

# SUPERNOVAS

## la llave del lado oscuro del universo

Lluís Galbany



Abenduak 28, Ostirala, Oñatiko Kultur Etxean

# Aceleración de la expansión del universo

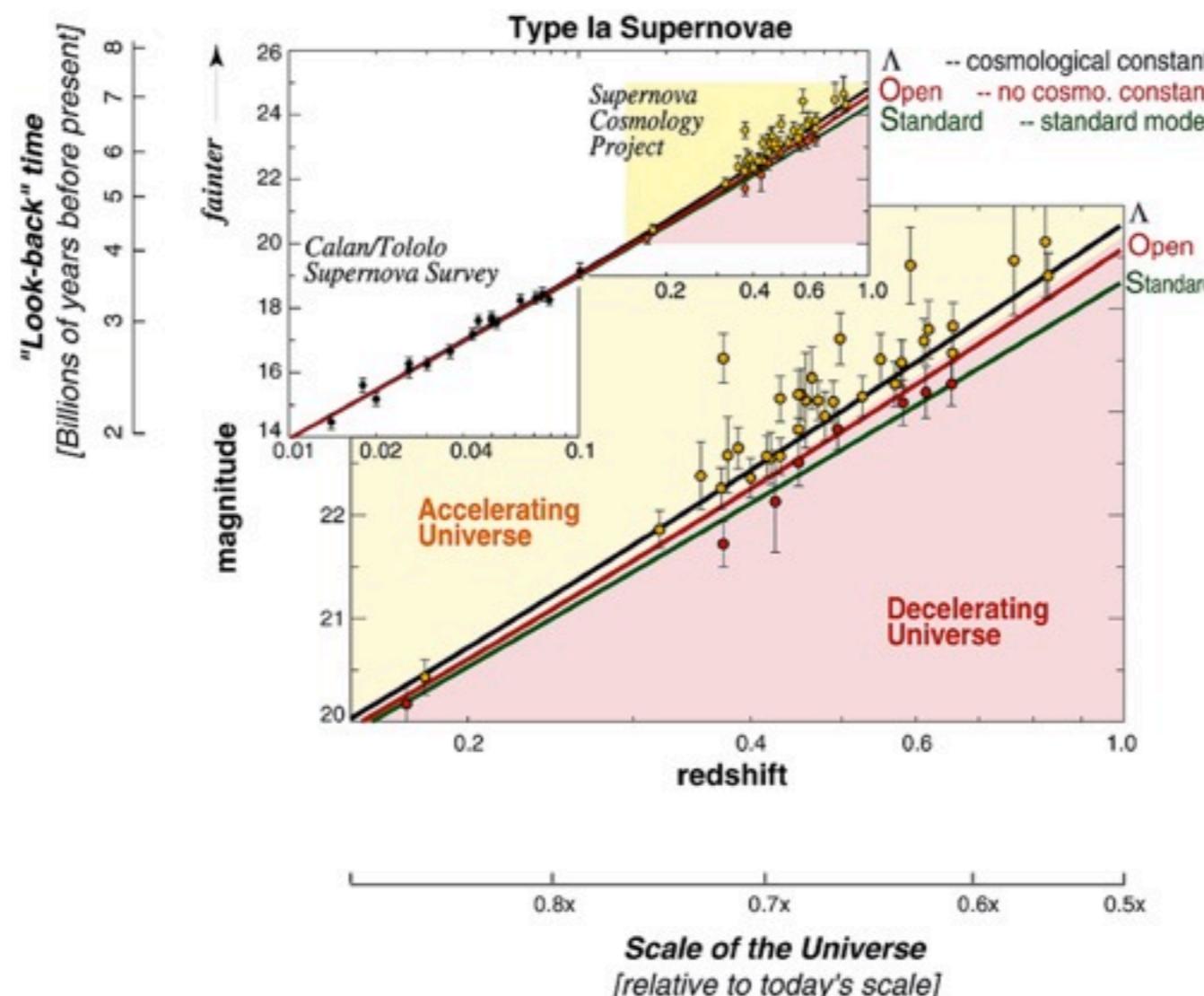
- En 1998 dos grupos de astrónomos y físicos que estudiaban supernovas del tipo Ia encontraron que el ritmo de expansión del universo se estaba acelerando

Supernova Cosmology Project

Perlmutter et al. 1999

High-z Supernova Team

Riess et al. 1998



# Aceleración de la expansión del universo

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Supernova Cosmology Project

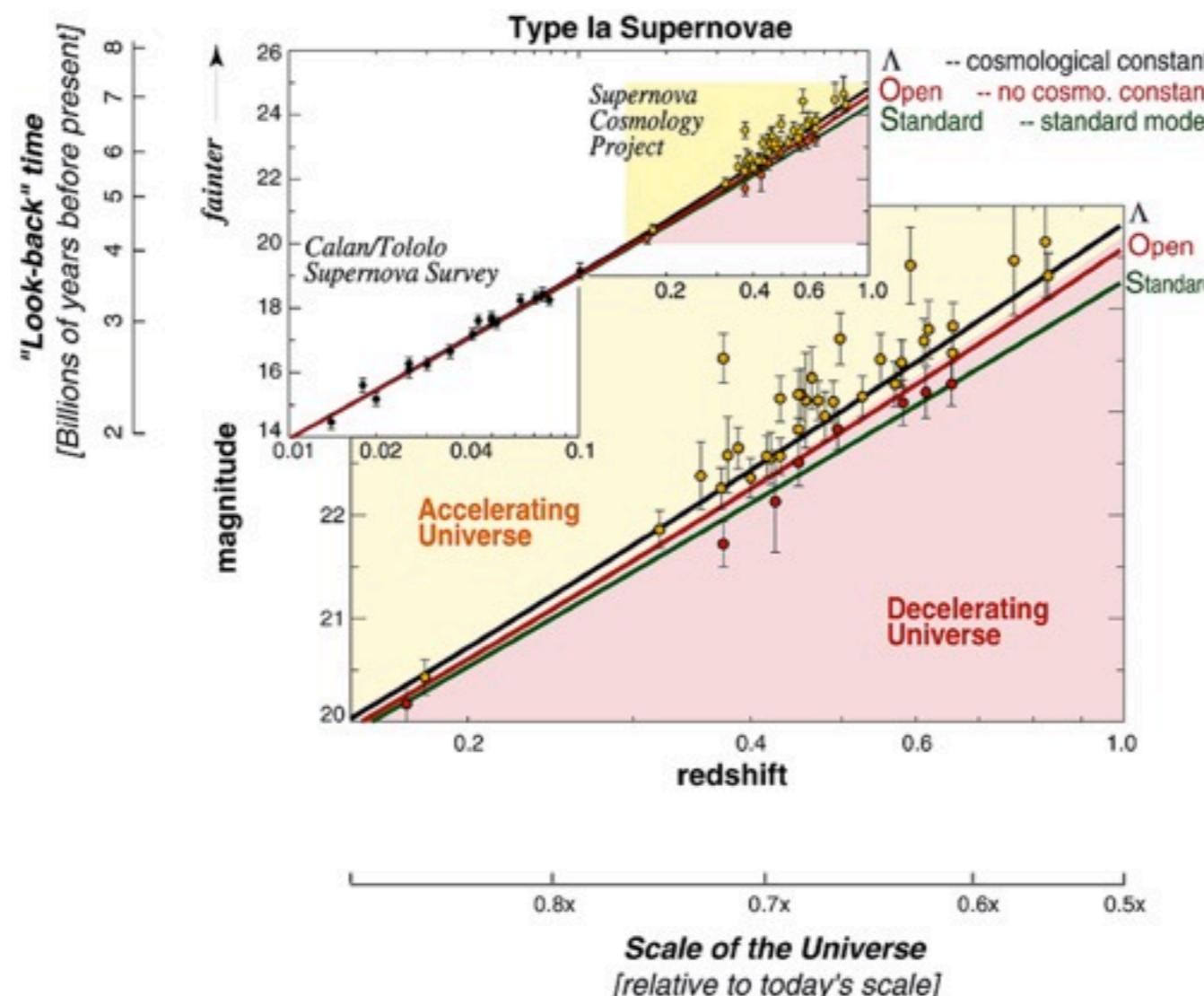
Perlmutter et al. 1999

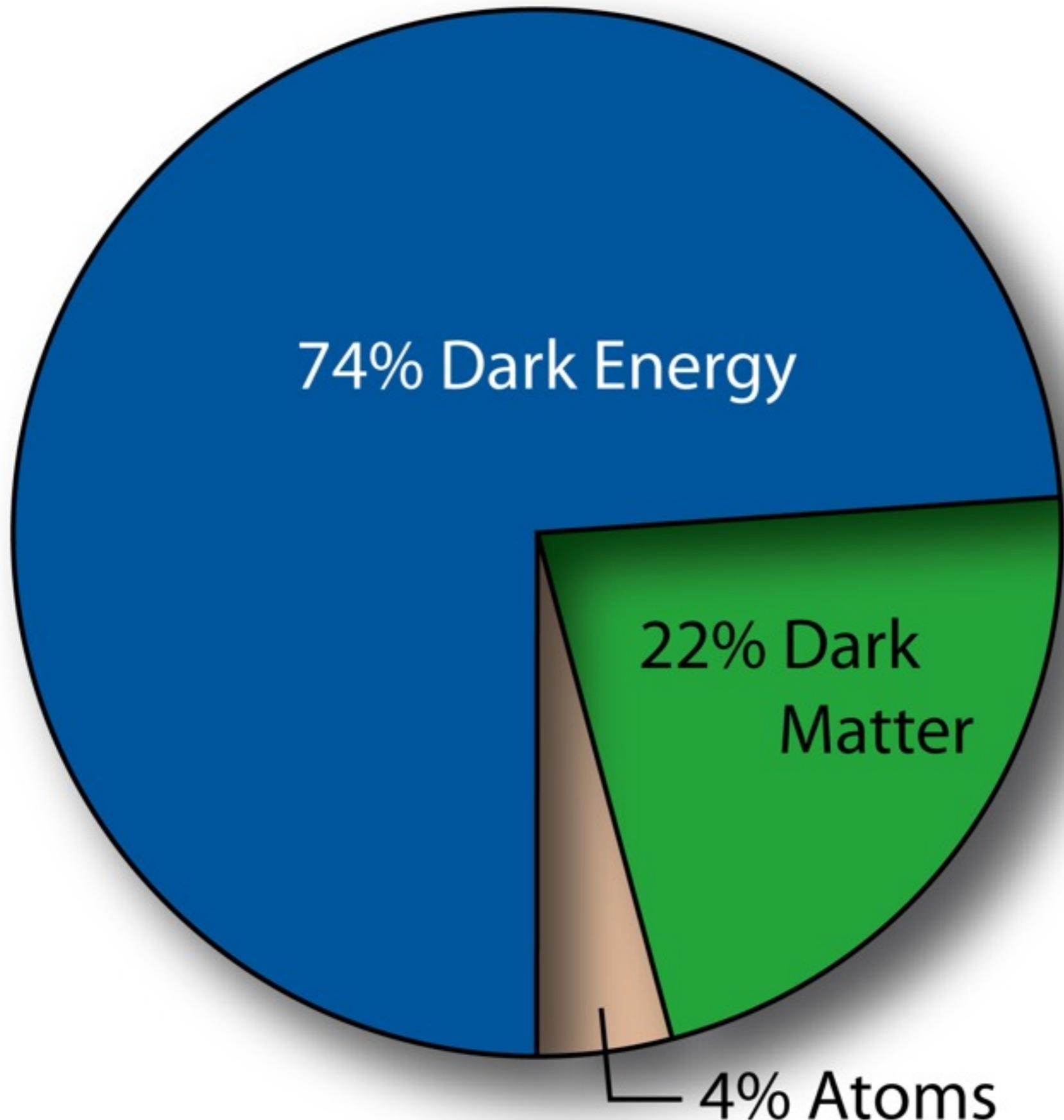


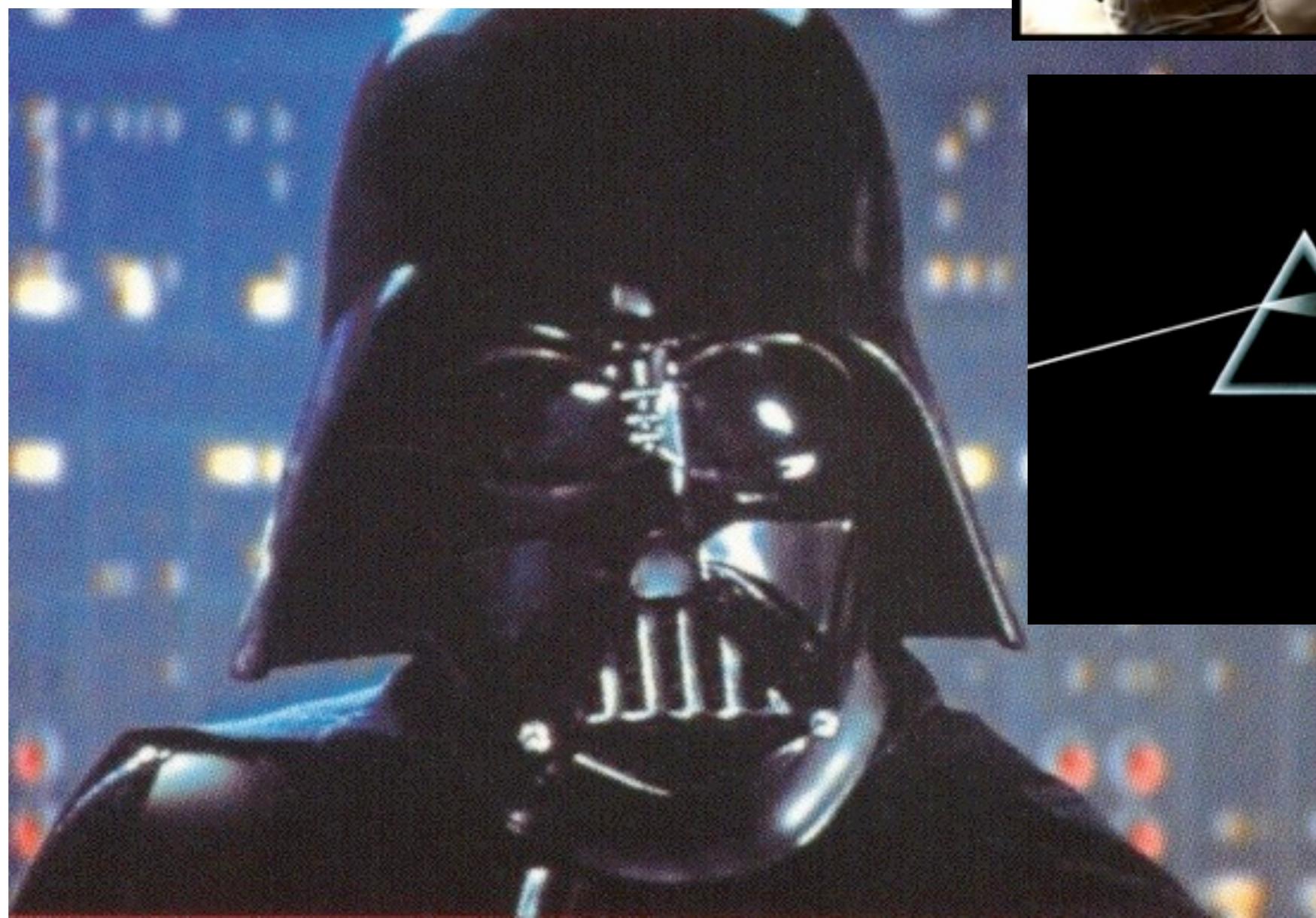
2011

High-z Supernova Team

Riess et al. 1998







# FIN

(intro)

## Índice

- Que son las supernovas
- Que tipos hay
- Que nos dicen (y como las escuchamos)
- Que hacemos con esa informacion

# Supernovas

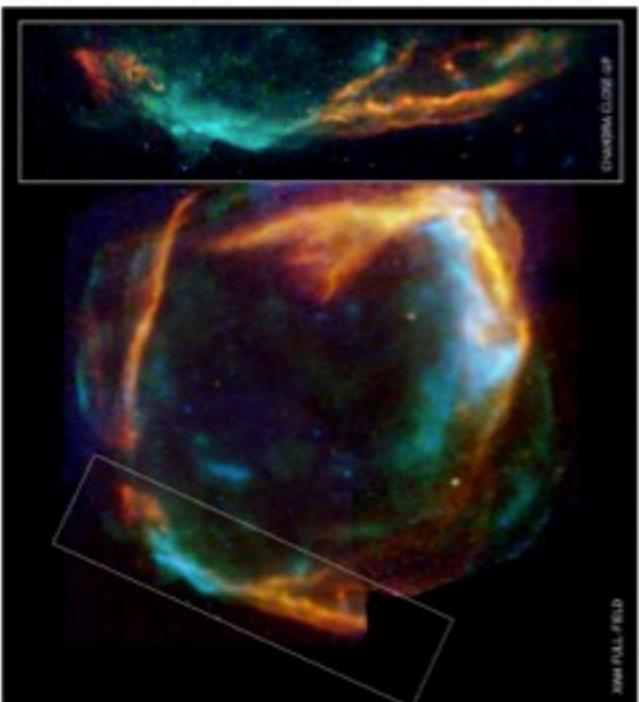
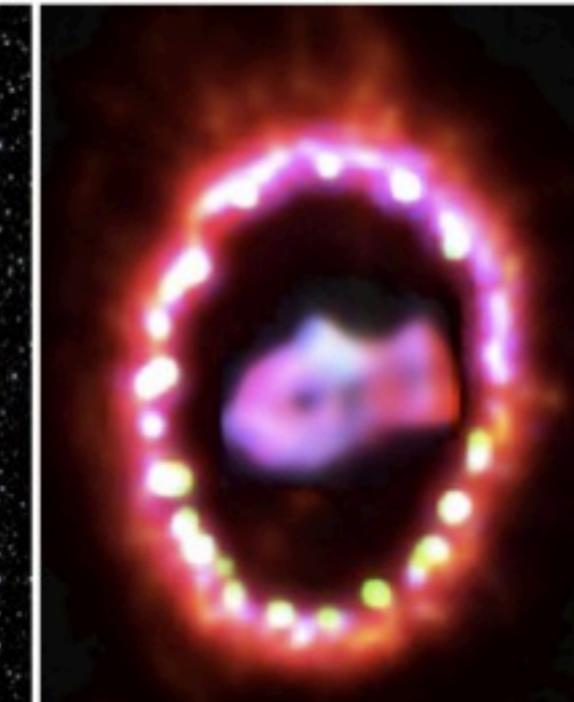
SN1006



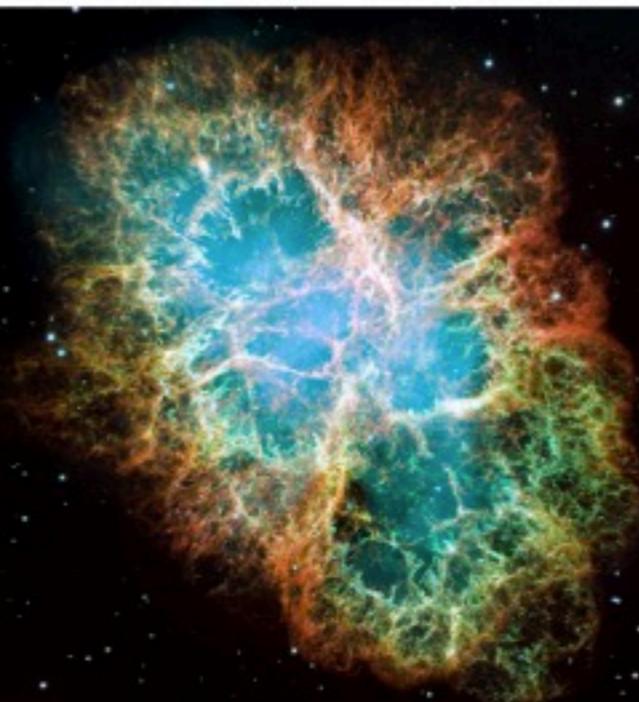
Brahe  
SN1572



LMC  
SN1987



SN185

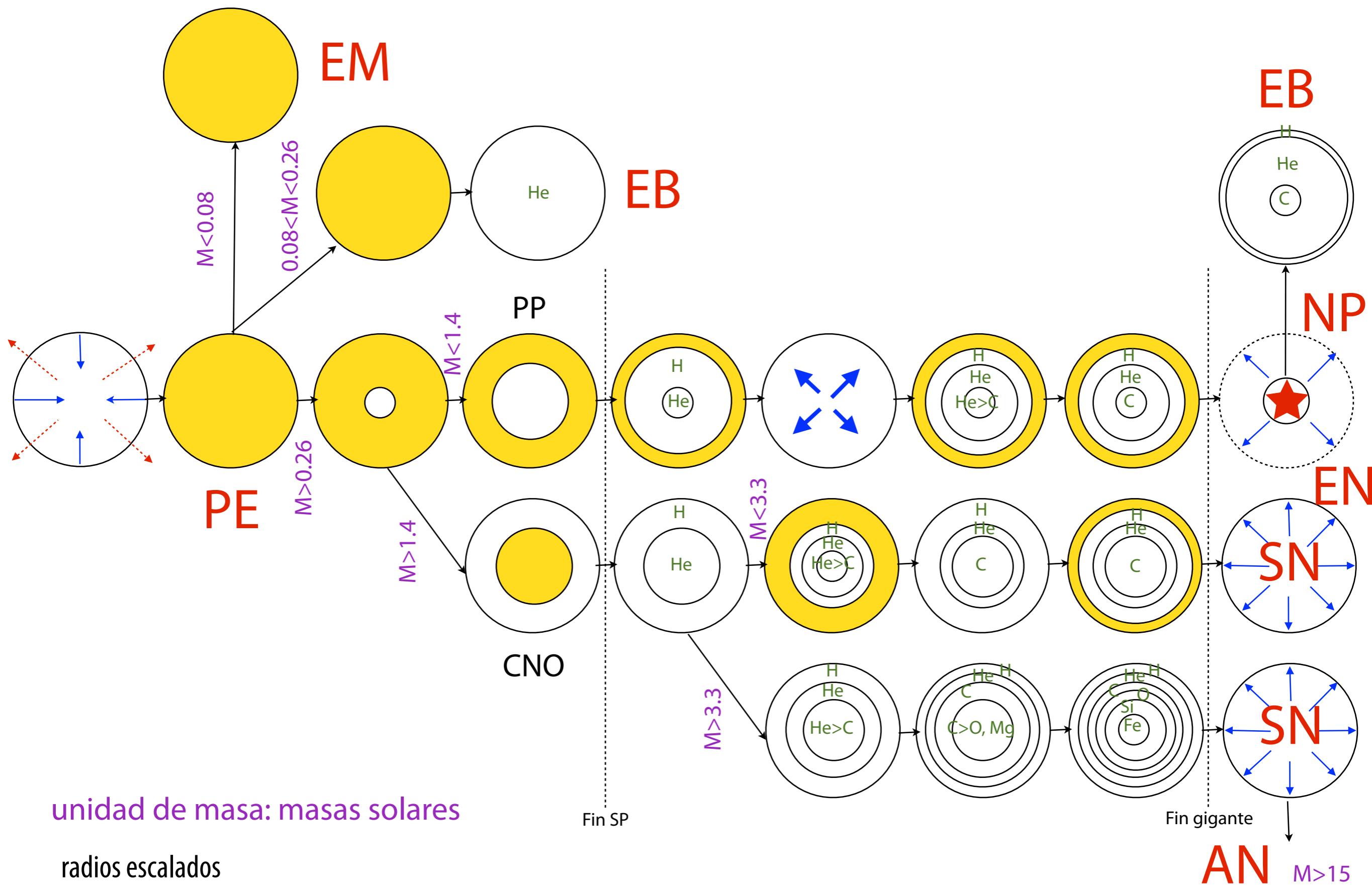


SN1054  
Crab

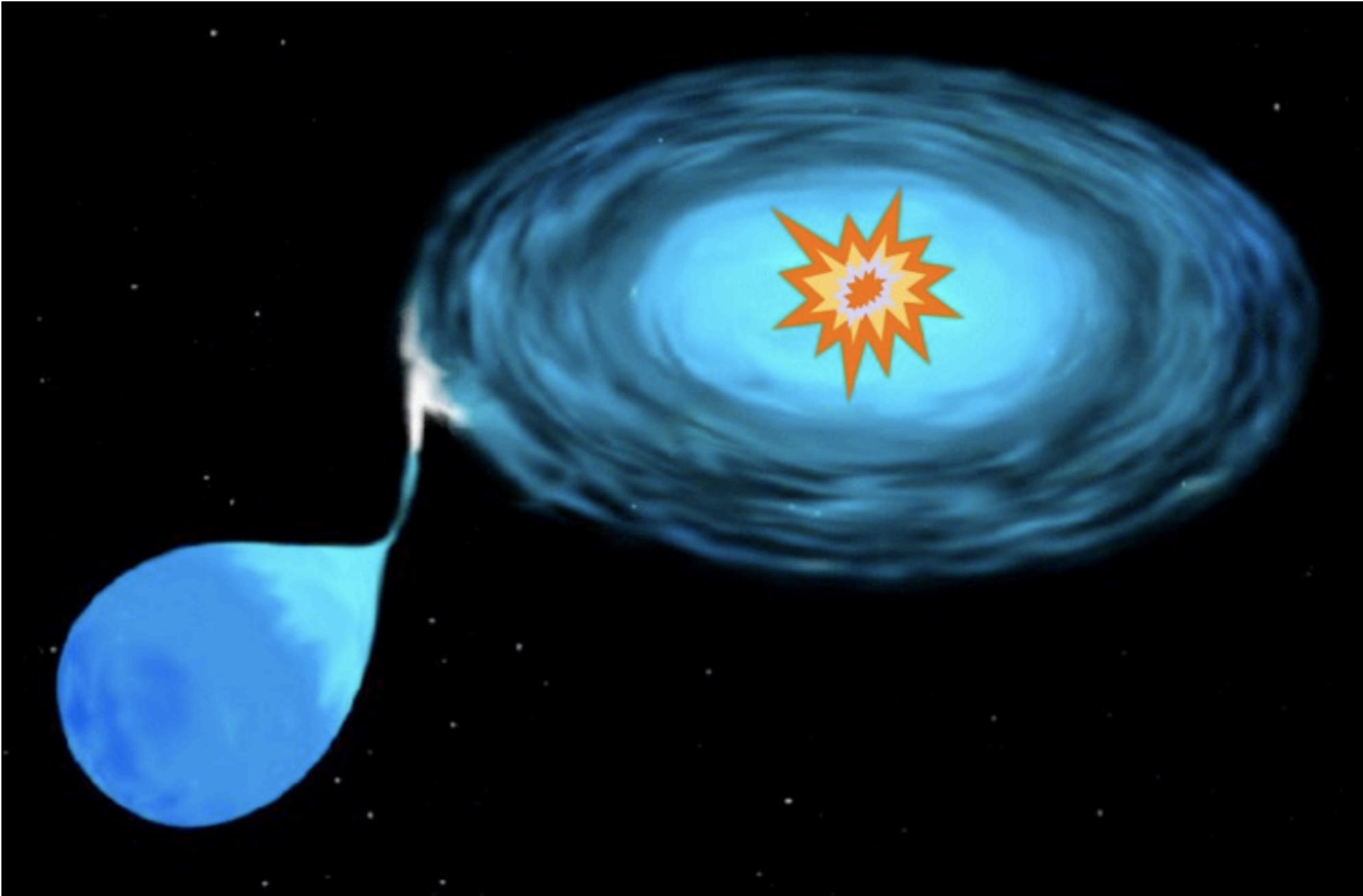


SN1604  
Kepler

# Evolución estelar



# Supernova Ia

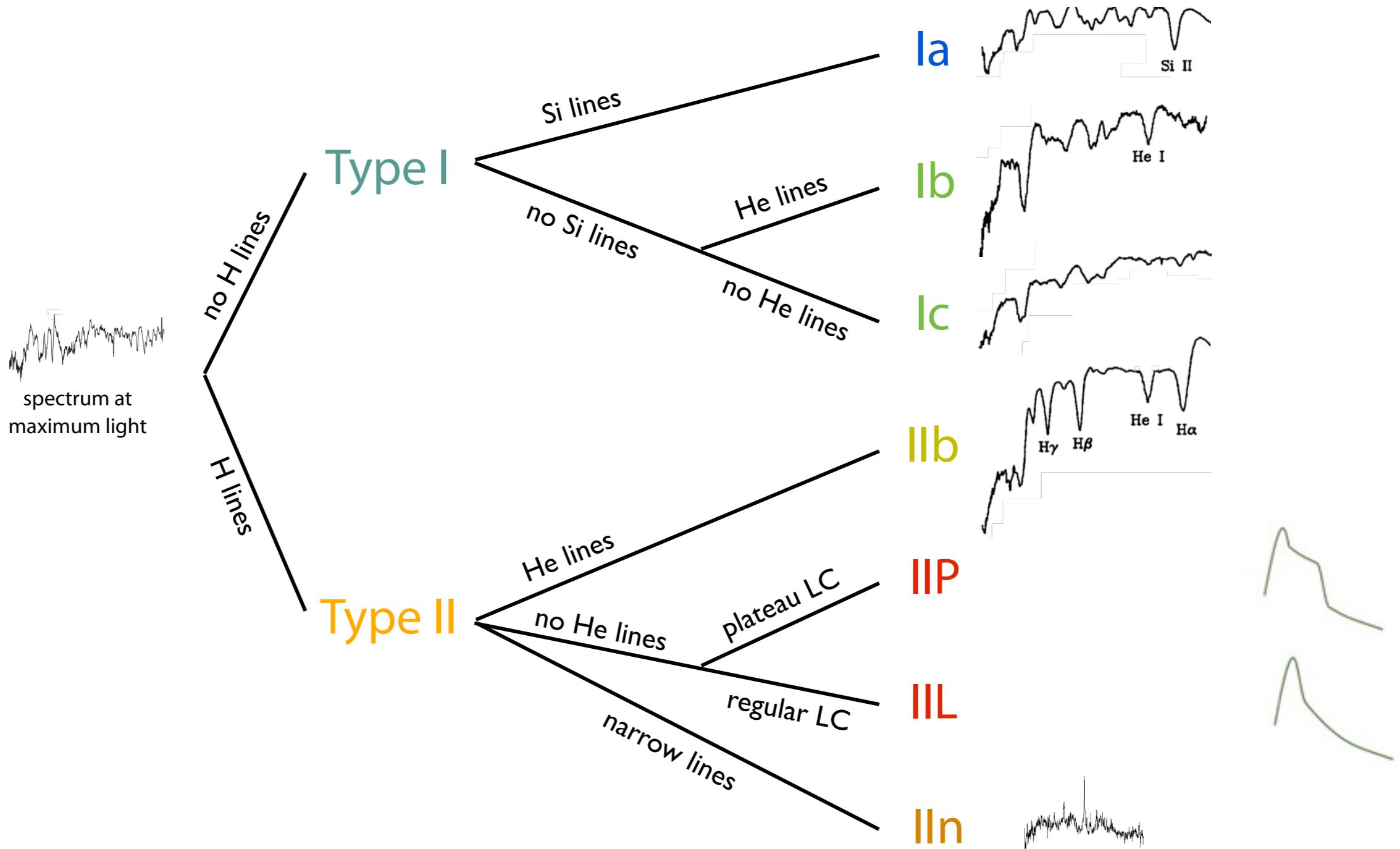


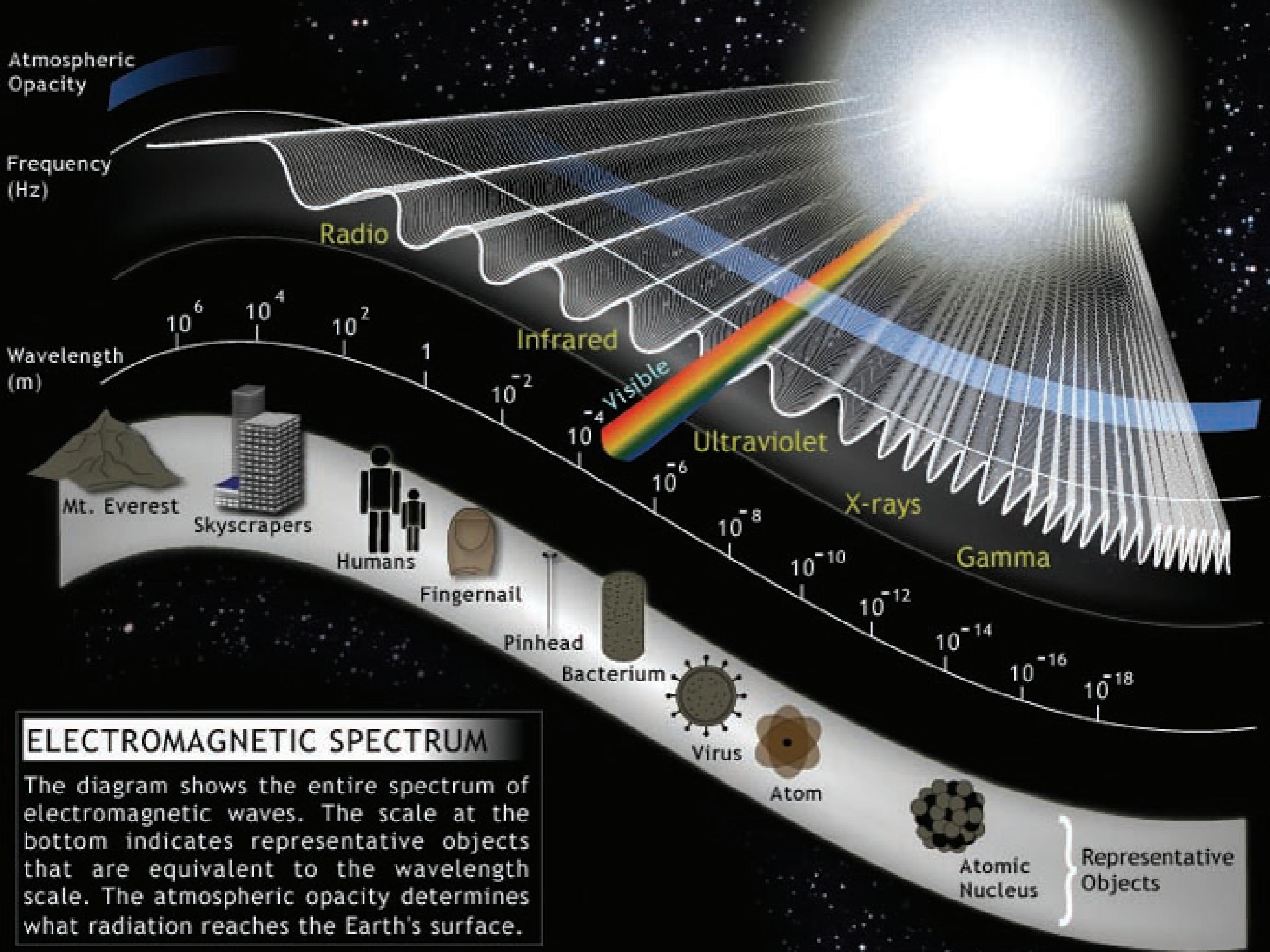


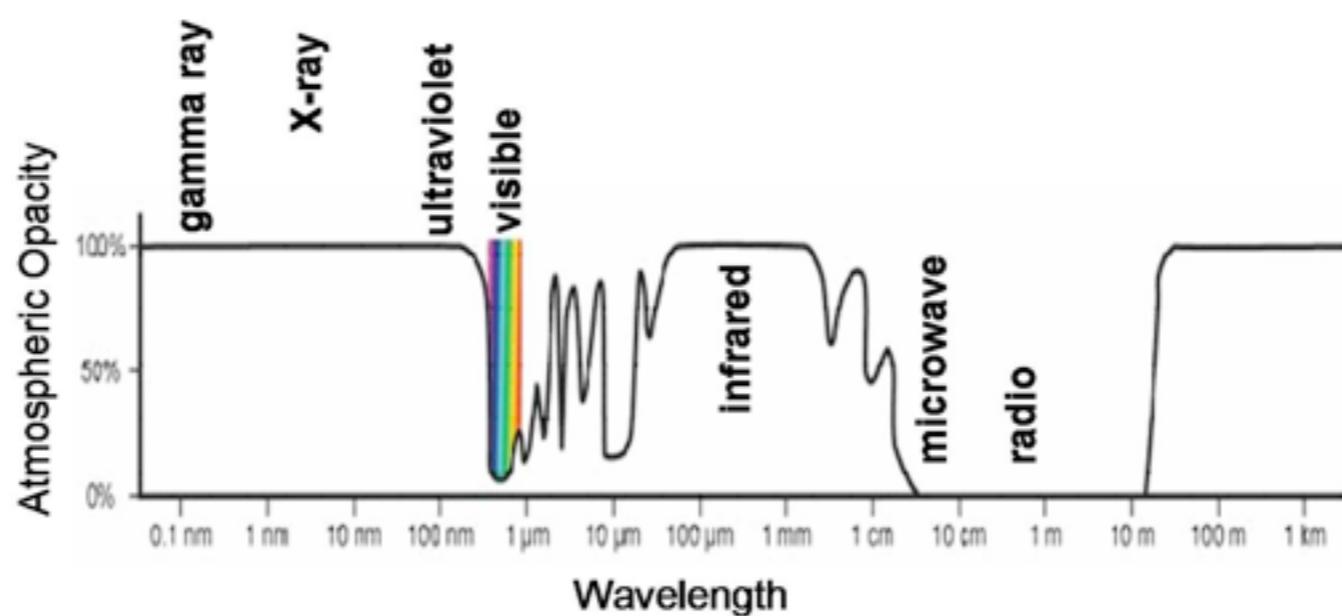
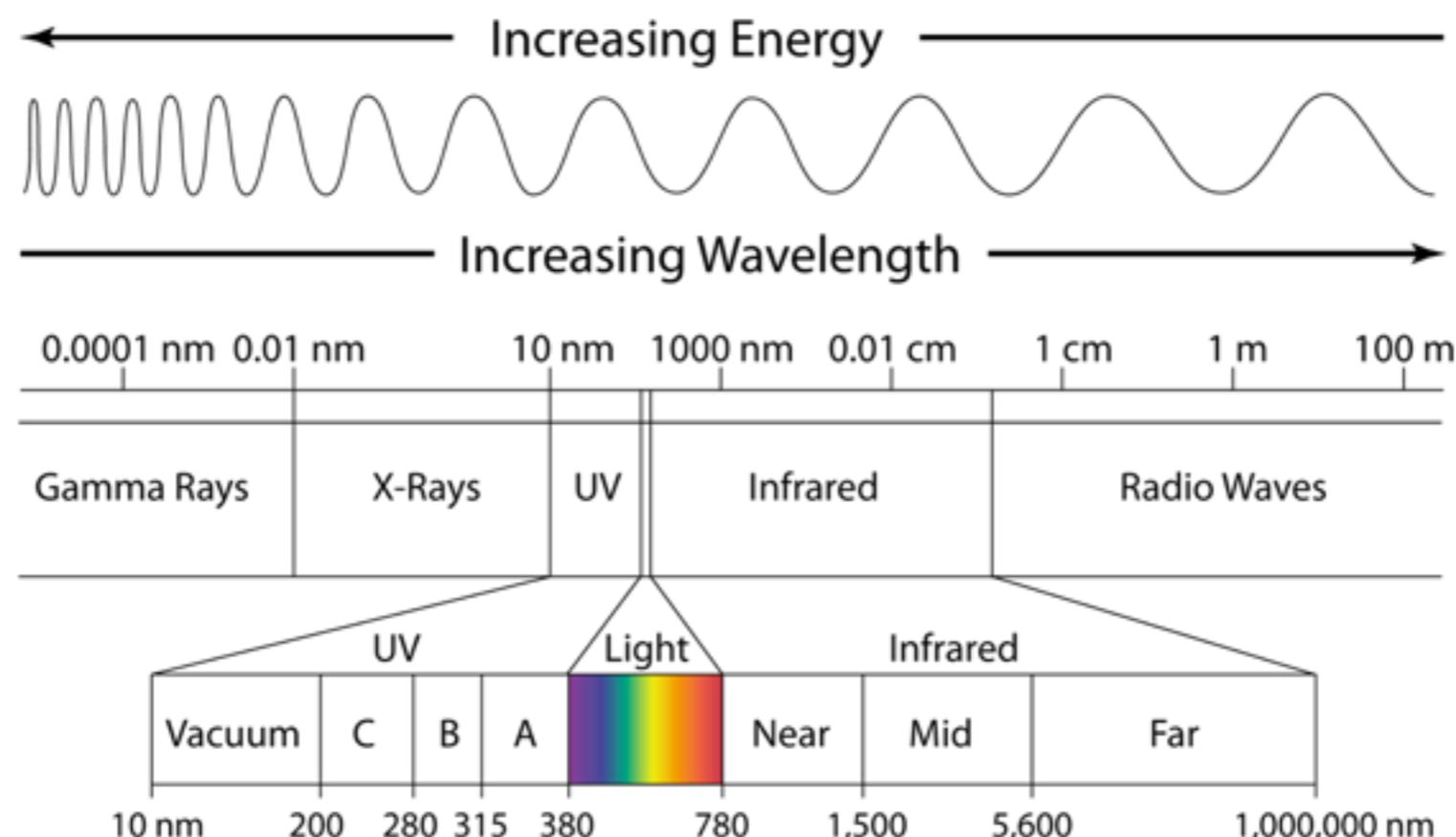
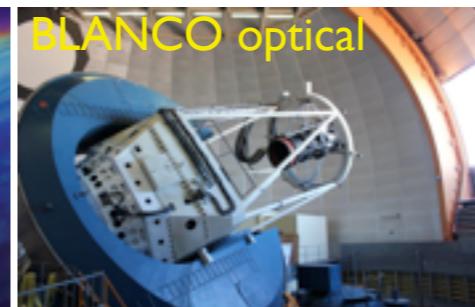
Módulo de distancia

$$\mu = m - M$$

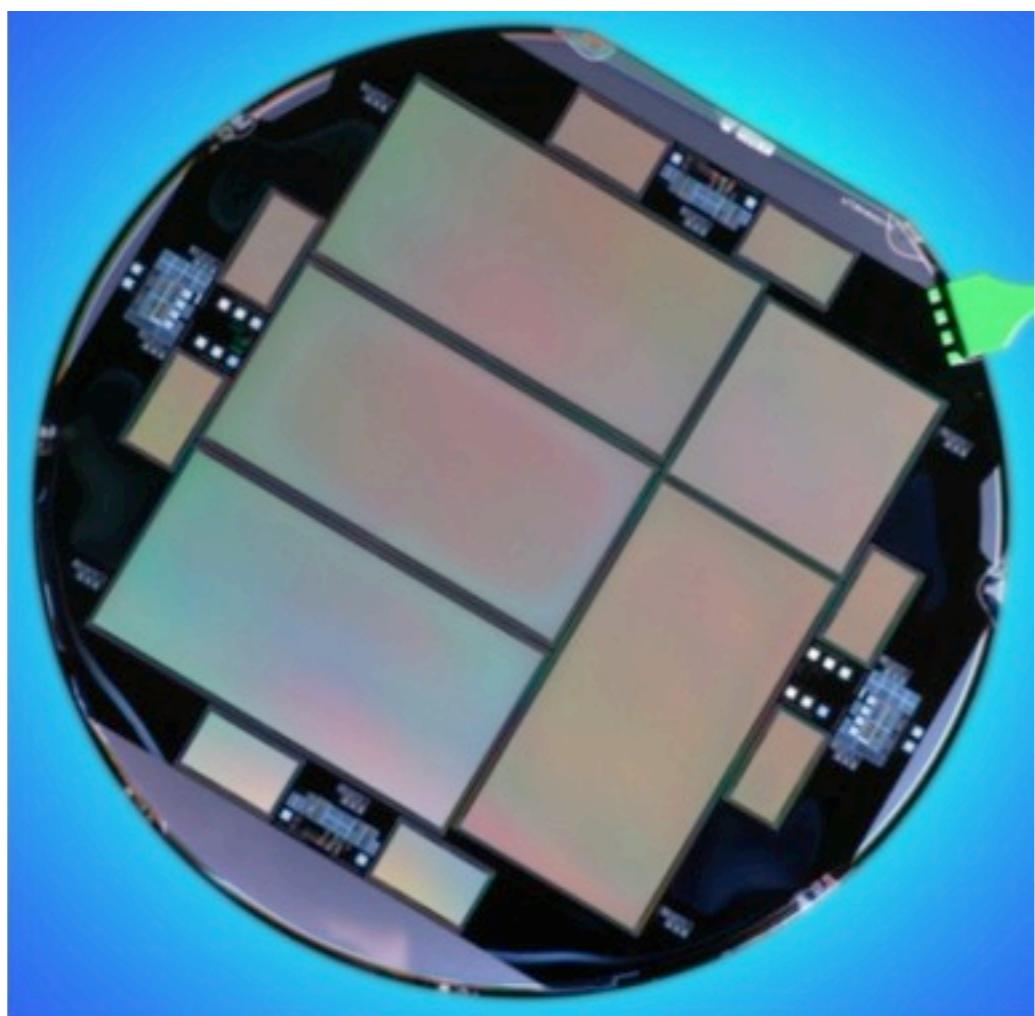
# Clasificación







# Fotometría - CCDs



Bucket Brigade CCD Analogy

Integration of  
Photon-Induced  
Charge

Parallel  
Bucket –  
Array

Parallel Register  
Shift (1 Row)

Serial Register  
Shift to Output

Conveyer Belt

Calibrated  
Measuring –  
Container

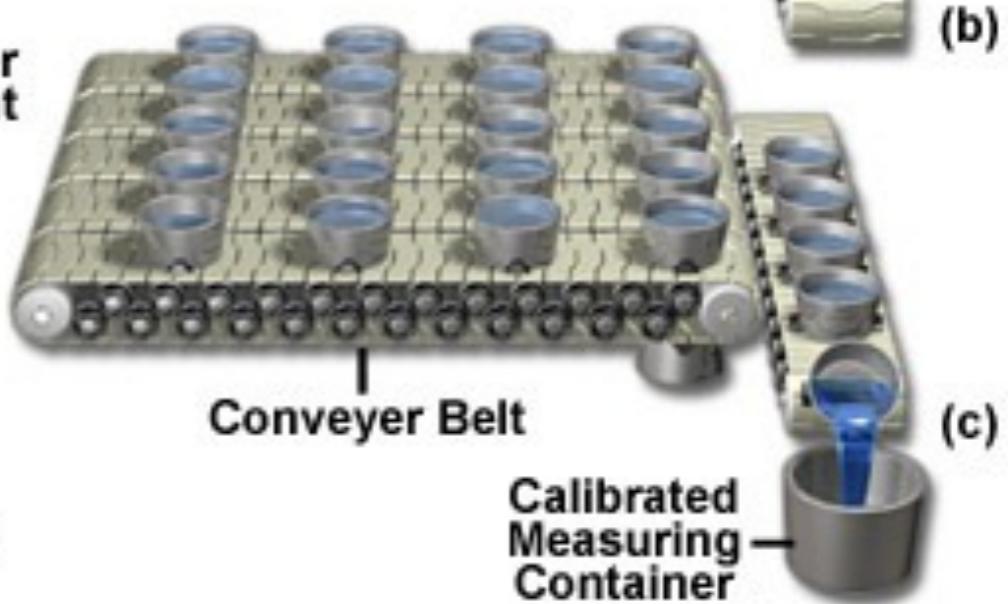
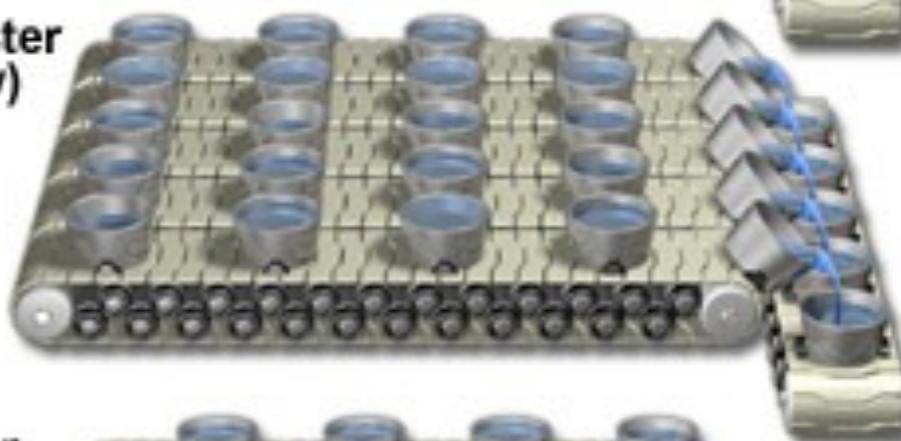
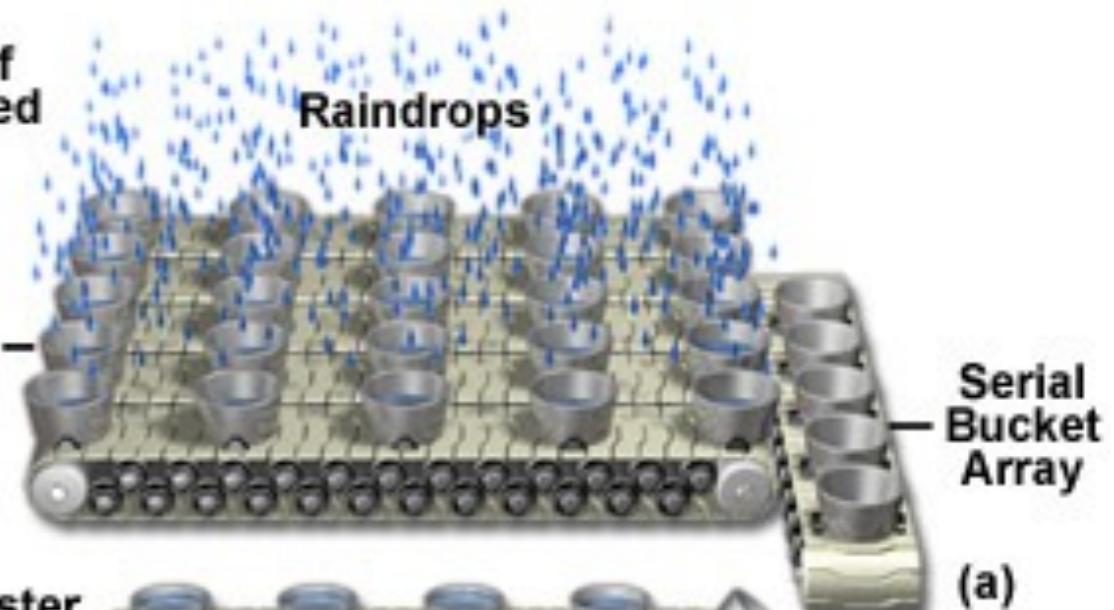
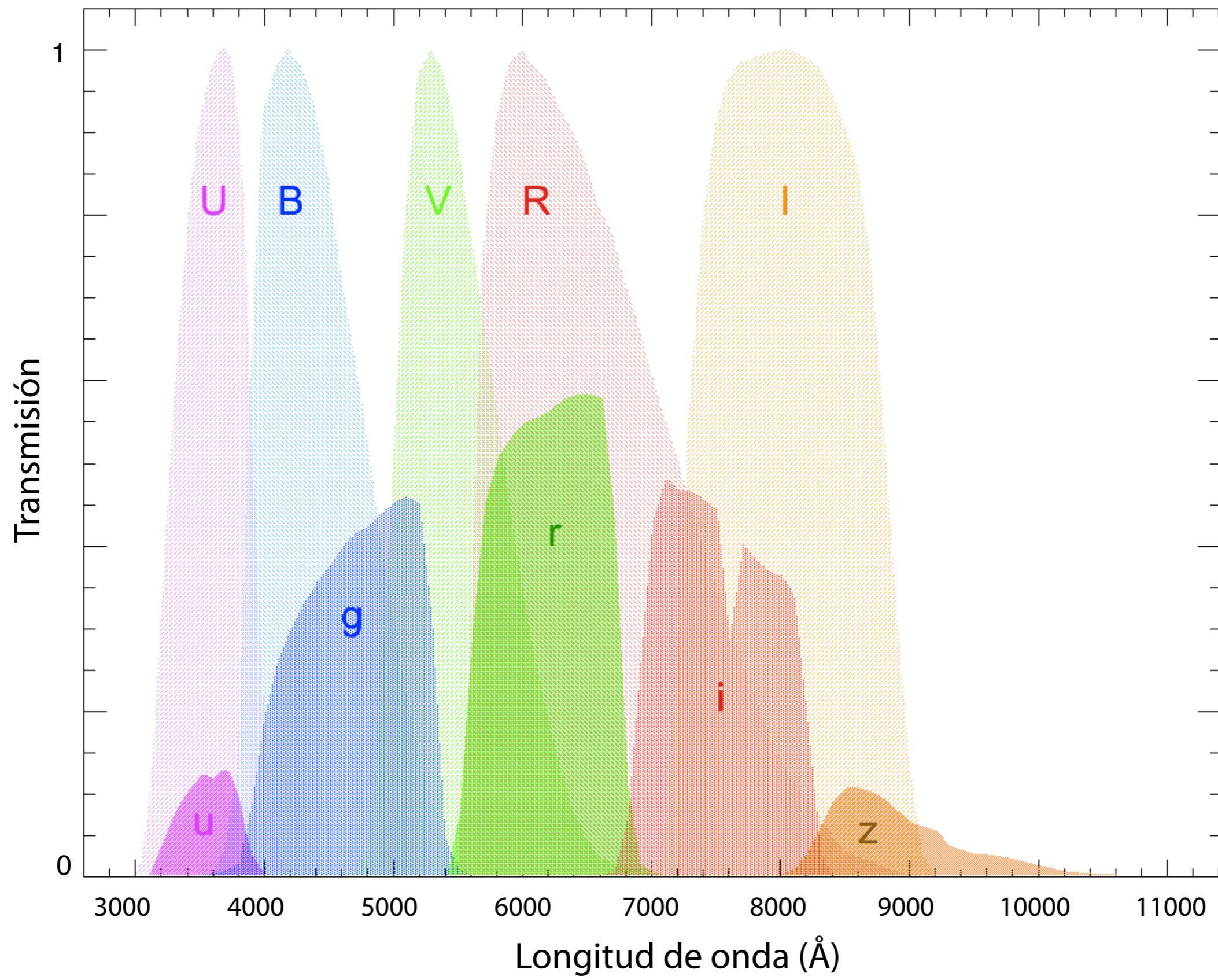
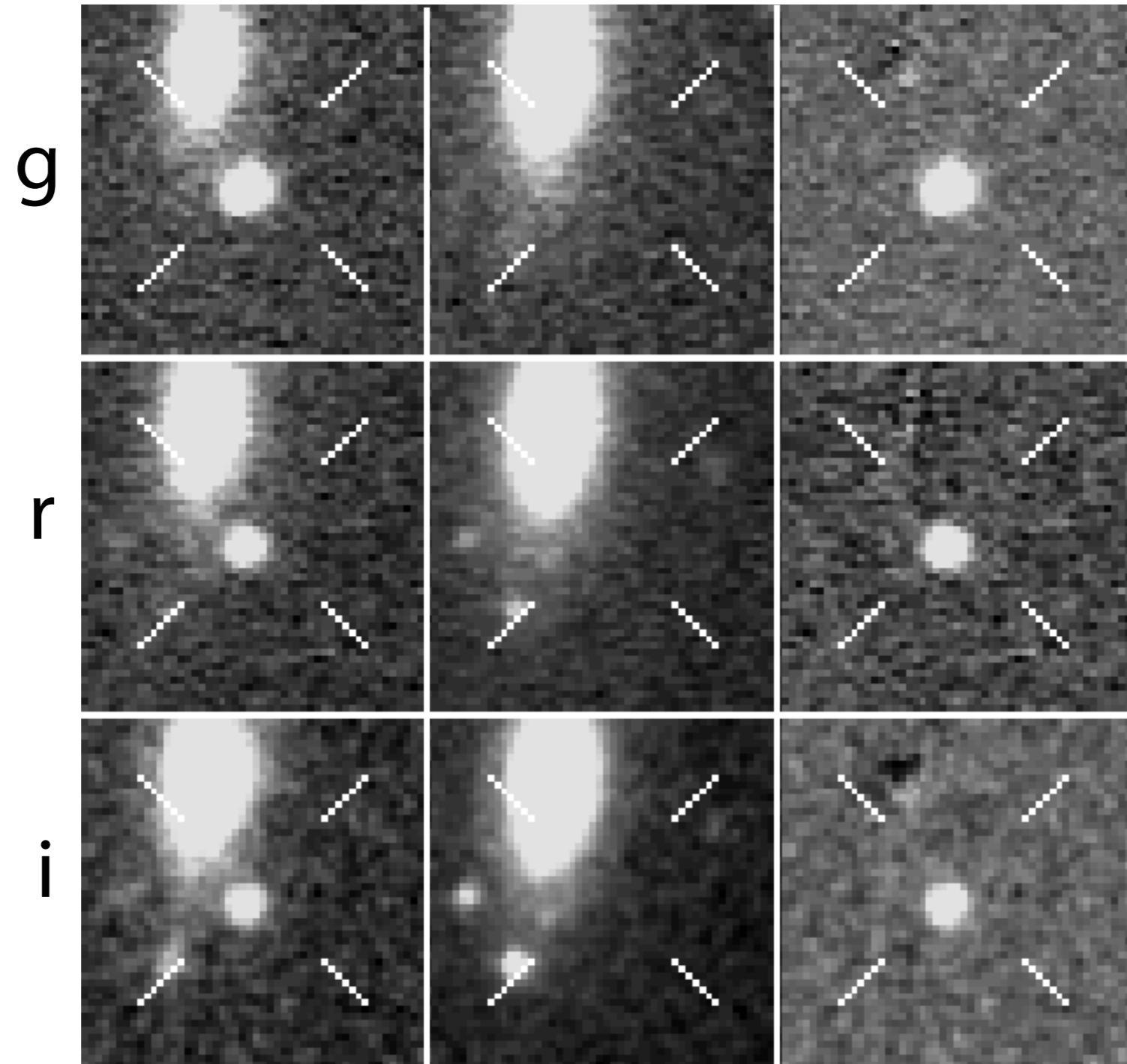


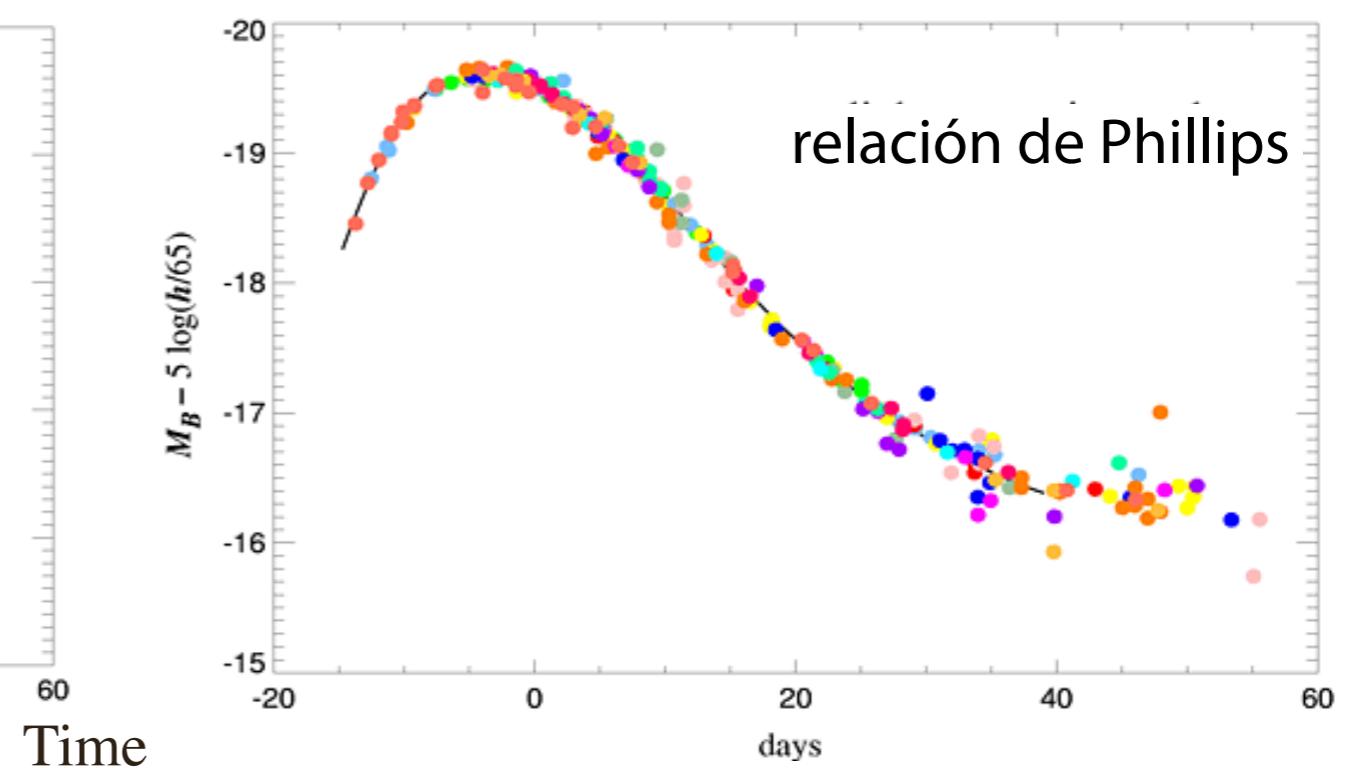
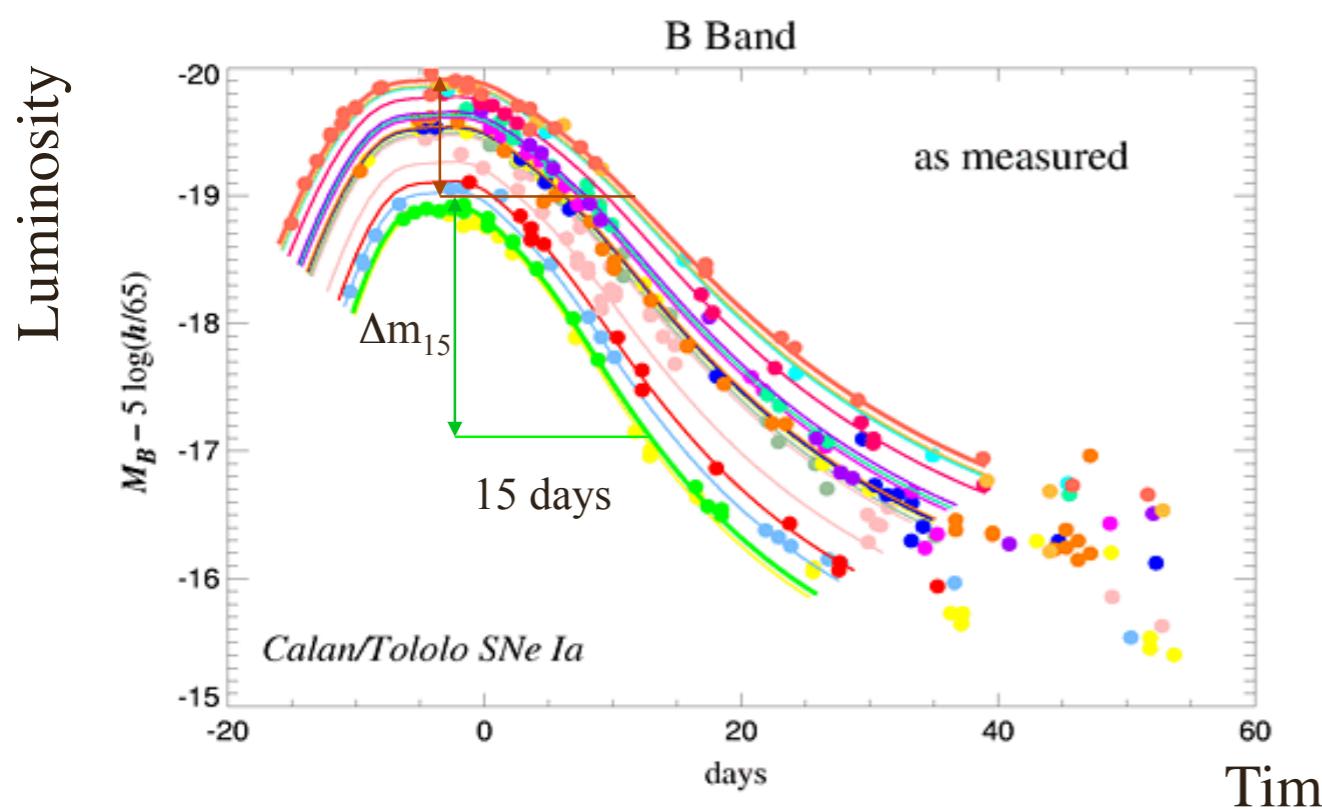
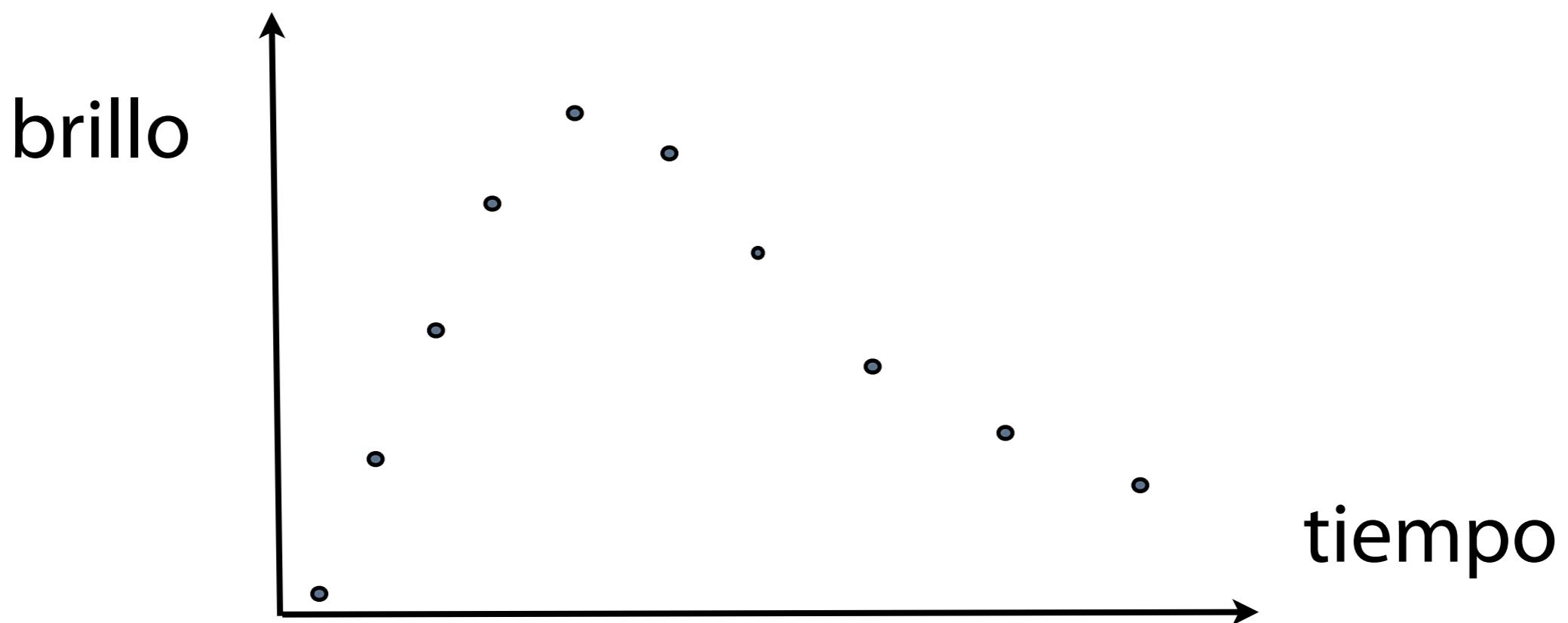
Figure 6



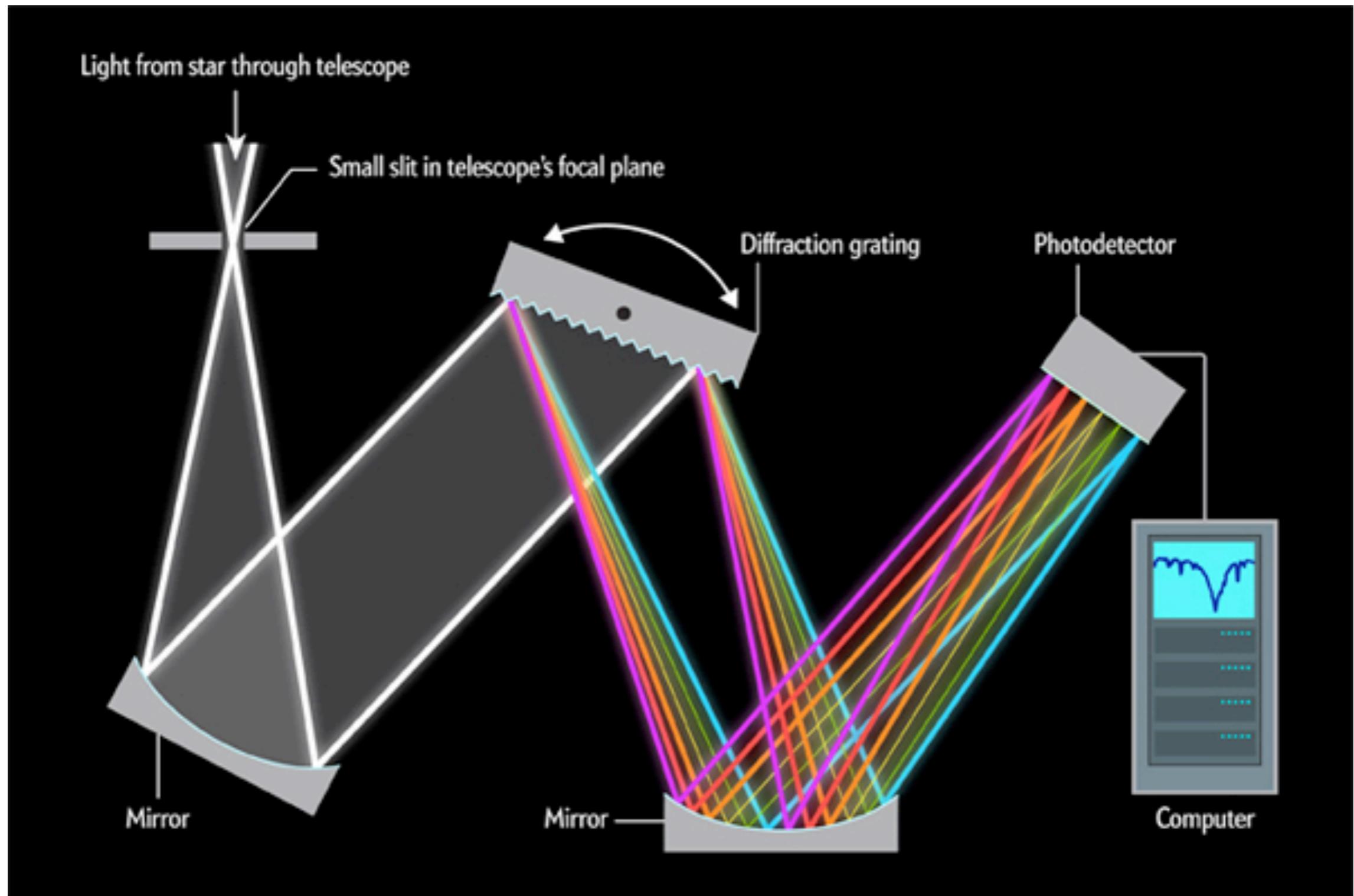
Search      Template      Difference



# Curvas de luz



# Espectroscopía



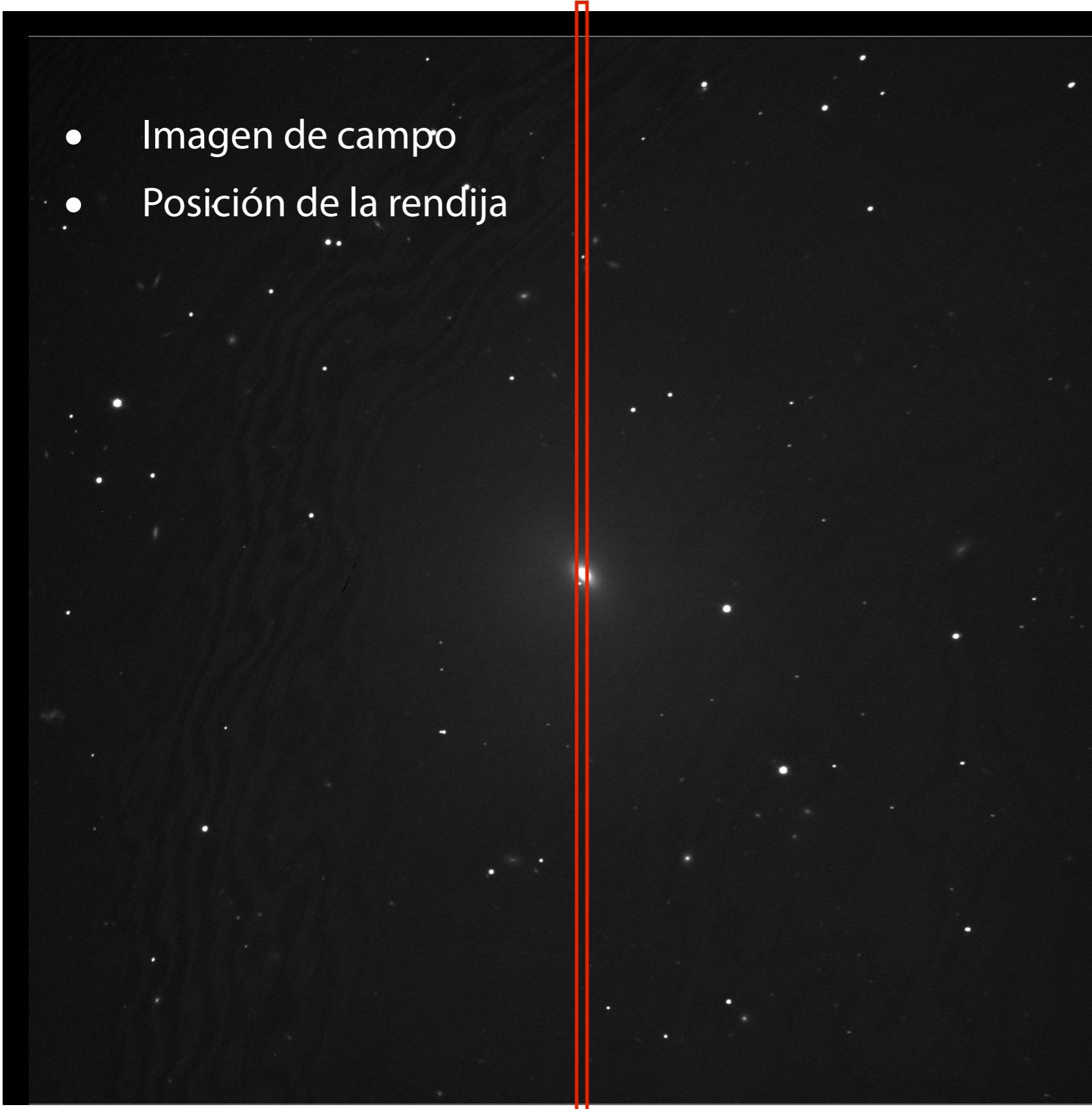
# Obtención espectro

- Imagen de campo



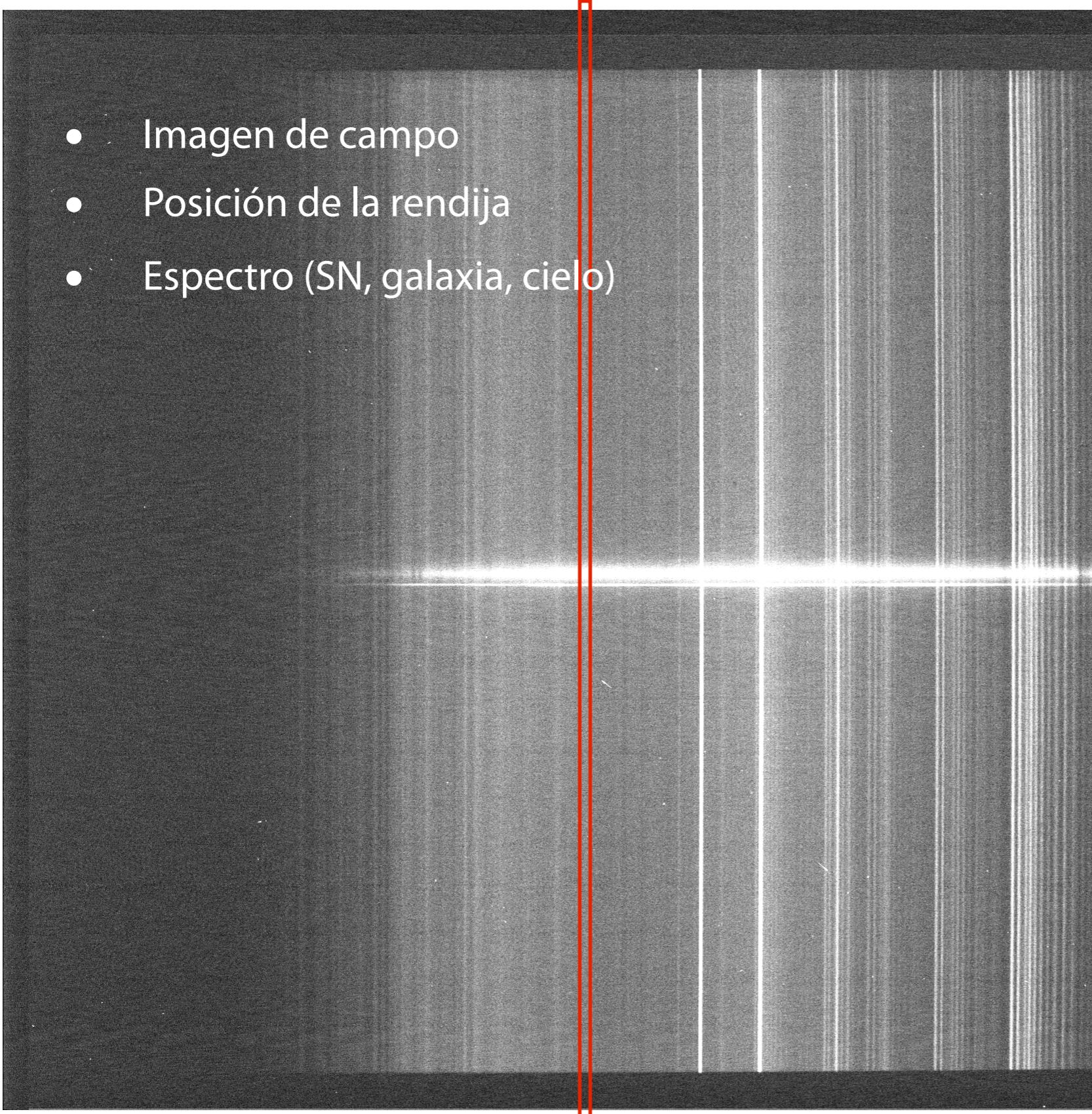
# Obtención espectro

- Imagen de campo
- Posición de la rendija



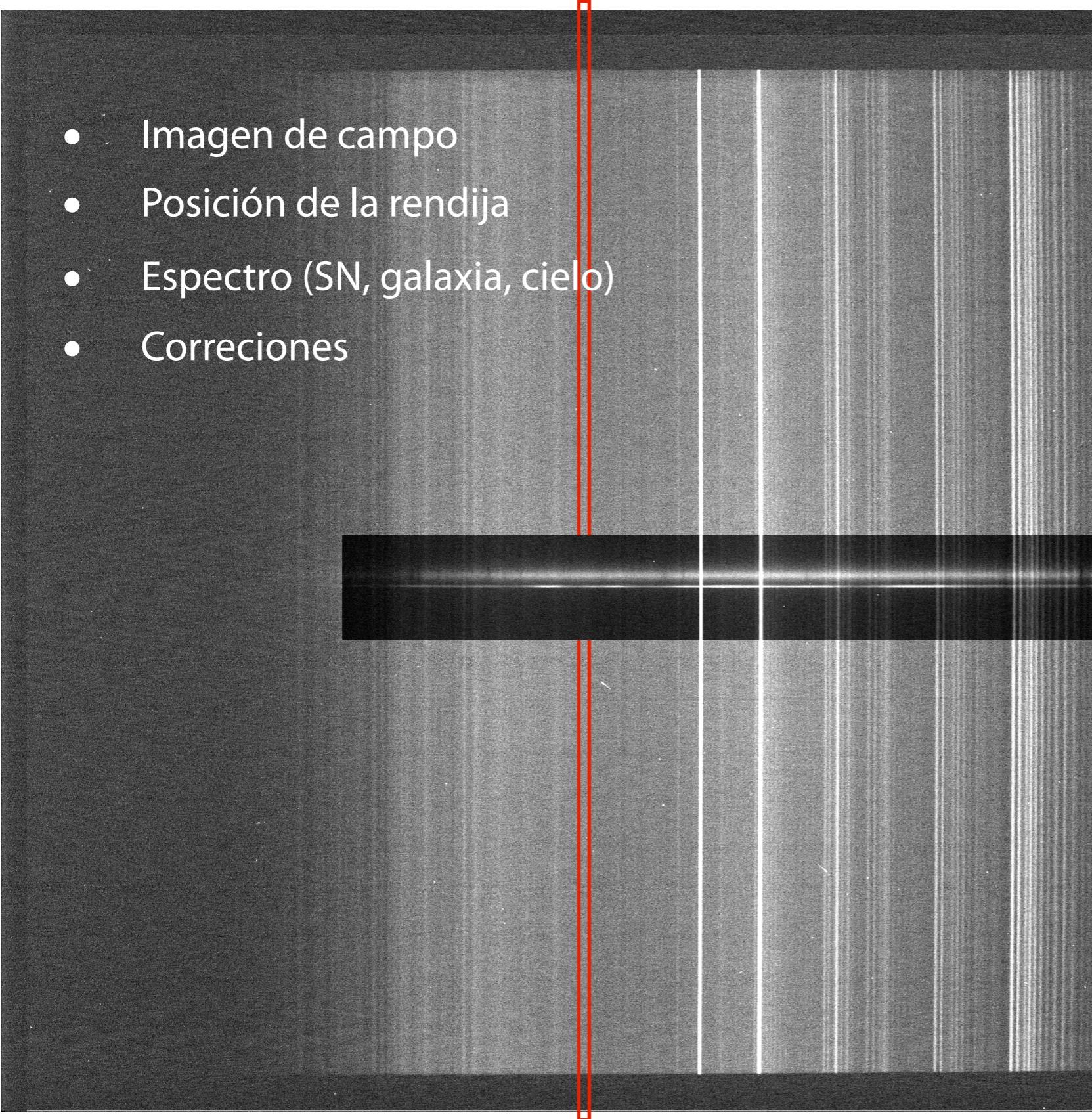
# Obtención espectro

- Imagen de campo
- Posición de la rendija
- Espectro (SN, galaxia, cielo)



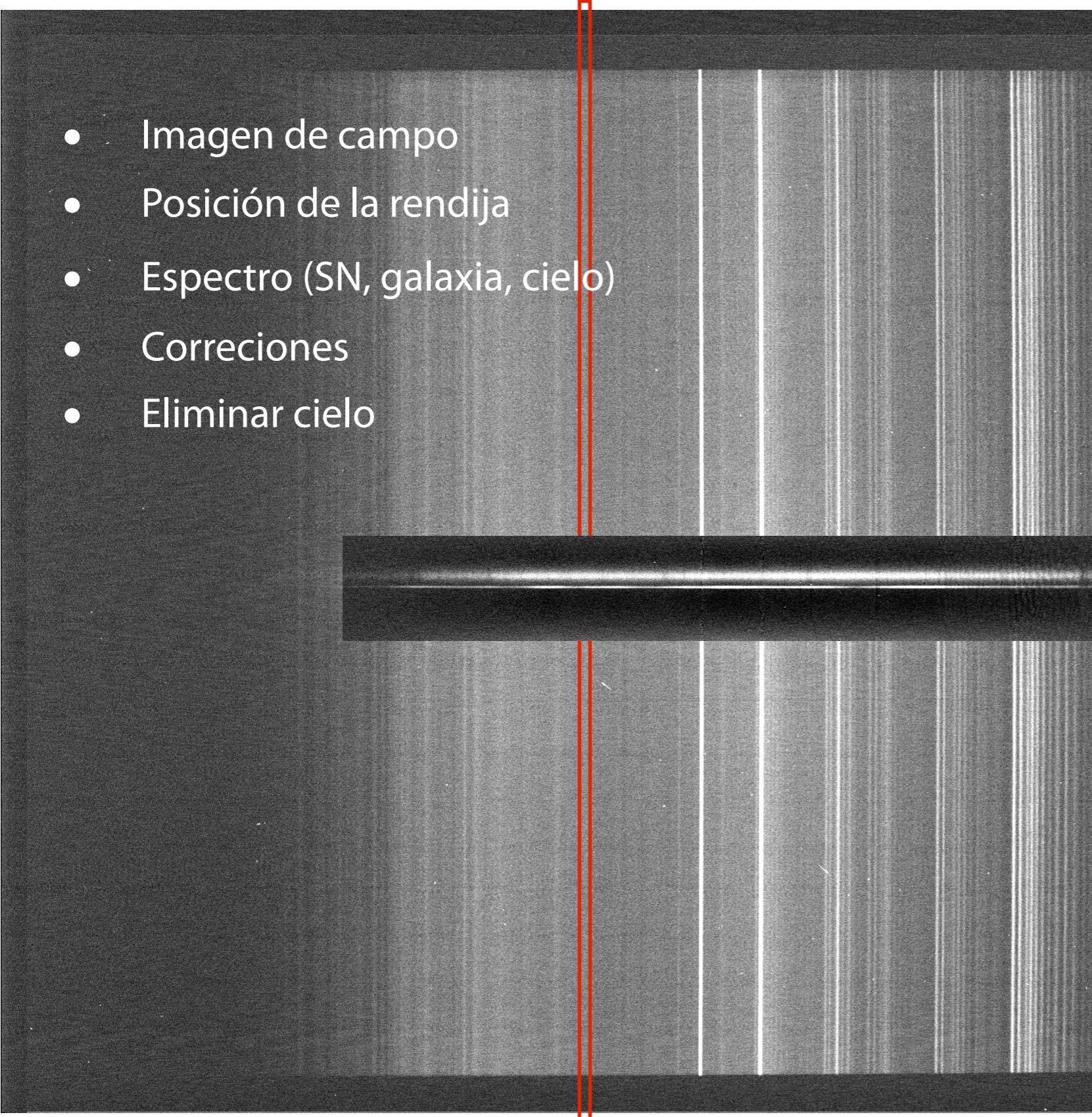
# Obtención espectro

- Imagen de campo
- Posición de la rendija
- Espectro (SN, galaxia, cielo)
- Correciones



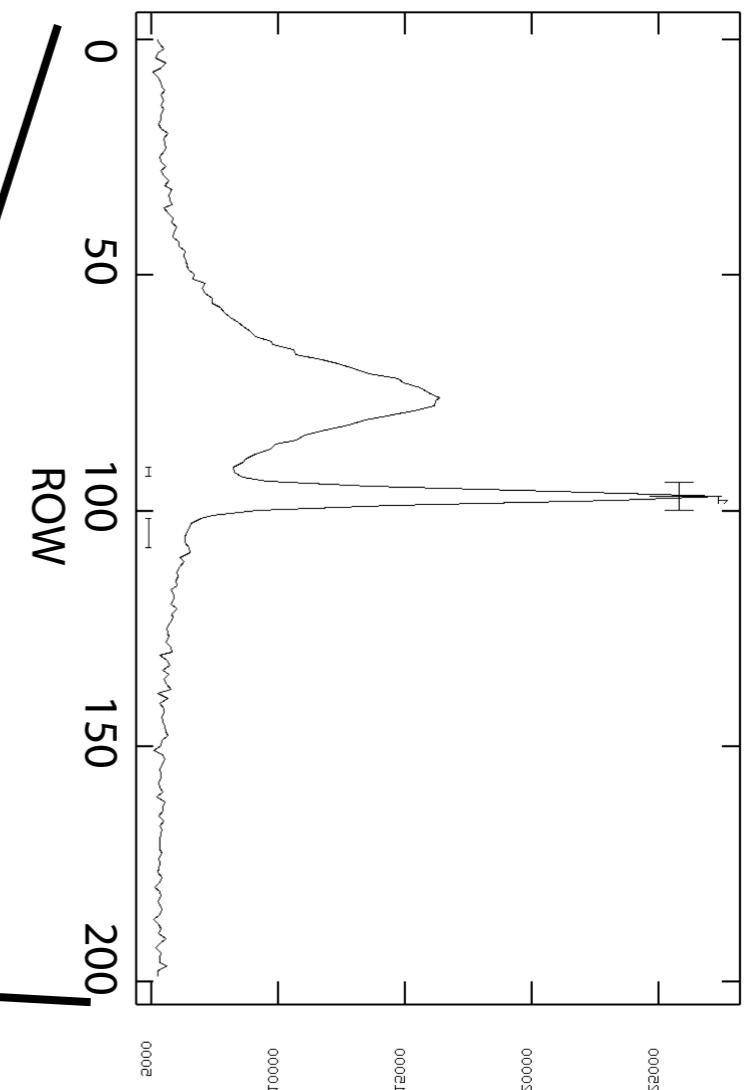
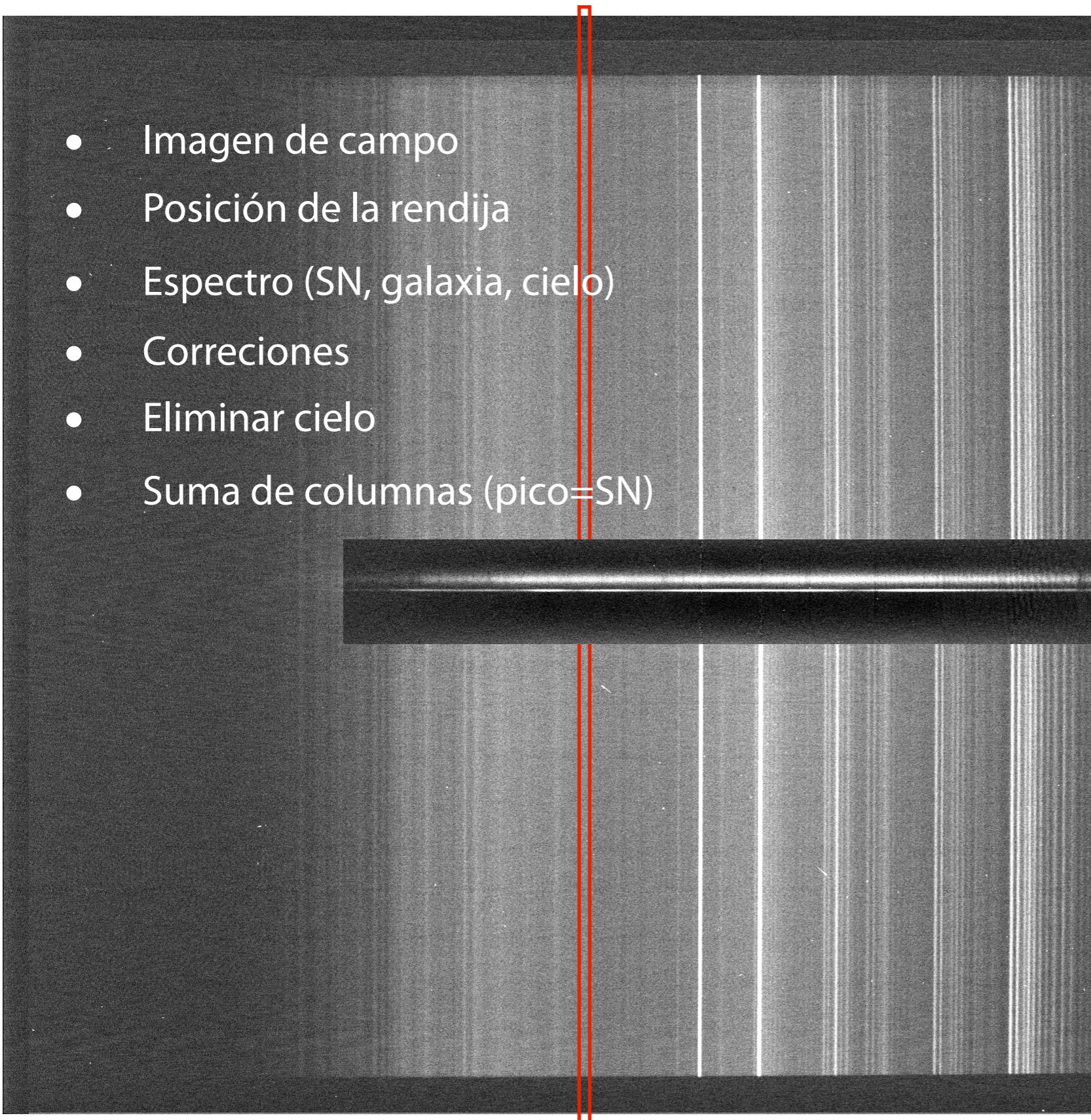
# Obtención espectro

- Imagen de campo
- Posición de la rendija
- Espectro (SN, galaxia, cielo)
- Correciones
- Eliminar cielo



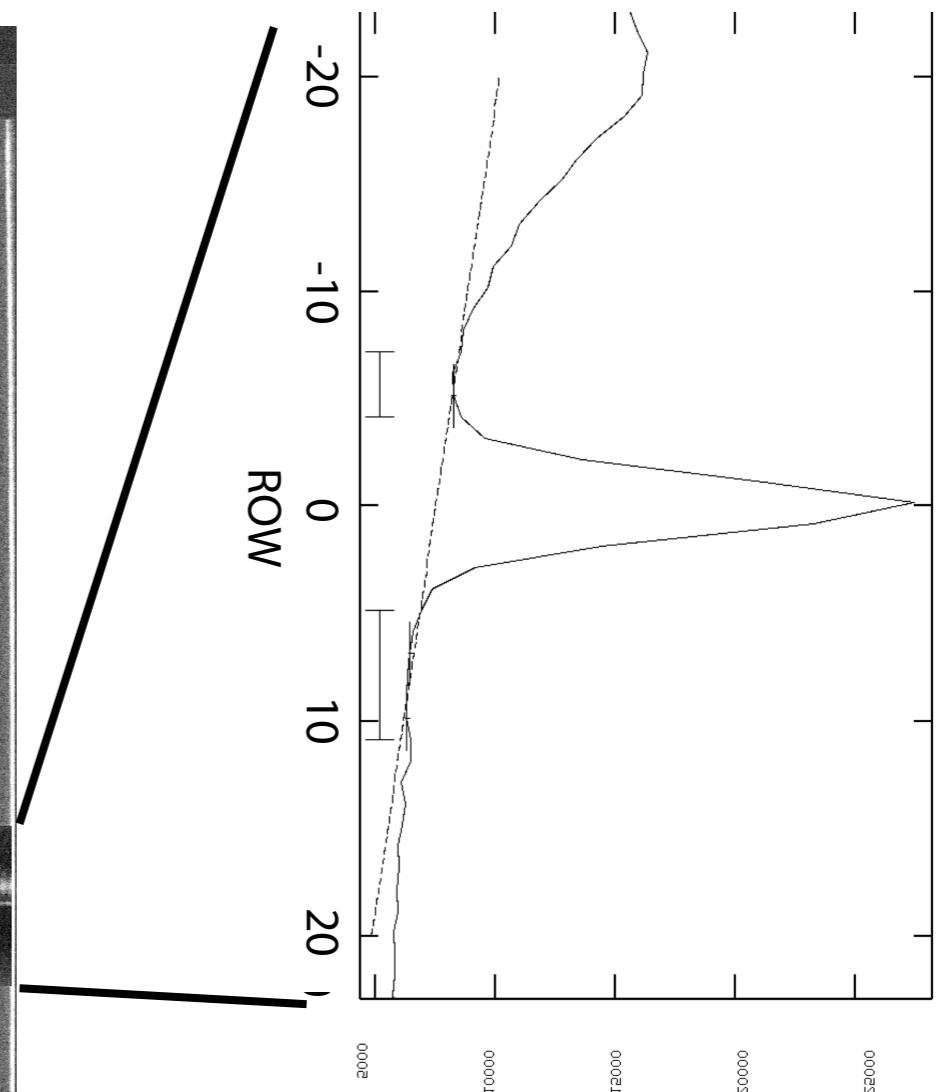
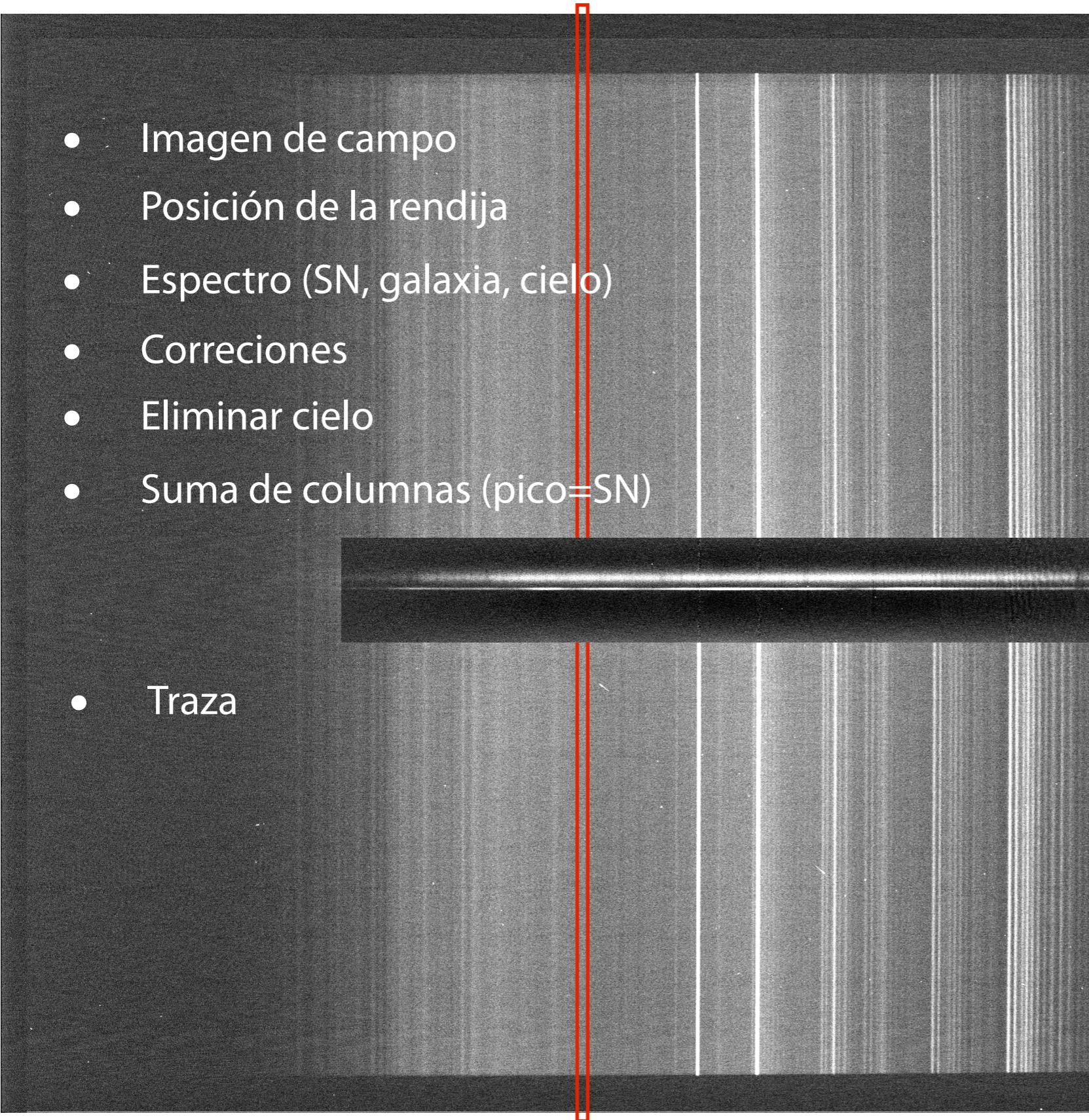
# Obtención espectro

- Imagen de campo
- Posición de la rendija
- Espectro (SN, galaxia, cielo)
- Correciones
- Eliminar cielo
- Suma de columnas (pico=SN)



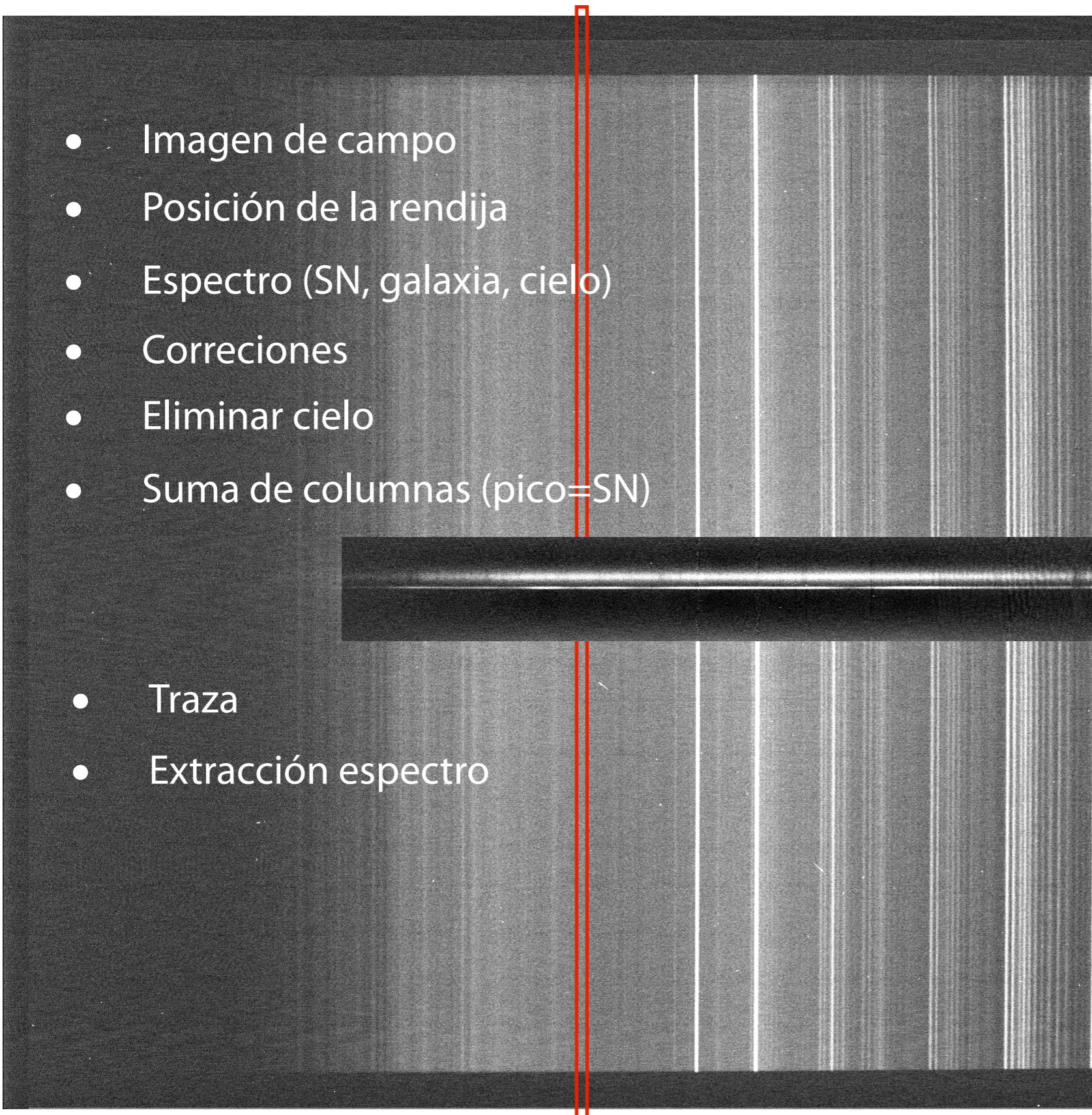
# Obtención espectro

- Imagen de campo
- Posición de la rendija
- Espectro (SN, galaxia, cielo)
- Correciones
- Eliminar cielo
- Suma de columnas (pico=SN)
- Traza

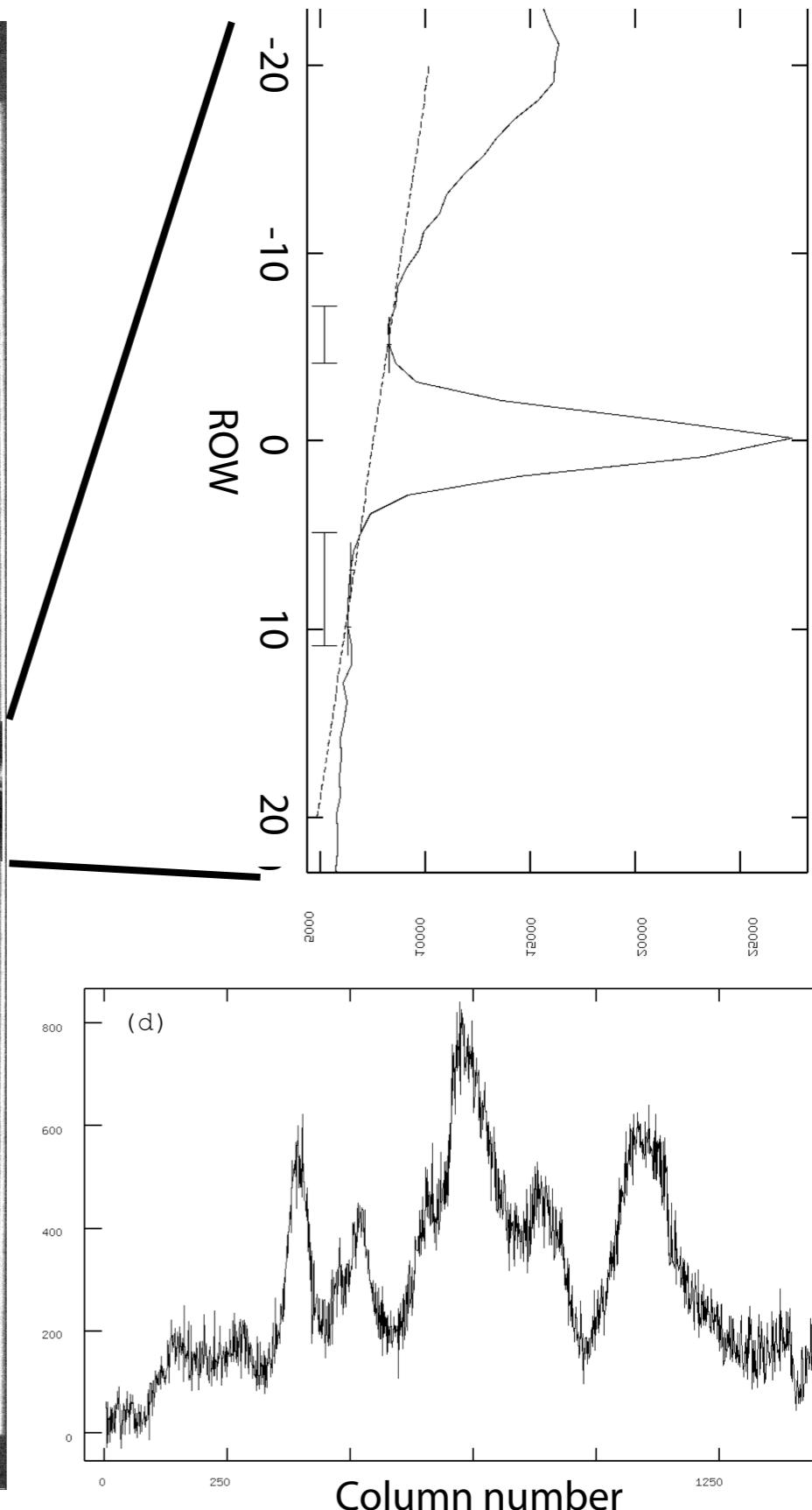


# Obtención espectro

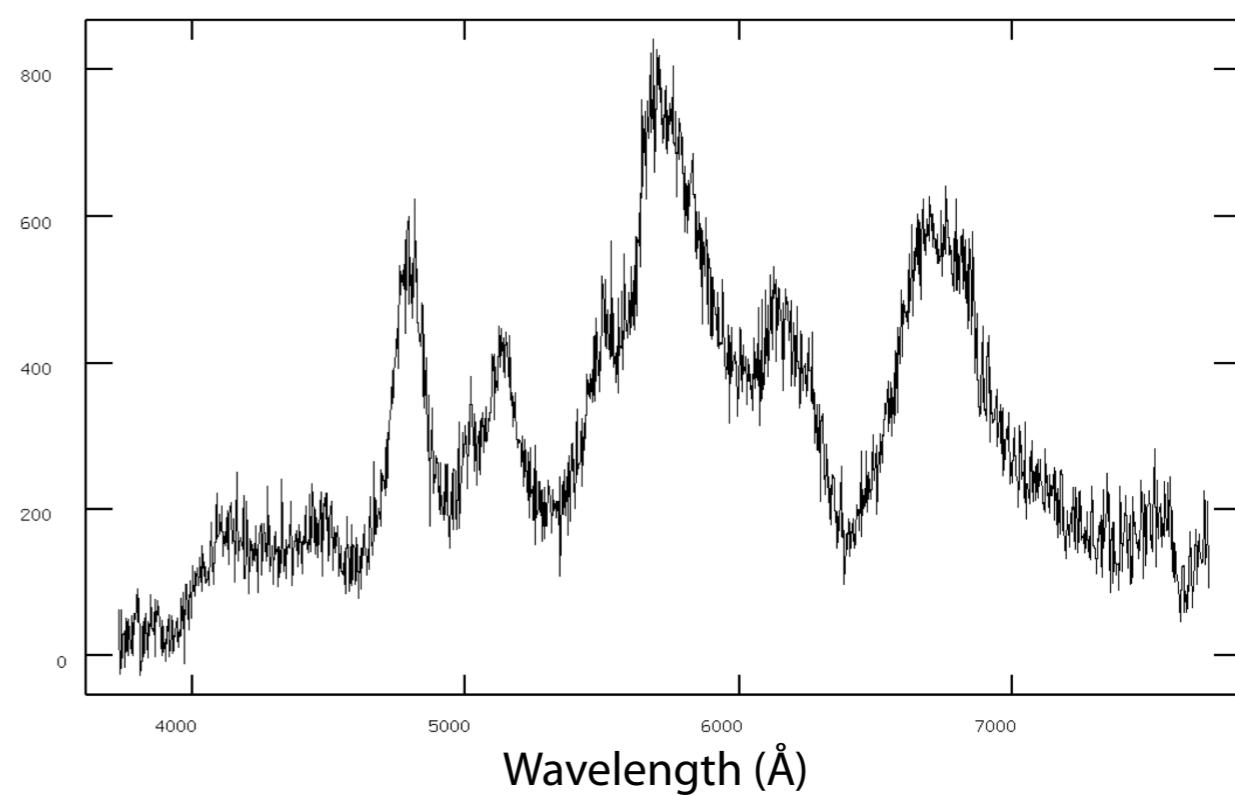
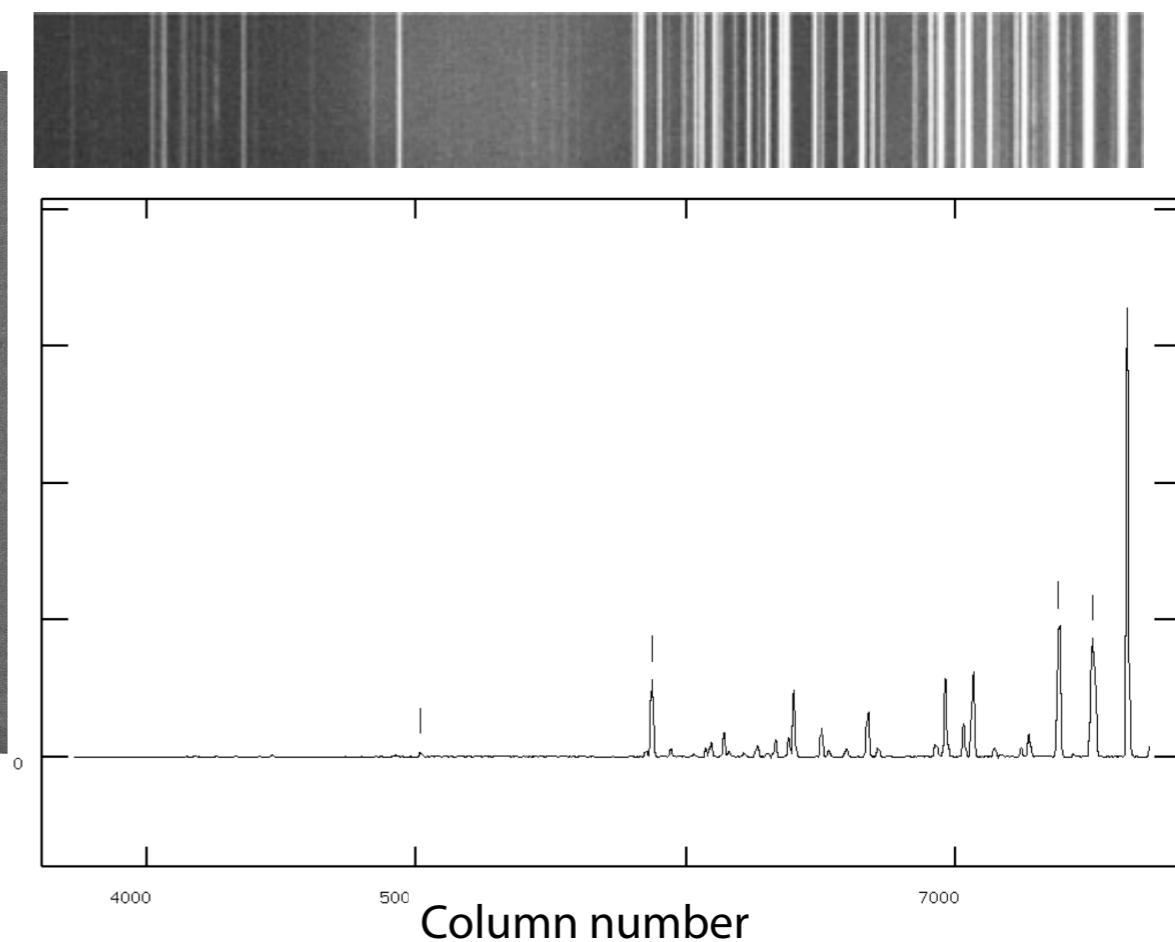
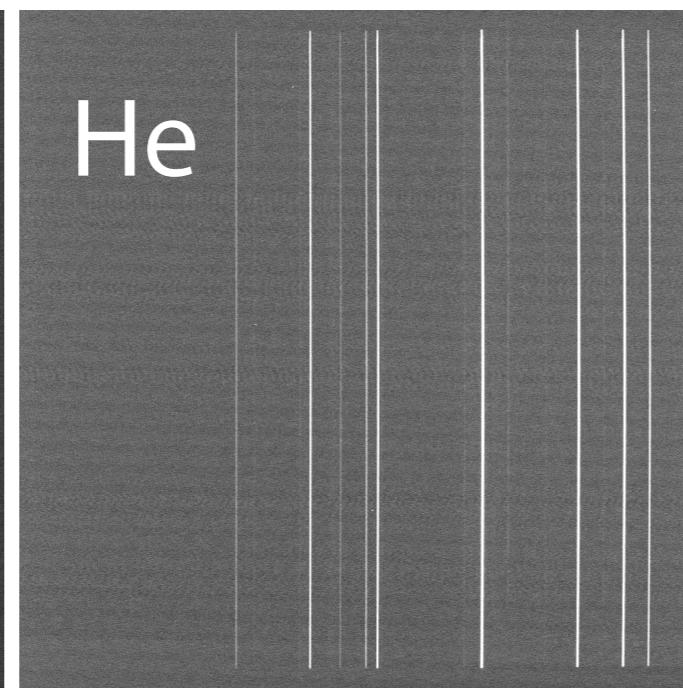
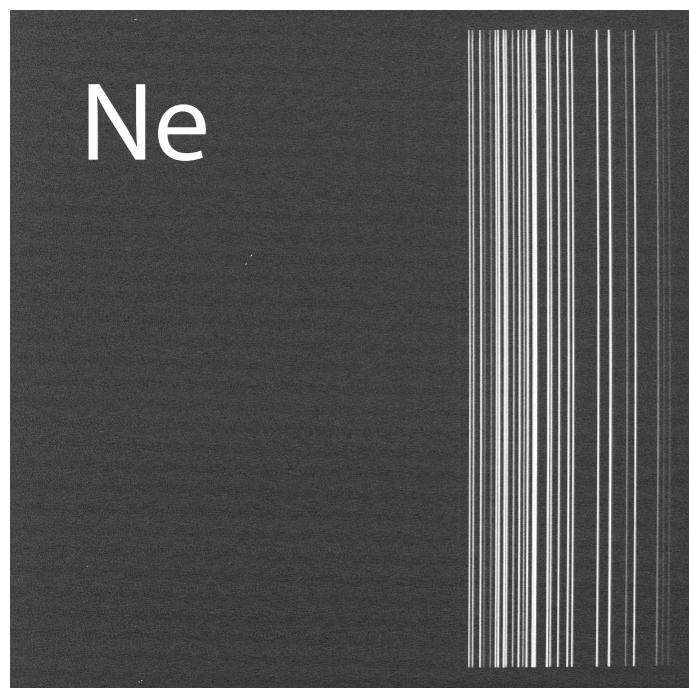
- Imagen de campo
- Posición de la rendija
- Espectro (SN, galaxia, cielo)
- Correciones
- Eliminar cielo
- Suma de columnas (pico=SN)



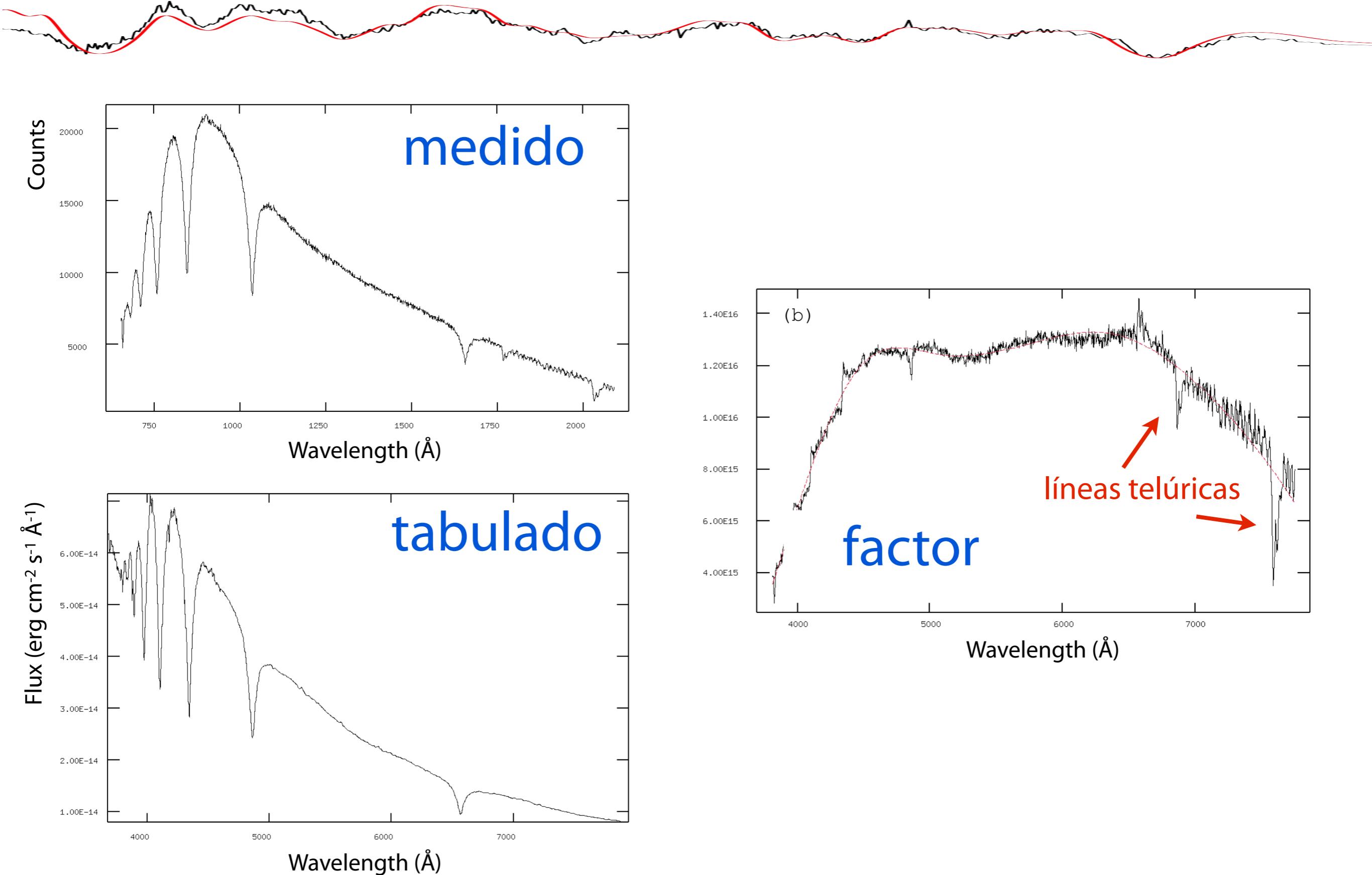
- Traza
- Extracción espectro



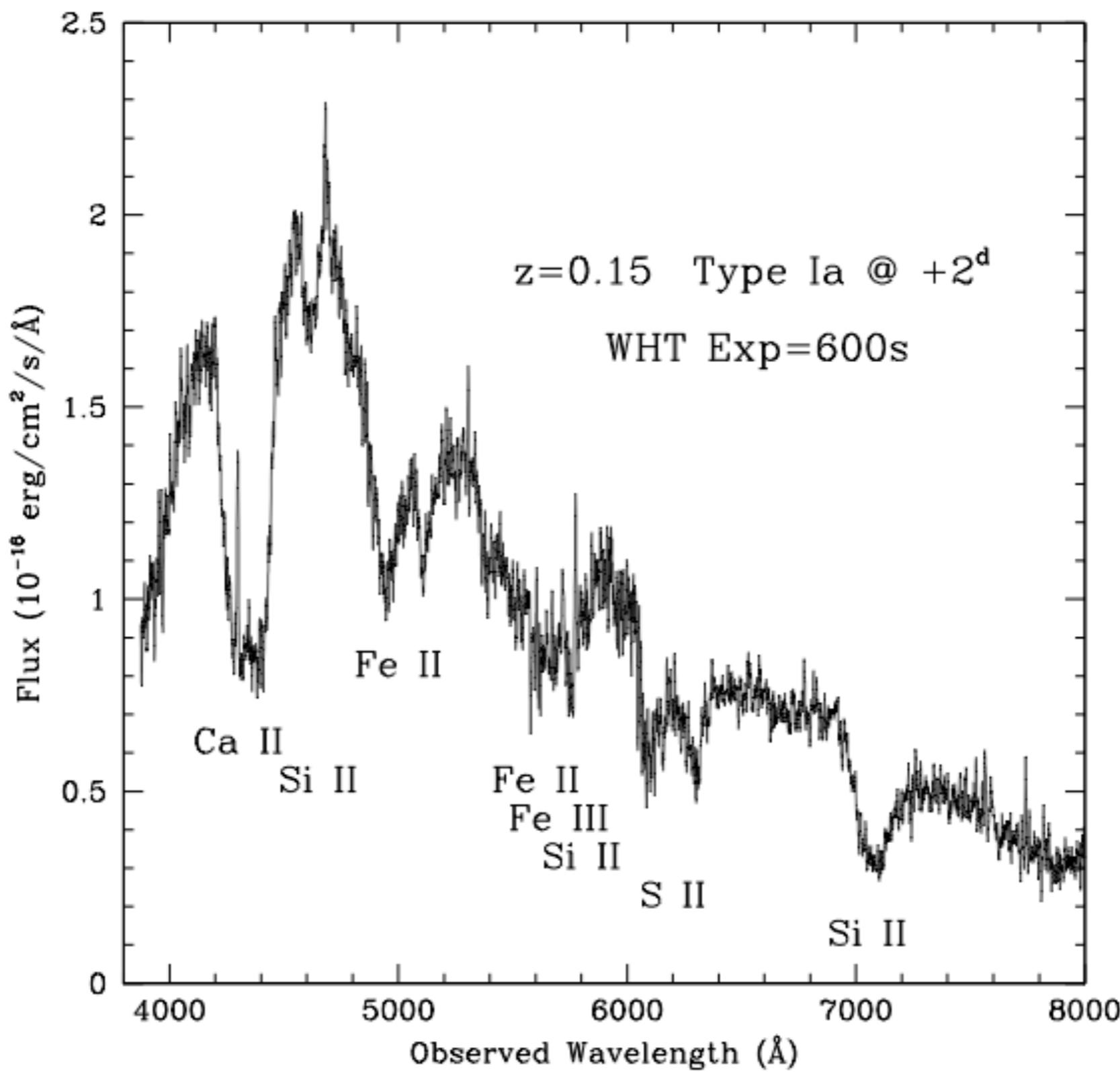
# Calibracion en longitud de onda



# Calibración en flujo



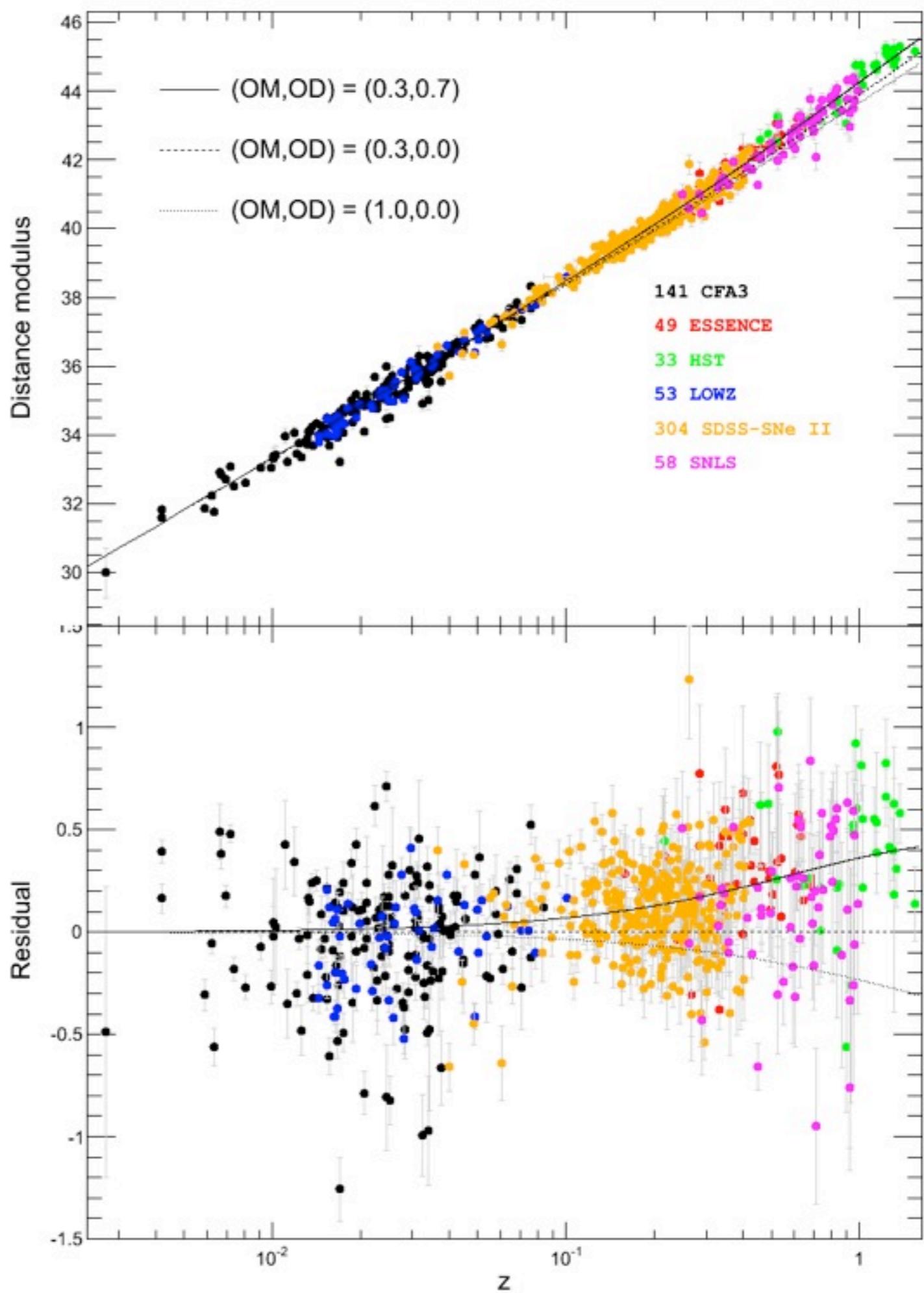
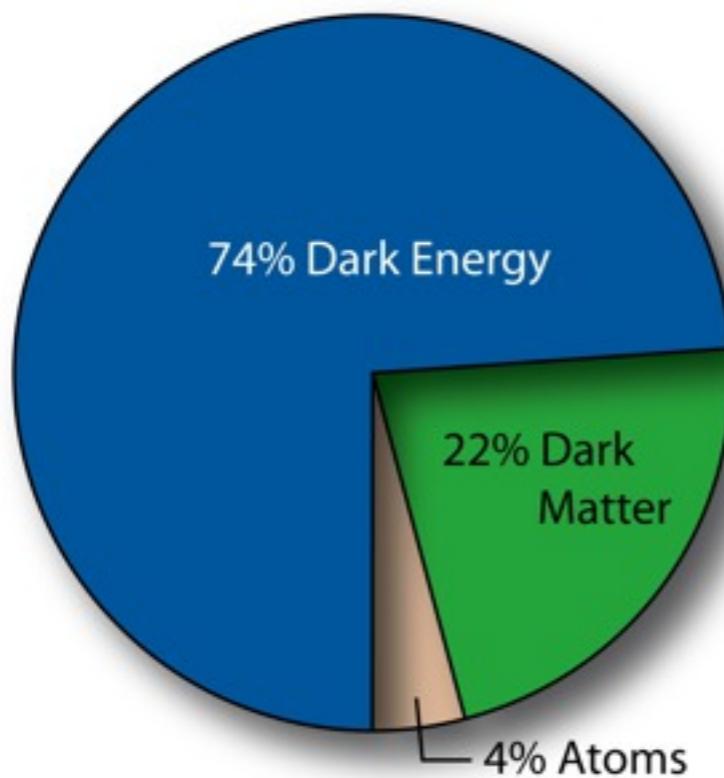
# Espectro SN Ia



# Módulo distancia

Redshift  
(corrimiento al rojo)

## Modelos cosmológicos





**FIN**

(ahora si)

y que la fuerza (oscura)  
os acompañe!

