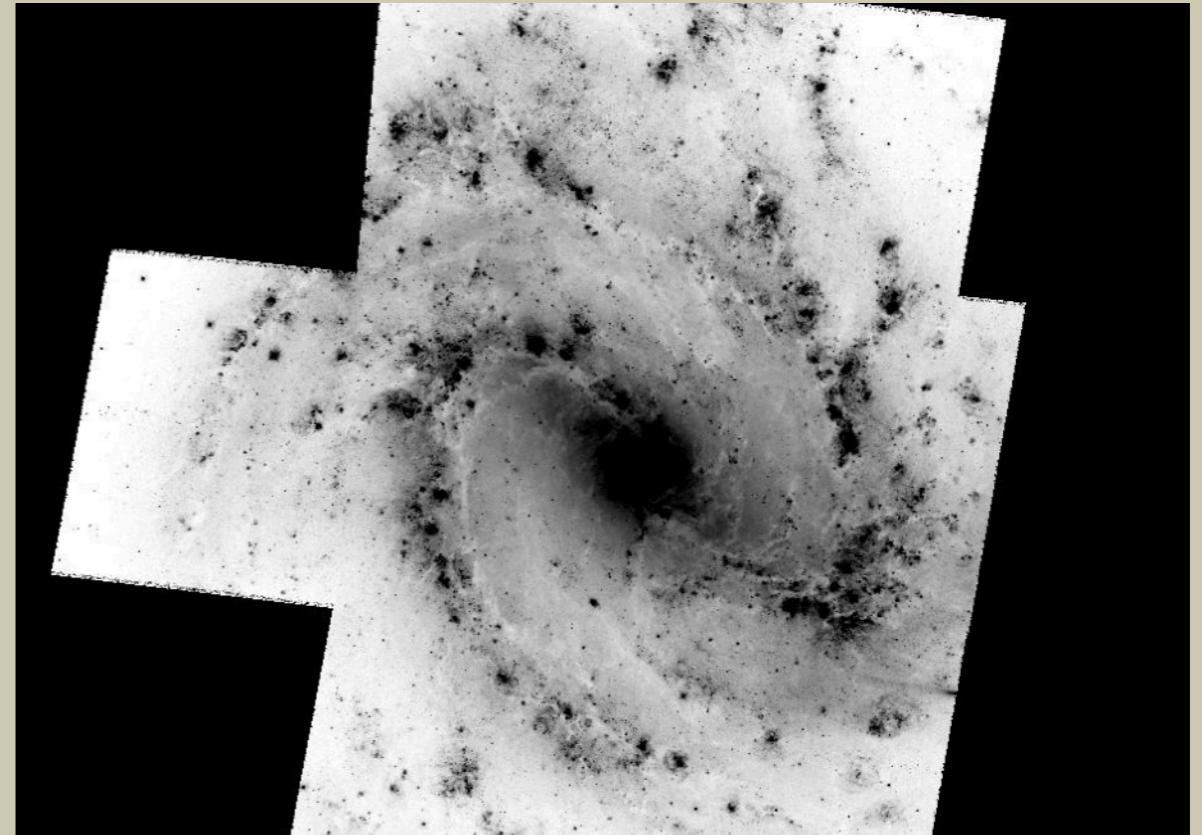


# Taller de introducción al análisis de datos astronómicos

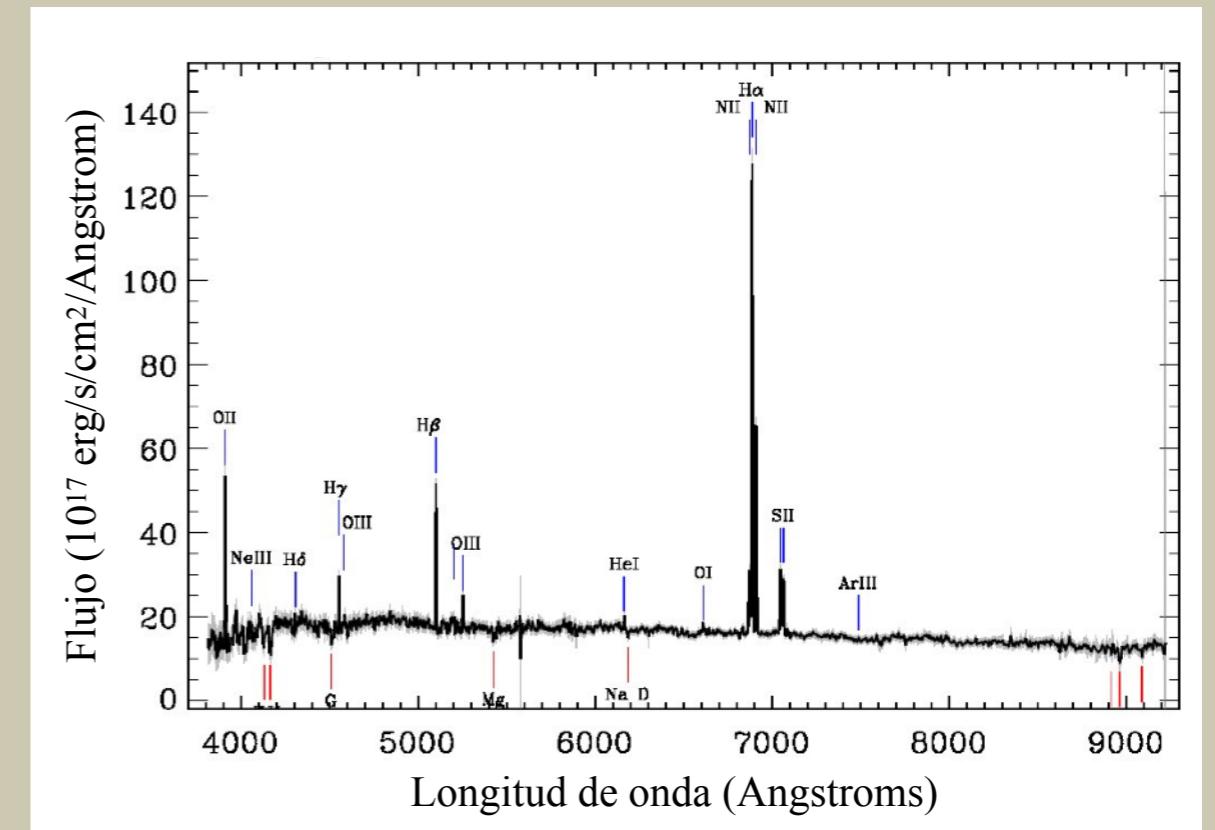


## INSTRUCTORES:

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

## SEDE Y FECHA:

U. Autónoma de Ciudad Juárez  
22-23 Abril 2021, 12-14 hr



# 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.**

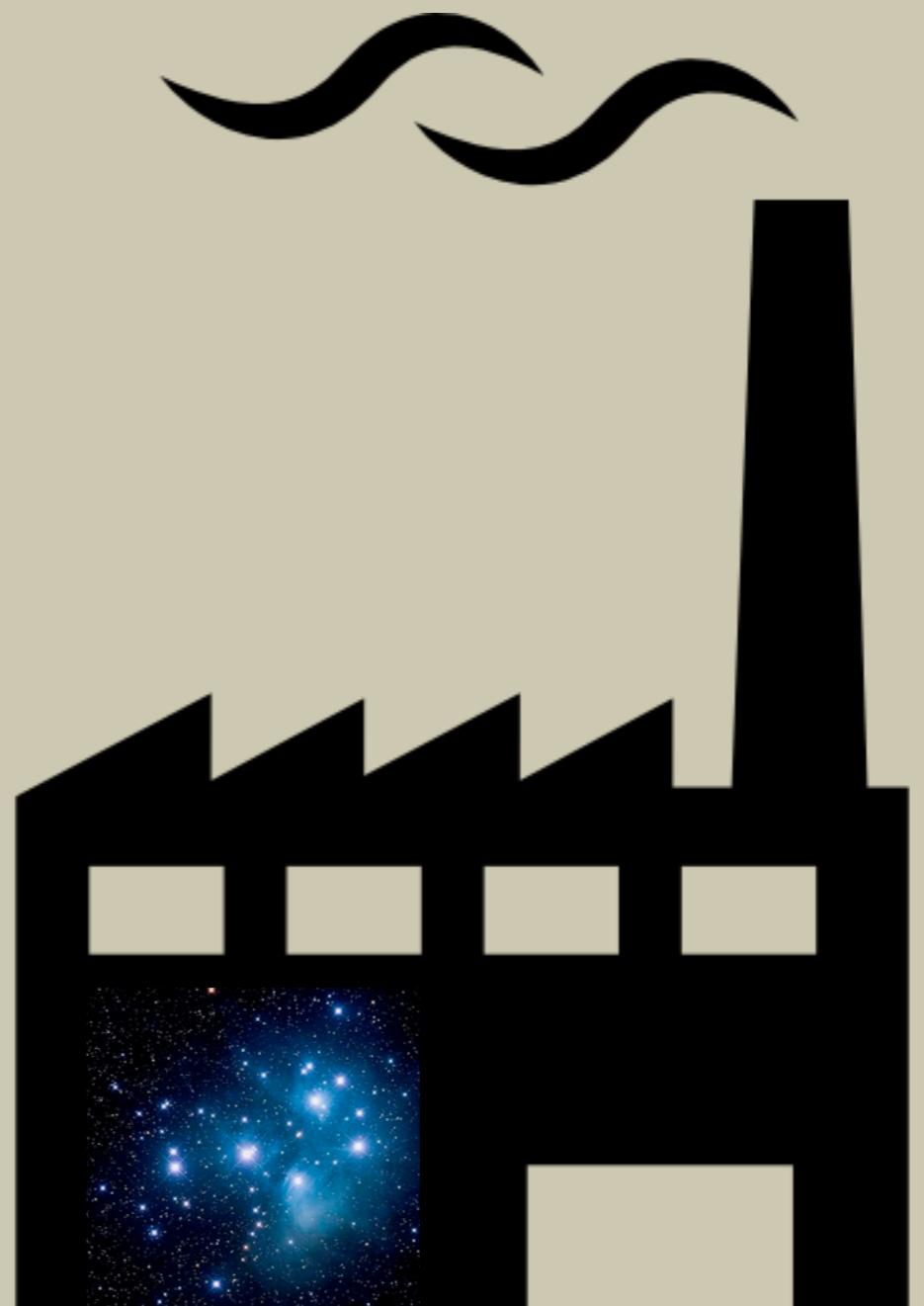
# Introducción a las galaxias.

**Definición informal de galaxia: fábrica de estrellas.**



**M101 (HST)**

=

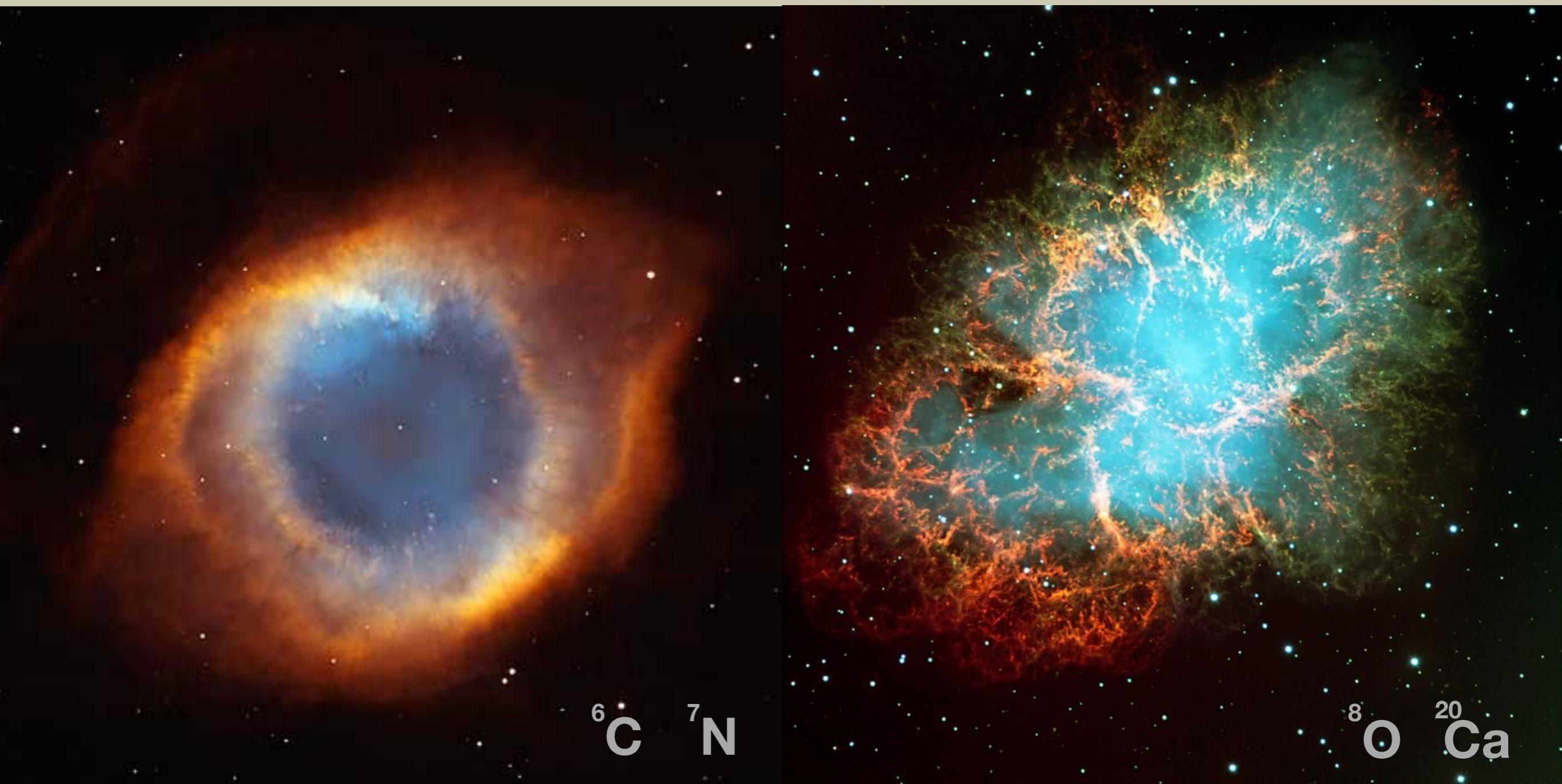


# Estrellas naciendo (vistas por HST)

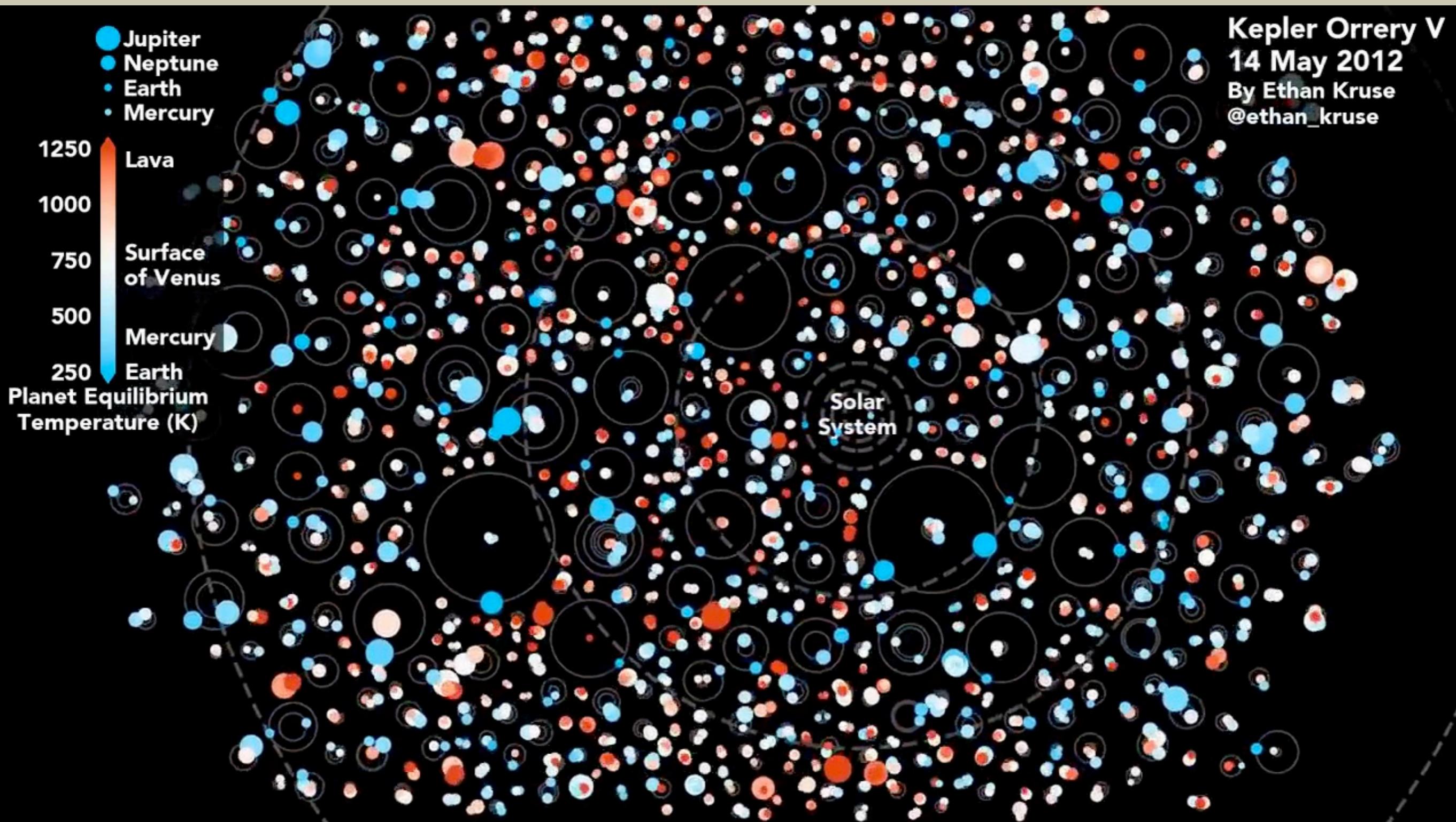


infrarojo

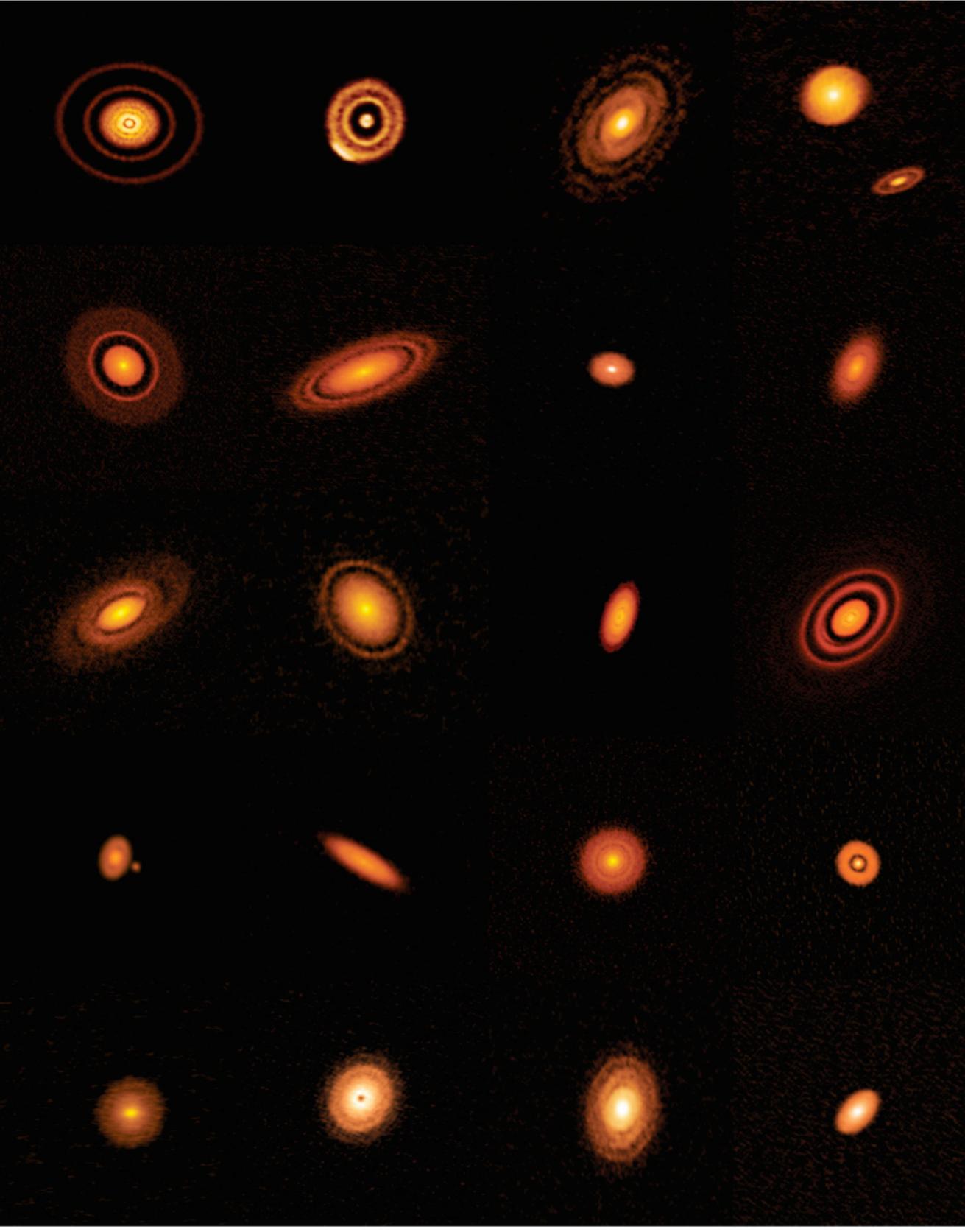
# Estrellas muriendo (vistas por HST)



# Las estrellas tienen planetas (sondeo de Kepler).

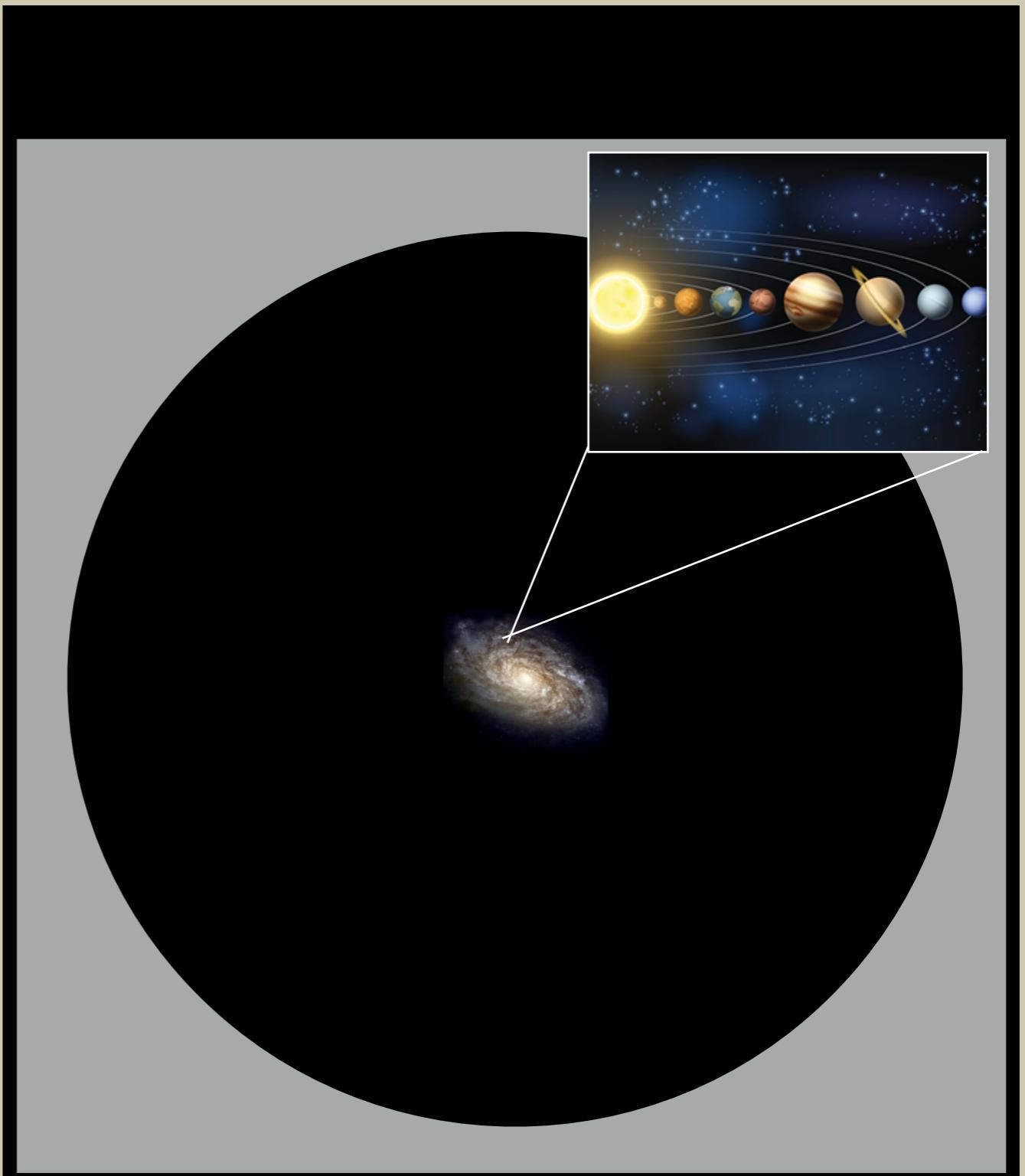


# Planetas naciendo (vistos por ALMA).

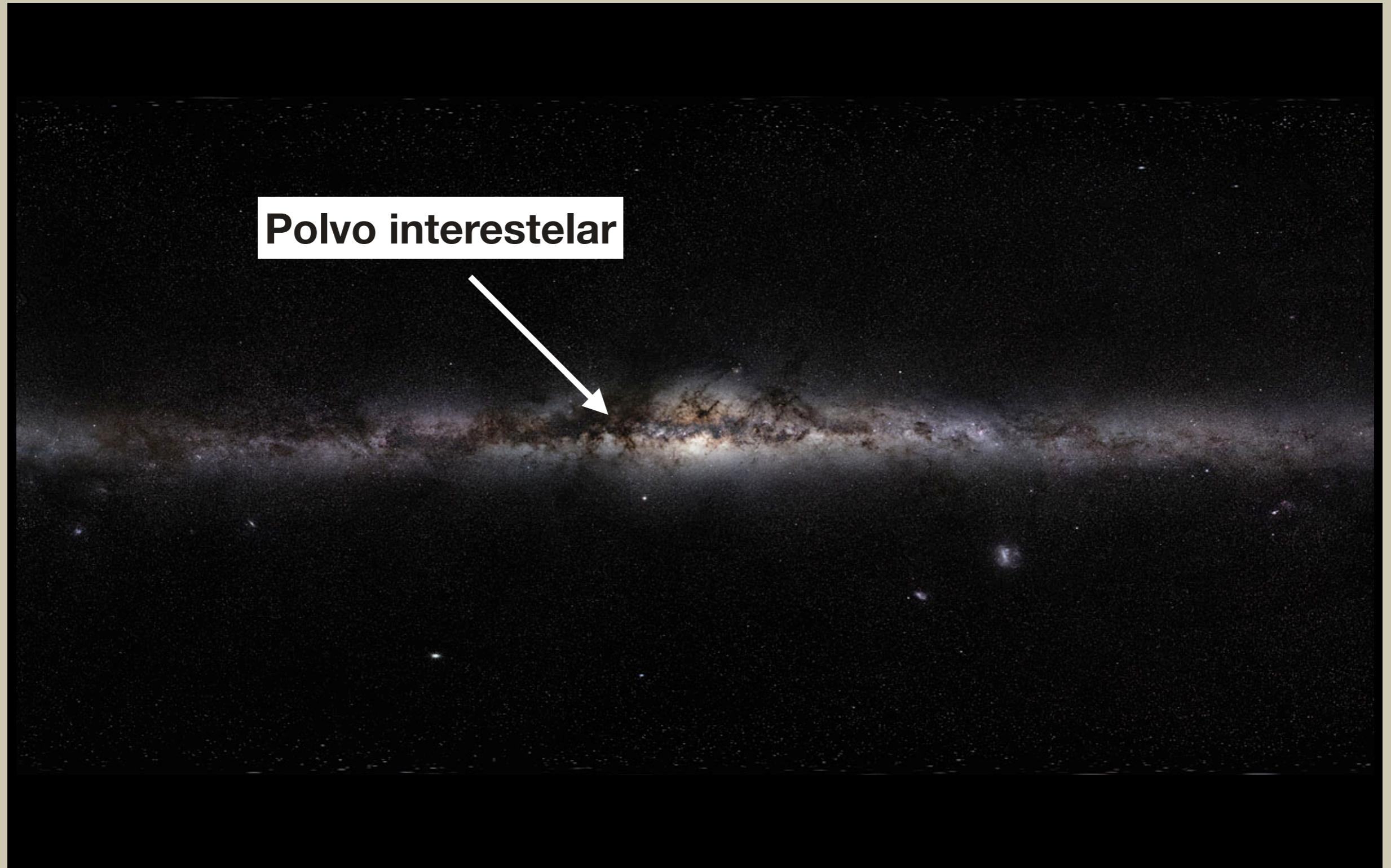


# Definición más sofisticada de galaxia.

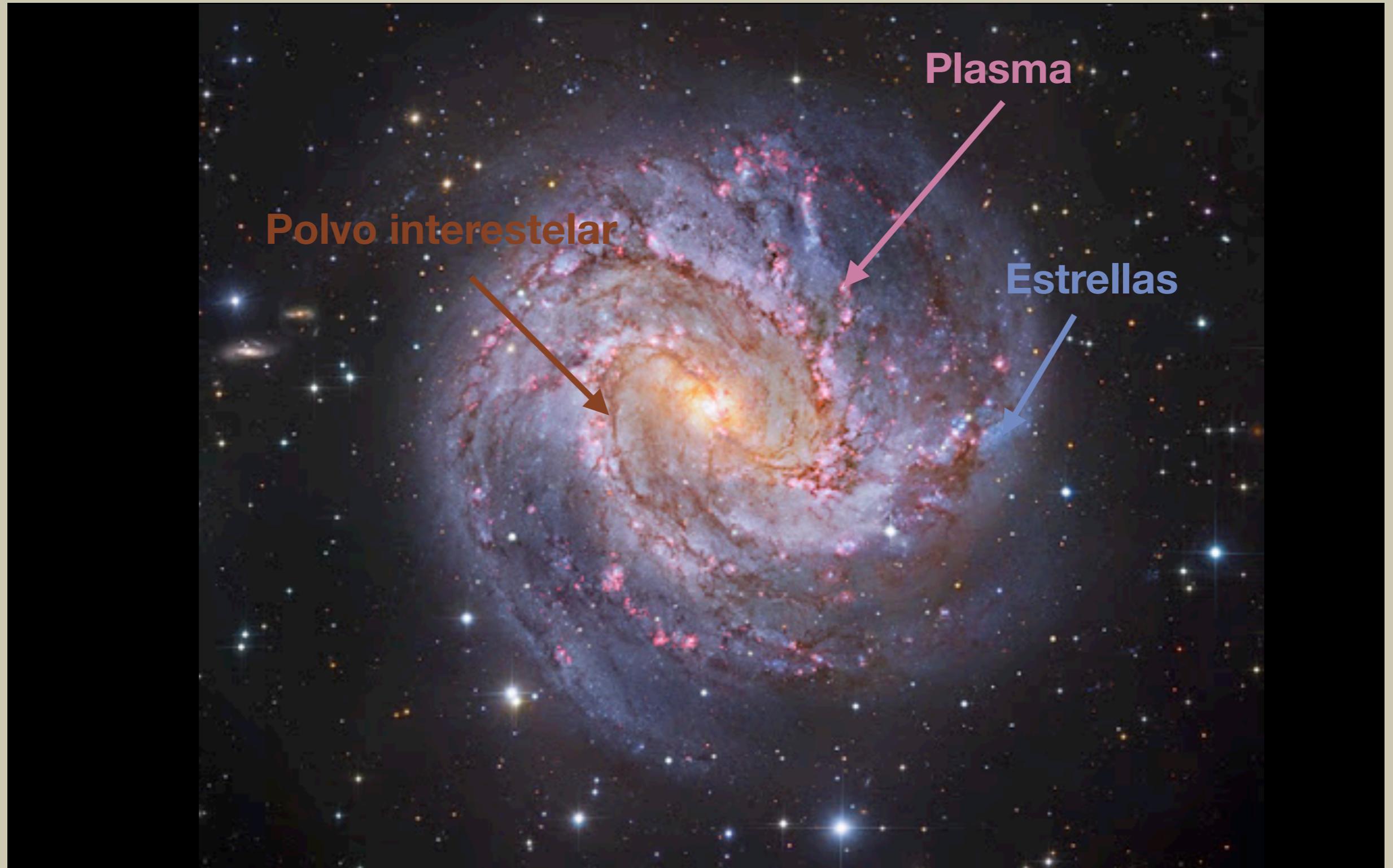
Un halo de materia oscura que en su centro tiene un conjunto de gas, polvo y miles de millones de estrellas con sus sistemas solares, retenidos por la fuerza de gravedad.



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



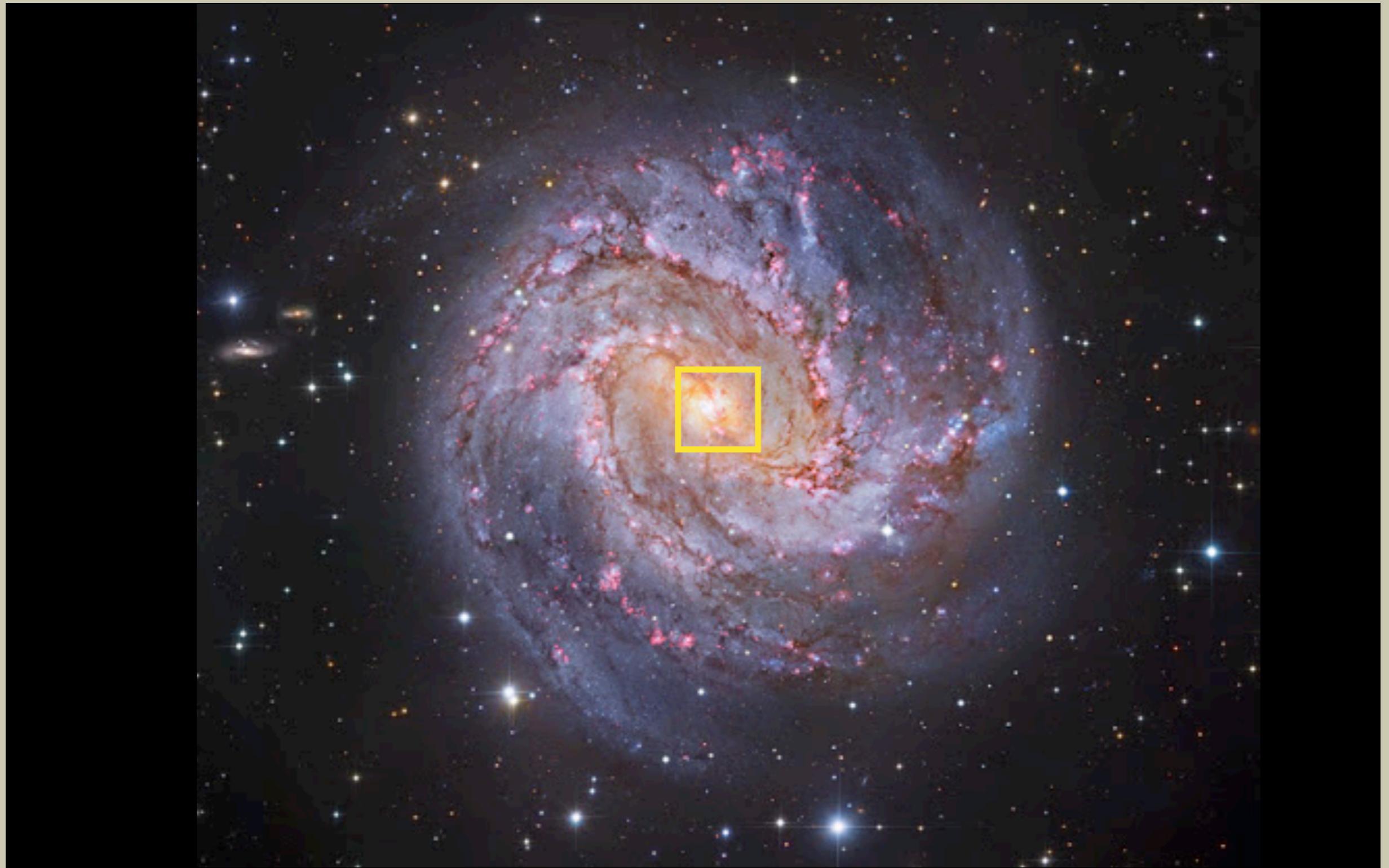
# Nuestra galaxia se parece a M83.



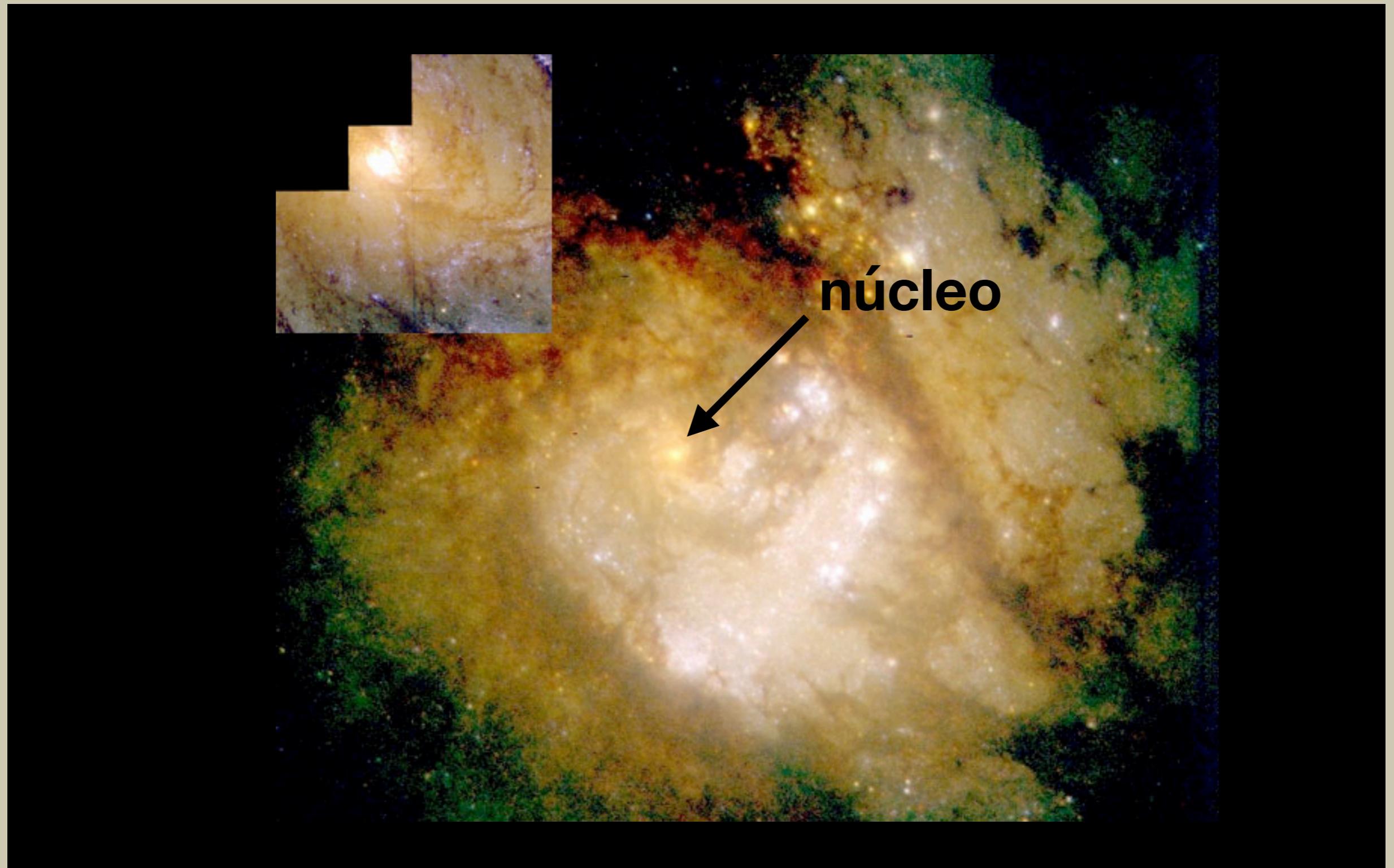
A menudo las imágenes que ven son mosaicos.



# 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

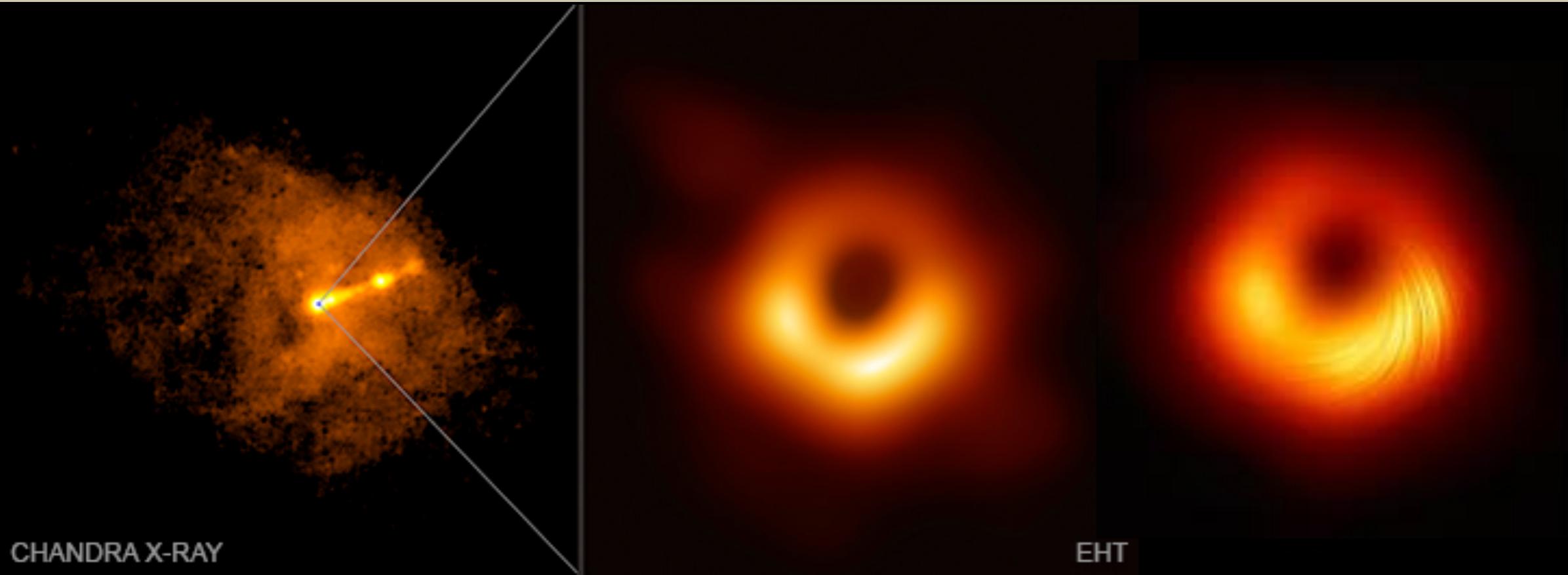
# Galaxia elíptica M87 y jet que sale de su agujero negro central.



Hubble Space Telescope 07/06/2000

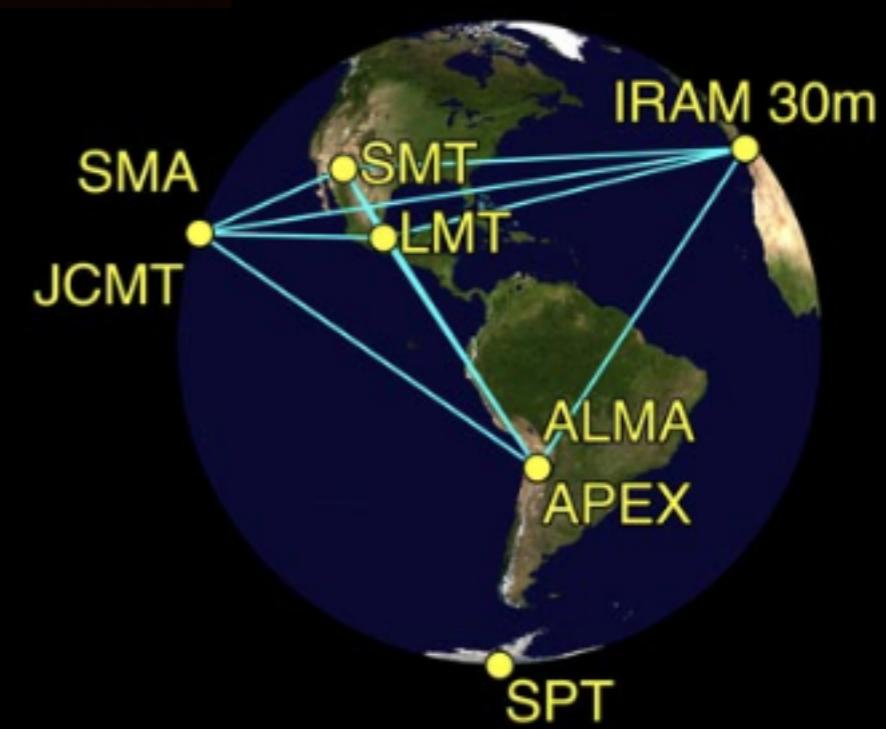
Rolf Wahl Olsen  
08/04/2010 57 x 30.5s  
10" Newton / ToUCam Pro SC1

# La sombra del agujero negro central.

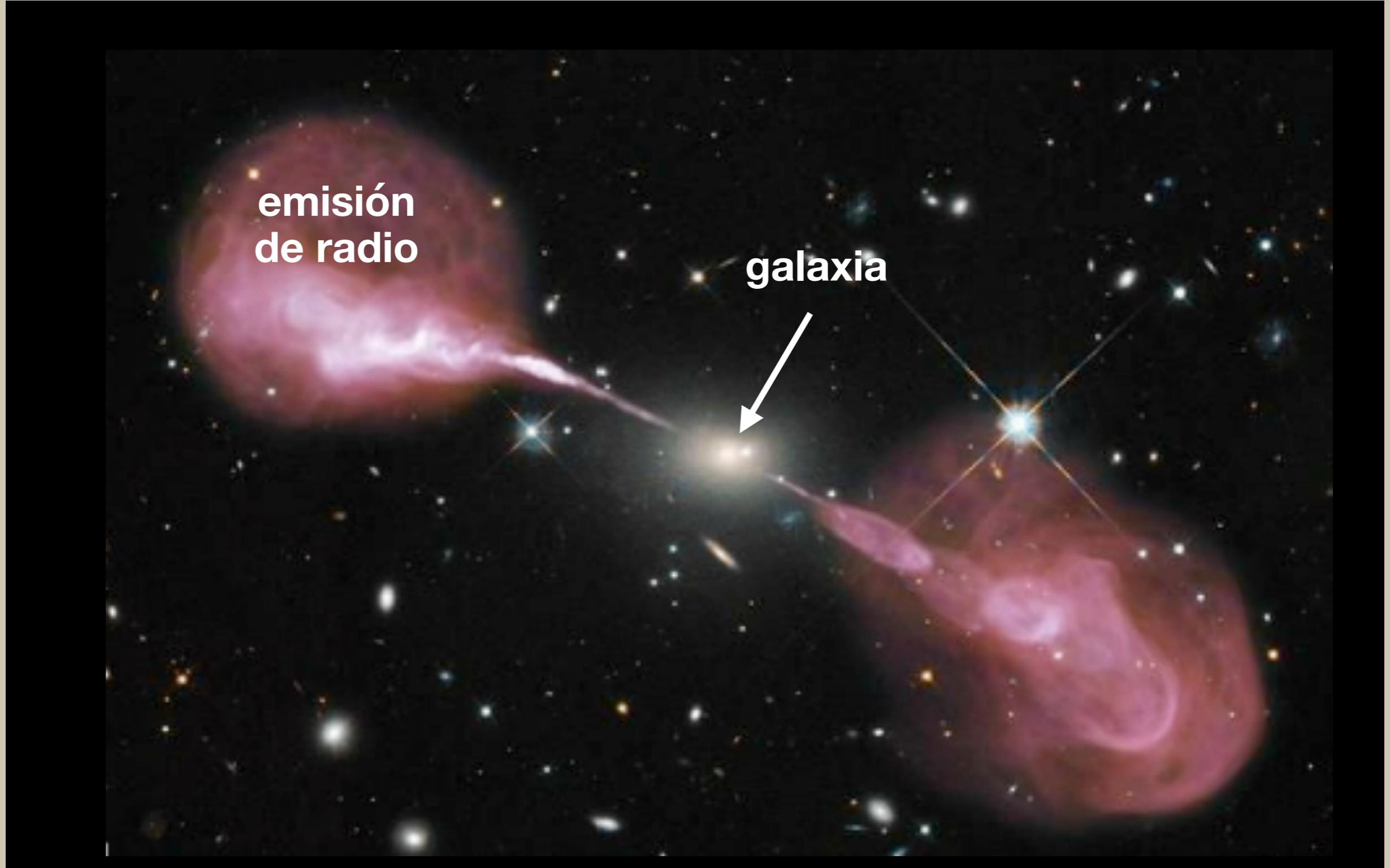


CHANDRA X-RAY

EHT



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.

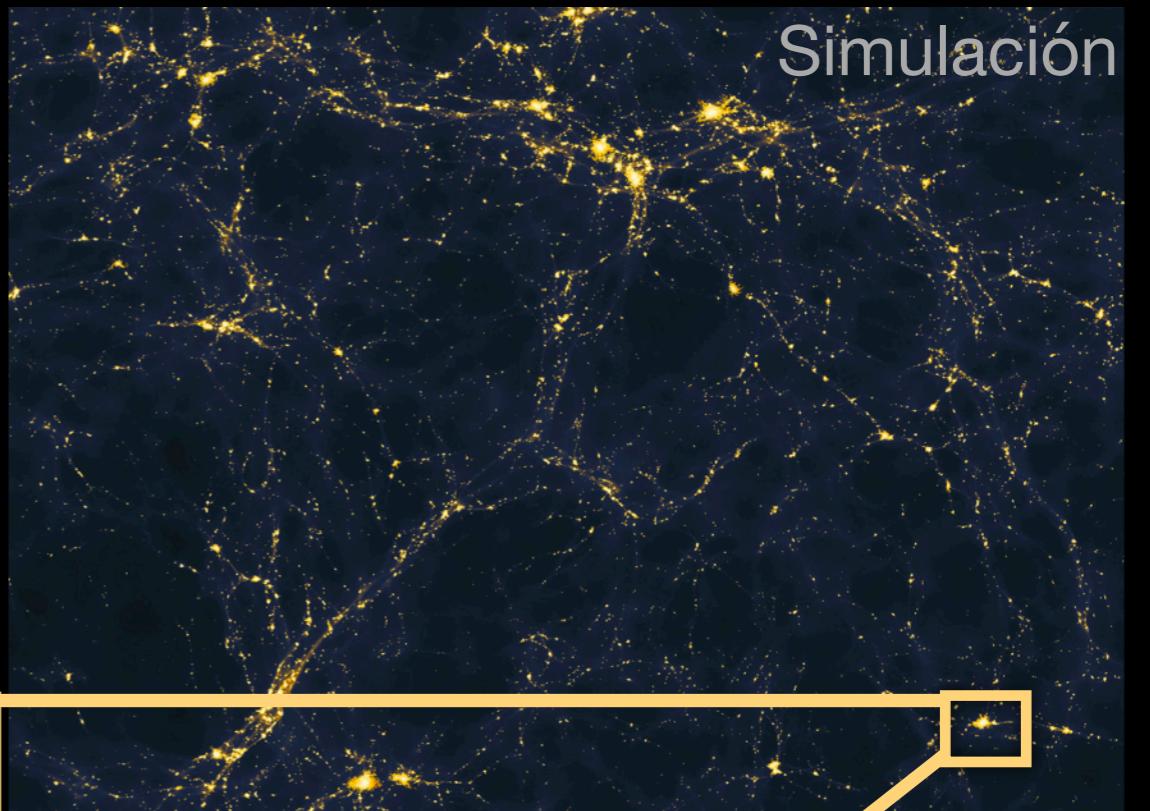
Stephan's Quintet



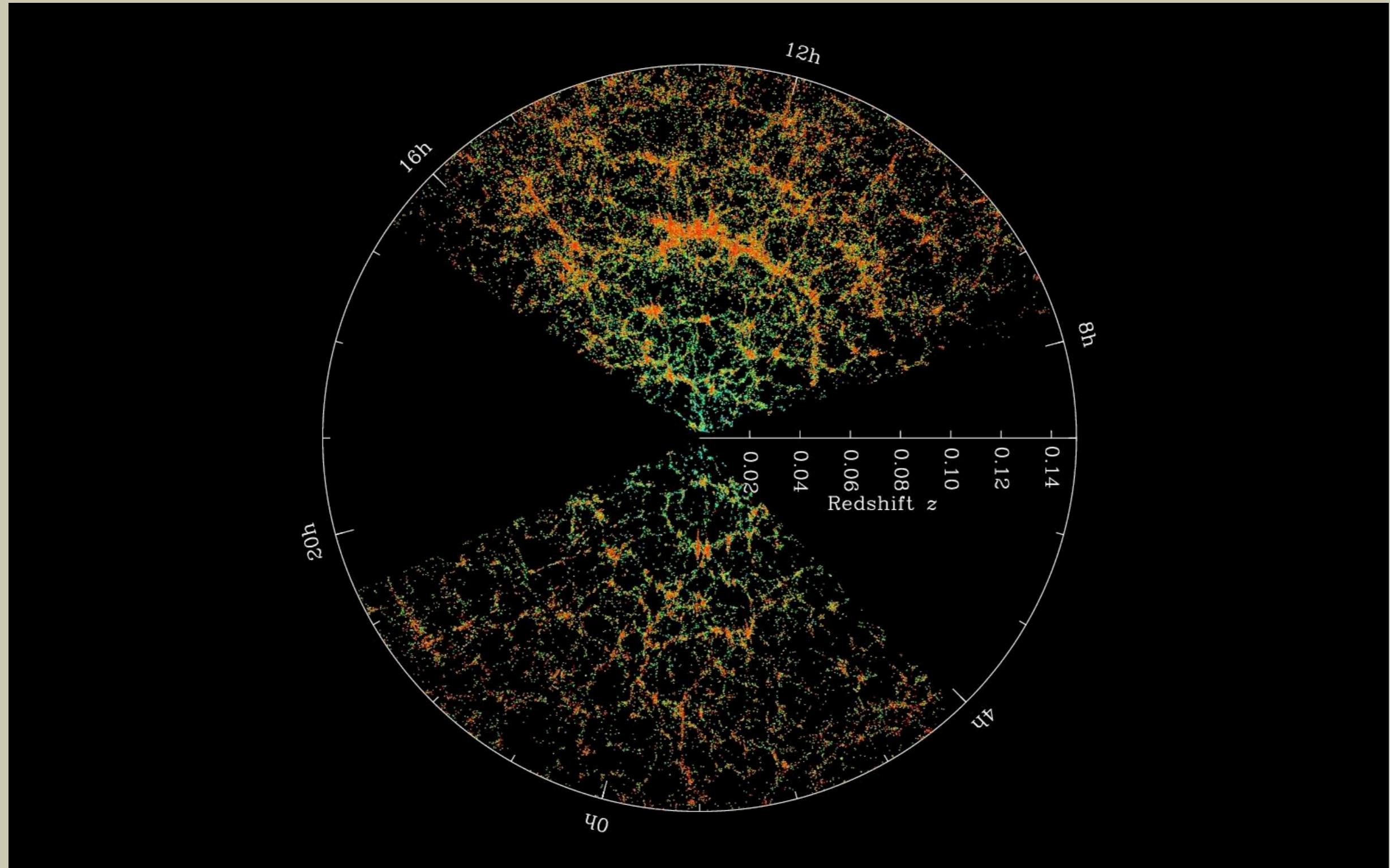
Abell 2744



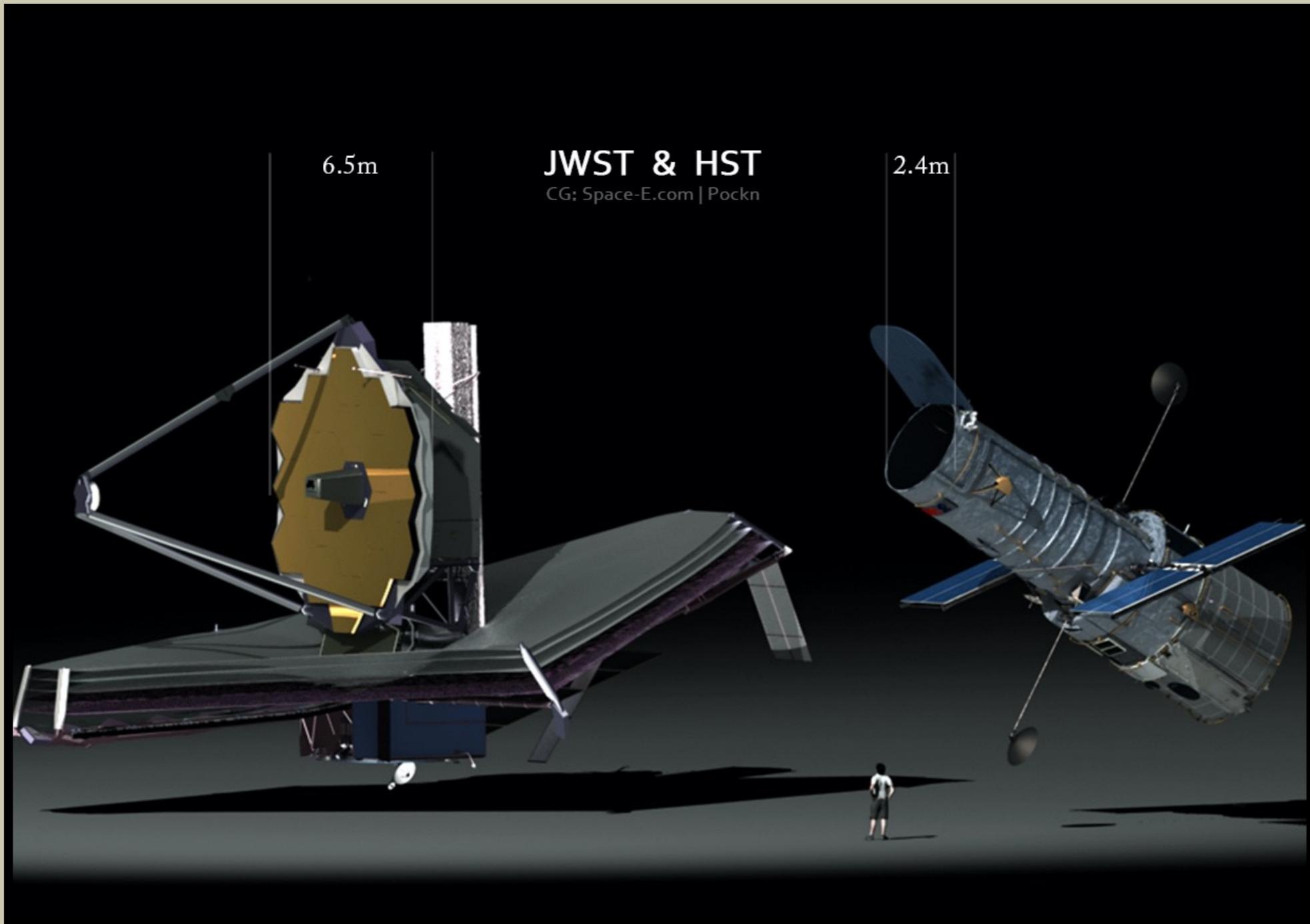
Simulación



# 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.**



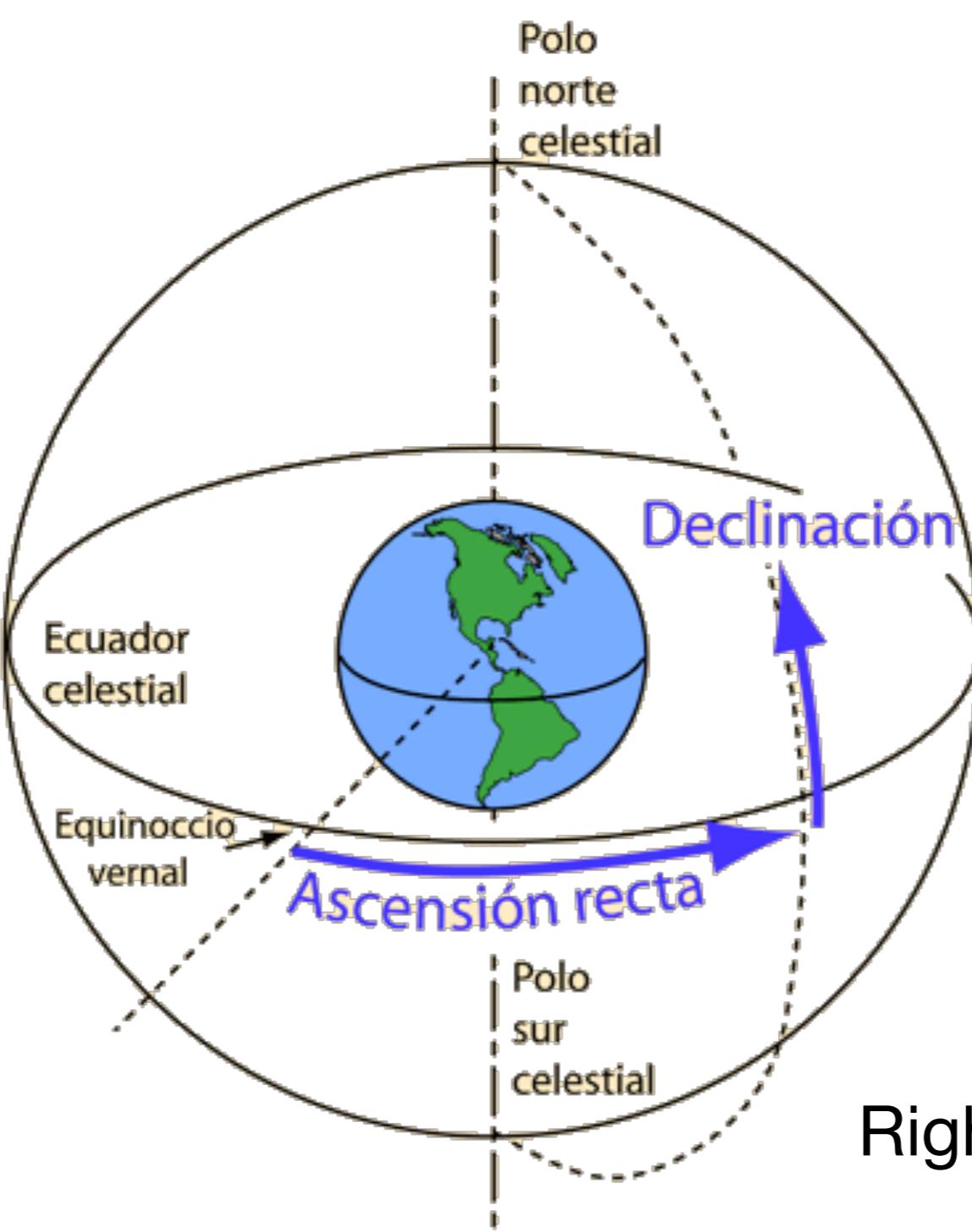
# **Los repositorios de datos y herramientas de trabajo.**

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

# En las bases de datos puedo encontrar...

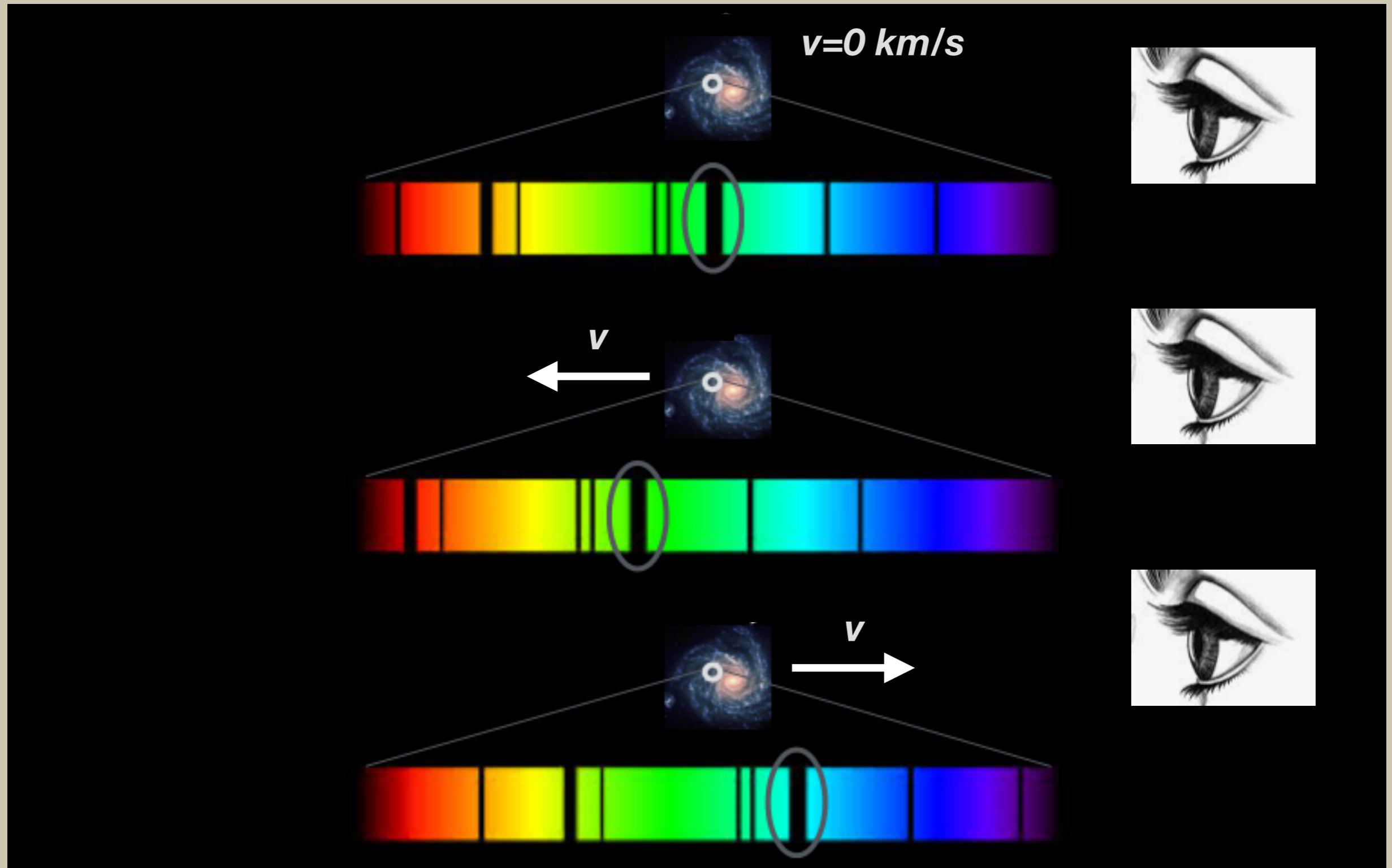
- Coordenadas
- Corrimientos al rojo
- Extinción debida a polvo en la Vía Láctea
- Imágenes y espectros de diferentes objetos astronómicos

# Coordenadas.

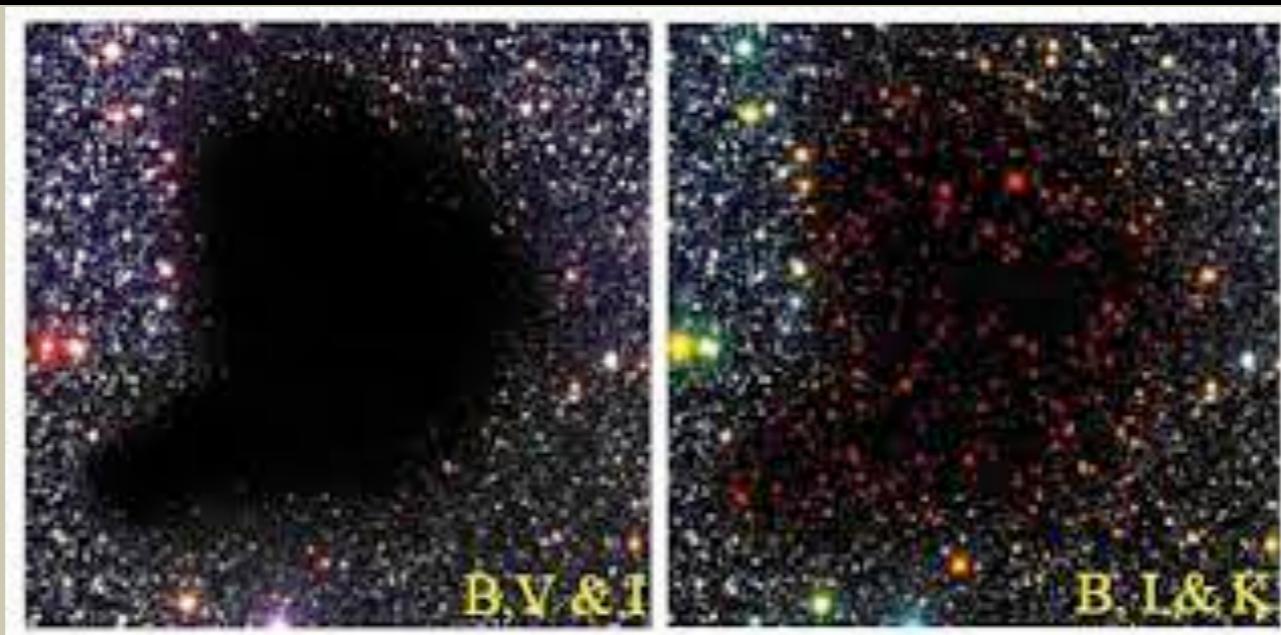
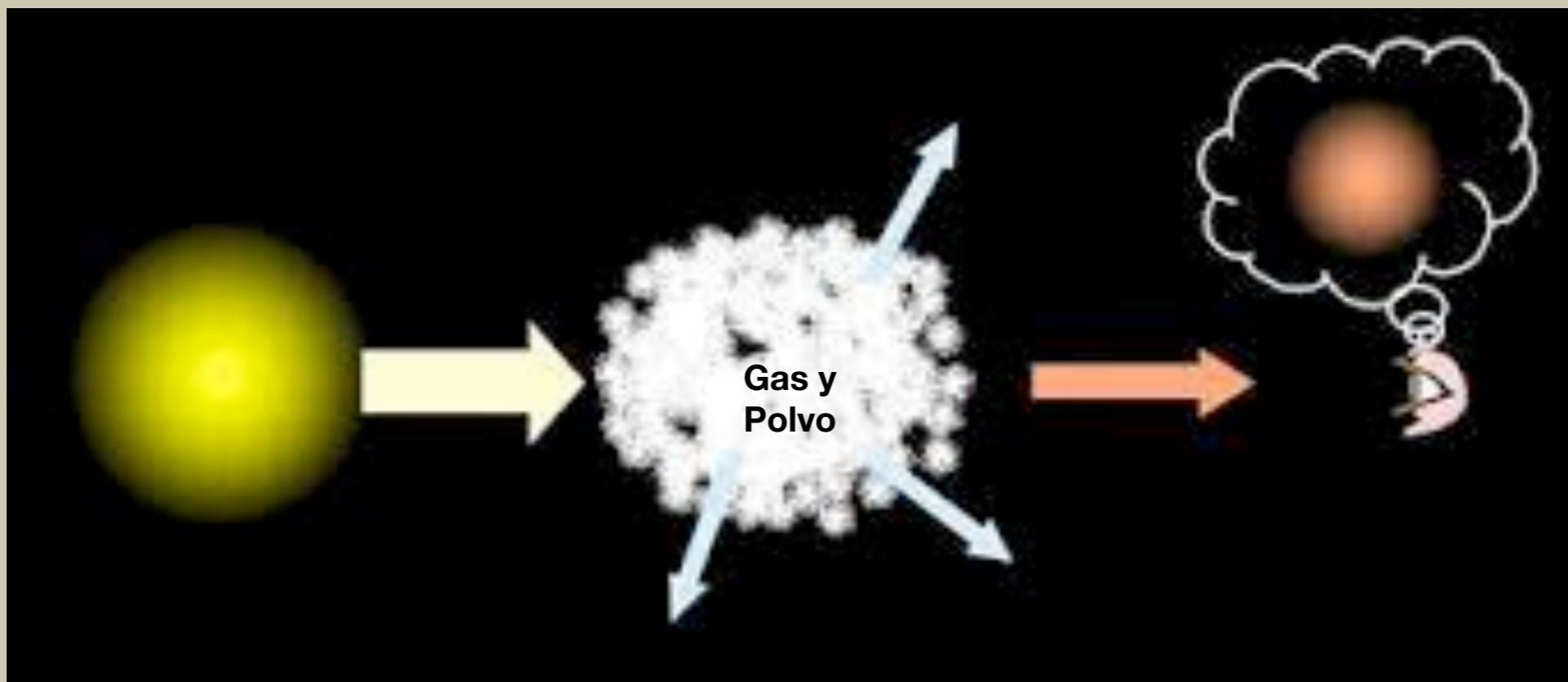


En inglés:  
Right Ascension (RA)  
Declination (Dec)

# Corrimiento al rojo por efecto Doppler.

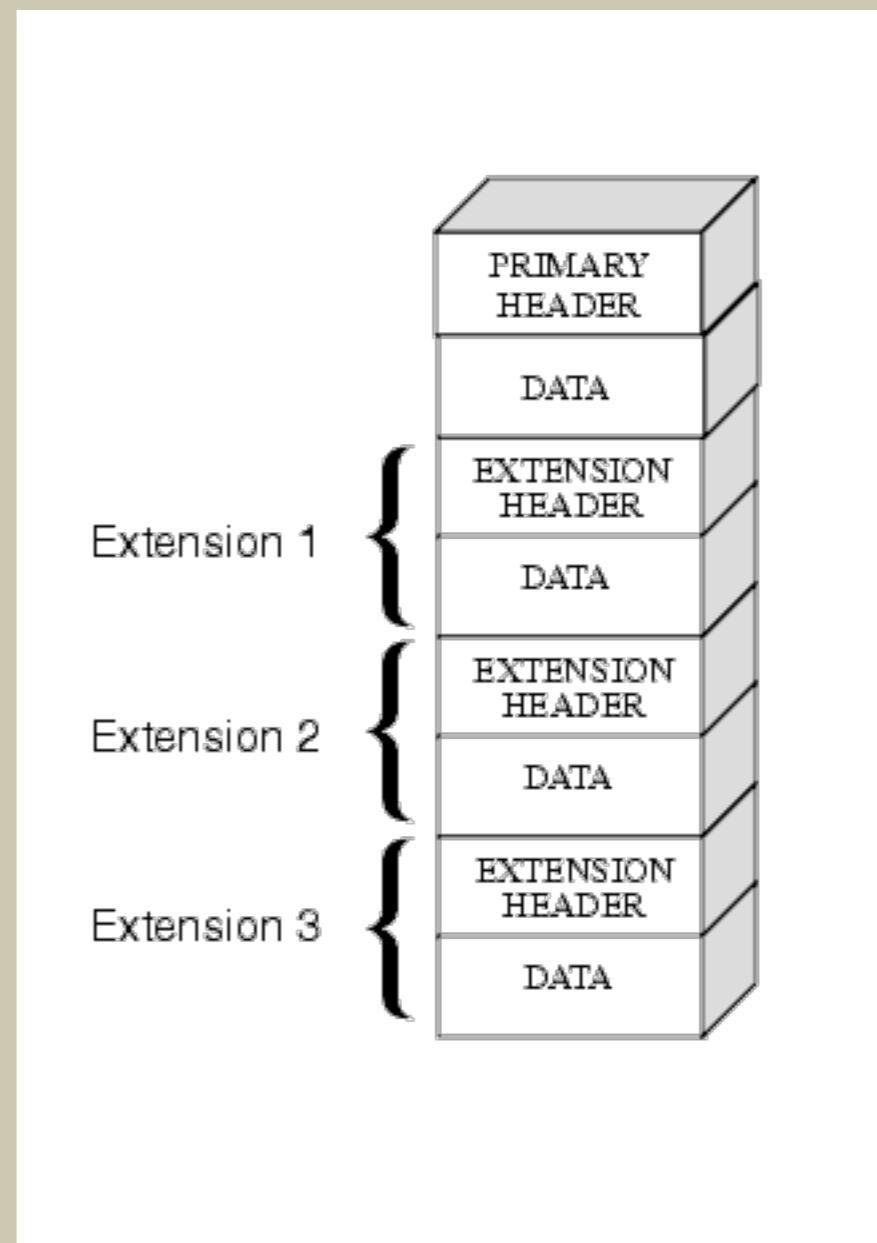


# Corrección por extinción.



# 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 blue NED logo with a white swoosh. To the right of the logo, the text "NASA/IPAC Extragalactic Database" is displayed in white. 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 bottom of the page towards the search bar. At the bottom, the text "KISSR 298" and "Kitt Peak Spectroscopic Survey - Red" is displayed in large, bold, grey letters.

ipac

NED

NASA/IPAC Extragalactic Database

Home    Search Objects »    Literature »    Services »    Tools »    Information »

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						
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)
RA/Dec Equatorial (J2000.0)	202.457480	29.579716	13h29m49.795s	+29d34m46.98s	5.00E-01	5.00E-01

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)	<b>Redshifts (10)</b>	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 of

If you're new to the Finding Chart, please see the [Visual Tools main page](#) with [Introduction to the SDSS Visual Tools](#) and [with Finding Chart](#).

**DR12**

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

**Parameters**

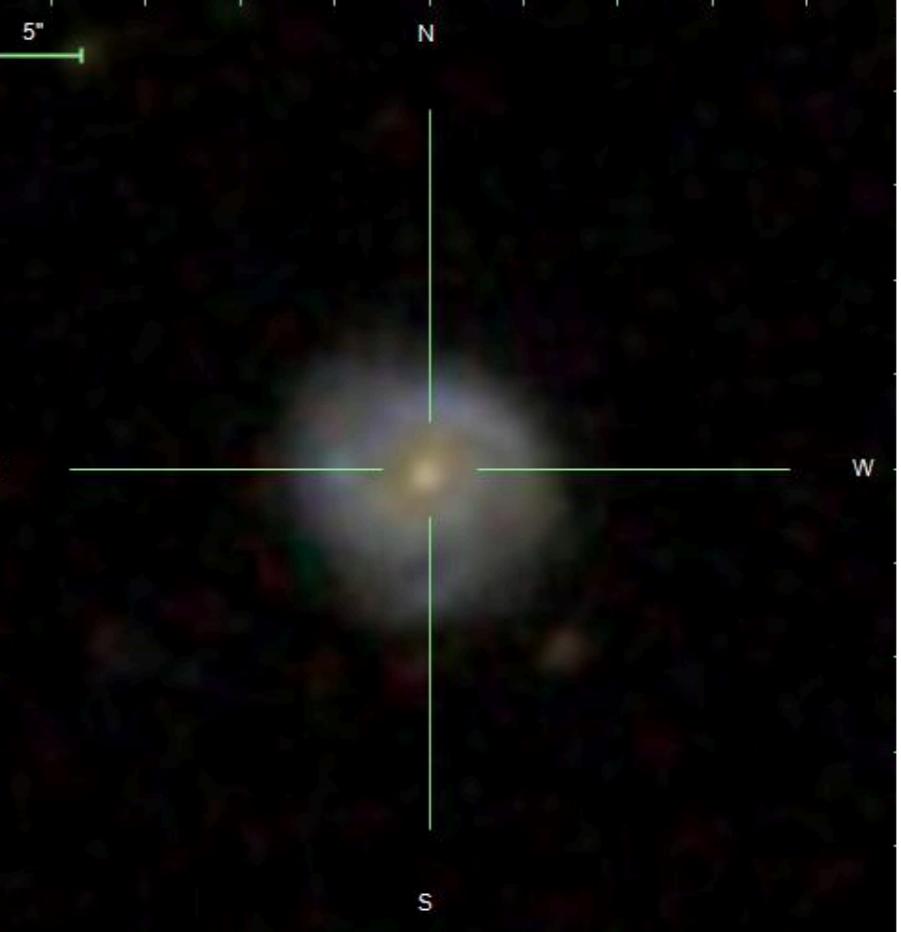
ra	202.45748	deg
dec	29.579716	deg
scale	0.09903175	"/pix
width	512	pix
height	512	pix
opt	G	

**Get Image**

+ -

Use query to mark objects

**Drawing options**  
 Grid



**Use query to mark objects:**

This option will draw a triangle at the center of 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

# 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. Columns must be separated by tabs, spaces, commas or semicolons. The list may contain as many columns as wished.



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

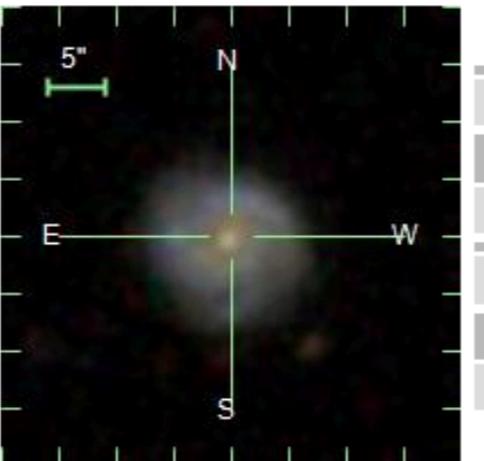
FSPSGranWideNoDust

[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

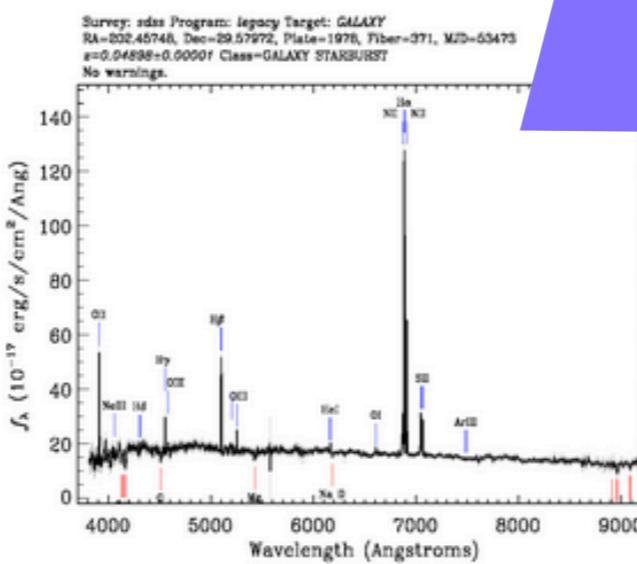
Flags

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 a 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 (Facebook and Twitter icons), Register, Forum, HST Home, About HST, Discovery Portal, Reprocessing Status, and HST Search.

The main content area has a sidebar on the left with links for HST Target Search, HST Abstract Search, FAQ, Search & Retrieval, MAST Services, Daily Data Reports, About HST Data, and High-Level Science. The main content area features a large image of the Hubble Space Telescope and text about its orbiting nature and instruments. A sidebar on the right lists news items with dates and titles.

**Mission Search** dropdown menu (highlighted with a red box):

- 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
- VMM-OM

**News**

- 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

Register

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\*\*](#)**Search****Reset****Clear Form****Target Name**  
KISSR 298**Resolver**

Resolve

**Radius (arcmin)**

3.0

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

J2000

**Imagers** ALL NONE STIS NICMOS WFPC2 WF/PC FOC ACS WFC3 COS**Spectrographs** ALL NONE STIS NICMOS GHRS FOS FOC ACS WFC3 COS**Other** ALL NONE FGS HSP**Start Time****Exp Time****Proposal ID****Release Date****Dataset****Filters/Gratings****Obset ID****Archive Date****Target Descrip****Apertures****Observations****PI Last Name**

Wofford

 Science Calibration

**Oportunidades de licenciatura  
y/o posgrado en astronomía en  
la UNAM campus Ensenada o  
Morelia.**

# Ocho científicos en México han liderado 20 programas de observación con el Hubble.



**Luc  
Binette**



**Gloria  
Koenigsberger**



**Yair  
Krongold**



**Anna Lia  
Longinotti**



**Alberto  
López**



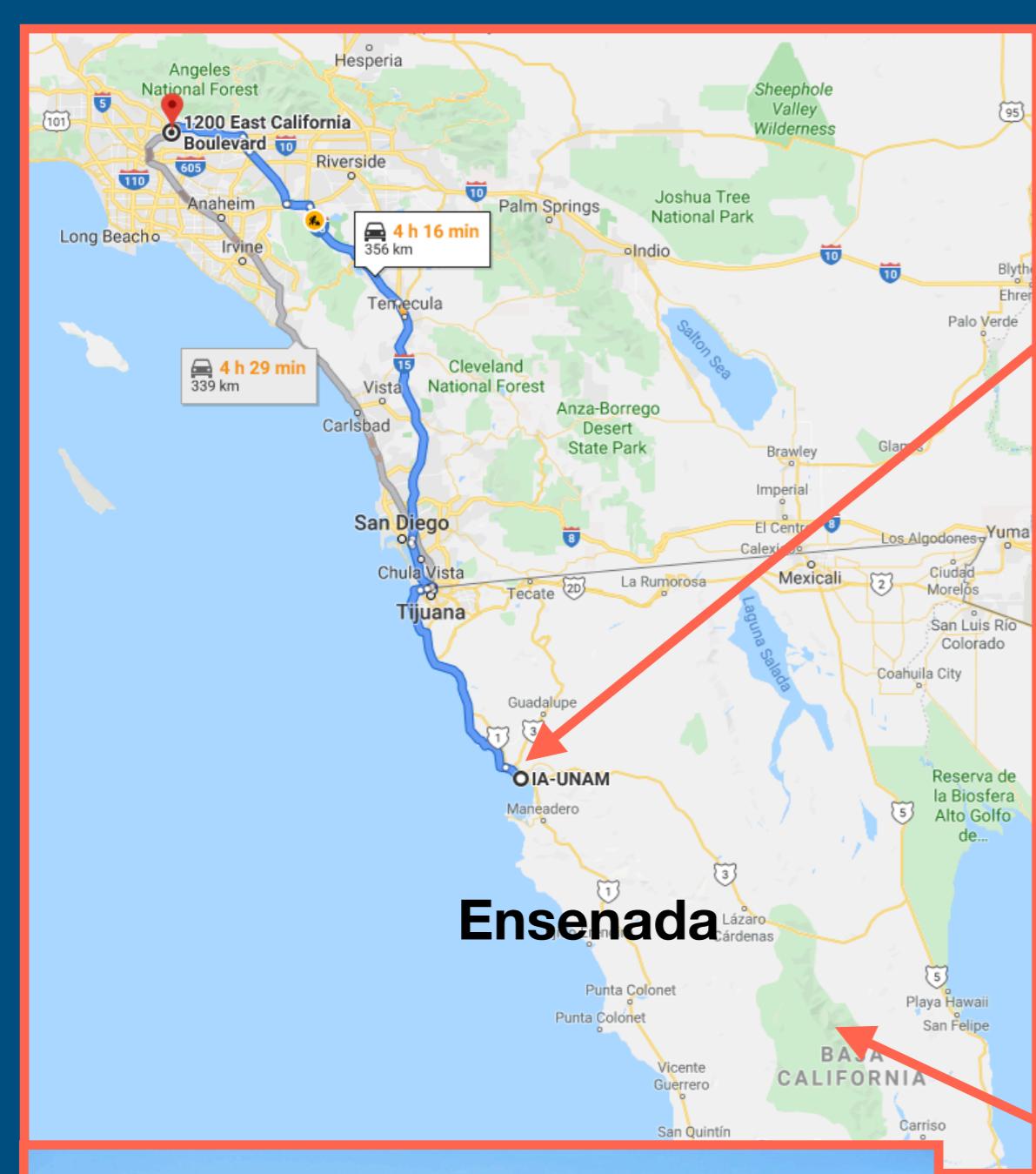
**Miriam  
Peña**



**Silvia  
Torres-Peimbert**



**Aida  
Wofford**



# Instituto de Astronomía, UNAM



## Observatorio Astronómico Nacional



Dr. Carlos Román Zúñiga, croman@astro.unam.mx

Tengo dinero de conacyt para una beca de tesis de licenciatura. Tengo dos temas posibles, muy adecuados para quien tome tu taller:

- 1) hacer un portal de visualizacion via web para datos espectroscopicos de estrellas jovenes en el catálogo SDSS-IV APOGEE-2.
- 2) hacer una analisis de las propiedades espectrales de estrellas jovenes con datos opticos e infrarrojos del sondeo SDSS-V Milky Way Mapper.

Dra. Margarita Pereyra Talamantes, mpereyra@astro.unam.mx

- 1.- Estudio de variabilidad en la emisión de la binaria compacta *MAXI J1807+132* observada desde el Observatorio Astronómico Nacional.
- 2.- La búsqueda del instrumento DDOTI, de las contrapartes ópticas para estallidos de rayos gamma detectados por Fermi-GBM.