



DALLE ONDE GRAVITAZIONALI ALLE NUOVE TERRE: LE SFIDE DELL'ASTROFISICA DEI PROSSIMI 20 ANNI

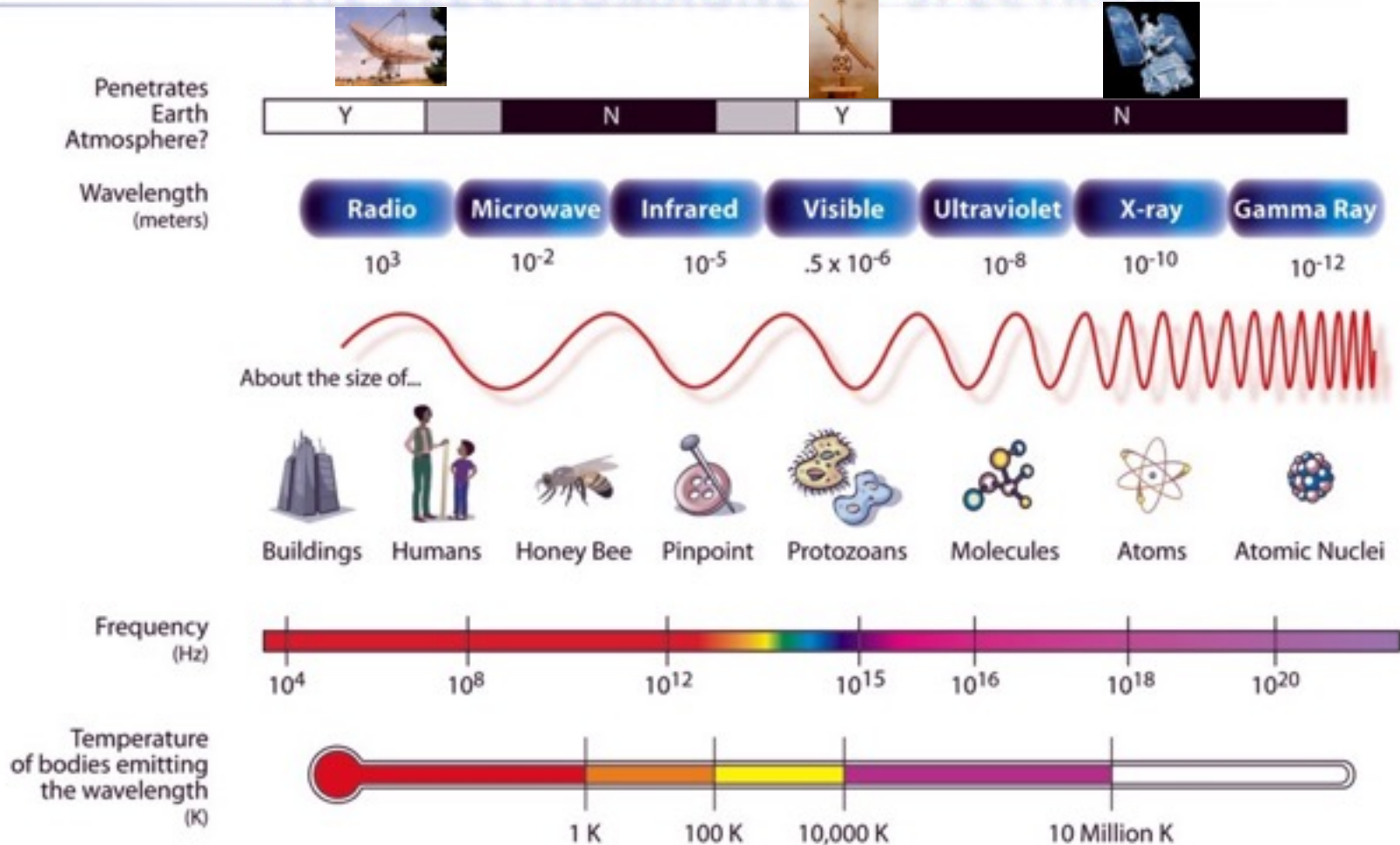


Stefano Covino e Paolo D'Avanzo
INAF / Osservatorio Astronomico di Brera

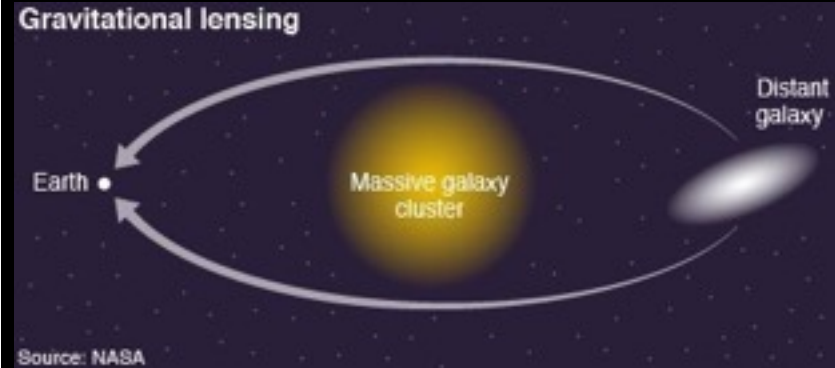


Astronomia multifrequenza

THE ELECTROMAGNETIC SPECTRUM

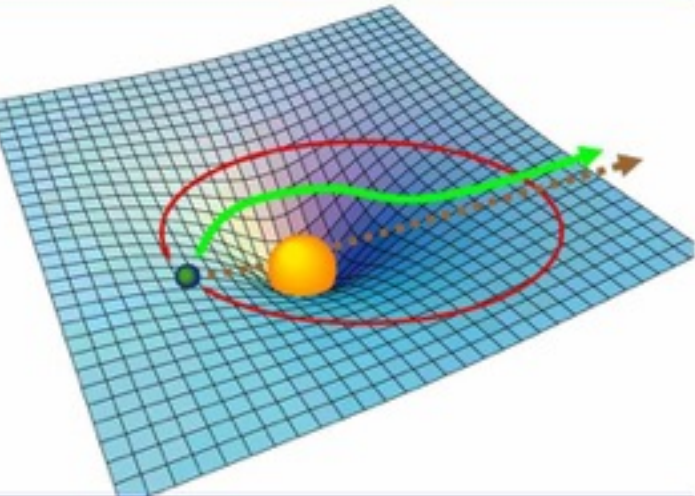
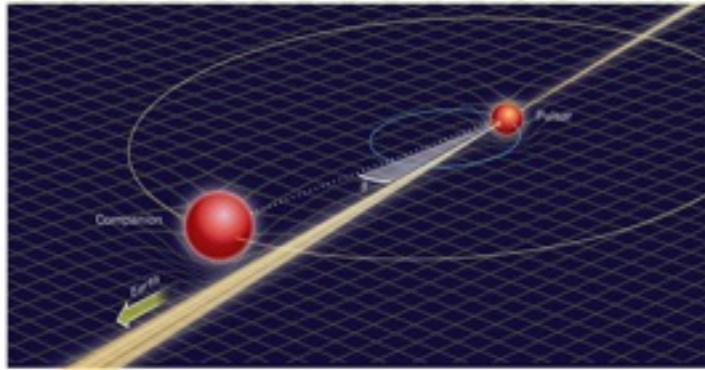


Lenti gravitazionali

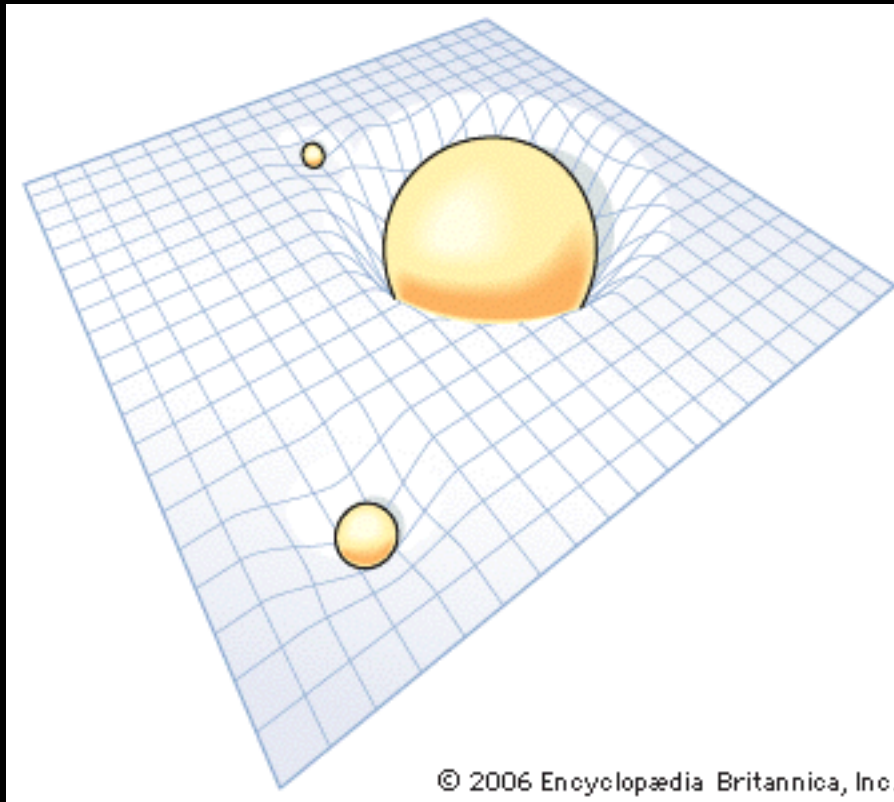


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Lenti gravitazionali



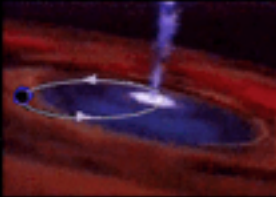
Oltre lo spettro EM: le onde gravitazionali



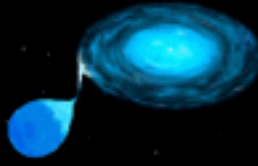
Sorgenti di onde gravitazionali



Coalescence of massive black holes during collisions between galaxies, perhaps in formation of massive black holes, probing the central engines powering quasars.



Black holes orbiting massive black holes, providing precision tests of gravitational theory in the high-field limit.



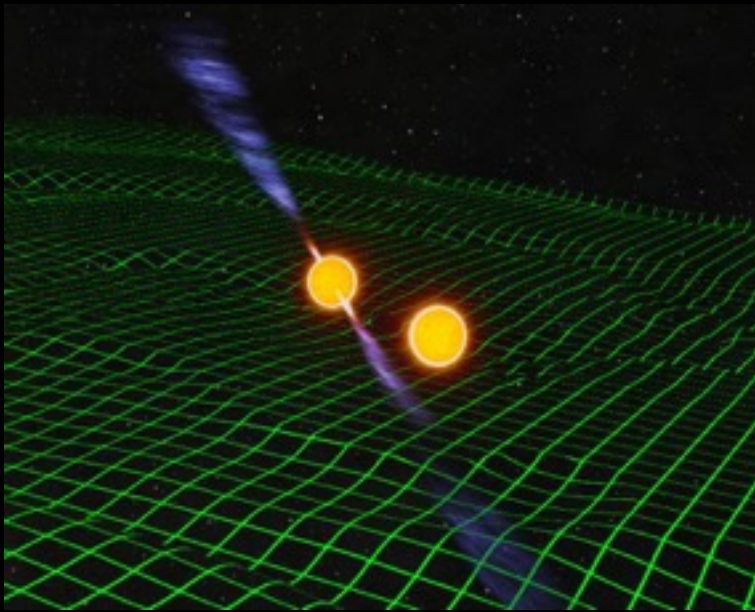
Hundreds of galactic binary star systems, many containing neutron stars or black holes, including several known binary systems.



Supernovae

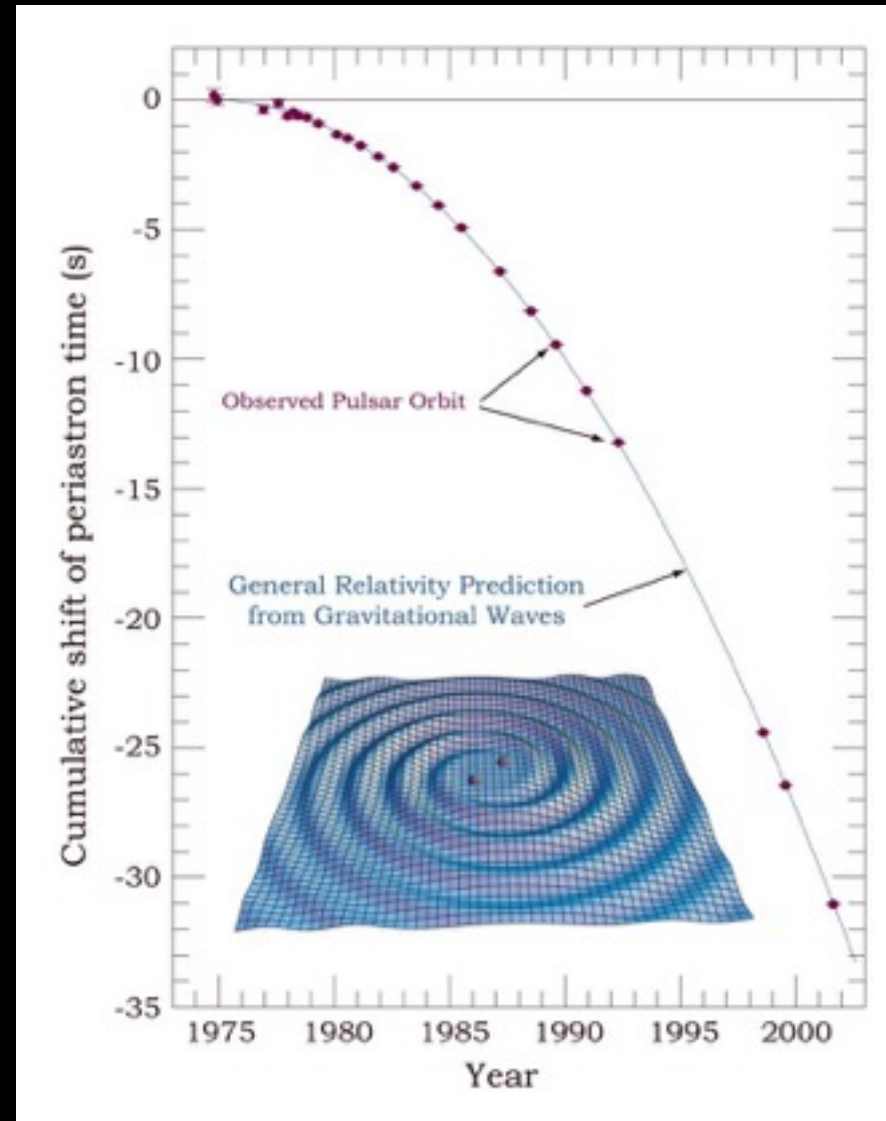
Test di relativita` generale (I)

Hulse-Taylor binary pulsar
PSR 1913+16

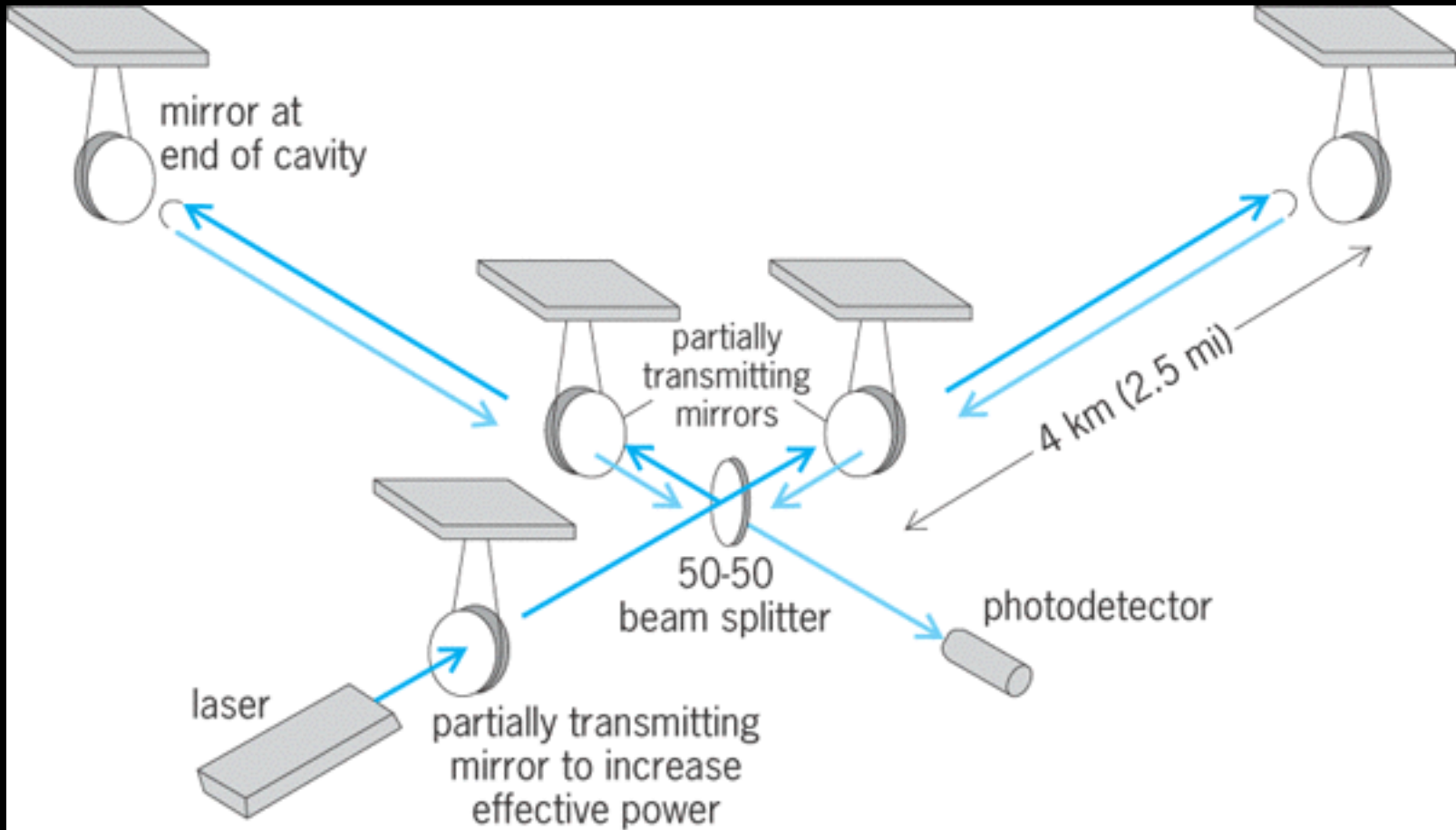


Nobel per la Fisica nel 1993

Dal 2003: PSR J0737-3039
Due pulsar in un sistema
binario (scoperta italiana!)



Rivelatori di onde gravitazionali



Rivelatori di onde gravitazionali

LIGO

Laser Interferometer Gravitational-Wave Observatory



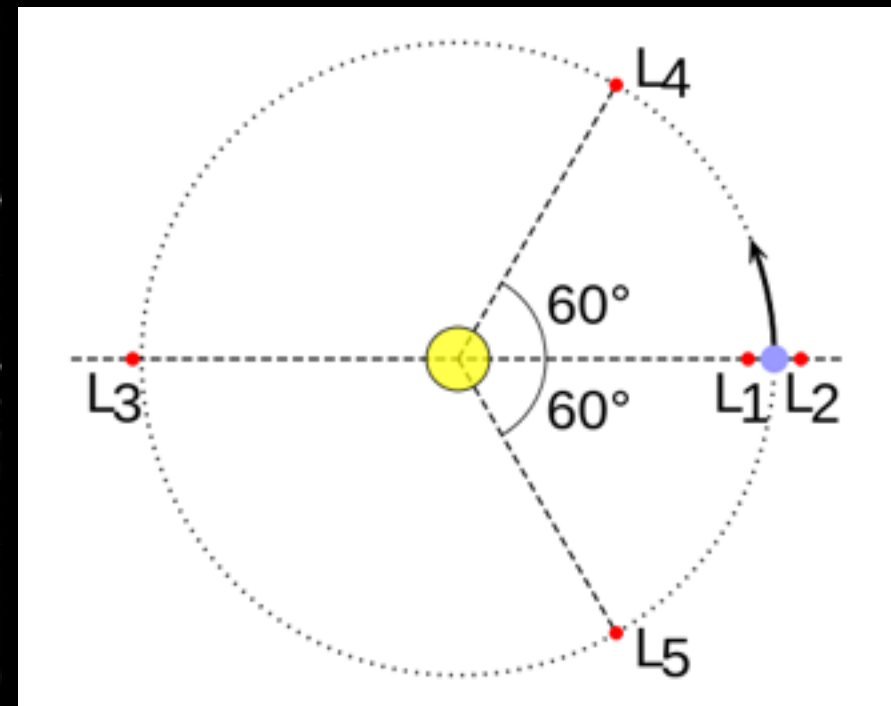
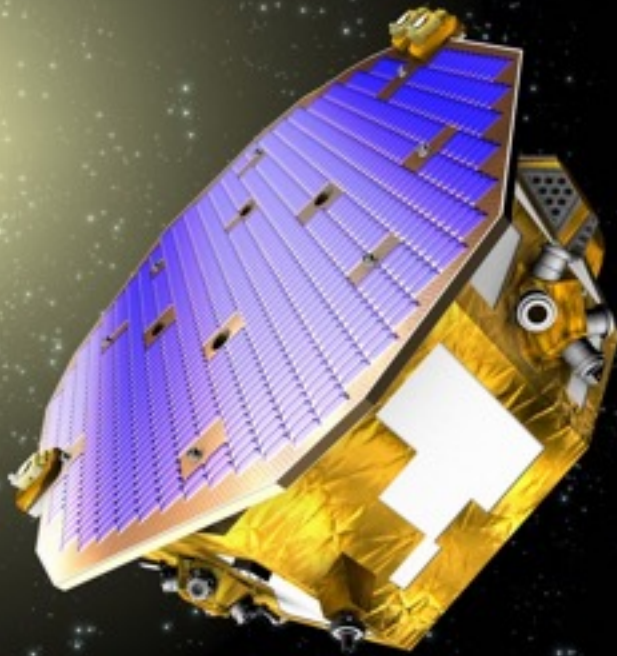
VIRGO



Ciascun braccio dell'interferometro e` lungo circa 3-4 km
Distorsione prevista: 10^{-18} m

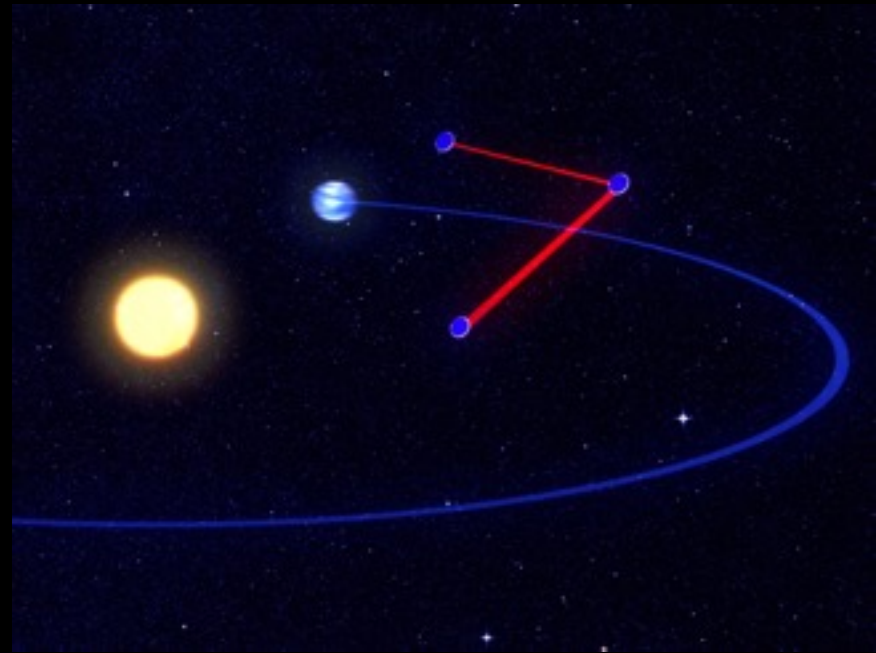
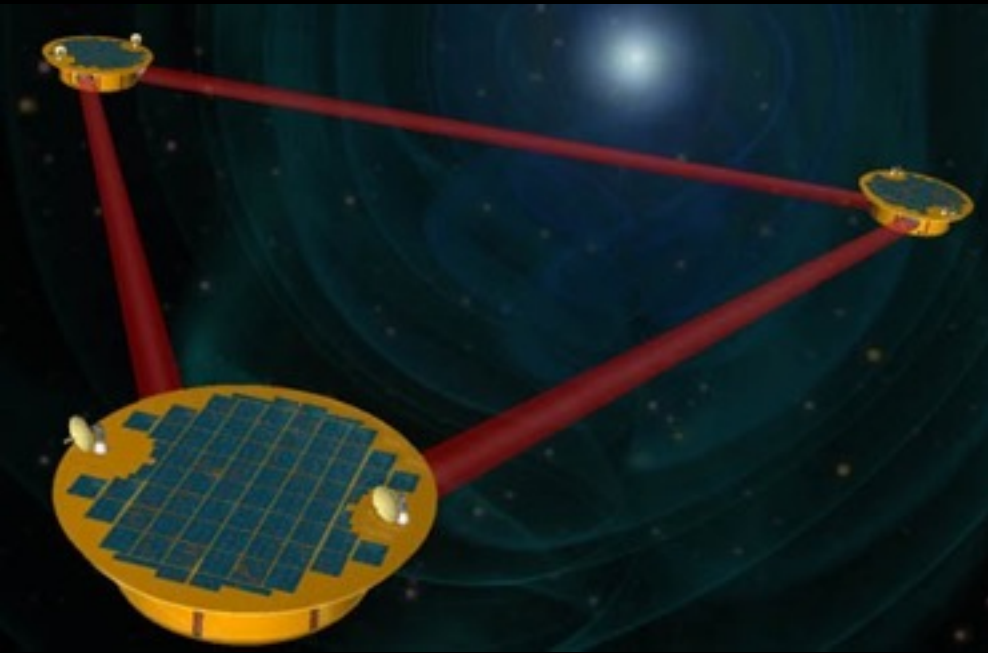
Rivelatori di onde gravitazionali il futuro

LISA (Laser Interferometer Space Antenna) pathfinder (2015)



Rivelatori di onde gravitazionali: il futuro

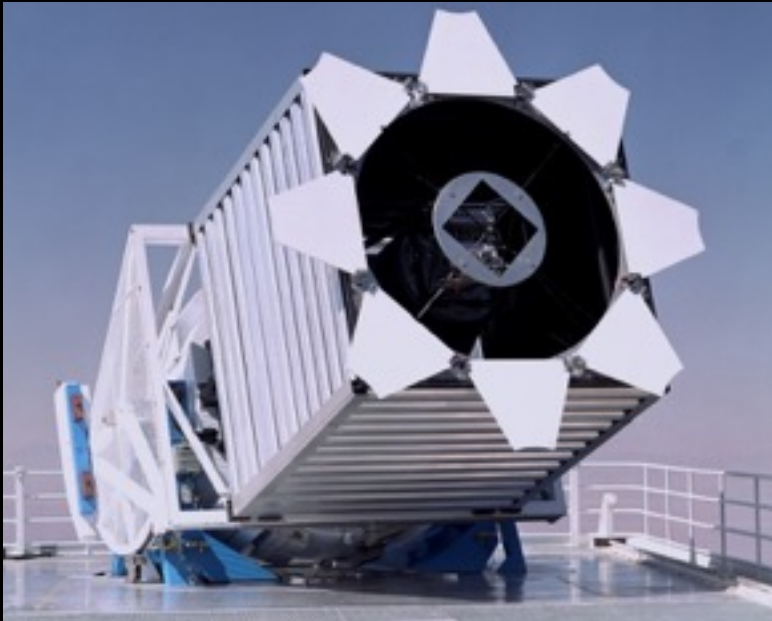
eLISA/NGO (202?)



Ancora il caro vecchio spettro EM: surveys

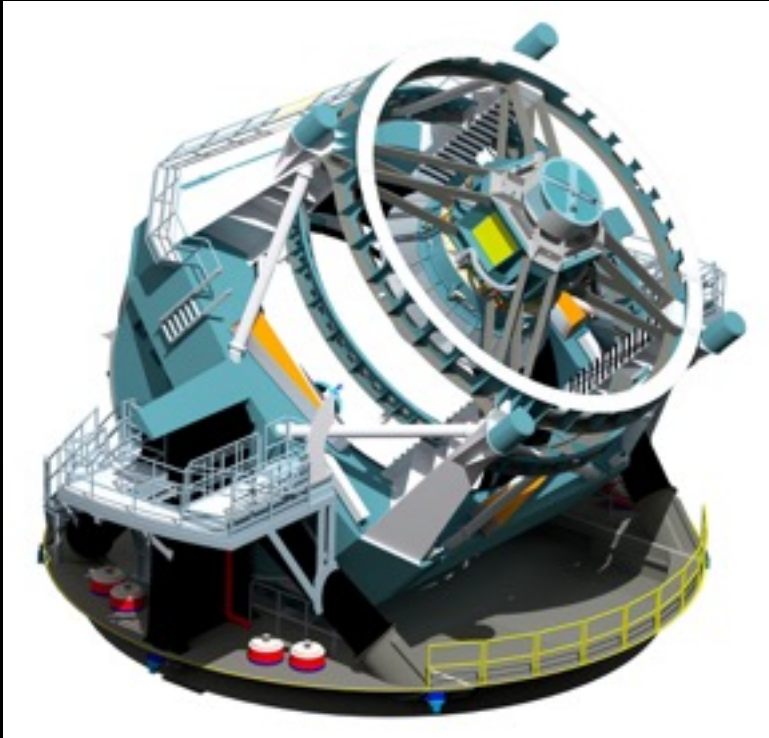
Sloan Digital Sky Survey (SDSS)

230 million celestial objects detected in 8,400 square degrees of imaging and spectra of 930,000 galaxies, 120,000 quasars, and 225,000 stars



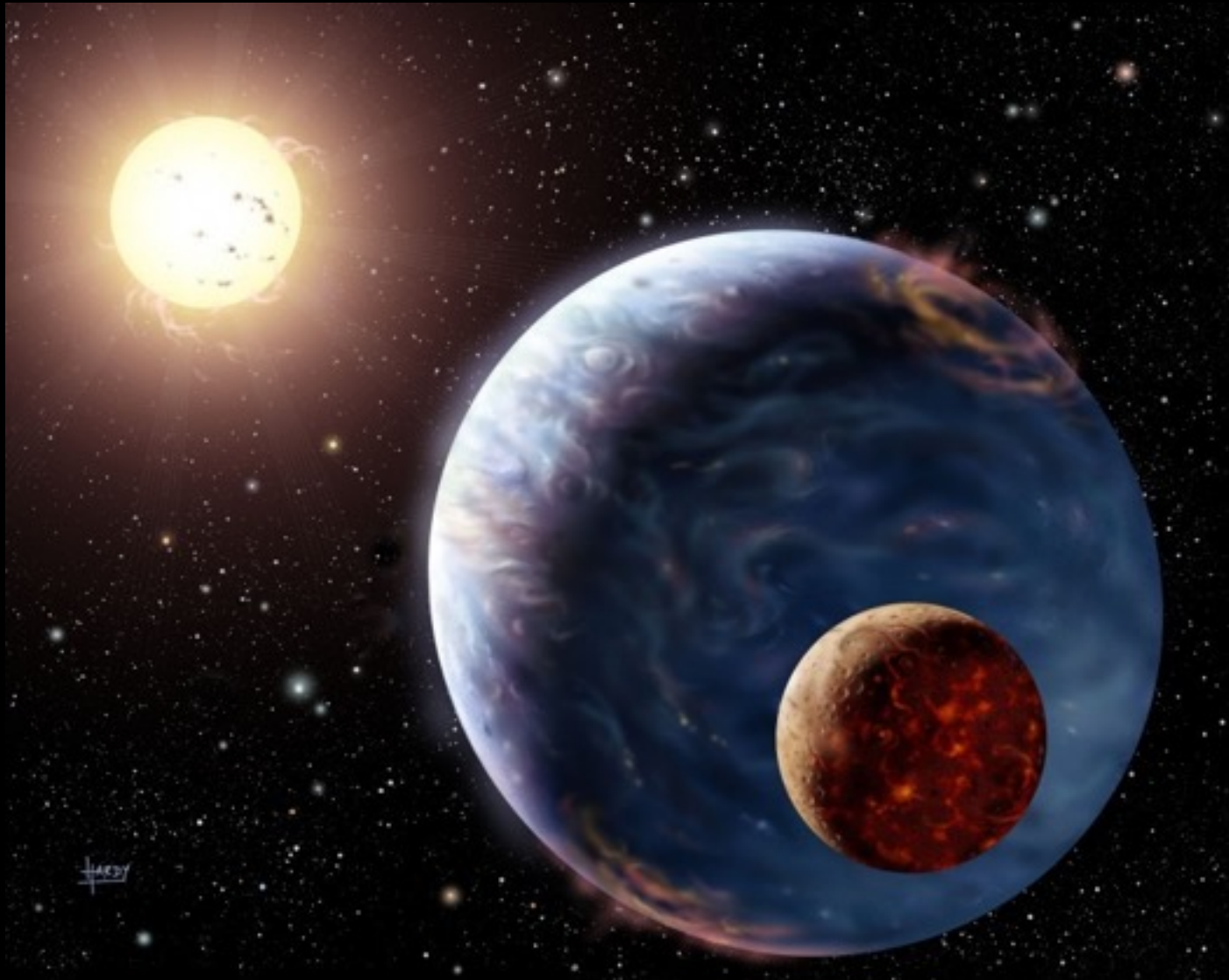
Survey del futuro: LSST

Large Synoptic Survey Telescope (2020)

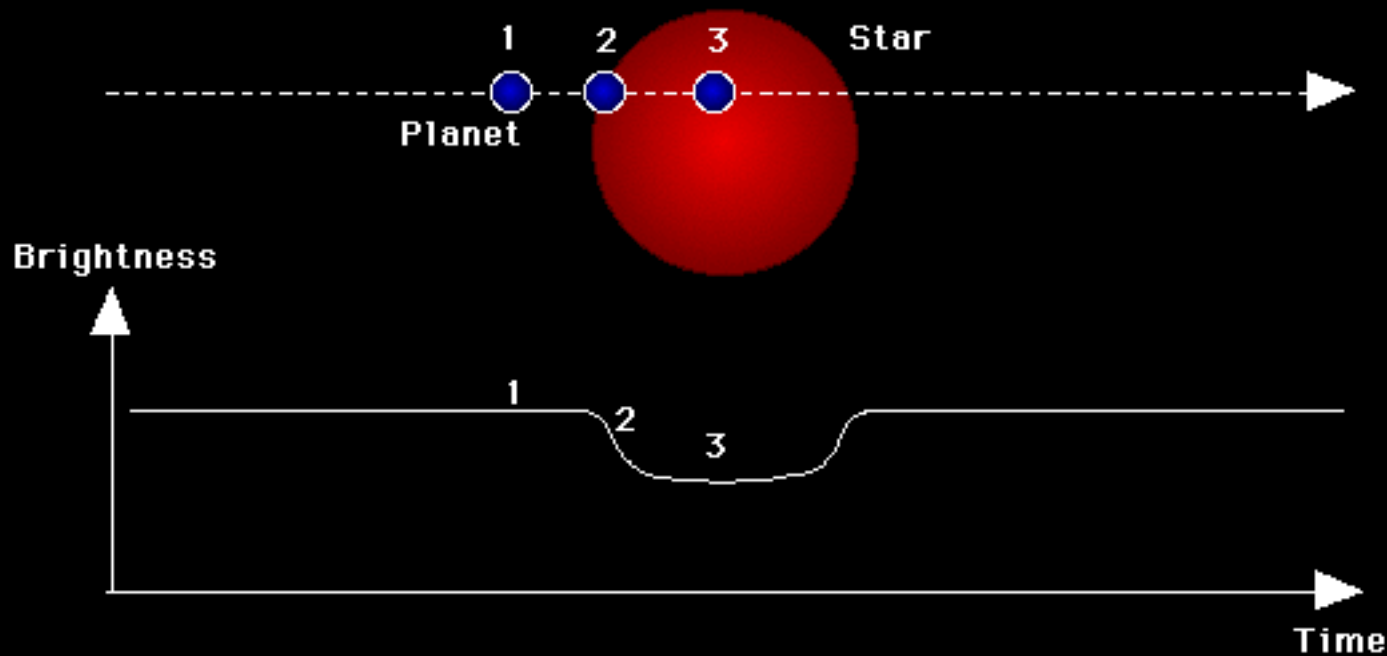


- 18000 gradi quadri ogni 3-4 notti (50% del cielo)
- sorgenti variabili
- 15 Tbyte (1000 Gb) di dati ogni notte per 10 anni
- 8.4 metri di apertura

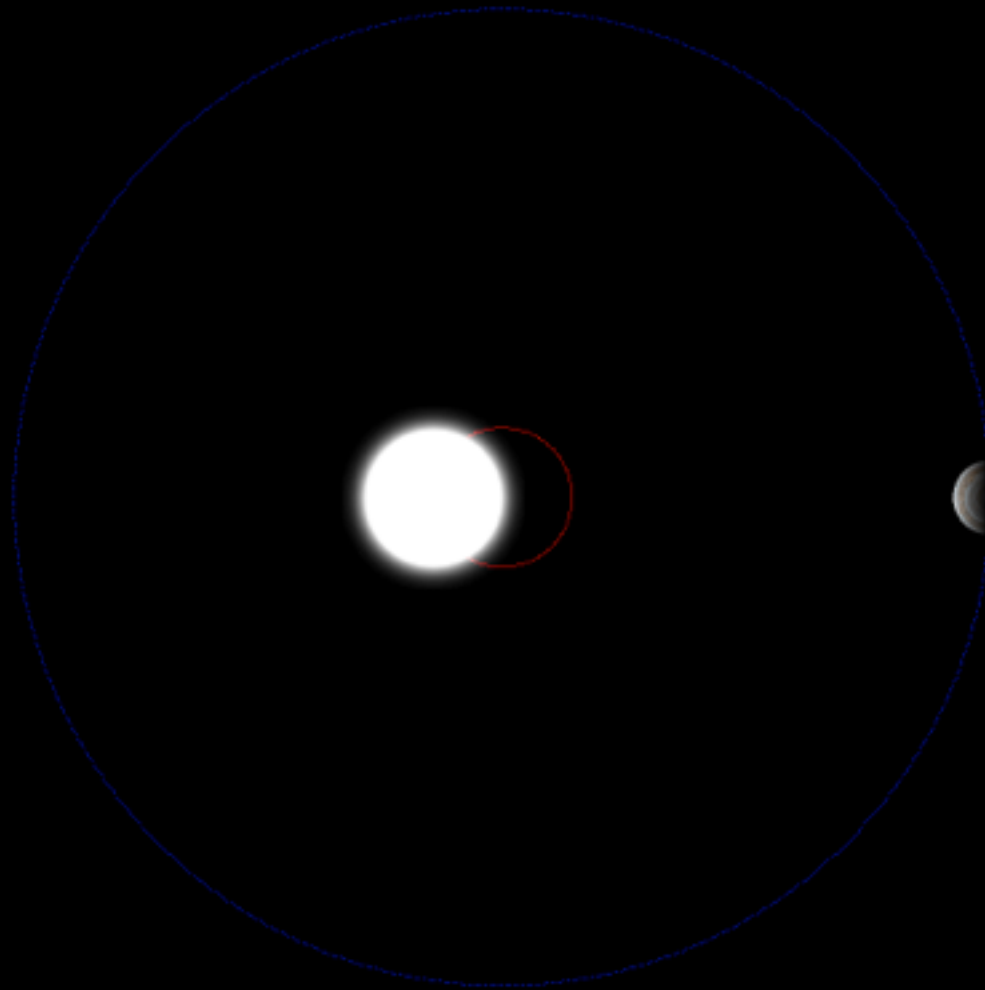
Esopianeti



Esopianeti: transiti



Esopianeti: velocità radiali



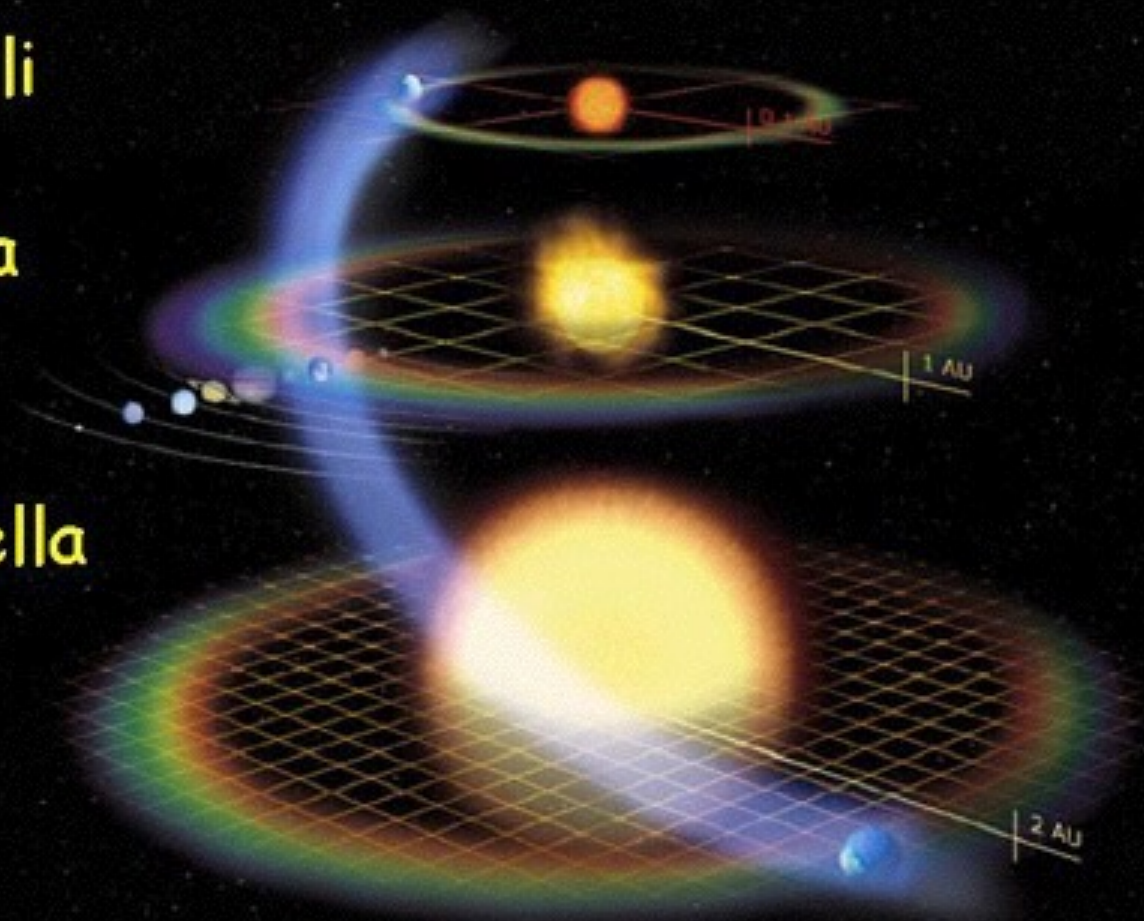
Pianeti abitabili

- Un pianeta e' abitabile quando...
 - Ha una superficie solida
 - Non e' troppo piccolo
 - Gravita', atmosfera
 - Non e' troppo grande
 - Gravita', diventa "gigante"
 - Non e' ne' troppo freddo ne' troppo caldo
 - $0 < T < 100$ gradi, permette di avere acqua



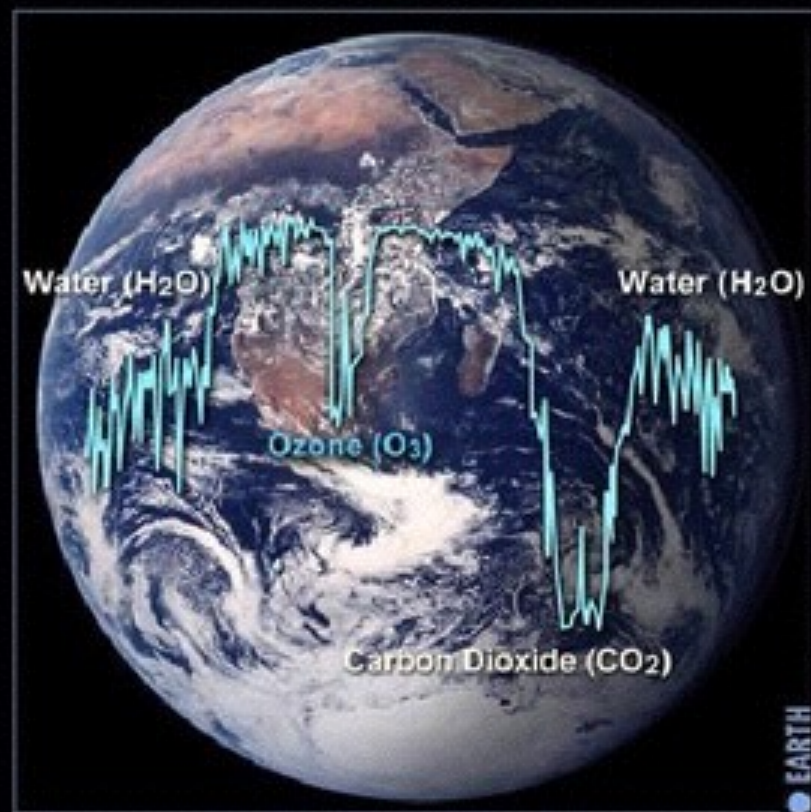
A seconda del tipo di stella...

- I pianeti abitabili possono essere molto diversi fra loro...
- ... e a distanze diverse dalla stella "madre"...

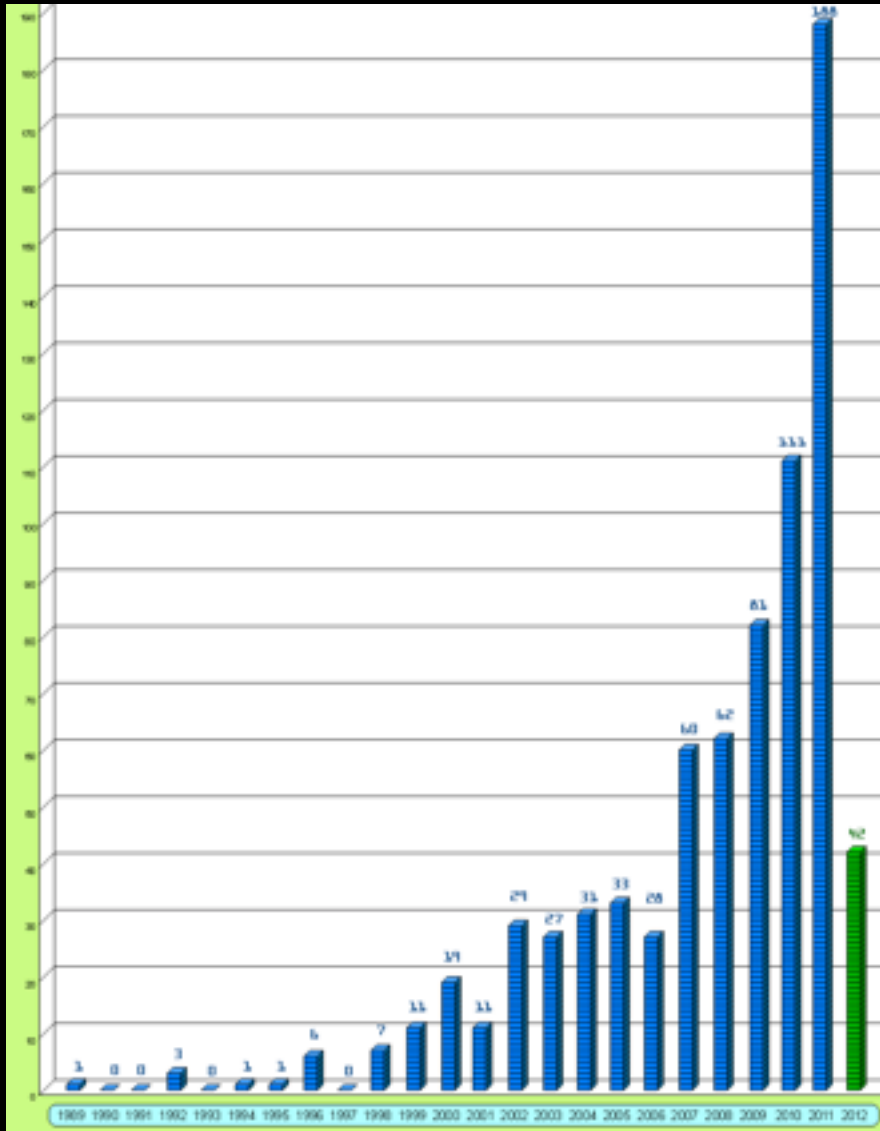


Tracce indirette di vita...

- Cercheremo tracce di ossigeno, ozono, clorofilla...



Quanti esopianeti?



- 837 esopianeti confermati
- attorno a 653 stelle
- 54 nella zona abitabile
- 6 con massa simile (ma maggiore) alla Terra

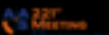
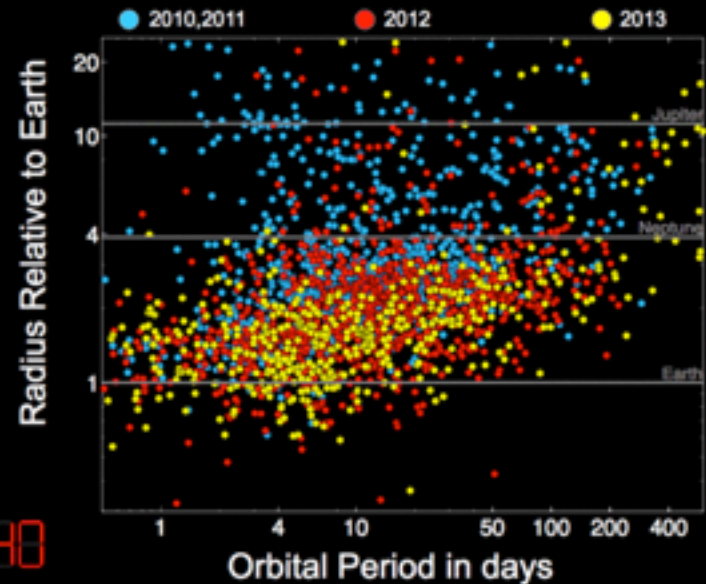
Quanti esopianeti? La missione Kepler



2090

Kepler's Planet Candidates

22 Months: May 2009 - Mar 2011

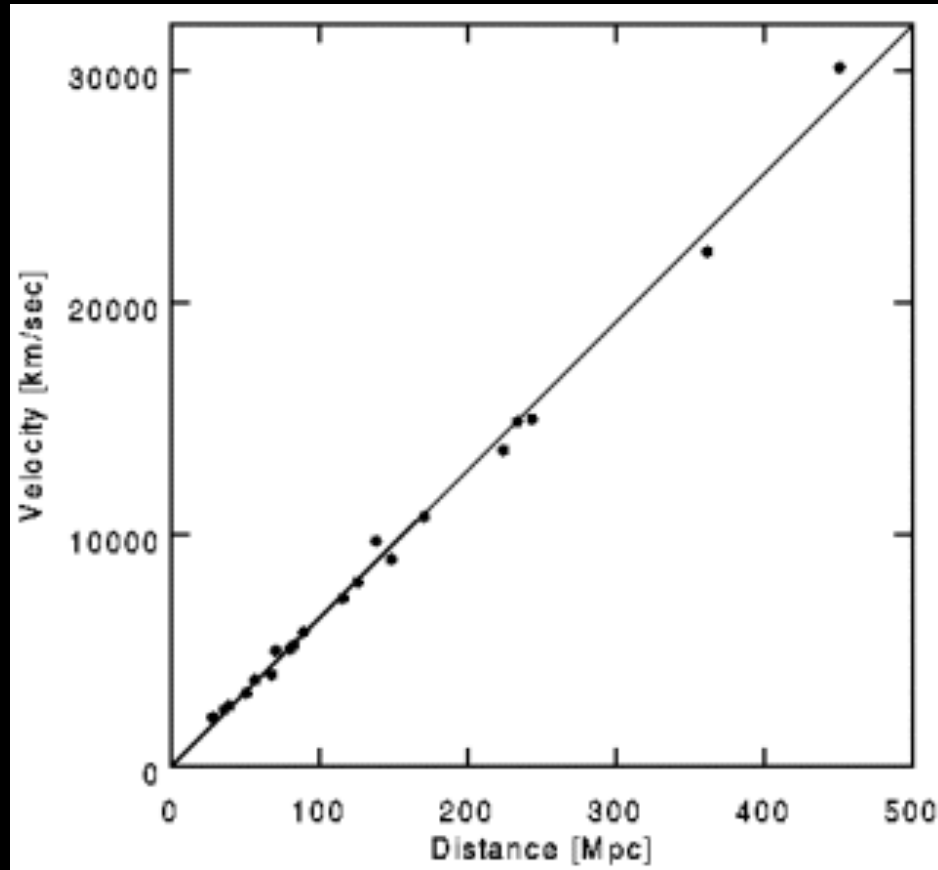


Chris Burke:
216.02

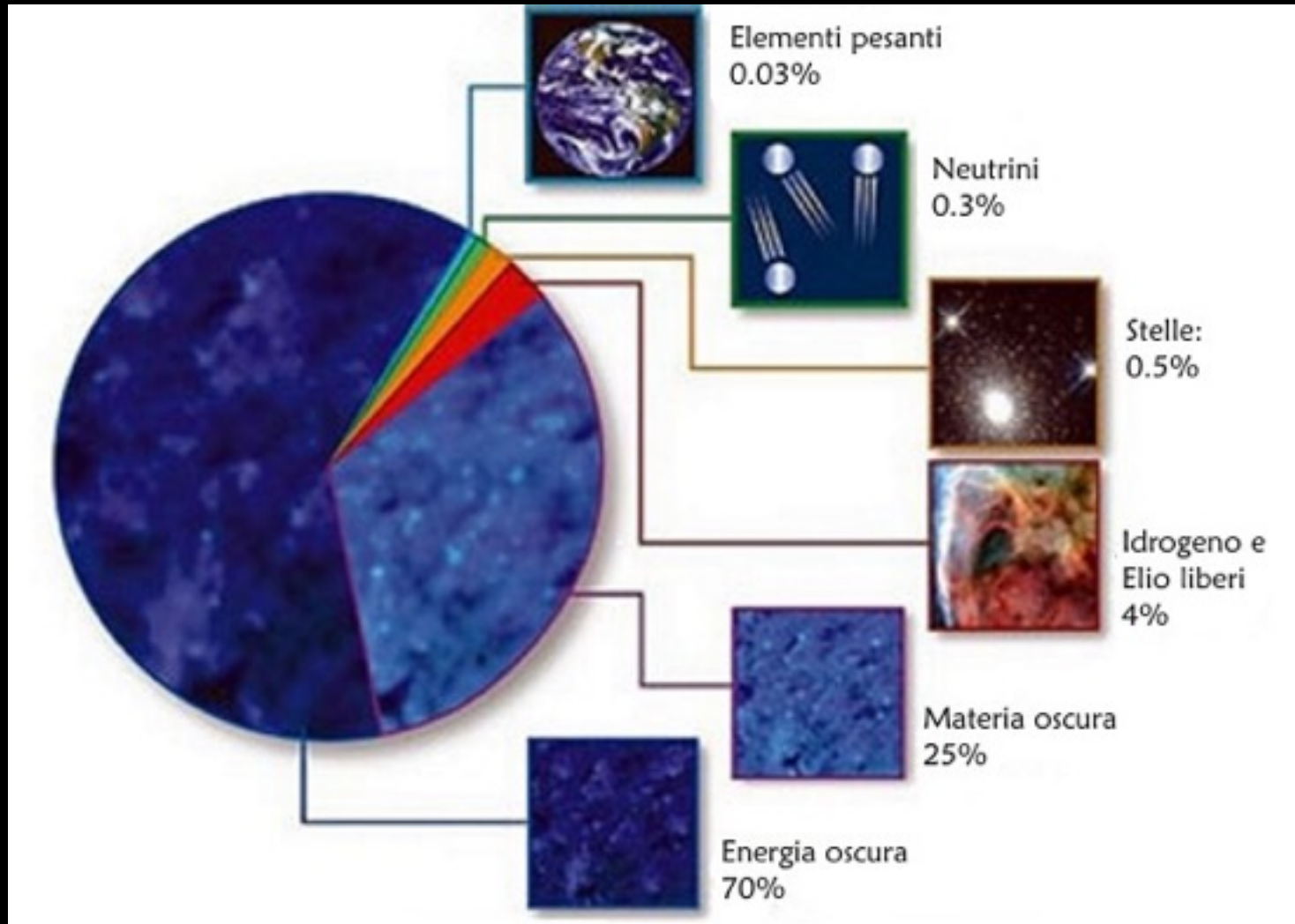
A vast field of galaxies, each with a unique color and shape, scattered across a dark, starry background. The galaxies range from small, distant points of light to larger, more detailed structures. The colors include bright yellows, oranges, reds, blues, and purples, set against a deep black space.

COSMOLOGIA

Universo in espansione



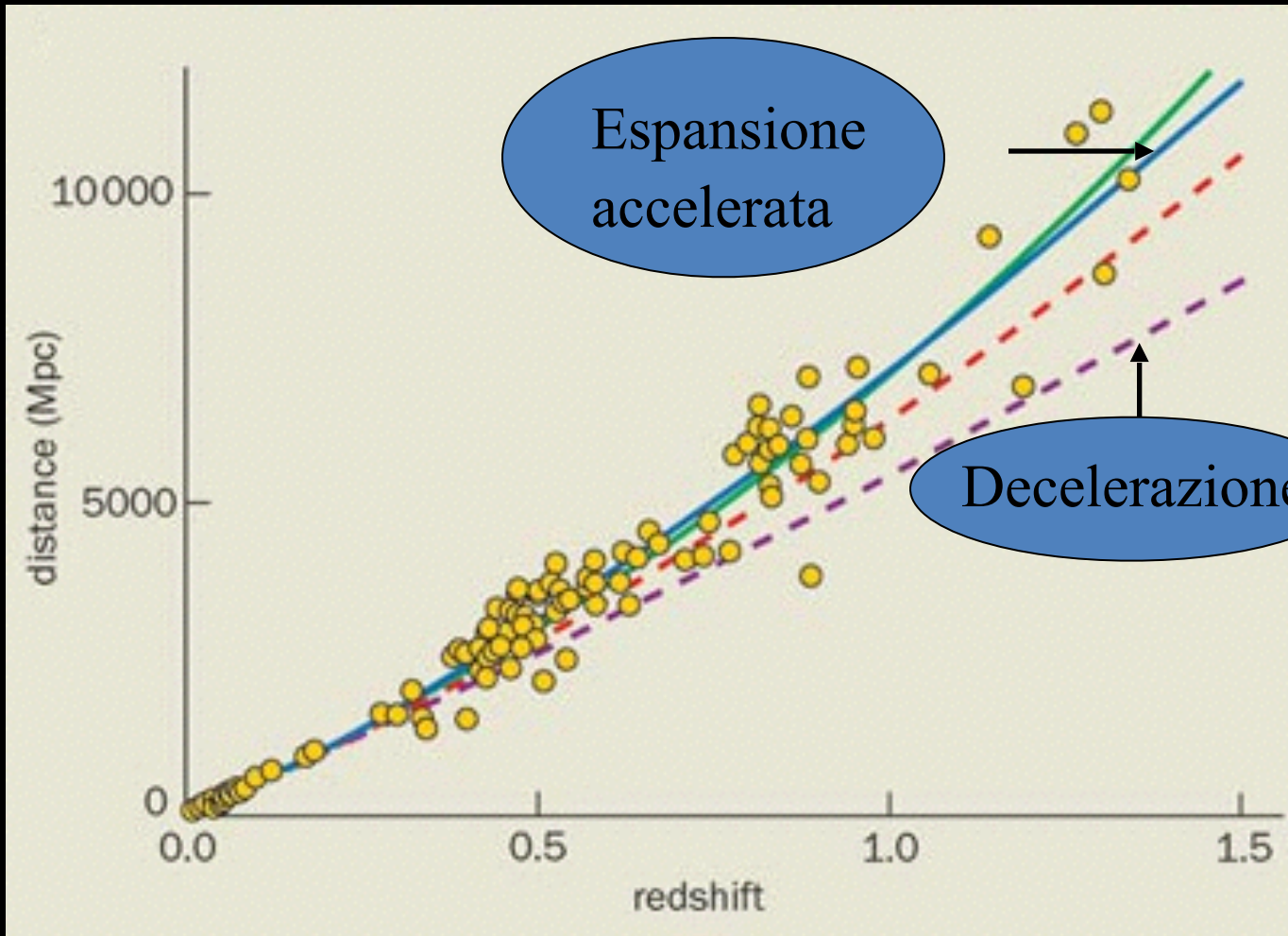
Dark energy



Supernovae & Dark Energy

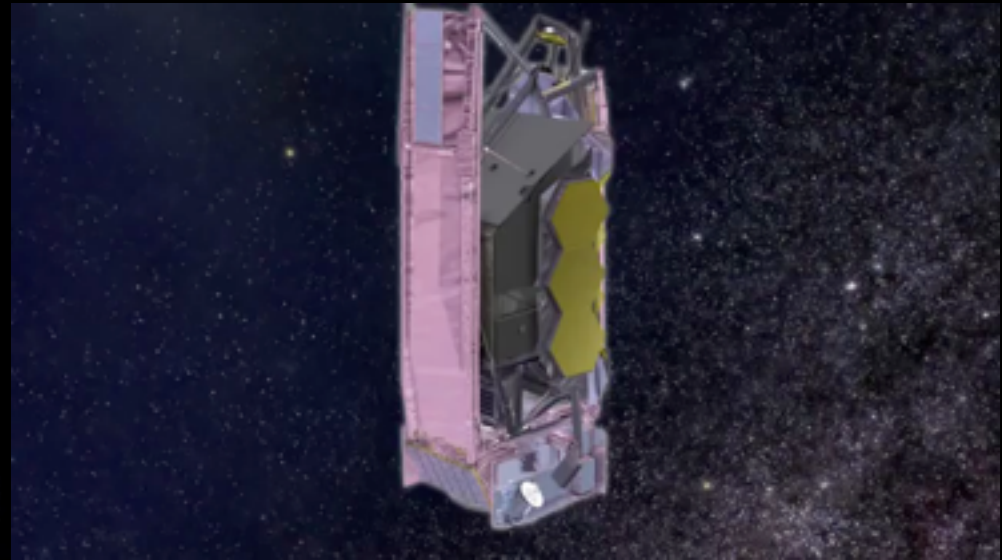
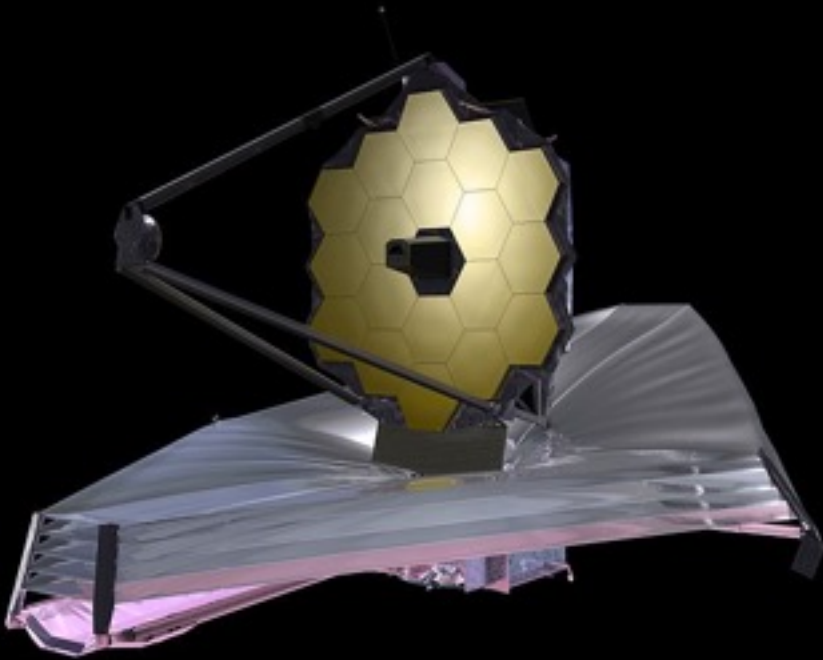


Dark energy



I telescopi del futuro: JWST

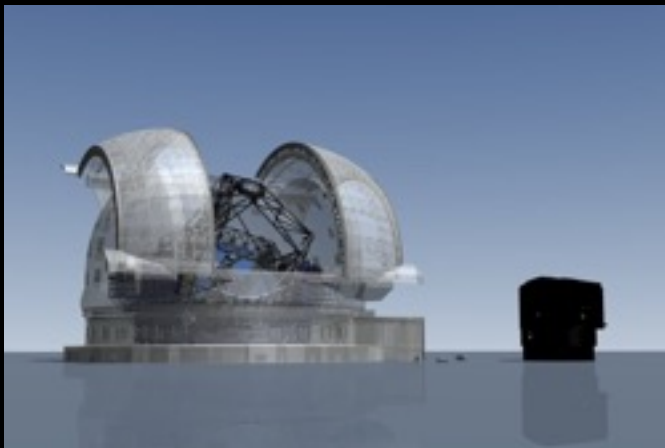
James Webb Space Telescope (2018)



I telescopi del futuro: E-ELT

European Extremely Large Telescope (2020)

Diametro: 39 m



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Name	Aperture diameter (m)
E-ELT	39.3
Thirty Meter Telescope (TMT)	30
Giant Magellan Telescope (GMT)	24.5



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