Galaxias a Redshift z=10

UV Luminosity Functions at Redshifts z~4 to z~10: 11000 Galaxies from HST Legacy Fields

R. J. Bouwens, G. D. Illingworth, P. A. Oesch, M. Trenti, I. Labbe', L. Bradley, M. Carollo, P.G. van Dokkum, V. Gonzalez, B. Holwerda, M. Franx, L. Spitler, R. Smit, D. Magee

17 Mar 2014
arXiv:1403.4295

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UV Luminosity Functions at Redshifts z~4 to z~10:
11000 Galaxies from HST Legacy Fields

Felipe Gómez
Abril-2014

Galaxias a Redshift z=10

- Redshift
  - Tiempo vs. Redshift Cosmológico
- Telescopios
- Observaciones
- Función de Luminosidad

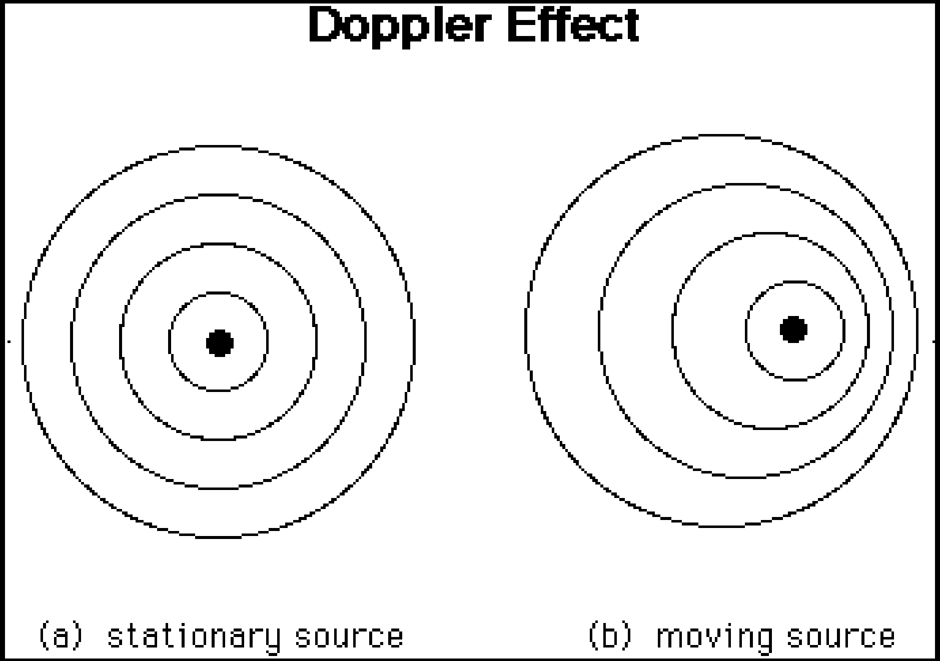
Redshift

- Análogo al efecto Doppler

http://youtu.be/O5rqMPdQMQ8

Redshift

- Análogo al efecto Doppler
- Cambio de la frecuencia observada



Redshift

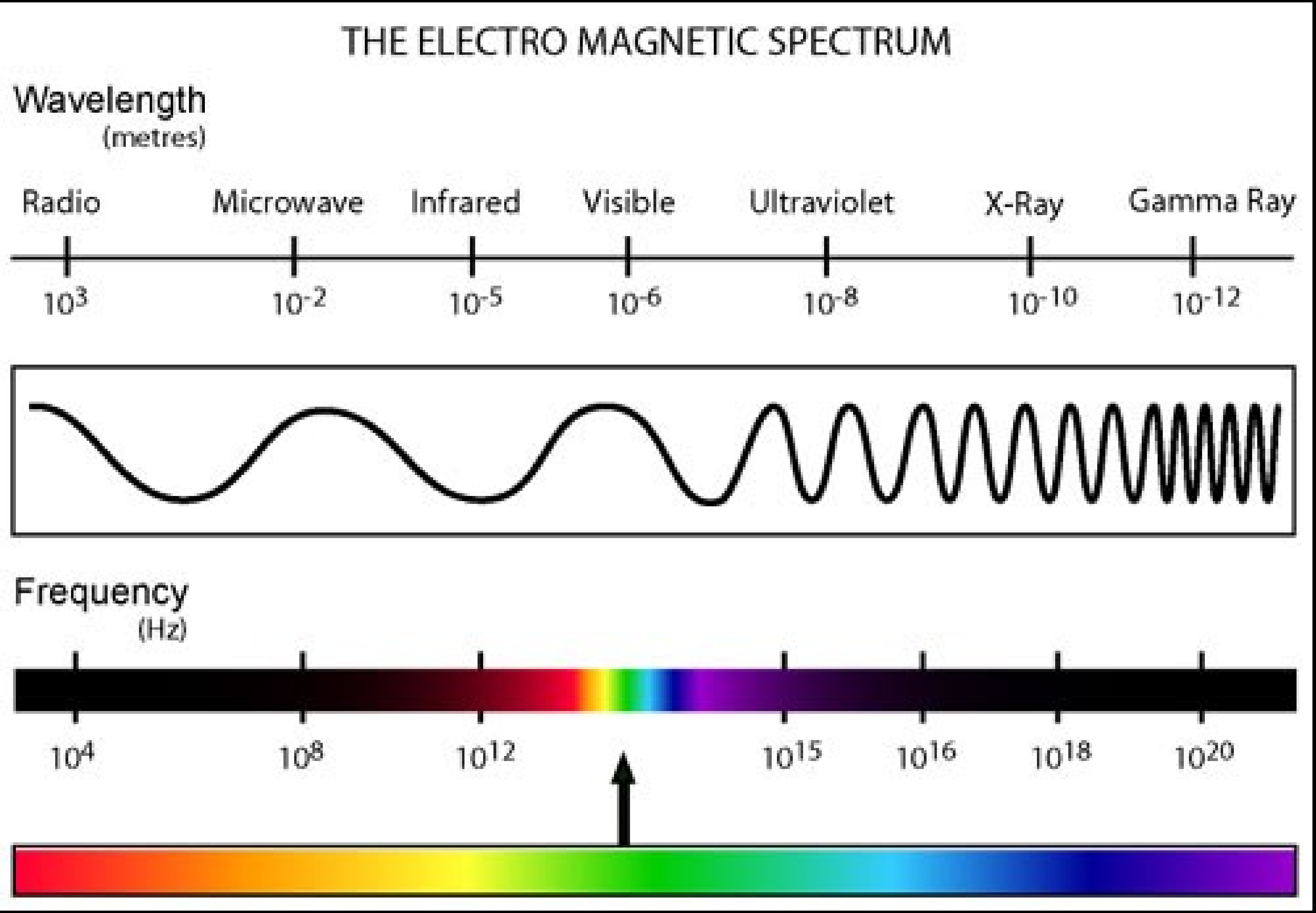
- Análogo al efecto Doppler
- La frecuencia observada *f_d* es diferente de la frecuencia de la fuente *f_s*

$$f_d = f_s\left(\frac{v+v_d}{v-v_s}\right)$$

Redshift

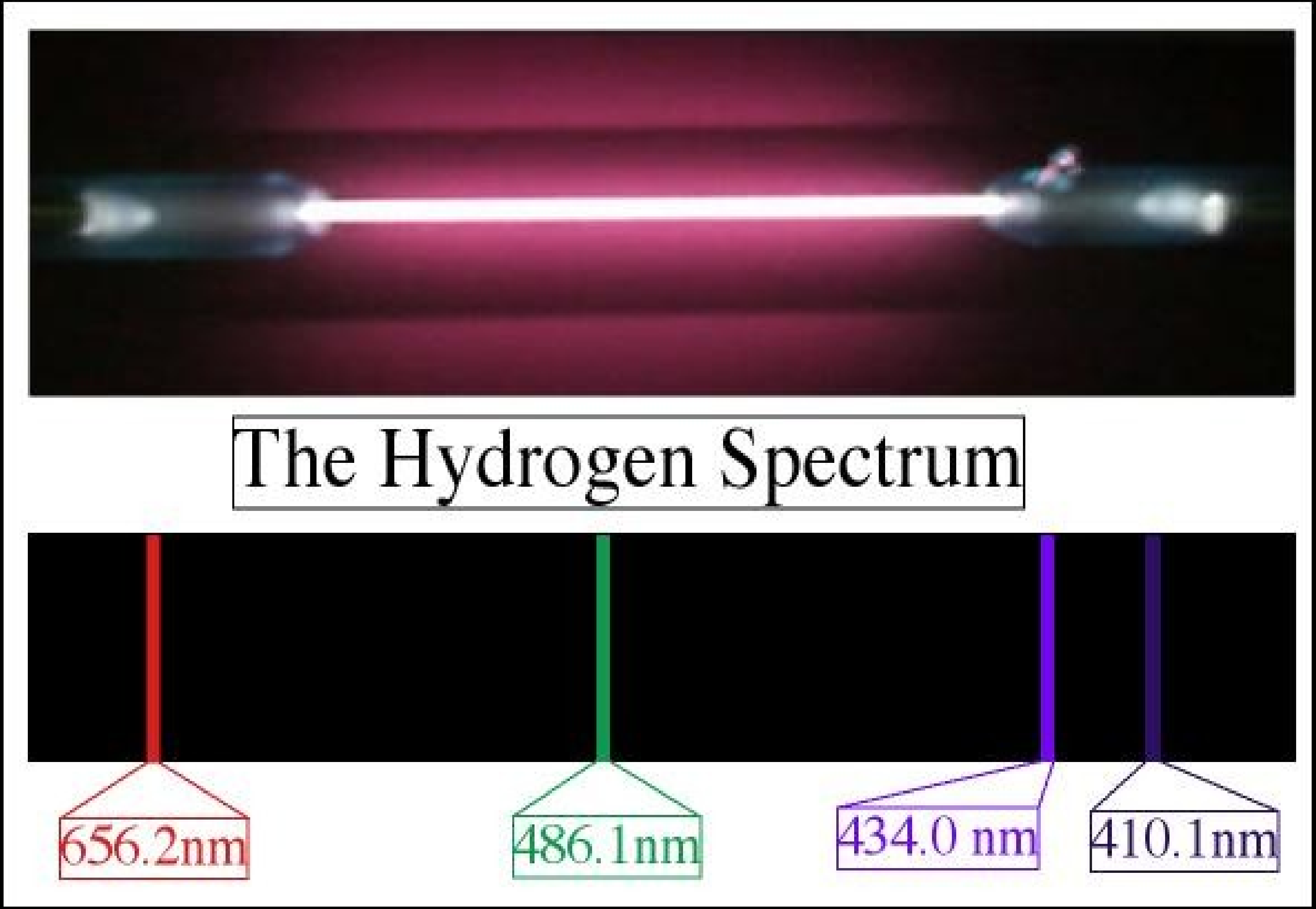
Espectro electromagnético visible

Redshift

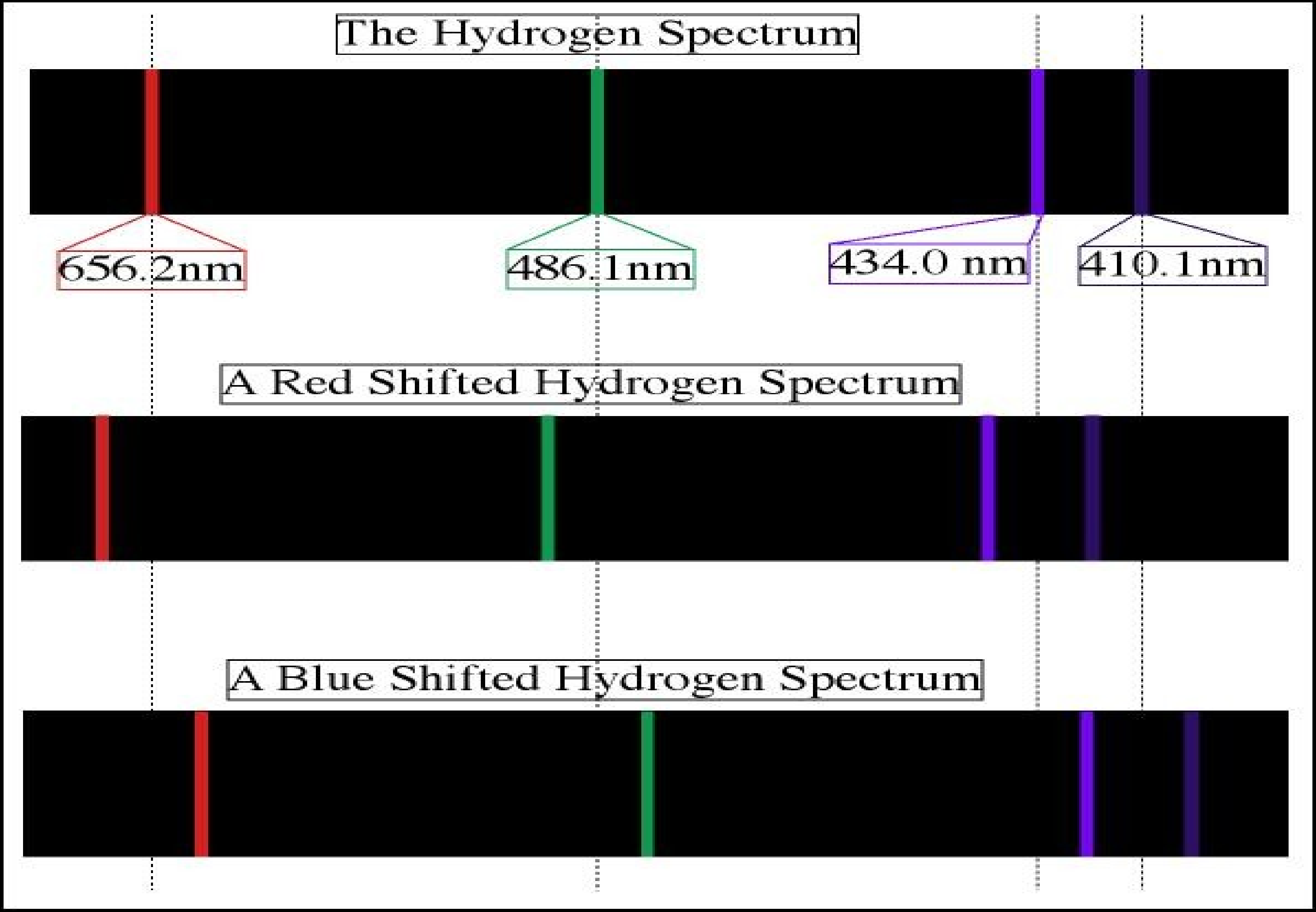


THE ELECTRO MAGNETIC SPECTRUM
Wavelength
(metres)
Radio
Microwave
Infrared
Visible
Ultraviolet
X-Ray
Gamma Ray
10^{3}
10^{-2}
10^{-5}
10^{-6}
10^{-8}
10^{-10}
10^{-12}
Frequency
(Hz)
10^{4}
10^{8}
10^{12}
10^{15}
10^{16}
10^{18}
10^{20}

Redshift

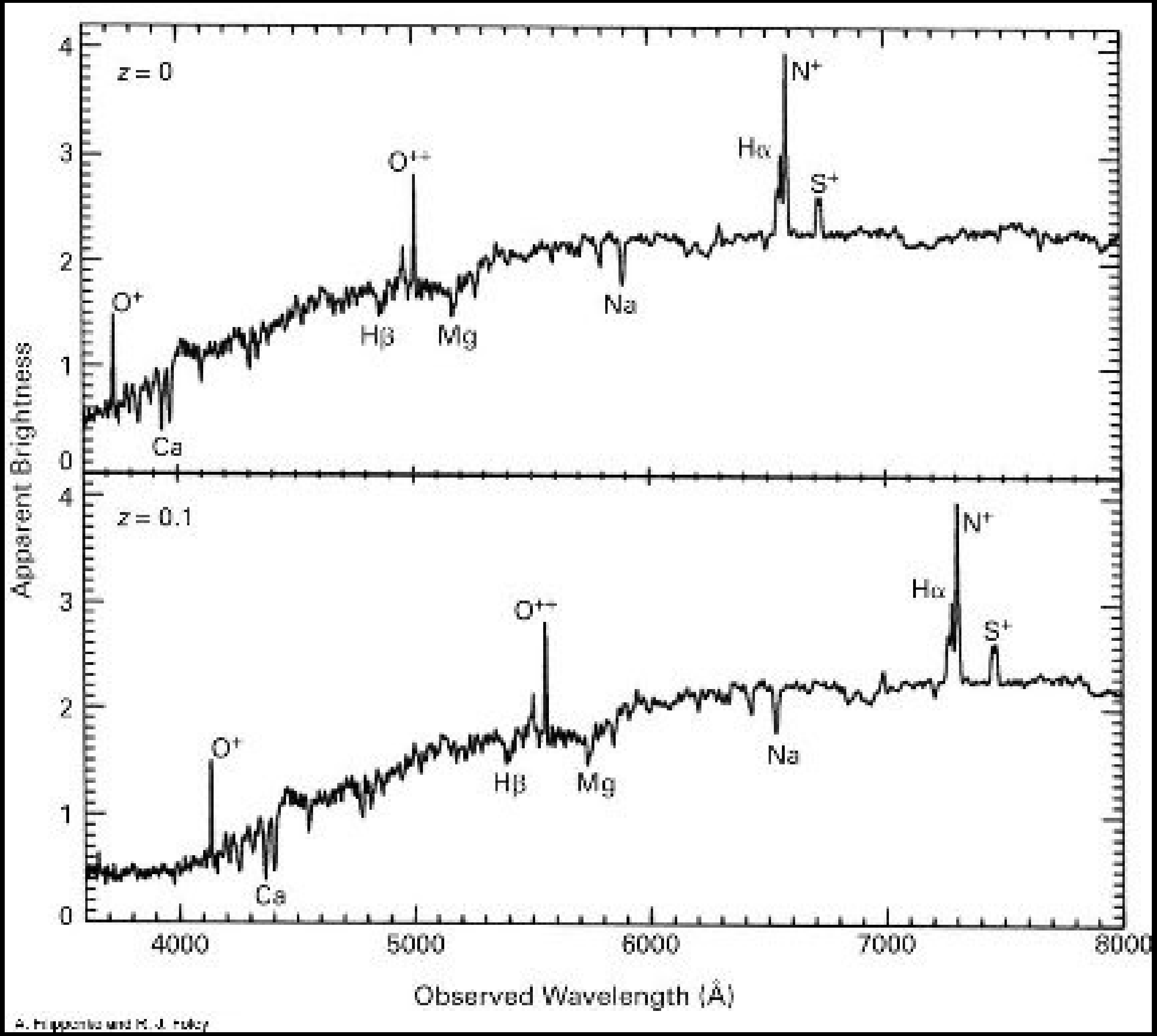


Redshift

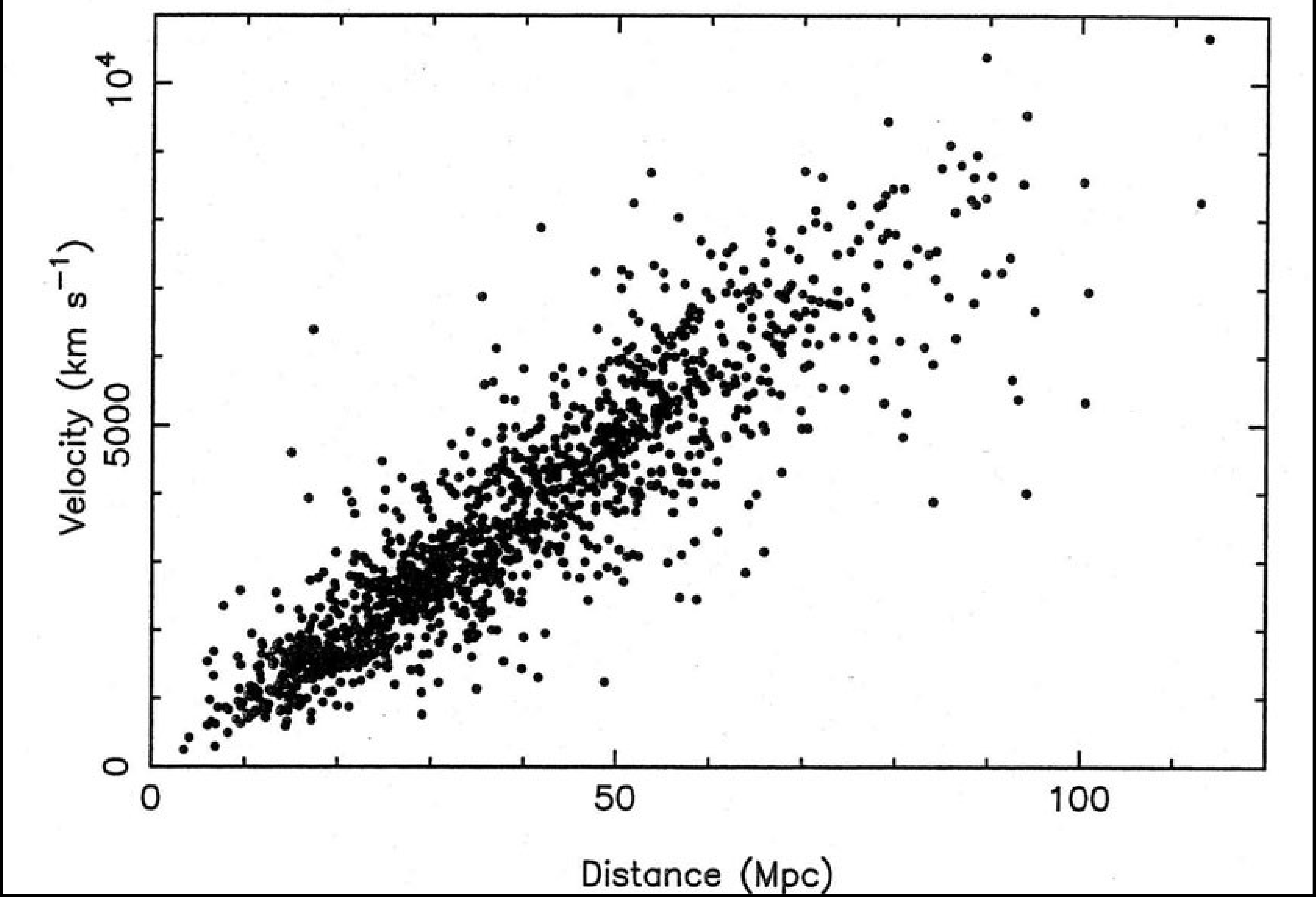


The Hydrogen Spectrum
656.2nm
486.1nm
434.0 nm
410.1nm
A Red Shifted Hydrogen Spectrum
A Blue Shifted Hydrogen Spectrum

Redshift en galaxias cercanas



Redshift en galaxias cercanas



Redshift en galaxias cercanas

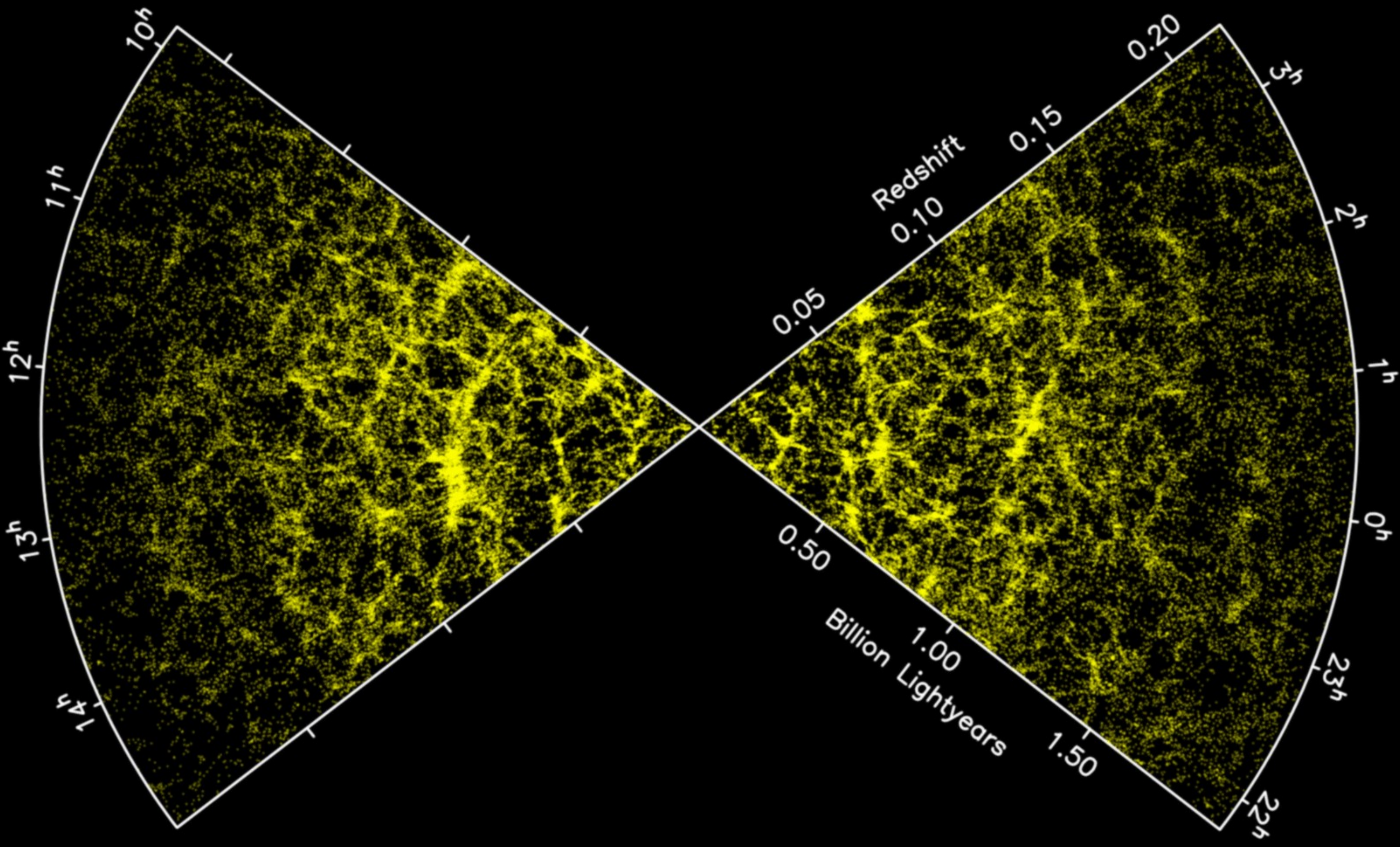
$$v = H_0 d$$

$$v = recessional\ velocity\ of\ galaxy$$

$$H_0 = Hubble\ constant$$

$$d = distance\ to\ galaxy$$

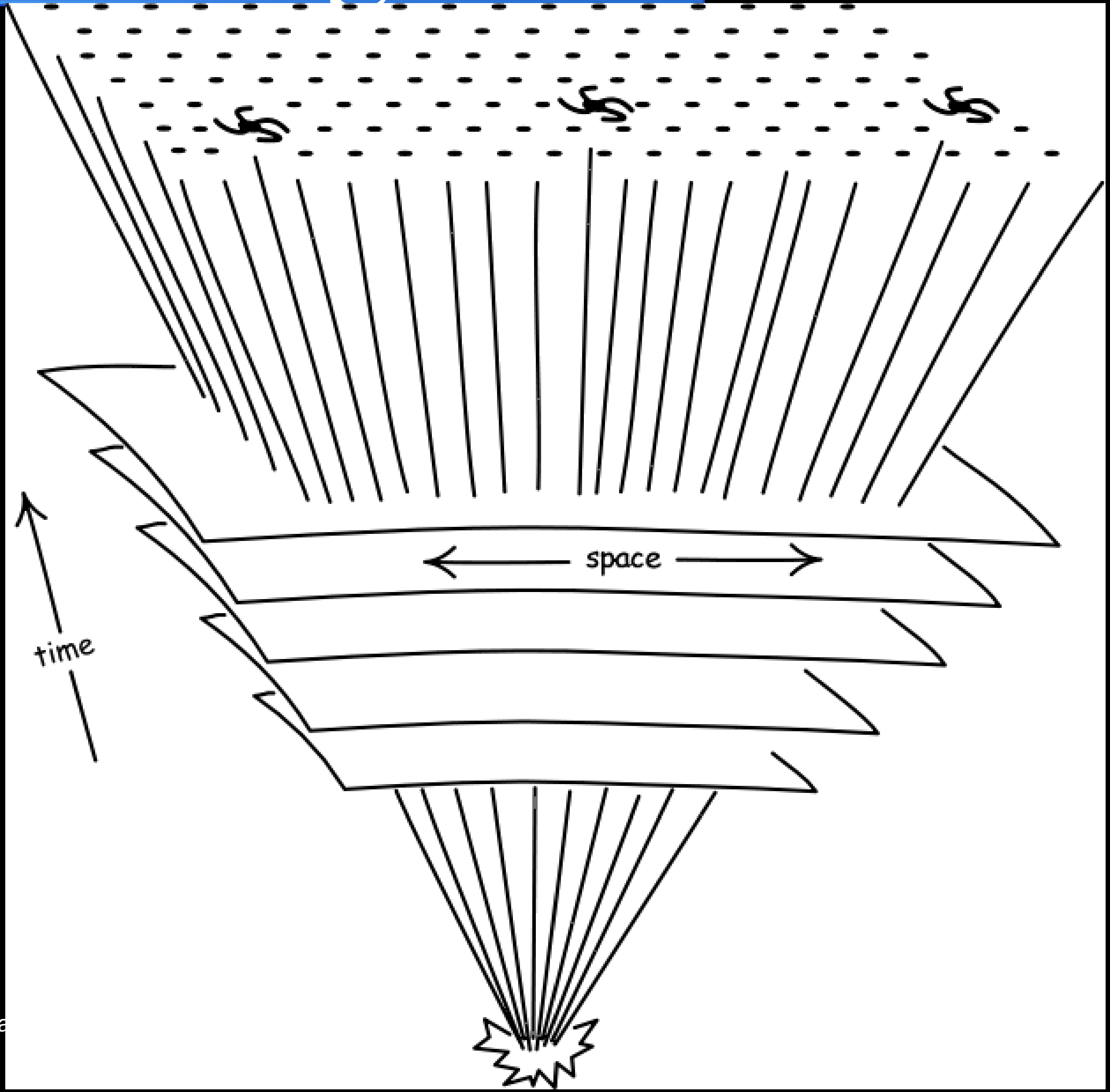
Redshift en galaxias cercanas



Universo en expansión: Redshift Cosmológico

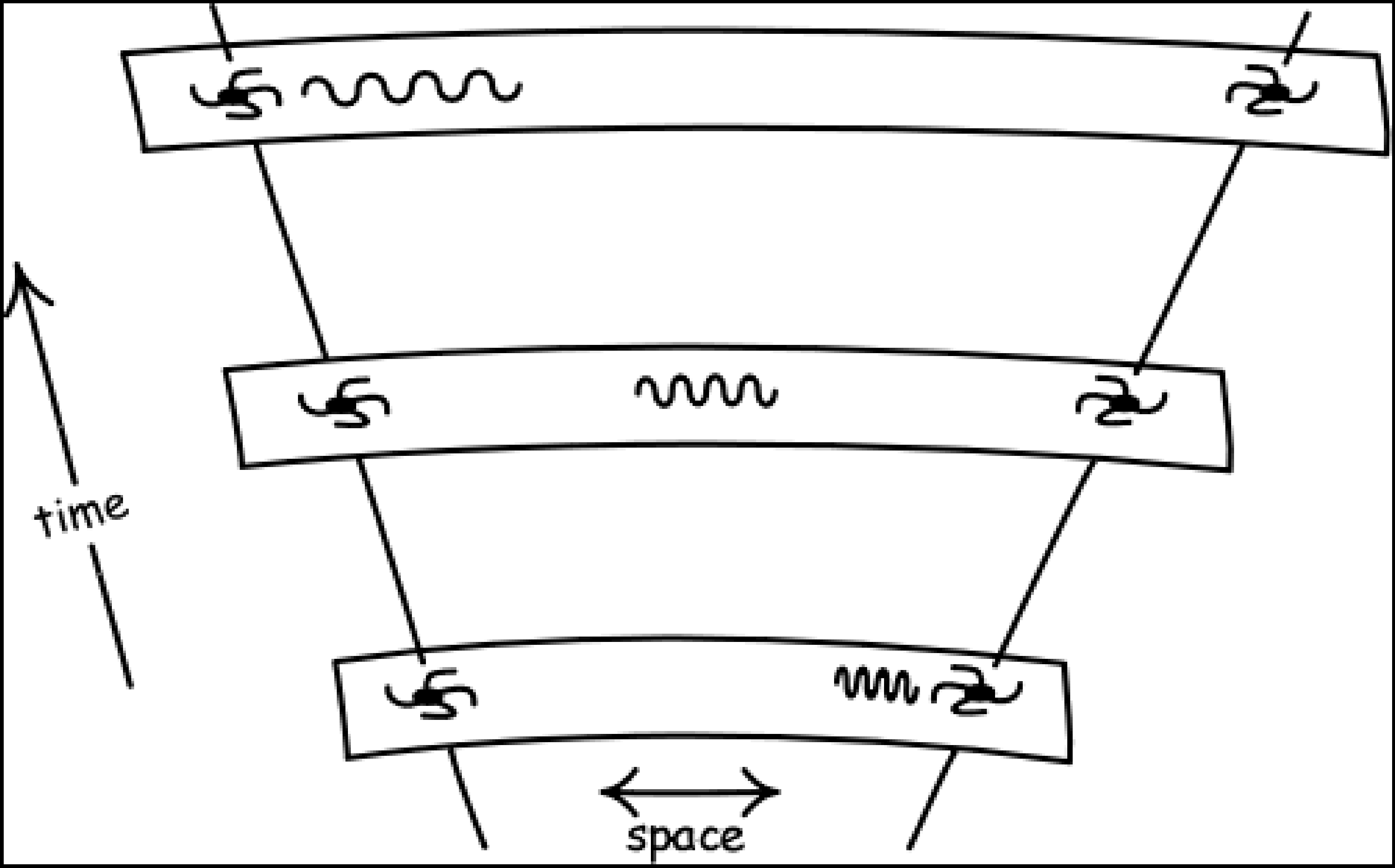
Universo en expansión: Redshift Cosmológico

Debido a la expansión del espacio



http://www.pitt.edu/~jdnorton/teaching/HPS_0410/chapters/big_ba

Universo en expansión: Redshift Cosmológico



Universo en expansión: Redshift Cosmológico

Parámetro de Hubble

$$H \equiv \frac{\dot{a}(t)}{a(t)}$$

Factor de escala

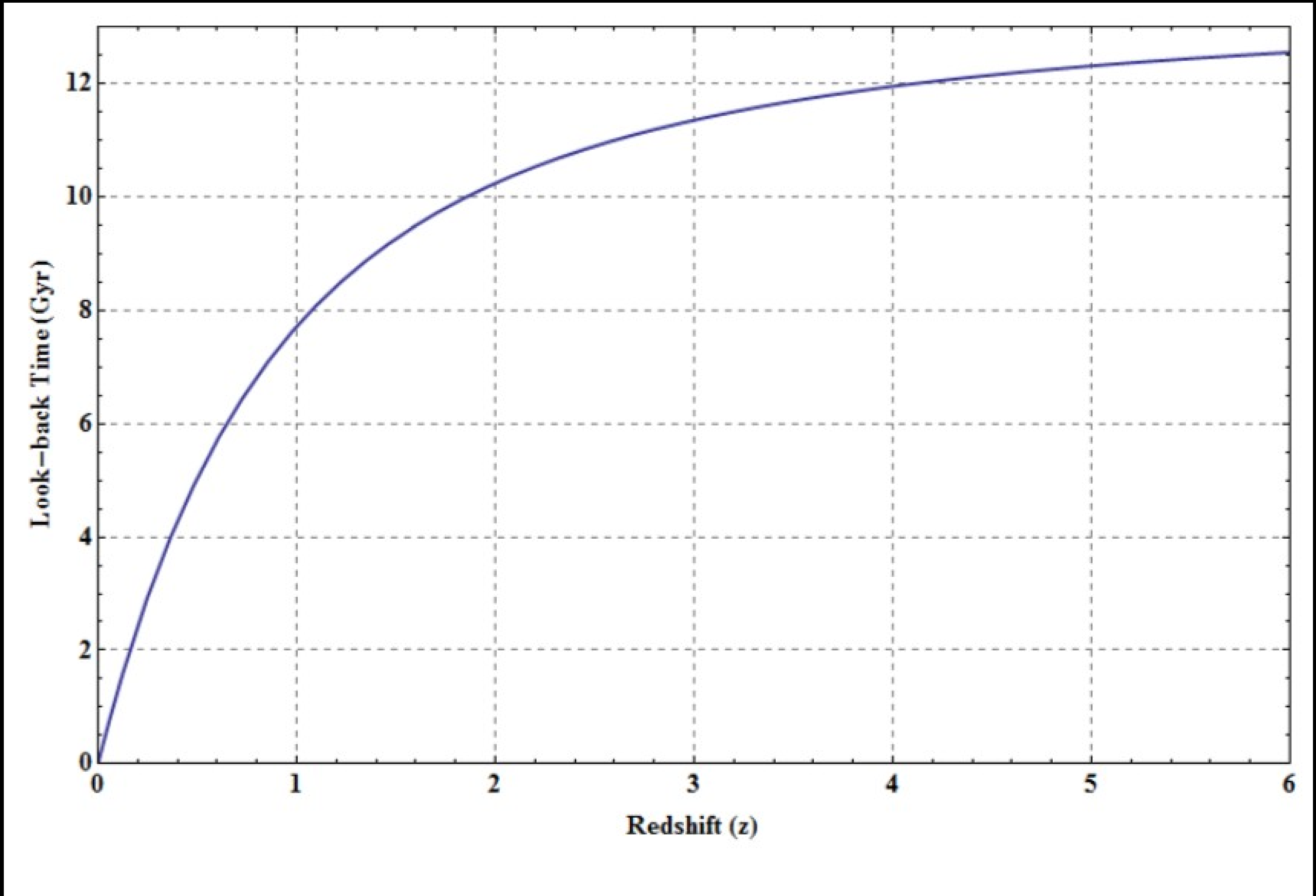
$$a(t) = \frac{1}{1+z}$$

Modelo Λ-CDM

$$\frac{H^2}{H_0^2} = \Omega_R a^{-4} + \Omega_M a^{-3} + \Omega_k a^{-2} + \Omega_\Lambda.$$

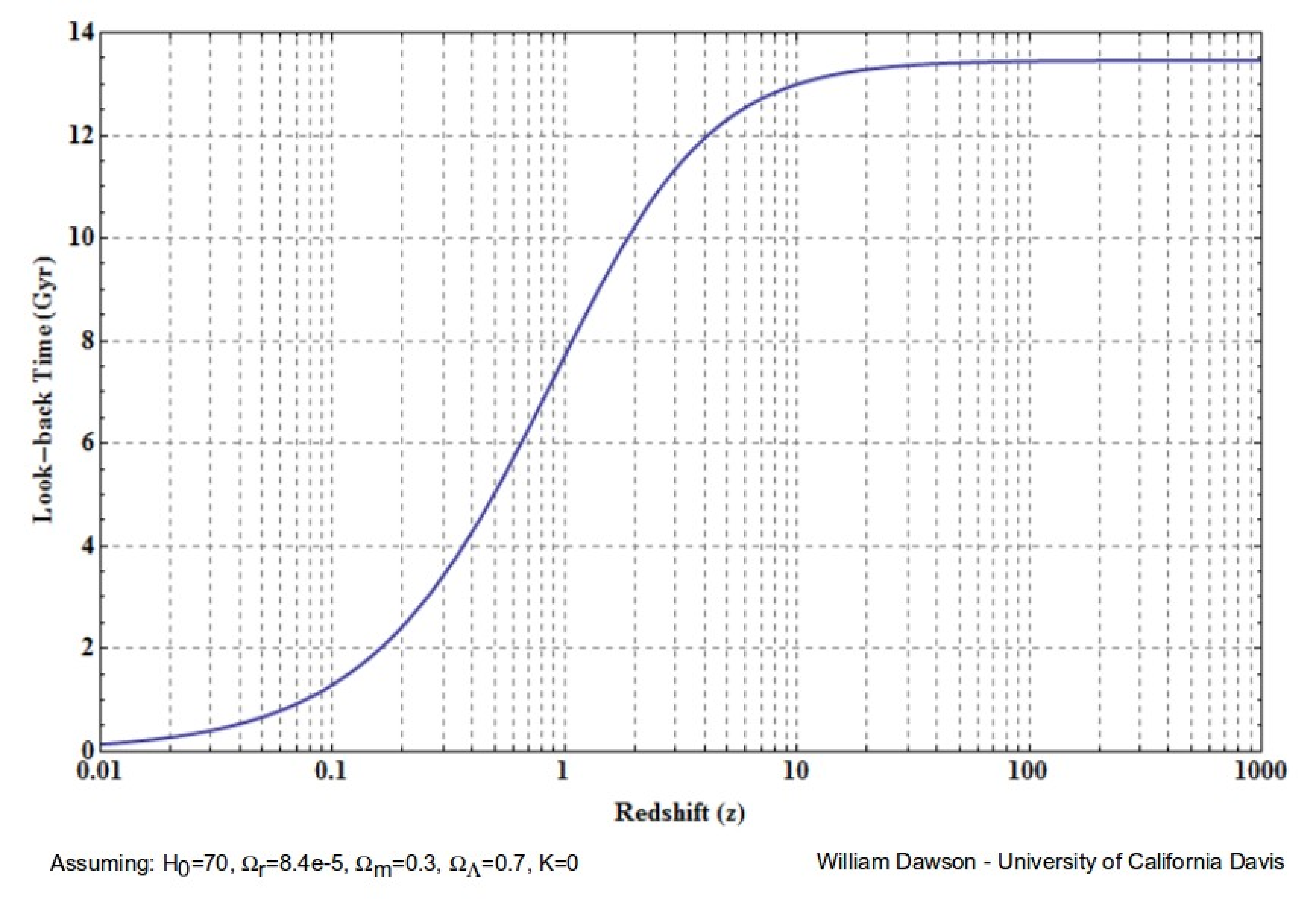
Tiempo VS. Redshift Cosmológico

$$t(z) = \frac{2}{3H_0{\Omega_0}^{1/2}(1+z)^{3/2}}$$



Tiempo VS. Redshift Cosmológico

$$t(z) = \frac{2}{3H_0{\Omega_0}^{1/2}(1+z)^{3/2}}$$



Tiempo VS. Redshift Cosmológico

$$t(z) = \frac{2}{3H_0\Omega_0{}^{1/2}(1+z)^{3/2}}$$

Edad actual del universo: $z = 0.0$

$$13.6 \times 10^{9}\ yr$$

Tiempo VS. Redshift Cosmológico

$$t(z) = \frac{2}{3H_0\Omega_0{}^{1/2}(1+z)^{3/2}}$$

Edad del universo con $z = 10.0$

$$0.54 \times 10^9\ yr$$

Tiempo VS. Redshift Cosmológico

$$t(z) = \frac{2}{3H_0\Omega_0^{1/2}(1+z)^{3/2}}$$

$0.54\times10^{9}\,yr$

$z = 10.0$

$13.6\times10^{9}\,yr$

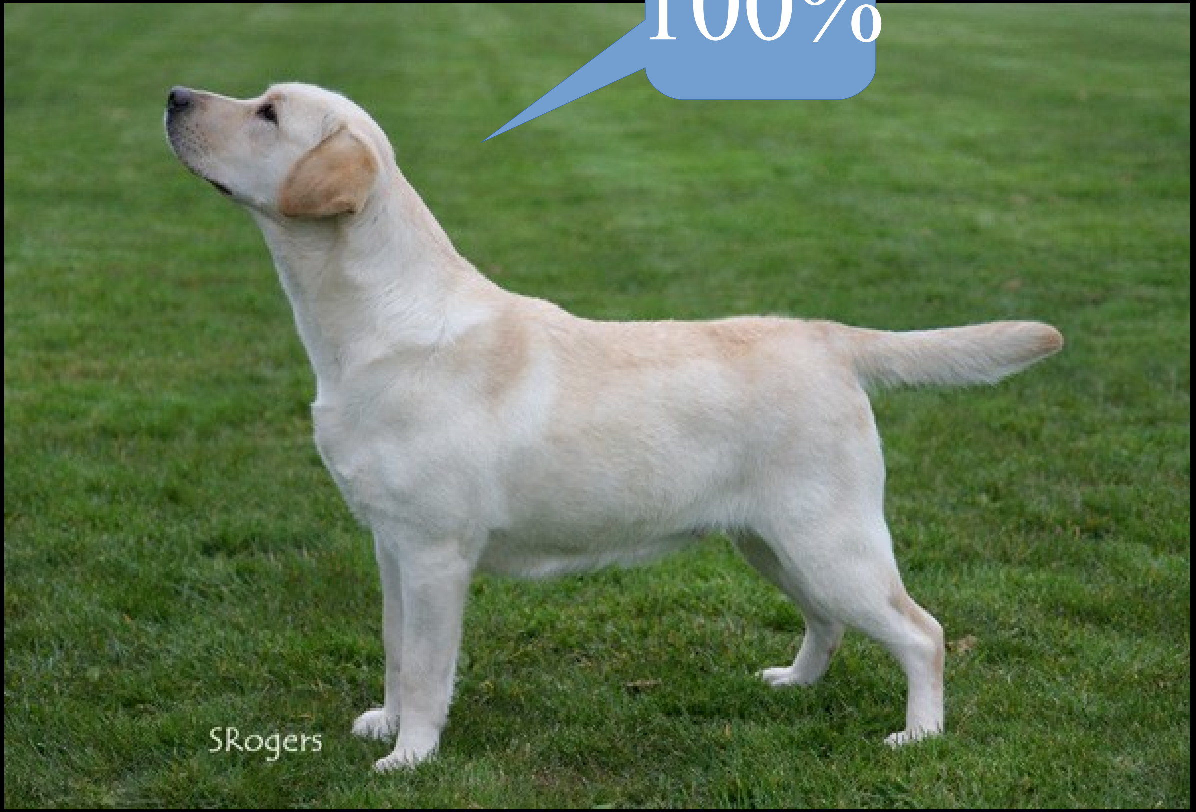
$z = 0.0$

Tiempo VS. Redshift Cosmológico

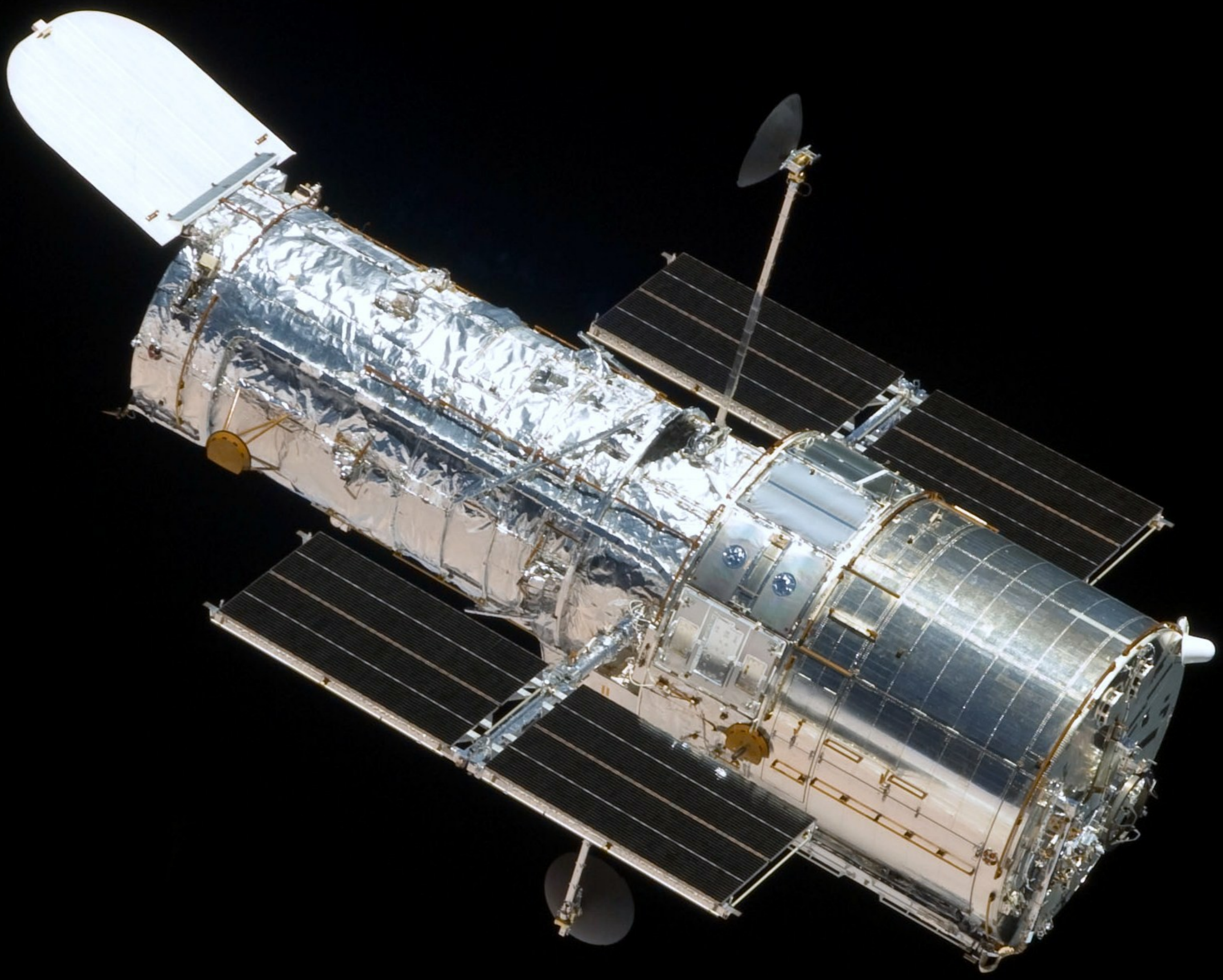
$$t(z) = \frac{2}{3H_0\Omega_0{}^{1/2}(1+z)^{3/2}}$$

4%

100%



Hubble Space Telescope

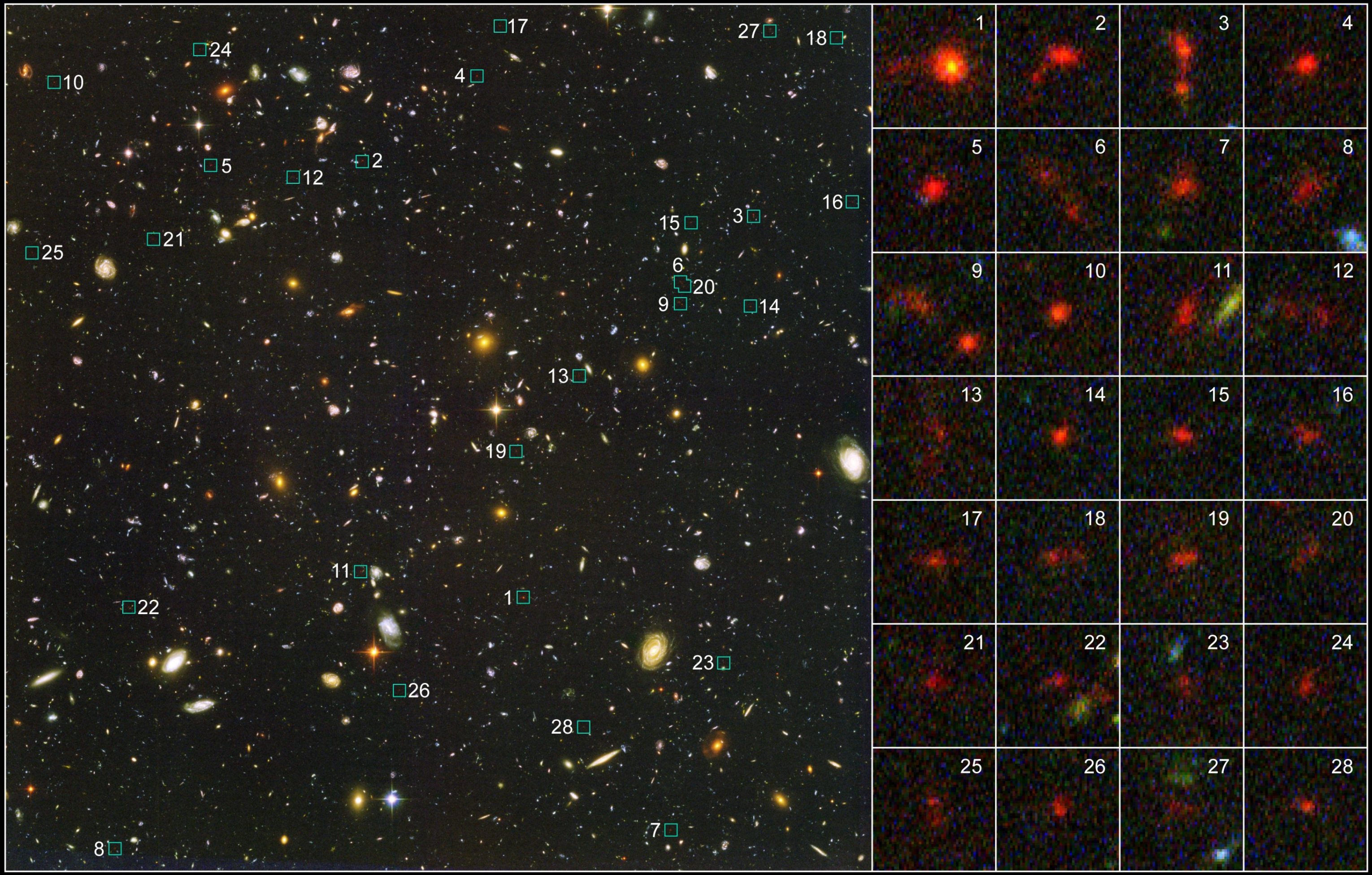


WFC3

WFC3

Wide Field Camera 3

Observaciones HUDF09

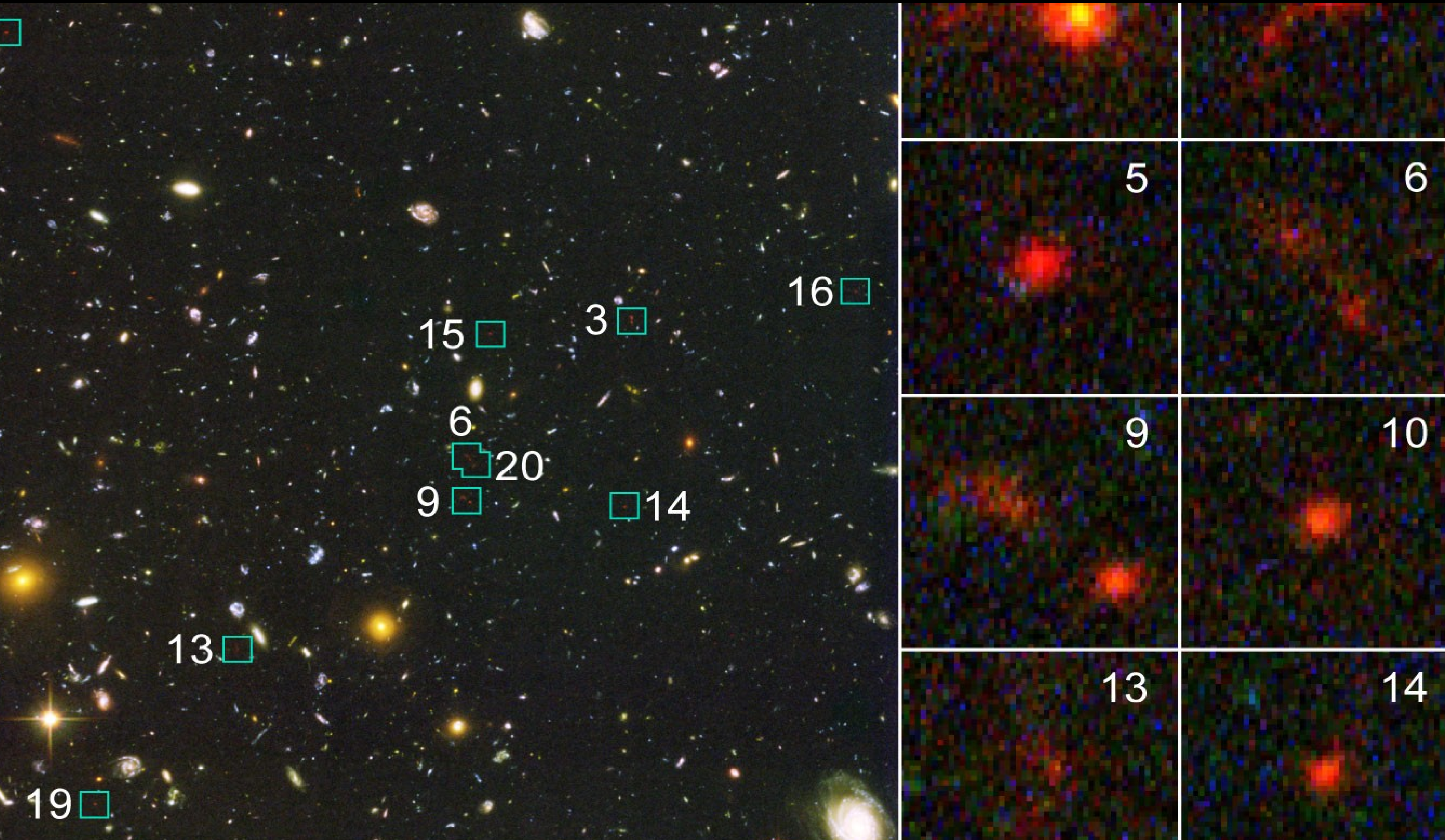


Distant Galaxies in the Hubble Ultra Deep Field
Hubble Space Telescope • Advanced Camera for Surveys

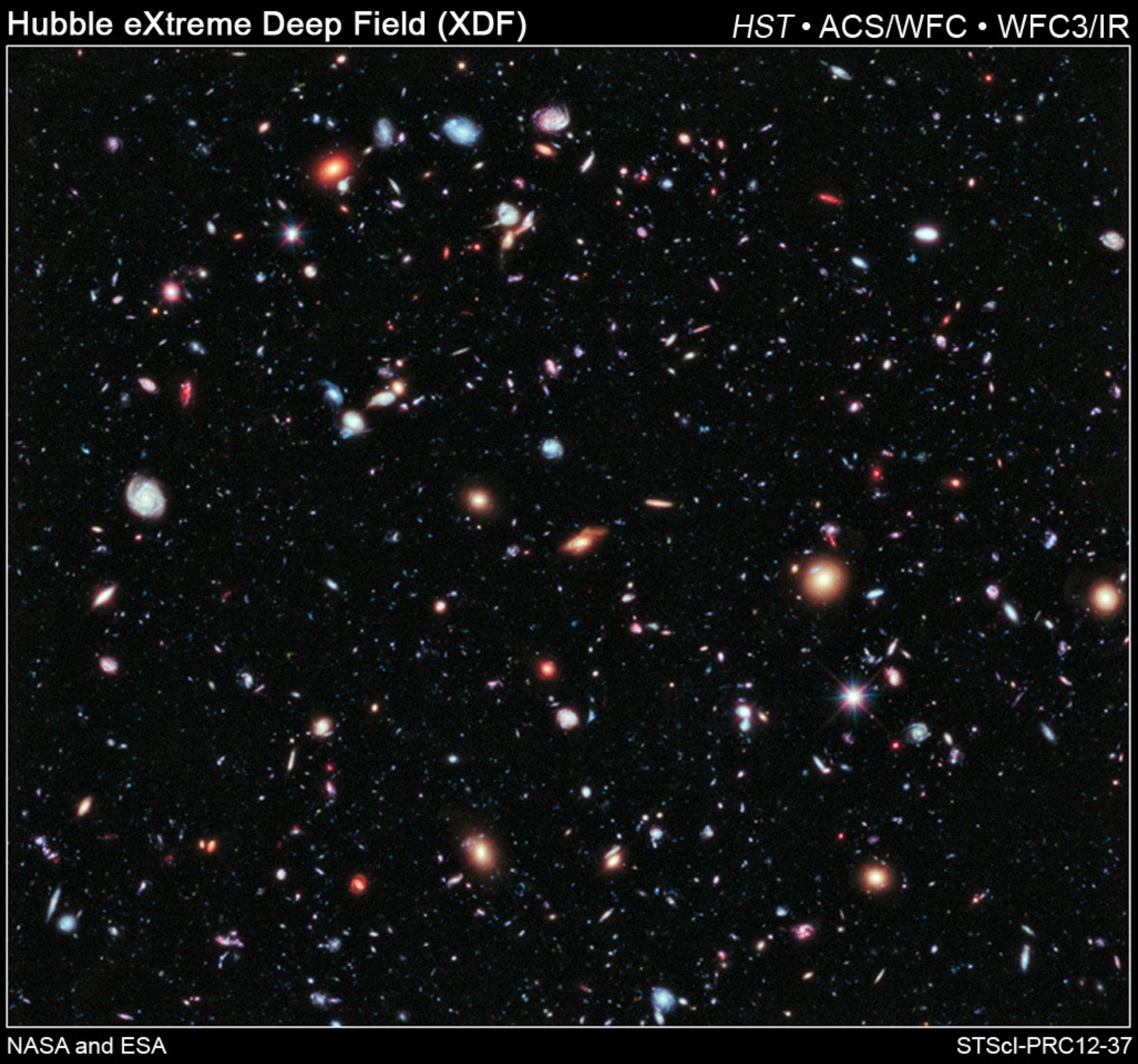
NASA, ESA, R. Bouwens and G. Illingworth (University of California, Santa Cruz)

STScI-PRC06-12

Observaciones HUDF09



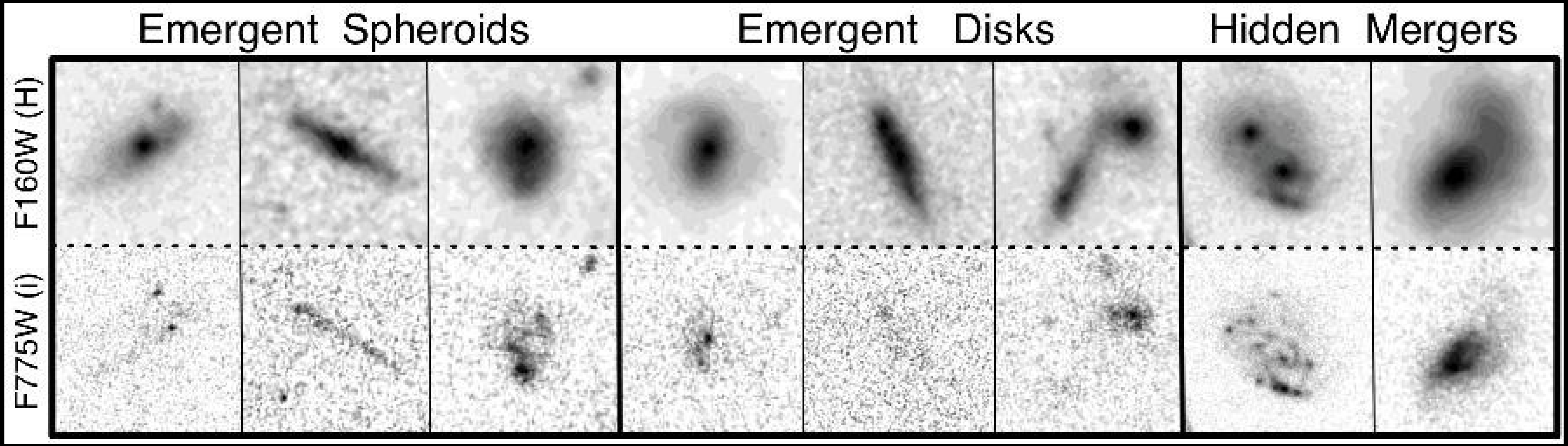
Observaciones HUDF09



CANDELS

Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey:

WFC3 (near IR) + ACS (visible)



NASA

HIPPIES

Hubble Infrared Pure Parallel Imaging Extragalactic Survey

utilizes long-duration pure parallel visits (~> 3 orbits) of HST at high Galactic latitude (|b|>20o) to take deep, multi-band images in WFC3 (since Cycle 17) and in ACS (starting Cycle 18). It is unique in its large number of descrete fields along random sightlines, and thus is complementary to other surveys over contiguous fields but along limited sightlines.

NASA

SUBARU

National Astronomical Observatory of Japan

8m

CFHT

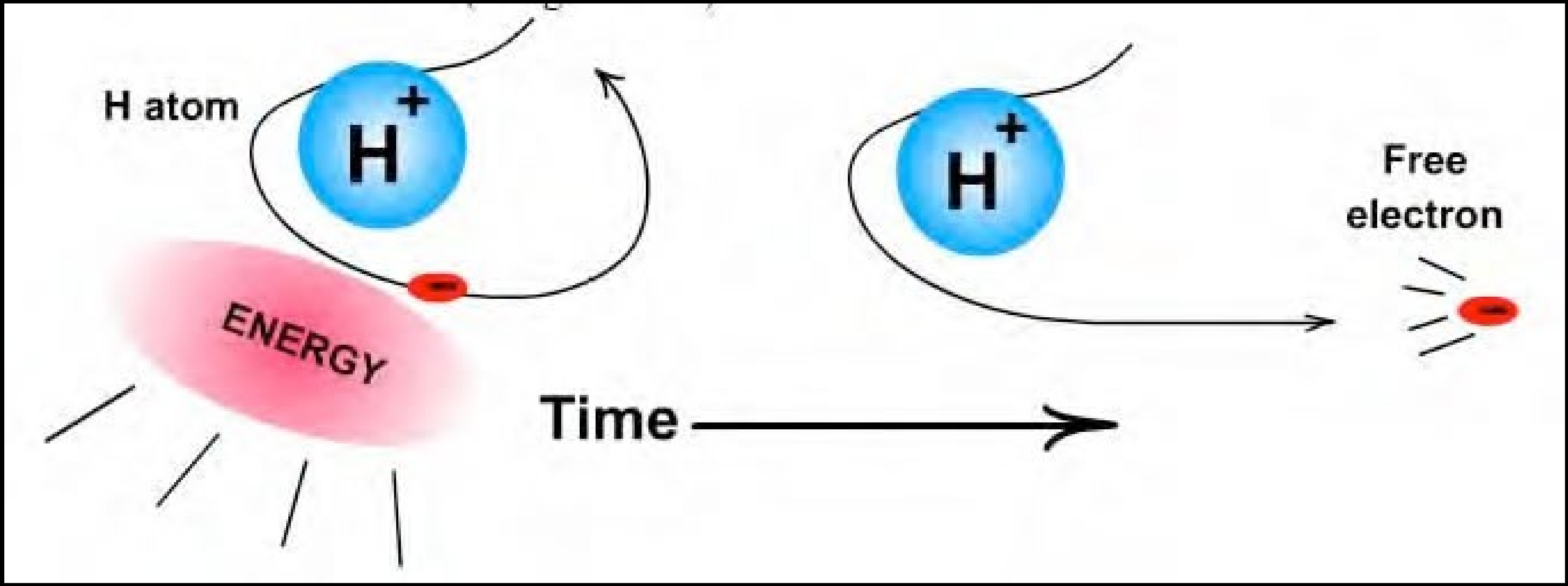
Canada
France
Hawaii
Telescope

4m

Drop-outs Technique

Energía de ionización del hidrógeno neutro: 13.6 eV

Longitud de onda: 912Å



Drop-outs Technique

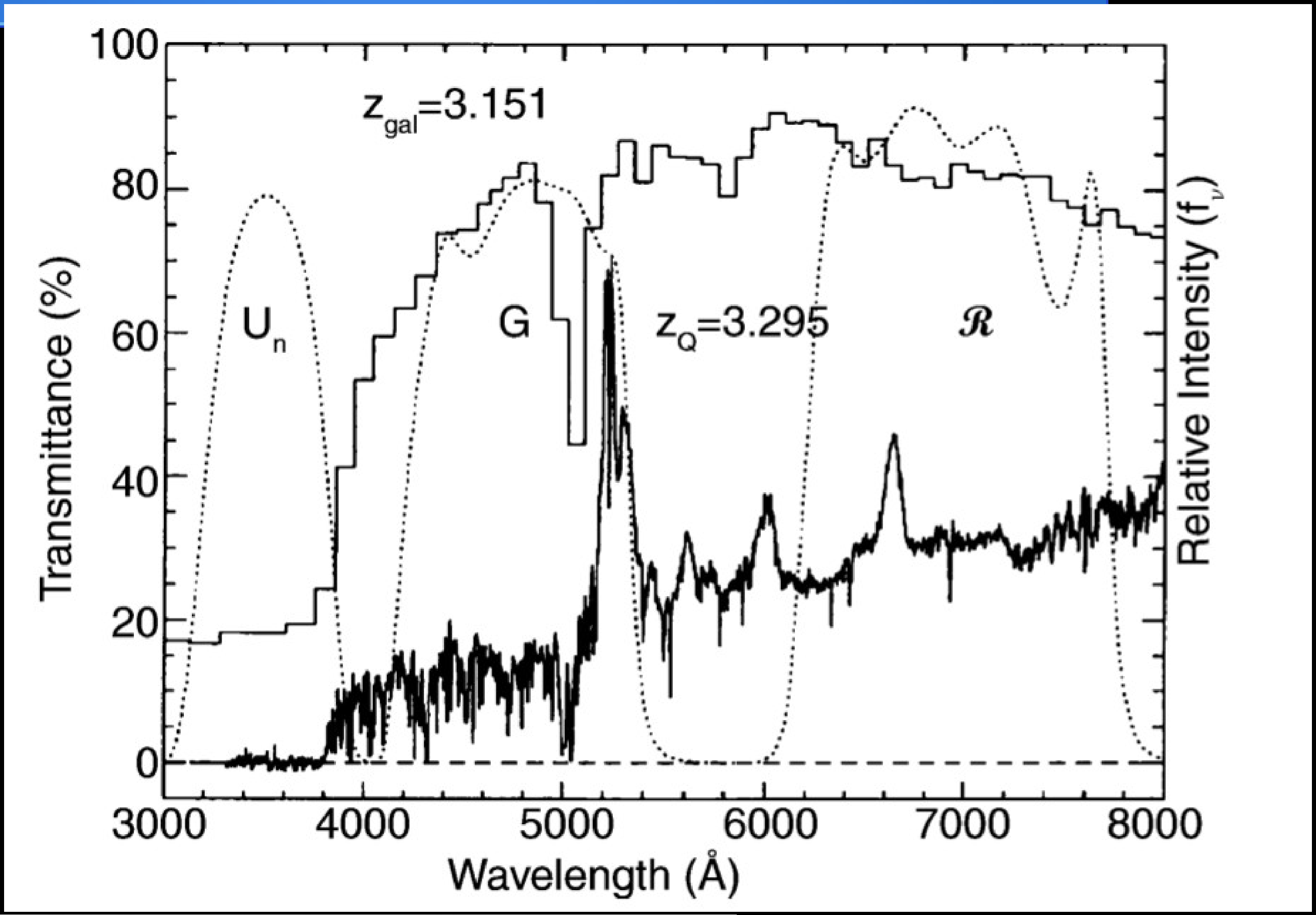


Fig. 9.2. Principle of the Lyman-break method. The histogram shows the synthetic spectrum of a galaxy at $z = 3.15$, generated by models of population synthesis; the spectrum belongs to a QSO at slightly higher redshift. Clearly, the decline of the spectrum at $\lambda \leq 912(1+z)$Å is noticeable. The three dotted curves are the transmission curves of three broad-band filters,

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Drop-outs Technique

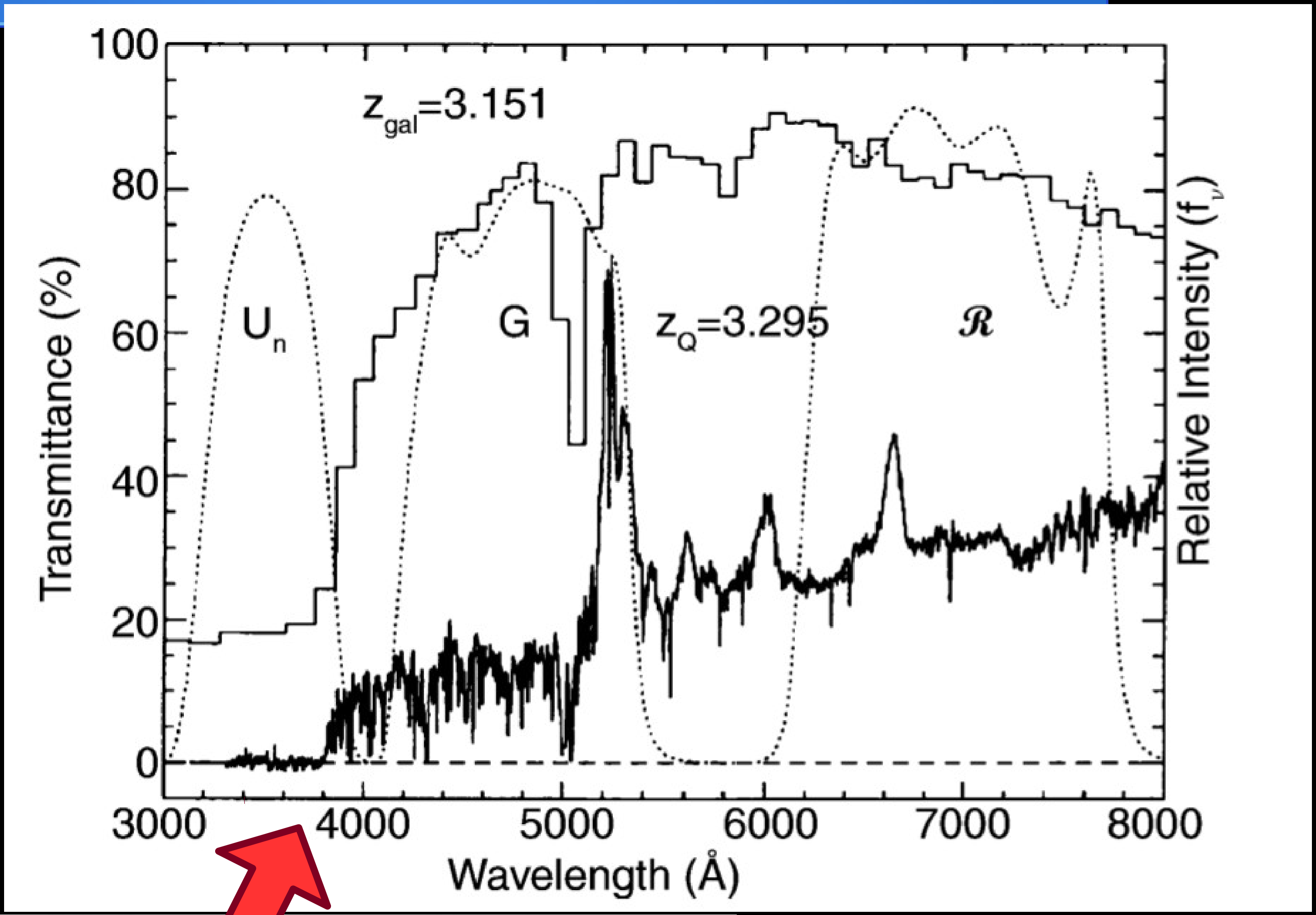

Fig. 9.2. Principle of the Lyman[illegible]eak method. The histogram shows the synthetic spectrum [illegible]a galaxy at $z = 3.15$, generated by models of populatio[illegible]nthesis; the spectrum belongs to a QSO at slightly higher re[illegible]shift. Clearly, the decline of the spectrum at $\lambda \leq 912(1+z)$Å is noticeable. The three dotted curves are the transmission curves of three broad-band filters,

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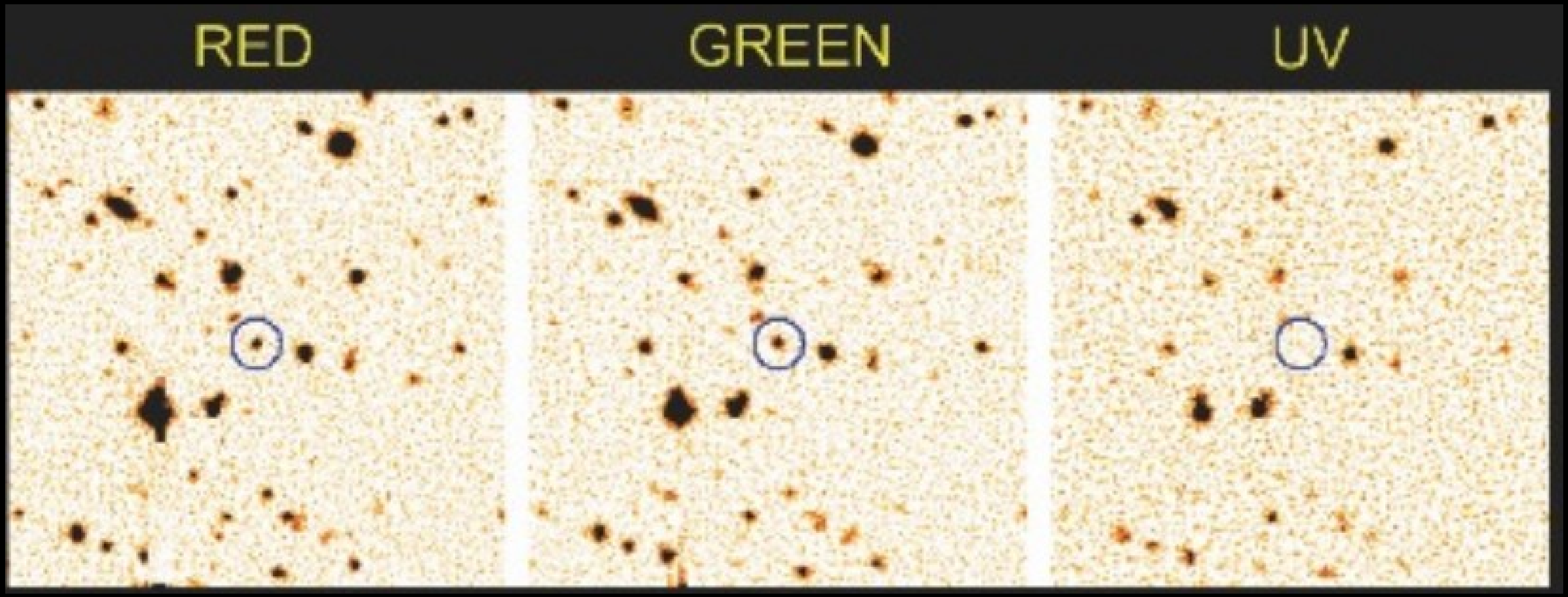
Drop-outs Technique



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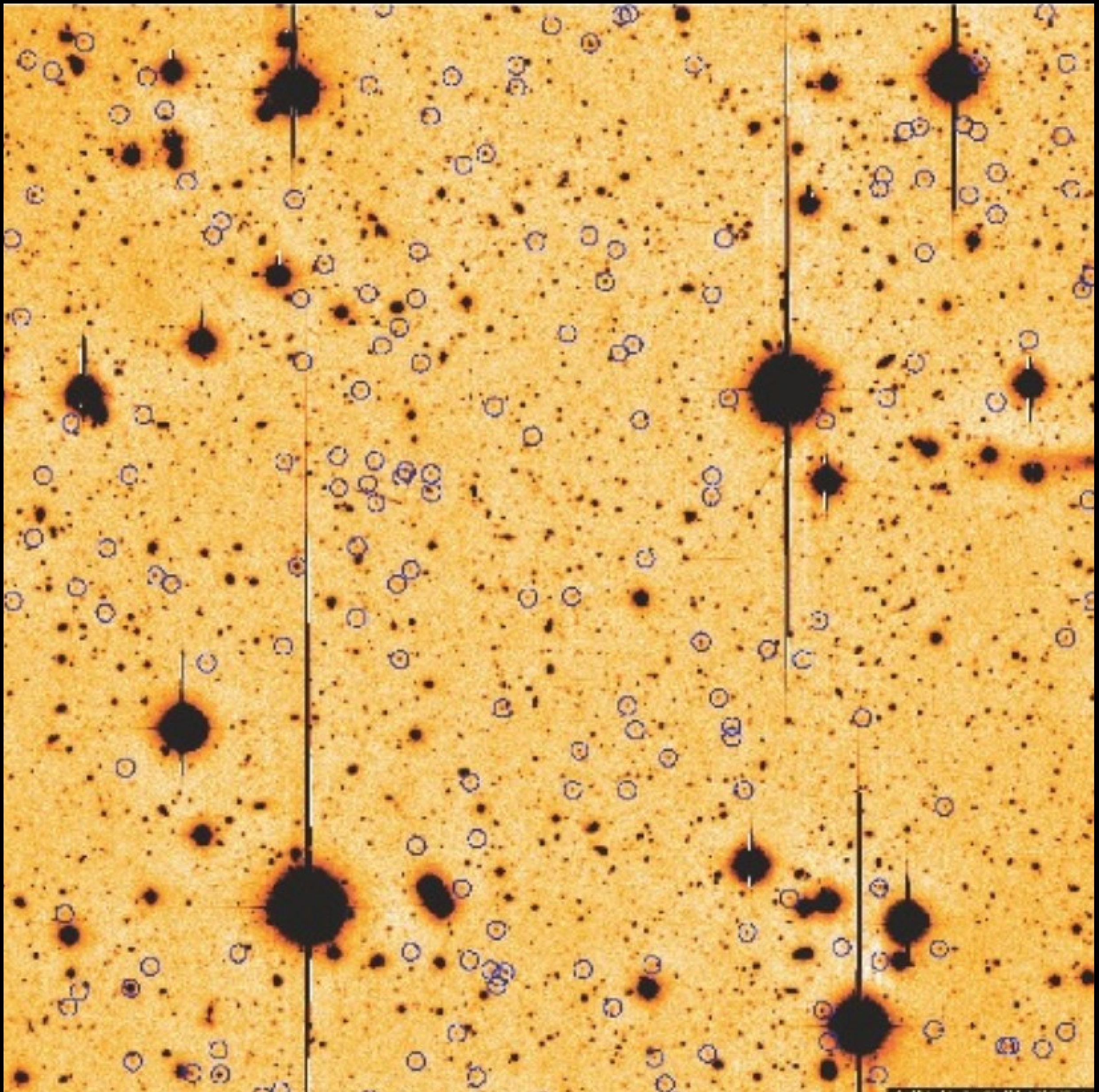
Drop-outs Technique



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The Data

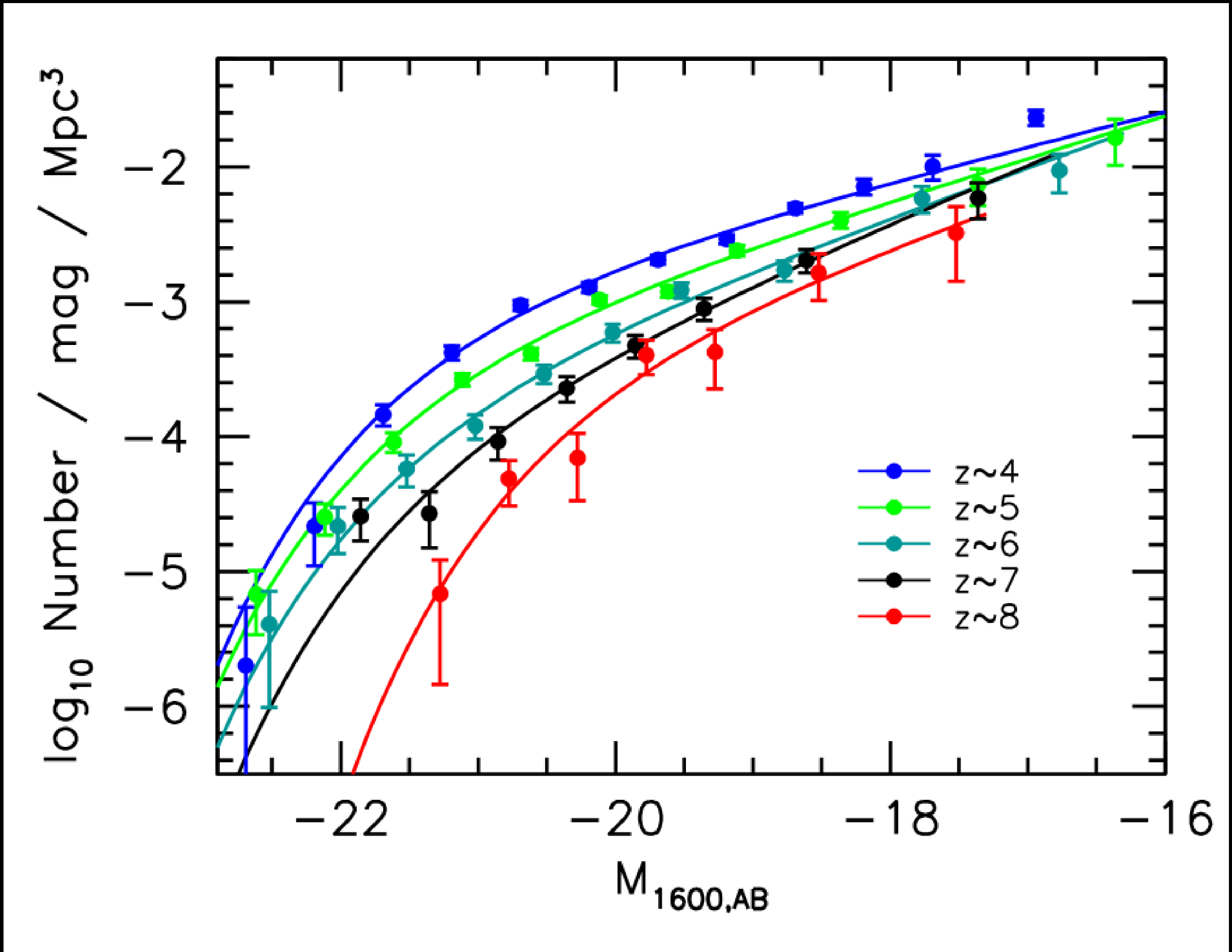
TABLE 2
TOTAL NUMBER OF SOURCES IN OUR $z \sim 4$, $z \sim 5$, $z \sim 6$, $z \sim 7$, $z \sim 8$, AND $z \sim 10$ SAMPLES USED IN DERIVING THE PRESENT HIGH-REDSHIFT LFs.

Field	Area (arcmin^2)	$z \sim 4$ #	$z \sim 5$ #	$z \sim 6$ #	$z \sim 7$ #	$z \sim 8$ #	$z \sim 10$ #
HUDF/XDF	4.7	362	151	102	66	34	2
HUDF09-1	4.7	—	93	38	28	20	0
HUDF09-2	4.7	147	83	36	25	15	0
CANDELS-SOUTH-DEEP	64.5	1644	545	206	104	34	1
CANDELS-SOUTH-WIDE	34.2	453	135	46	9	3	0
ERS	40.5	762	209	62	55	9	0
CANDELS-NORTH-DEEP	68.3	1723	742	194	173	52	2
CANDELS-NORTH-WIDE	65.4	900	323	80	44	22	1
CANDELS-UDS	151.2	—	309	46	21	6	0
CANDELS-COSMOS	151.9	—	353	62	18	7	0
CANDELS-EGS	150.7	—	448	68	55[a]	—	0
BORG/HIPPIES	218.3	—	—	—	—	23	0
Total	959.1	5991	3391	940	598	225	6

[a] Some of the candidate $z \sim 7$ galaxies in the CANDELS-EGS fields could correspond to $z \sim 8$ galaxies.

Bouwens et al.
arXiv:1403.4295

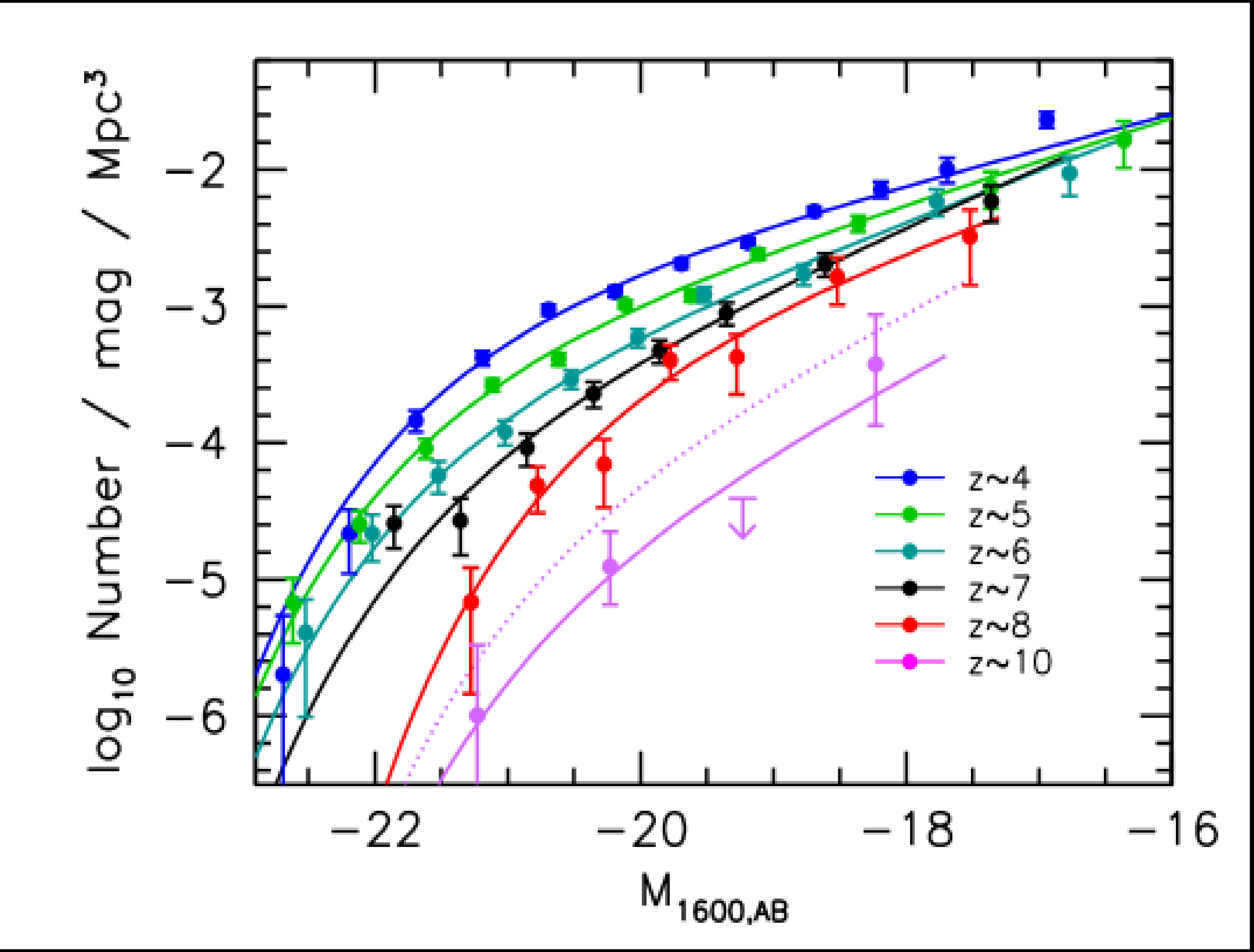
Luminosity Functions



Schechter Function

Bouwens et al.
arXiv:1403.4295

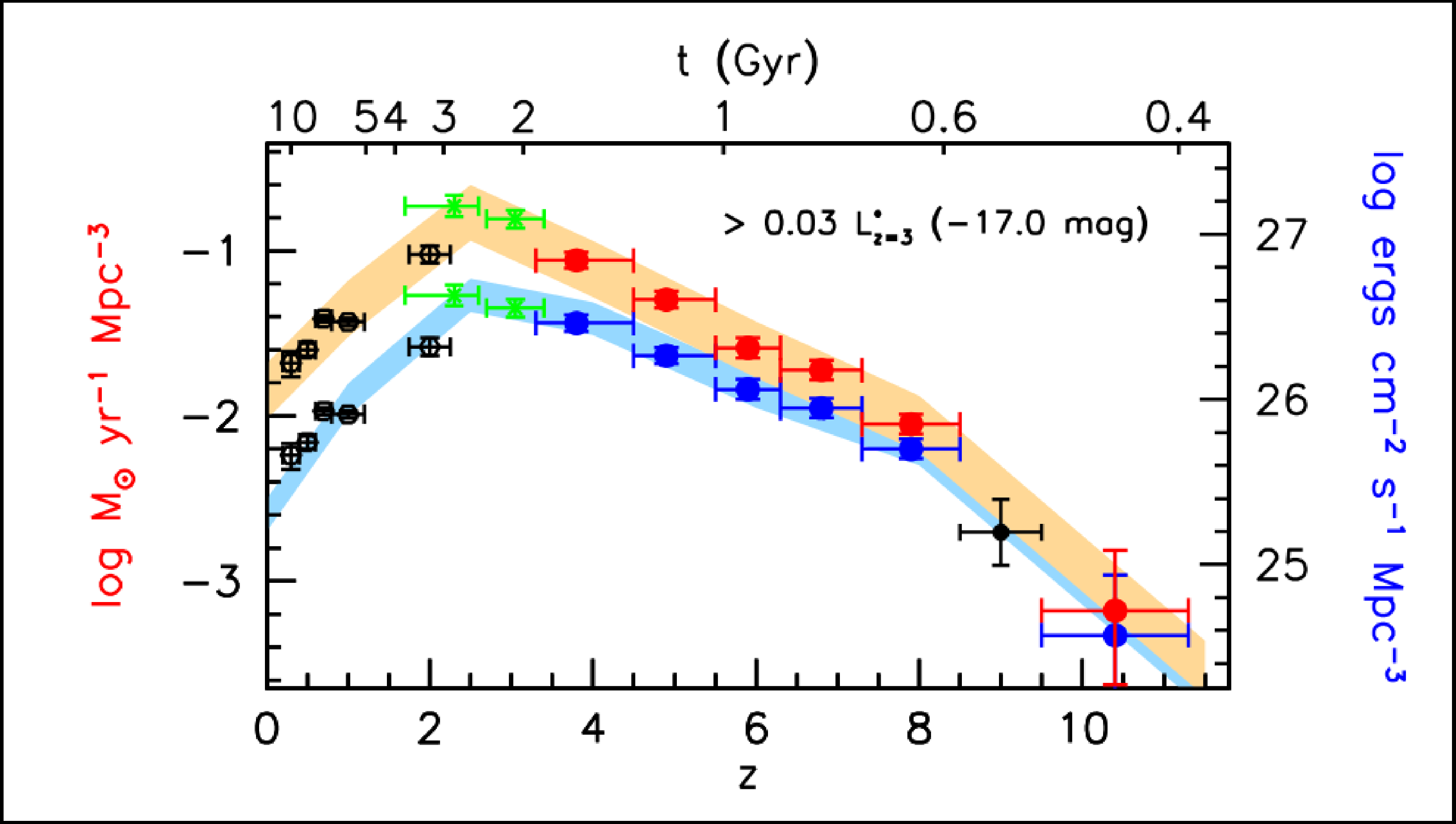
Luminosity Functions



Schechter Function

Bouwens et al.
arXiv:1403.4295

Star Formation Rate



Bouwens et al.
arXiv:1403.4295

Resumen

- Se observaron galaxias a distintos redshift (4-10)
- Construcción de funciones de luminosidad
- Estimación de la tasa de formación estelar