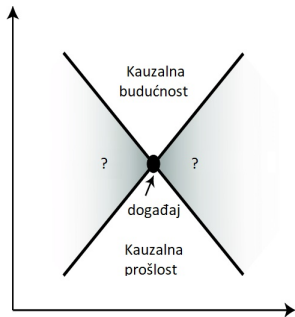
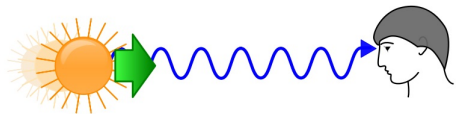
Paradoks merdevina



Relativistički doplerov efekat



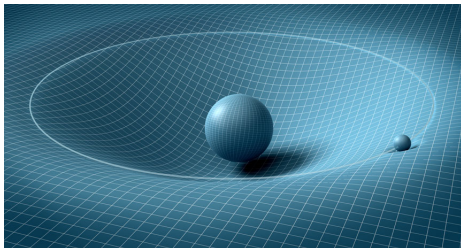
Svetlosni konus i kauzalnost



Ekvivalencija mase i energije

$$E = mc^2$$

Opšta teorija relativnosti (1915)



Specijalna teorija
relativnosti

+

Gravitacija

= dinamičan prostor-vreme

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Princip ekvivalencije



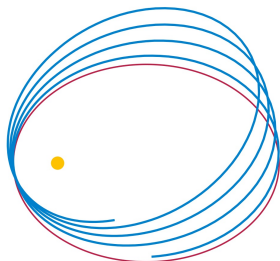
Slobodan pad
= inercijalni sistem



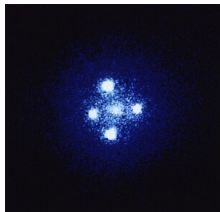
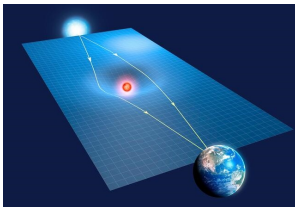
Zakoni fizike su isti u svim lokalnim Lorencovim sistemima

Posledice teorije

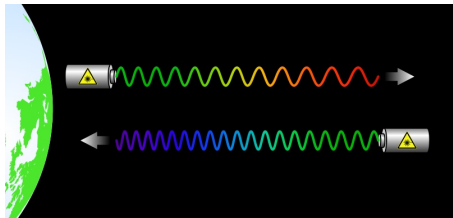
Precesija Merkura



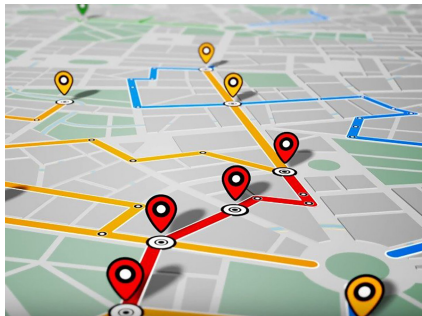
Graviraciona sočiva
(1919)



Gravitacioni crveni pomak (1954)



Gravitaciono usporenje vremena



Ekspanzija univerzuma



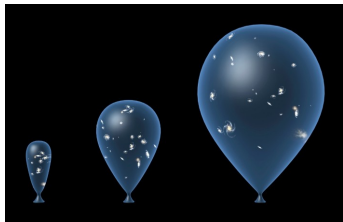
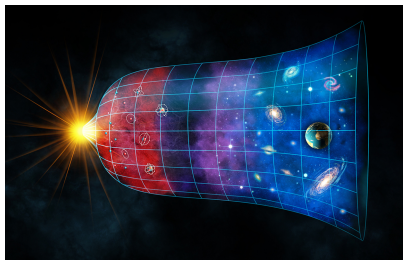
Knut Lundmark (1889 - 1958)



George Lemaitre (1894 - 1966)



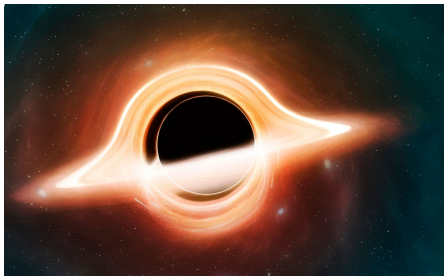
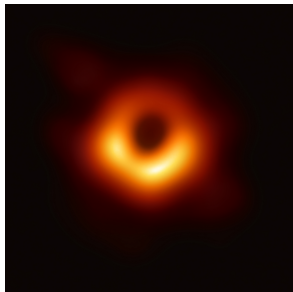
Edvin Habi (1889 - 1953)



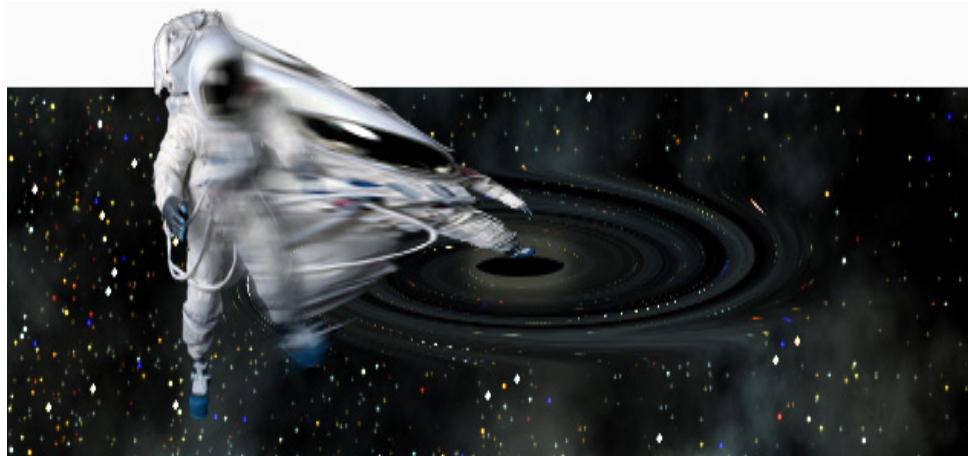
Crne rupe



Karl Švarcšild (1873 - 1916)



Pad u crnu rupu



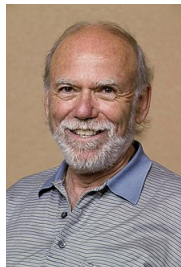
Gravitacioni talasi (2016)



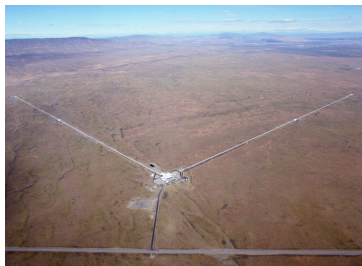
Reiner Vais (1932 -)

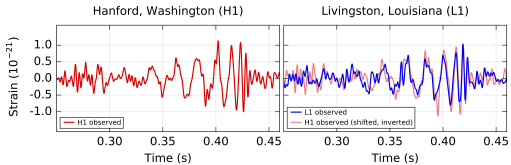
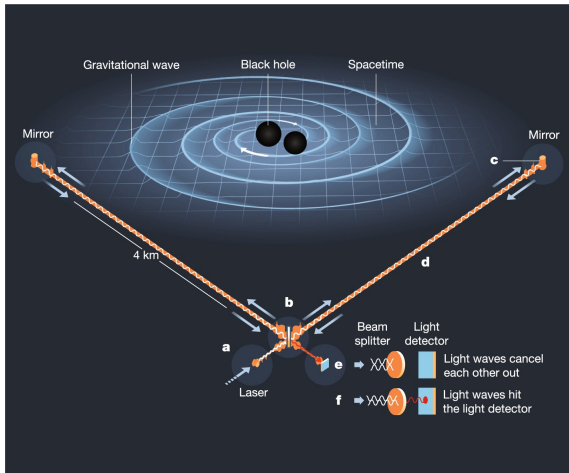


Kip Thorne (1940 -)



Beri Beriš (1936 -)

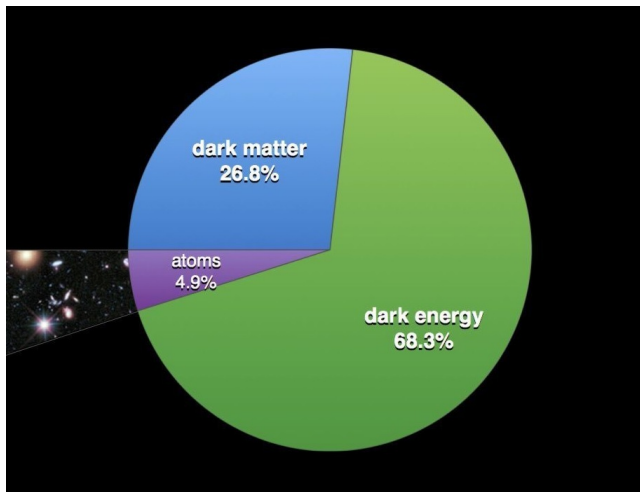




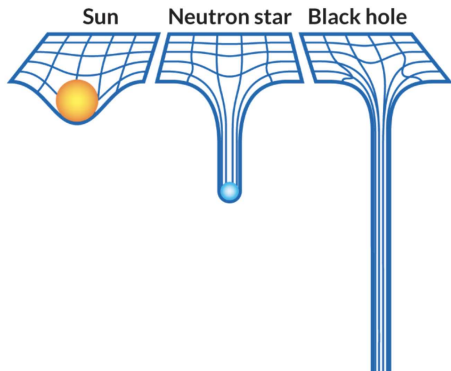
Granice teorije

Tamna materija

Tamna energija



Singularitet u centru crne rupe



Nastanak univerzuma

"Neka bude svetlost!"

Knjiga postanja 1:3



Hvala na pažnji