

Società Astronomica G.V. Schiaparelli



Luci del lontano universo



Luca G Molinari
S.Monte, 5 aprile 2014

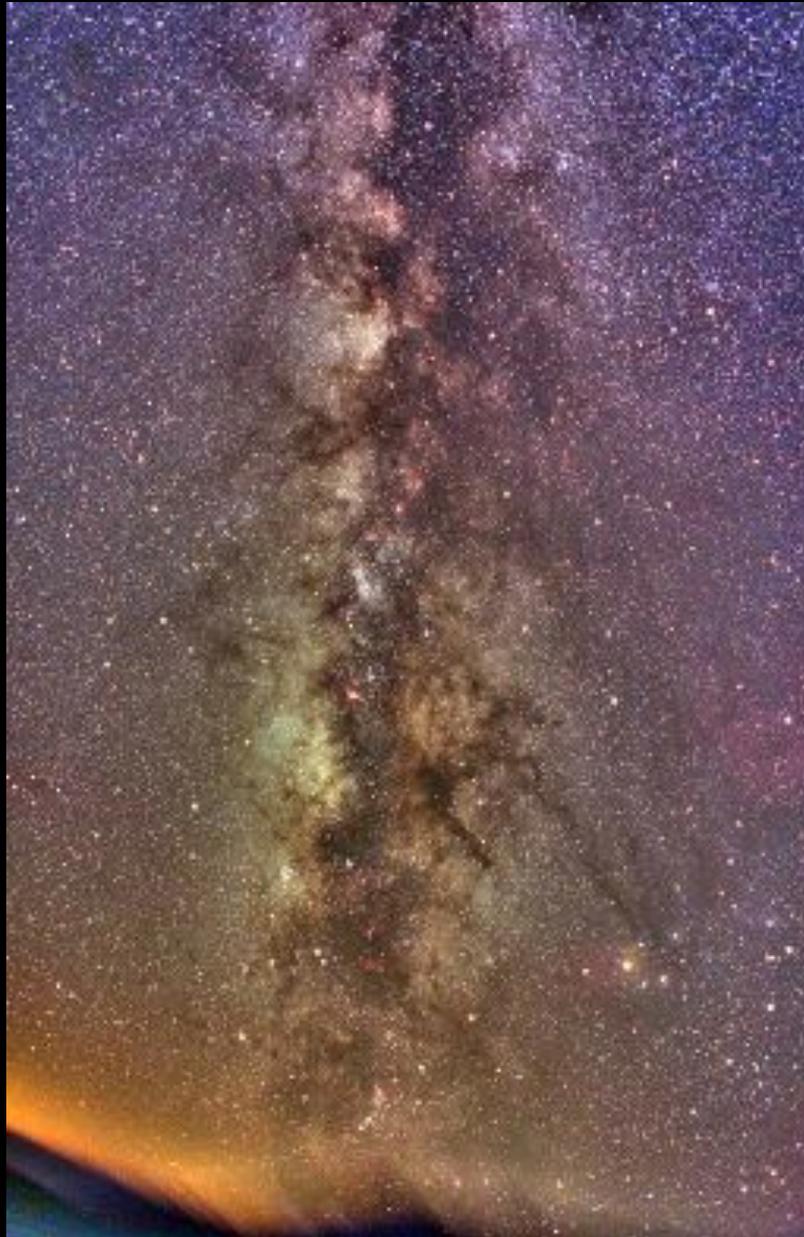
Con le tenebre si apre l'abisso,
e il cielo si popola di mondi e
luci lontane . . .



Uno spettacolo immenso si
manifesta ai nostri occhi,



E per comprenderlo
dobbiamo misurarlo . . .



Solo 180 anni fa
si misurarono le
prime distanze di
stelle.

La piu' vicina
dista da noi
quaranta mila
miliardi di
chilometri ...

all'inizio del '900
la Via Lattea e altre luci
splendevano da altezze
ancora sconosciute



Cosa sono le galassie?

Nessuno lo sapeva prima del 1900.

Pochissimi lo sapevano nel 1920.

Tutti gli astronomi lo seppero nel 1924.

(A. Sandage)

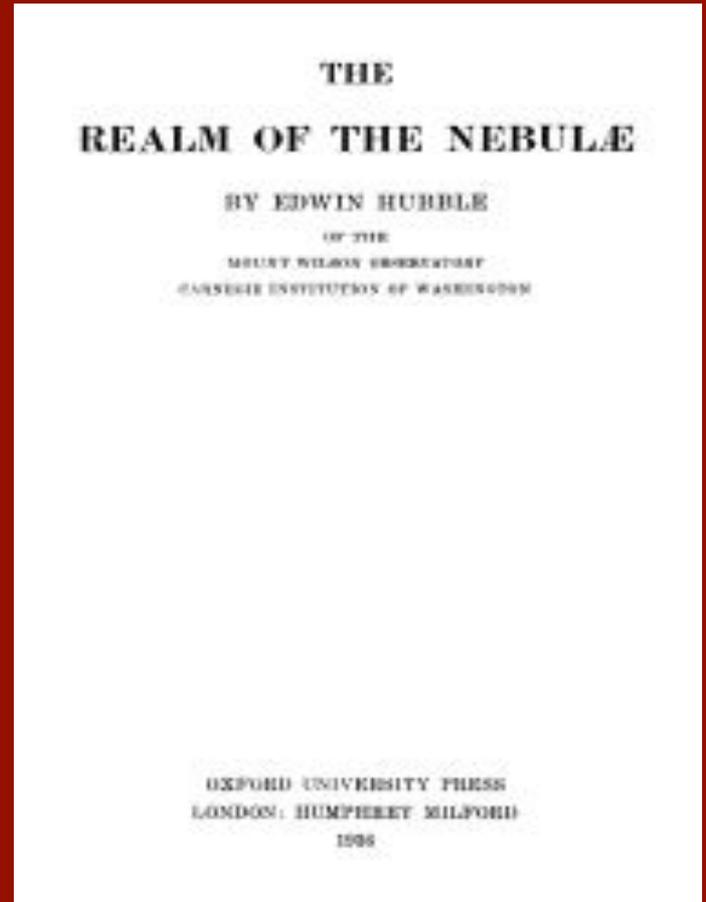
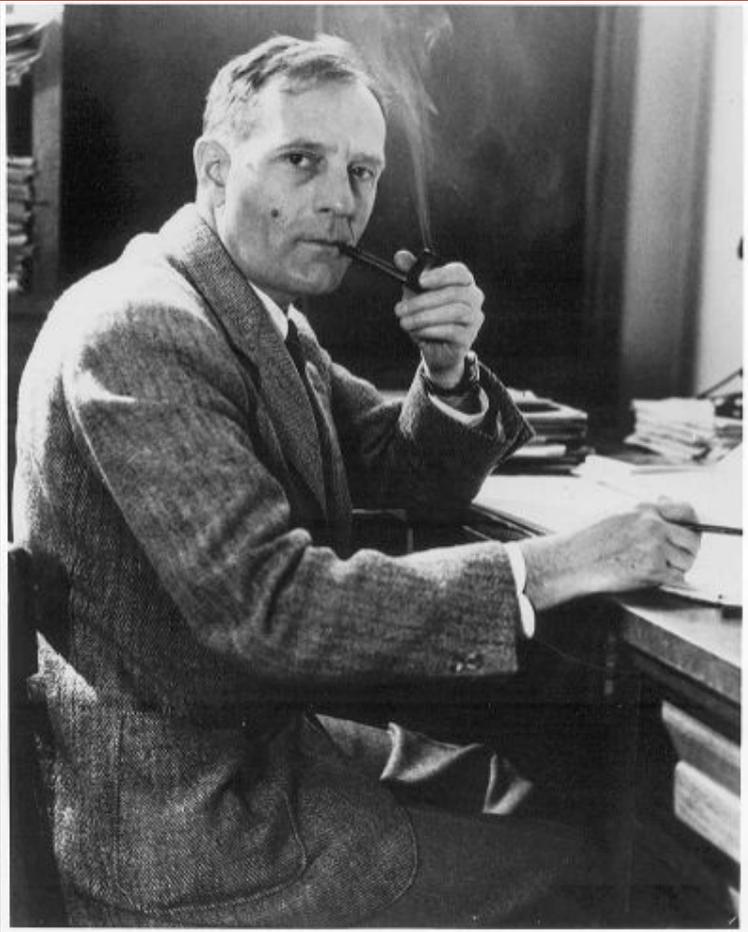


La Galassia di Andromeda, fotografia del 1899



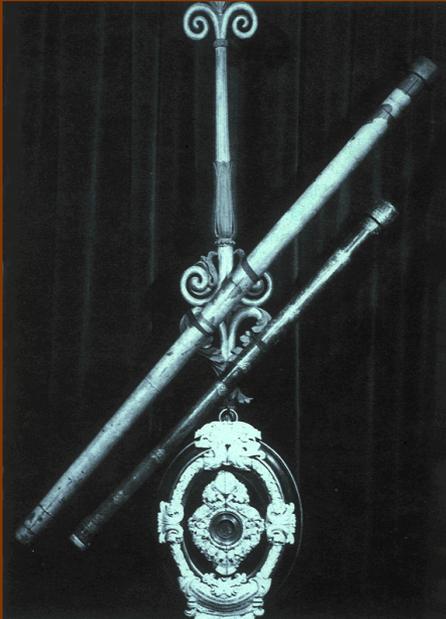
Quanto
distano le
galassie?

Perchè il
cielo è buio?



Edwin Powell Hubble
1889 - 1950

Come Galilei nel 1609,
Hubble nel 1924-29 ha
rivoluzionato la nostra
visione dell'universo



William & John Herschel
e Lord Rosse

William Herschel e il figlio
John osservarono migliaia di
nebulose, di natura ignota.



The Leviathan of Parsonstown (1845)

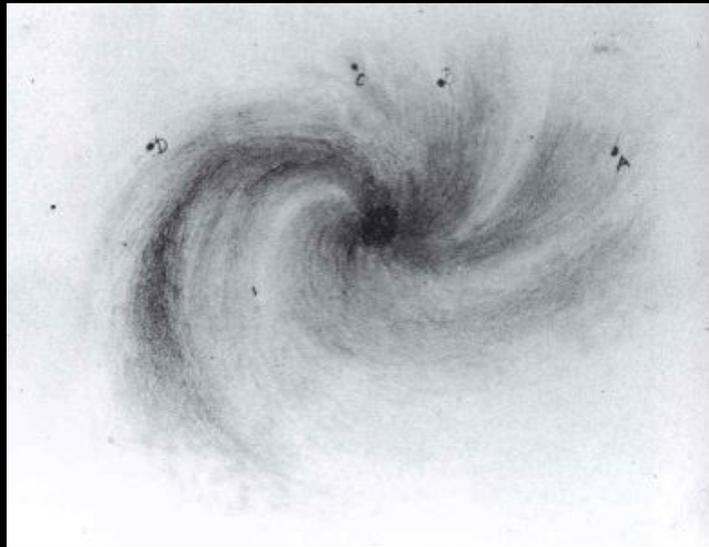


La struttura a spirale delle nebulae

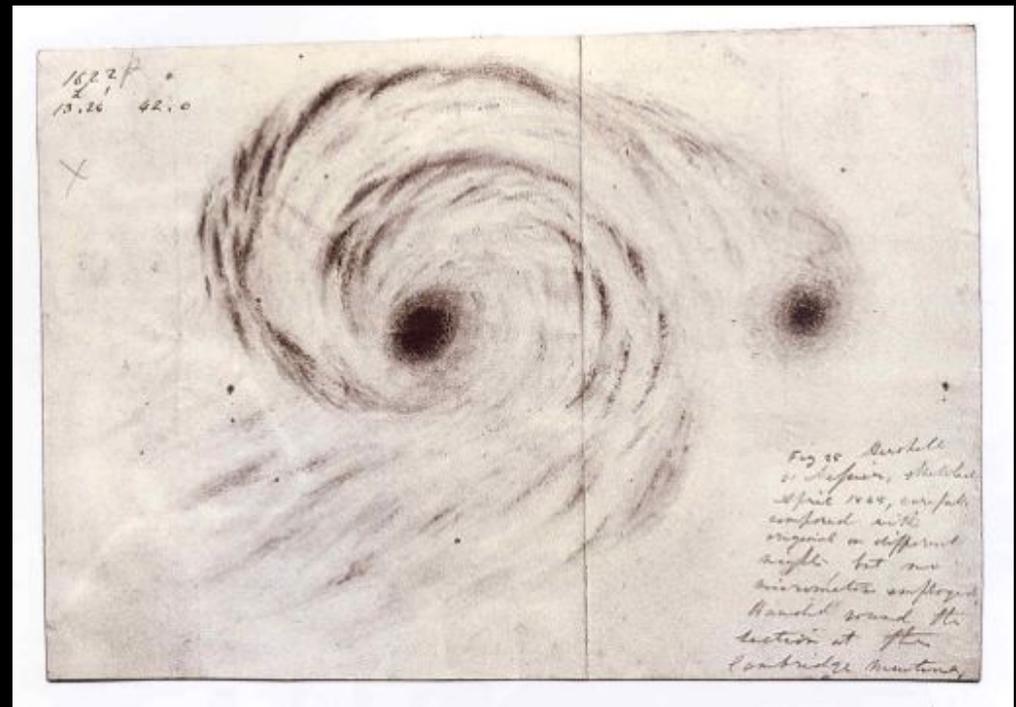


Nebulosa Vortice (M51)

W. Herschel, E. Kant
universi – isole



P. S. Laplace
sistemi planetari in
formazione



Le variabili Cefeidi e la misura della Via Lattea

L'osservatorio di Harvard (1900)





Scanned at the American
Institute of Physics.



Il computer
di Harvard

Henrietta Leavitt



Scanned at the American
Institute of Physics

“1777 variables in the Magellanic Clouds”
Ann. Astr. Obs. Harv. (1908).

Seleziona 16 stelle variabili e osserva:
.. The brighter ones have longer periods.

LE VARIABILI CEFEIDI

POLARE
●



CEFEO



L'indagine spettroscopica mostra che la stella è pulsante (da 31 a 35 raggi solari.)

1912 Henrietta Leavitt, studiando le cefeidi nella Piccola Nube di Magellano, scopre la relazione PERIODO - LUMINOSITÀ.

Le più luminose hanno periodo più lungo

1918 Modello di Shapley della galassia.

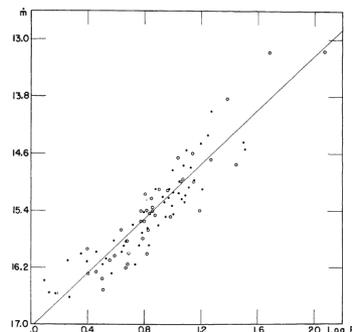


FIG. 4. Period-magnitude relation for the eighty-eight Cepheid variables. Open circles indicate variables in large Magellanic Cloud.

the mean is composed. The mean values for the two subdivisions are also given in table 3 and figure 3. For these three mean curves the sub-indices are, respectively, 8.3, 10.6, and 5.3.

In the foregoing analysis, light curves from the two Magellanic Clouds were combined without an adjustment of the zero-points of the two systems of photographic magnitudes. Apparently it was not needed. That the two Clouds can be treated as essentially the same distance is indicated in

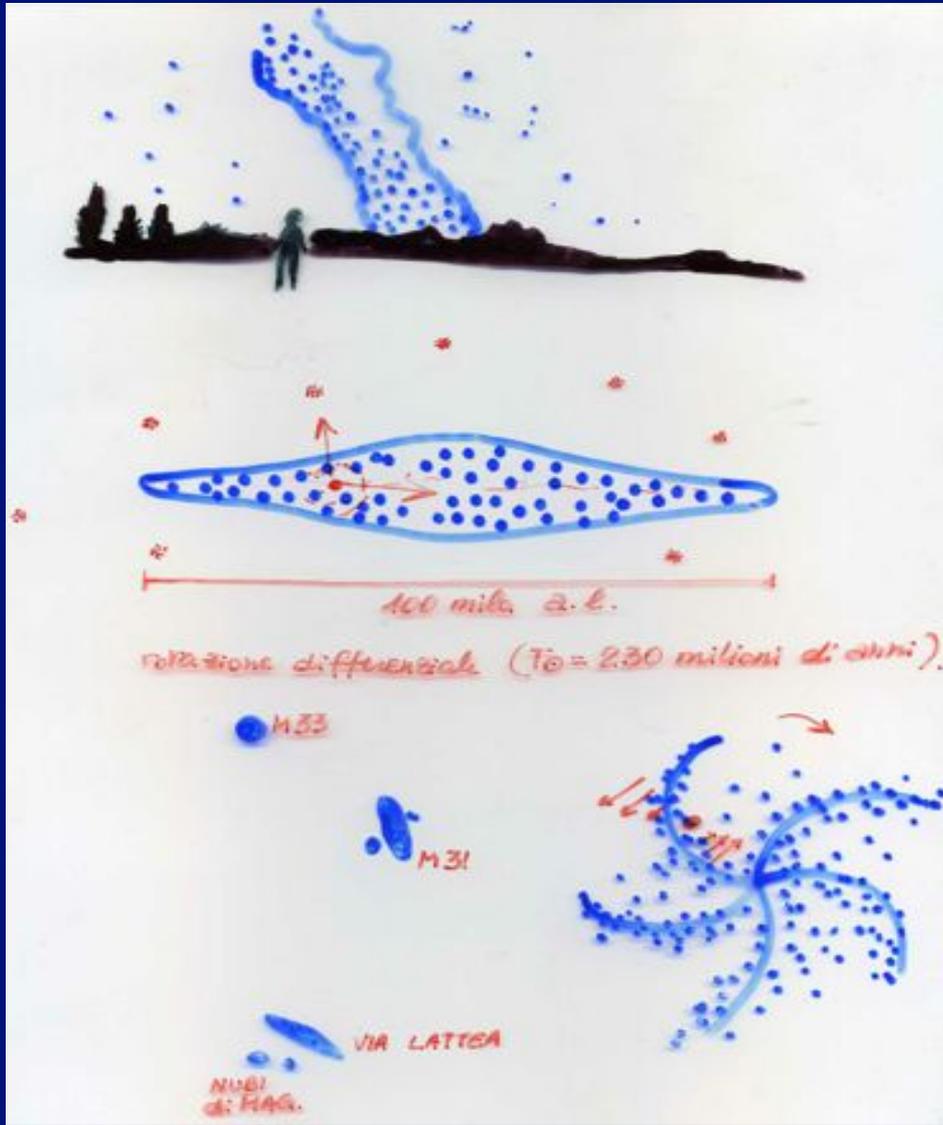
figure 4, which shows the period-luminosity relation based on all eighty-eight variables. The adopted distance modulus is 17.25 for both Clouds. The corresponding distance is approximately eighty thousand light years, if we adopt a value of 0.3 mag. as the correction for intervening space absorption.*

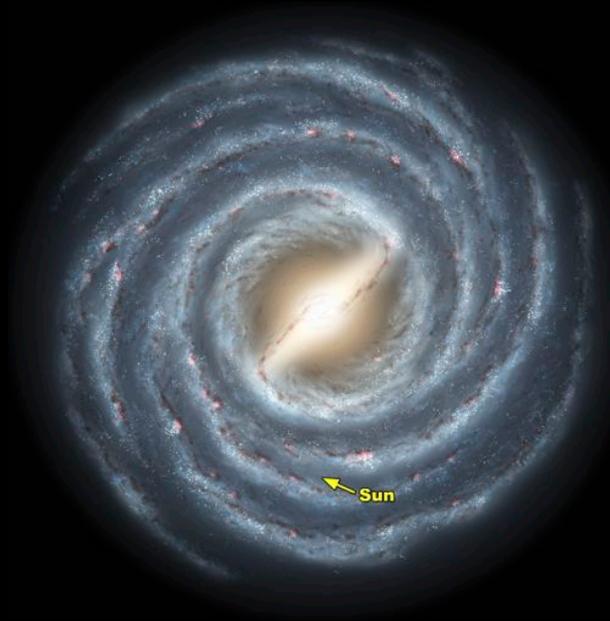
* Both in the tables and figures the median photographic magnitude of HV 252 has been corrected by subtracting one magnitude to allow for light absorption by the 20 Doradoe Nebula in which it is involved.

Le stelle cefeidi sono *pietre miliari* nel cielo



Shapley misurò la Via Lattea con le Cefeidi







I grandi telescopi

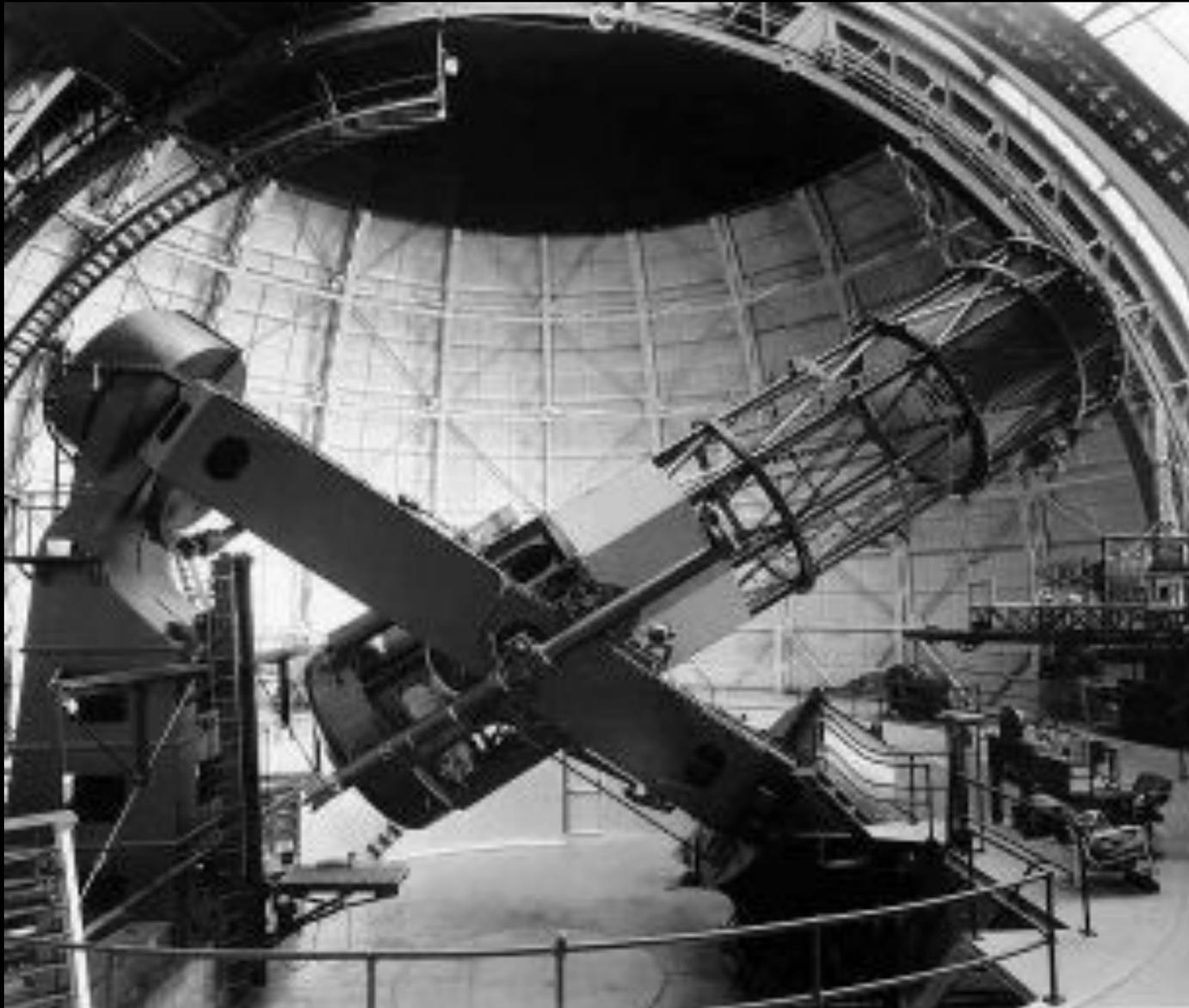
La distanza delle galassie



George E. Hale



Yerkes



Mount Wilson, 100" Hooker telescope



Timberline 1902 by 1903
Andrew Carnegie and Dr. Halls. Engine Goodrich
Wheeler on South. to be Black.
Mr. Wilson. Calif.

The great debate

National Acad. of Science, Washington 1920



Herbert Curtis (Lick obs)
Le nebulae sono galassie



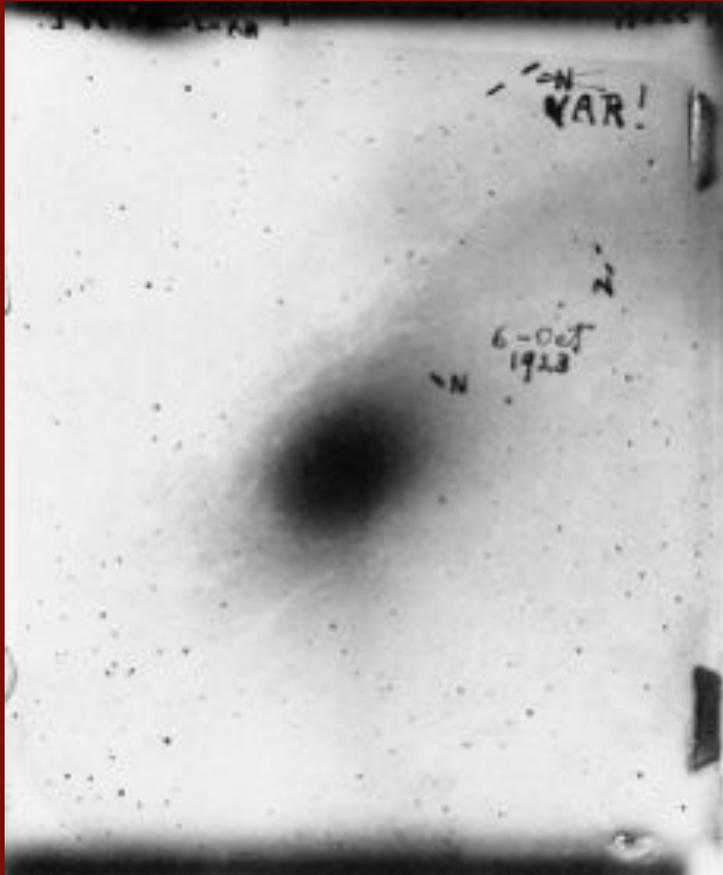
Harlow Shapley
Una sola Via Lattea



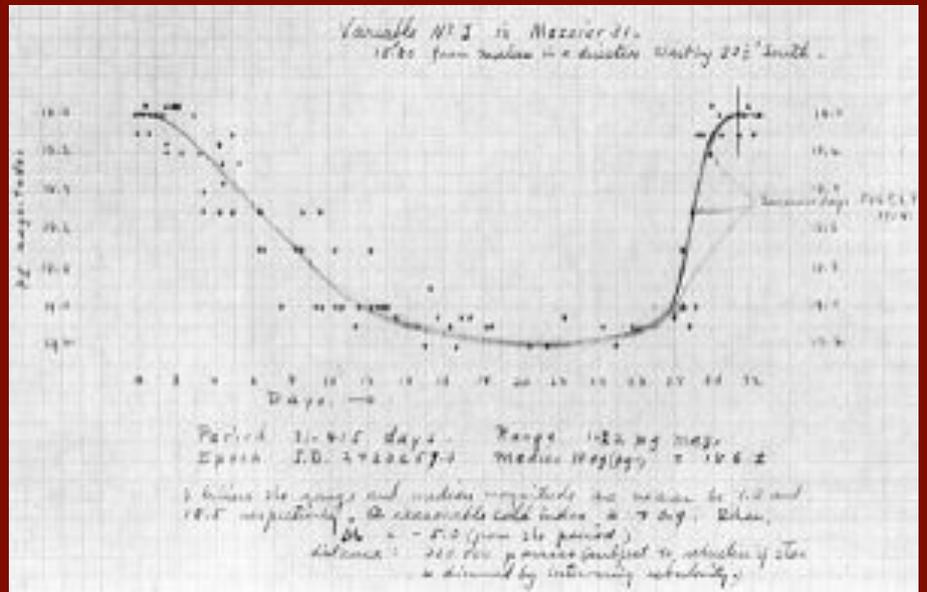




VAR!



156										187																														
110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150



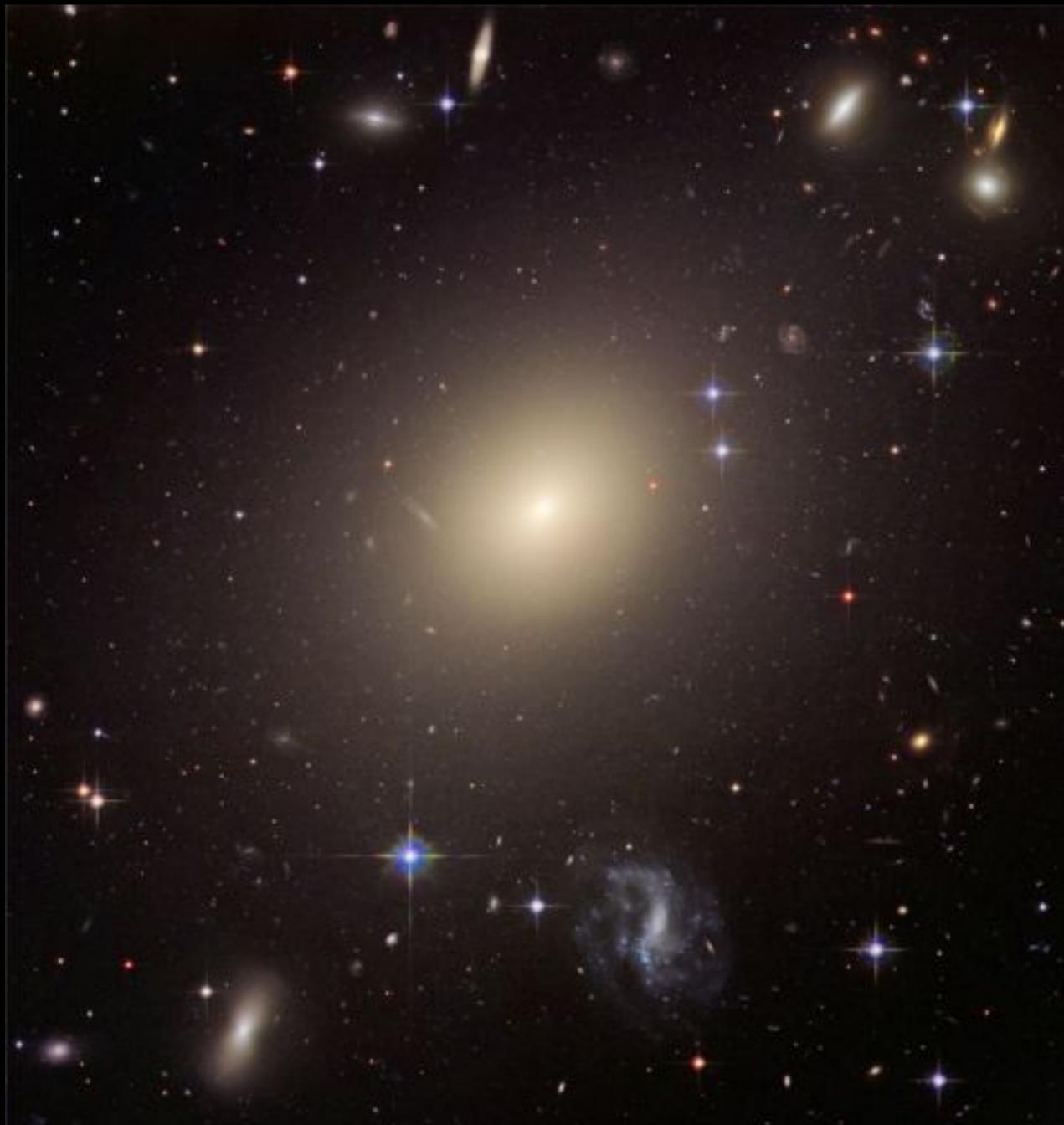
2,3 milioni di anni luce



Daniel López
Observatorio del Teide, IAC

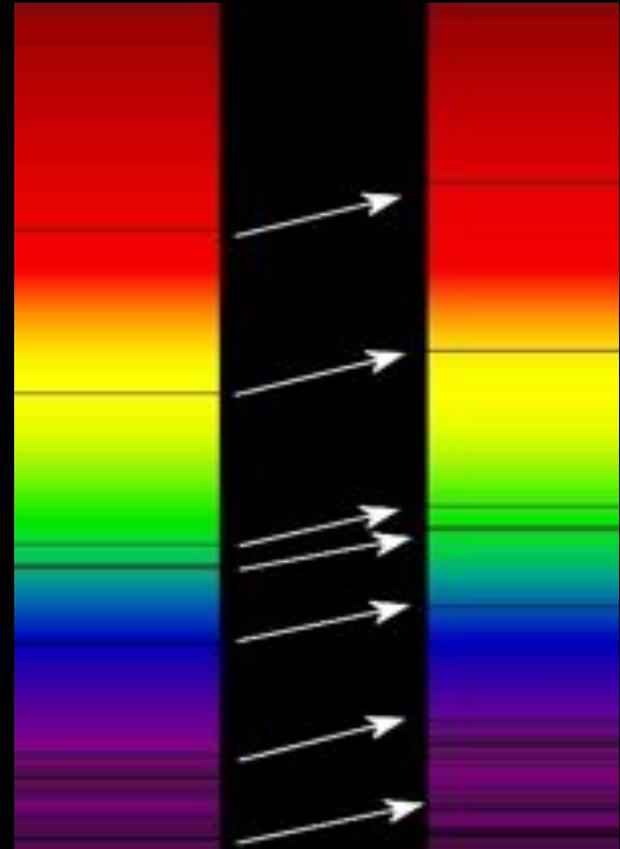
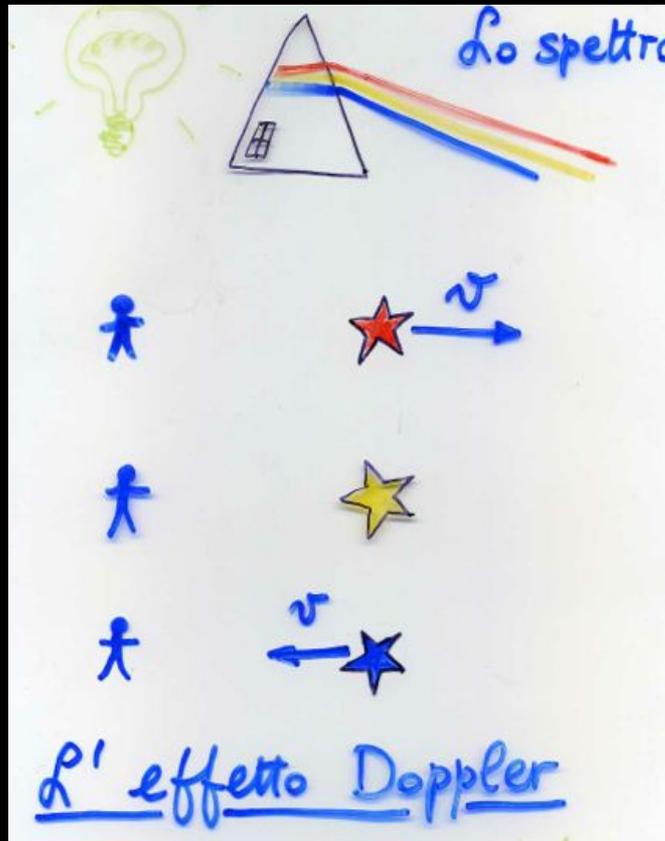






La legge di Hubble e l'espansione dell'universo

L'effetto Doppler



1914 - Vesto Slipher
REDSHIFT DELLE NEBULAE
Le nebulae si allontanano da noi
con velocità fino a 2000 km/s





*Humason
&
Hubble*



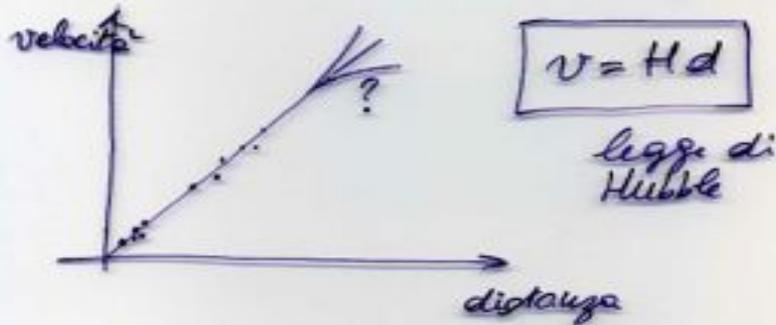
Lo spostamento verso il rosso (redshift)



1910-1920 Slipher: effetto Doppler dovuto al moto del sistema solare.

1925 Cefeidi nelle spirali.

1929 Edwin HUBBLE redshift di natura COSMOLOGICA

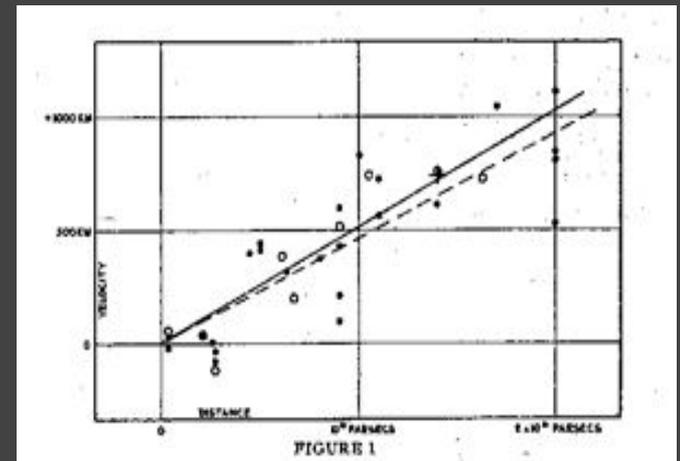


1952 W Baade: due classi di cefeidi. $d \times 2,6$

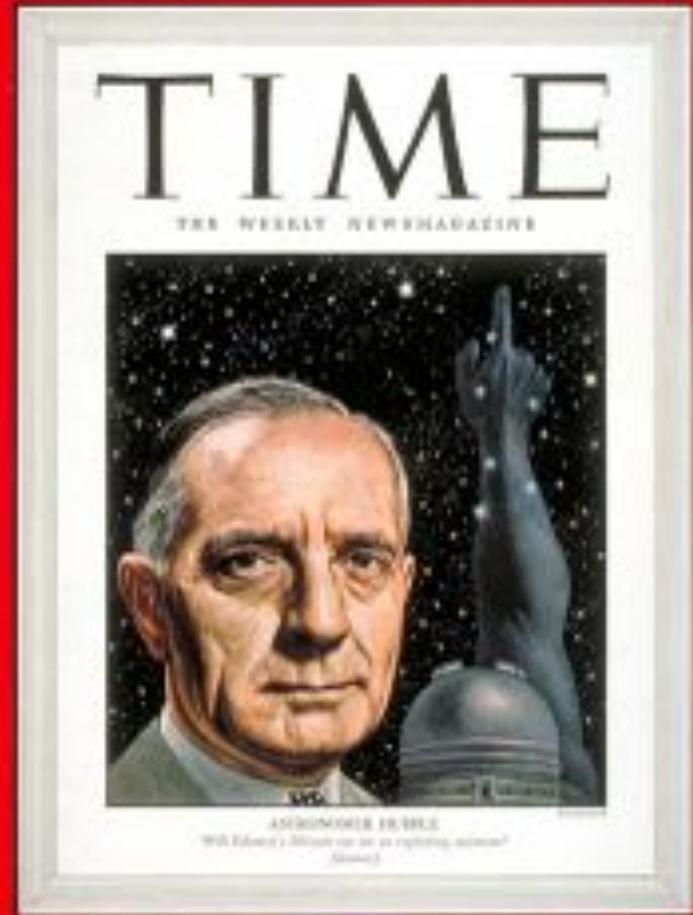
$$H = 15 \text{ km/sec} / 10^6 \text{ a. l.}$$

LA LEGGE DI HUBBLE

$$V = H d$$



Youth who left
Ozark mountain to
study stars causes
Einstein to change
his mind

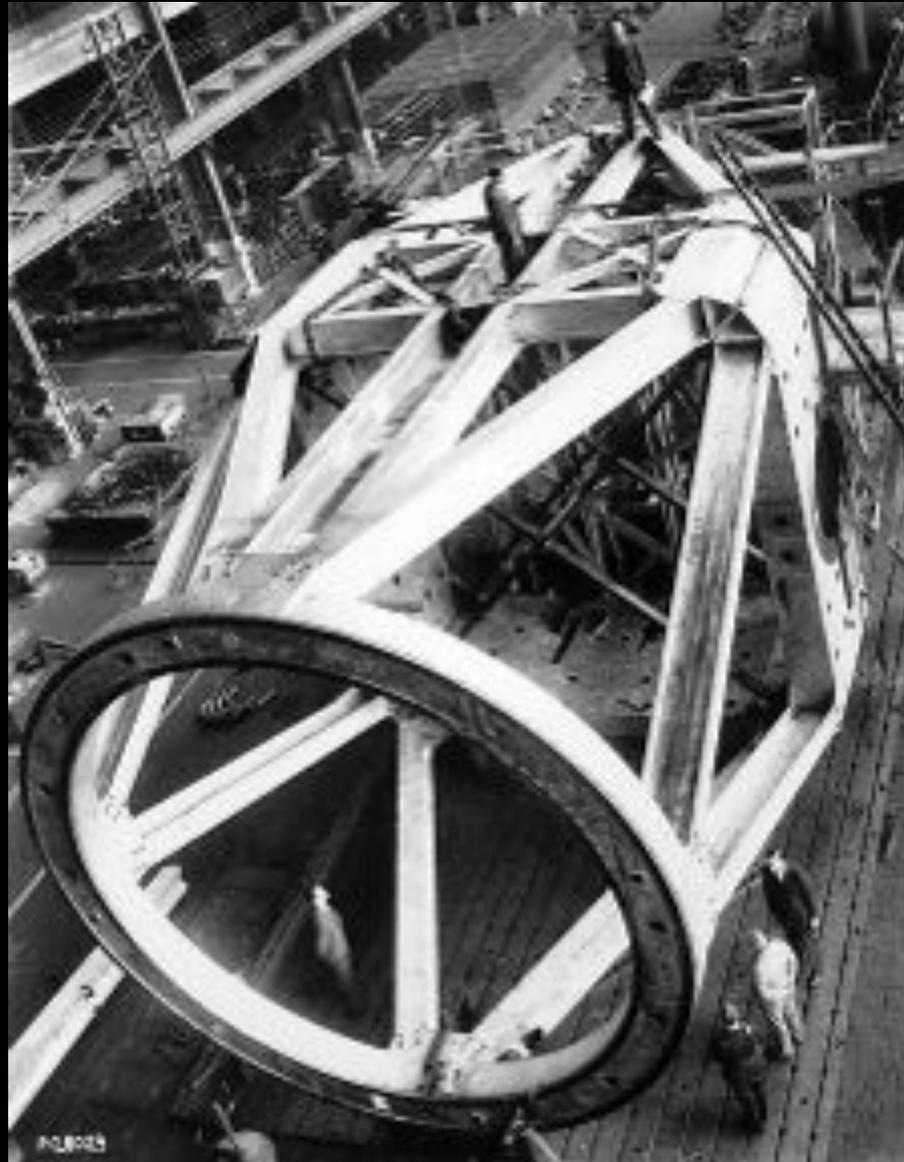




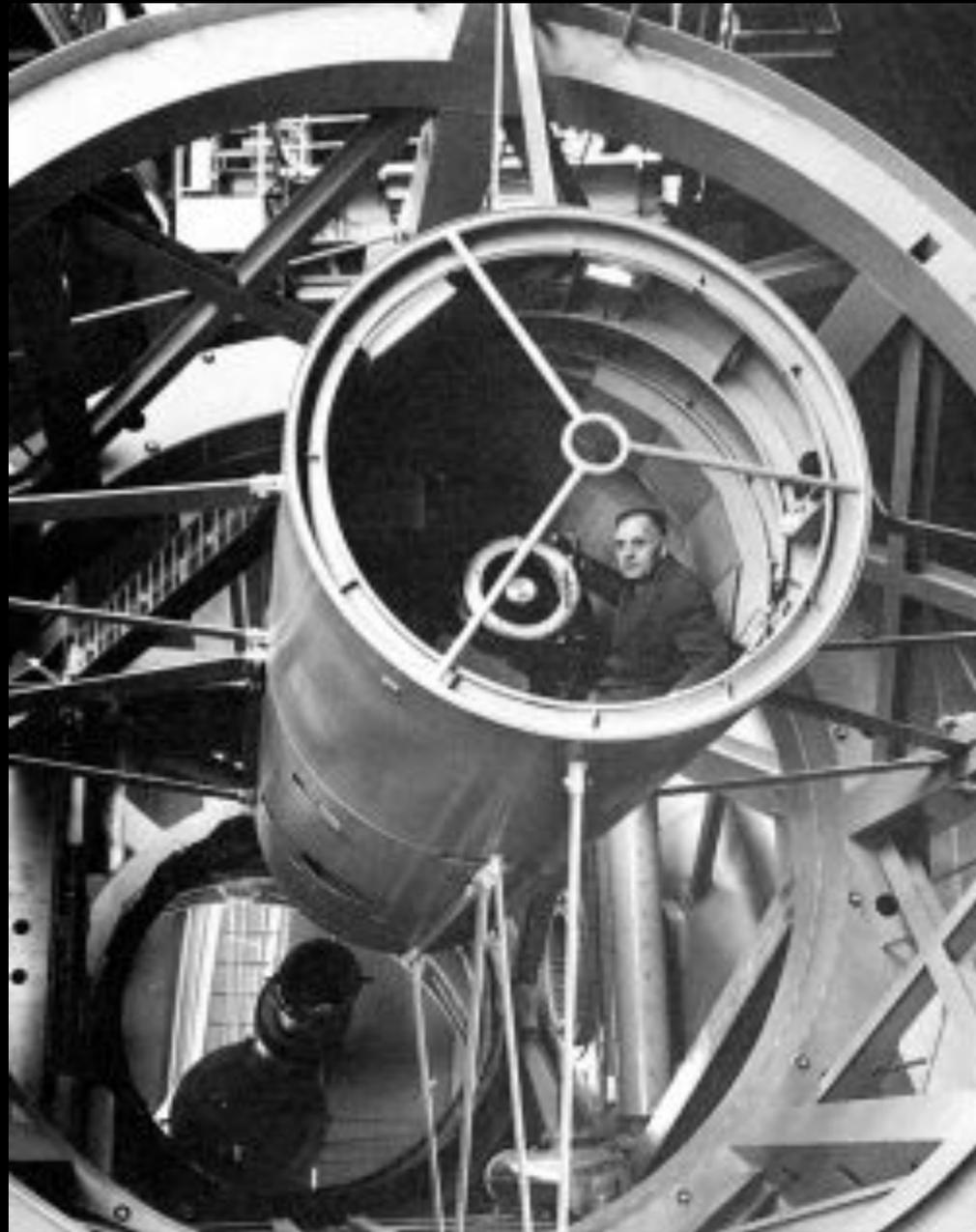
Dedication of Palomar 1948







PL 8023



National
Geographic
and
Palomar Obs.
Sky Survey





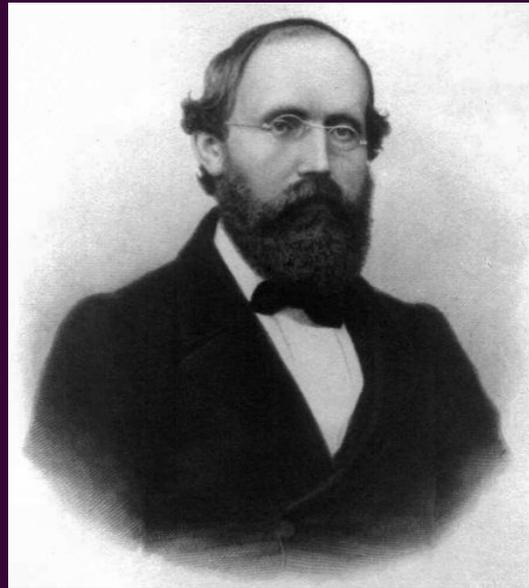
Allen Sandage

Teoria e osservazione: La Cosmologia

Le geometrie non euclidee *e la geometria intrinseca*



Carl F. Gauss

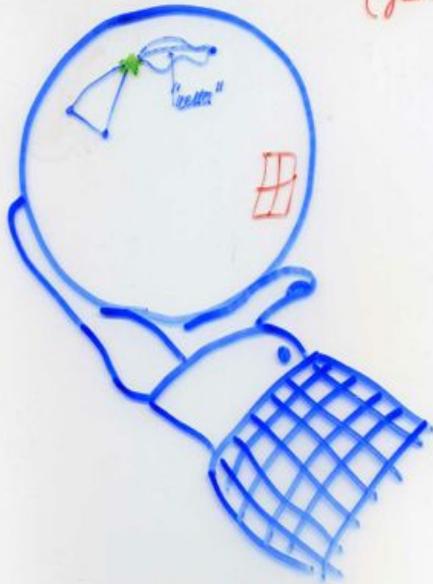


Bernhard Riemann



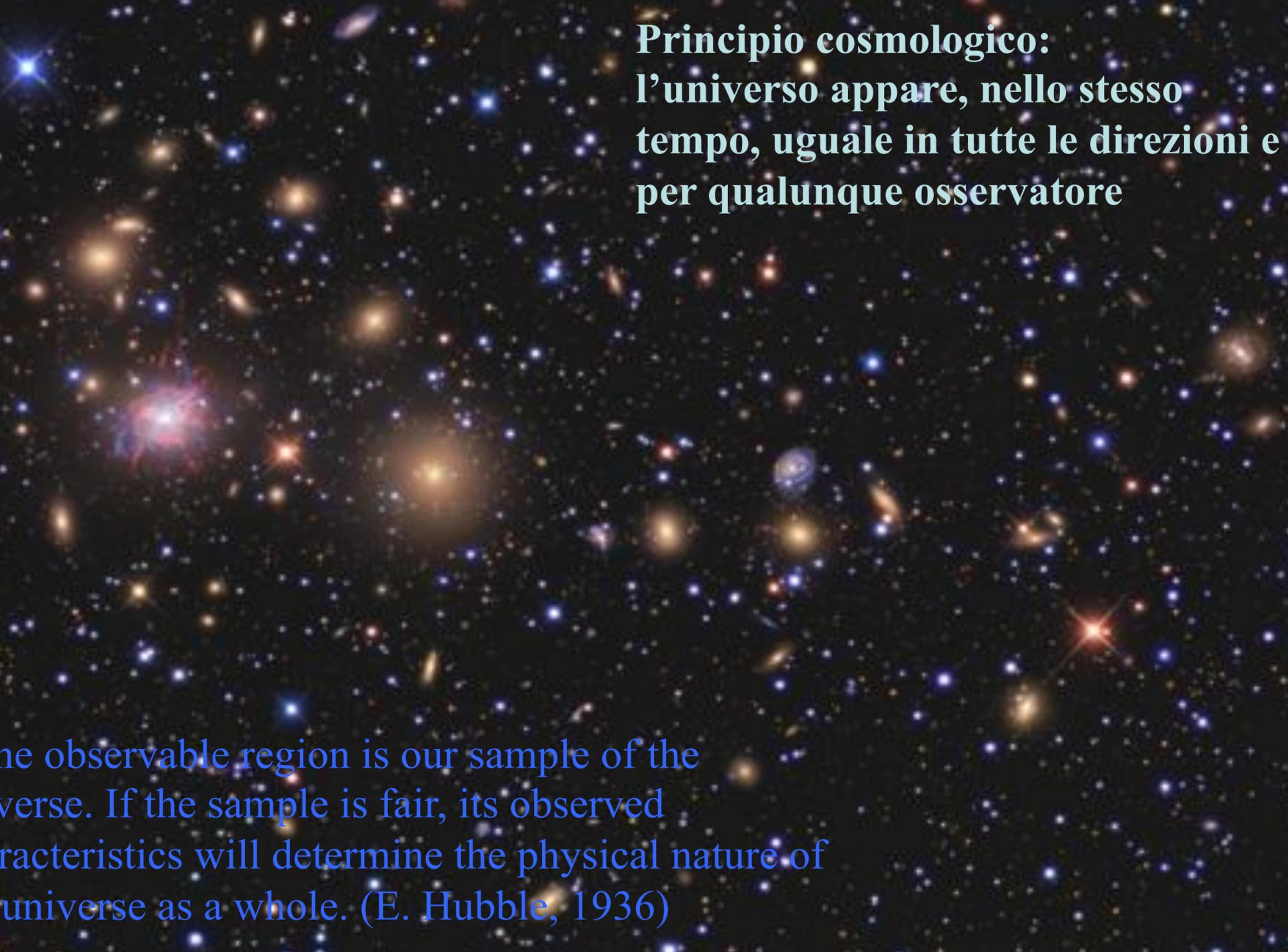
Tullio Levi Civita

uscire l'atomo a esplorare
l'UNIVERSO? LA GEOMETRIA INTRINSECA!
(Gauss)



ELEMENTARE WATSON,
E' UNA SFERA!

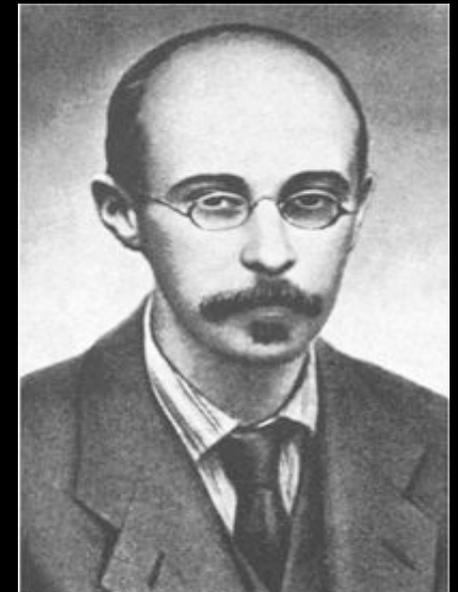
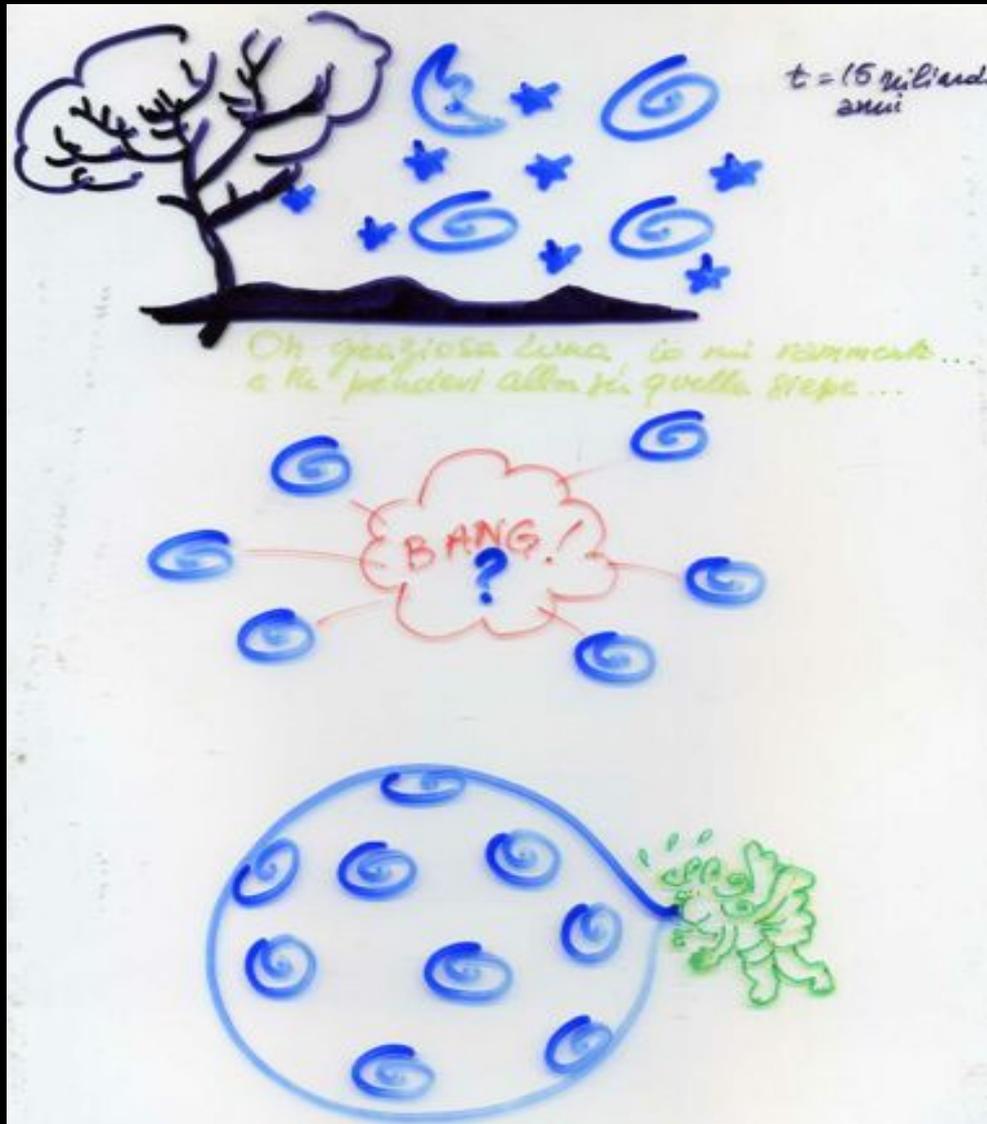




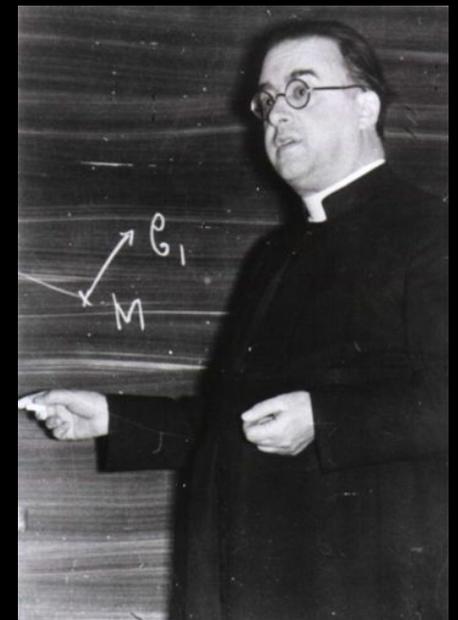
**Principio cosmologico:
l'universo appare, nello stesso
tempo, uguale in tutte le direzioni e
per qualunque osservatore**

the observable region is our sample of the
universe. If the sample is fair, its observed
characteristics will determine the physical nature of
the universe as a whole. (E. Hubble, 1936)

Le soluzioni di Friedman e Lemaitre



Georges Lemaître





Hubble Space Telescope

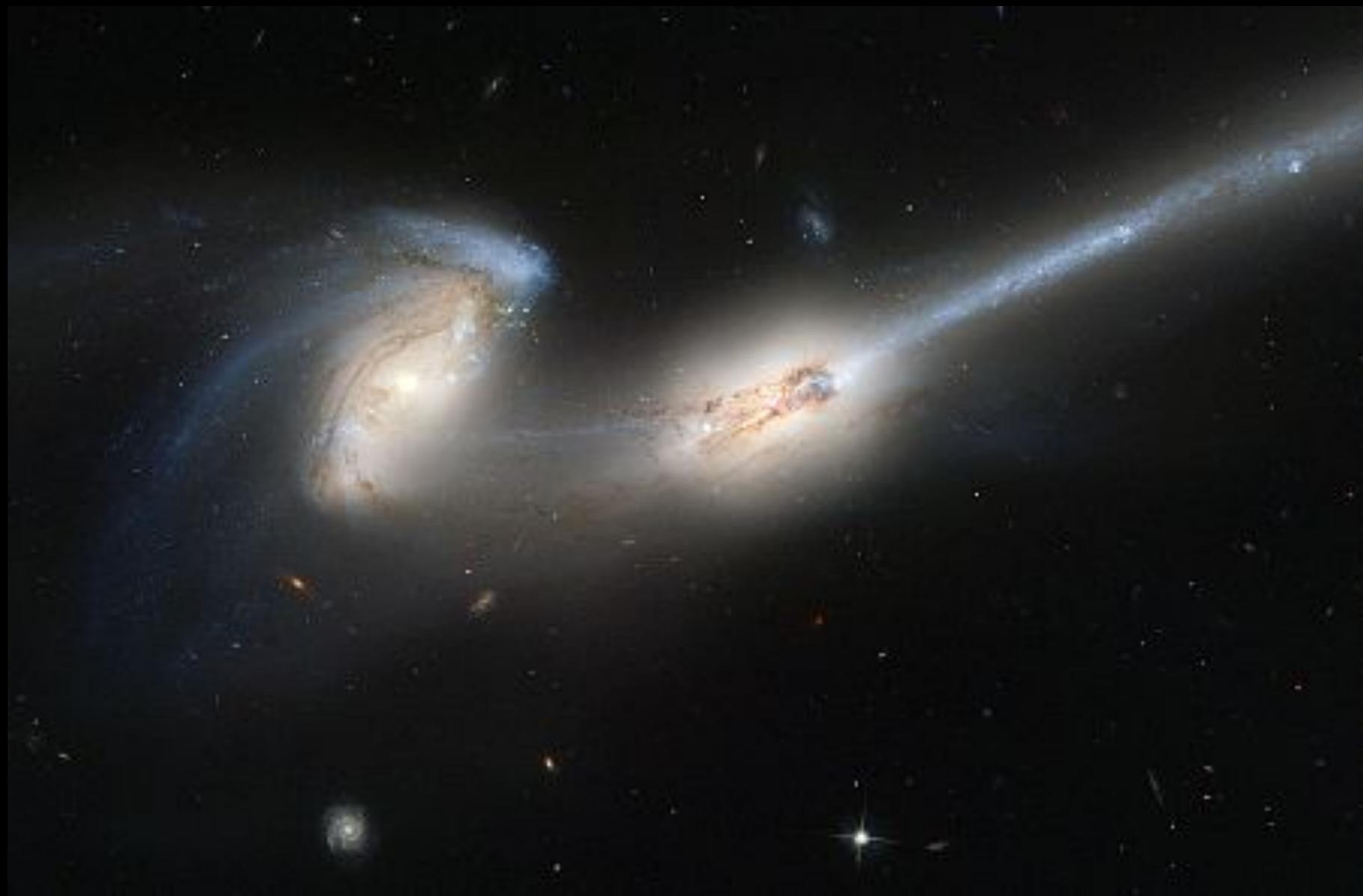
Il Regno delle Galassie

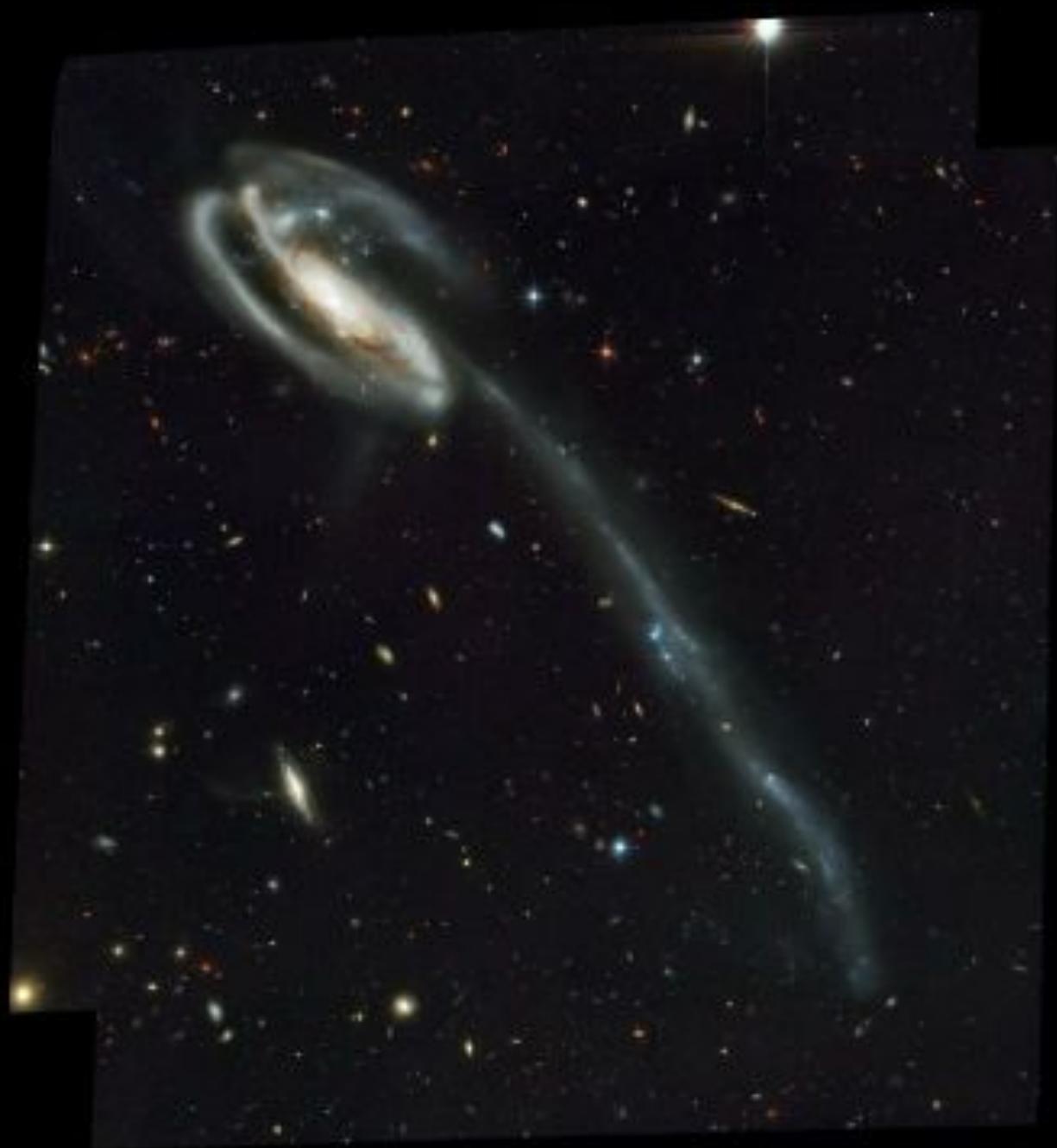












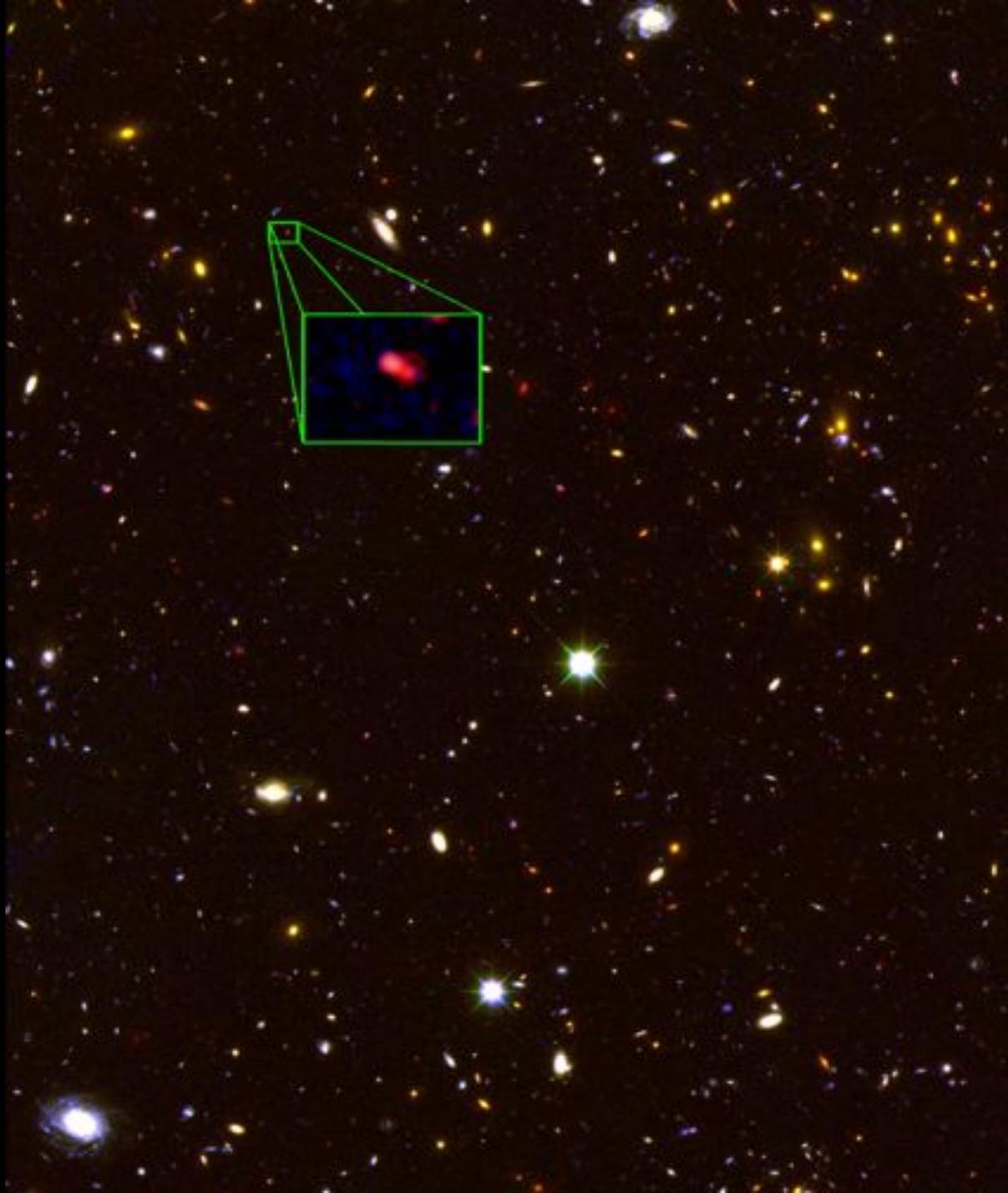




NGC 1132









Fine della prima puntata

L'universo Oscuro
6 giugno 2014 ore 21
Palazzo Estense