Galaxias Infrarrojas Ultraluminosas

fuego, polvo y humo

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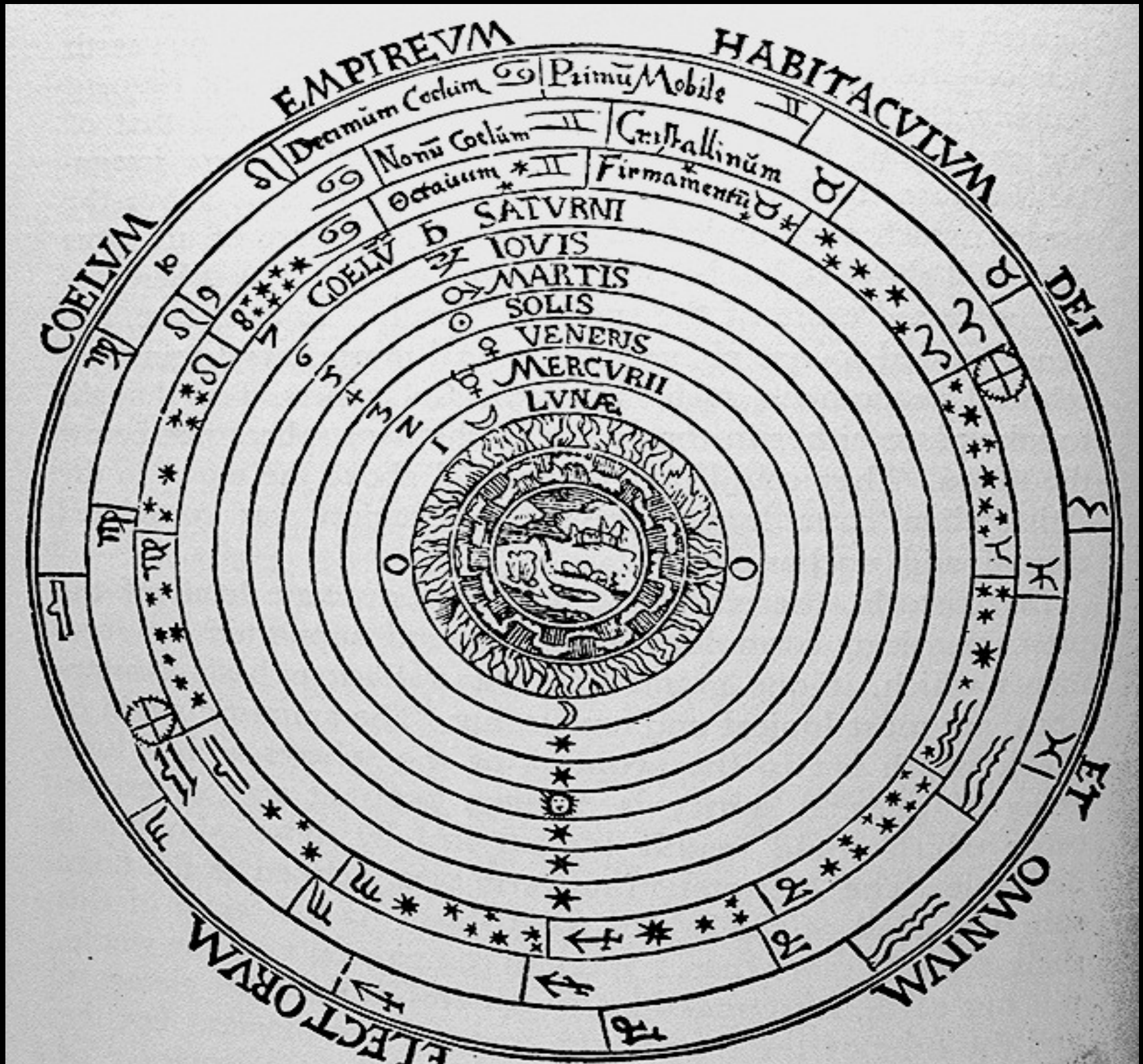
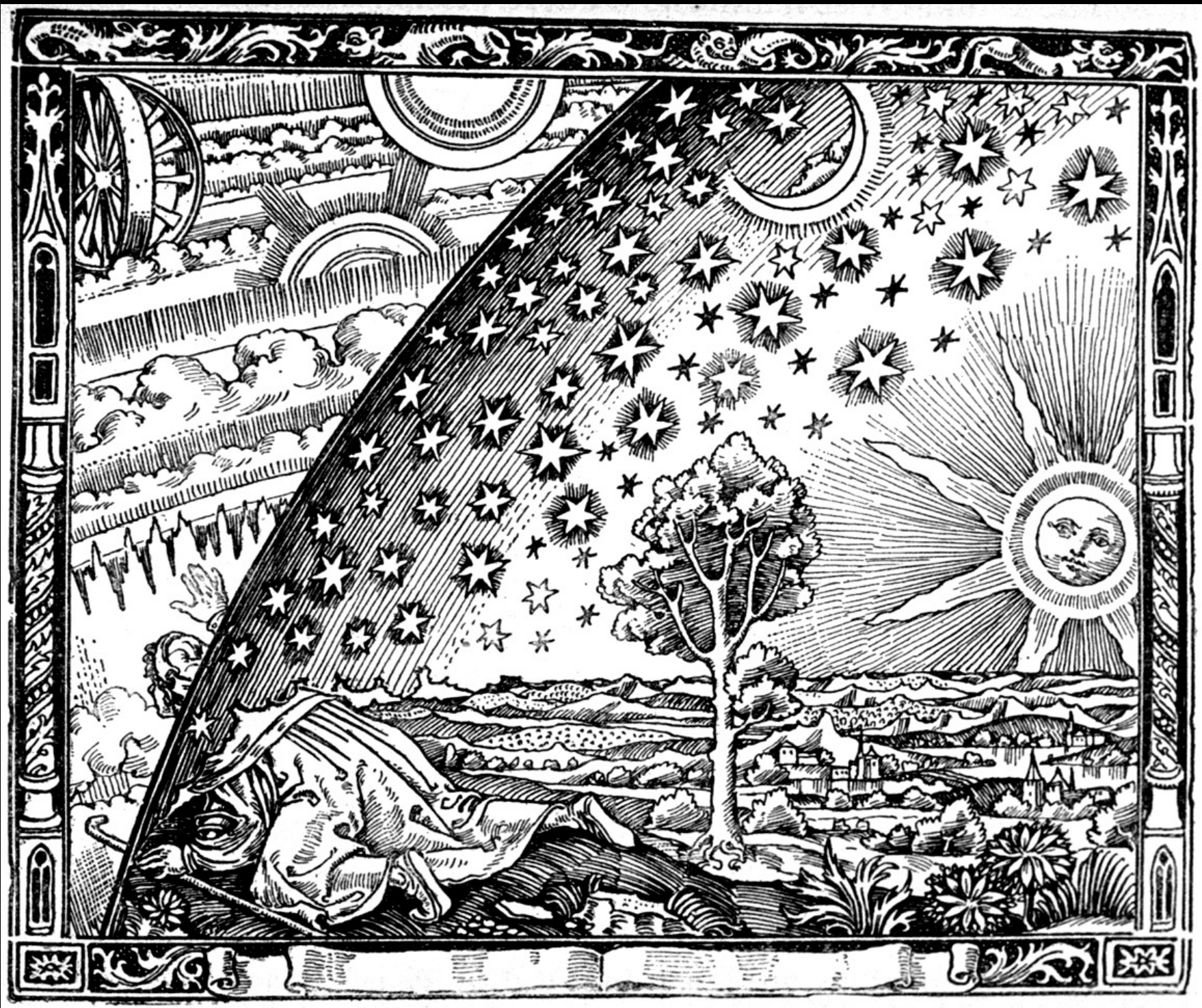
Departamento de Astronomía Molecular e Infrarroja

17 noviembre 2009 Instituto de Estructura de la Materia CSIC

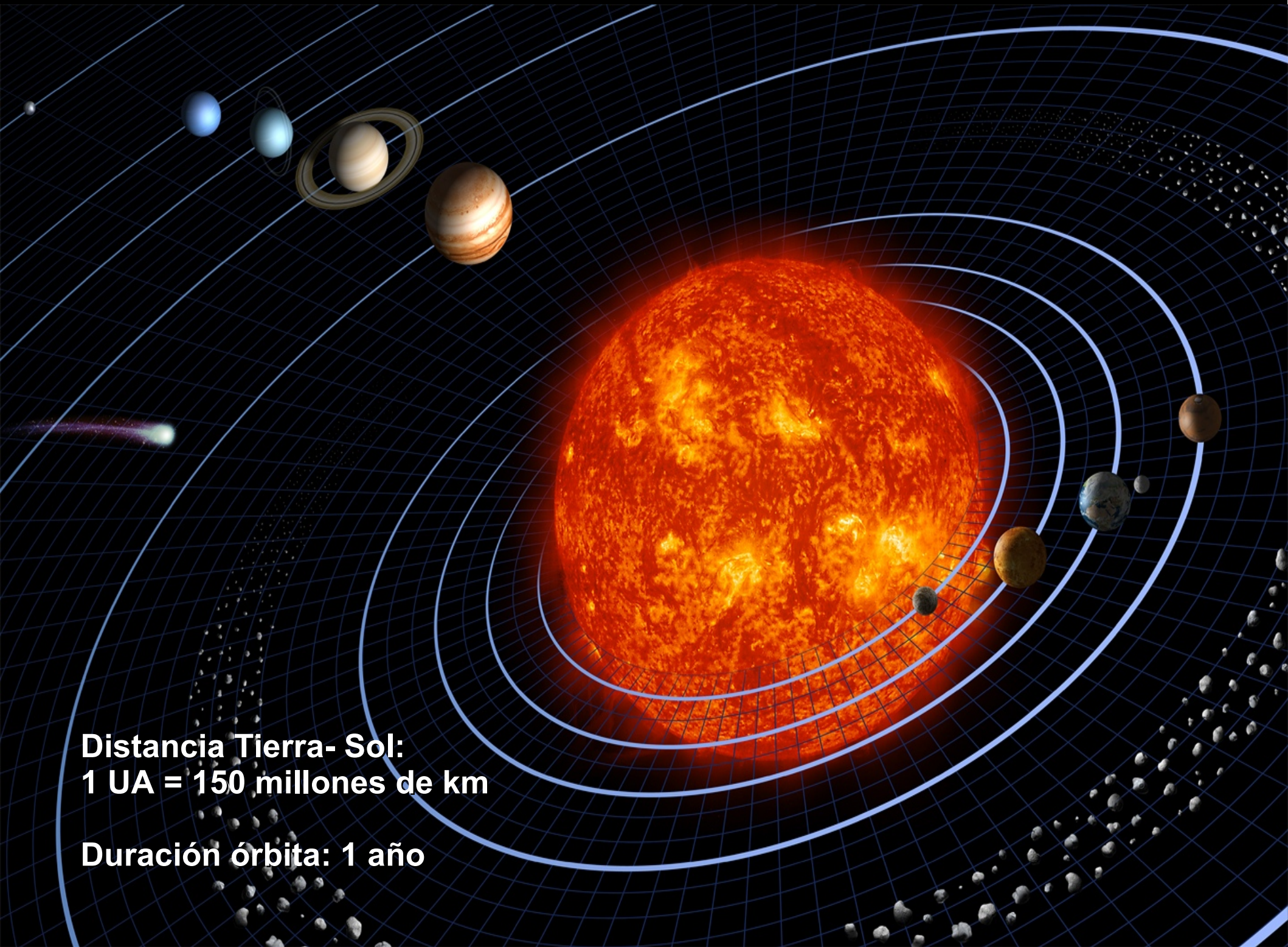
THE UNIVERSE YOURS TO DISCOVER

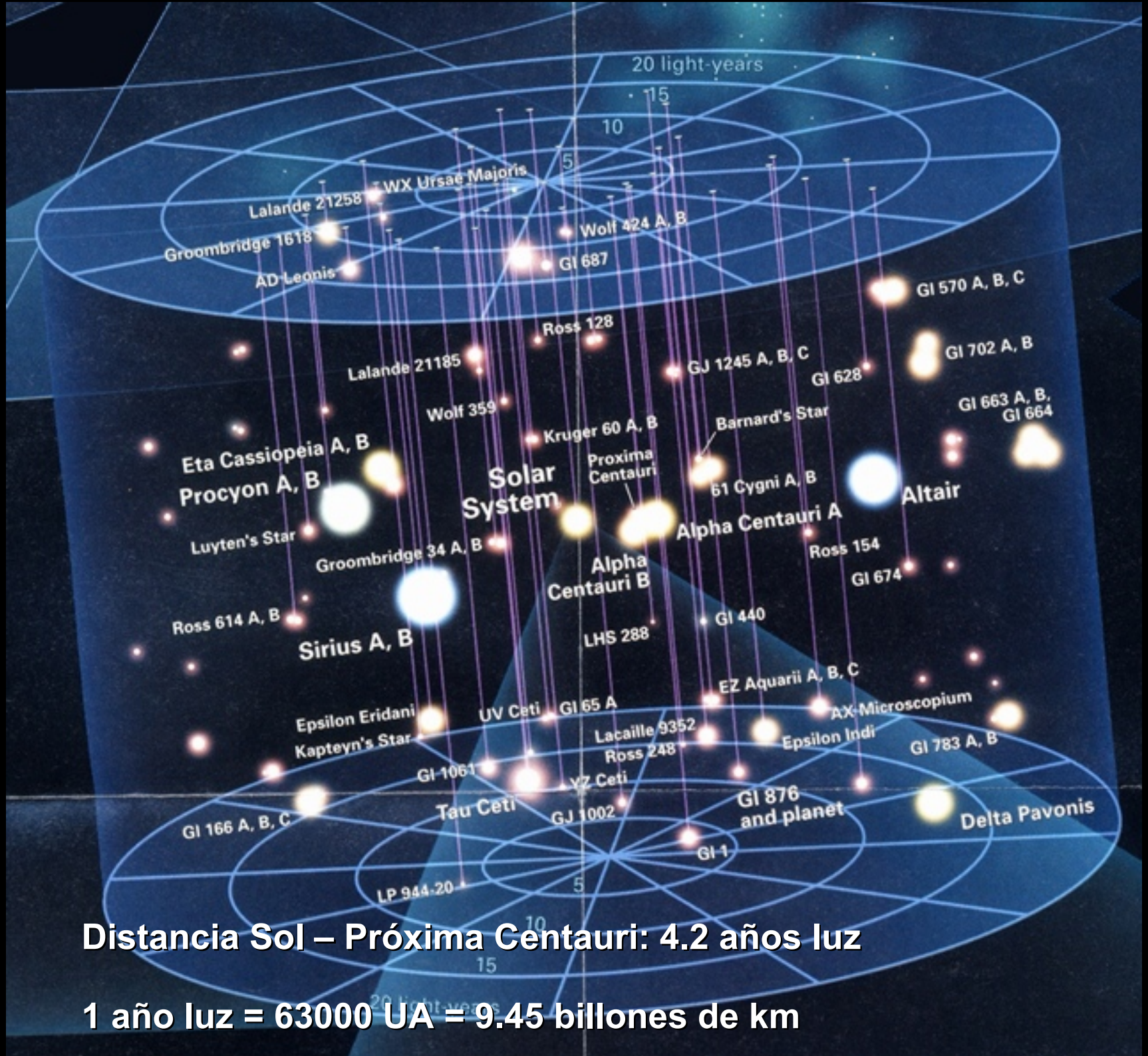
INTERNATIONAL YEAR OF ASTRONOMY


EMPIREVM
HABITACVLVM
DEI
ET
OMNIVM
ELECTORVM
COELVM
Primũ Mobile
Crystallinũ
Firmamentũ
Octauum
Nonũ Coelũ
Decimũ Coelum
COELV
SATVRNI
IOVIS
MARTIS
SOLIS
VENERIS
MERCVRII
LVNÆ



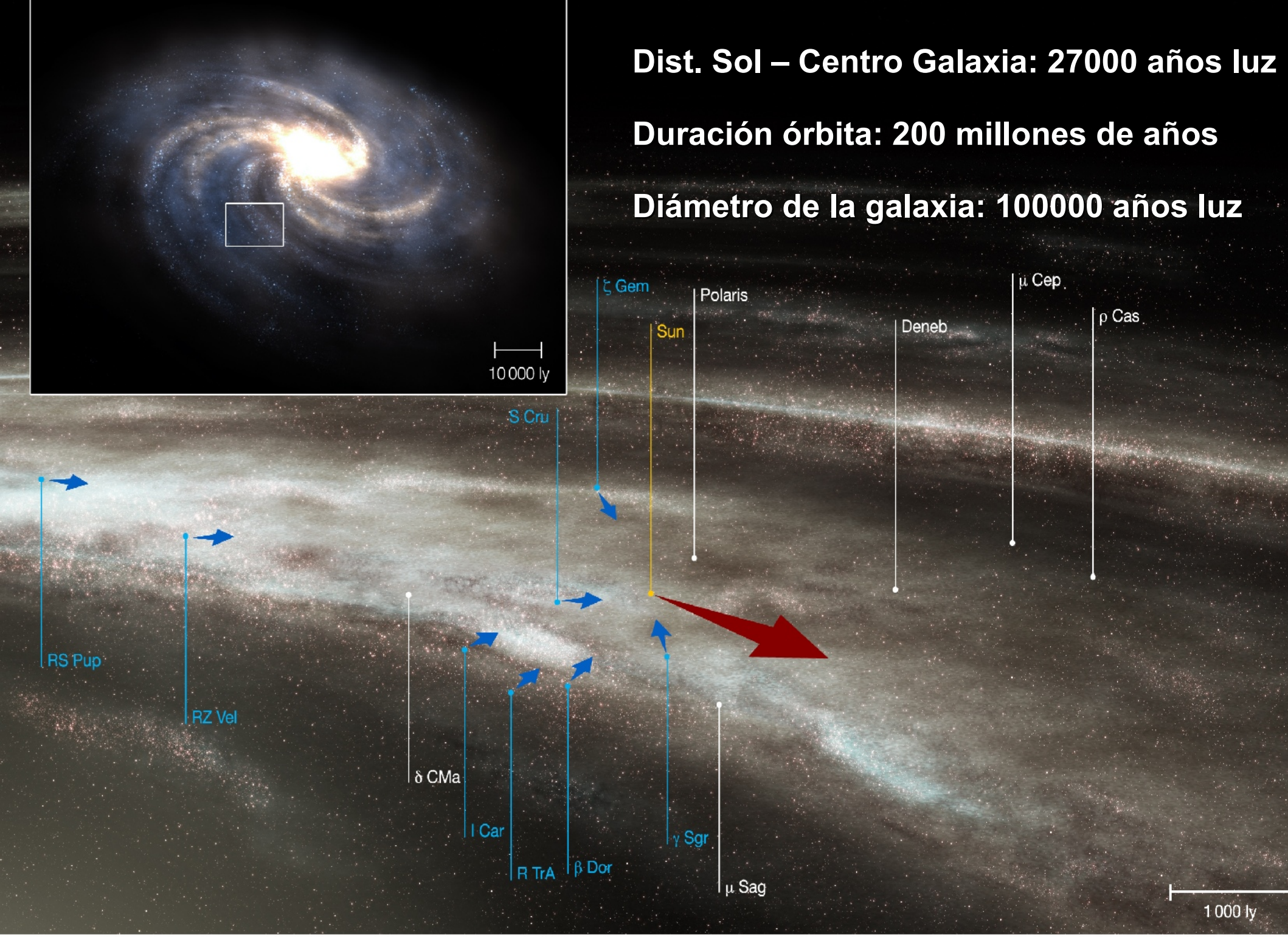
Un missionnaire du moyen âge raconte qu'il avait trouvé le point
où le ciel et la Terre se touchent...

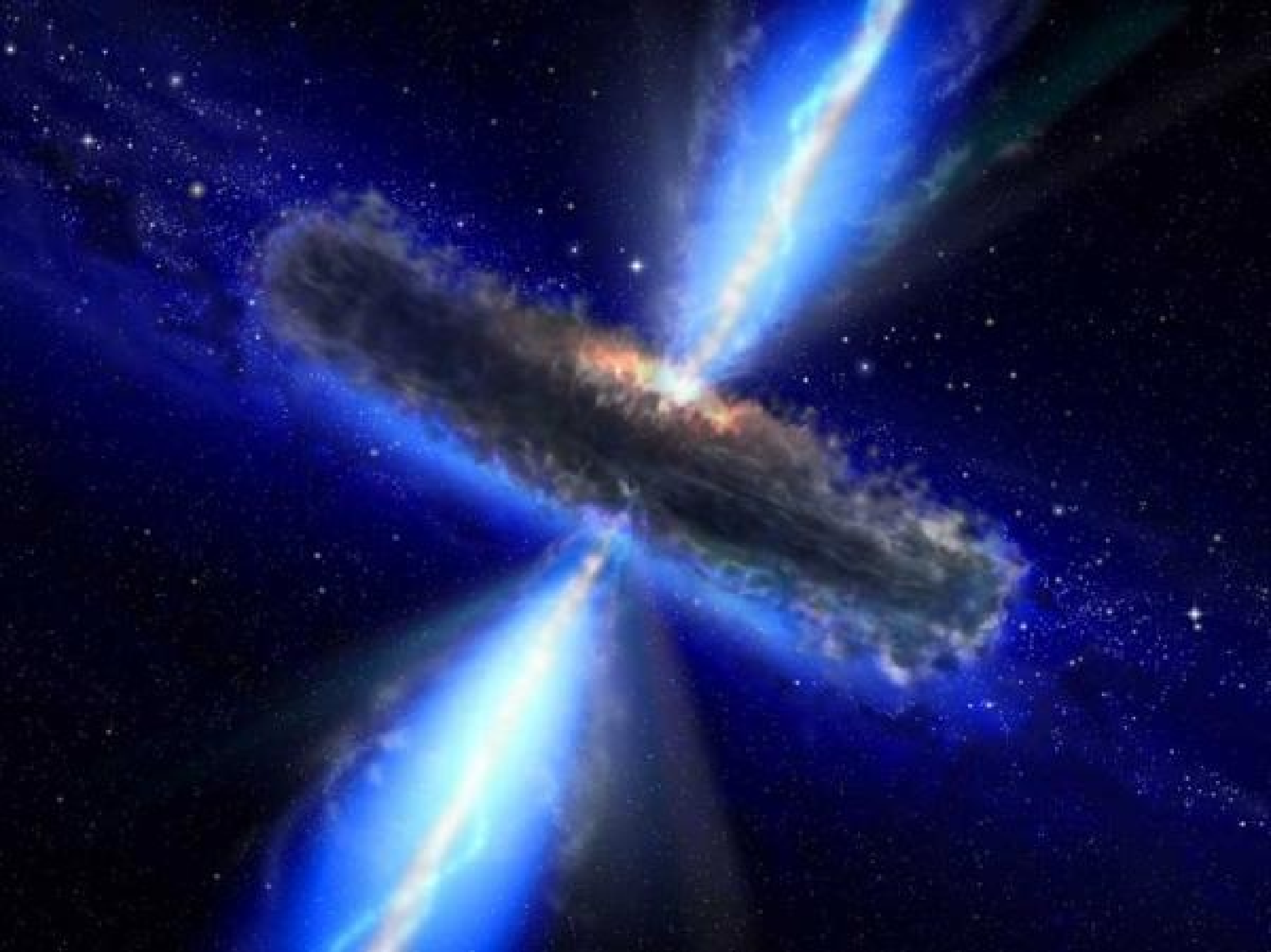

Distancia Tierra- Sol:
1 UA = 150 millones de km
Duración órbita: 1 año

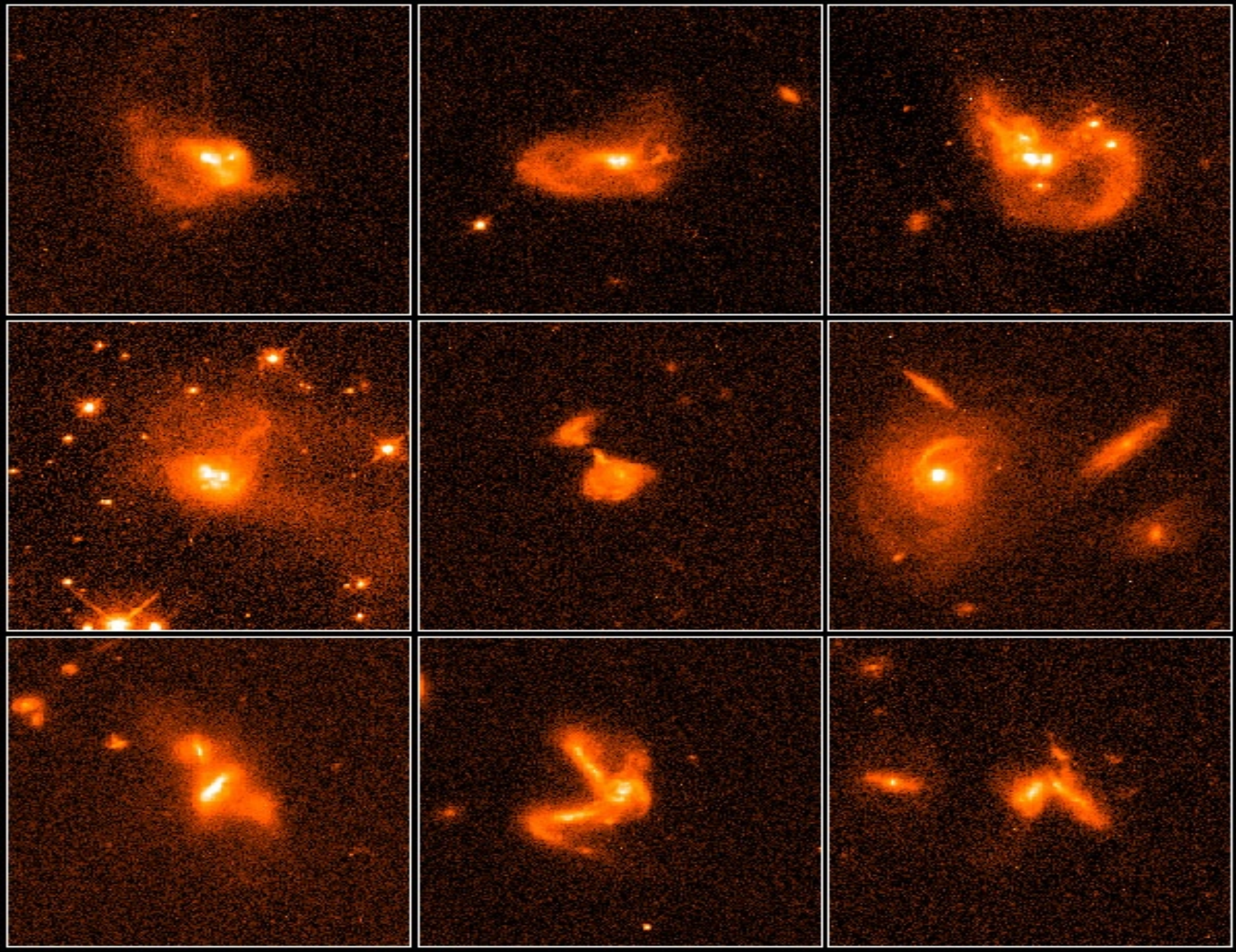


Distancia Sol – Próxima Centauri: 4.2 años luz

1 año luz = 63000 UA = 9.45 billones de km


Dist. Sol – Centro Galaxia: 27000 años luz
Duración órbita: 200 millones de años
Diámetro de la galaxia: 100000 años luz
10 000 ly
ζ Gem
Polaris
Sun
Deneb
μ Cep
ρ Cas
S Cru
RS Pup
RZ Vel
δ CMa
l Car
R TrA
β Dor
γ Sgr
μ Sag
1 000 ly

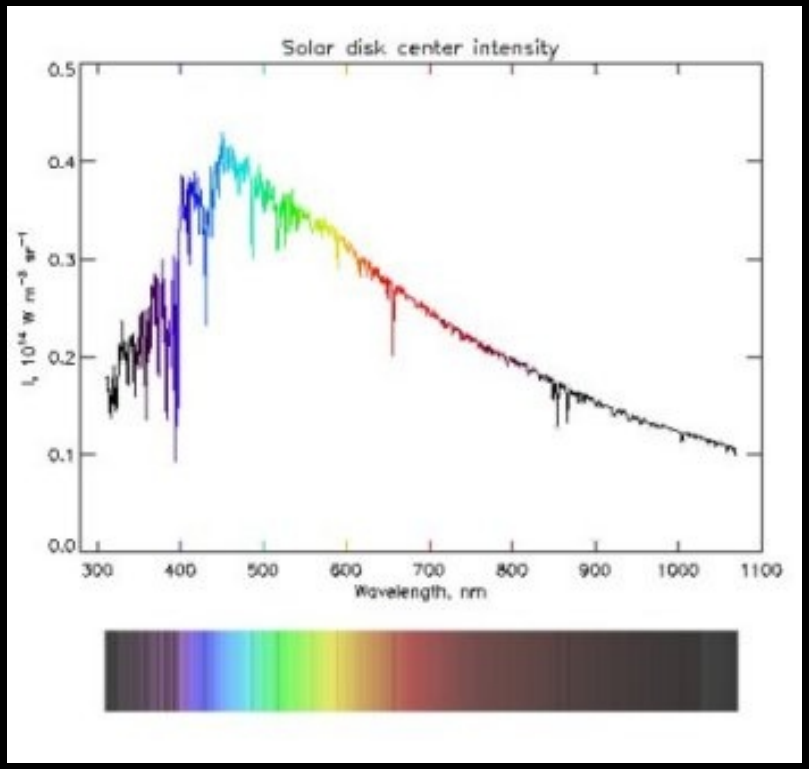


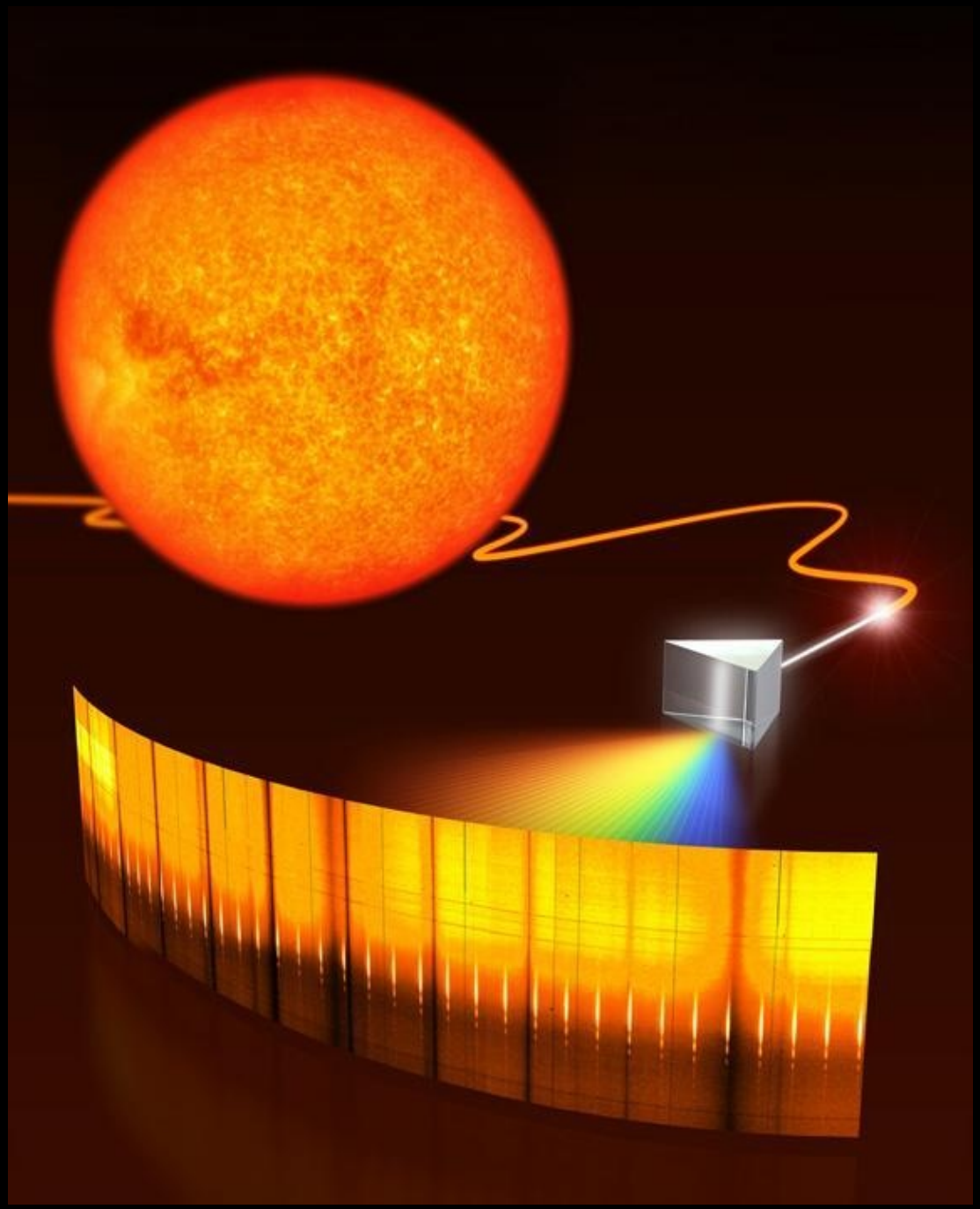


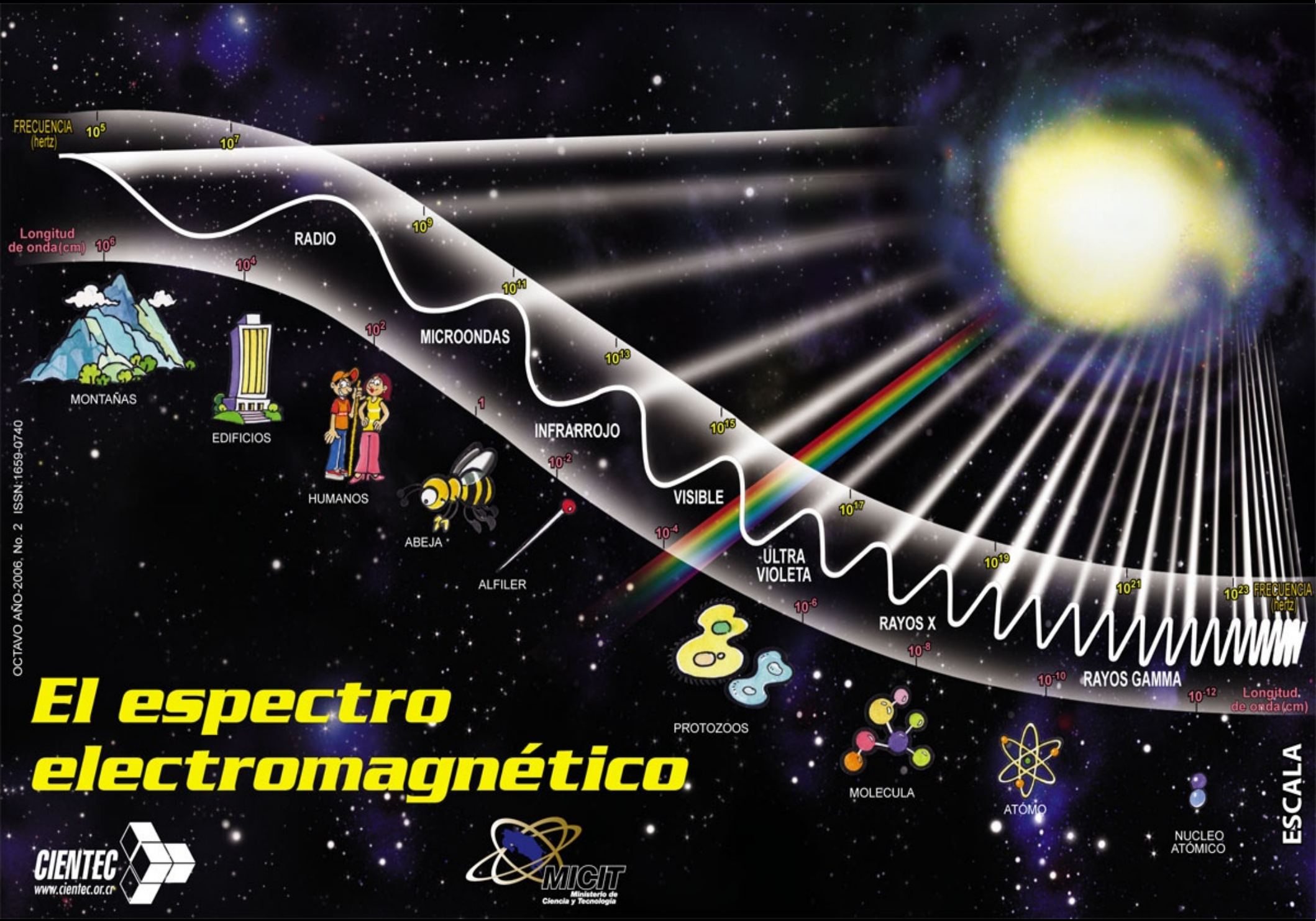
Ultraluminous Infrared Galaxies **HST** • WFPC2

NASA and K. Borne (Raytheon ITSS and NASA Goddard Space Flight Center), H. Bushouse (STScI), L. Colina (Instituto de Fisica de Cantabria, Spain) and R. Lucas (STScI)

El espectro del Sol







El espectro electromagnético

OCTAVO AÑO-2006, No. 2 ISSN:1659-0740

CIENTEC
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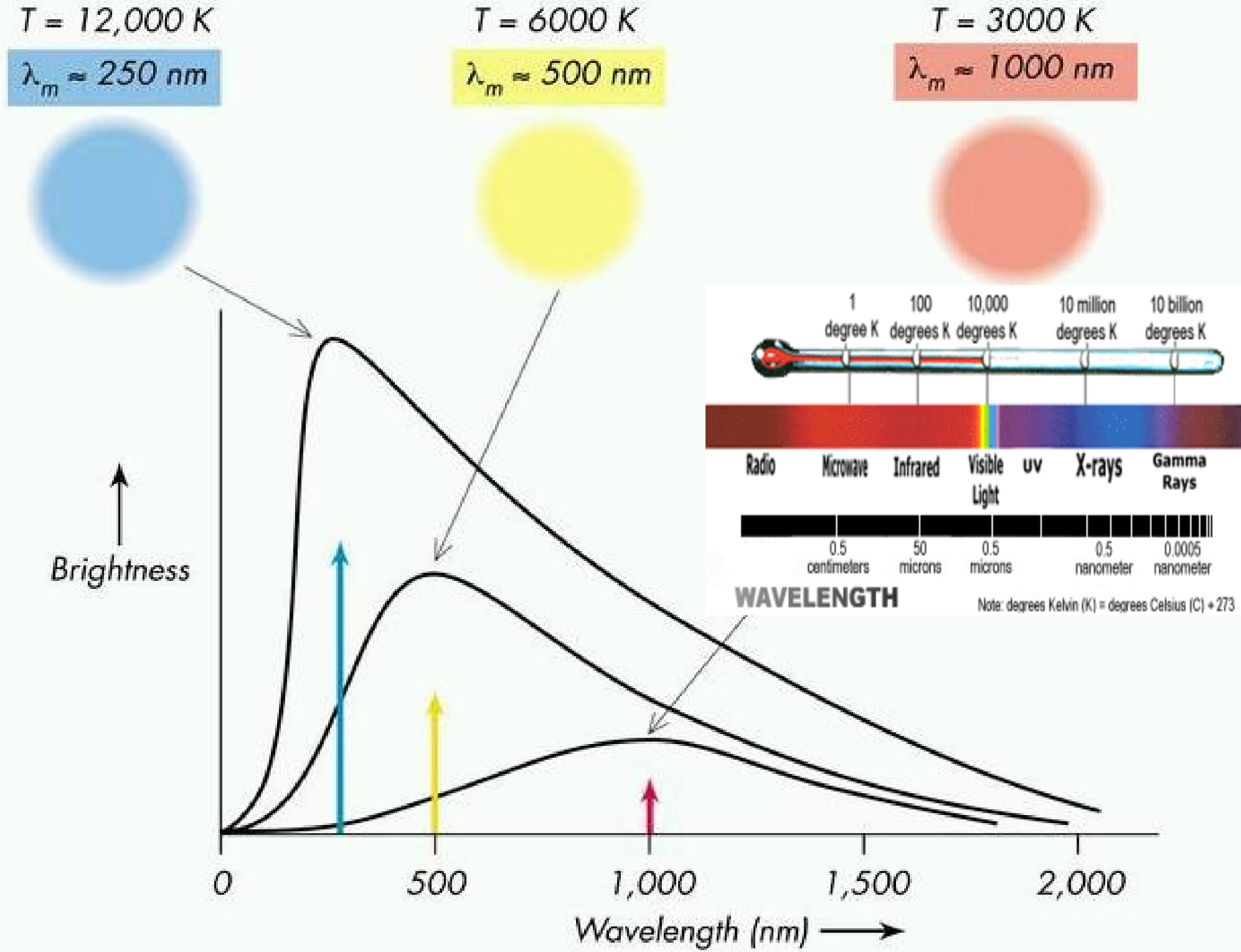
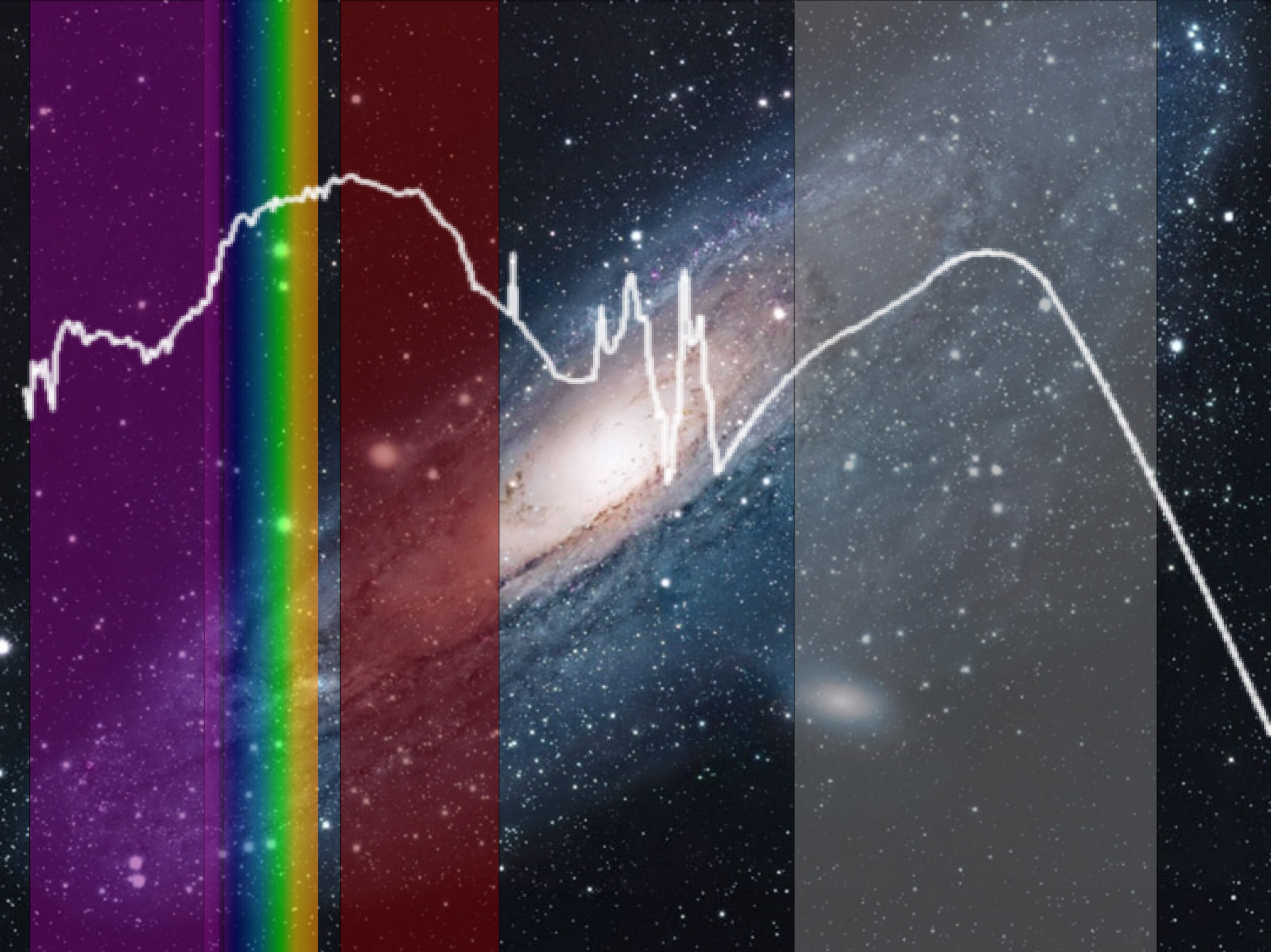
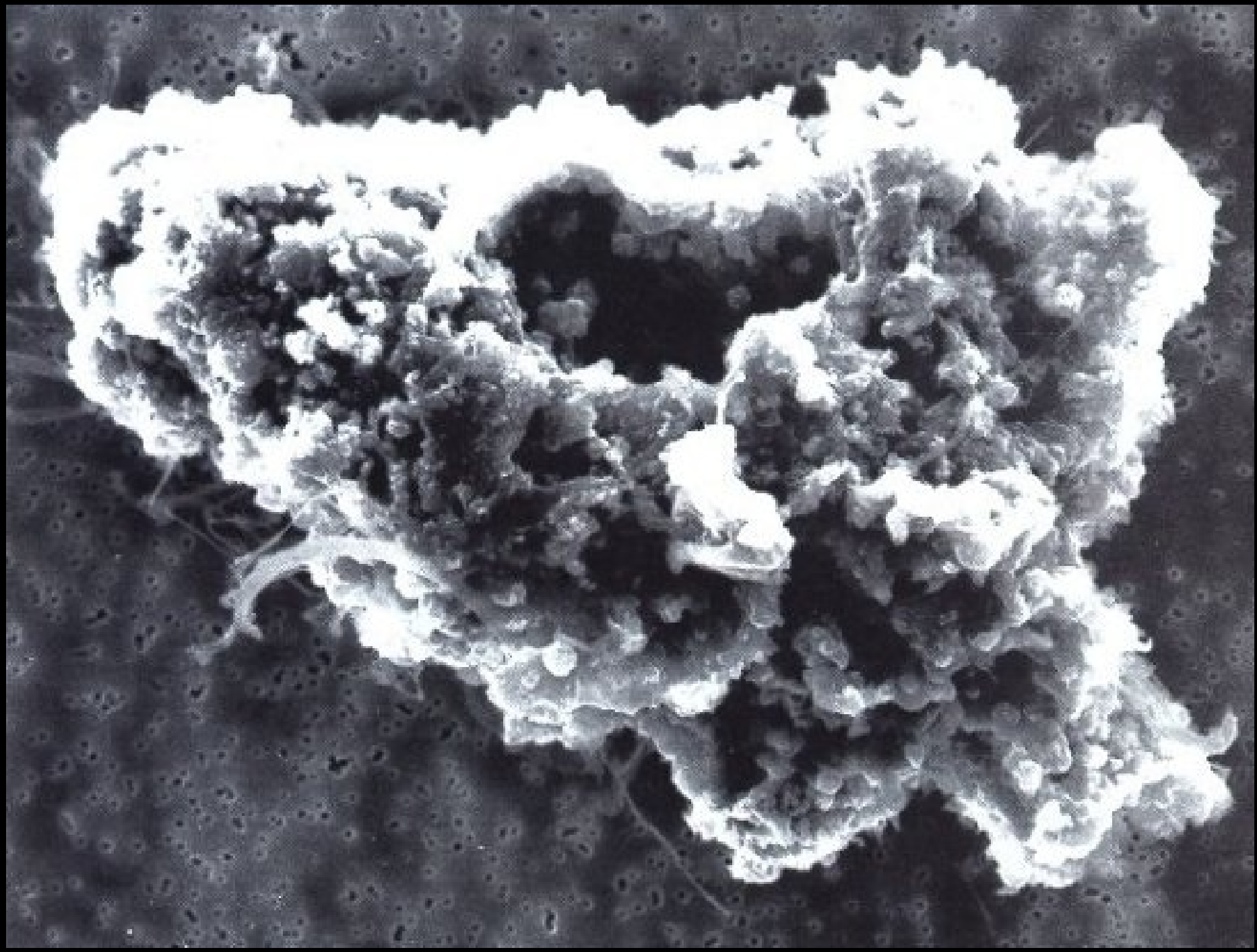
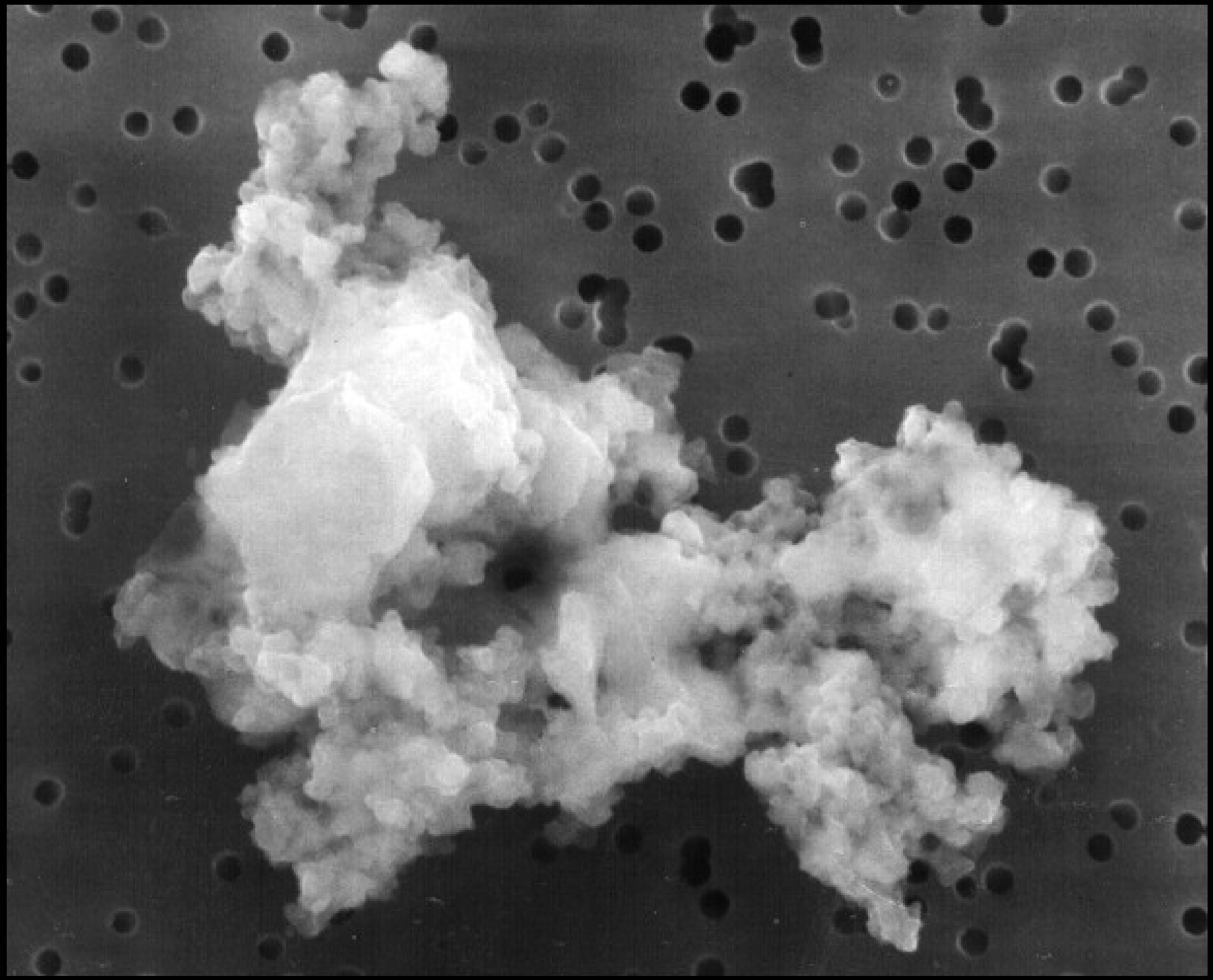
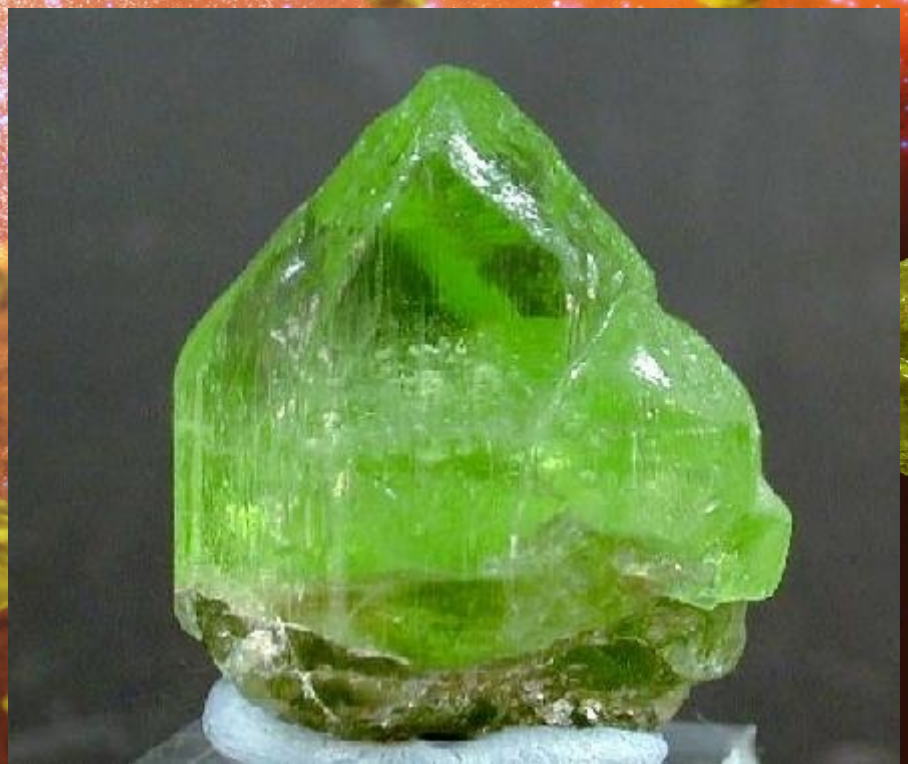
MICIT
Ministerio de Ciencia y Tecnología

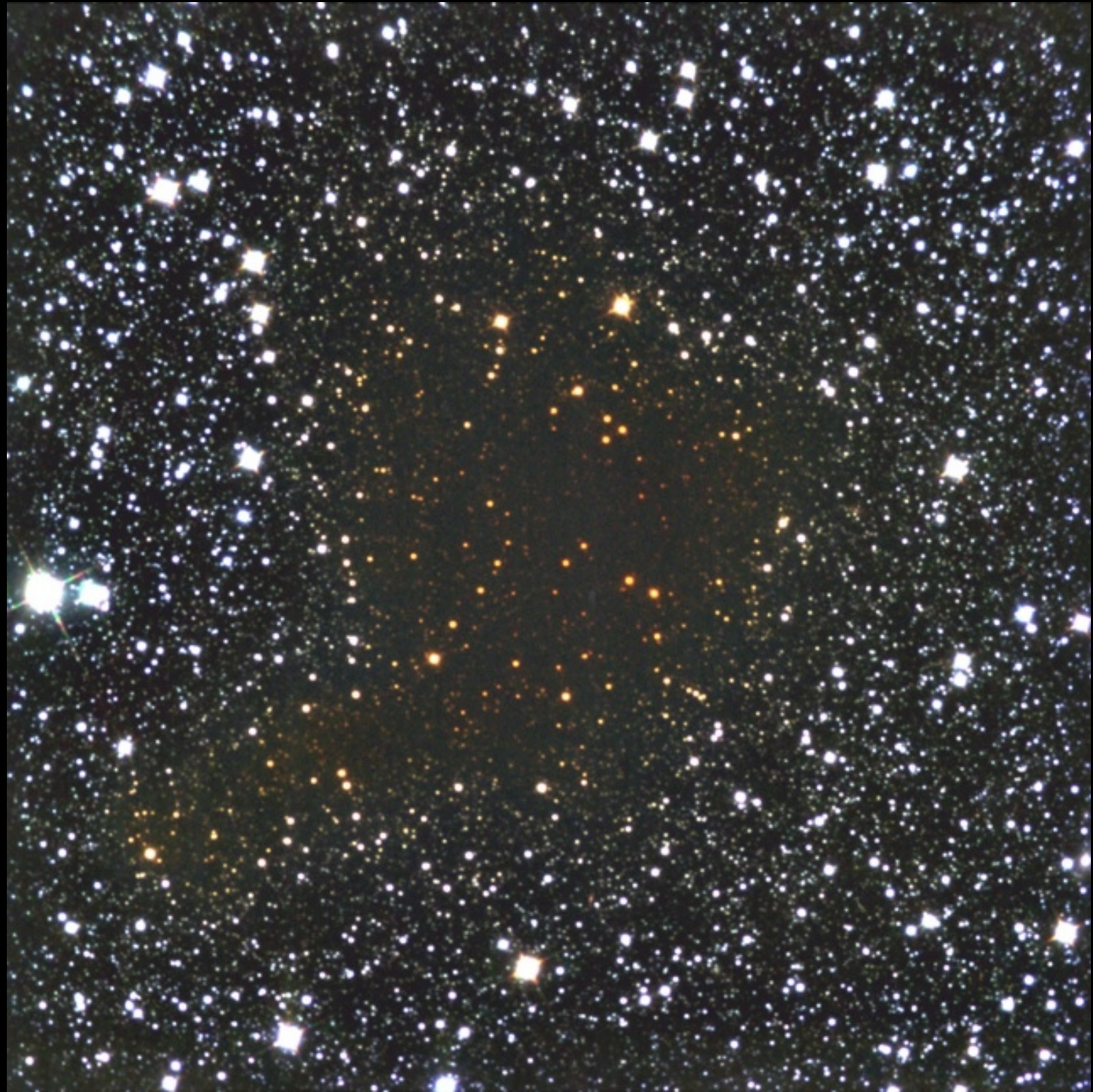

T = 12,000 K
λm ≈ 250 nm
T = 6000 K
λm ≈ 500 nm
T = 3000 K
λm ≈ 1000 nm
Brightness
0
500
1,000
1,500
2,000
Wavelength (nm)
1 degree K
100 degrees K
10,000 degrees K
10 million degrees K
10 billion degrees K
Radio
Microwave
Infrared
Visible Light
uv
X-rays
Gamma Rays
0.5 centimeters
50 microns
0.5 microns
0.5 nanometer
0.0005 nanometer
WAVELENGTH
Note: degrees Kelvin (K) = degrees Celsius (C) + 273

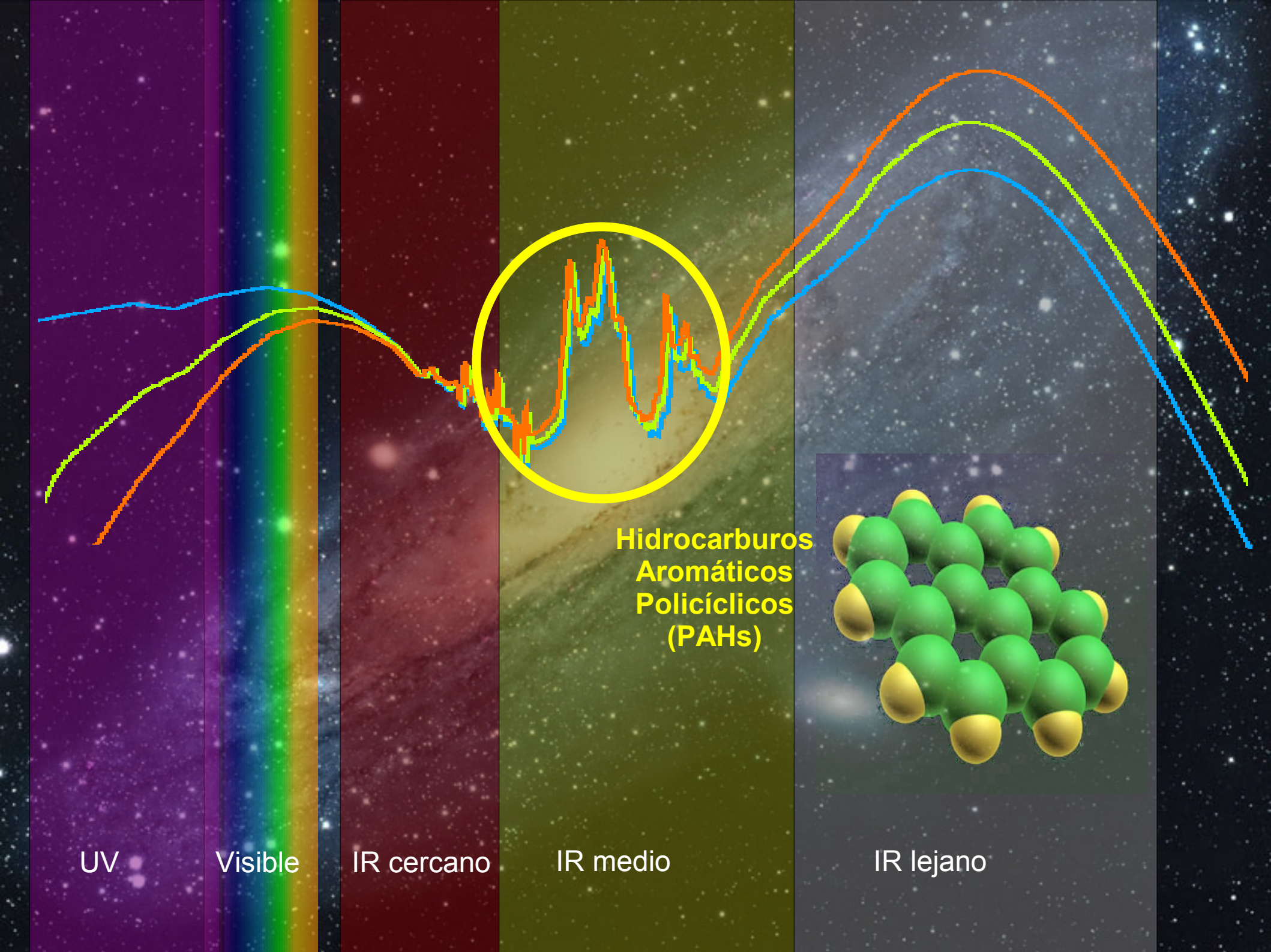


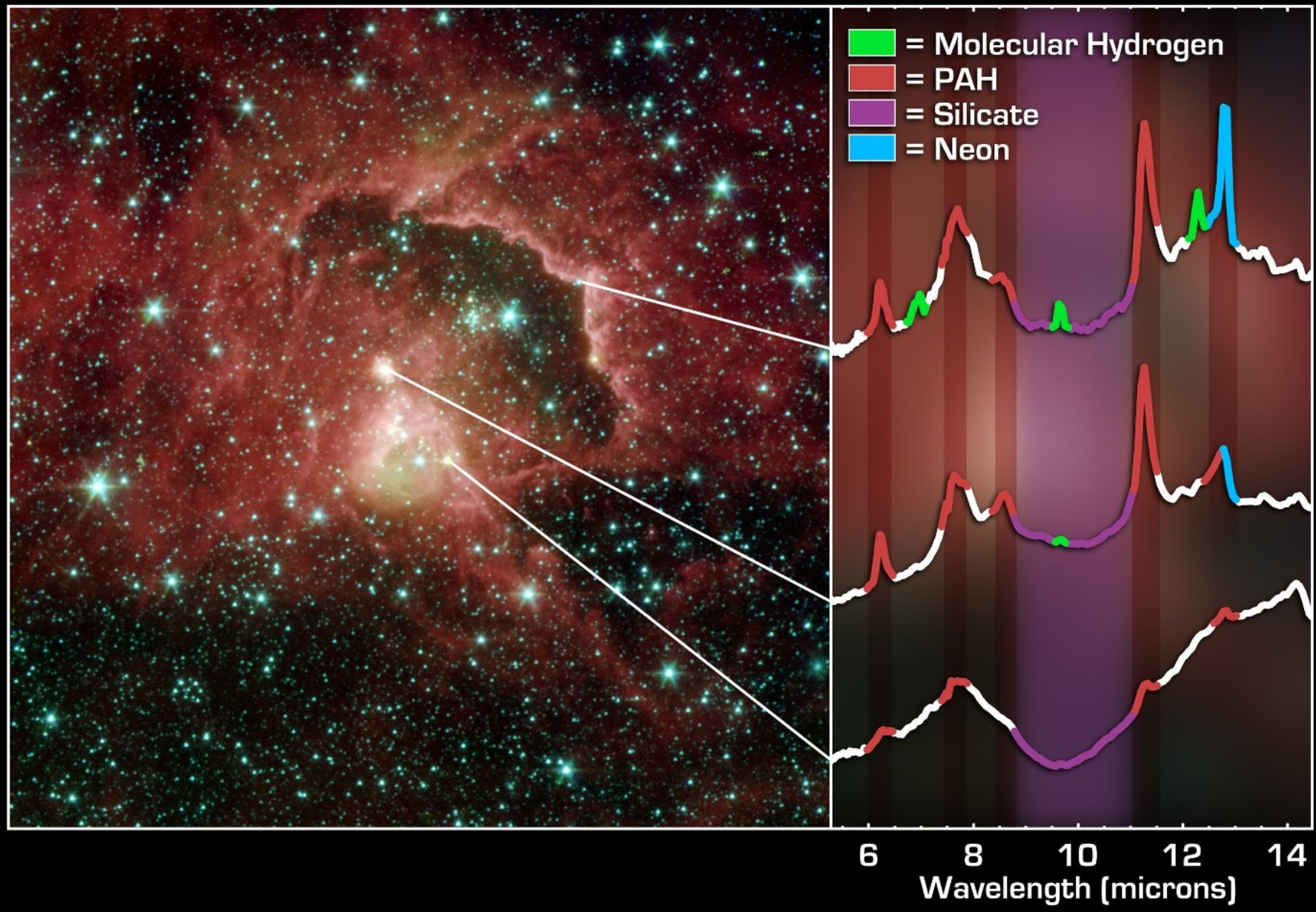









Hidrocarburos
Aromáticos
Policíclicos
(PAHs)
UV
Visible
IR cercano
IR medio
IR lejano



Star-Forming Cloud in Cepheus

Spitzer Space Telescope • IRS

(Image: Spitzer Space Telescope • IRAC)

NASA / JPL-Caltech / J. Ingalls & S. Carey (Spitzer Science Center/Caltech)

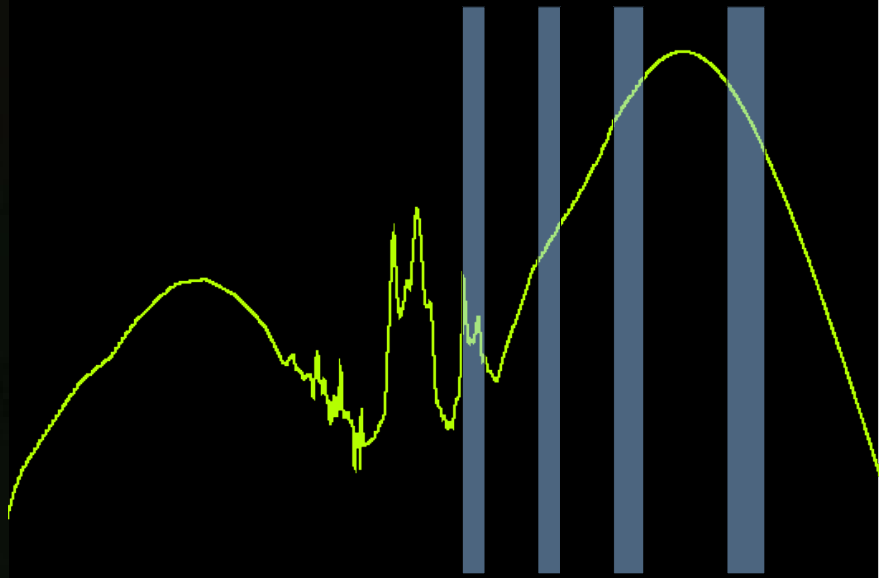
sig06-021

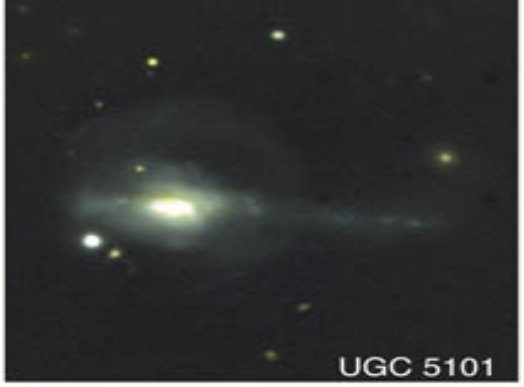
IRAS 1984

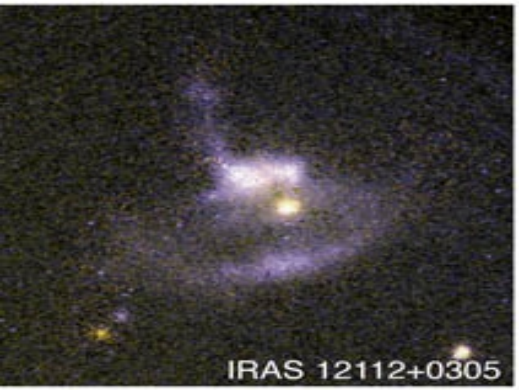
All sky survey: 12, 25, 60 y 160 μm

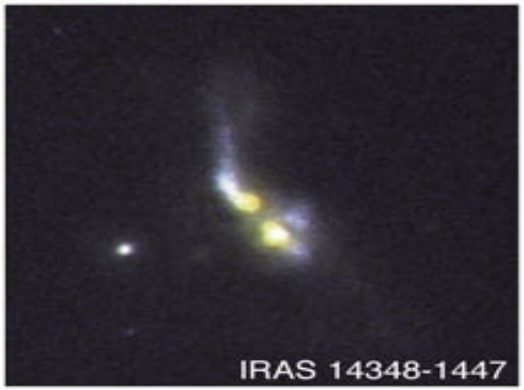
descubre 30.000 galaxias infrarrojas

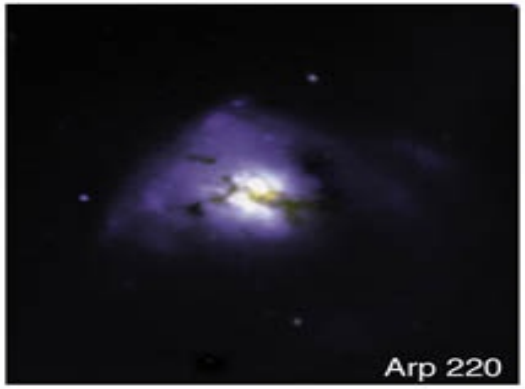
LIRGs: Lum. IR < 10^{12} Lsol
ULIRGs: Lum. IR > 10^{12} Lsol

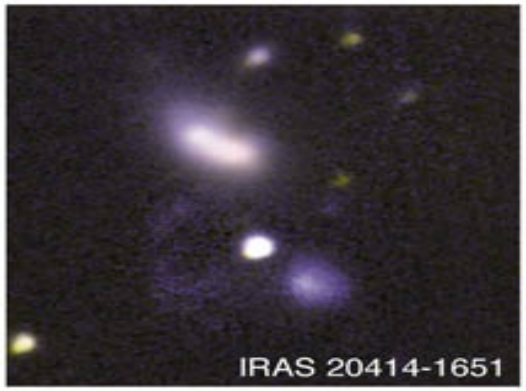


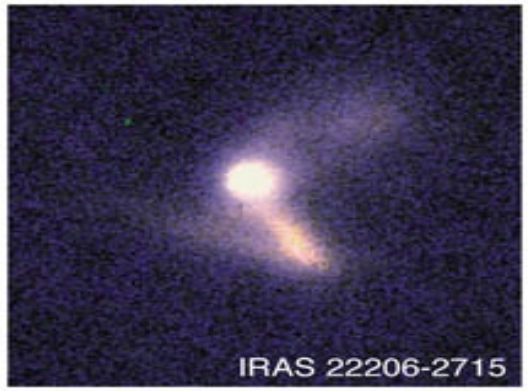


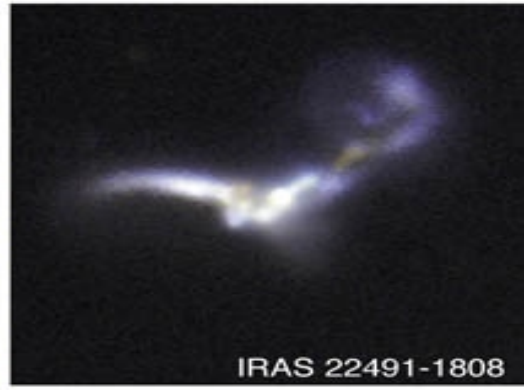


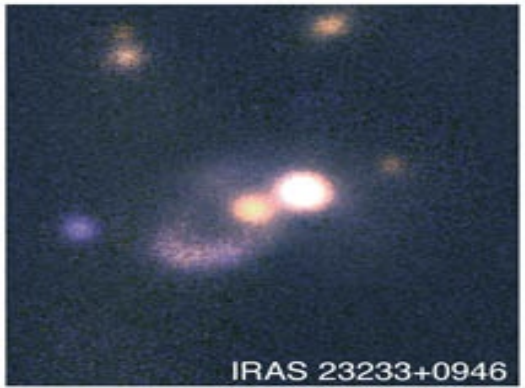




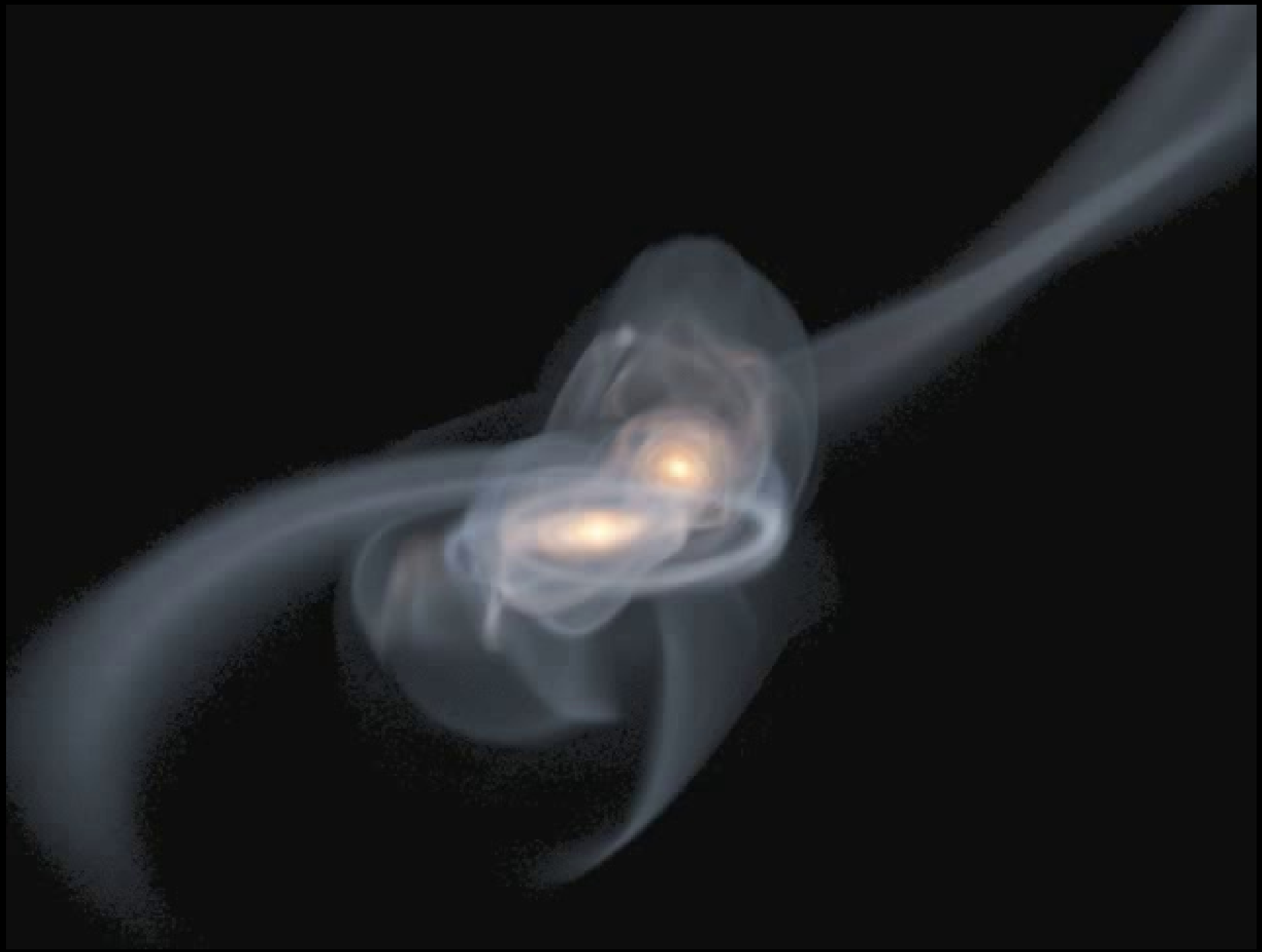


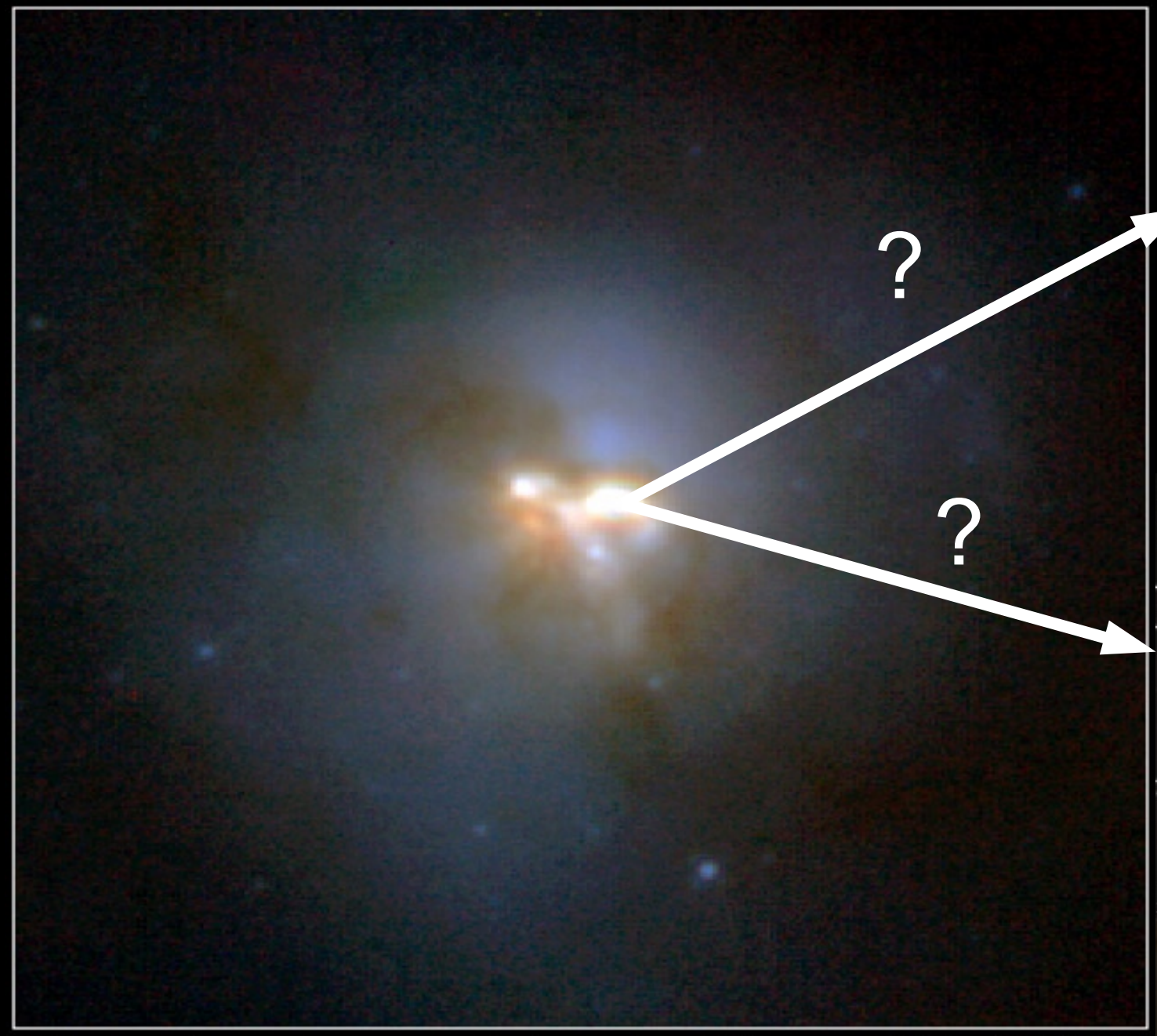


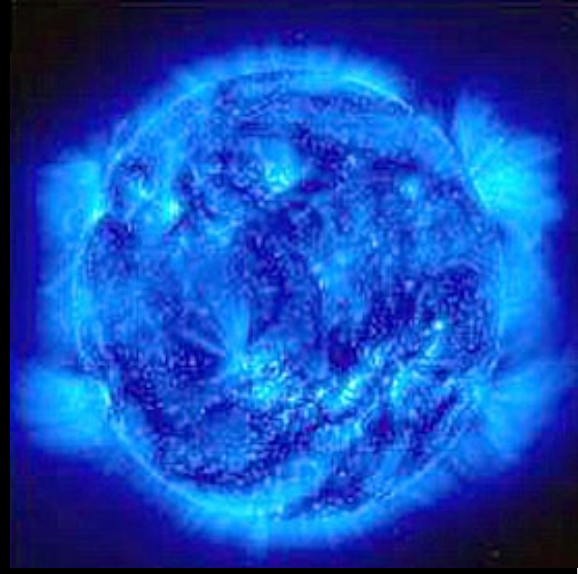


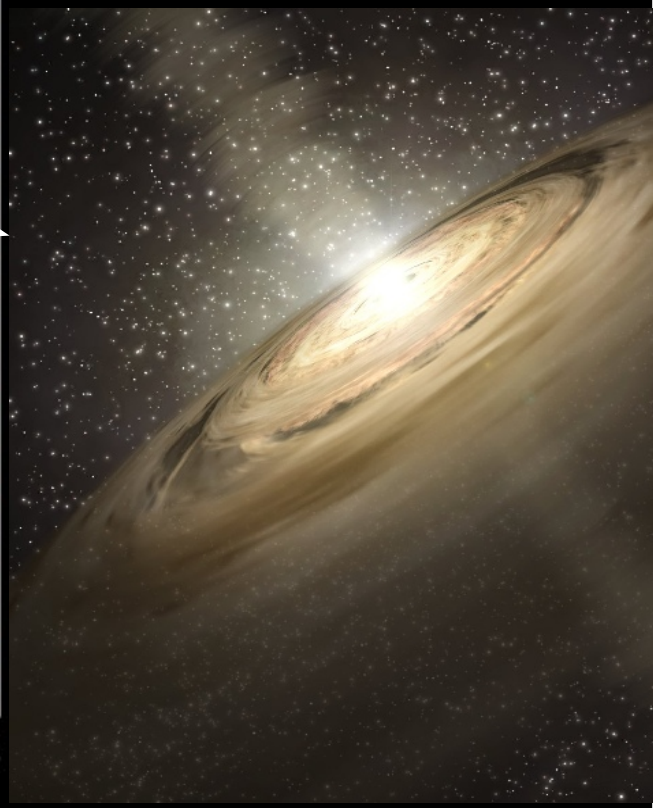


ULIRGs cercanas vistas con el Telescopio Espacial Hubble









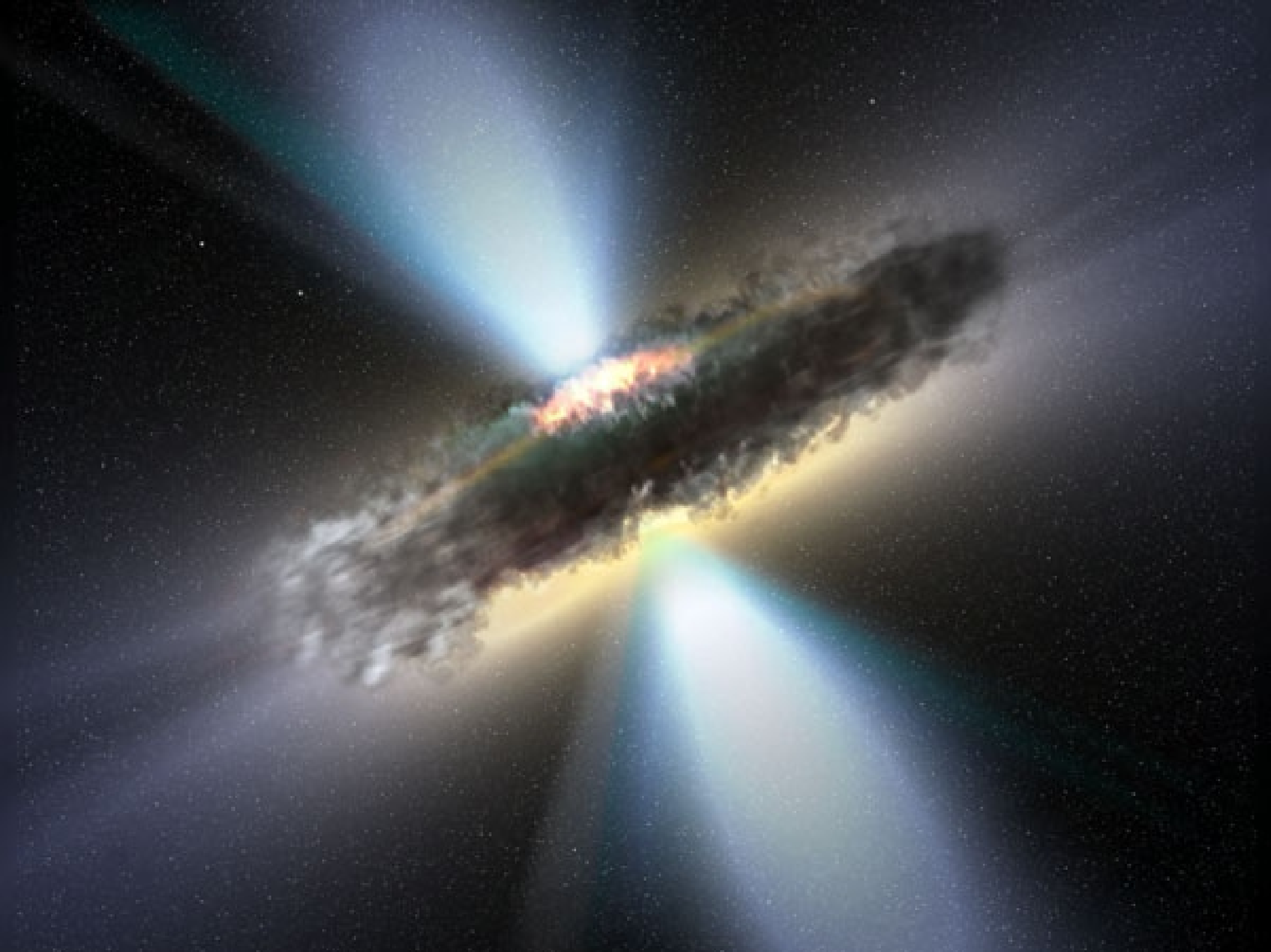
Ultraluminous Infrared Galaxy Arp 220 HST • NICMOS

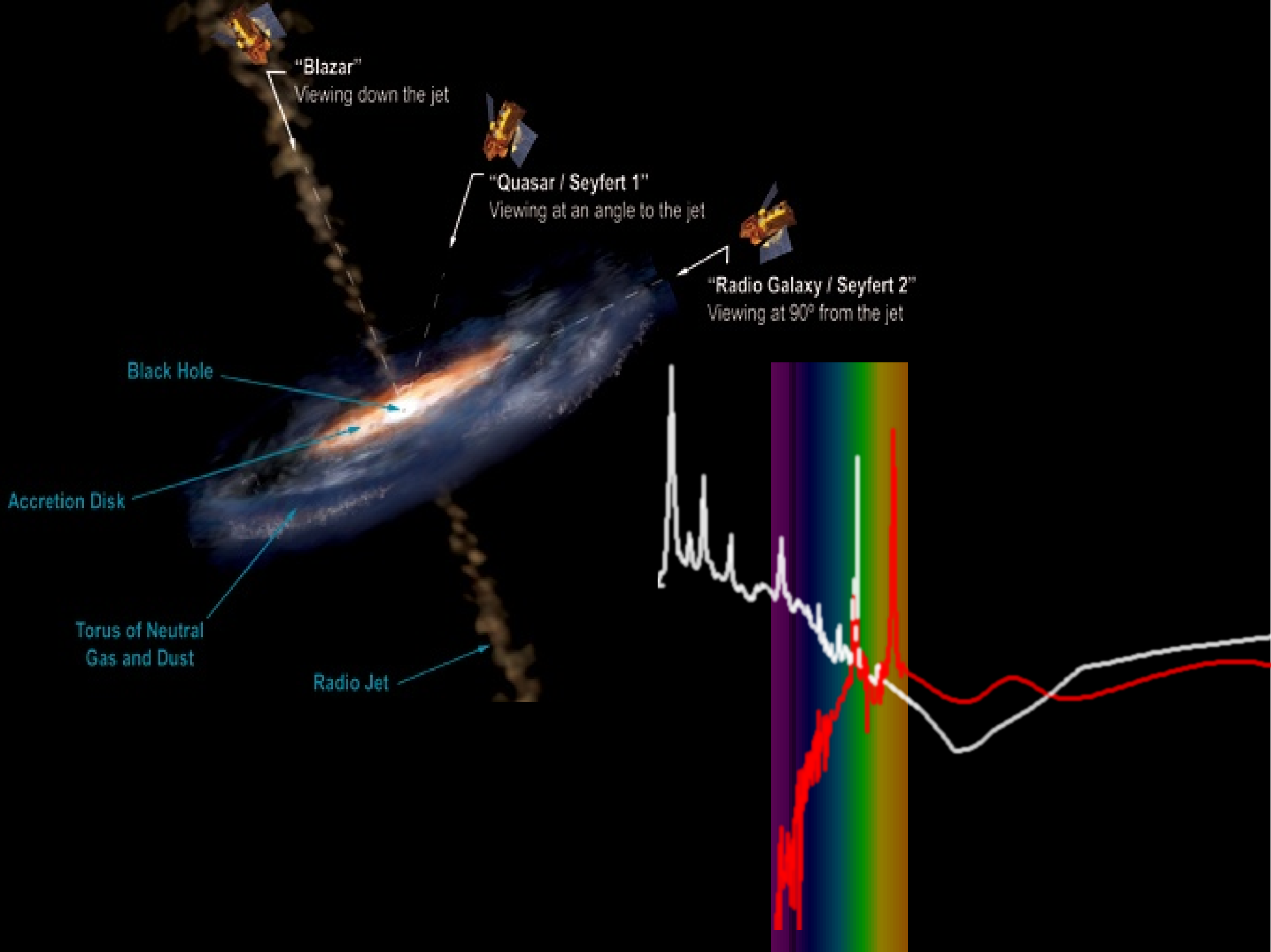
PRC97-17 • ST ScI OPO • June 9, 1997

R. Thompson (University of Arizona),

N. Scoville (California Institute of Technology) and NASA


ASTRO
CRUISE



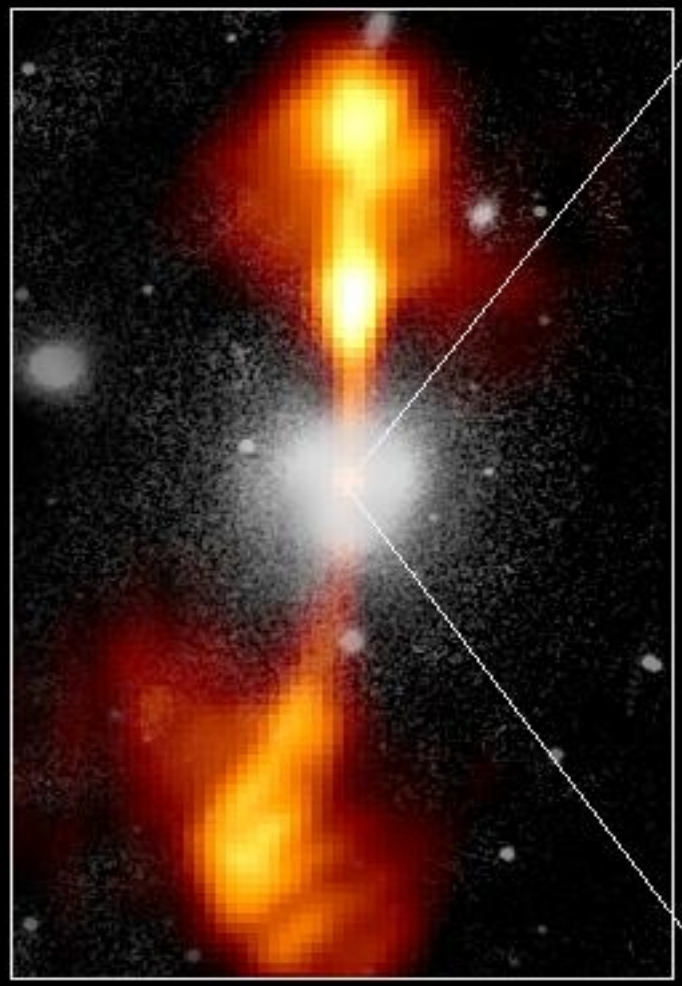

"Blazar"
Viewing down the jet
"Quasar / Seyfert 1"
Viewing at an angle to the jet
"Radio Galaxy / Seyfert 2"
Viewing at 90° from the jet
Black Hole
Accretion Disk
Torus of Neutral
Gas and Dust
Radio Jet

Core of Galaxy NGC 4261

Hubble Space Telescope

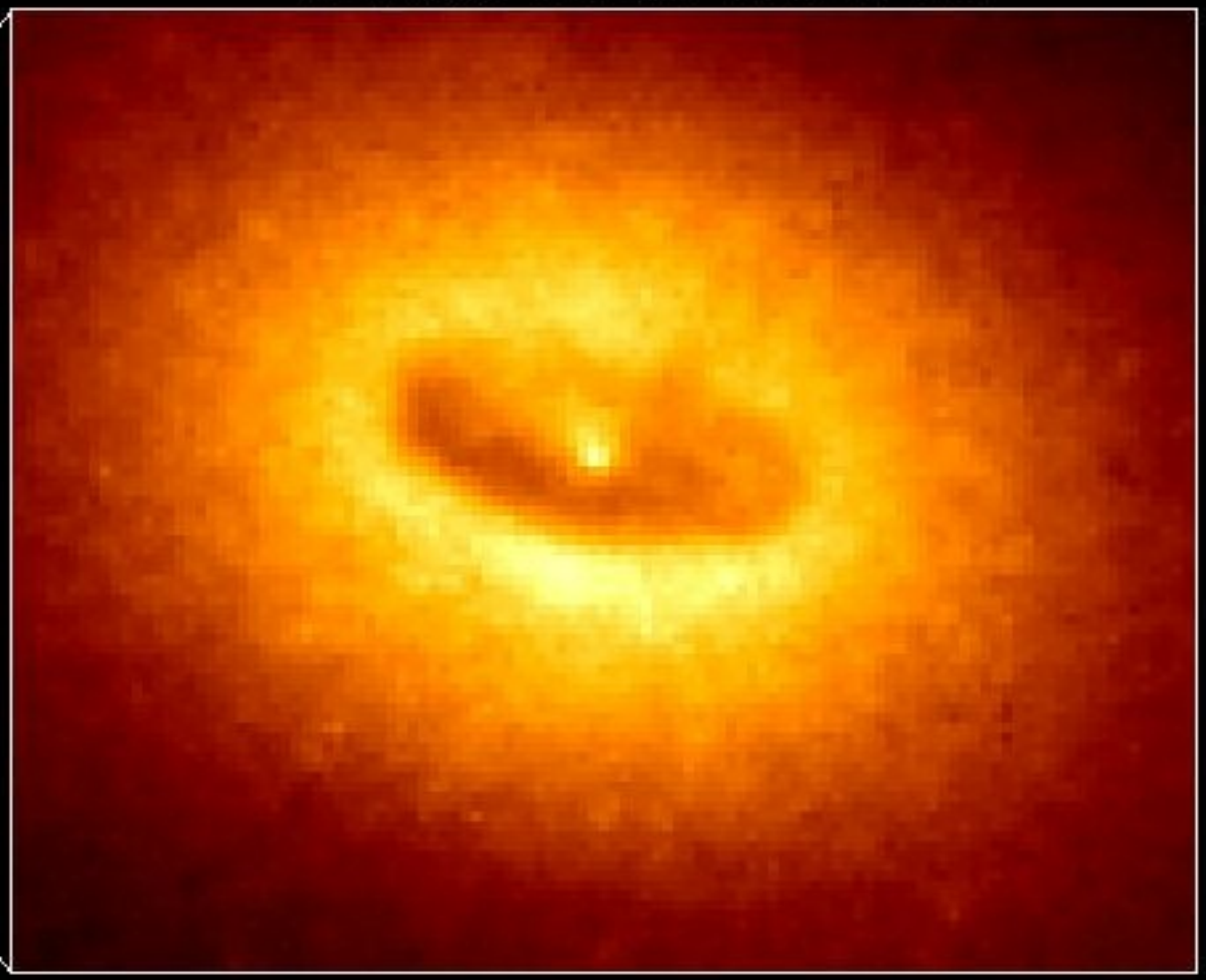
Wide Field / Planetary Camera

Ground-Based Optical/Radio Image

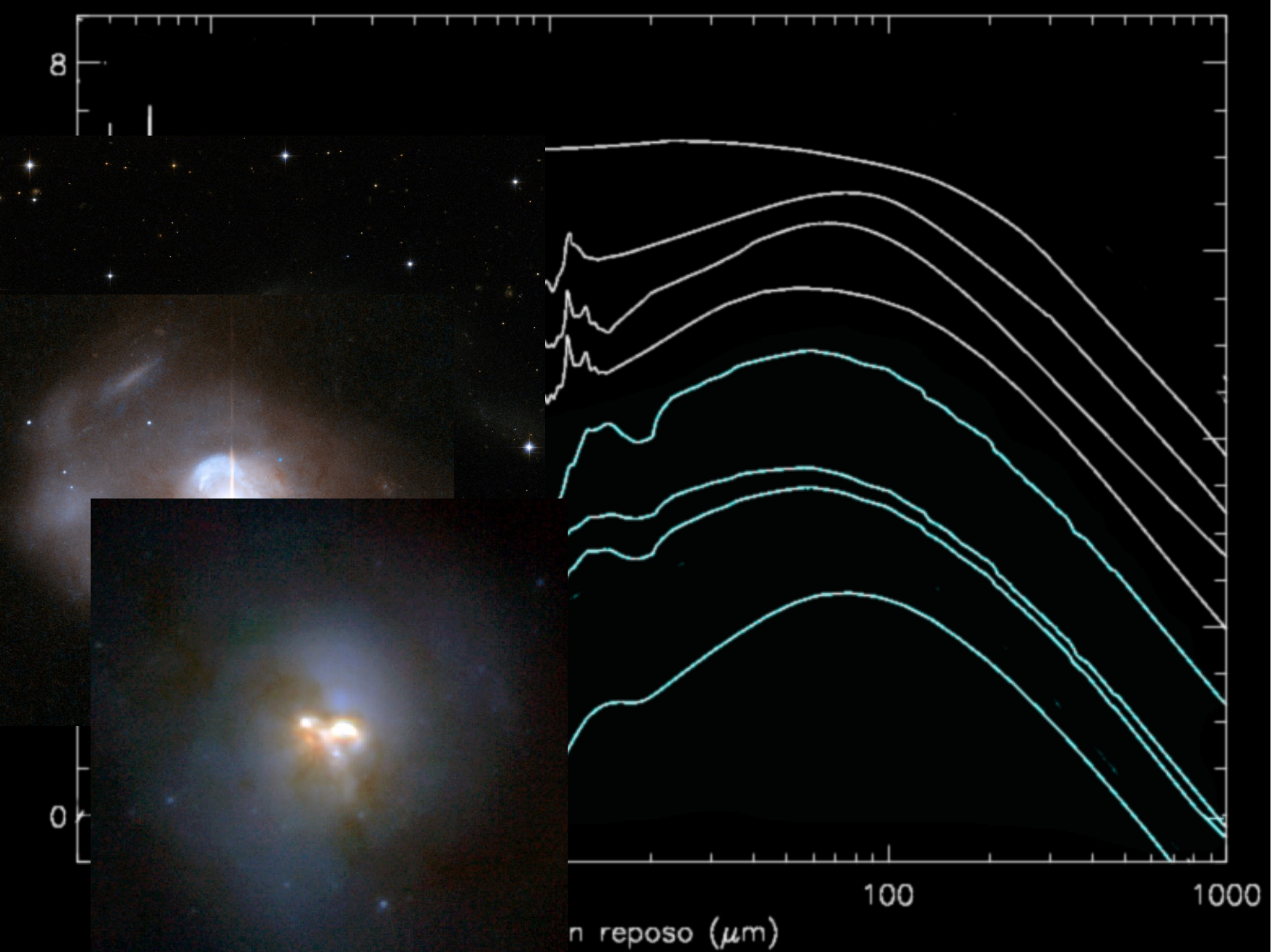


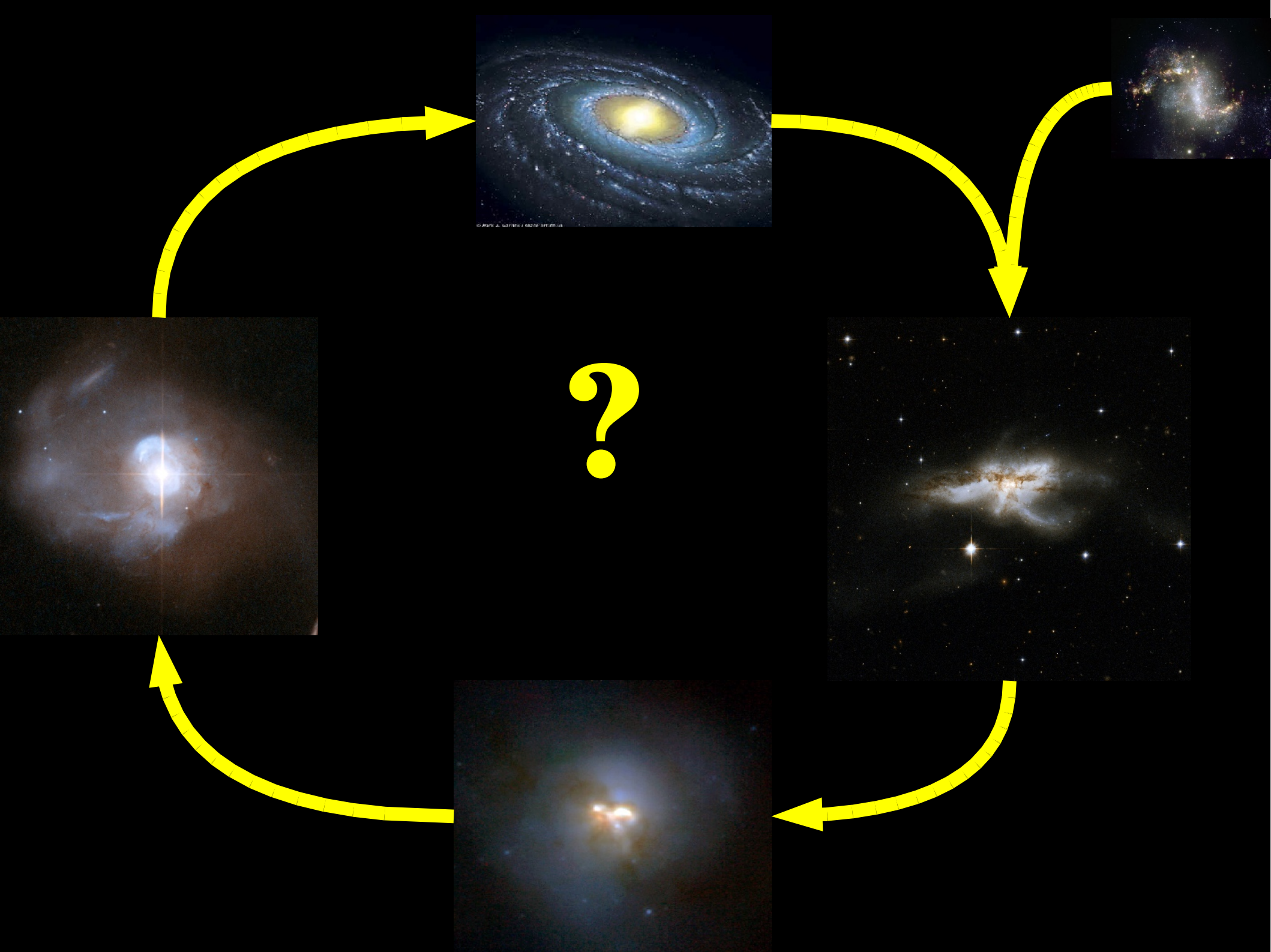
380 Arc Seconds
88,000 LIGHT-YEARS

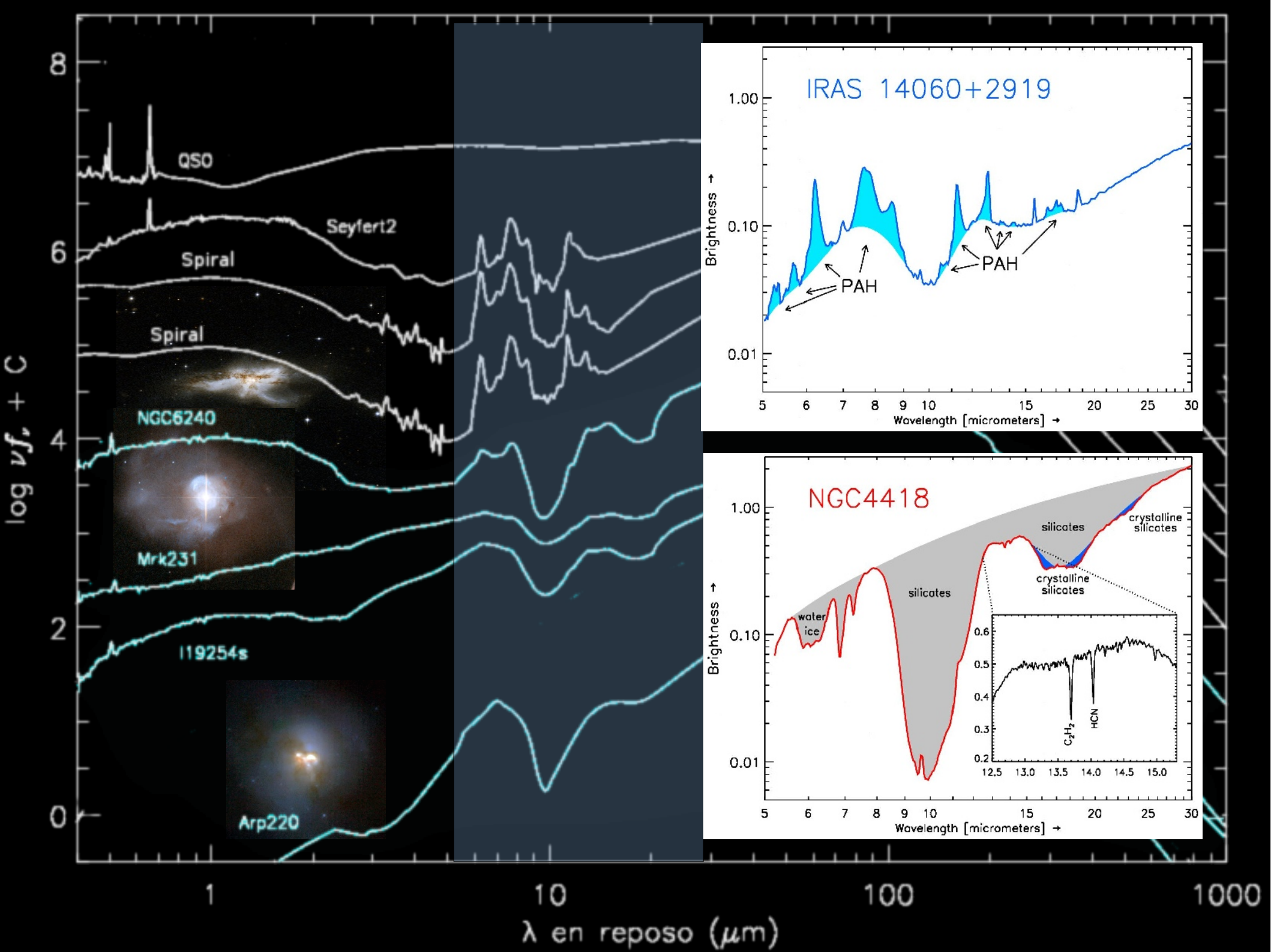
HST Image of a Gas and Dust Disk

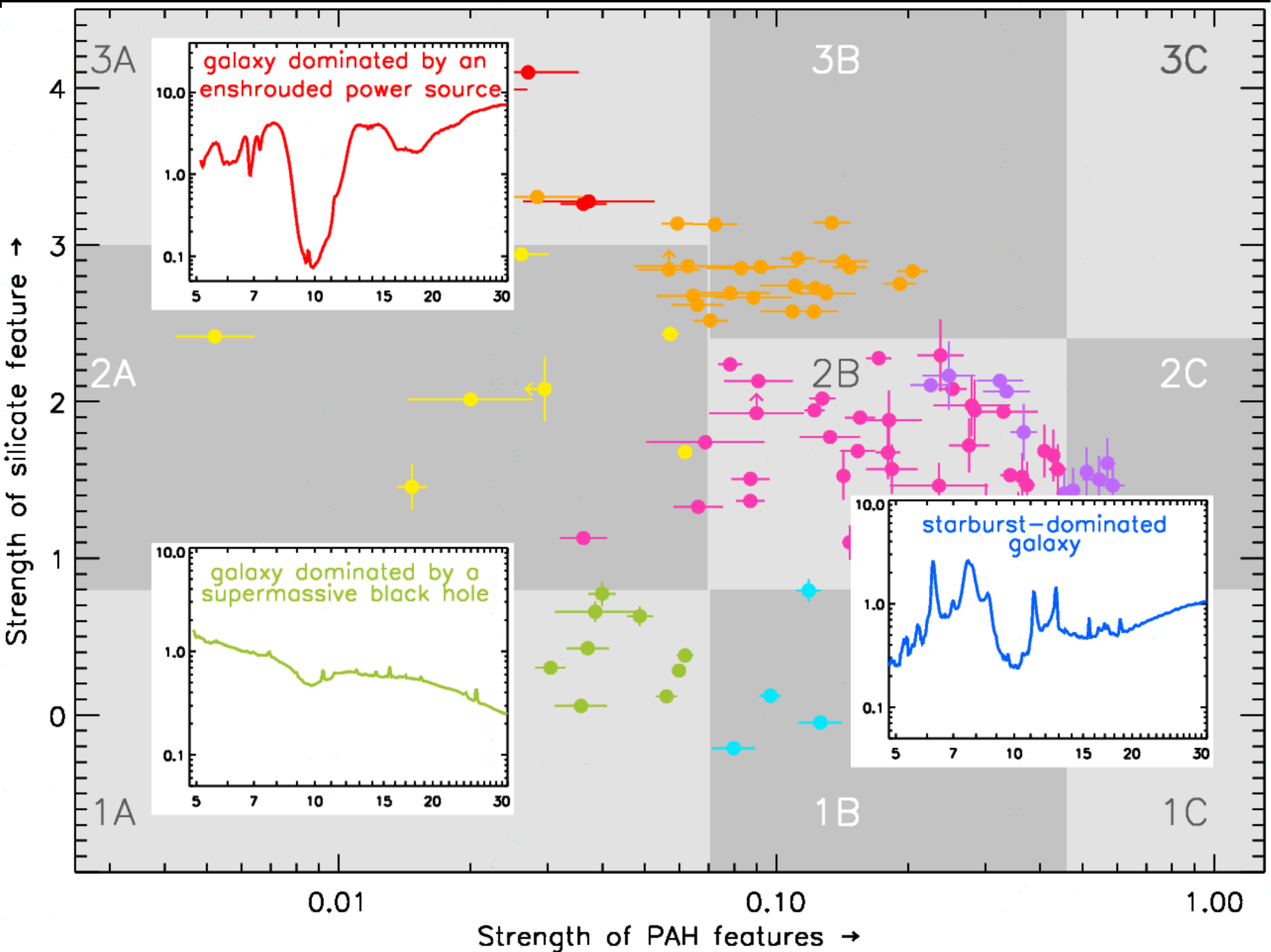


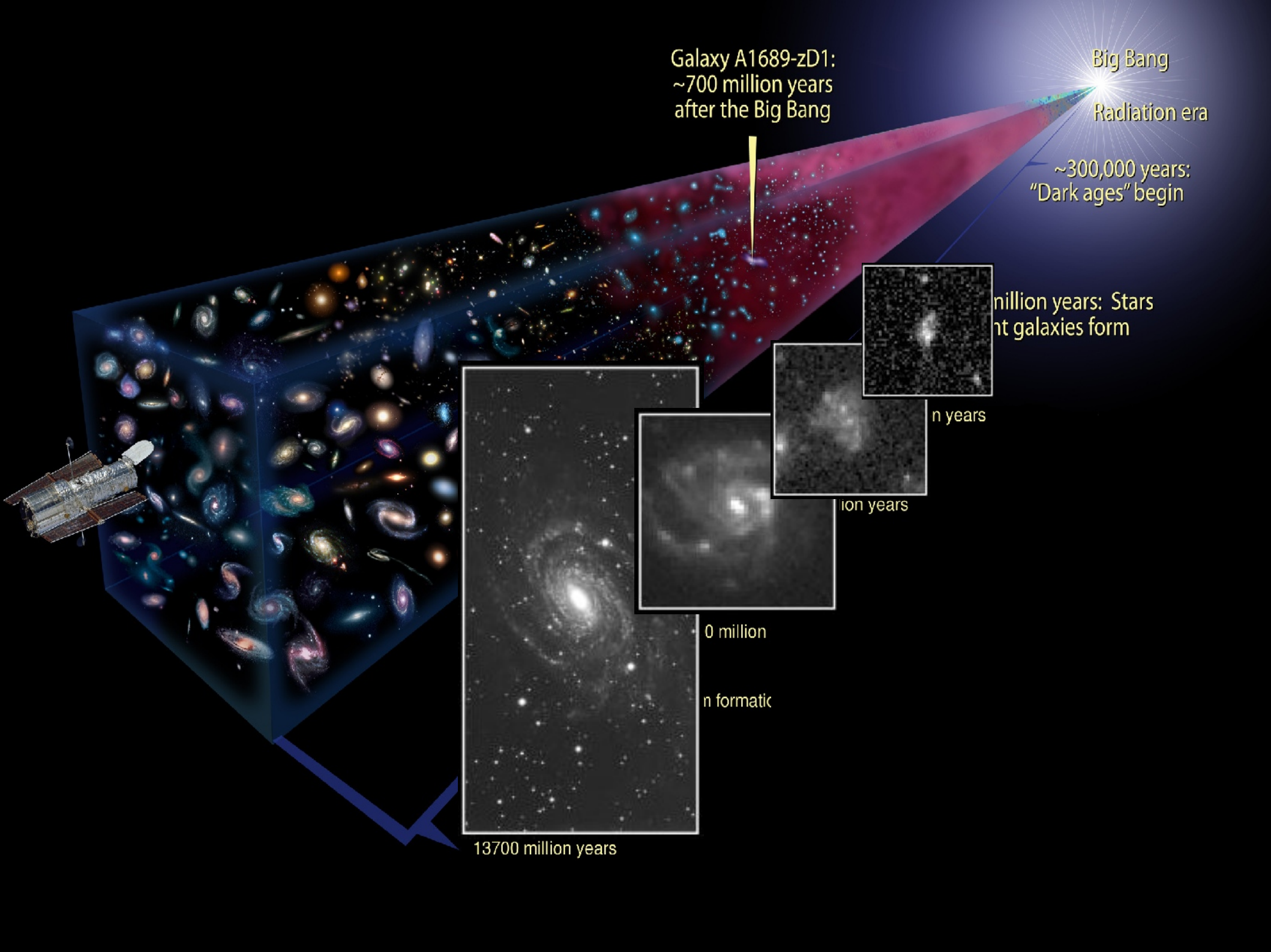
1.7 Arc Seconds
400 LIGHT-YEARS

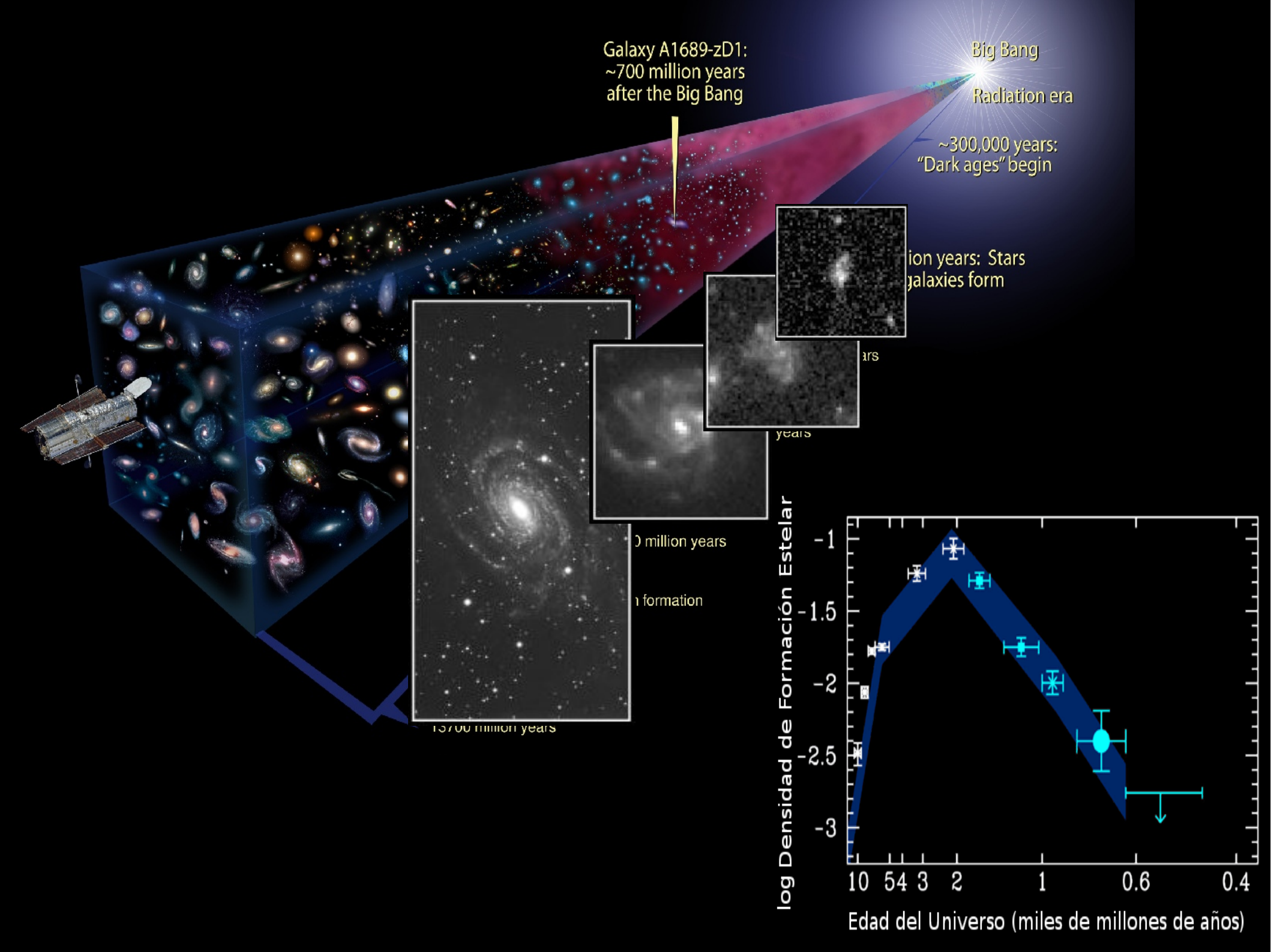

8
0
100
1000
n reposo (μm)

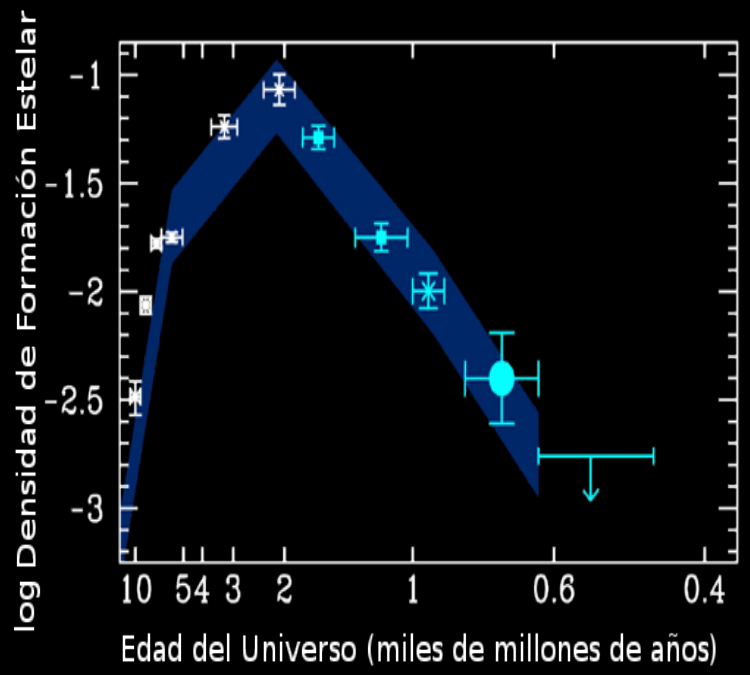


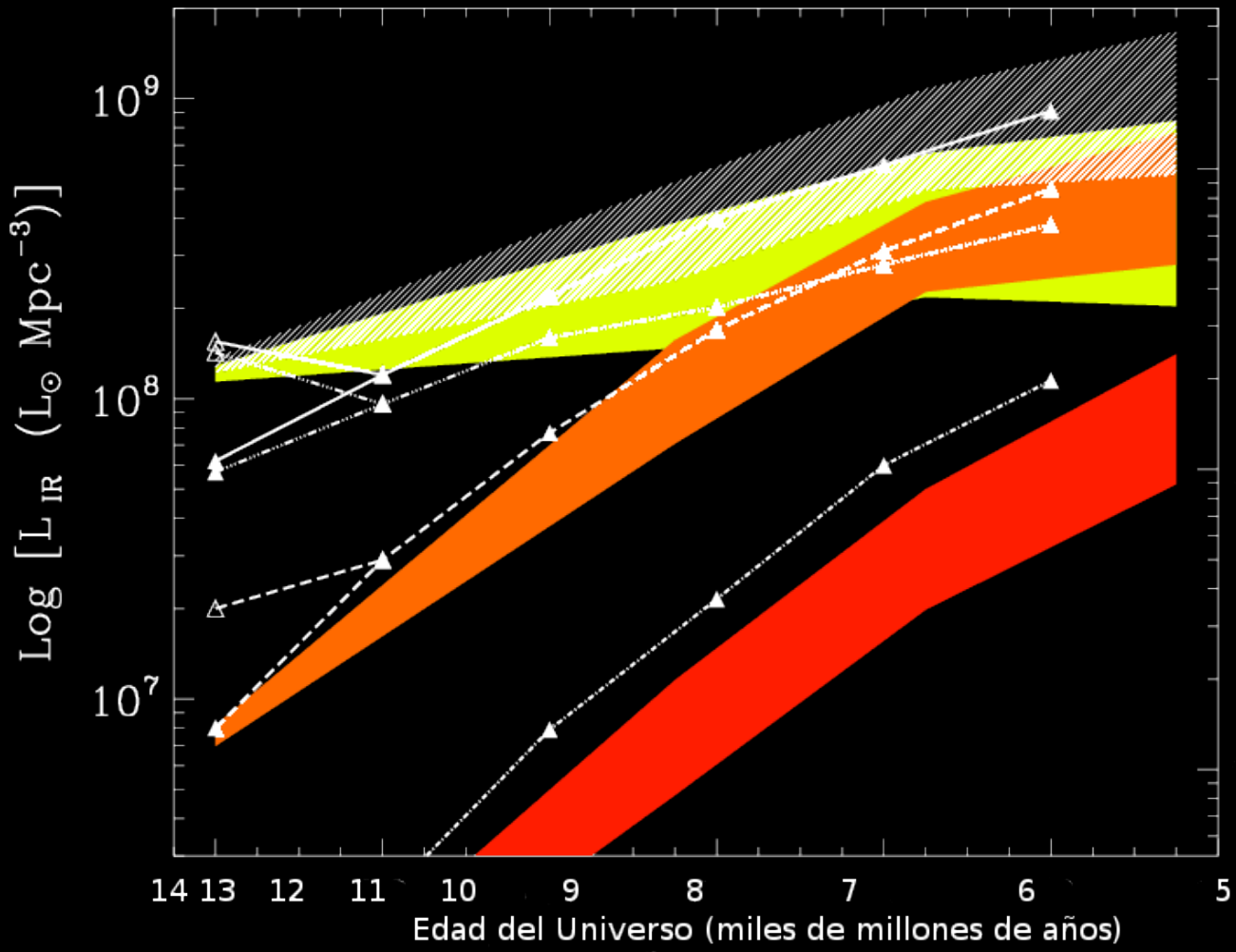

QSO
Seyfert2
Spiral
Spiral
NGC6240
Mrk231
I19254s
Arp220
log νf_ν + C
λ en reposo (μm)
IRAS 14060+2919
PAH
PAH
Brightness
Wavelength [micrometers]
NGC4418
silicates
crystalline silicates
crystalline silicates
silicates
water ice
C2H2
HCN

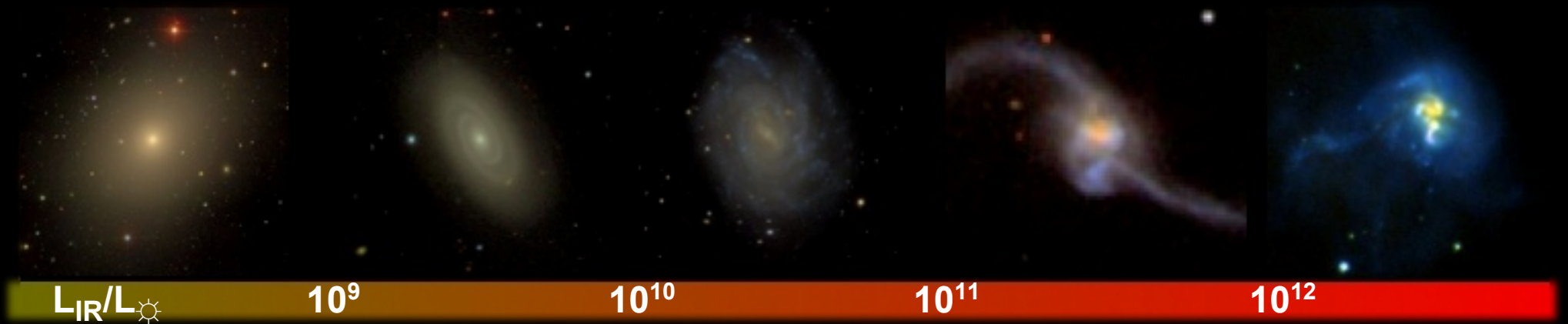

3A
3B
3C
2A
2B
2C
1A
1B
1C
galaxy dominated by an enshrouded power source
galaxy dominated by a supermassive black hole
starburst–dominated galaxy
Strength of silicate feature →
Strength of PAH features →
4
3
2
1
0
0.01
0.10
1.00
10.0
1.0
0.1
5
7
10
15
20
30


Galaxy A1689-zD1:
~700 million years
after the Big Bang
Big Bang
Radiation era
~300,000 years:
"Dark ages" begin
nillion years: Stars
nt galaxies form
n years
ion years
0 million
n formatic
13700 million years


Galaxy A1689-zD1:
~700 million years
after the Big Bang
Big Bang
Radiation era
~300,000 years:
"Dark ages" begin
ion years: Stars
galaxies form
ars
years
) million years
n formation
13700 million years
log Densidad de Formación Estelar
-1
-1.5
-2
-2.5
-3
10
5
4
3
2
1
0.6
0.4
Edad del Universo (miles de millones de años)


log Densidad de Formación Estelar
-1
-1.5
-2
-2.5
-3
10
5
4
3
2
1
0.6
0.4
Edad del Universo (miles de millones de años)


Log [L IR (L⊙ Mpc⁻³)]
10⁹
10⁸
10⁷
14
13
12
11
10
9
8
7
6
5
Edad del Universo (miles de millones de años)


LIR/L☼
10⁹
10¹⁰
10¹¹
10¹²

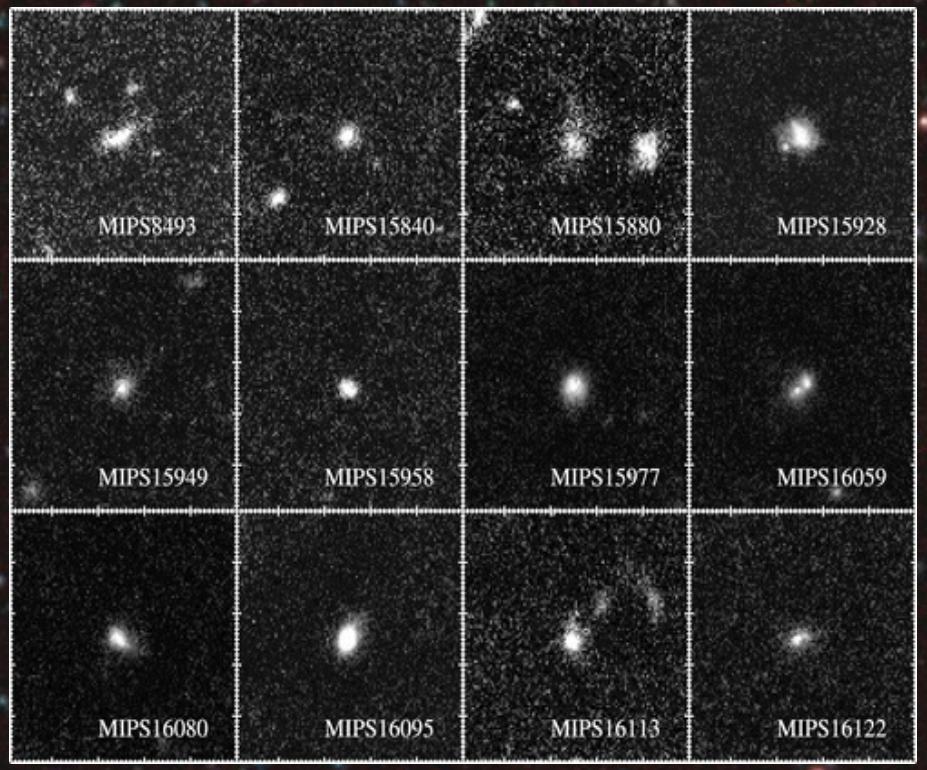
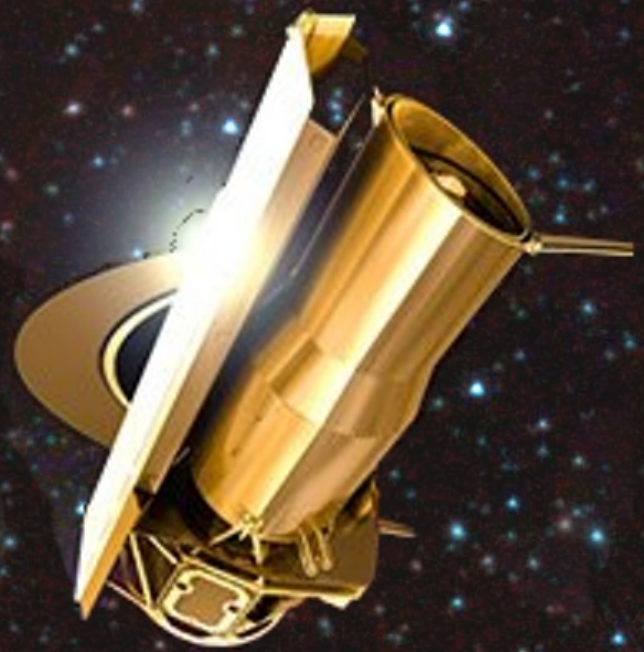
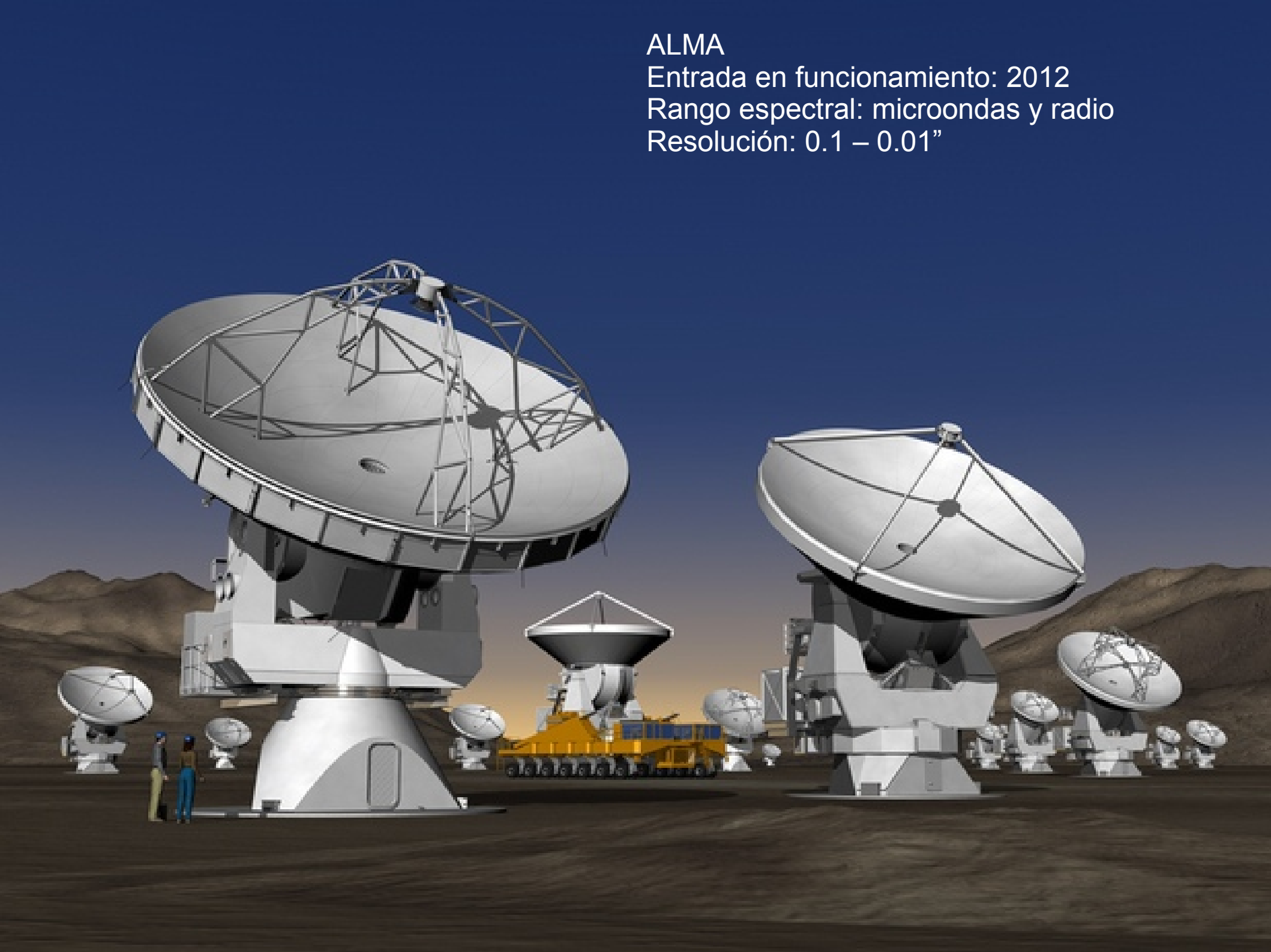
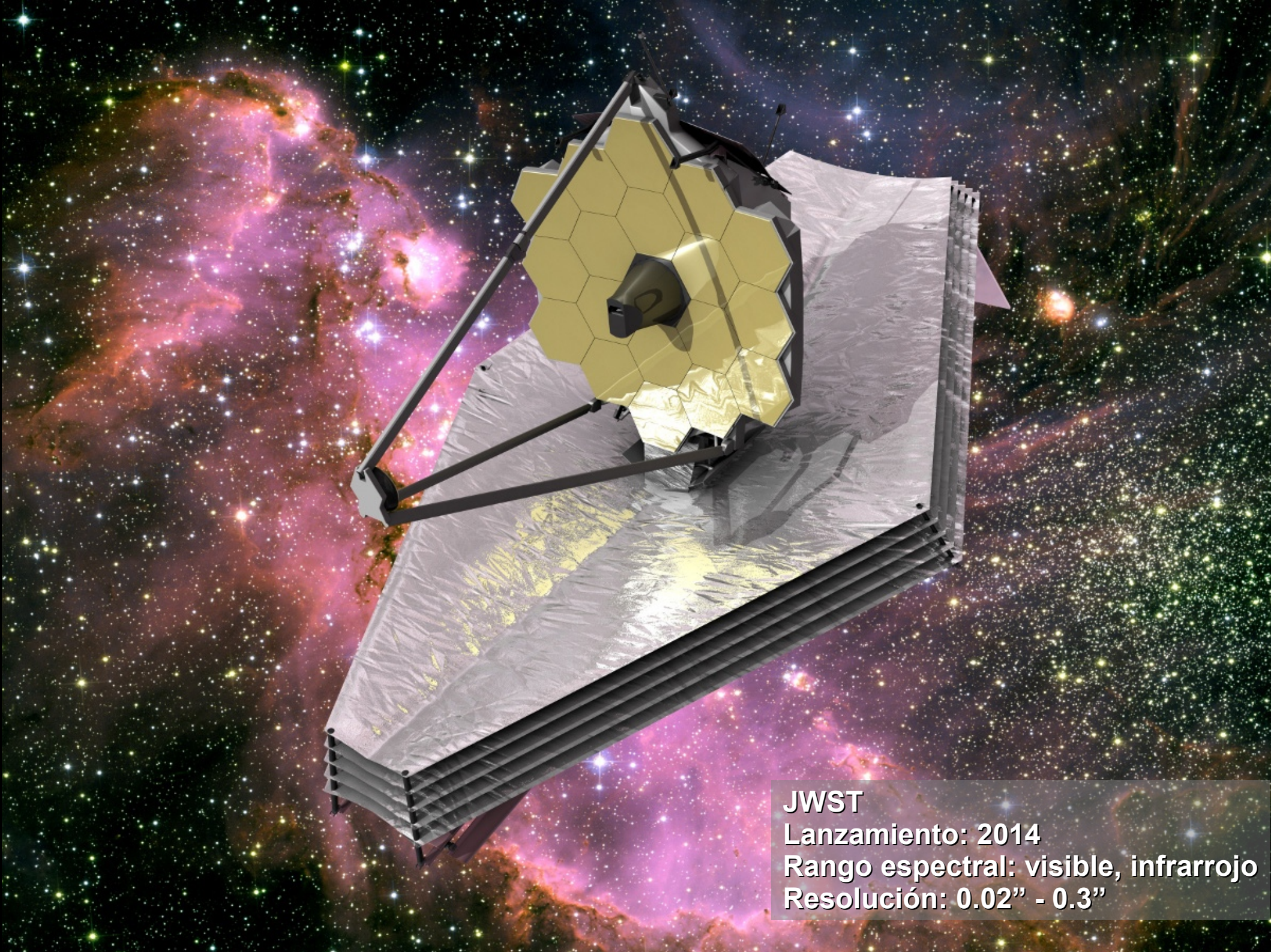


Imagen HST de ULIRGs a z = 2
Distancia = 51000 millones años luz
Edad universo = 3300 millones de años



Telescopio Espacial Spitzer
Misión principal: 2004 – 2009
(actualmente en misión extendida)
Rango espectral: Infrarrojo medio y lejano
Resolución: 2”-50”


ALMA
Entrada en funcionamiento: 2012
Rango espectral: microondas y radio
Resolución: 0.1 – 0.01”

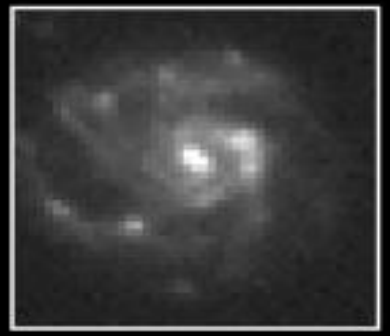

JWST
Lanzamiento: 2014
Rango espectral: visible, infrarrojo
Resolución: 0.02” - 0.3”

Age of the Universe

Today: 14 Billion Years | 9 Billion Years | 5 Billion Years | 2 Billion Years




Elliptical



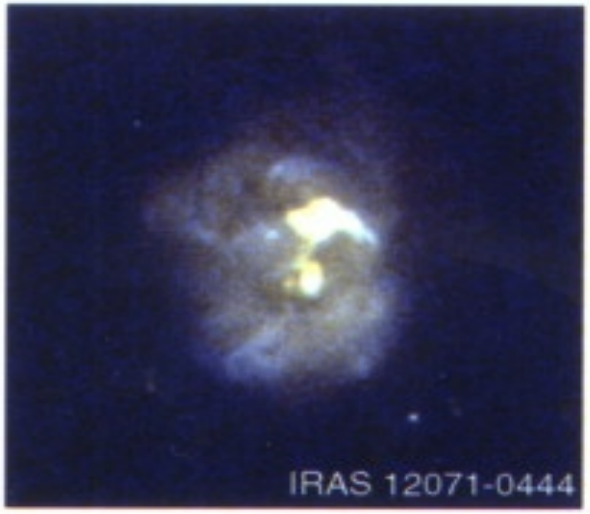

Spiral

SPACE TELESCOPE SCIENCE INSTITUTE

Galaxies: Snapshots in Time

HST · WFPC2

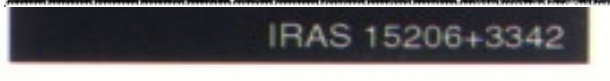
PR94-52c · Office of Public Outreach · December 6, 1994 · ZGL

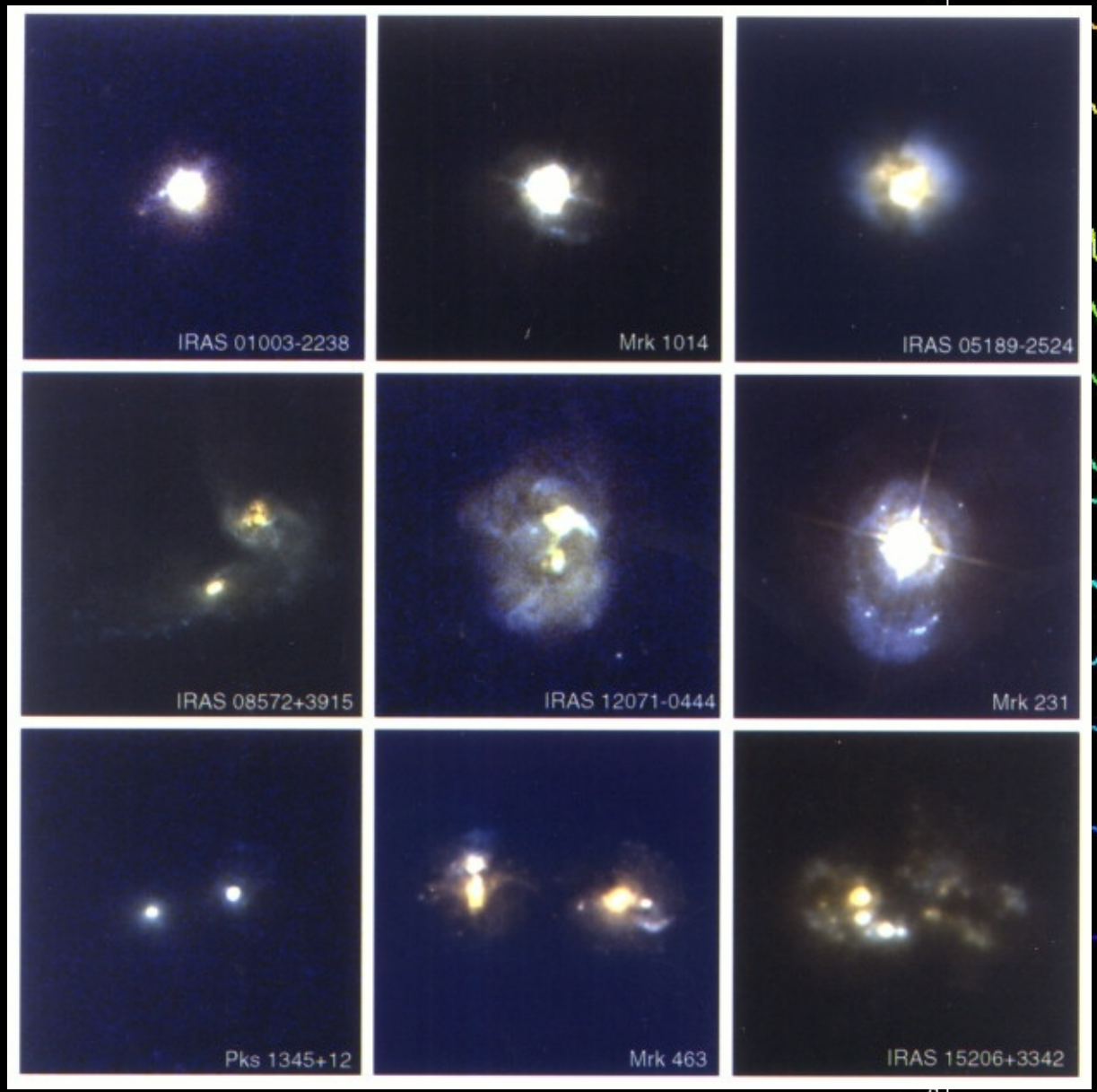


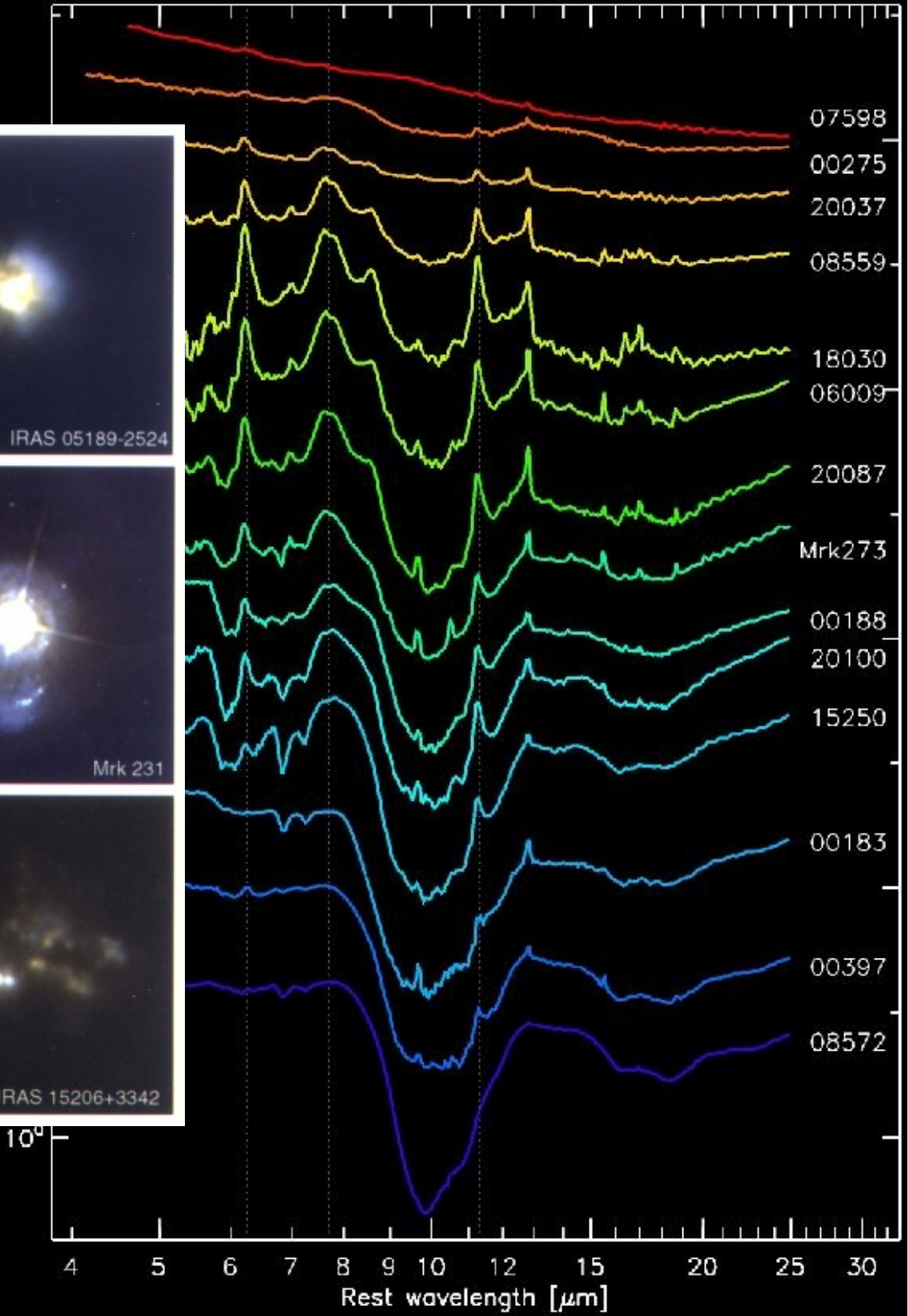
ULIRGs z < 0.15:
Distancia < 2000 millones años luz
Edad universo > 12000 millones de años

LIRGs z = 1:
Distancia = 21500 millones años luz
Edad universo = 6000 millones de años

ULIRGs z = 2:
Distancia = 51000 millones años luz
Edad universo = 3300 millones de años




IRAS 01003-2238
Mrk 1014
IRAS 05189-2524
IRAS 08572+3915
IRAS 12071-0444
Mrk 231
Pks 1345+12
Mrk 463
IRAS 15206+3342


07598
00275
20037
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06009
20087
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00183
00397
08572
10⁰
4
5
6
7
8
9
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12
15
20
25
30
Rest wavelength [μm]


Gracias por su atención