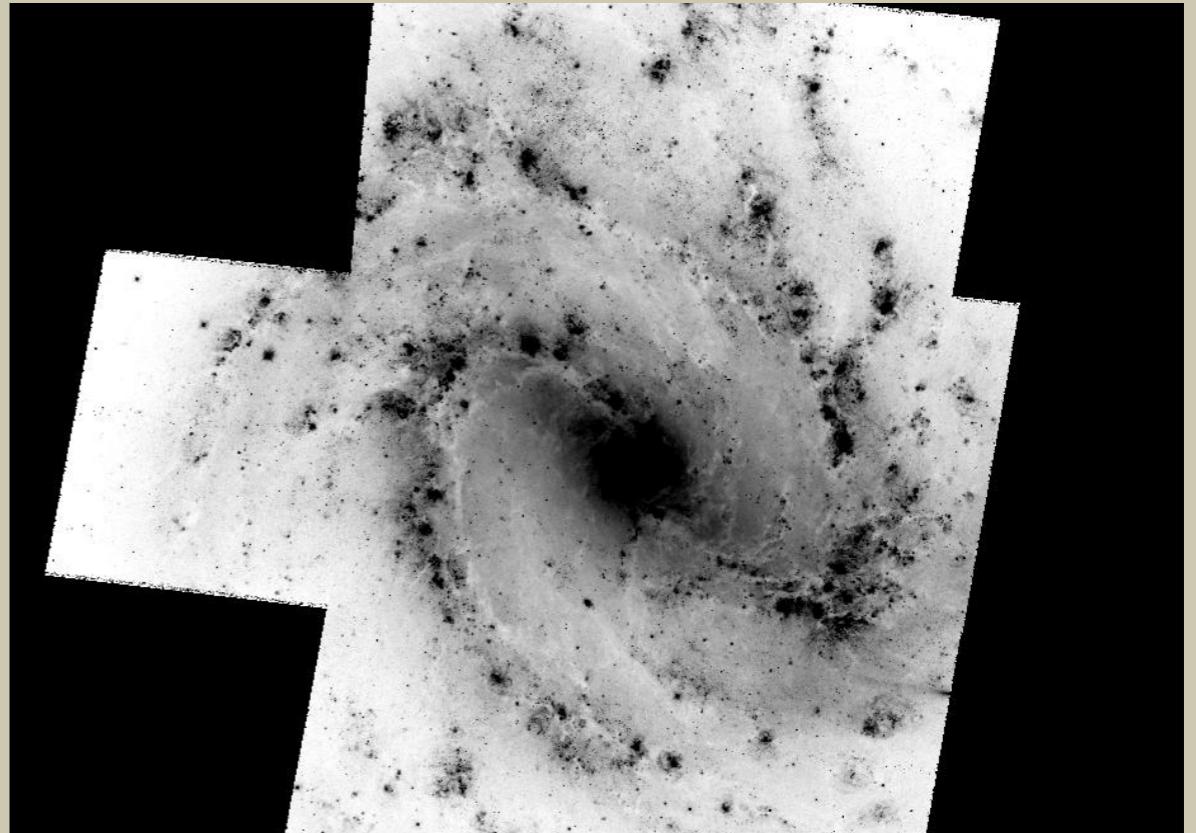


Taller de introducción al análisis de datos astronómicos

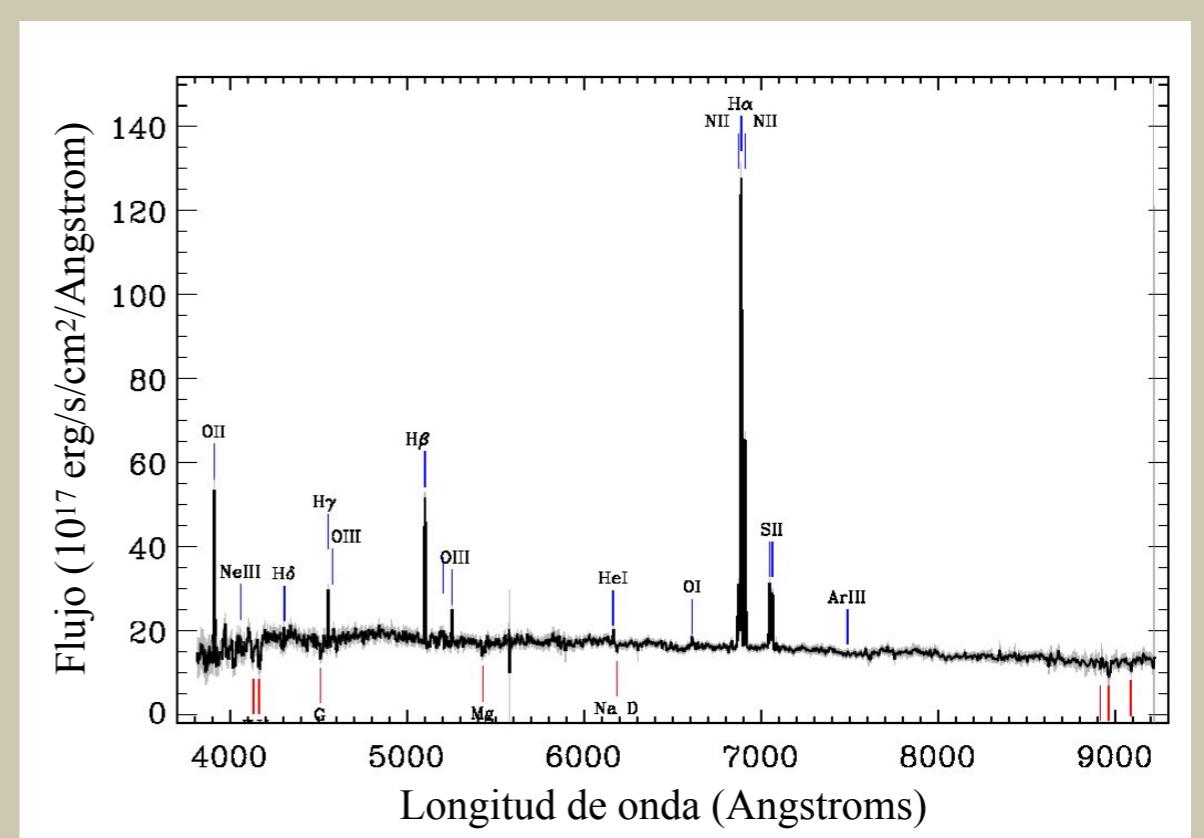


INSTRUCTORES:

Aida Nava de Wofford (IA, UNAM)
Sundar Srinivasan (IRyA, UNAM)

SEDE Y FECHA:

U. Autónoma de Ciudad Juárez
22-23 Abril 2021, 11-13 hr, CDMX



Las láminas de la presentación están disponibles en

https://github.com/sundarjhu/UACJ_Jornada2021

Parte1_20210422.pdf

Parte2_20210422.pdf

PROGRAMA

- **Hora 1: Introducción a las galaxias**
- **Hora 2: Introducción a las bases de datos astronómicas, Oportunidades de estudio**
- **Hora 3: Introducción al Hubble Space Telescope, práctica de manipulación de imágenes**
- **Hora 4: Introducción al telescopio de la Fundación Sloan, práctica de manipulación de espectros**

TEMAS QUE SE CUBRIRÁN

- 1. Introducción a las galaxias (el tipo de objeto que analizaremos es una galaxia).**
- 2. Los telescopios e instrumentos que se emplearon para observar a la galaxia que analizaremos.**
- 3. Dos tipos de datos astronómicos: imágenes y espectros.**
- 4. Los repositorios de datos astronómicos y herramientas de trabajo.**
- 5. Práctica.**
- 6. Oportunidades de tesis de licenciatura o estudios de posgrado en la UNAM campus Ensenada o Morelia.**

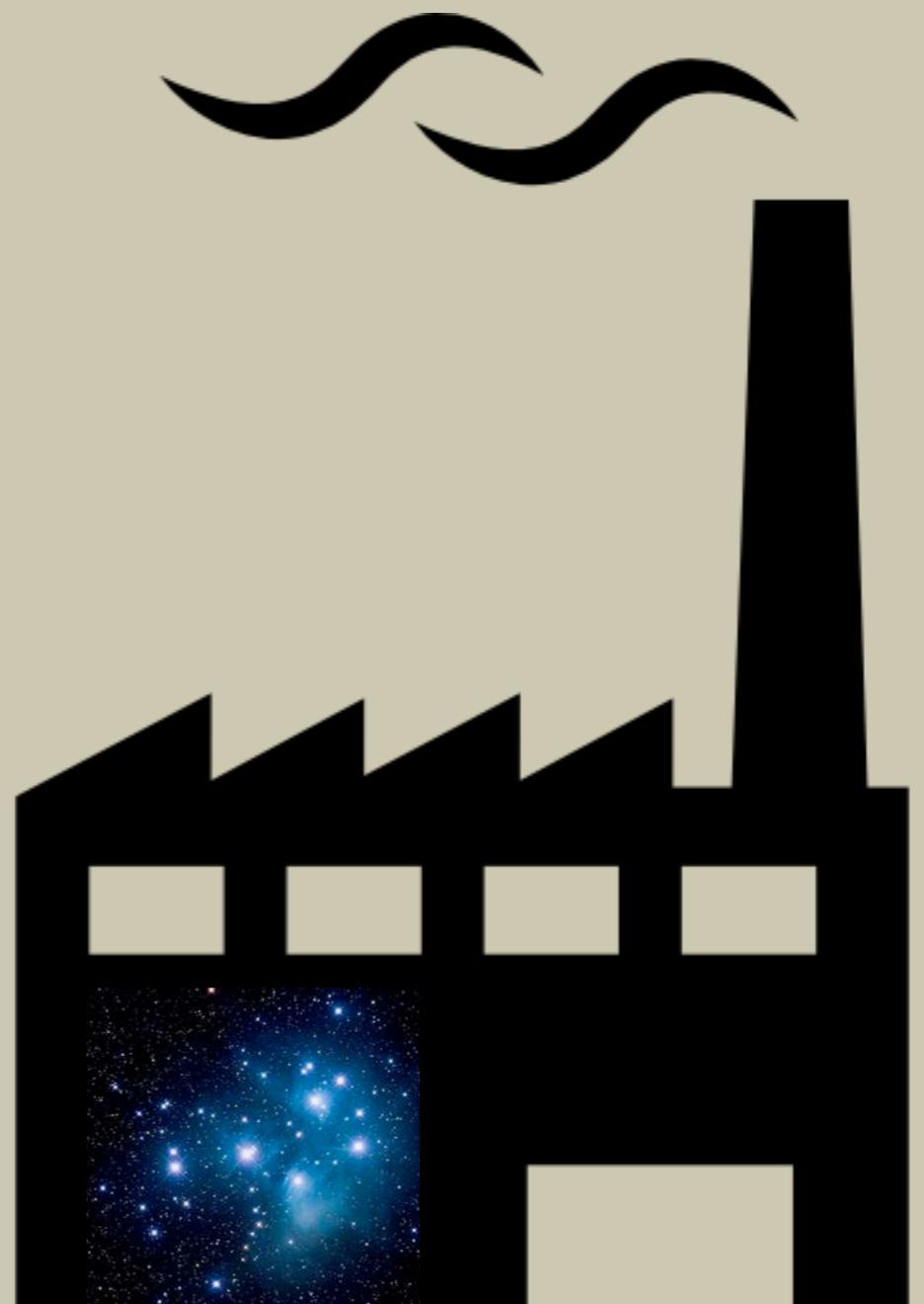
Introducción a las galaxias.

Definición informal de galaxia: fábrica de estrellas.



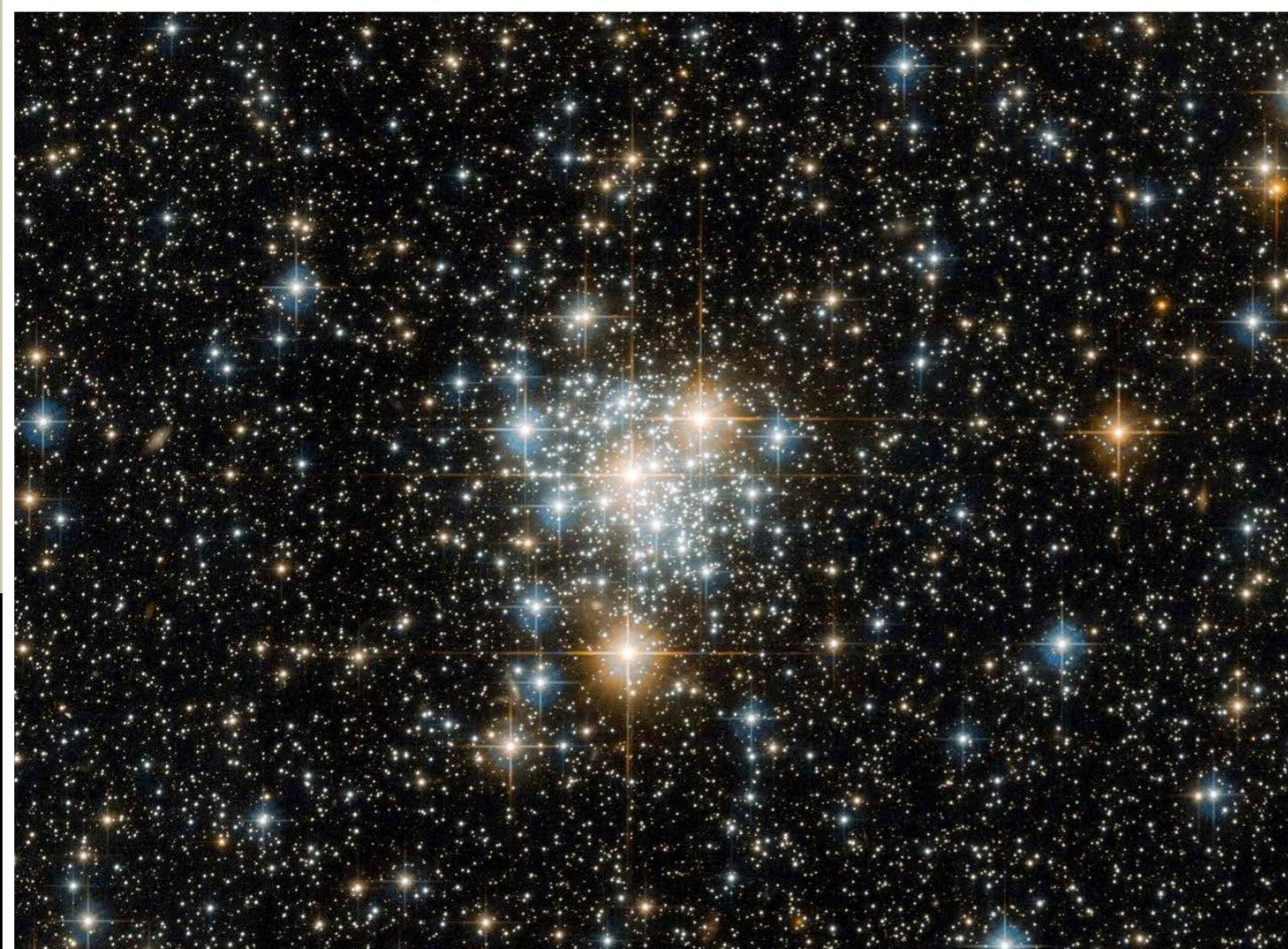
M101 (HST)

=

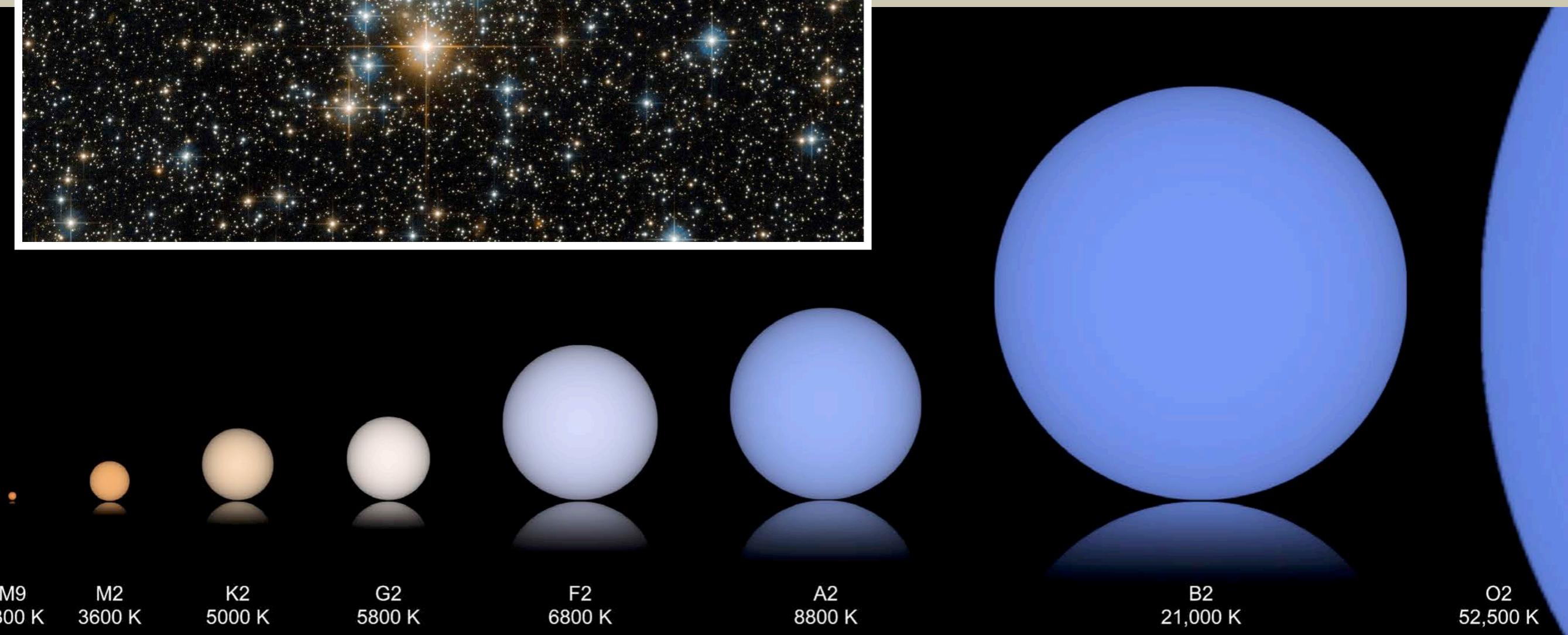


Diversidad de estrellas.

NGC 299 por HST

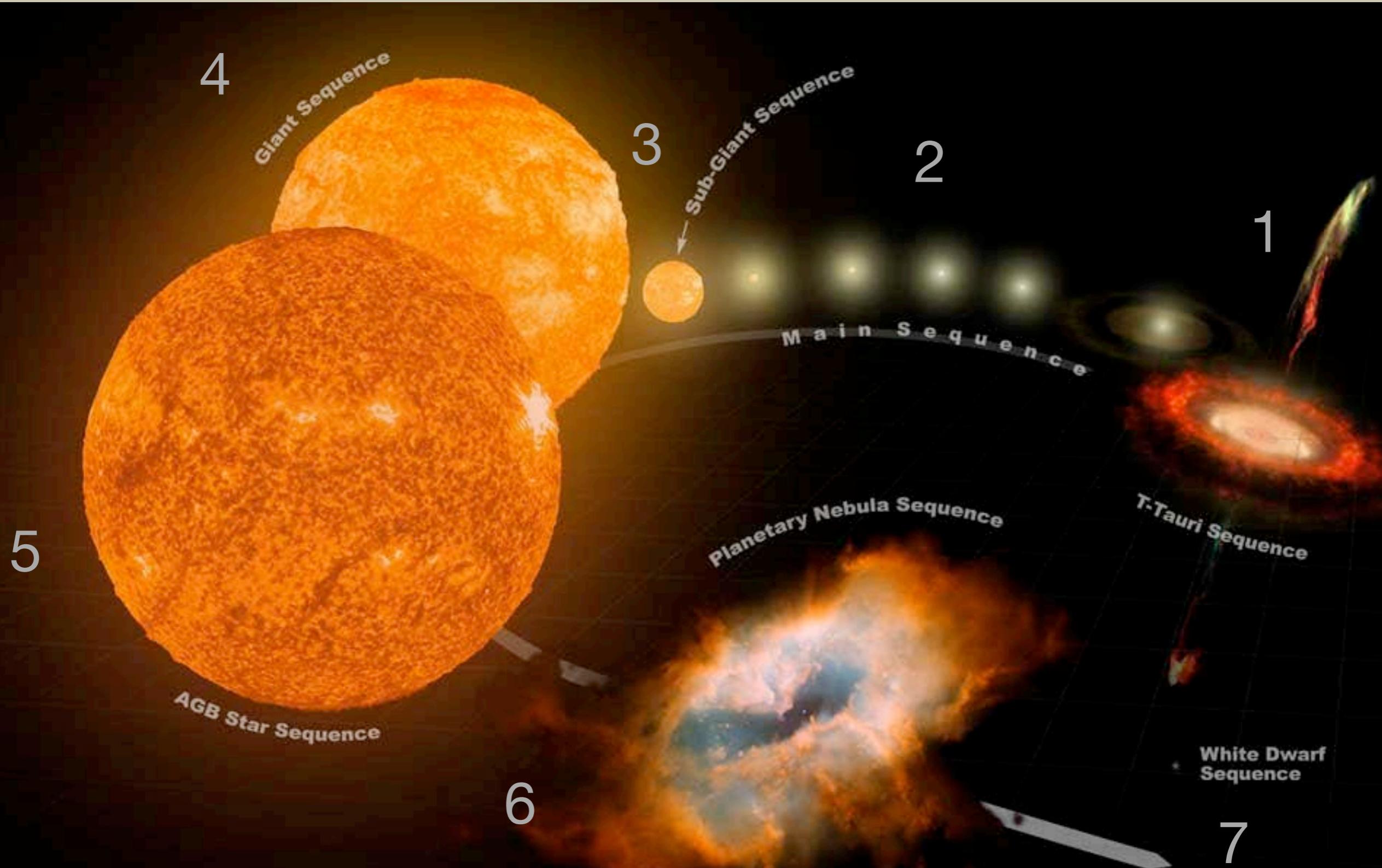


arXiv:2101.06254 (2021)



Las estrellas evolucionan.

Evolución para estrellas de inicialmente 0.8 a 8 masas solares.



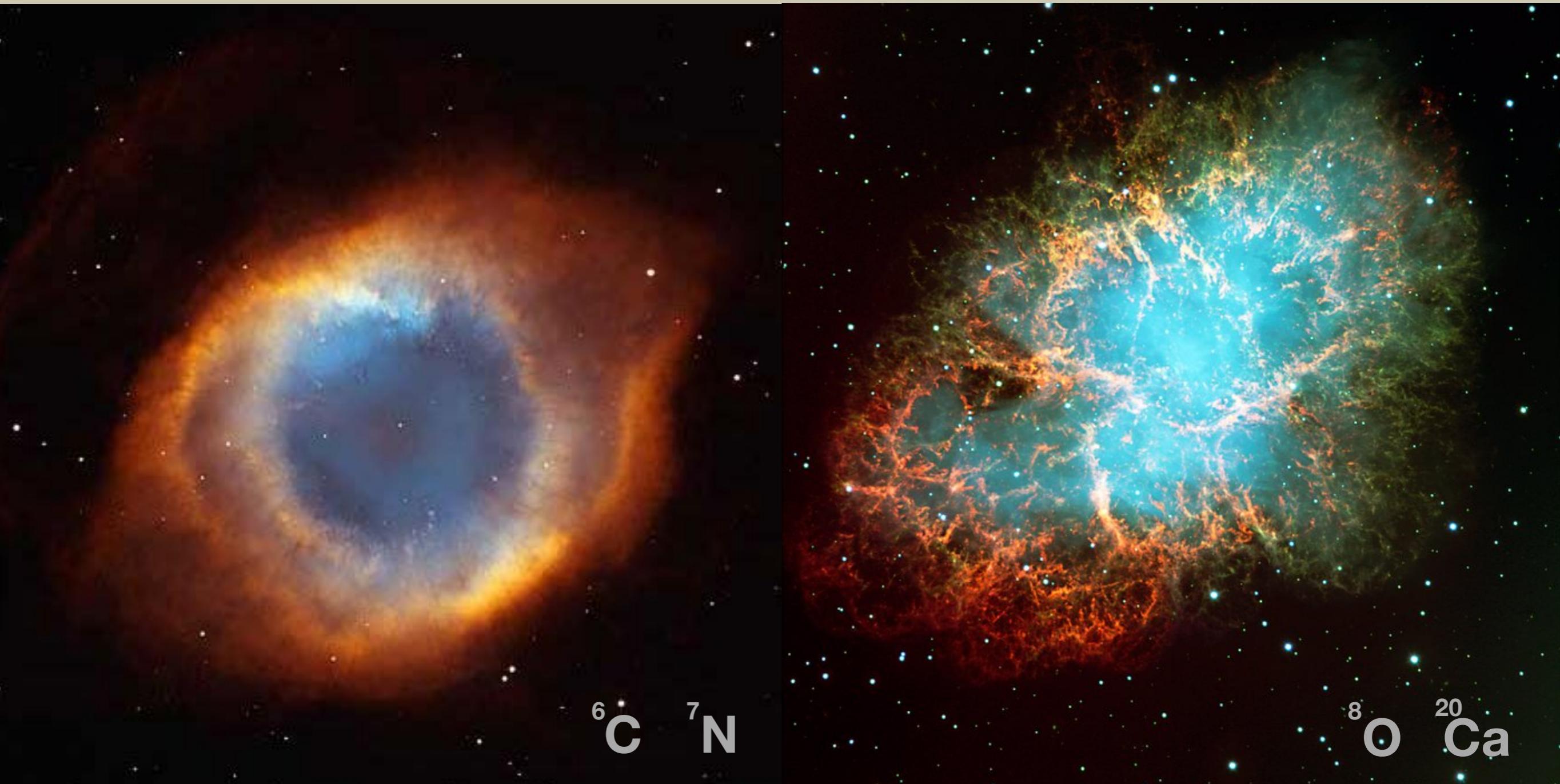
Imágenes de estrellas naciendo (vistas por el telescopio espacial Hubble, HST)



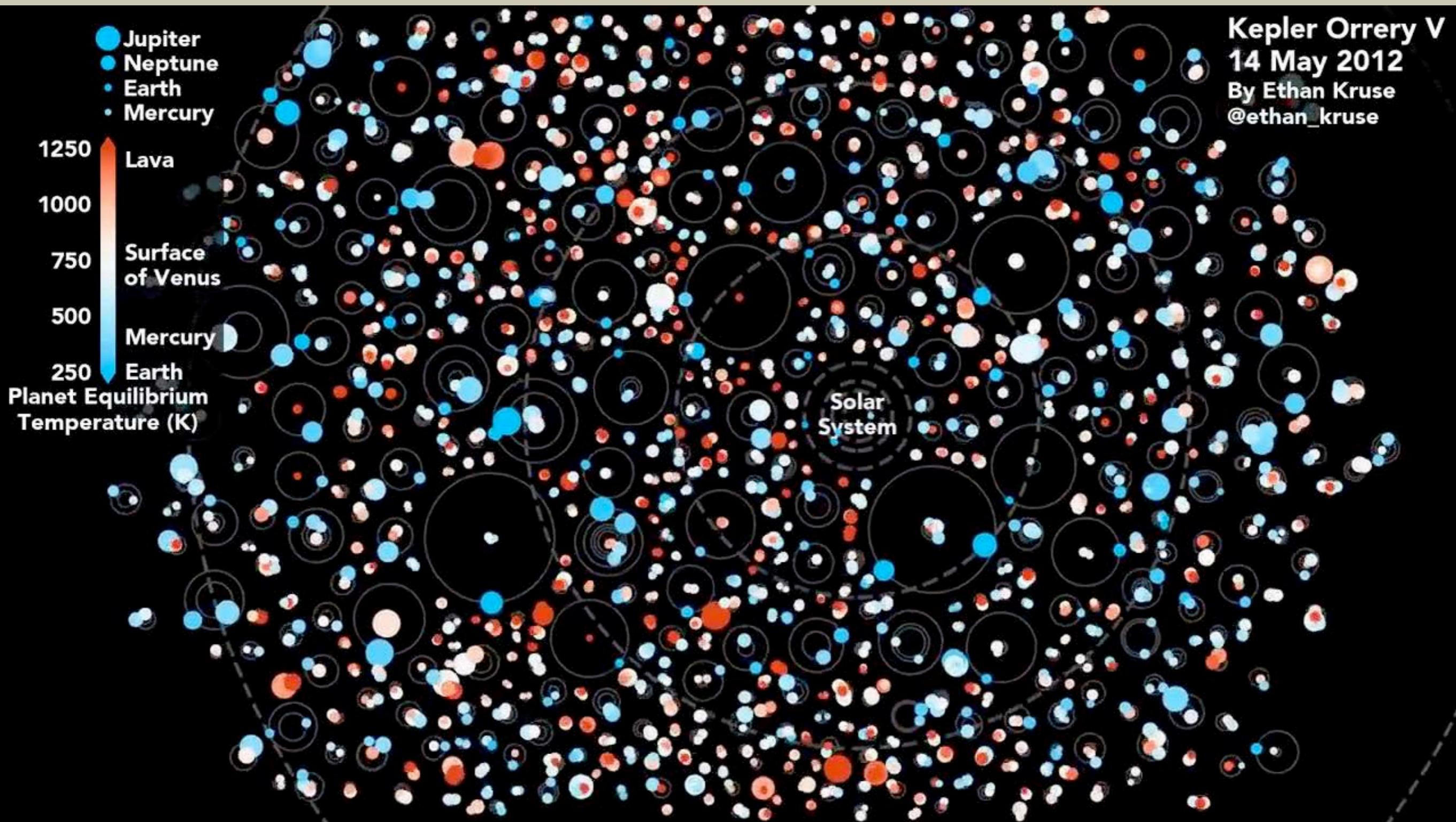
visible

infrarojo

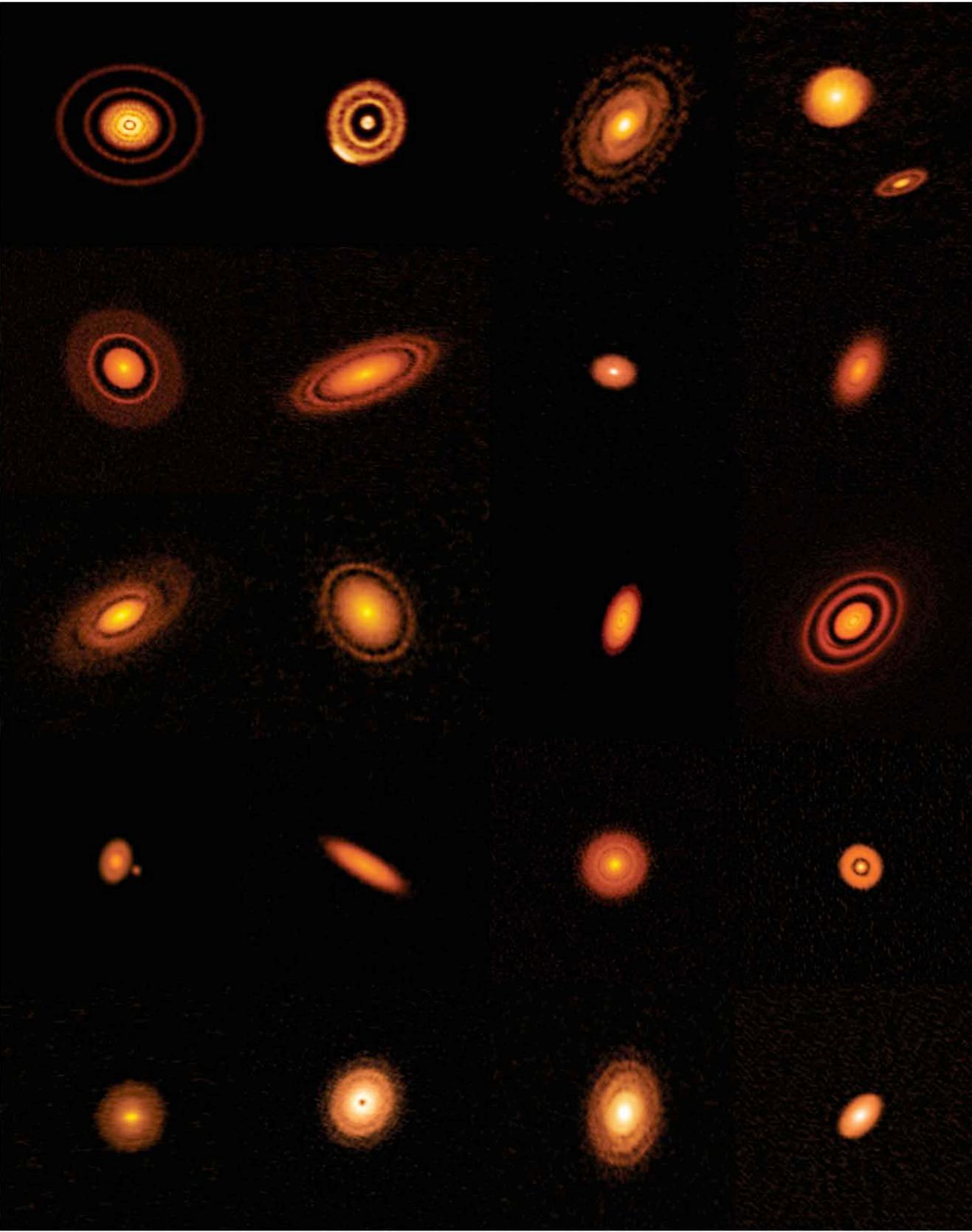
Estrellas muriendo (vistas por HST)



Las estrellas tienen planetas (sondeo de Kepler).

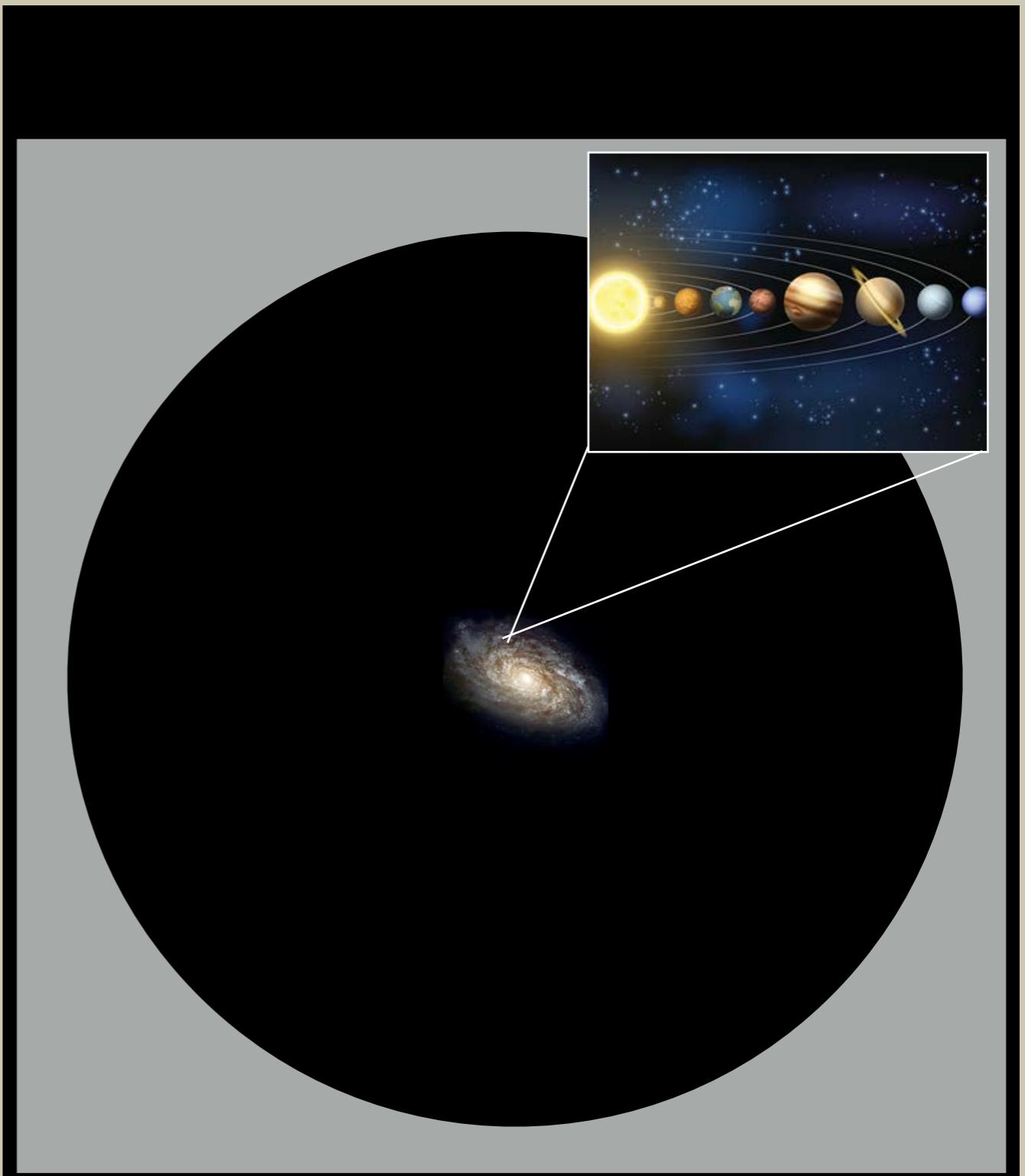


Planetas naciendo (vistos por ALMA).

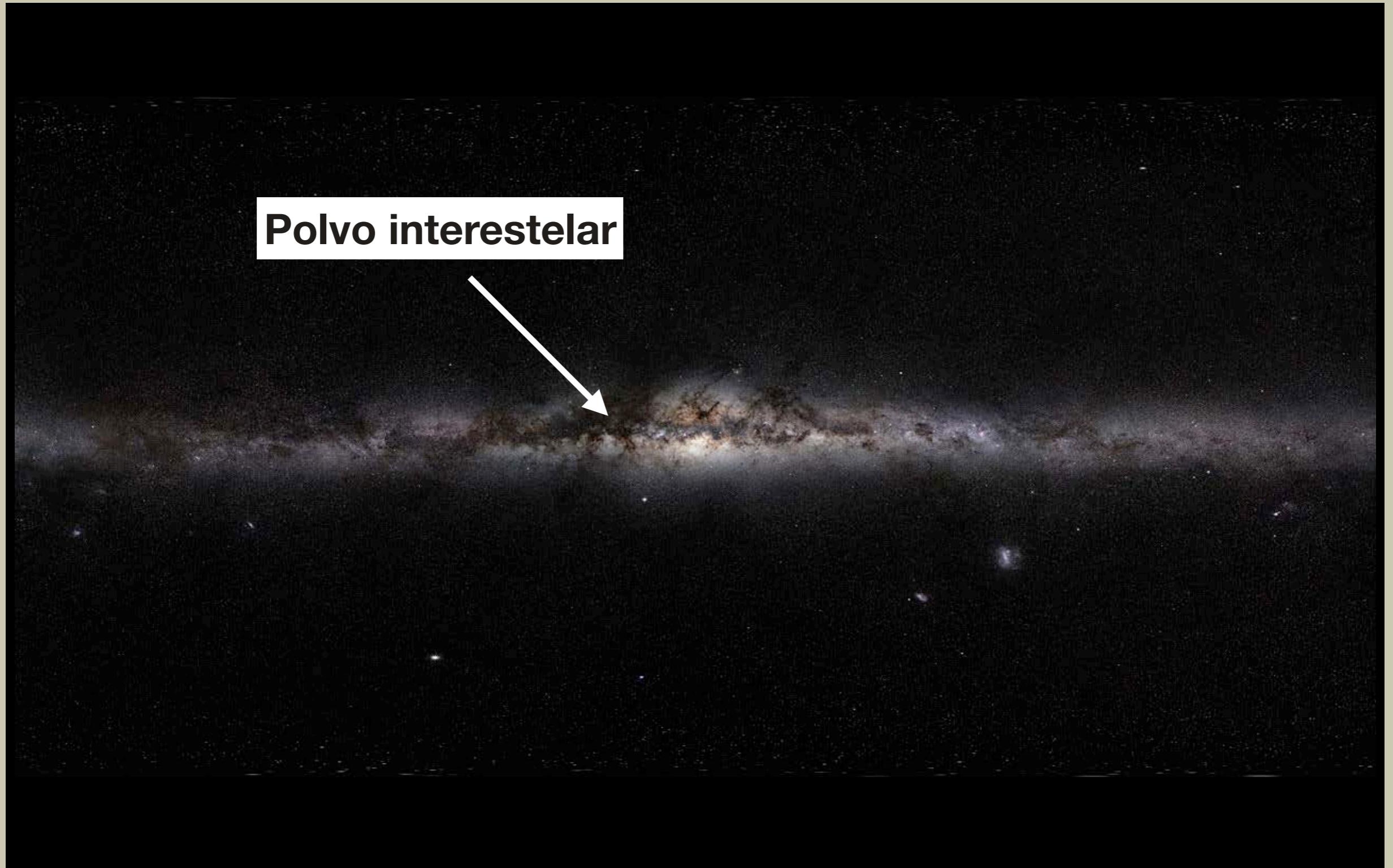


Definición más sofisticada de galaxia.

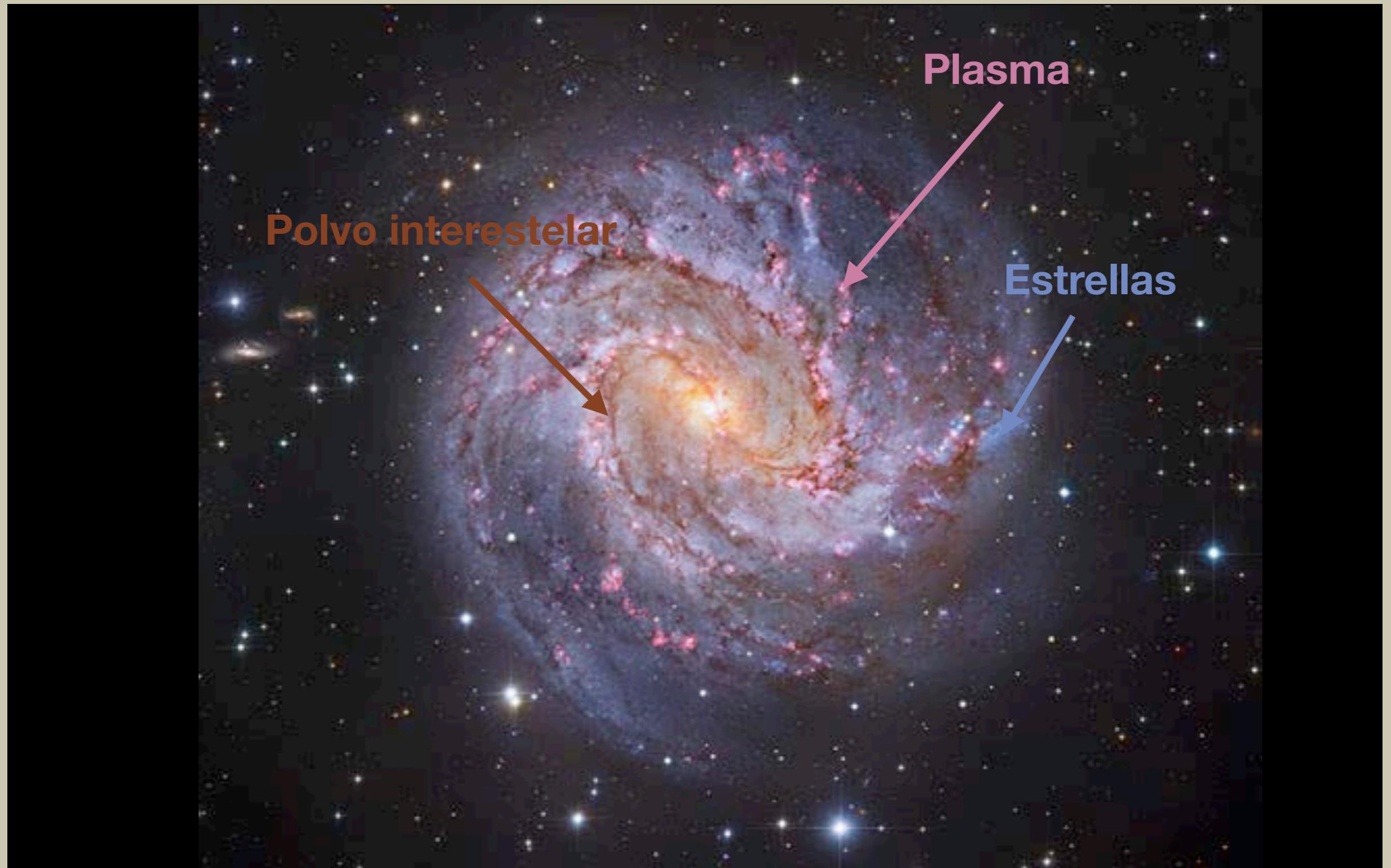
Un halo de materia oscura que en su centro tiene un conjunto de gas, polvo y miles de millones de estrellas con sus sistemas solares, retenidos por la fuerza de gravedad.



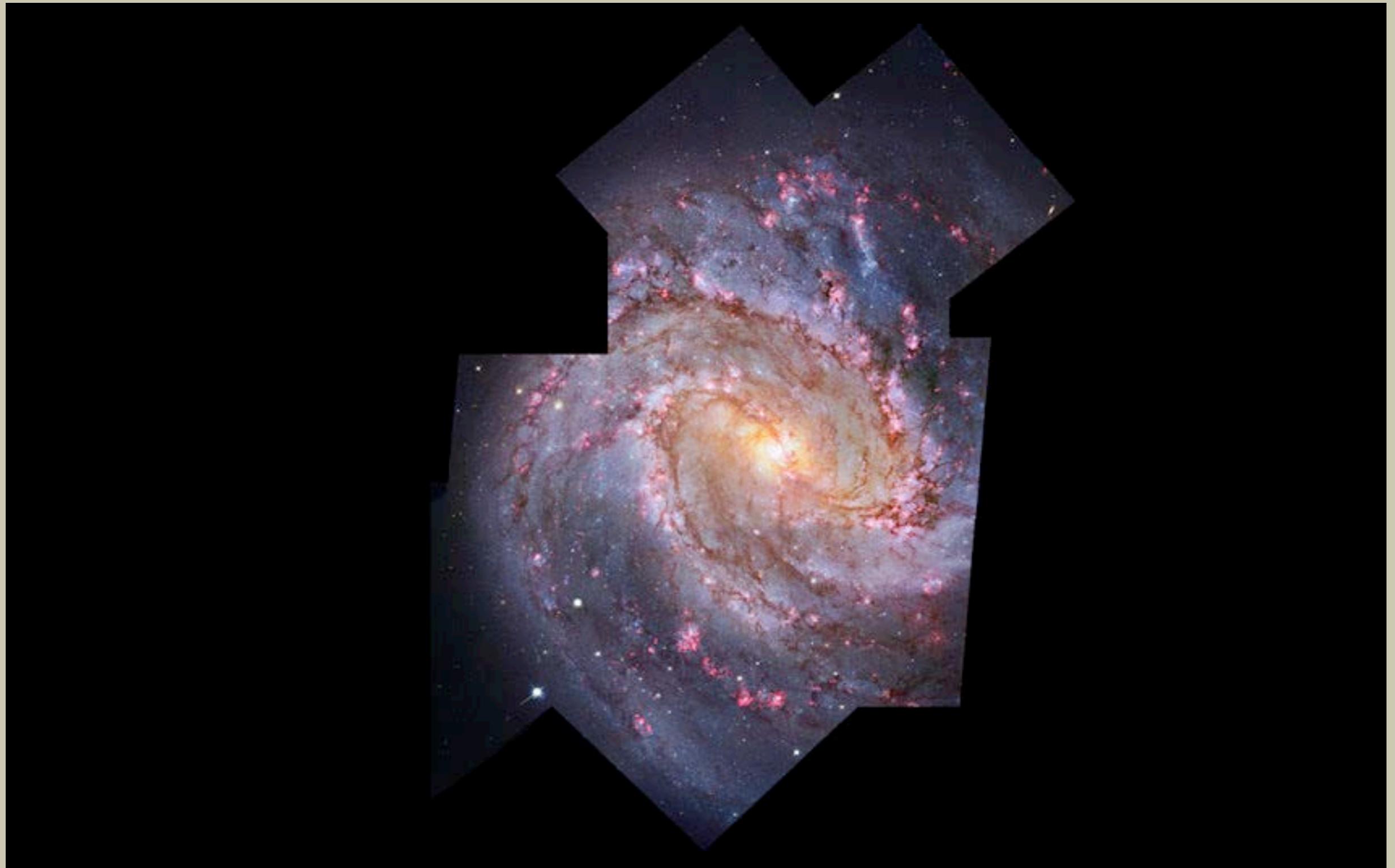
**Nuestra galaxia es la Vía Láctea.
Es un fino disco de estrellas, gas y polvo.**



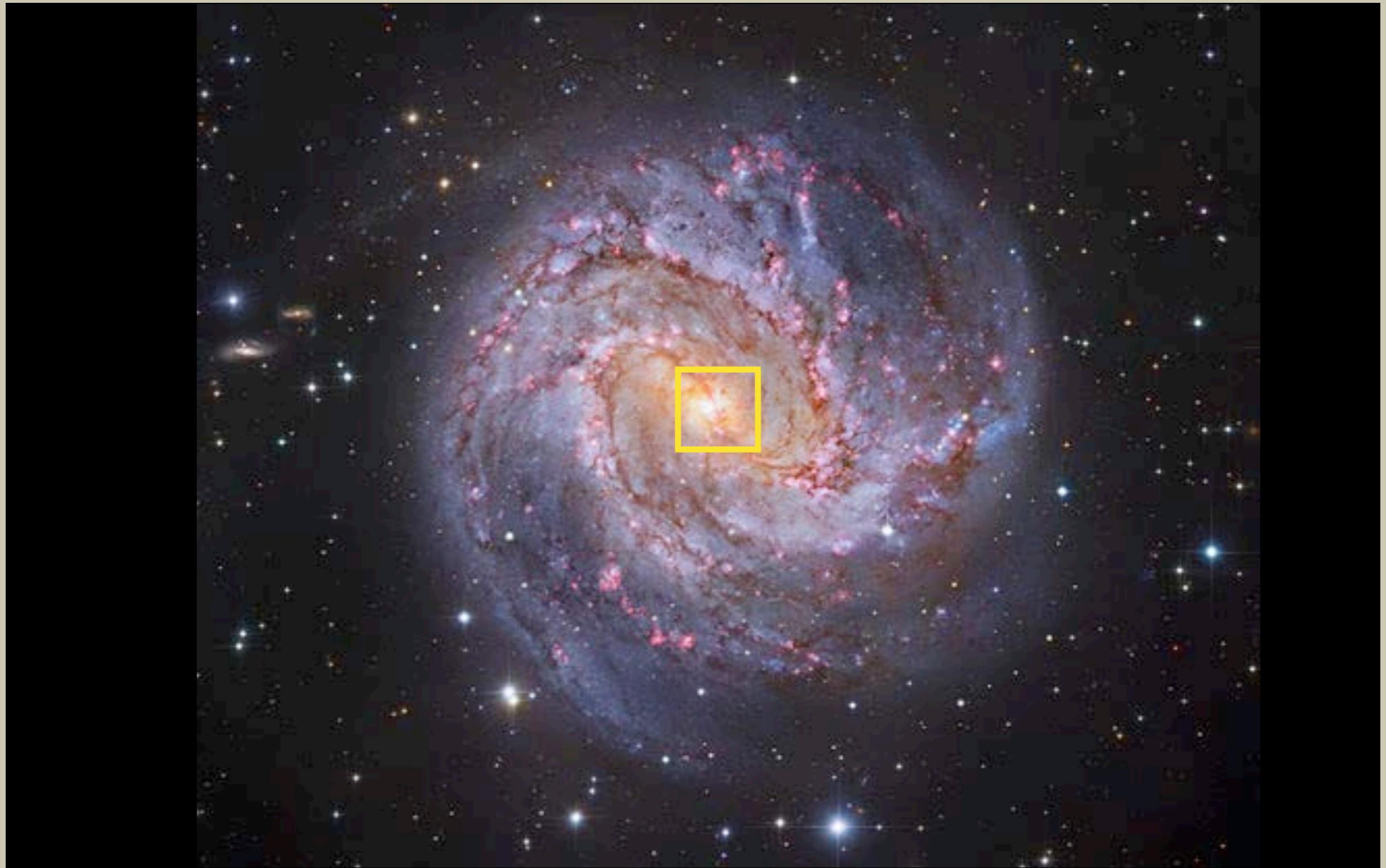
Nuestra galaxia se parece a M83.



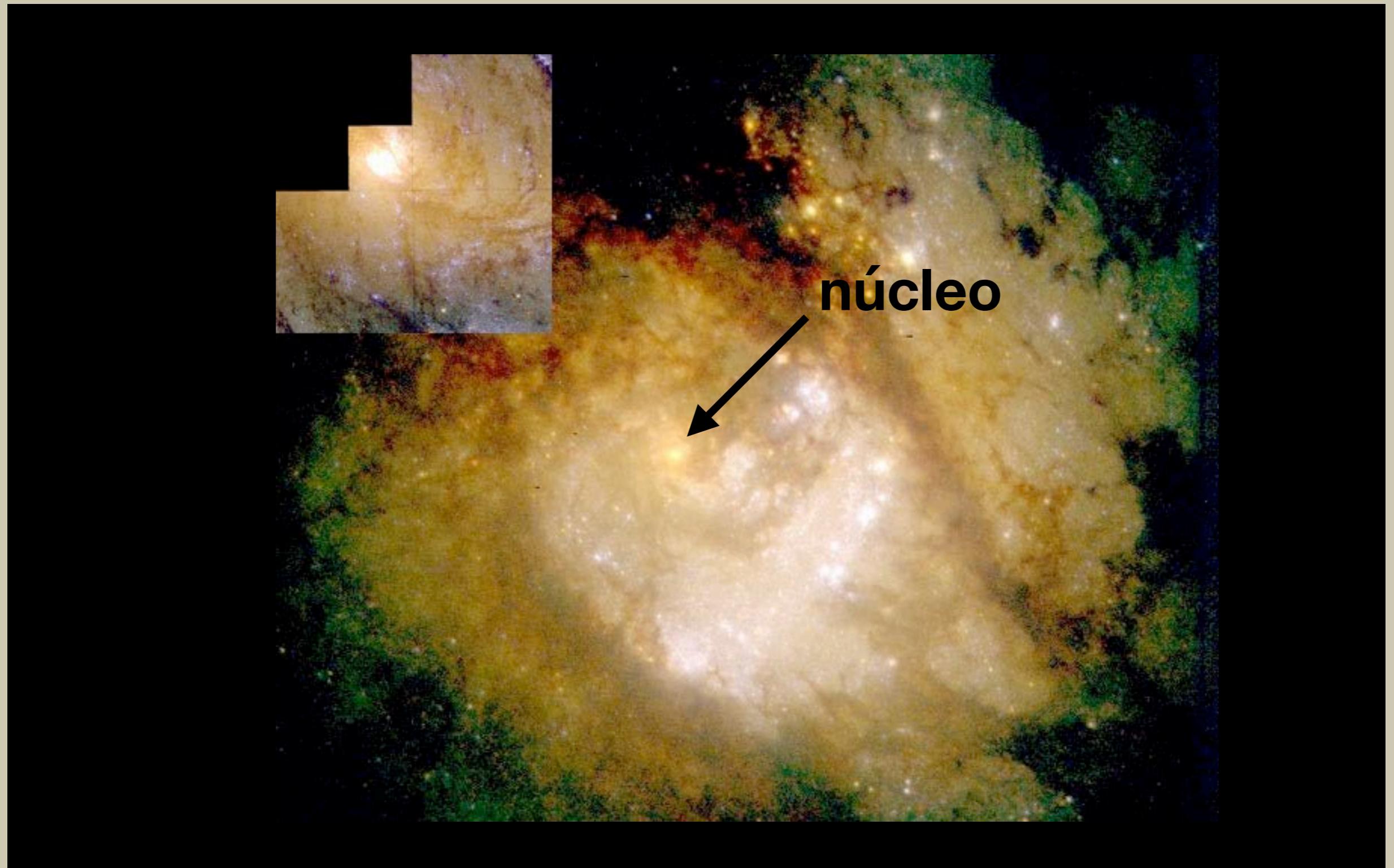
A menudo las imágenes que ven son mosaicos.



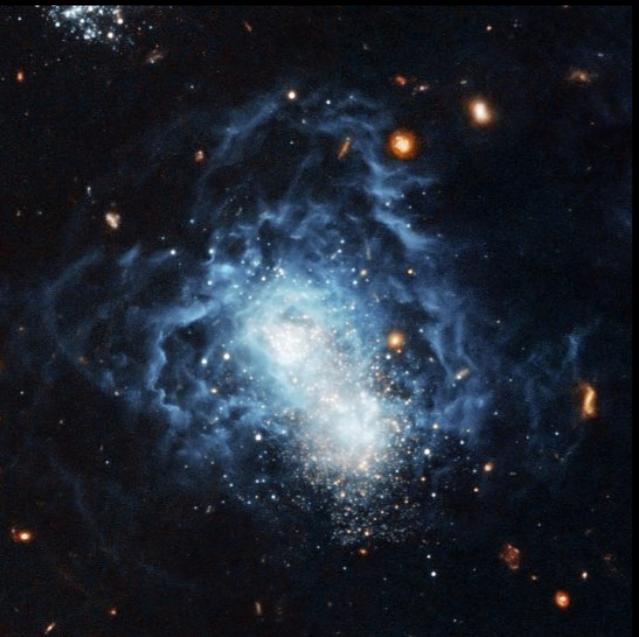
Acerquémonos a la parte central.



En el núcleo de M83 hay una densa concentración de 10^6 estrellas.



Las galaxias evolucionan en el tiempo.



Irregular, I Zw 18



Espiral, Andrómeda



Elíptica, M87

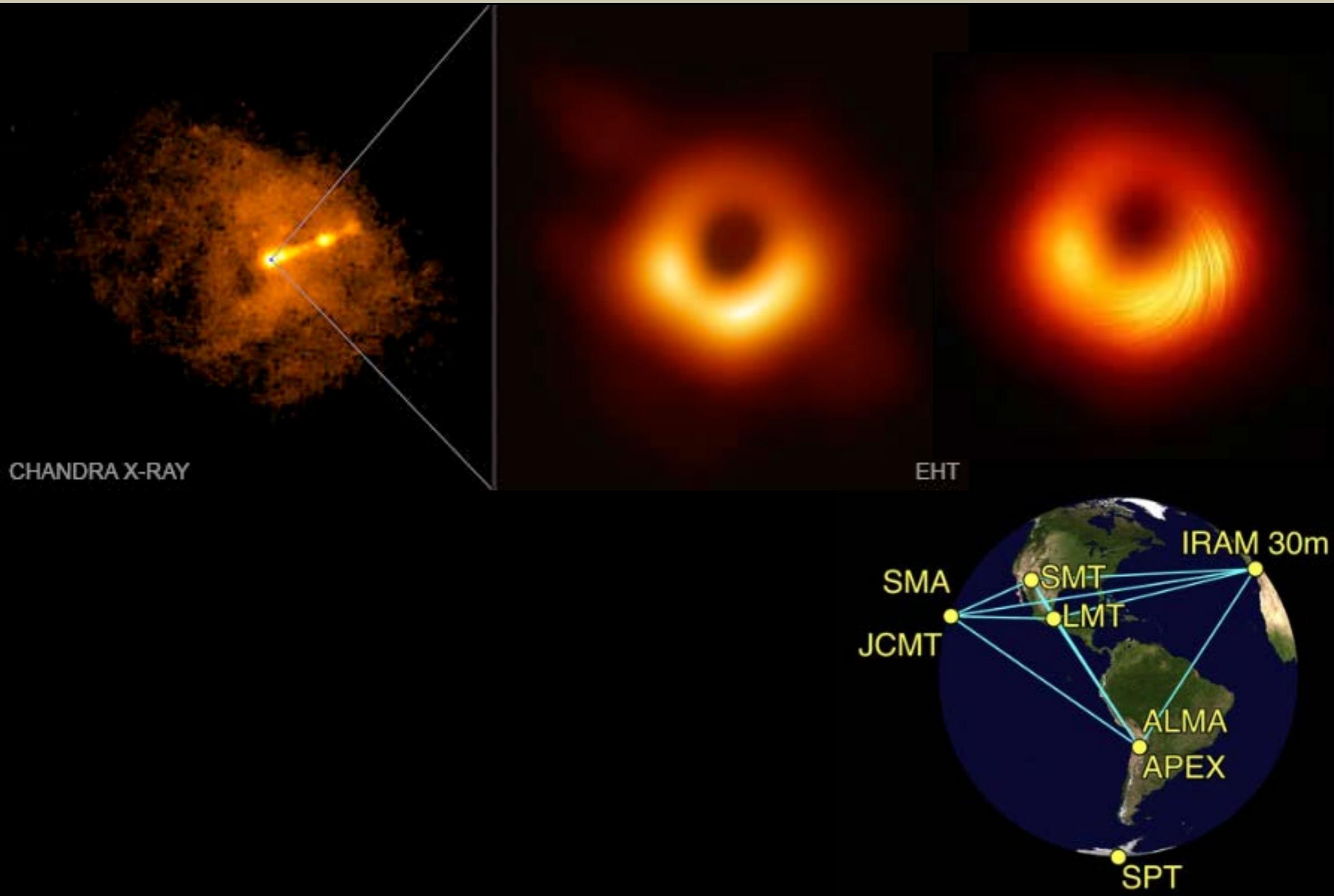
Galaxia elíptica M87 y jet que sale de su agujero negro central.



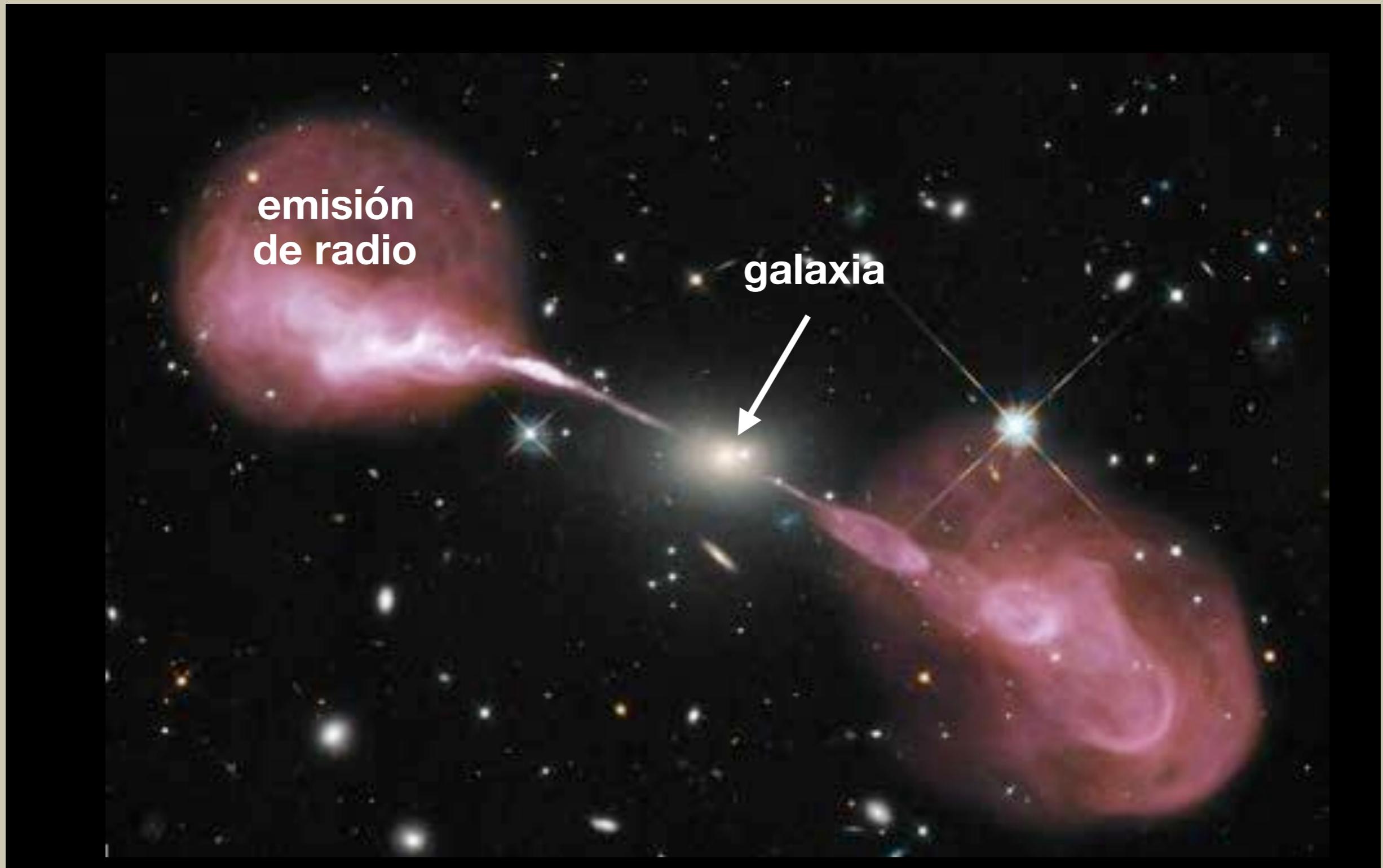
Hubble Space Telescope 07/06/2000

Rolf Wahl Olsen
08/04/2010 57 x 30.5s
10" Newton / ToUCam Pro SC1

La sombra del agujero negro central.



Cuando la explosión central es grande vemos lóbulos que emiten en radio
(radio galaxia Hércules A, credito: Very Large Array)



Las galaxias tienen vientos.



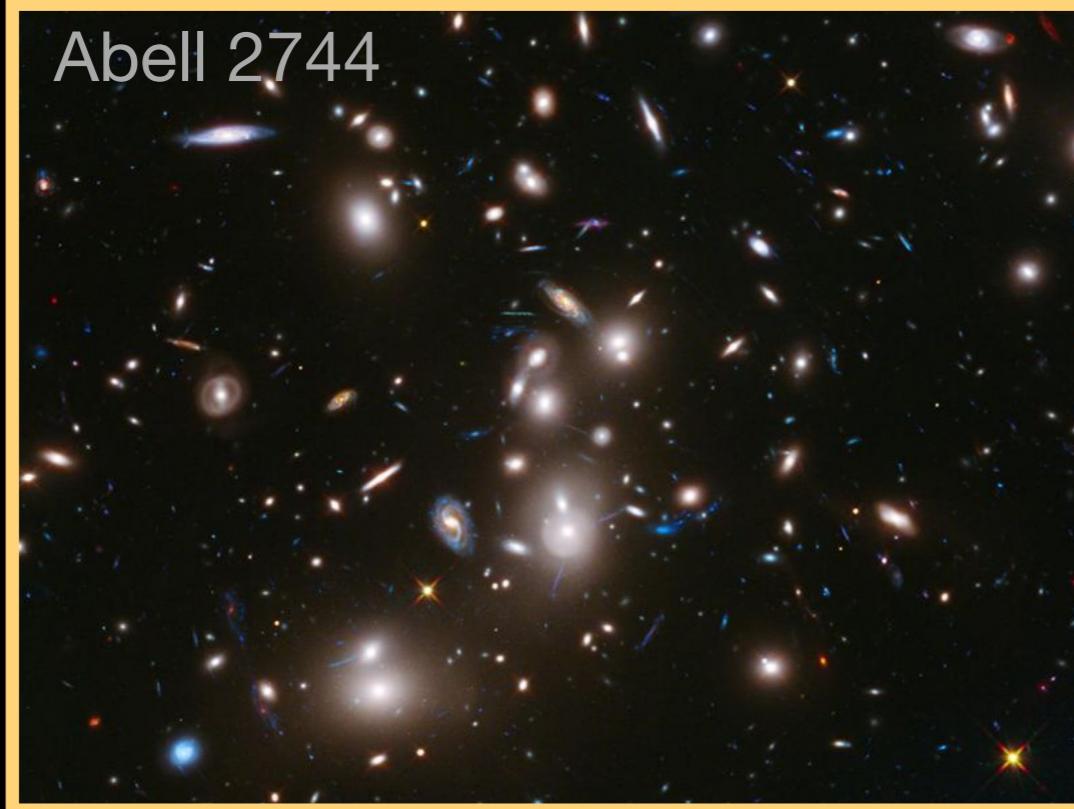
M82 vista por HST, Spitzer y Chandra

Las galaxias se agrupan.

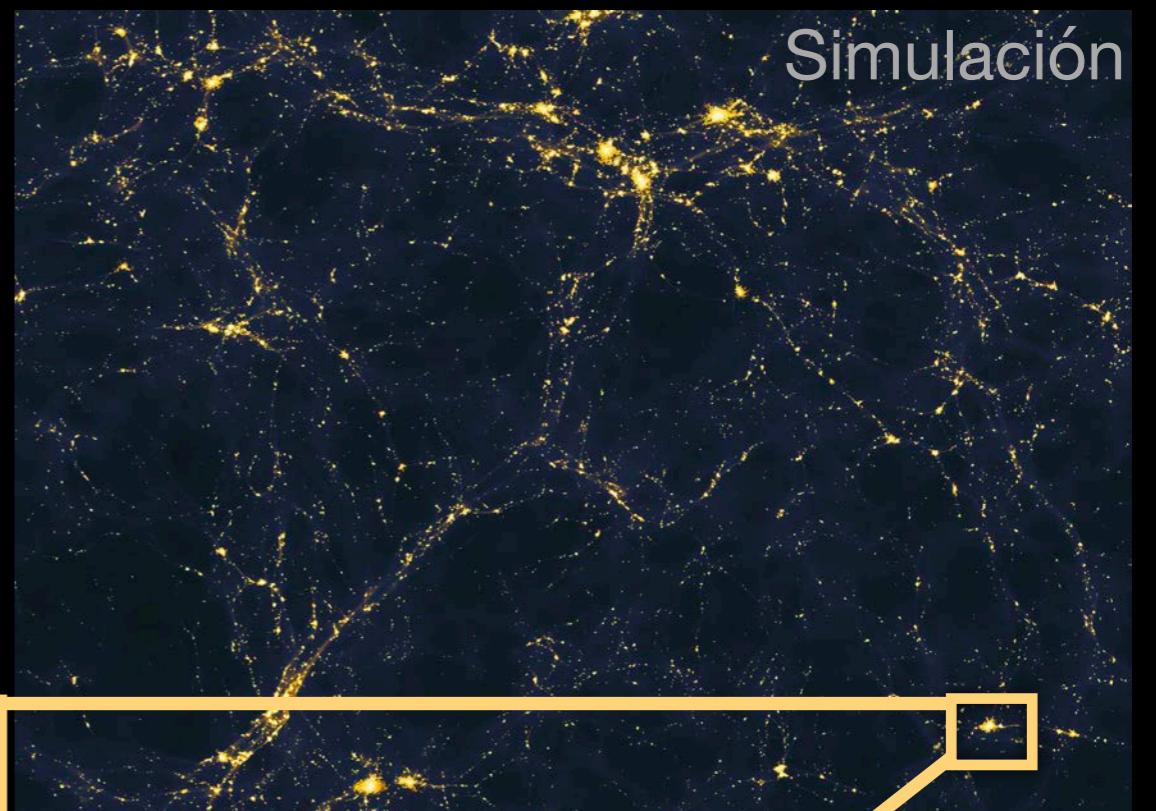
Stephan's Quintet



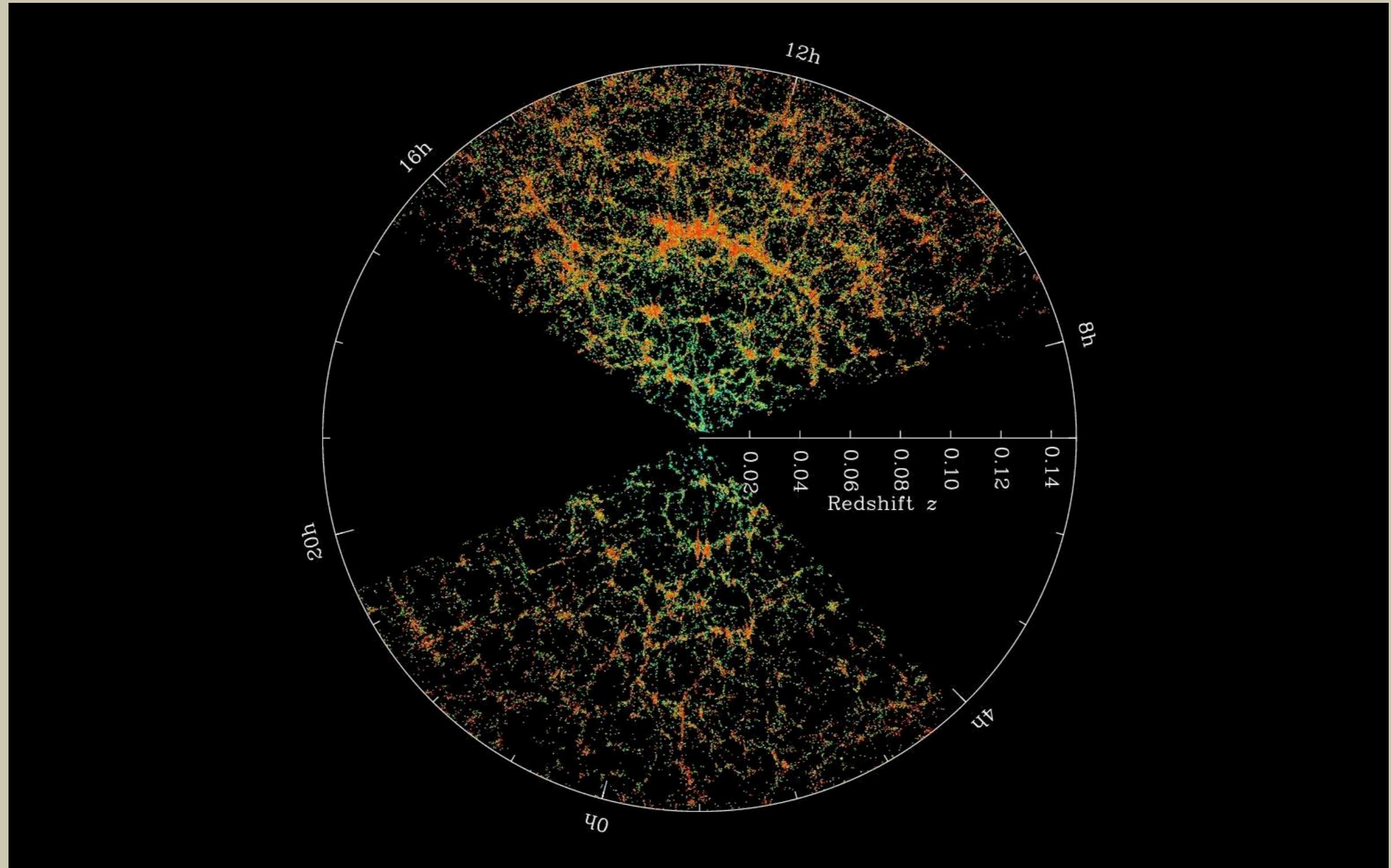
Abell 2744



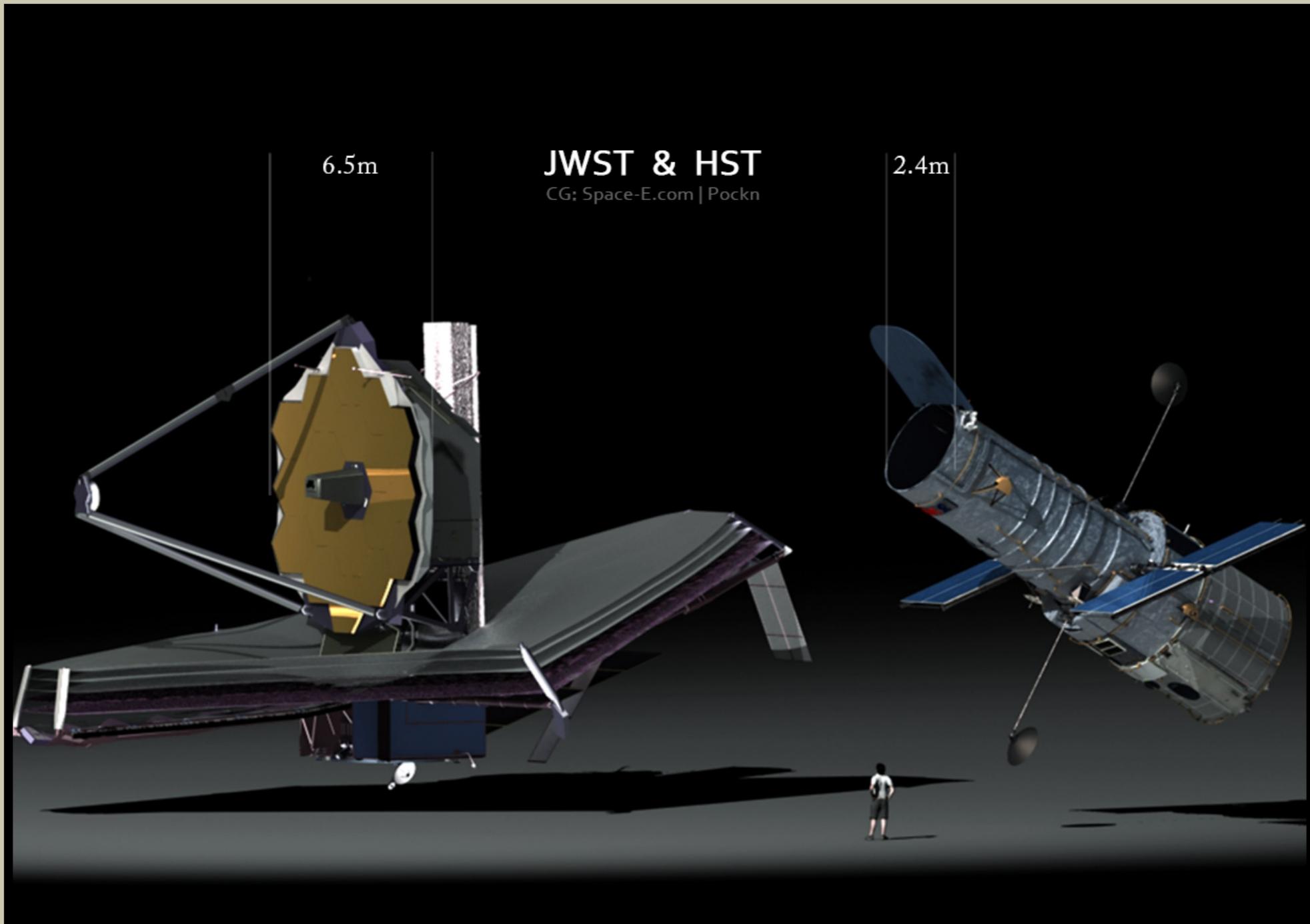
Simulación



Mapa de la distribución de galaxias en el Universo.



El futuro telescopio espacial James Webb Space Telescope podrá ver las primeras galaxias jamás formadas en el Universo.



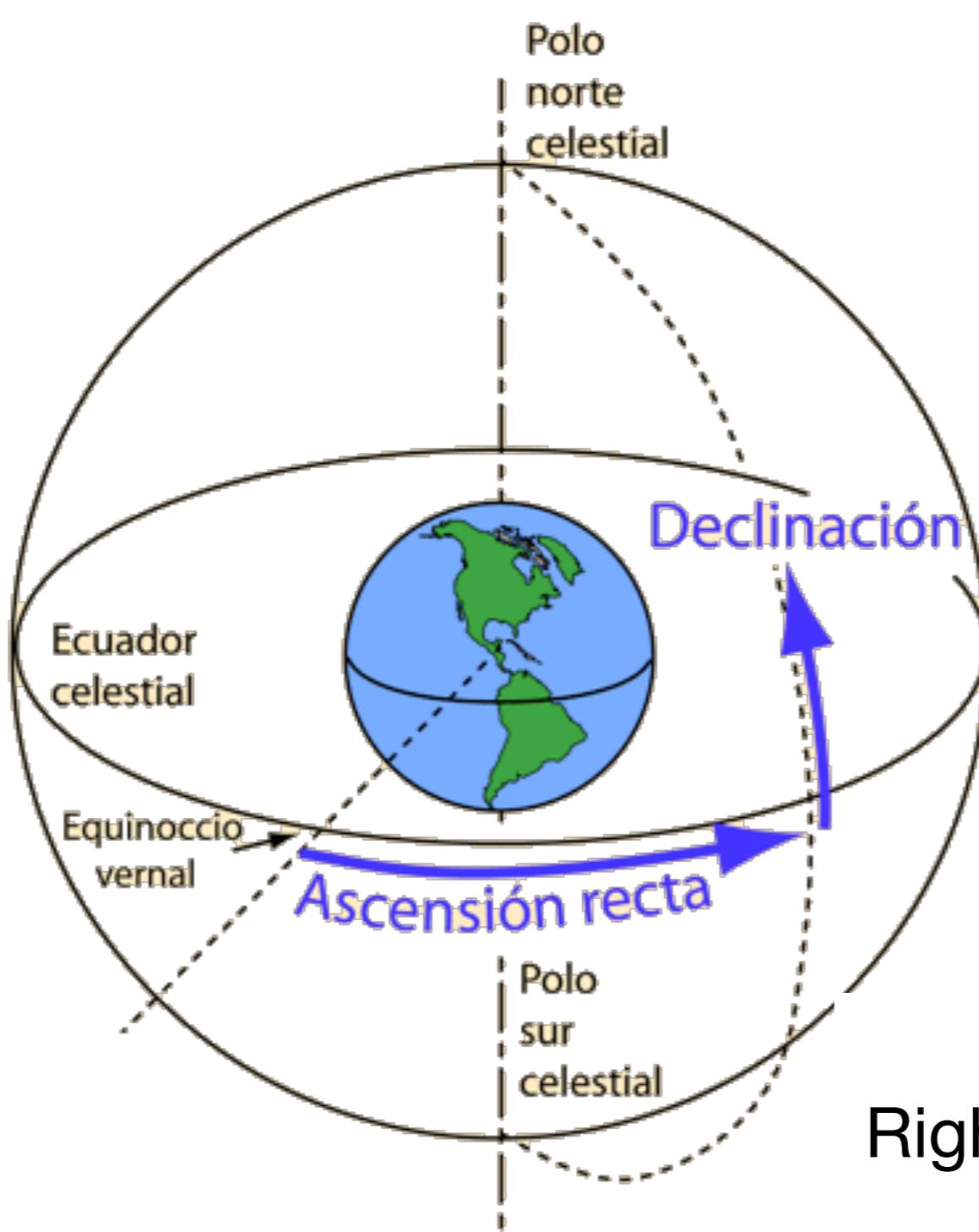
Los repositorios de datos y herramientas de trabajo.

**Archivos astronómicos, Python, Notebook,
Google Colaboratory.**

En las bases de datos puedo encontrar...

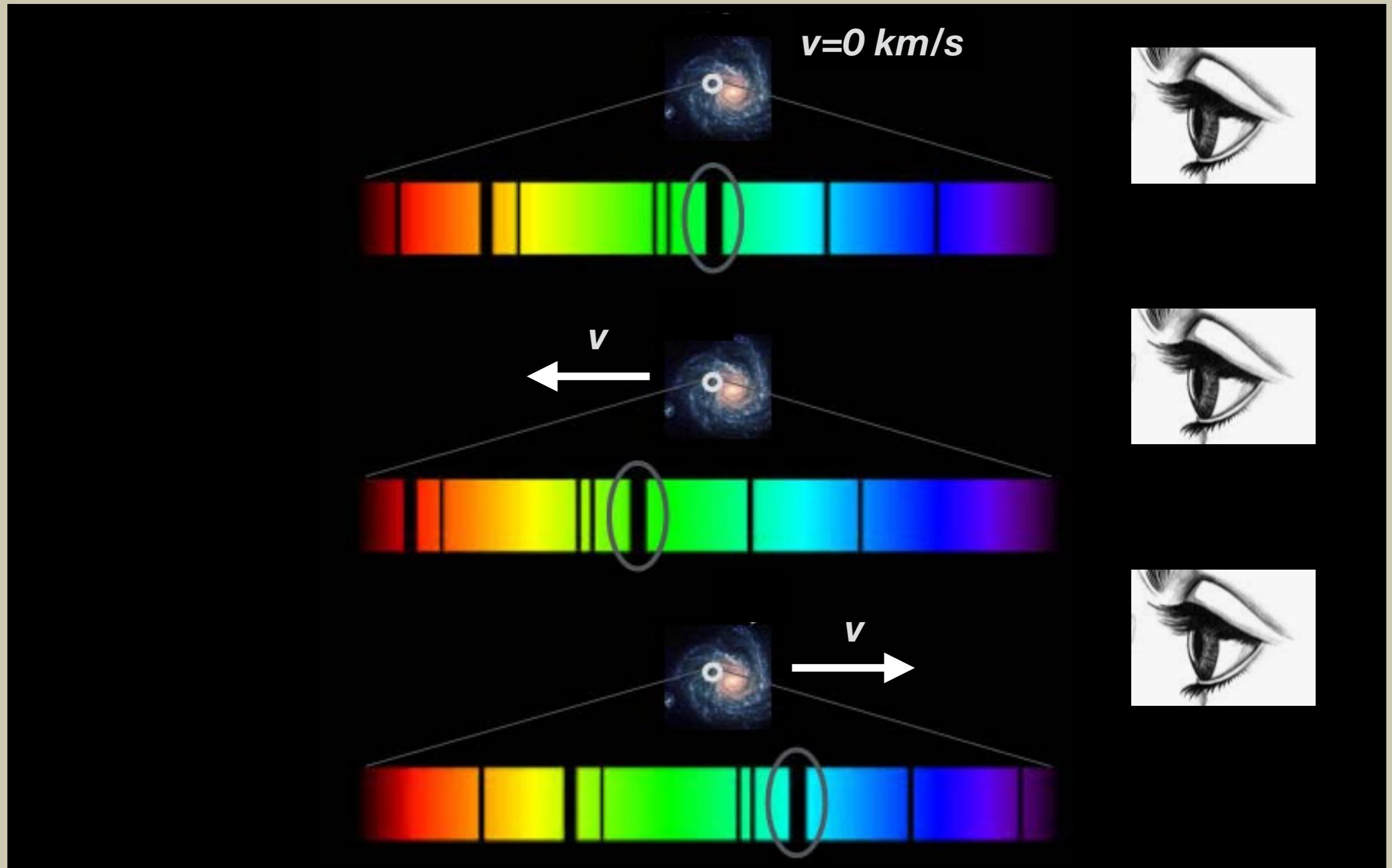
- Coordenadas
- Corrimientos al rojo
- Extinción debida a polvo en la Vía Láctea
- Imágenes y espectros de diferentes objetos astronómicos

Coordenadas.

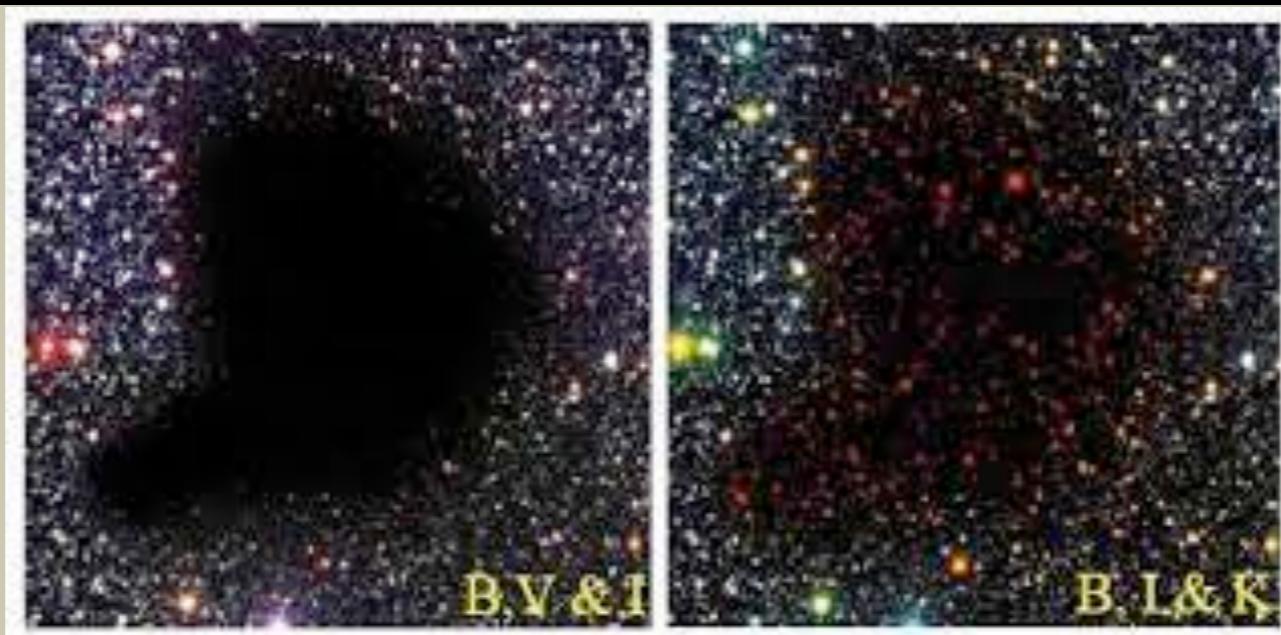
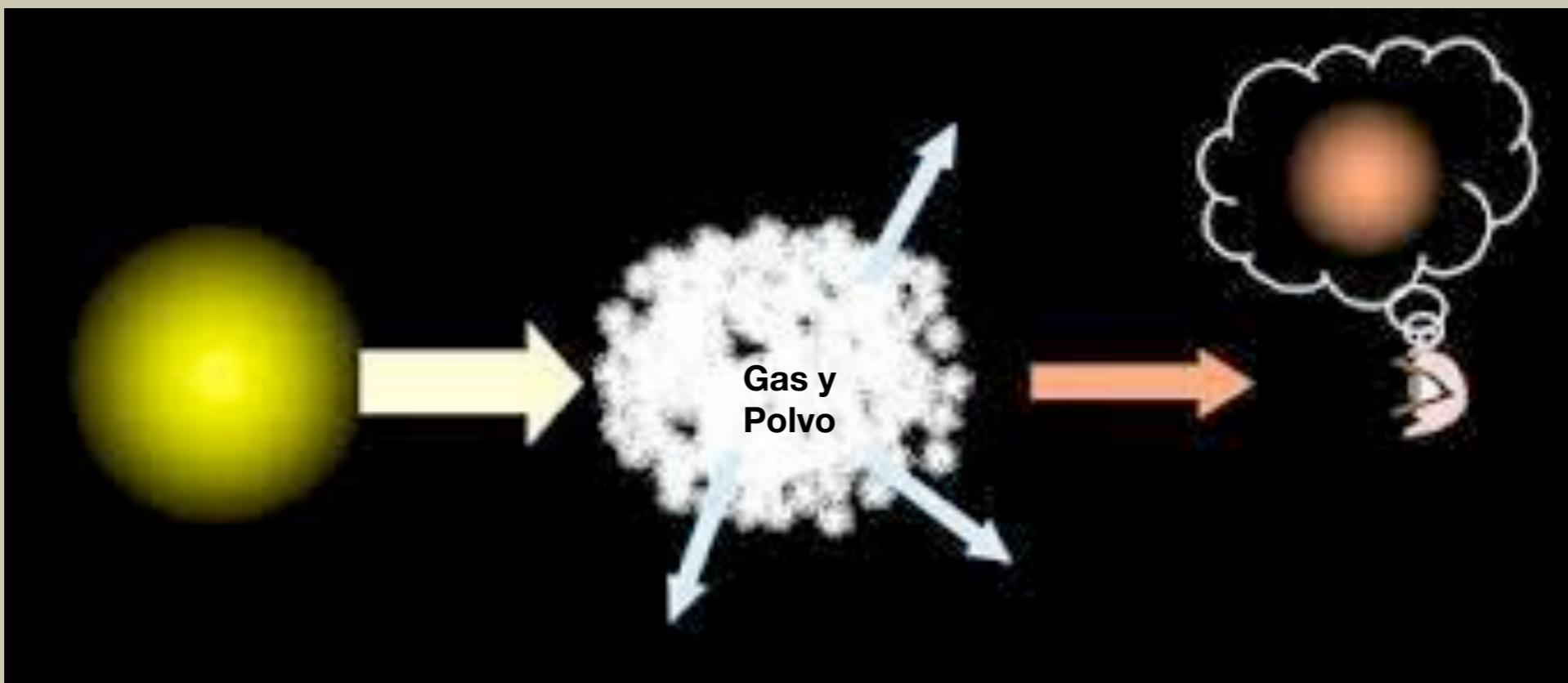


En inglés:
Right Ascension (RA)
Declination (Dec)

Corrimiento al rojo por efecto Doppler.

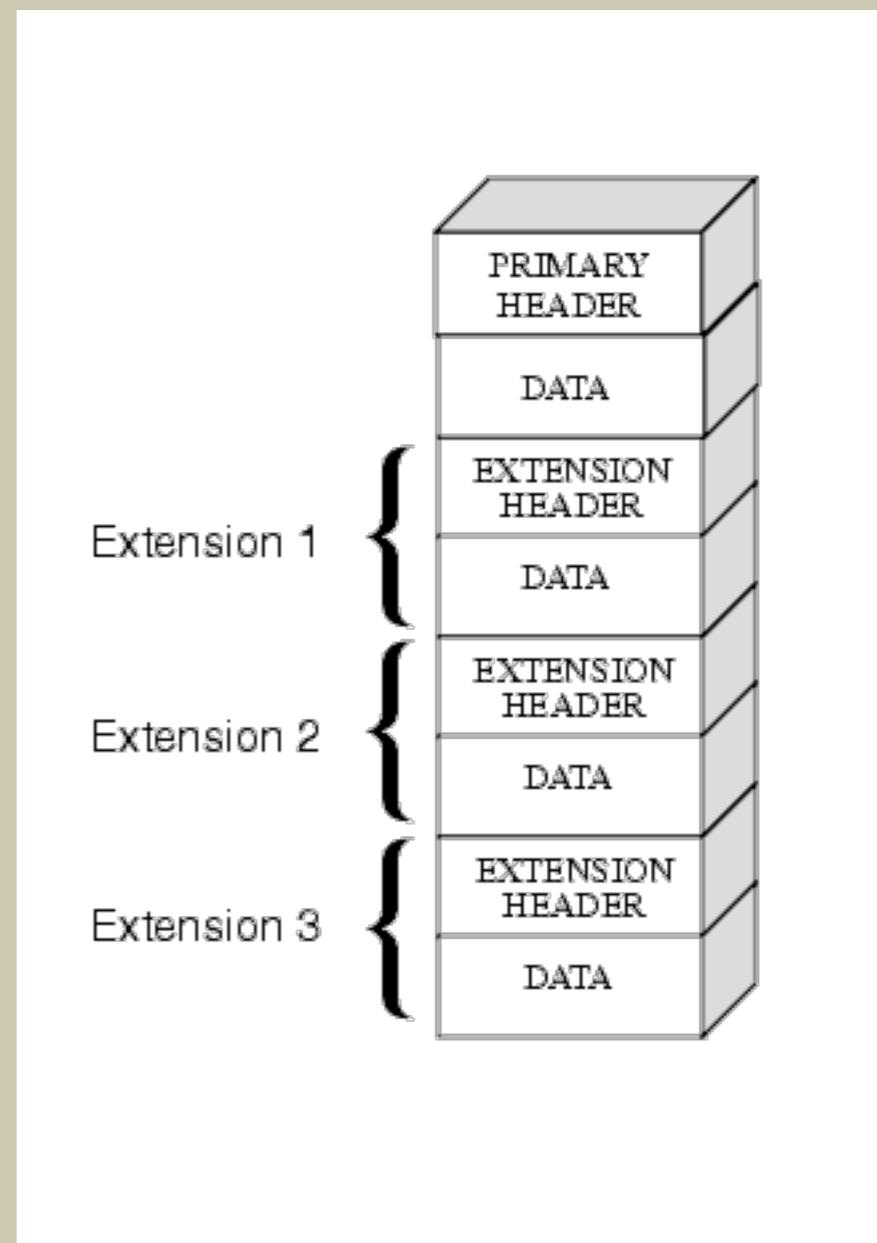


Corrección por extinción.



Formato de los archivos con imágenes y espectros

El Sistema de transporte de imágenes flexible (FITS) es un estándar abierto que define un formato de archivo digital útil para el almacenamiento, transmisión y procesamiento de datos: formateados como matrices multidimensionales (por ejemplo, una imagen 2D) o tablas. FITS es el formato de archivo digital más utilizado en astronomía.



NASA/IPAC Extragalactic Database

<https://ned.ipac.caltech.edu/>

Búsqueda por nombre del objeto.

The screenshot shows the NED homepage with a dark background featuring a star field. At the top left is the IPAC logo, and at the top center is the large 'NED' logo with a blue swoosh. To the right of the logo, the text 'NASA/IPAC Extragalactic Database' is displayed. Below the header is a navigation menu with links for Home, Search Objects », Literature », Services », Tools », and Information ». A search bar contains the text 'kissr 298' with a magnifying glass icon, and a blue 'Go' button is to its right. A large blue arrow points upwards from the search bar towards the object name 'KISSR 298' and its description below.

kissr 298

Go

KISSR 298
Kitt Peak Spectroscopic Survey - Red

Coordenadas del objeto.

• Detailed Information for a Named Object

Object Name

kissr 298

▶ Search Options

Go

Results for object 2MASX J13294981+2934455 (kissr 298)

Overview	Cross-IDs (16)	Coordinates (10)	Redshifts (10)	Distances (0)	Classifications (0)	Galactic Extinctions	
Notes (0)	Diameters (10)	Photometry & SED (59)	Spectra (1)	Images (1)	References (23)	External Links	
Survey Coverage							
Coordinates for 2MASX J13294981+2934455							
Preferred Position: 13h29m49.795s +29d34m46.98s Equatorial J2000.0 (2007SDSS6.C...0000:)							
▼ Preferred Position of 2MASX J13294981+2934455							
Reference Frame	Longitude	Latitude	Longitude	Latitude	Uncertainty Ellipse (arcsec)		
	Decimal Degrees	Decimal Degrees	Sexagesimal	Sexagesimal	Semimajor (a)	Semiminor (b)	PA (deg)
RA/Dec Equatorial (J2000.0)	202.457480	29.579716	13h29m49.795s	+29d34m46.98s	5.00E-01	5.00E-01	0

RA/DEC

Corrimiento al rojo del objeto.

② Detailed Information for a Named Object

Object Name

kissr 298

▶ Search Options

Go

Results for object 2MASX J13294981+2934455 (kissr 298)

Overview	Cross-IDs (16)	Coordinates (10)	Redshifts (10)	Distances (0)	Classifications (0)	Galactic Extinctions
Notes (0)	Diameters (10)	Photometry & SED (59)	Spectra (1)	Images (1)	References (23)	External Links
Survey Coverage						

Redshifts and Derived Quantities for 2MASX J13294981+2934455

Preferred Redshift **Z = 0.04899, $H_0 = 67.8$ km/sec/Mpc, $\Omega_{\text{matter}} = 0.308$, $\Omega_{\text{vacuum}} = 0.692$**

Redshift

El archivo de objetos astronómicos del sondeo Sloan Digital Sky Survey.

**Me permite bajar imágenes y espectros de objetos
astronómicos.**

Incluye galaxias.

Interfaz de búsqueda: Finding Chart Tool

<http://skyserver.sdss.org/dr14/en/tools/chart/chartinfo.aspx>

 DR14

[Home | Help | List | Navi | Explore]

Parameters	
ra	179.689293 deg
dec	-0.4543790 deg
scale	0.79224 "/pix
width	512 pix
height	512 pix
opt	

Get Image 

 Use query to mark objects 

Drawing options

- Grid
- Label
- Photometric objects
- Objects with spectra
- Invert Image

Advanced options

- APOGEE Spectra
- SDSS Outlines

SDSS DR14 Finding Chart Tool

SciServer 

Not logged in [Help](#) [Login](#)

Finding Chart (ra, dec, scale, height, width, opt, query)

returns a JPEG image centered on (ra,dec), of size (height x width) where the image is scaled to an arbitrary scale (scale). In SDSS the default scale is 0.396127 arcsec/pix. Various drawing options can be specified (opt). Use mark query to select objects of special interest.

If you're new to the Finding Chart, please see the Visual Tools main page and Getting Started with Finding Chart.

Parameters:

ra center point right ascension in J2000 decimal degrees, hh mm ss.s, or hh:mm:ss.s
dec center point declination in J2000 decimal degrees, dd mm ss.s, or dd:mm:ss.s
scale arcsec/pixel (the natural scale of SDSS is 0.396127)
height image height in pixels, limited to [64..2048]
width image width in pixels, limited to [64..2048]
opt options string, a set of upper-case characters, like 'GPST'.

Use query to mark objects:

This option will draw a triangle on top of objects selected by a marking string. Objects must be inside the field of view of the image to be displayed. The format of the string can be from the following choices:

- 1. List of objects.** A header with RA and DEC columns must be included. Columns must be separated by tabs, spaces, commas or semicolons. The list may contain as many columns as wished.

Búsqueda por coordenadas.

**DR14**

[Home](#) | [Help](#) | [List](#) | [Navi](#) | [Explore](#) |

Parameters

ra	179.689293	deg
dec	-0.4543790	deg
scale	0.79224	"/pix
width	512	pix
height	512	pix
opt		

Get Image

Use query to mark objects

Drawing options
 Grid
 Label
 Photometric objects
 Objects with spectra
 Invert Image
 Advanced options
 APOGEE Spectra
 SDSS Outlines

SDSS DR14 Finding Chart Tool

Finding Chart (ra, dec, scale, height, width, opt, query)

returns a JPEG image centered on (ra,dec), of size (height x width) where to an arbitrary scale (scale). In SDSS the default scale is 0.396127 arcsec/drawn pixel. Drawing options can be specified (opt). Use mark query to select objects with

If you're new to the Finding Chart, please see the Visual Tools main page with Finding Chart.

**DR12**

[Home](#) | [Help](#) | [List](#) | [Navi](#) | [Explore](#) |

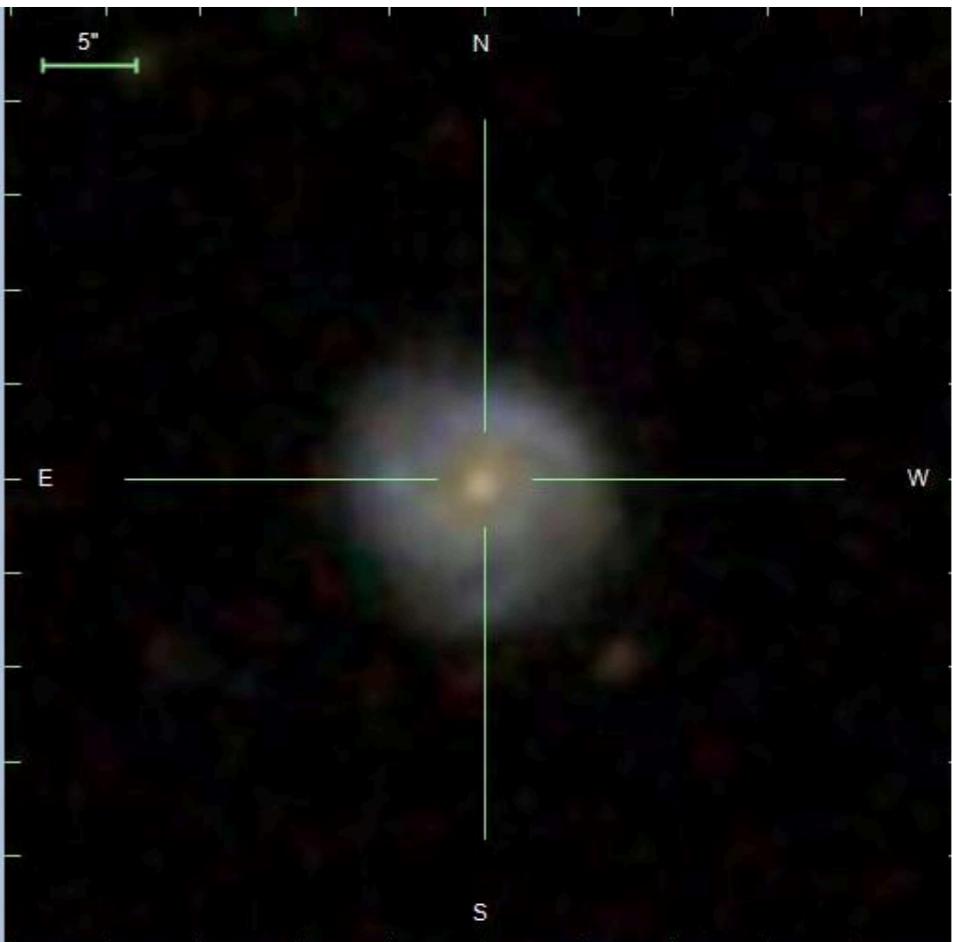
Parameters

ra	202.45748	deg
dec	29.579716	deg
scale	0.09903175	"/pix
width	512	pix
height	512	pix
opt	G	

Get Image

Use query to mark objects

Drawing options
 Grid



Parameters:

ra center point right ascension
dec center point declination
scale arcsec/pixel (the native scale)
height image height in pixels
width image width in pixels
opt options string, a set of

Use query to mark objects:

This option will draw a triangle at each object. Objects must be inside the file. The format of the string can be

- List of objects.** A header line followed by a list of objects. Columns must be separated by commas. The list may contain as

39

Visualización del espectro.

Explore

DR14

|Home |Help |List |Nav |Explore |

ra	19293 deg
dec	-4543790 deg
scale	0.79224 "/pix
width	512 pix
height	512 pix
opt	

Get Image

Use query to mark objects

Drawing options

- Grid
- Label
- Photometric objects
- Objects with spectra
- Invert Image
- Advanced options
- APOGEE Spectra
- SDSS Outlines

SDSS DR14 Finding Chart Tool

Finding Chart (ra, dec, scale, height, width, opt, query)

returns a JPEG image centered on (ra, dec) , of size $(height \times width)$ where to an arbitrary scale $(scale)$. In SDSS the default scale is 0.396127 arcsec drawing options can be specified (opt) . Use mark query to select objects

If you're new to the Finding Chart, please see the Visual Tools main page with Finding Chart.

Parameters:

ra	center point right ascension in J2000 decimal degrees, hh mm ss.ss
dec	center point declination in J2000 decimal degrees, dd mm ss.ss
scale	arcsec/pixel (the natural scale of SDSS is 0.396127)
height	image height in pixels, limited to [64..2048]
width	image width in pixels, limited to [64..2048]
opt	options string, a set of upper-case characters, like 'GPST'.

Use query to mark objects:

This option will draw a triangle on top of objects selected by a mark. Objects must be inside the field of view of the image to be displayed. The format of the string can be from the following choices:

1. **List of objects.** A header with RA and DEC columns must be present. Columns must be separated by tabs, spaces, commas or semicolons. The list may contain as many columns as wished.

40



DR12

SDSS J132949.78+293446.9

SciServer

Look up common name

Explore Home

Search

Imaging Summary

FITS

Finding chart

Other Observations

Neighbors

Galaxy Zoo

PhotoTag

Field

Frame

PhotoObj

PhotoZ

Cross-ID

Spec Summary

All Spectra

FITS

Plate

SpecObj

sppLines

galSpecLine

galSpecIndx

galSpecInfo

Fit Parameters

sppParams

StarformingPort

PassivePort

emissionLinesPort

PCAWiscBC03

PCAWiscM11

FSPSGranEarlyDust

FSPSGranEarlyNoDust

FSPSGranWideDust

FSPSGranWideNoDust

NED search

SIMBAD search

ADS search

Notes

Save in Notes

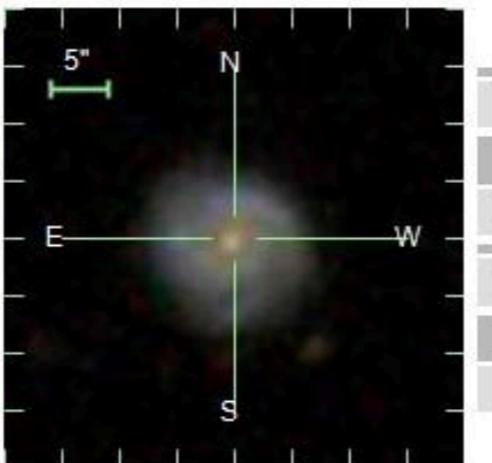
Show Notes

Print

Type	run	rerun	camcol	field	obj	SDSS Object ID	Not logged in
GALAXY	5072	301	5	39	172	1237667259357790380	H
RA, Dec						Galactic Coordinates (<i>l</i> , <i>b</i>)	
Decimal			Sexagesimal			<i>l</i>	<i>b</i>
202.457448174, 29.579719149			13:29:49.78, +29:34:46.98			51.362801963	81.208293429

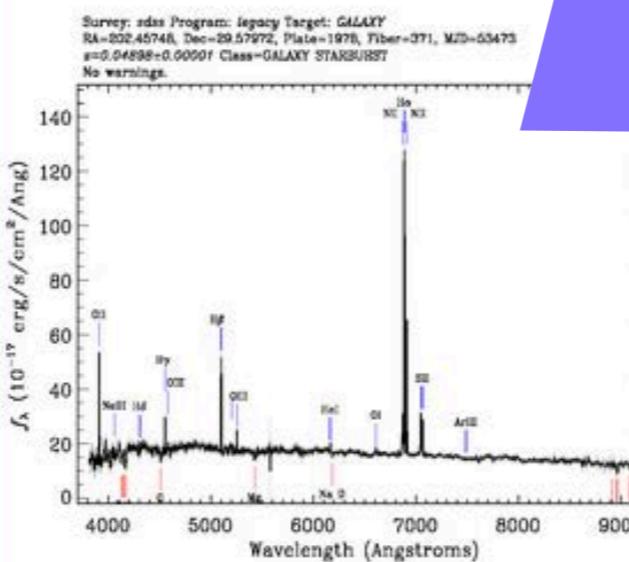
Imaging

Flags

DEBLENDED_AT_EDGE STATIONARY BINNED1 INTERP
CHILD

Magnitudes				
u	g	r	i	z
17.42	16.45	16.02	15.71	15.55
Magnitude uncertainties				
err_u	err_g	err_r	err_i	err_z
0.01	0.00	0.00	0.00	0.01

Image MJD	mode	Other observations	parentID	nChild	extinction_r	PetroRad_r (arcsec)
53354	PRIMARY	1	1237667259357790379	0	0.05	7.36 ± 0.066
Mjd-Date	photoZ (KD-tree method)				Galaxy Zoo 1 morphology	
12/15/2004	0.055 ± 0.0105				Spiral	

Cross-identifications [Show](#)Optical Spectra SpecObjID = 2237132051288 [Interactive spectrum](#) 

spectrograph	SDSS
class	GALAXY
Redshift (z)	0.049
Redshift error	0.00001
Redshift flags	OK
survey	sdss
programname	legacy
primary	1
Other spec	0
sourcetype	GALAXY
Velocity dispersion (km/s)	50.87
veldisp_error	13.231
targeting_flags	legacy_target1: GALAXY
plate	1978
mjd	53473
fiberid	371

El repositorio de datos del Hubble Space Telescope (HST).

The screenshot shows the homepage of the Mikulski Archive for Space Telescopes. At the top, there is a logo of the Hubble Space Telescope and the text "Barbara A. MIKULSKI ARCHIVE FOR SPACE TELESCOPES". The navigation bar includes links for MAST, STScI, Tools, Mission Search (which is highlighted with a red box), Search Website, Follow Us (with links to Facebook and Twitter), Register, Forum, HST Home, About HST, Discovery Portal, Reprocessing Status, and HST Search.

The main content area features a sidebar with links to various search functions: HST Target Search, HST Abstract Search, FAQ, Search & Retrieval, MAST Services, Daily Data Reports, About HST Data, and High-Level Science. The central column displays a list of mission-related links: Hubble, Hubble Legacy Archive, Hubble Spectral Legacy Archive, Hubble Source Catalog, Hubble Press Release Images, DSS, JWST SID Archive, K2 EPIC, K2 Data, Kepler Data, Kepler Targets, PanSTARRS, SwiftUVOT, TESS, and XMM-Newton. To the right, there is a "News" section with a list of recent updates:

- March 12, 2019: New HLSP: COS-GAL
- November 28, 2018: HLSP Update: FFLensModels - Abell 370 bradac v4.1
- October 31, 2018: HLSP Update: The Bat Shadow
- October 24, 2018: New HLSP: CCNSE
- September 26, 2018: New HLSP: ATLAS



Barbara A.

MIKULSKI ARCHIVE FOR SPACE TELESCOPES

MAST

STScI

Tools

Mission Search

Search Website



Follow Us

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Forum

HST Home

About HST

Getting Started

Archive Status

Reprocessing Status

HST Search

Archive Status

HST Data Search

[Help](#)
[Field Descriptions](#)

Standard Form

File Upload Form

Target Name

KISSR 298

Resolver

Resolve

Radius (arcmin)

3.0

Right Ascension**Declination****Equinox**

J2000

Imagers**Spectrographs****Other** STIS NICMOS WFPC2 WF/PC FOC ACS WFC3 COS STIS NICMOS GHRS FOS FOC ACS WFC3 COS FGS HSP**Start Time****Exp Time****Proposal ID****Release Date****Dataset****Filters/Gratings****Obset ID****Archive Date****Target Descrip****Apertures****Observations** Science

Calibration

PI Last Name

Wofford