29 Maggio 1919-30 Maggio 2019

30/5/19 Aula Magna DIFA – via Imerio 46 - 11.00-13.00

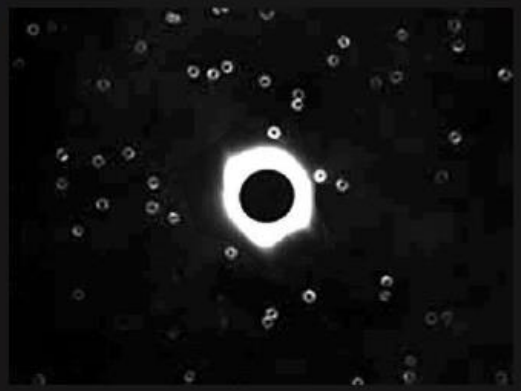
100 anni di indagini di estrema gravità

1.75″
l'obiettivo

Altro che Brexit!

Alla fine della I Guerra Mondiale un Inglese si fa finanziare un esperimento per dare ragione a un Tedesco contro Newton!

1 teoria in 3 interventi



Einstein and Eddington, 1930

la Repubblica.it

Einstein aveva ragione
(anche quando aveva torto)

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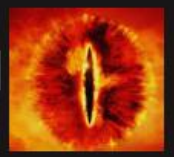
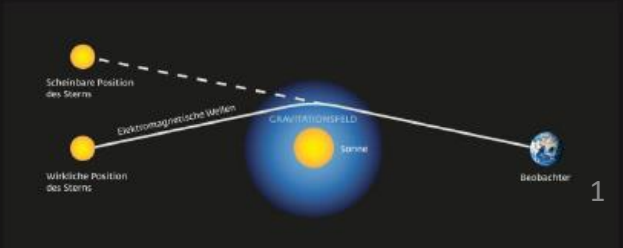
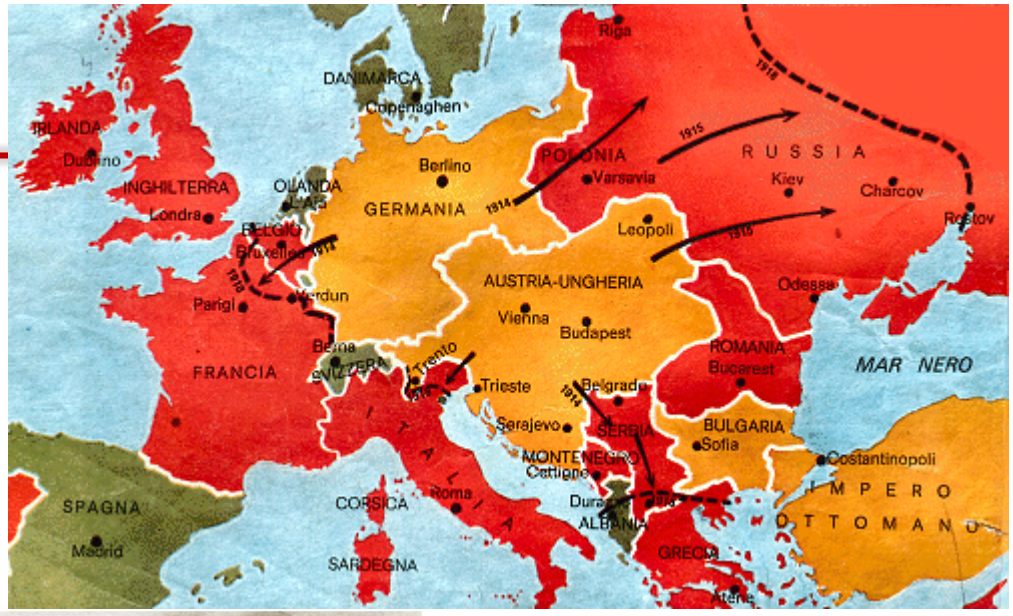
Ecco l'occhio di Sauron



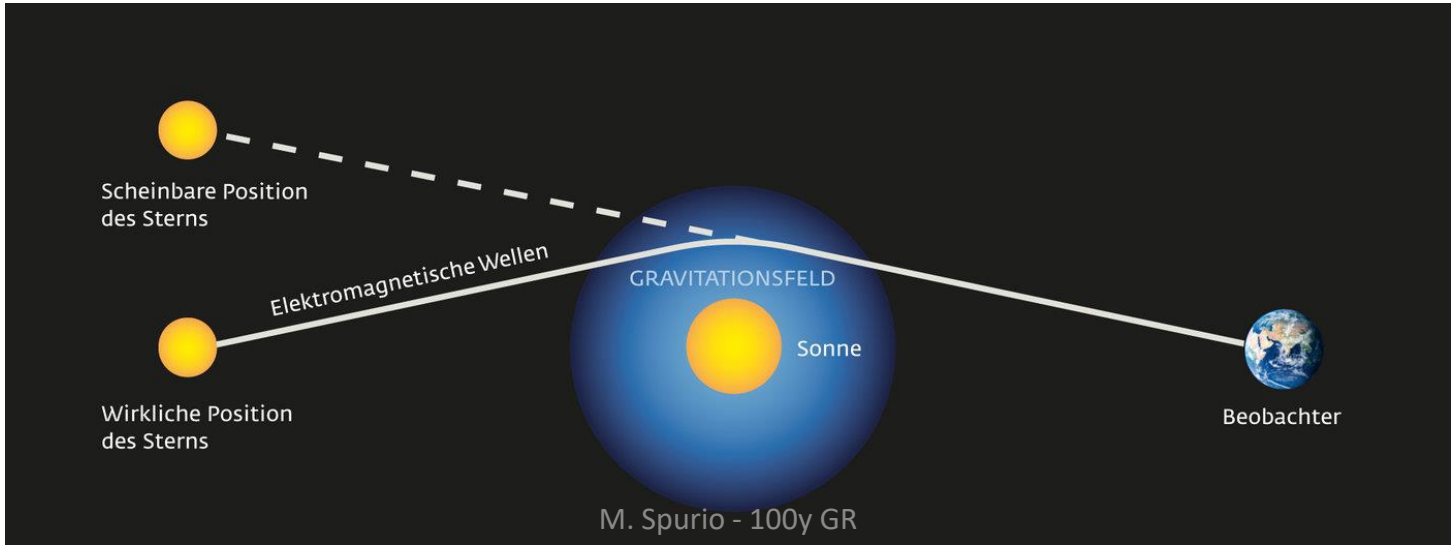


Solo 100 anni fa



Solo 100 anni fa

- 1915: Einstein presenta la Relatività generale all'Accademia di Scienze Prussiana
- 1915: Arthur Eddington si trova in Inghilterra
- 1915: **Germania e Inghilterra sono in fronti opposti nella I guerra mondiale**
- 1916: Willem De Sitter si trova nella neutrale Olanda, conosce il lavoro di Einstein sulla GR e lo trasmette in Inghilterra ad Eddington
- 1917: Eddington, alla Royal Astronomical Society, evidenzia come sia fondamentale verificare la GR attraverso la misura della deflessione della luce
- Sir Frank Watson Dyson comprende che l'eclisse prevista nel 1919 può essere propizia per la misura proposta
- In accordo con la GR, La deflessione della luce stellare che passa a una distanza pari a R_S deve venie deflessa di un angolo pari a 1,75''

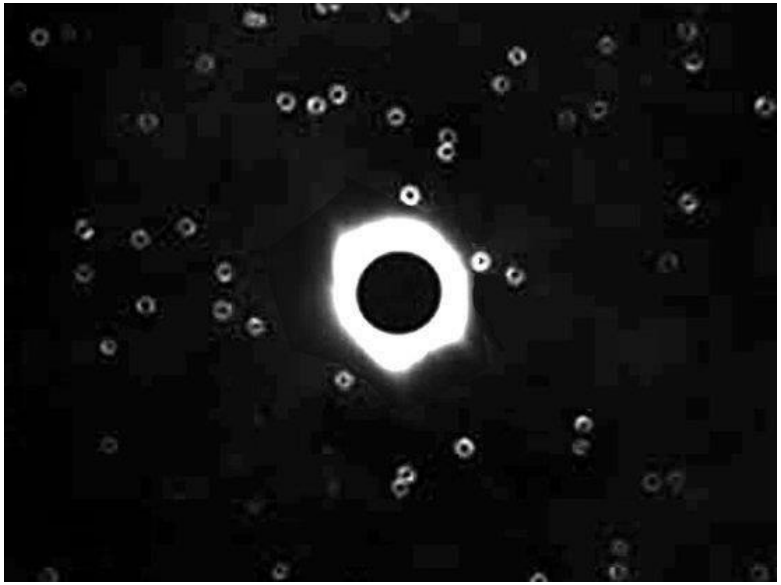


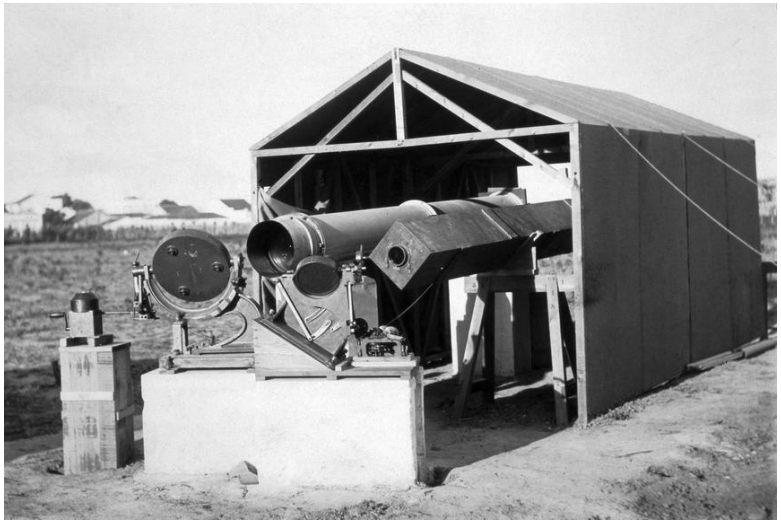
La preparazione e il risultato

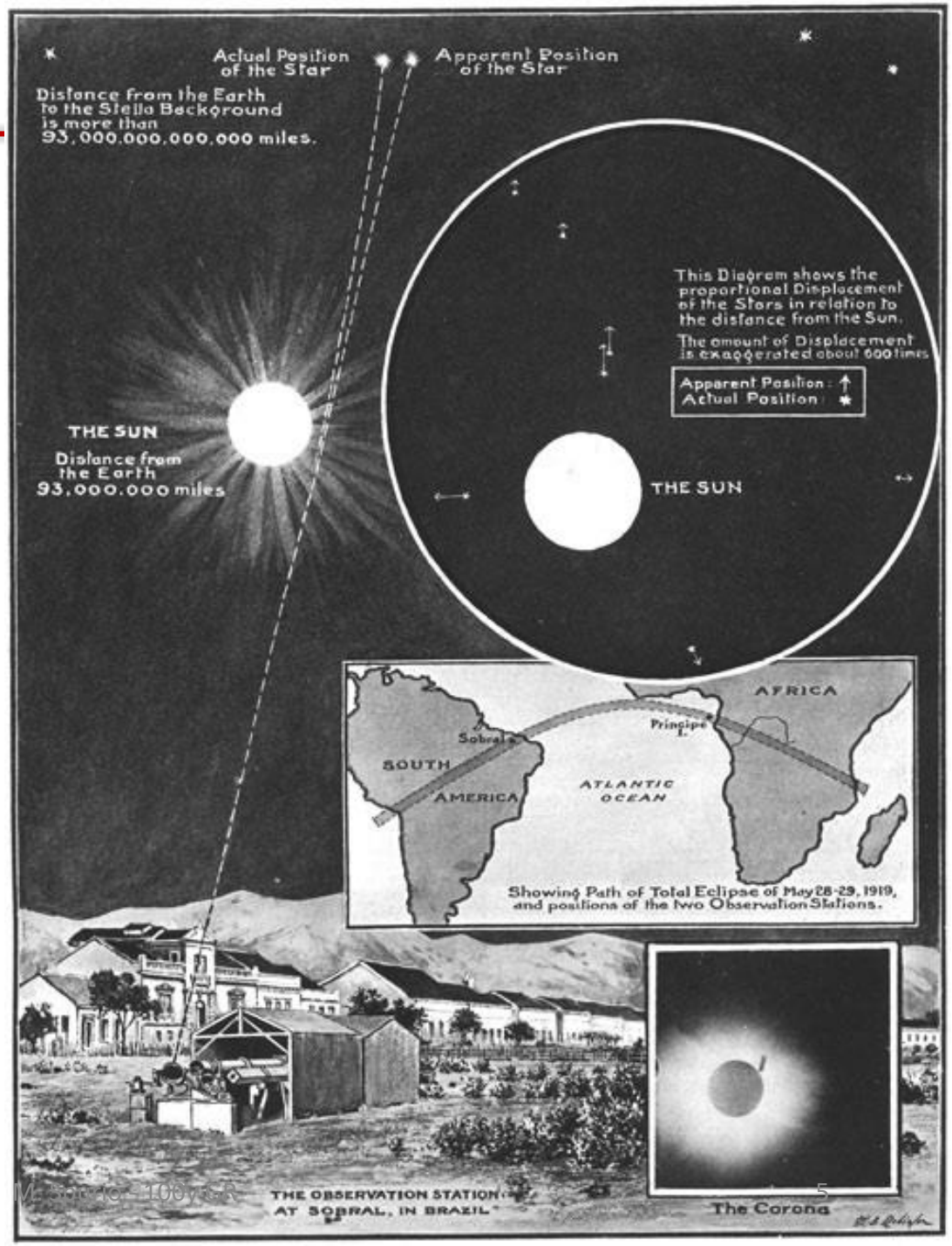
- The expected shift in the star's position at the periphery of the Sun is 1.75''
- It was decided to send two expeditions. One, led by Eddington, was to travel to the **island of Principe (**off the coast of Guinea, West Africa); and the other, led by Andrew Crommelin, would travel to **Sobral** in northern Brazil
- Six months before the total solar eclipse, the astronomers took photographs of the region in the sky where the darkened Sun was to be observed on 29 May 1919. It turned out to be a stroke of luck that the Sun would then be in the brightly shining star cluster known as the Hyades and the individual stars should be clearly visible close to the Sun.
- The calculated 1.75'' apply only for the case where the star is directly at the periphery of the Sun. At a distance of two solar radii, the angle shrinks to 0.6''.
- **A shift of 1'' is imaged on the glass photographic plate as a distance of only 0.026 mm by the telescope used by the expedition on the island of Principe!**
- In addition, the ever present air turbulence distorts the image of the star, and the refraction in the atmosphere plays its part as well.
- On 6 November, Crommelin presented the final result at a joint meeting of the Royal Society and Royal Astronomical Society: the deviation at the periphery of the sun amounted to (1.98± 0.18)'' for one telescope, and (1.60±0.31)'' for the other.

P. Coles, https://cds.cern.ch/record/489163/files/0102462.pdf

Le spedizioni

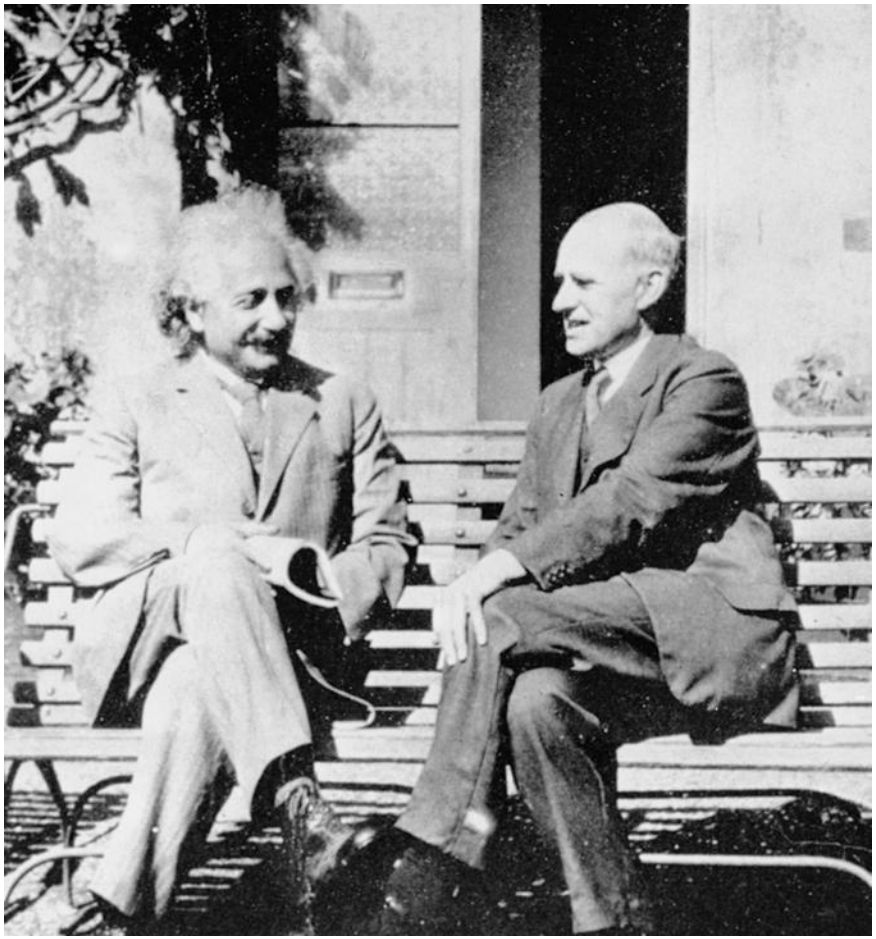






From the 22 November 1919 edition of the ***"Illustrated London News"***.

Risultato



- **Einstein and Eddington, 1930**

LIGHTS ALL ASKEW IN THE HEAVENS

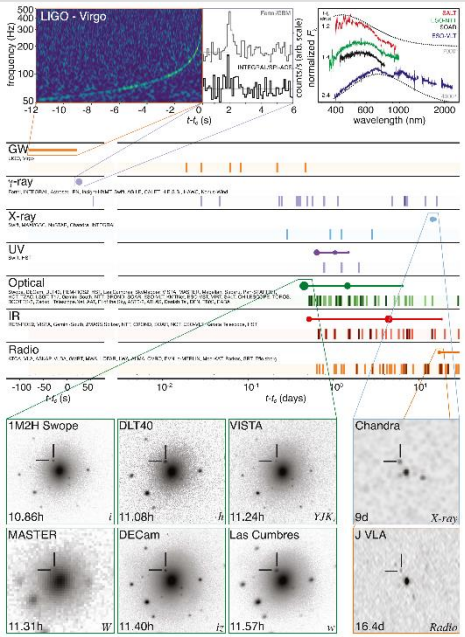
Men of Science More or Less Agog Over Results of Eclipse Observations.

EINSTEIN THEORY TRIUMPHS

Stars Not Where They Seemed or Were Calculated to be, but Nobody Need Worry.

- **New York Times, 10 Novembre 1919**

100 anni dopo…



The New York Times

Late Edition

Today, some sunshine giving way to times of clouds, cold, high 28. Tonight, a flurry or heavier squall late, low 15. Tomorrow, windy, frigid, high 21. Weather map, Page A19.

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CALTECH-M.I.T.-LIGO LABORATORY

A worker installed a baffle in 2010 to control light in the Laser Interferometer Gravitational-Wave Observatory in Hanford, Wash.

WITH FAINT CHIRP, SCIENTISTS PROVE EINSTEIN CORRECT

A RIPPLE IN SPACE-TIME

An Echo of Black Holes Colliding a Billion Light-Years Away

By DENNIS OVERBYE

A team of scientists announced on Thursday that they had heard and recorded the sound of two black holes colliding a billion light-years away, a fleeting chirp that fulfilled the last prediction of Einstein's general theory of relativity.

That faint rising tone, physicists say, is the first direct evidence of gravitational waves, the ripples in the fabric of space-time that Einstein predicted a century ago. It completes his vision of a universe in which space and time are interwoven and dynamic, able to stretch, shrink and jiggle. And it is a ringing confirmation of

CORRIERE DELLA SERA

mercoledì 10 aprile 2019 - Aggiornato alle 17:53

Meteo: Milano | 15.2°

ASTRONOMIA

Ecco la prima foto reale di un buco nero

Che cos'è, come si forma? La videoscheda

(nel riquadro a destra l'«occhio di Sauron» dalla trilogia cinematografica «Il Signore degli Anelli»)

la Repubblica.it

10 Aprile 2019 - Aggiornato alle 18.05

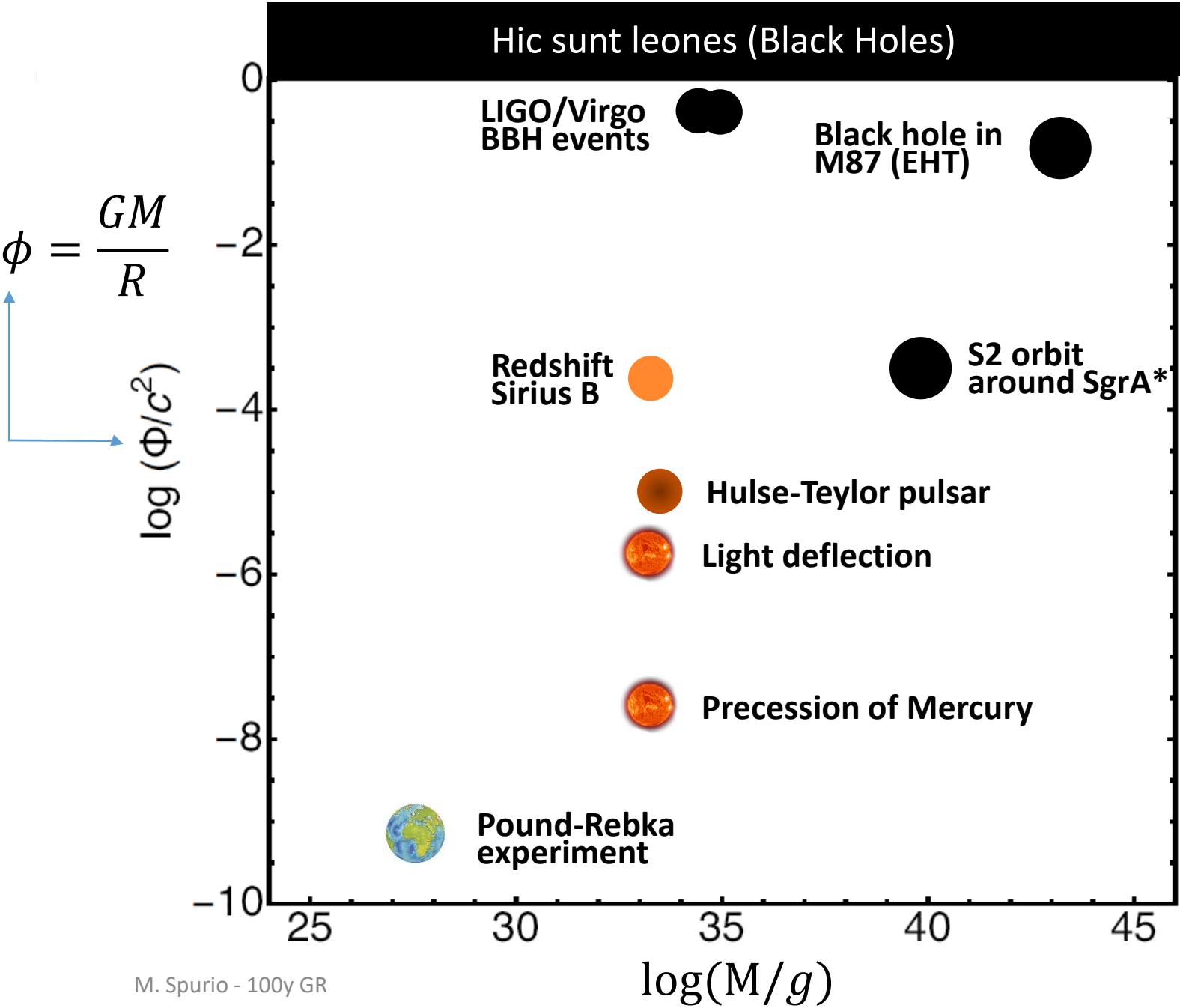
Ecco la prima immagine di un buco nero video

Conferma la teoria della Relatività: "Einstein aveva ragione"

di MATTEO MARINI

Hic sunt leones (Black Holes)

$$\phi = \frac{GM}{R}$$



References of well-established tests of GR

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- Precession of Mercury: Einstein, Ann. Phys., 354 (1916), 769
- Light deflection: the result of Eddington
- Hulse-Taylor pulsar: Taylor, J. H., & Weisberg, J. M., ApJ 253, (1982) 908
- Gravitational redshift of Sirius B: Greenstein, J. L., Oke, J. B., & Shipman, H. L., ApJ 169 (1971), 563
- LIGO/Virgo detections: PRL116 (2016) 241103; PRL116 (2016) 061102; ApJ 818 (2016), L22;
- S2 orbit around Sgr A: GRAVITY Collaboration A&A 615, L15 (2018)
- Black Hole in M87: EHT Collaboration ApJ 875 (2019):L1