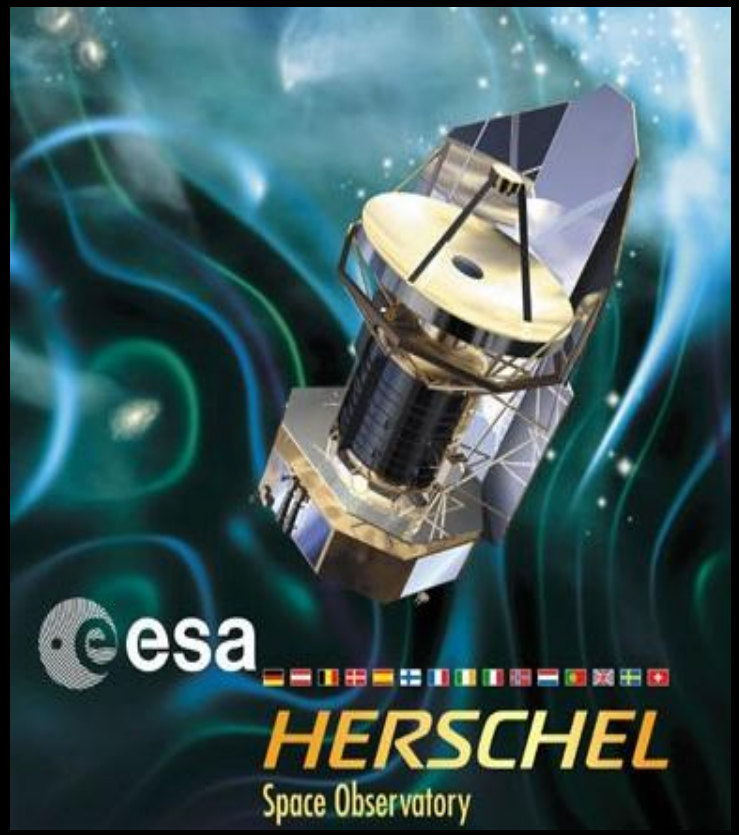
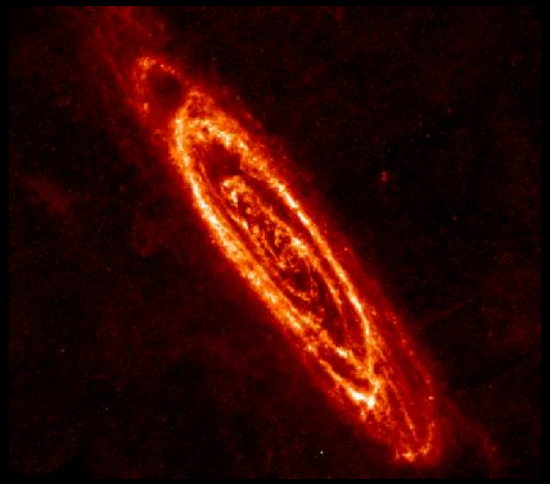
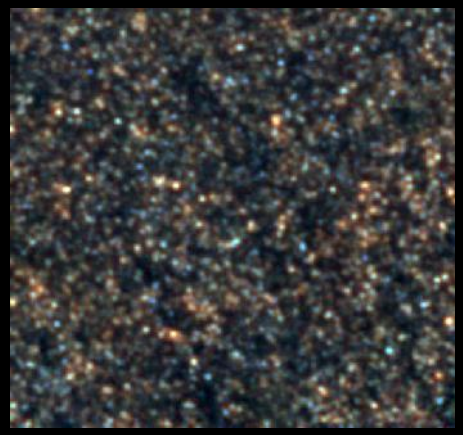
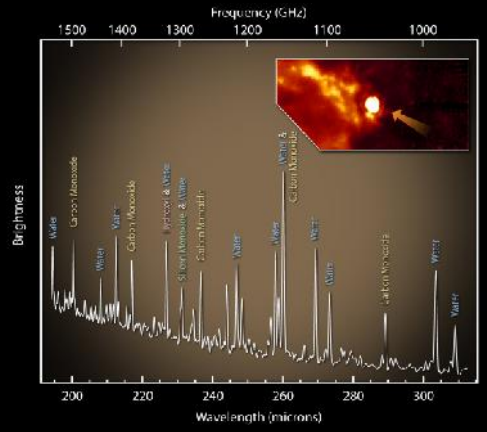
The *Herschel* Space Observatory

Matt Griffin, Cardiff University

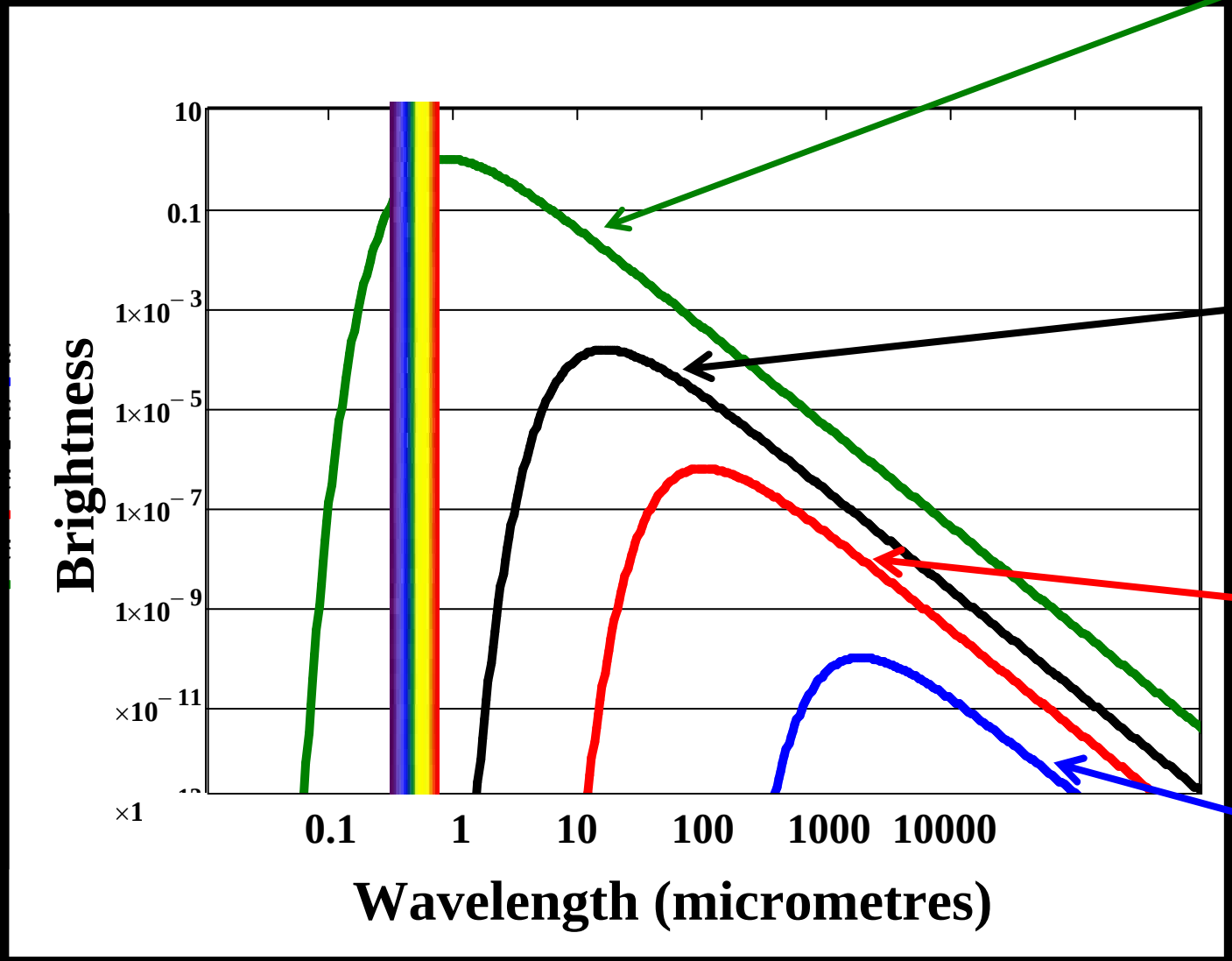


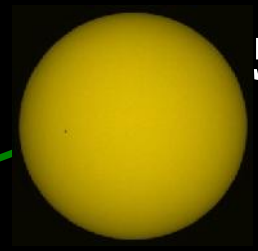


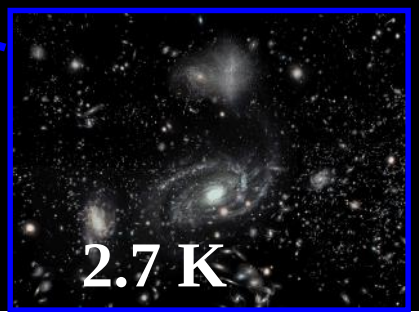


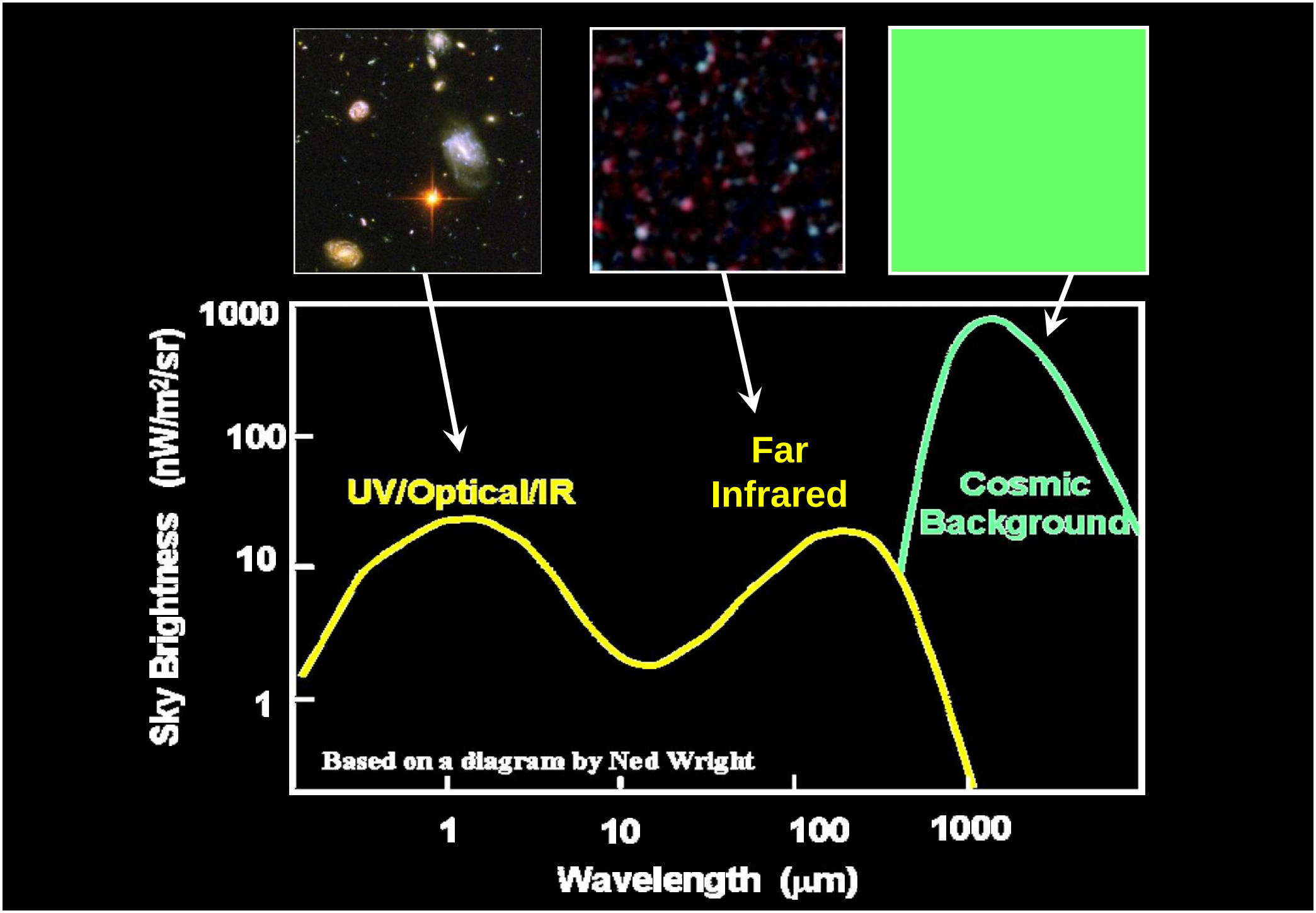


Thermal Radiation

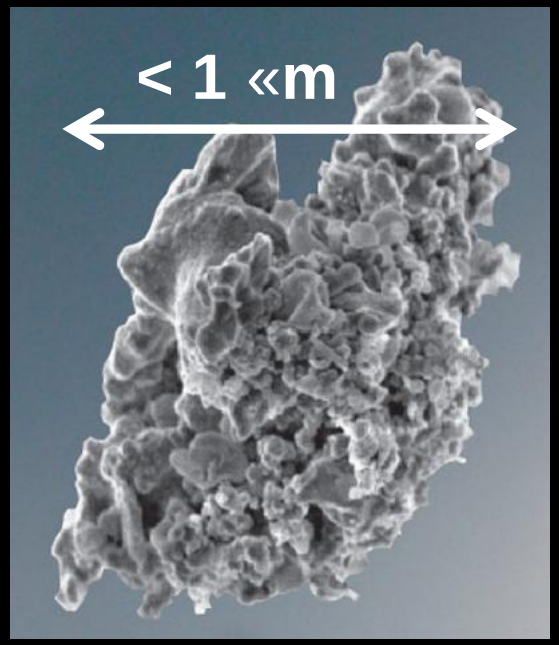


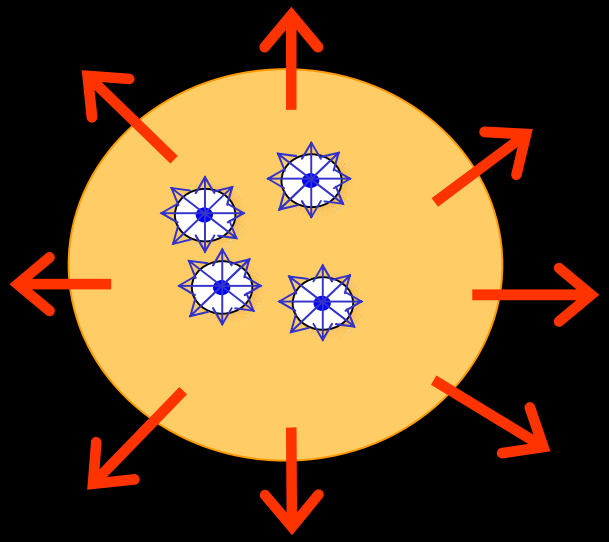


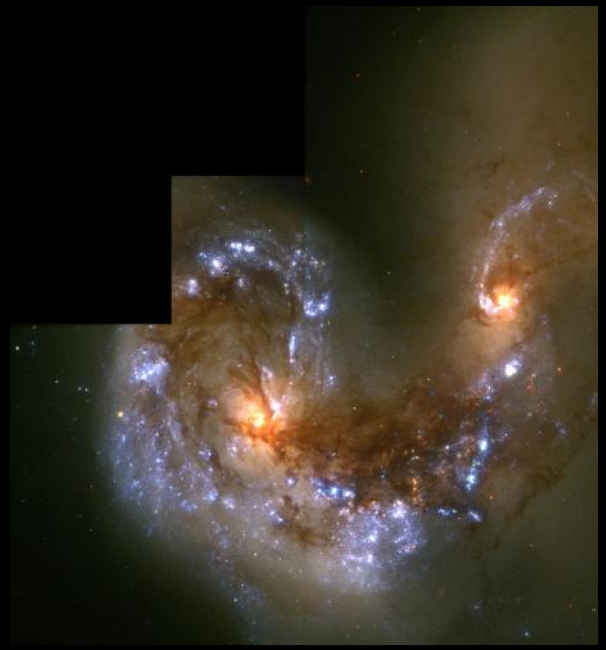


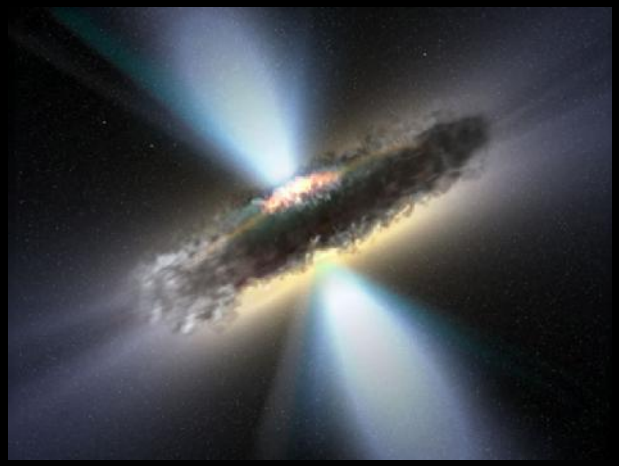

UV/Optical/IR
Far
Infrared
Cosmic
Background
Sky Brightness (nW/m²/sr)
1000
100
10
1
Based on a diagram by Ned Wright
1
10
100
1000
Wavelength (μm)

Conversion of Stellar Radiation and Accretion Energy to FIR

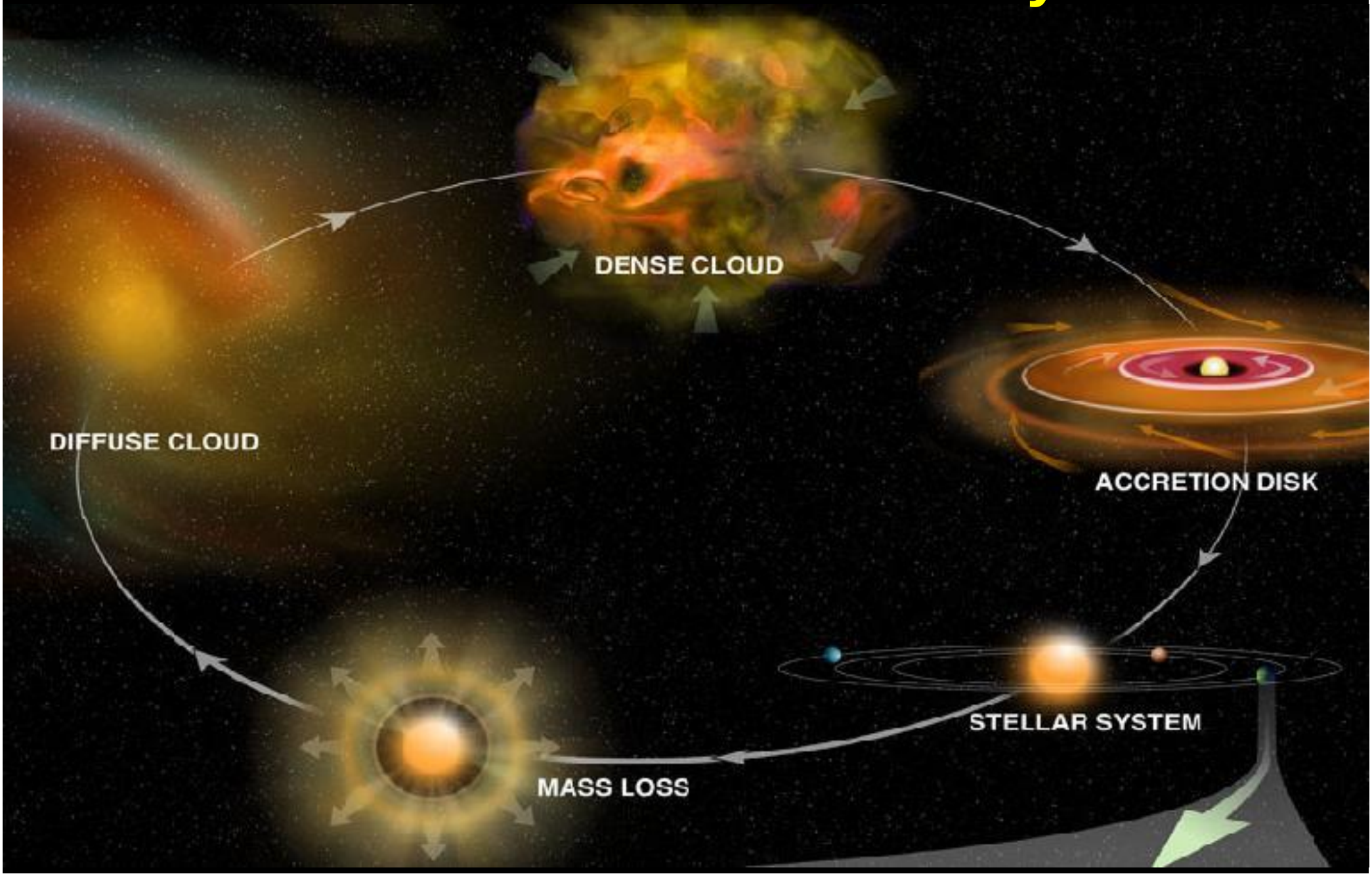




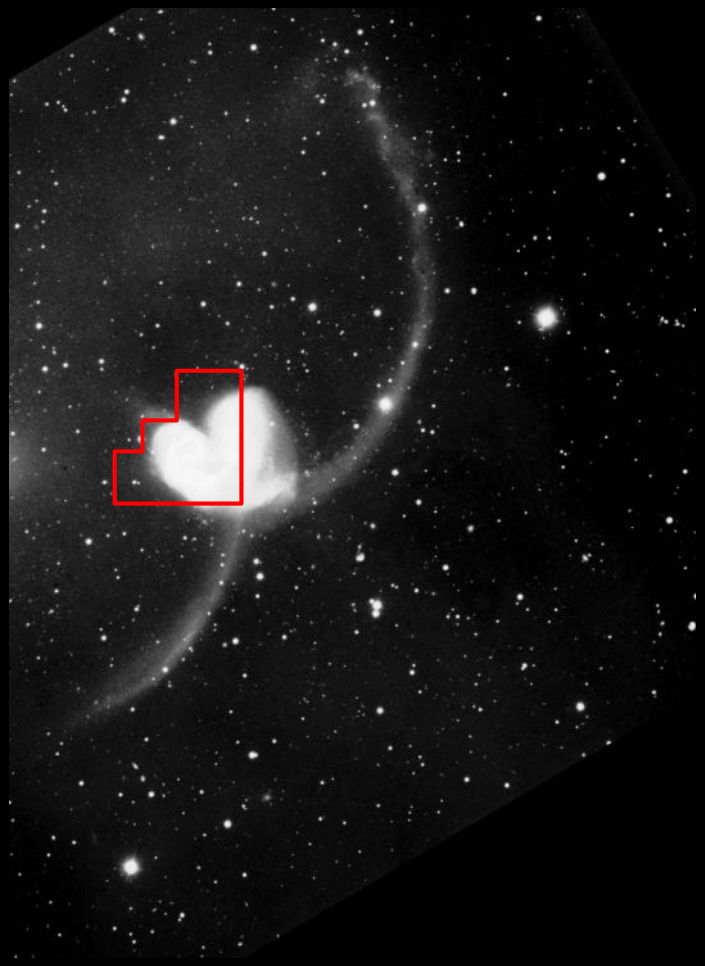


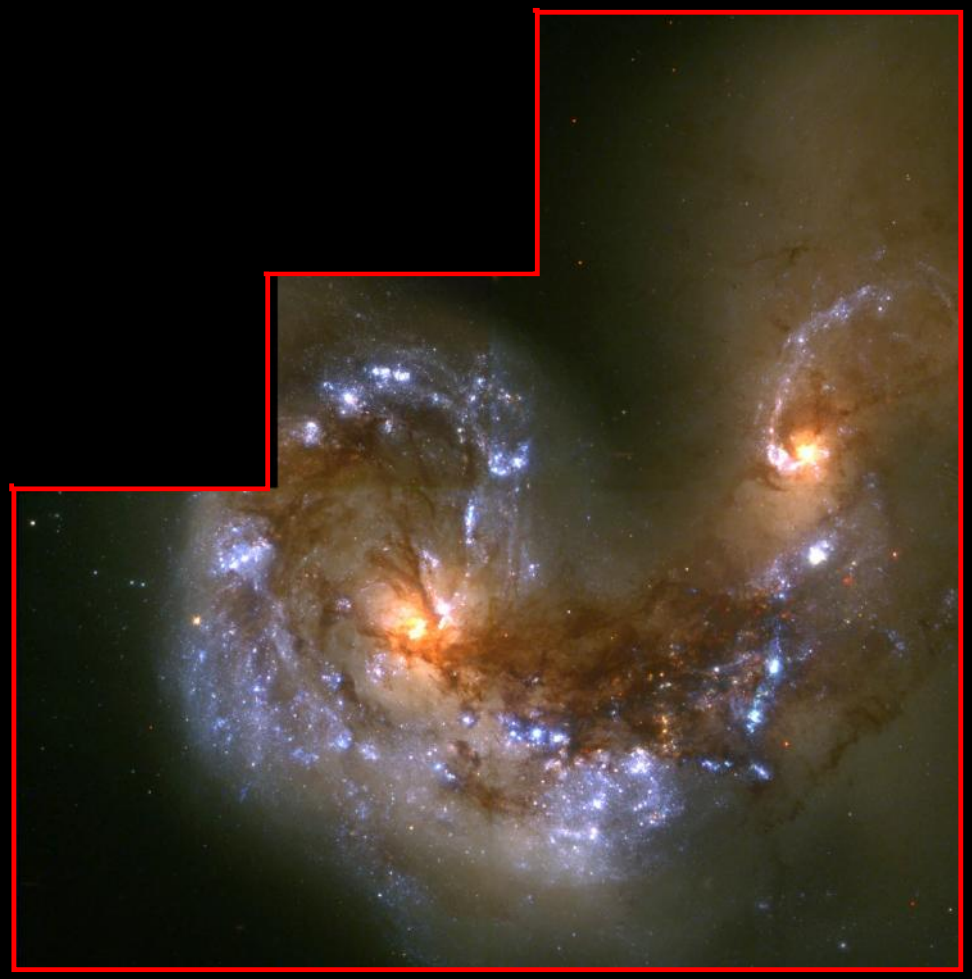


The Stellar-Interstellar Cycle

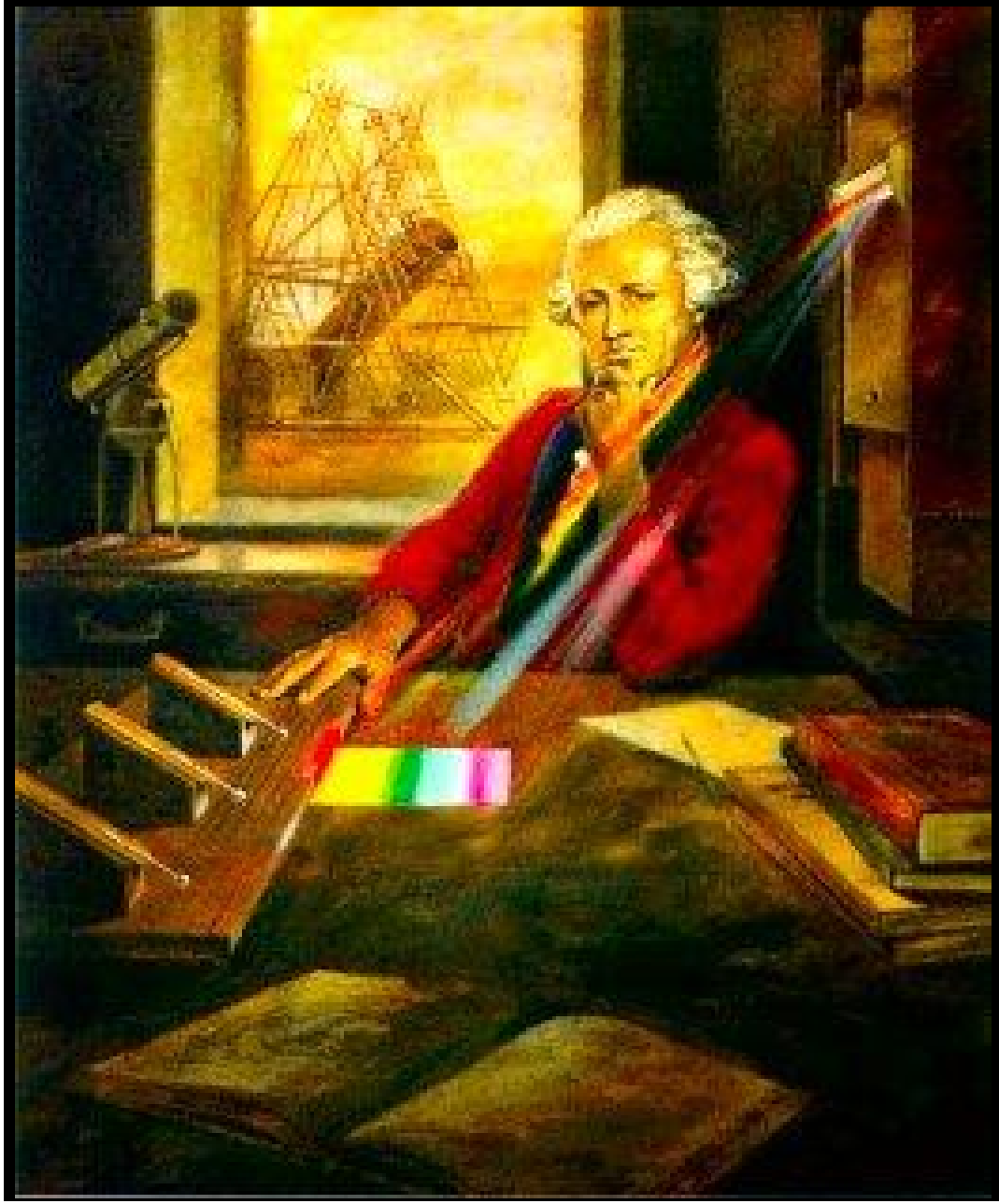


Burst of Star Formation Caused by Galaxy Collision





The Herschel Space Observatory



ESA
The English Setter Association

The English Setter 'A Gentleman By Nature'

Notice Board | About Club | About Breed | Breed Standard | Show Scene | Ju

EUROPEAN SNACKS ASSOCIATION

SNACKEX 2011 BARCELONA ENDS ON A HIGH NOTE

The 2011 edition of the biennial SNACKEX trade show and conference was held 13-14 June 2011 at the Fira de Barcelona, Gran Via exhibition grounds.

This year's event was very successful with over 1,900 savoury snack industry professionals participating and business worth many millions of euros contracted on the show floor.

See interim report.

More

INDUSTRY WELCOMES AGREEMENT ON FOOD INFORMATION

The European Snacks Association, representing savoury snack producers and their suppliers, welcomes the European Parliament's decision to adopt today a compromise proposal on food

ESA is the only trade association dedicated to the advancement of the European savoury snacks industry.

Our international membership includes the companies which make many of the world's favourite snack brands, as well as smaller, specialist companies and suppliers to the industry.

European Snacks Association

6 Catherine Street
London WC2B 5JJ
+44 (0)20 7420 7220

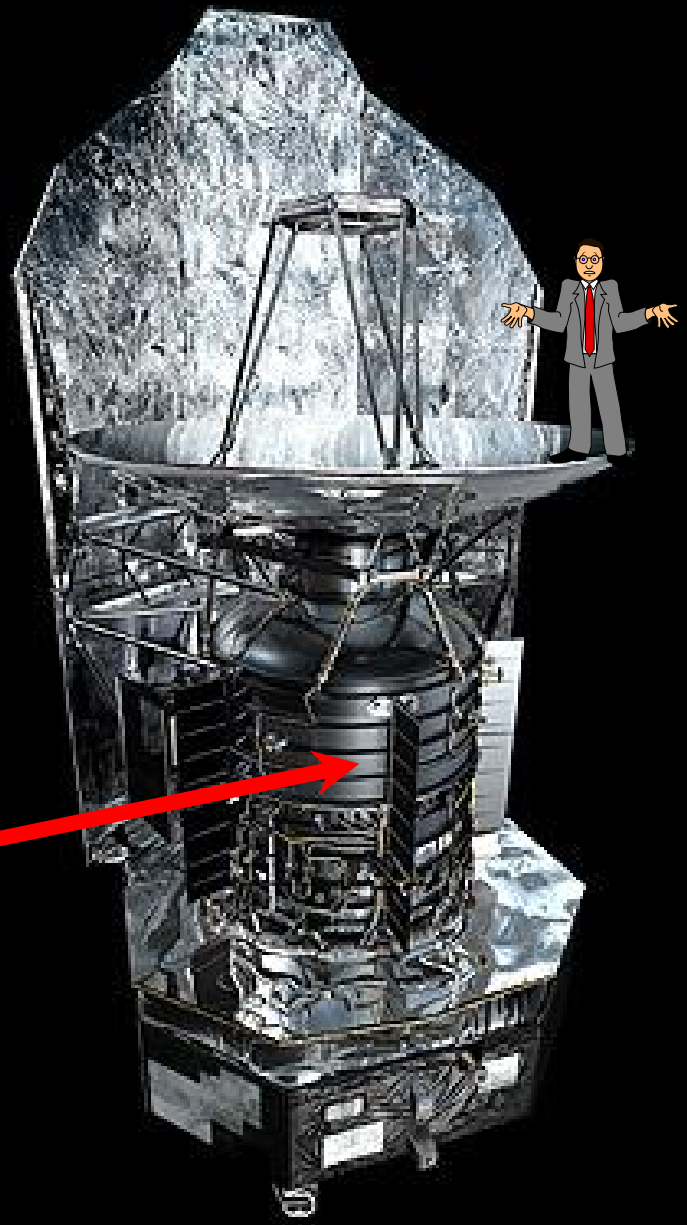
Rue Defacqz 1
B-1000 Brussels
+32 (0)2 538 20 39

esa

space for europe

The Herschel Space Observatory

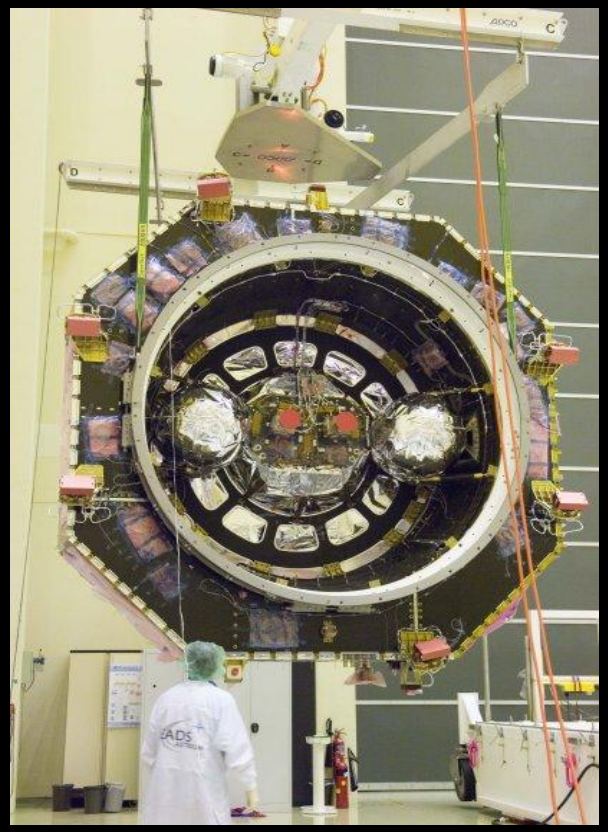
- Telescope diameter 3.5 m
- Height 7 metres
- Mass 3.3 Tonnes
- Helium tank capacity 2200 litres
- Wavelength range 60 – 700 «m



Build-up of the Herschel Satellite

Telescope

Service Module



Camera

250, 350, 500 «m

Spectrometer

195 - 670 «m

High-Resolution Spectrometer

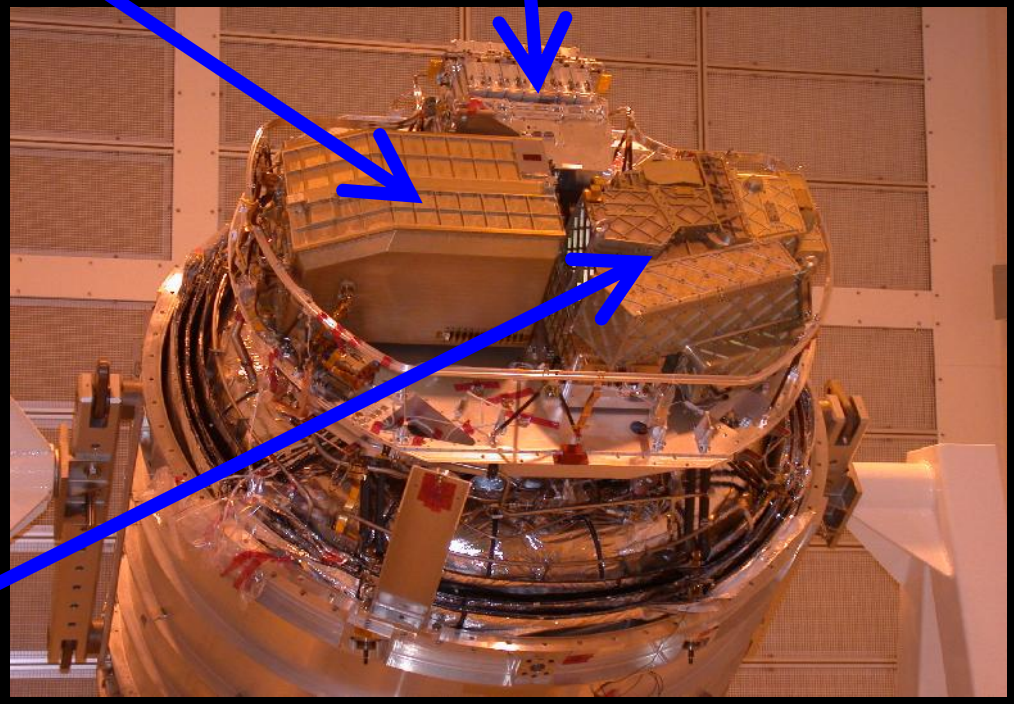
240 - 625 «m

Camera

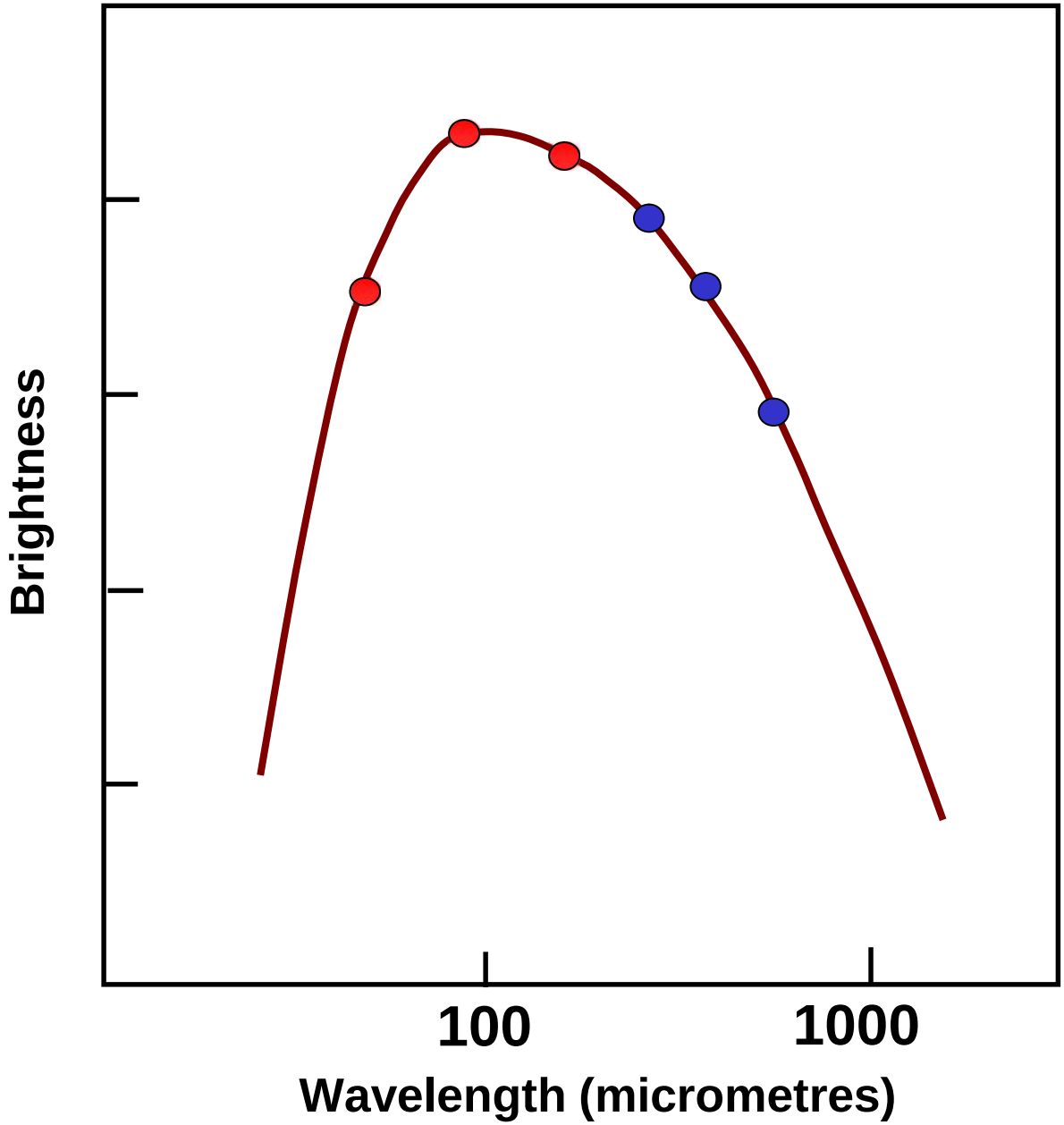
70, 100, 160 «m

Spectrometer

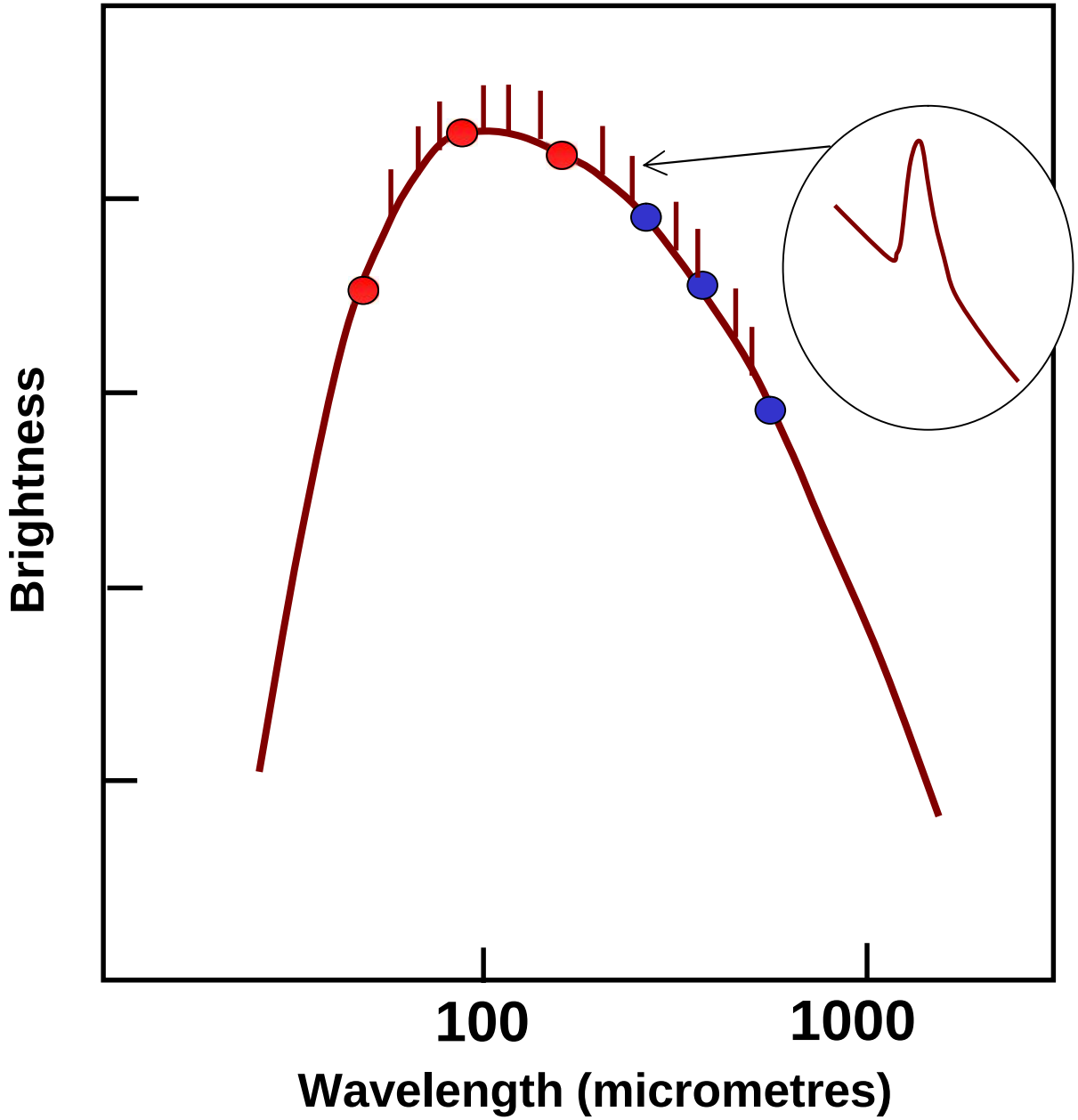
55 - 210 «m



Herschel Observations

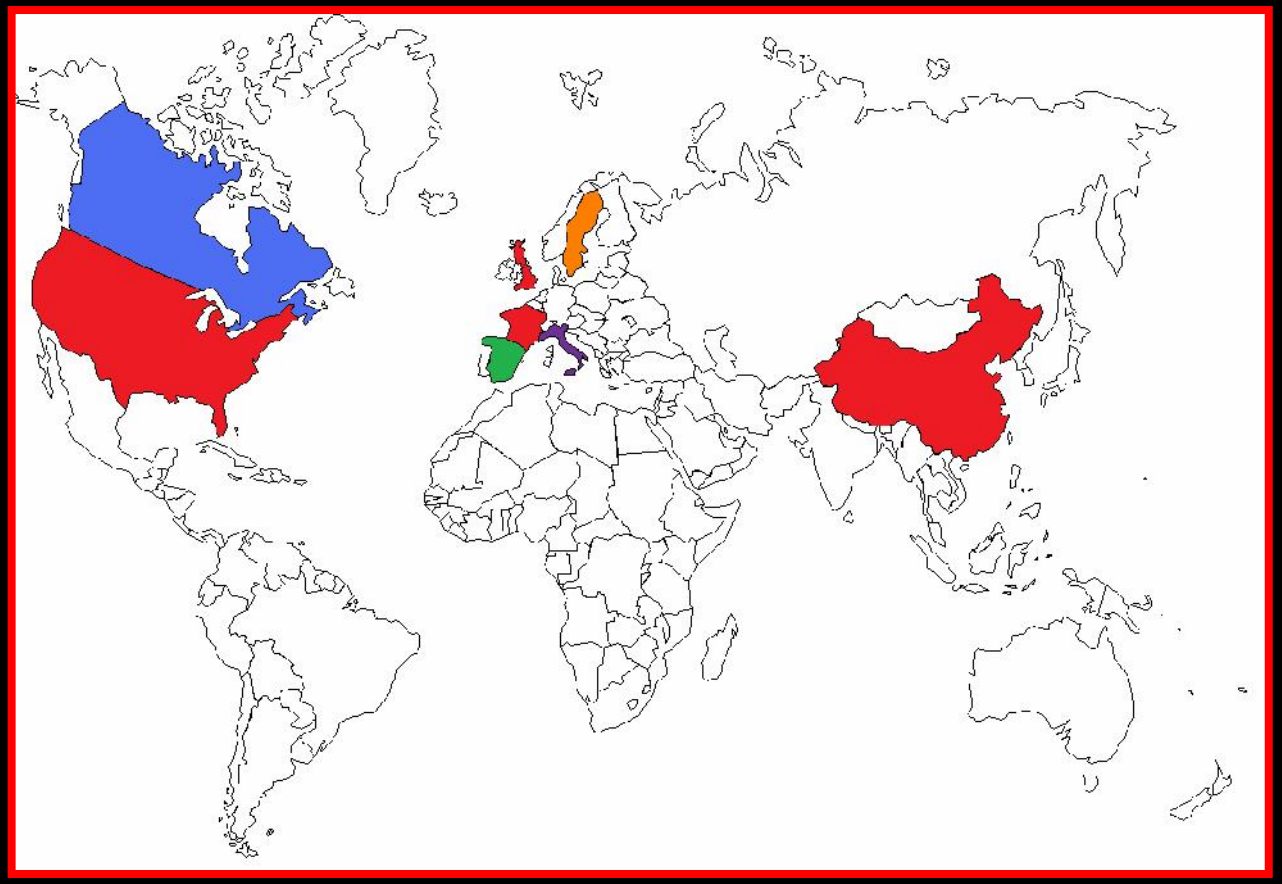


Herschel Observations



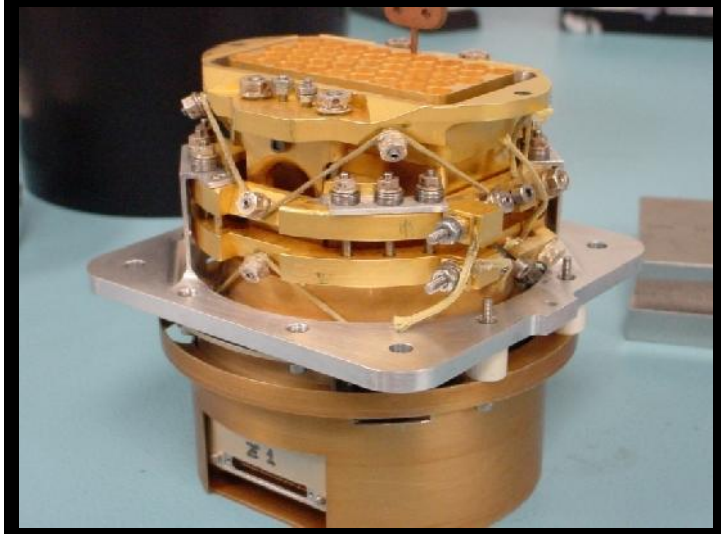
The SPIRE Team

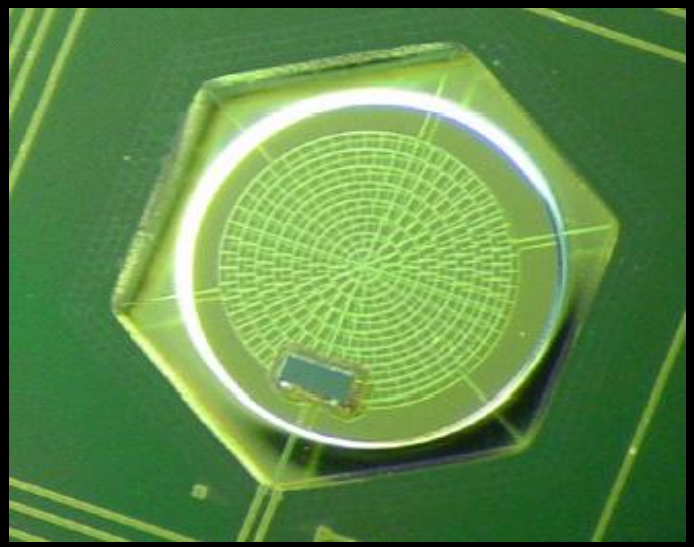
Canada China France Italy Spain Sweden UK USA

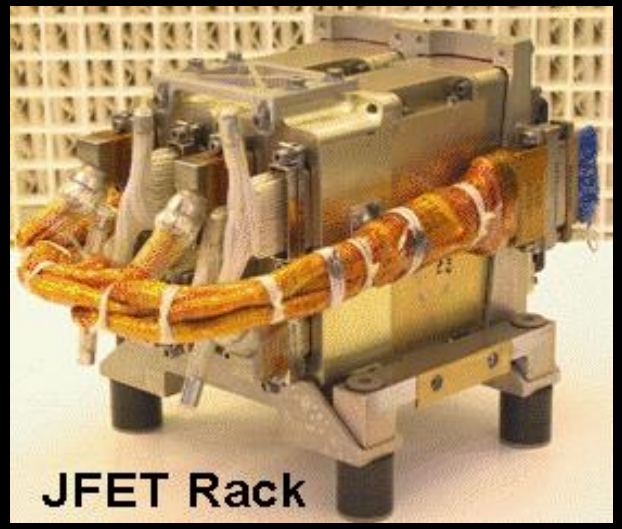


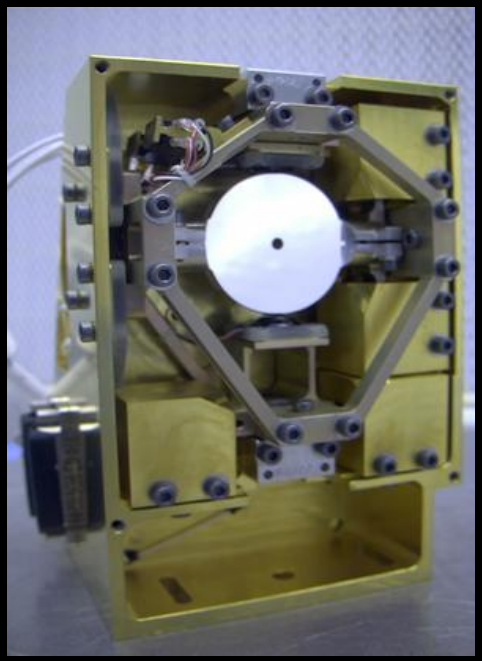
- 18 institutes 8 Countries 10-year project

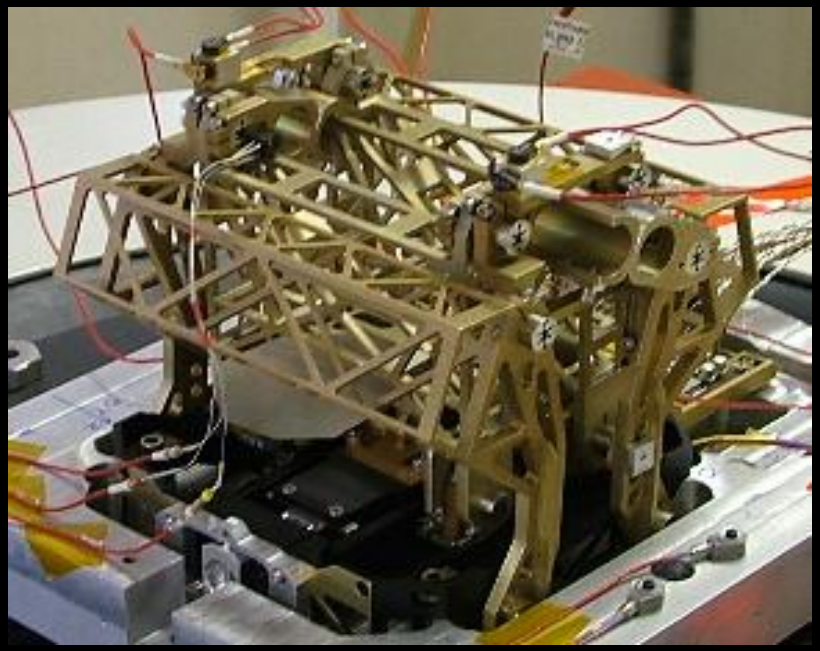
SPIRE Subsystems

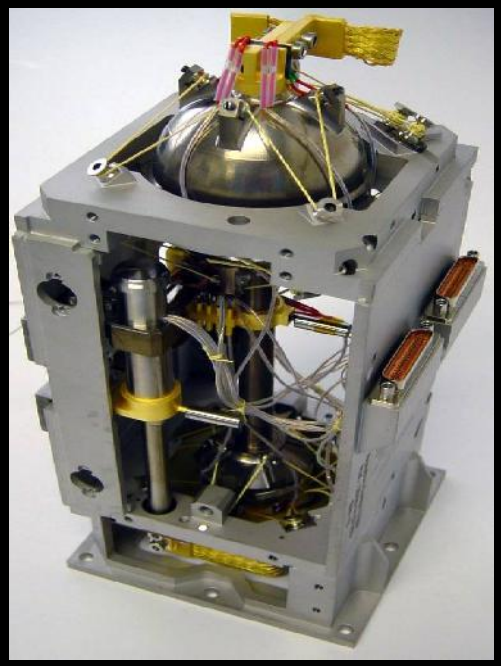




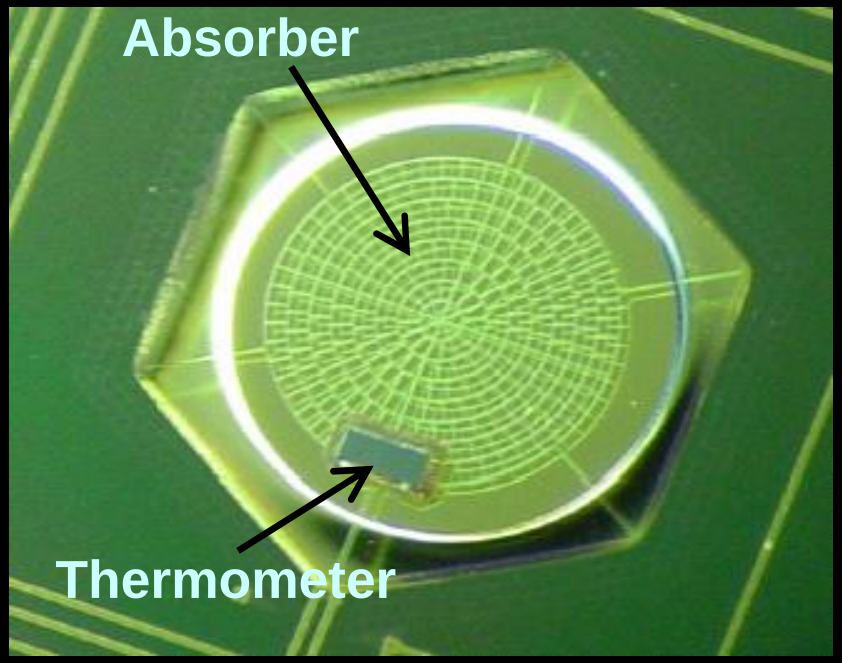




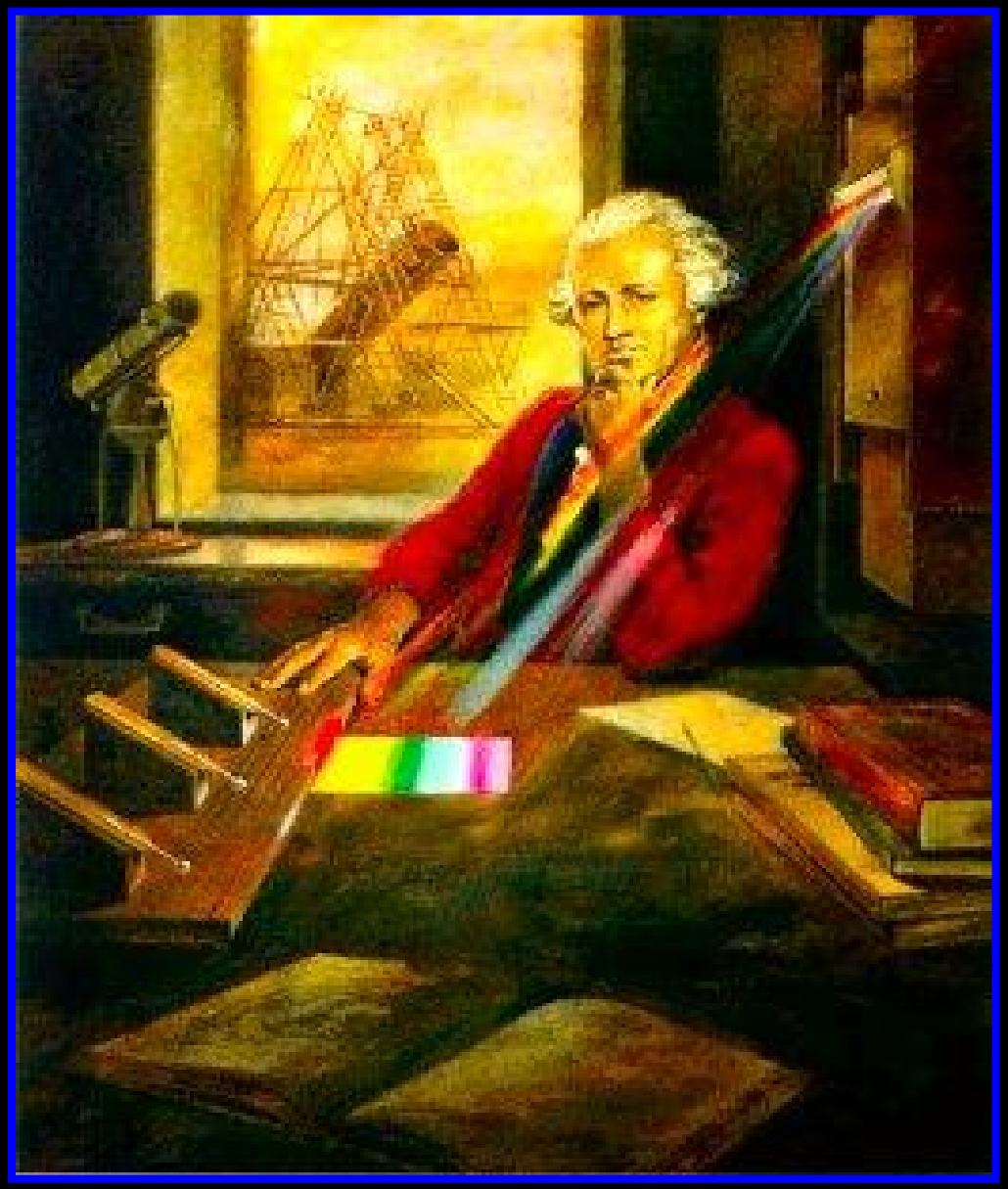




Bolometer Detectors

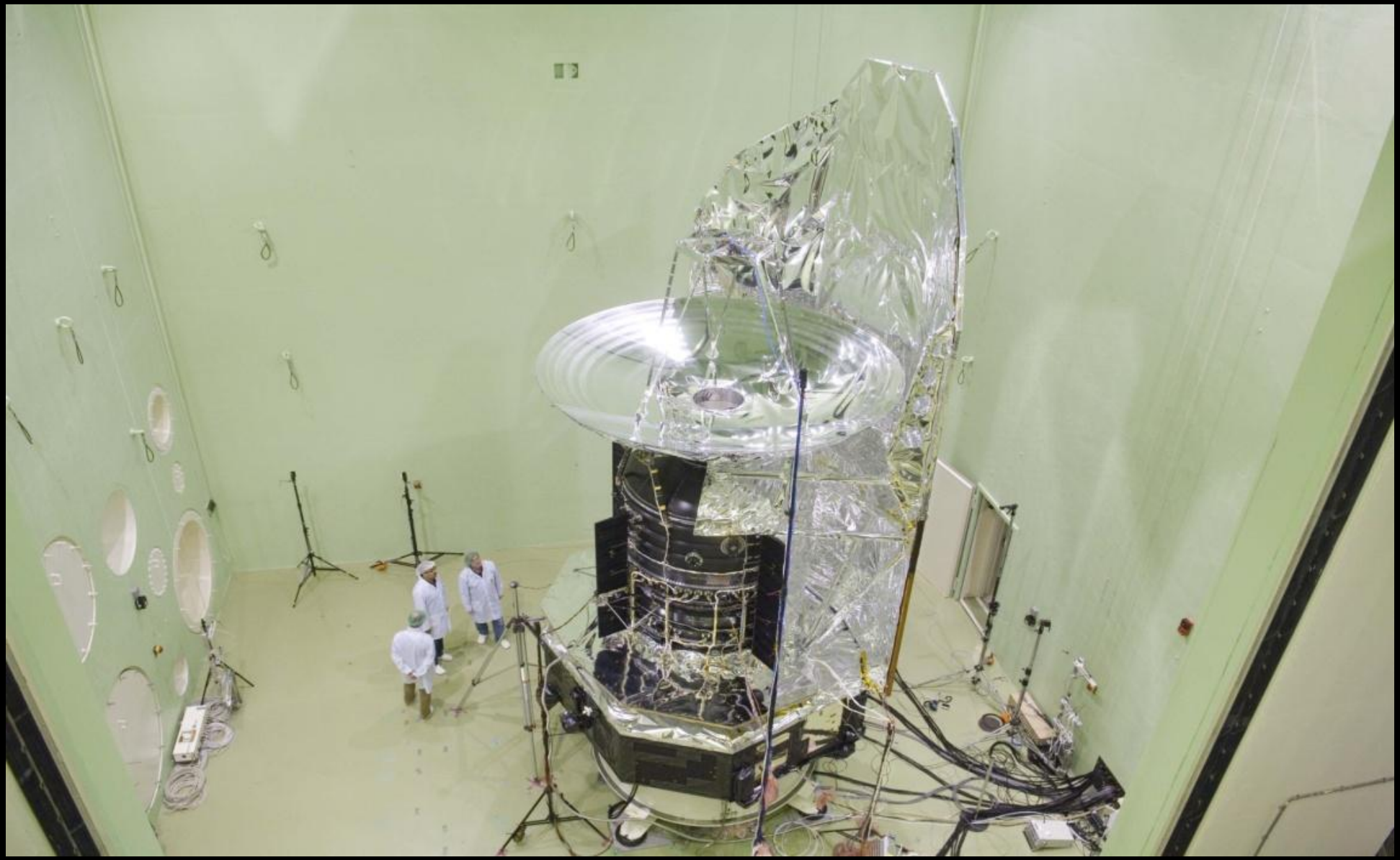


SPIRE Bolometer

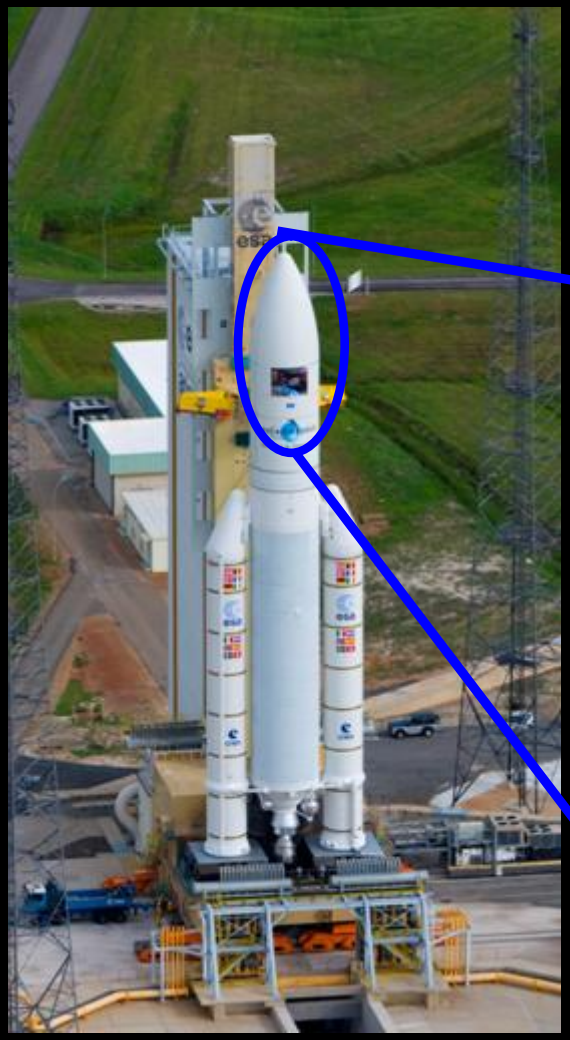



es

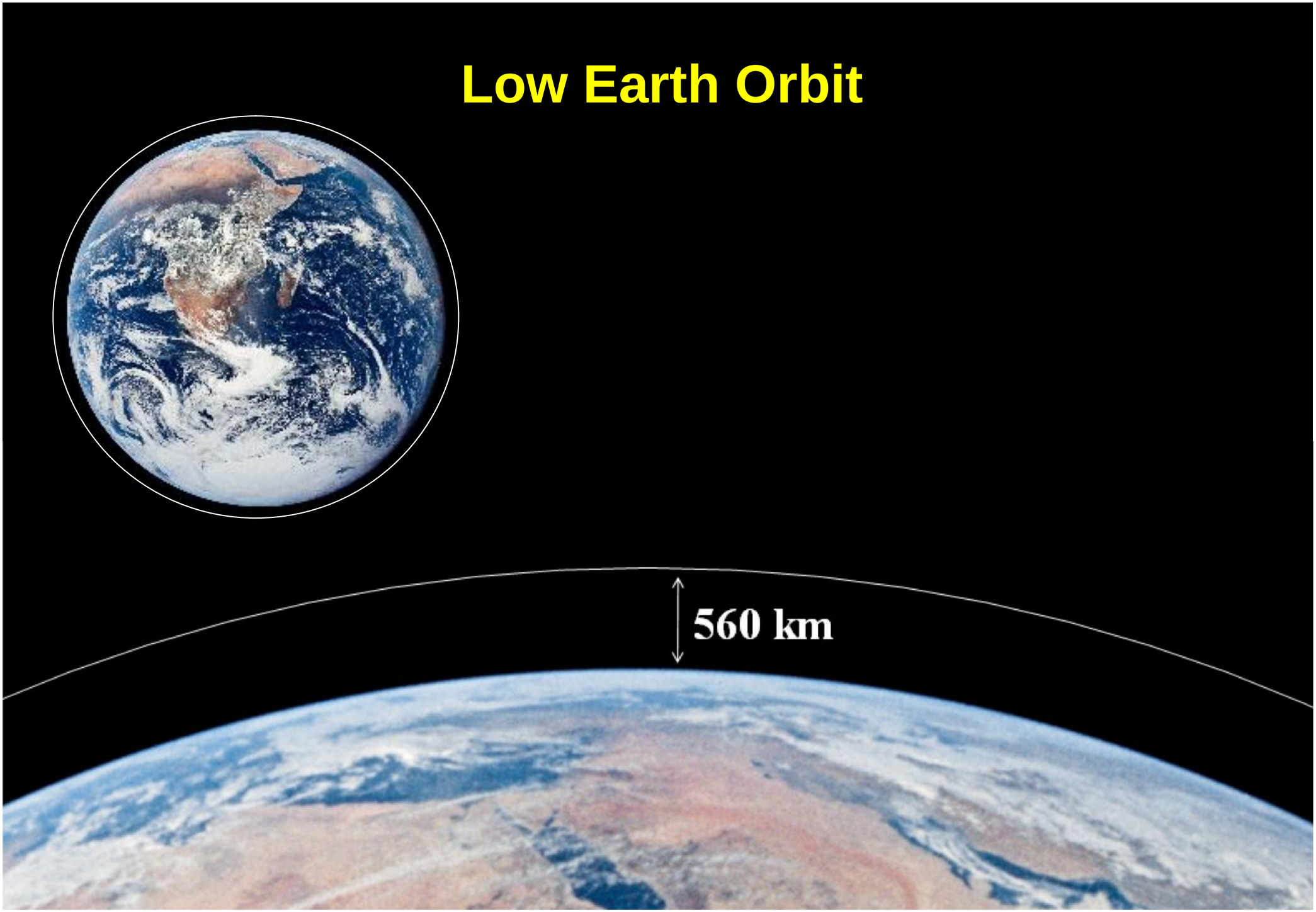

esa
esa

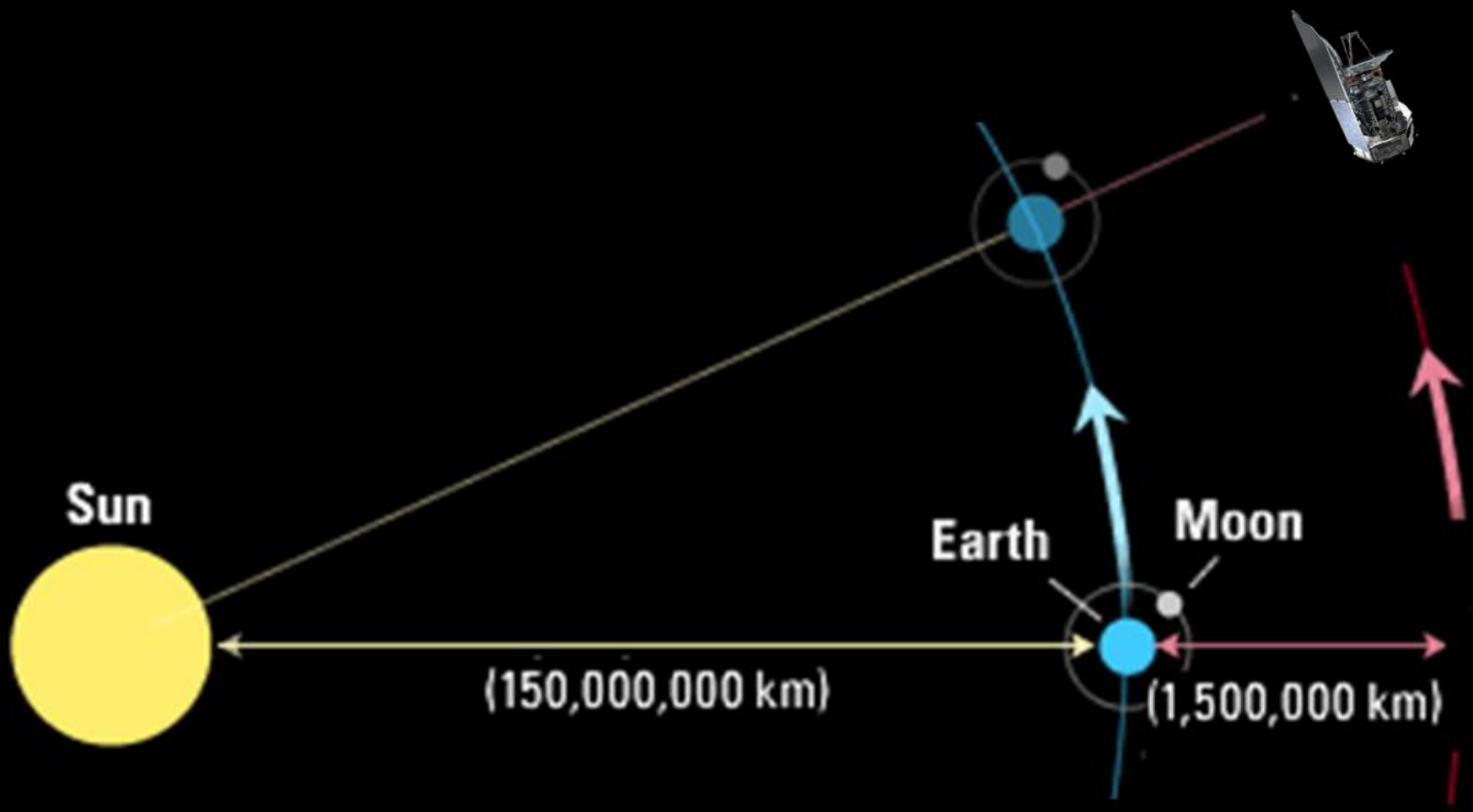


Launch (May 14 2009)



Low Earth Orbit





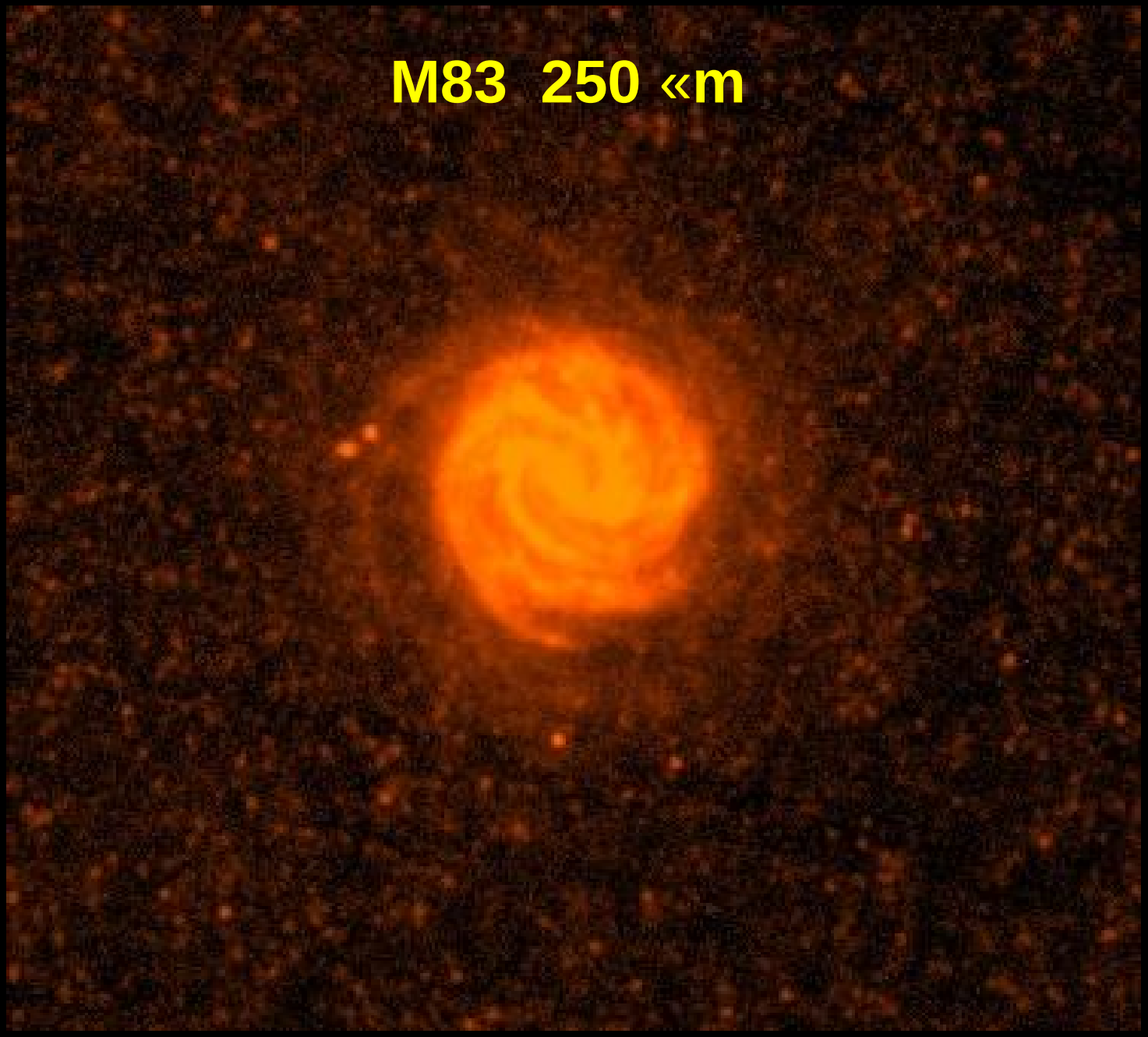
To scale

Earth

117 x Earth's diameter

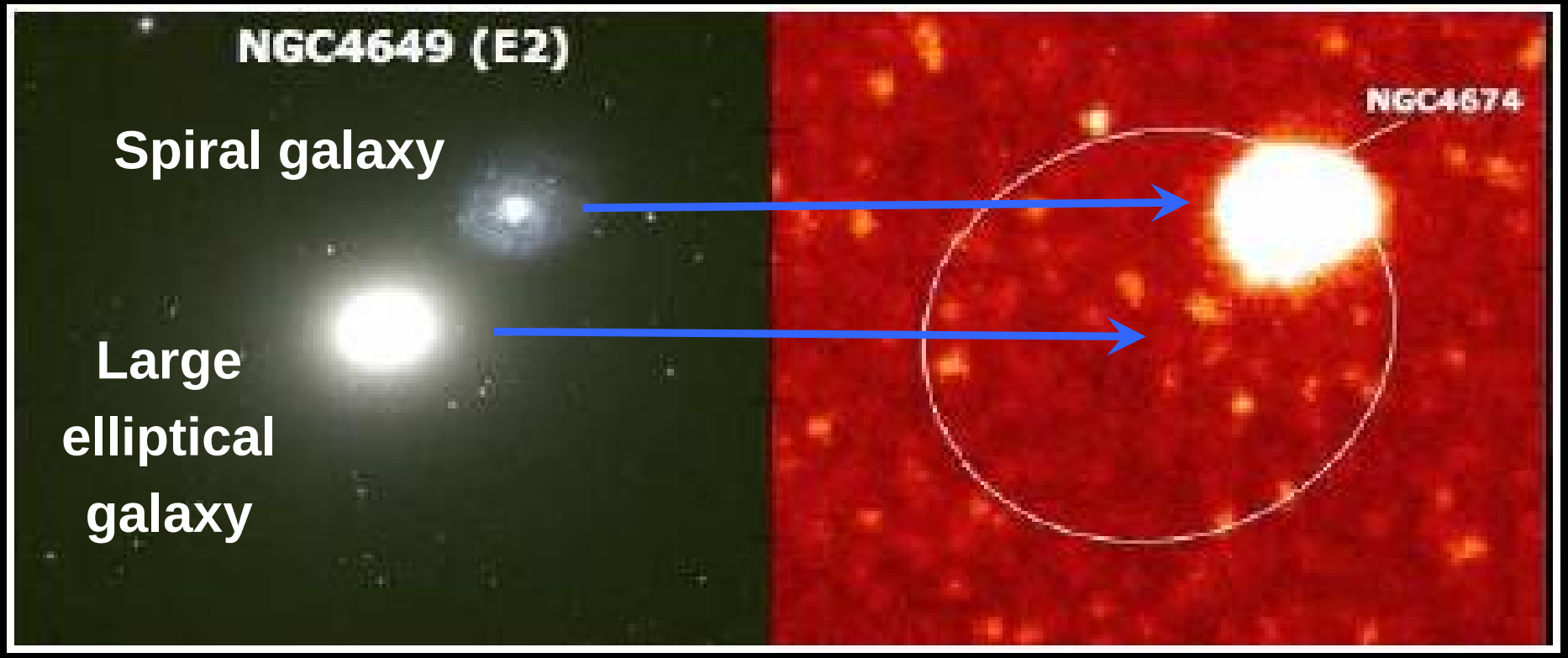
L2

Some Herschel Results


M83 250 «m

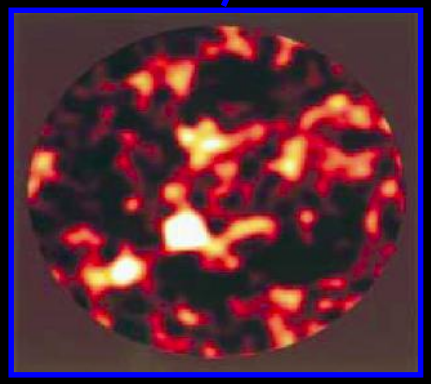
Dust in Spirals; No Dust in Ellipticals

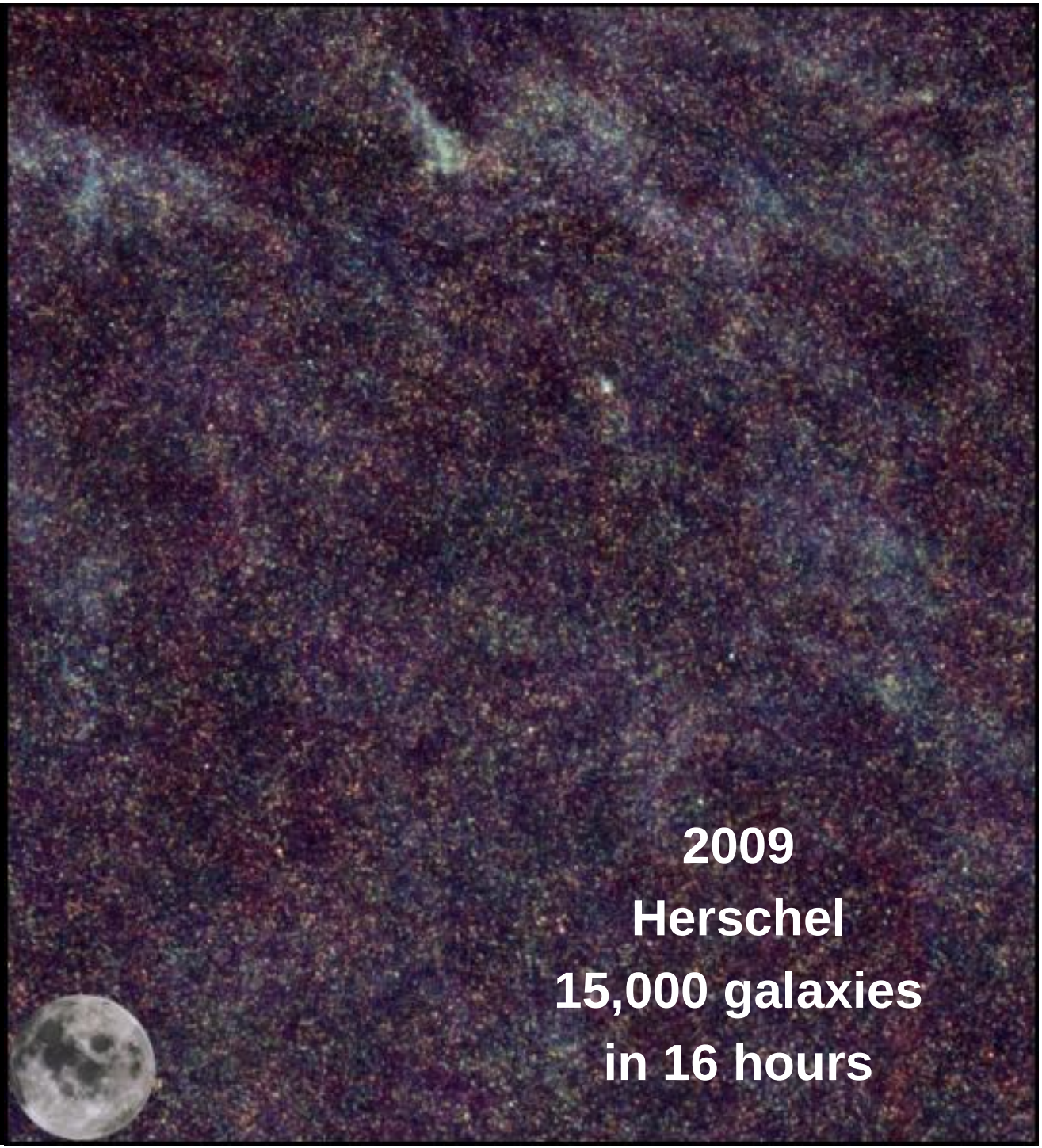
Visible **Herschel**

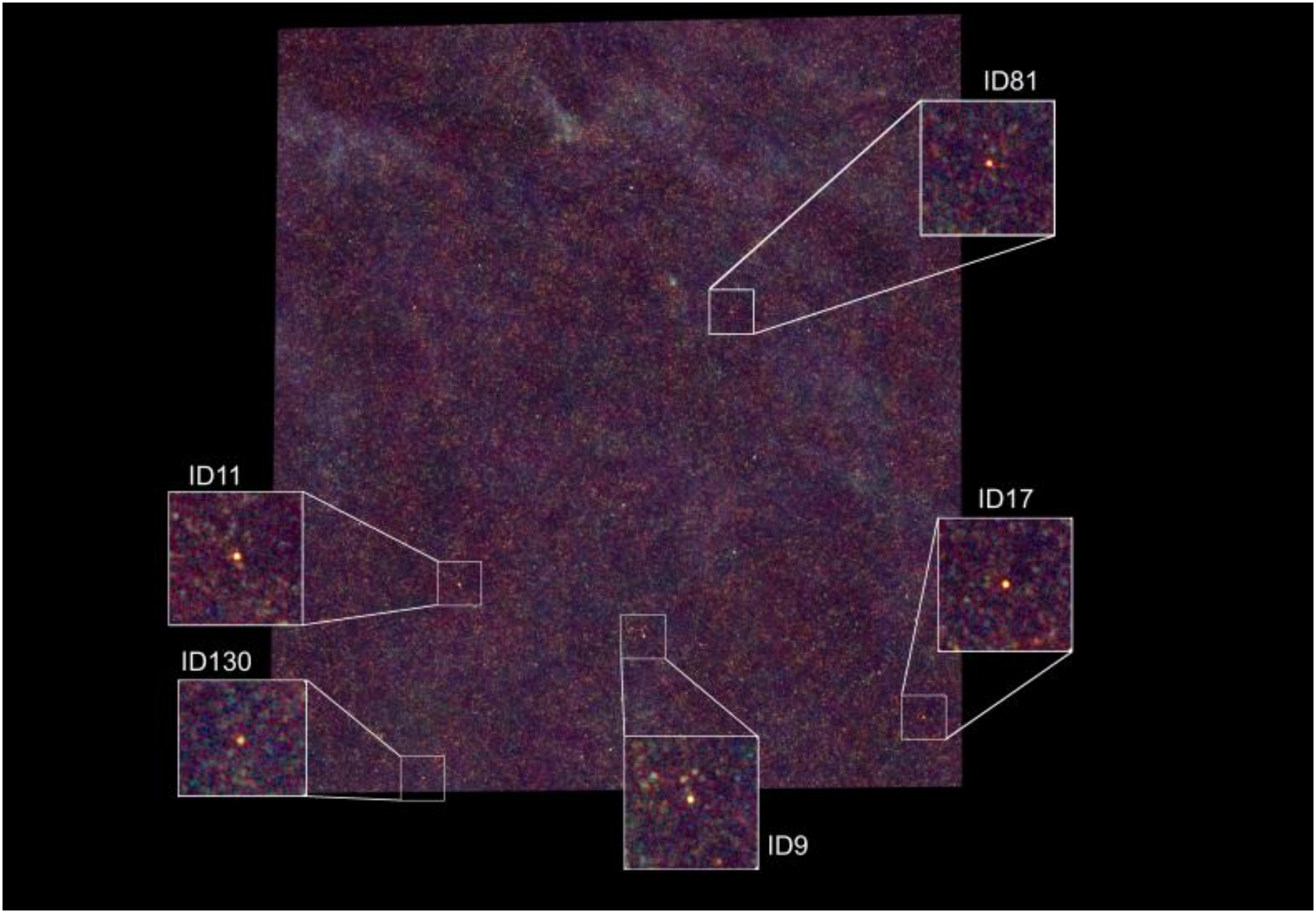


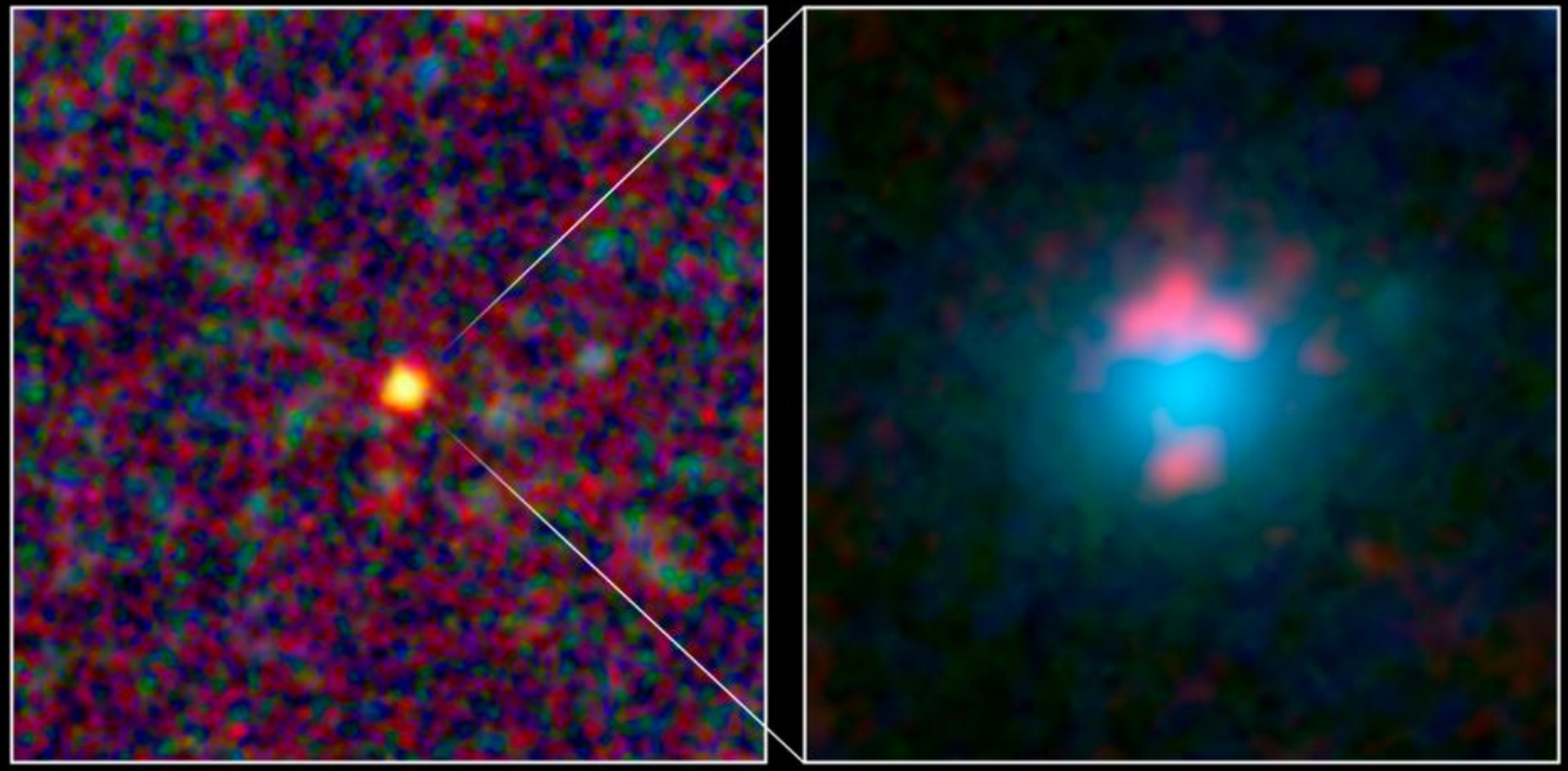
1998
Ground-based
5 galaxies
after 20 nights

To
scale



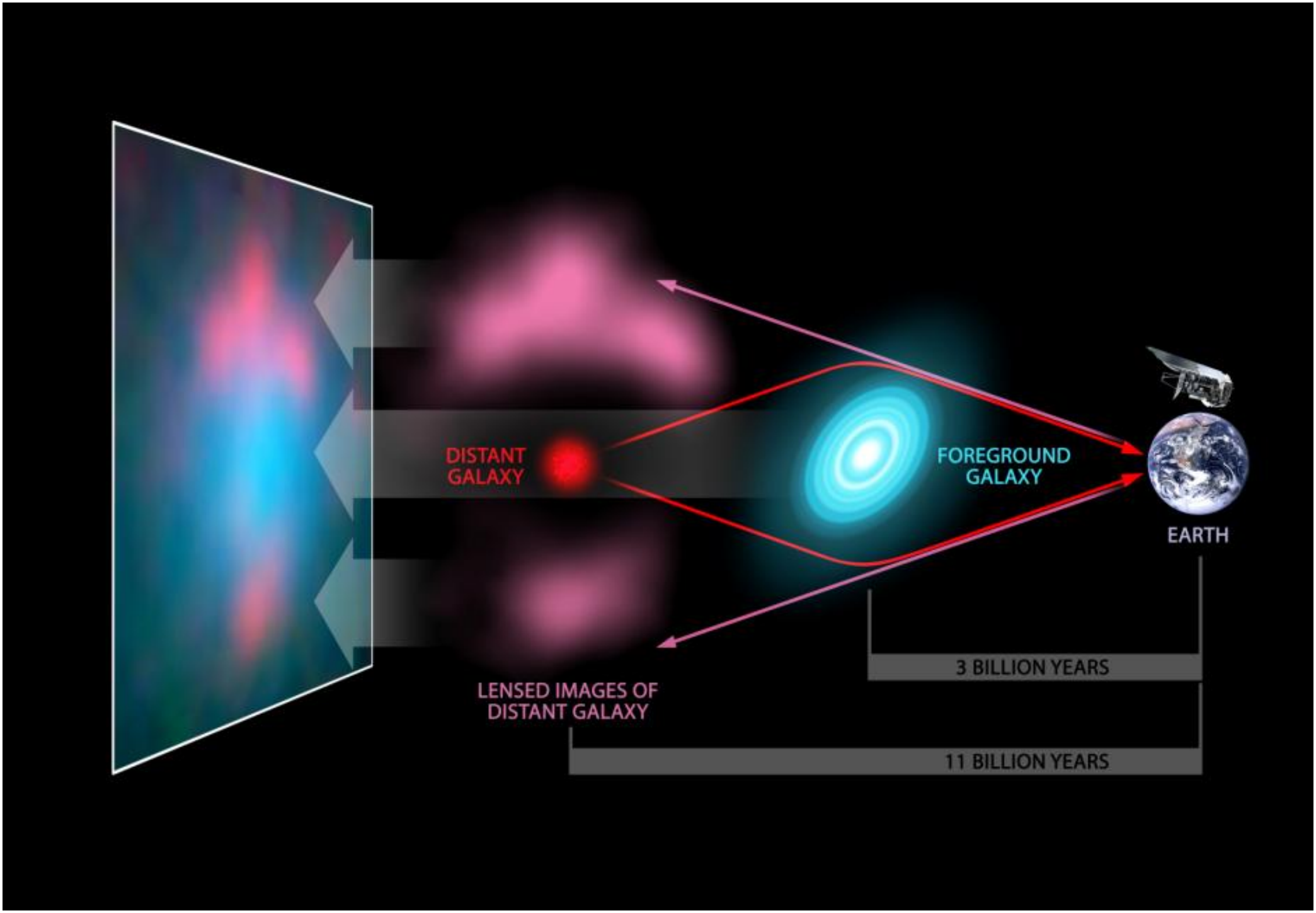



ID81
ID11
ID17
ID130
ID9

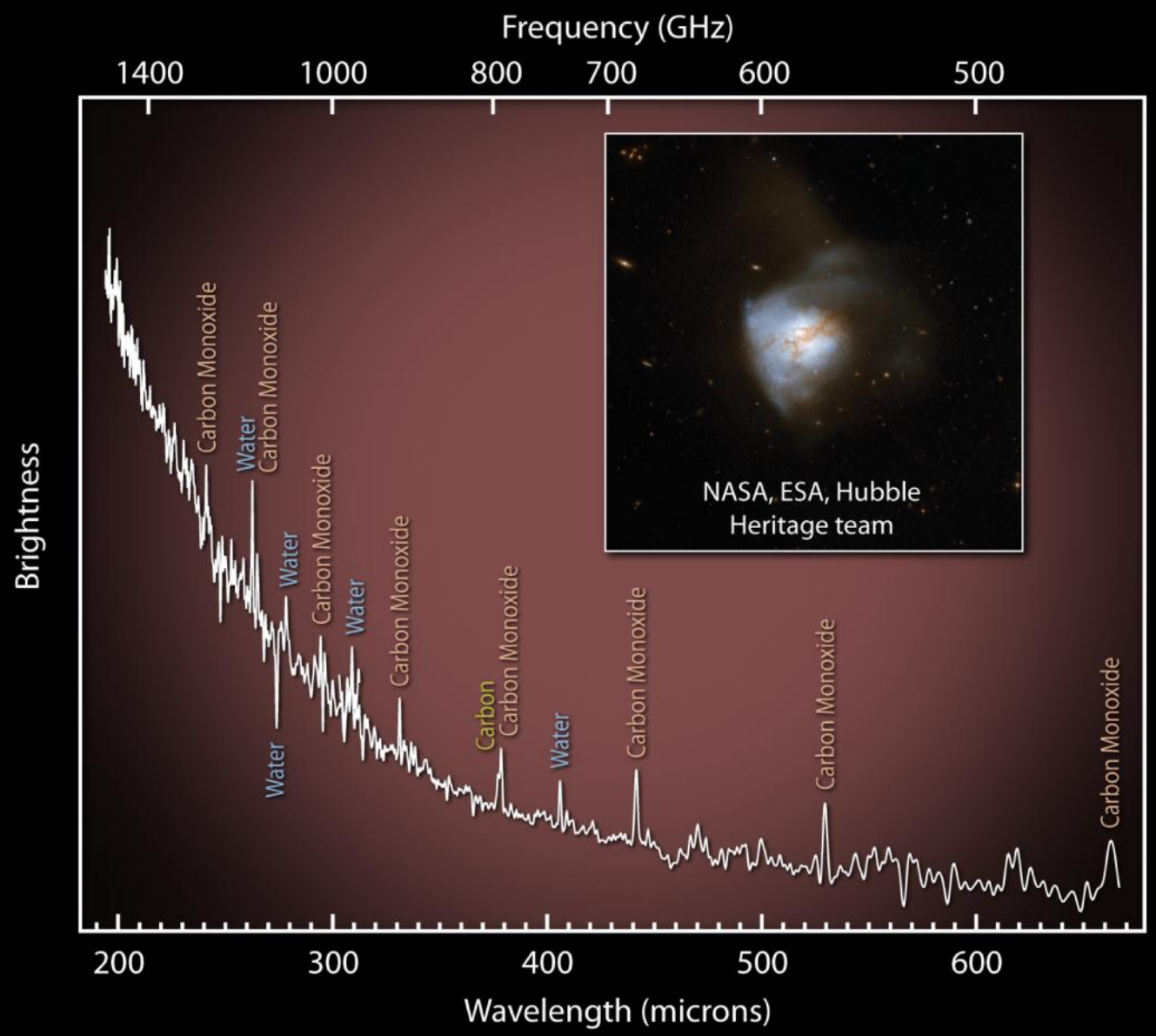


Herschel

Keck & SMA

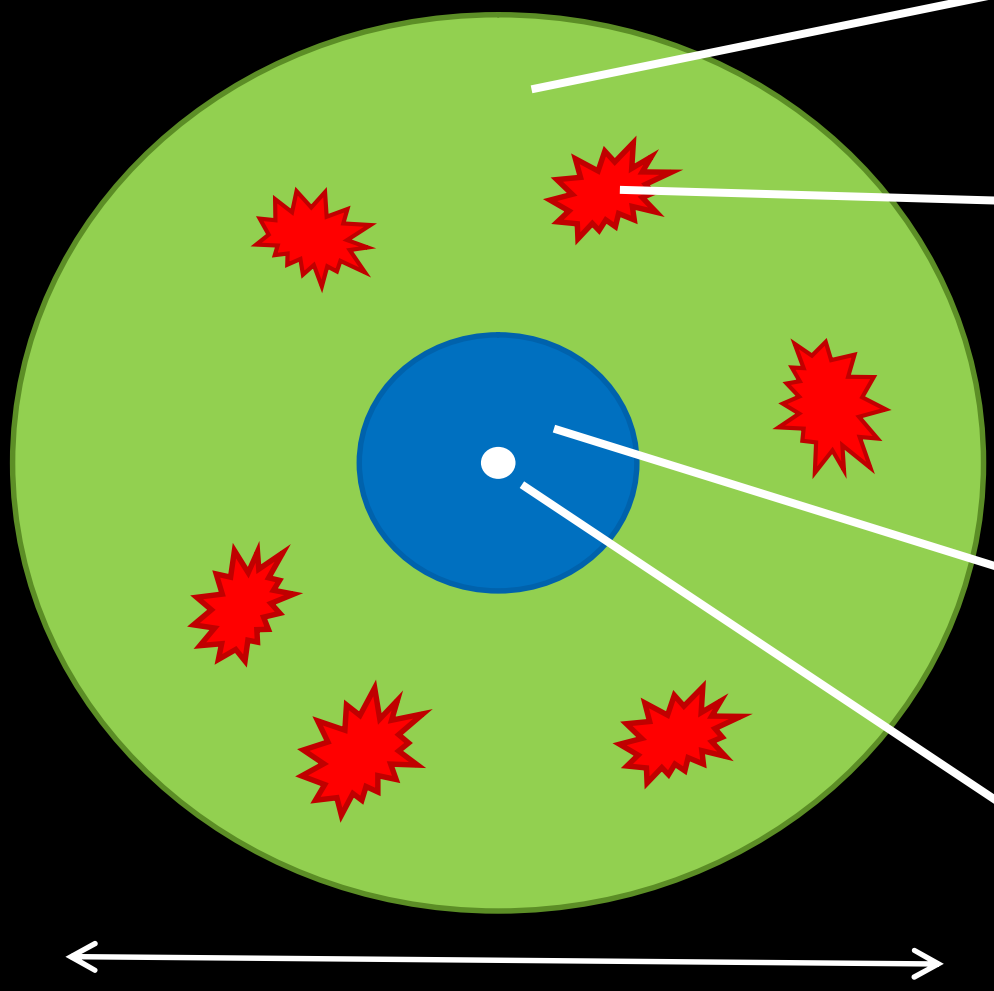

DISTANT GALAXY
FOREGROUND GALAXY
EARTH
3 BILLION YEARS
LENSED IMAGES OF DISTANT GALAXY
11 BILLION YEARS

Dust and Gas in a Star-Forming Galaxy Merger



Arp 220

Model of Mrk 231

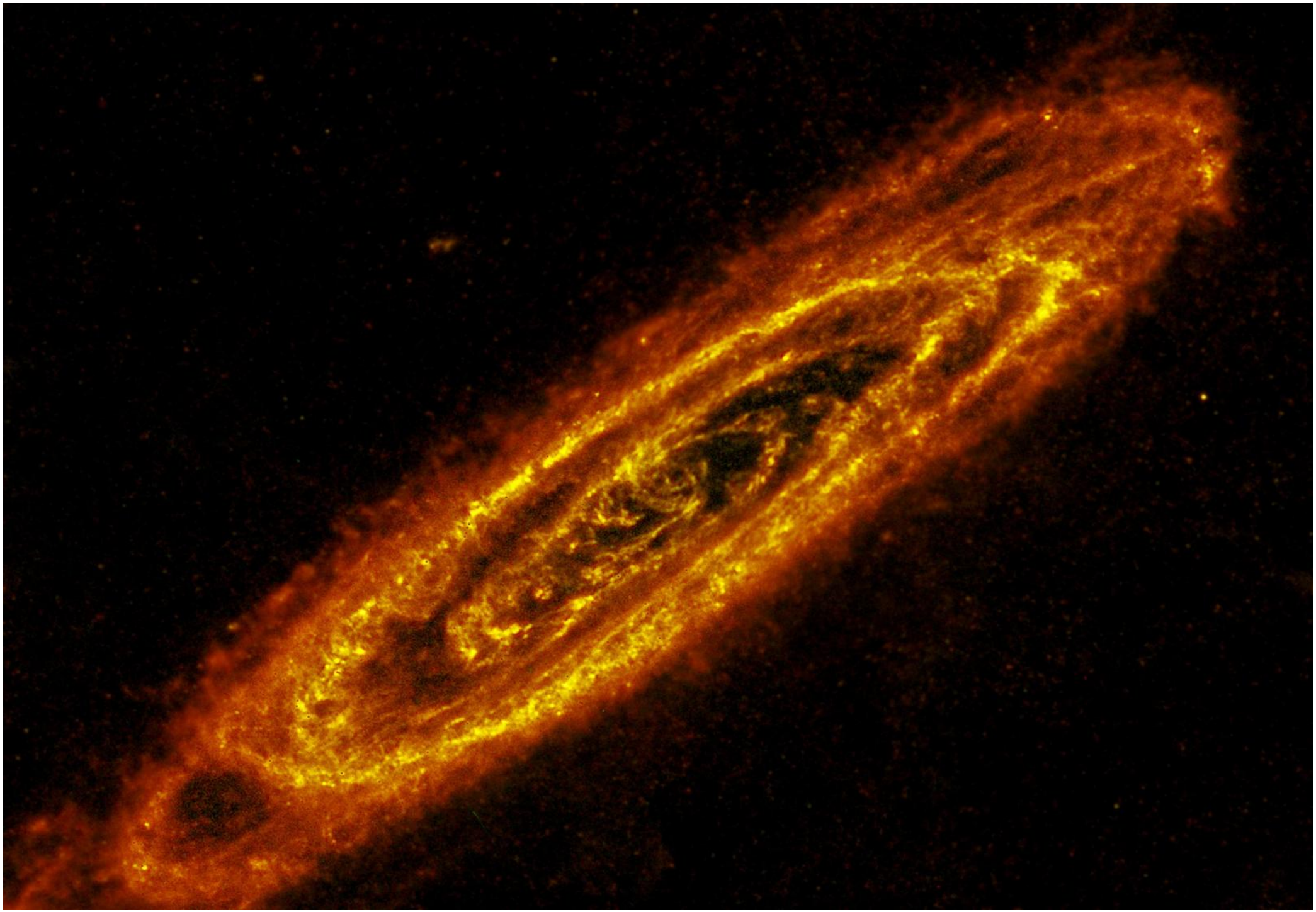


Large-scale molecular gas

Small, dense star-forming clumps

X-Ray dominated region

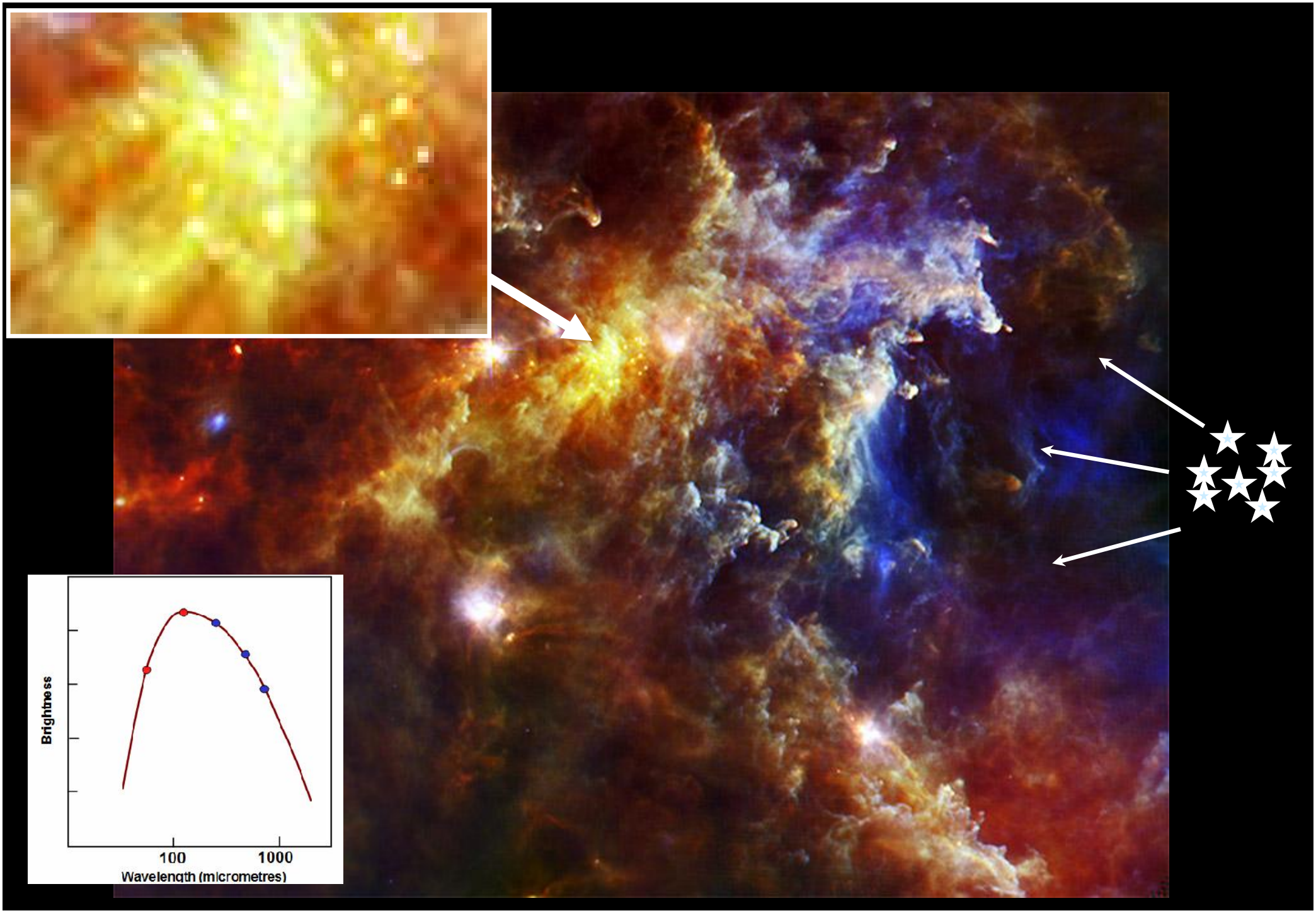
Accreting black hole

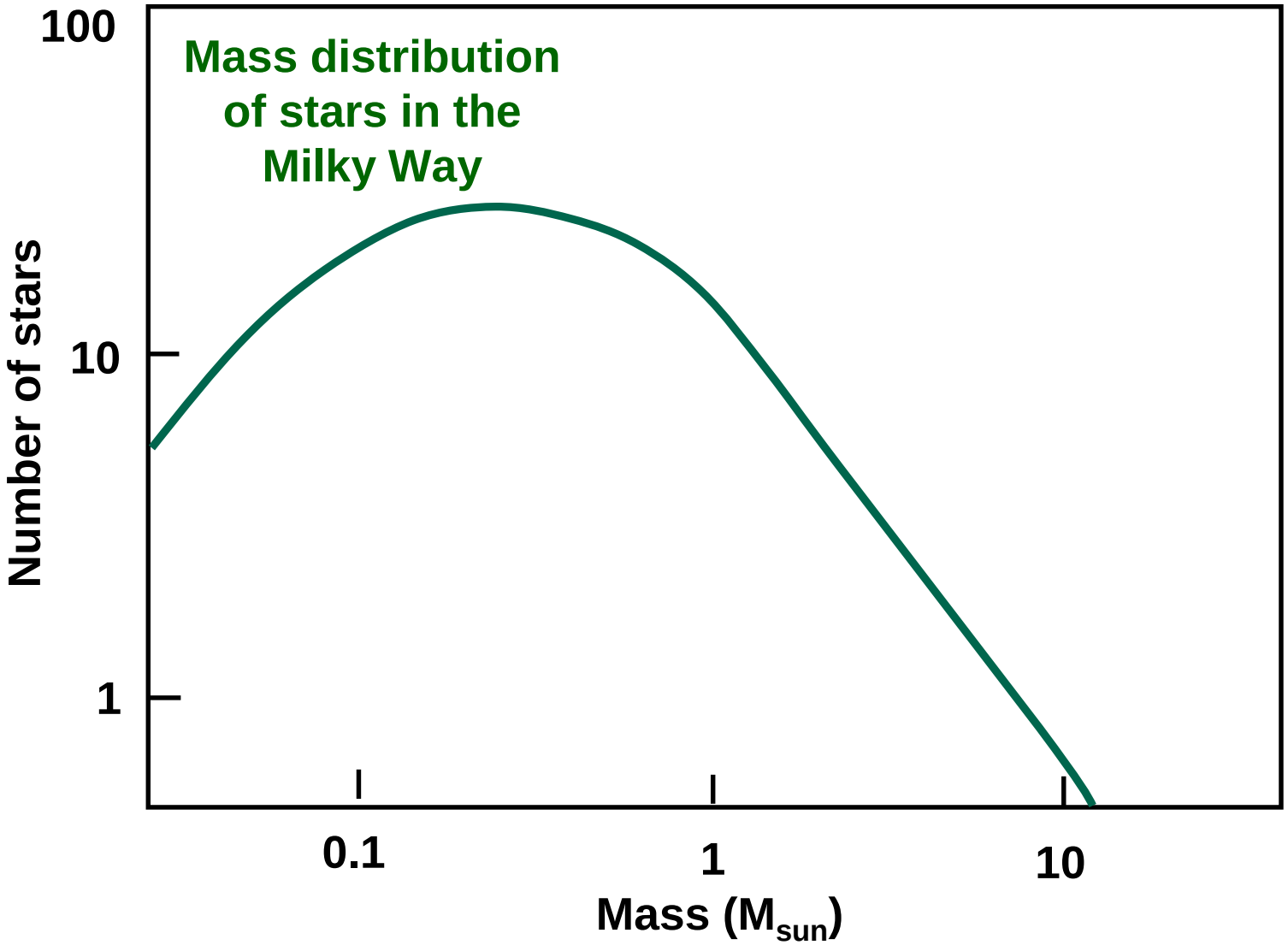


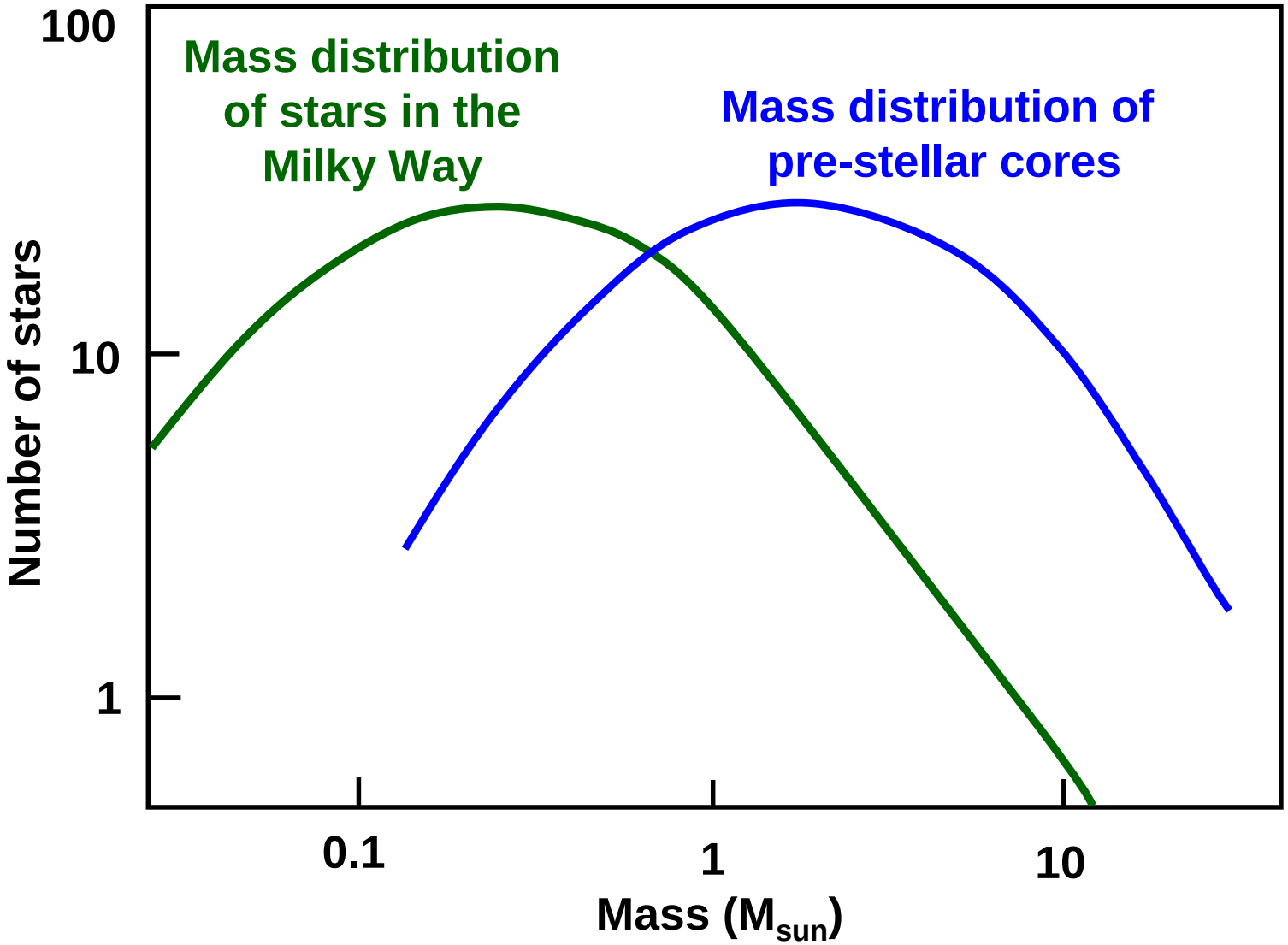
Taurus Star-Forming Cloud

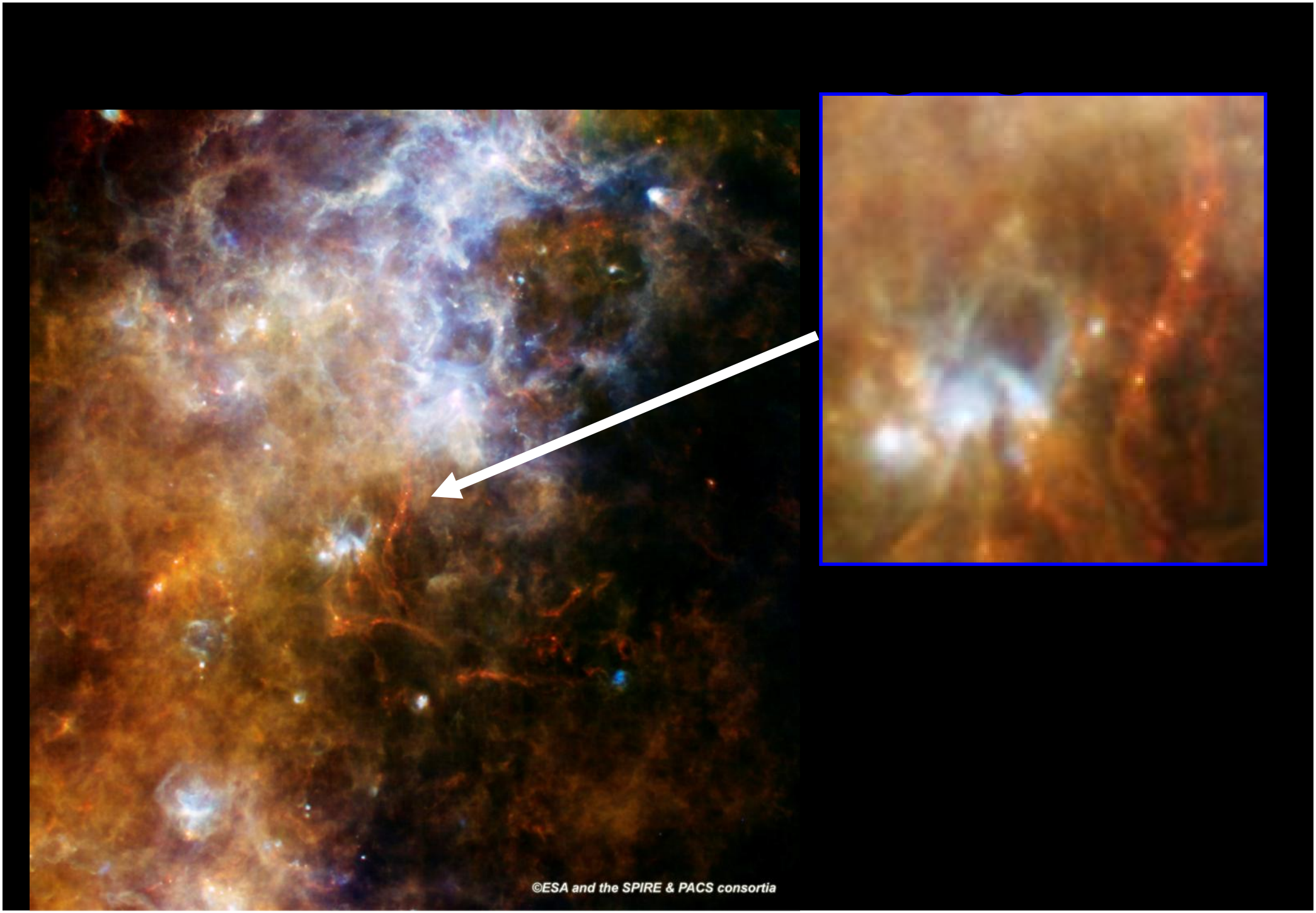
Taurus Star-Forming Cloud

Rosette Nebula

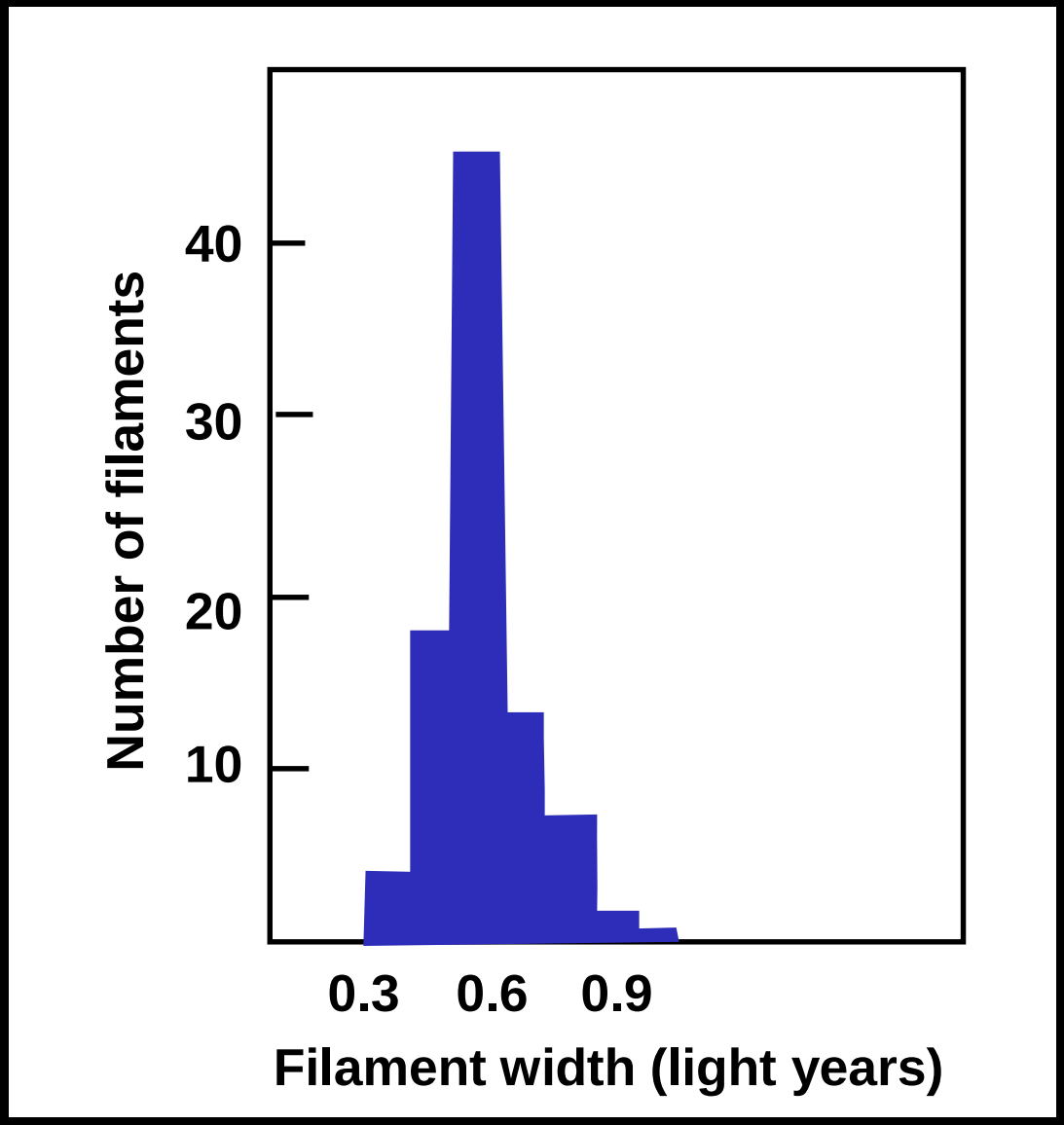

Brightness
100
1000
Wavelength (micrometres)


Mass distribution
of stars in the
Milky Way
100
10
1
Number of stars
0.1
1
10
Mass (M_{sun})

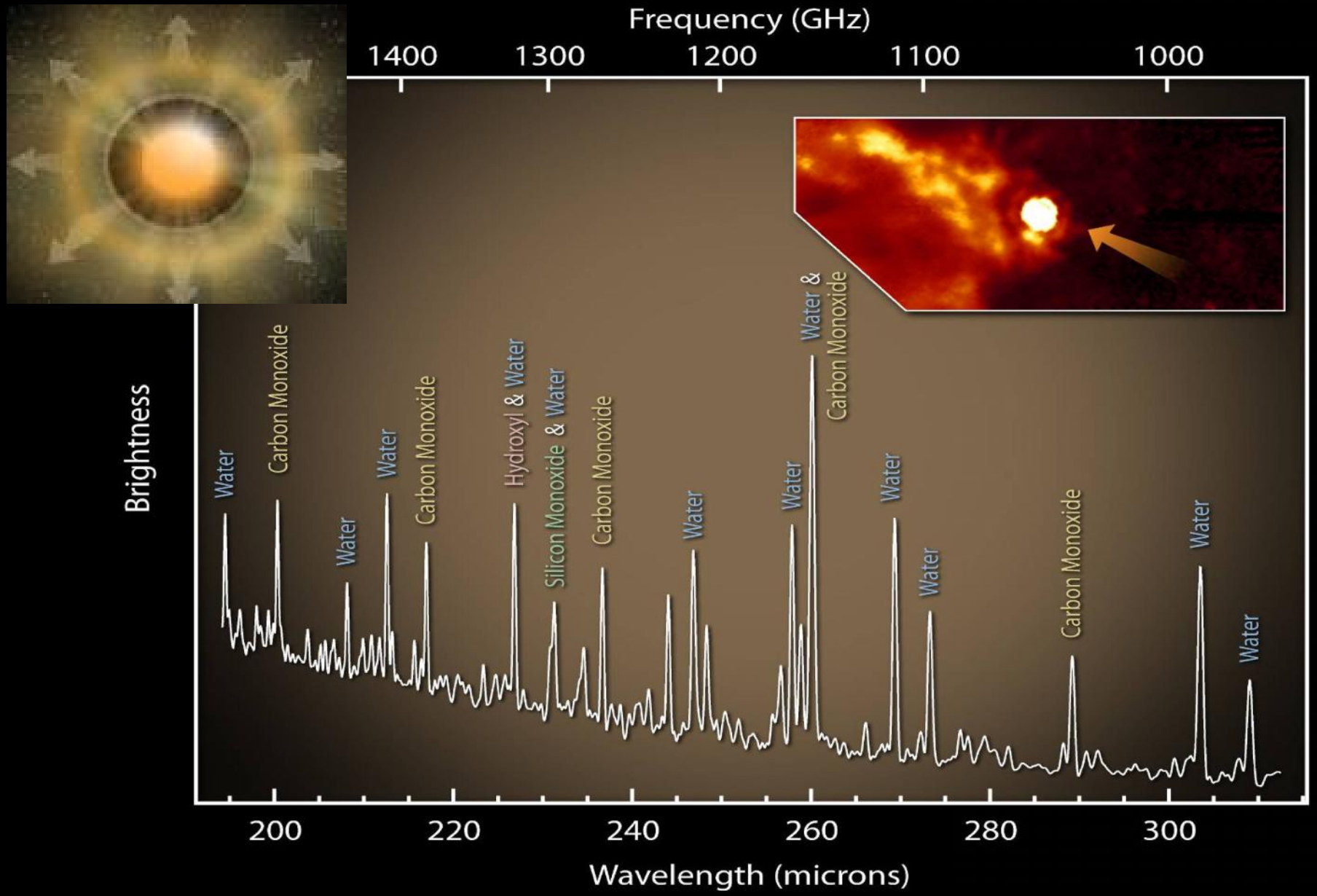

100
10
1
Number of stars
Mass distribution of stars in the Milky Way
Mass distribution of pre-stellar cores
0.1
1
10
Mass (M_{sun})


©ESA and the SPIRE & PACS consortia

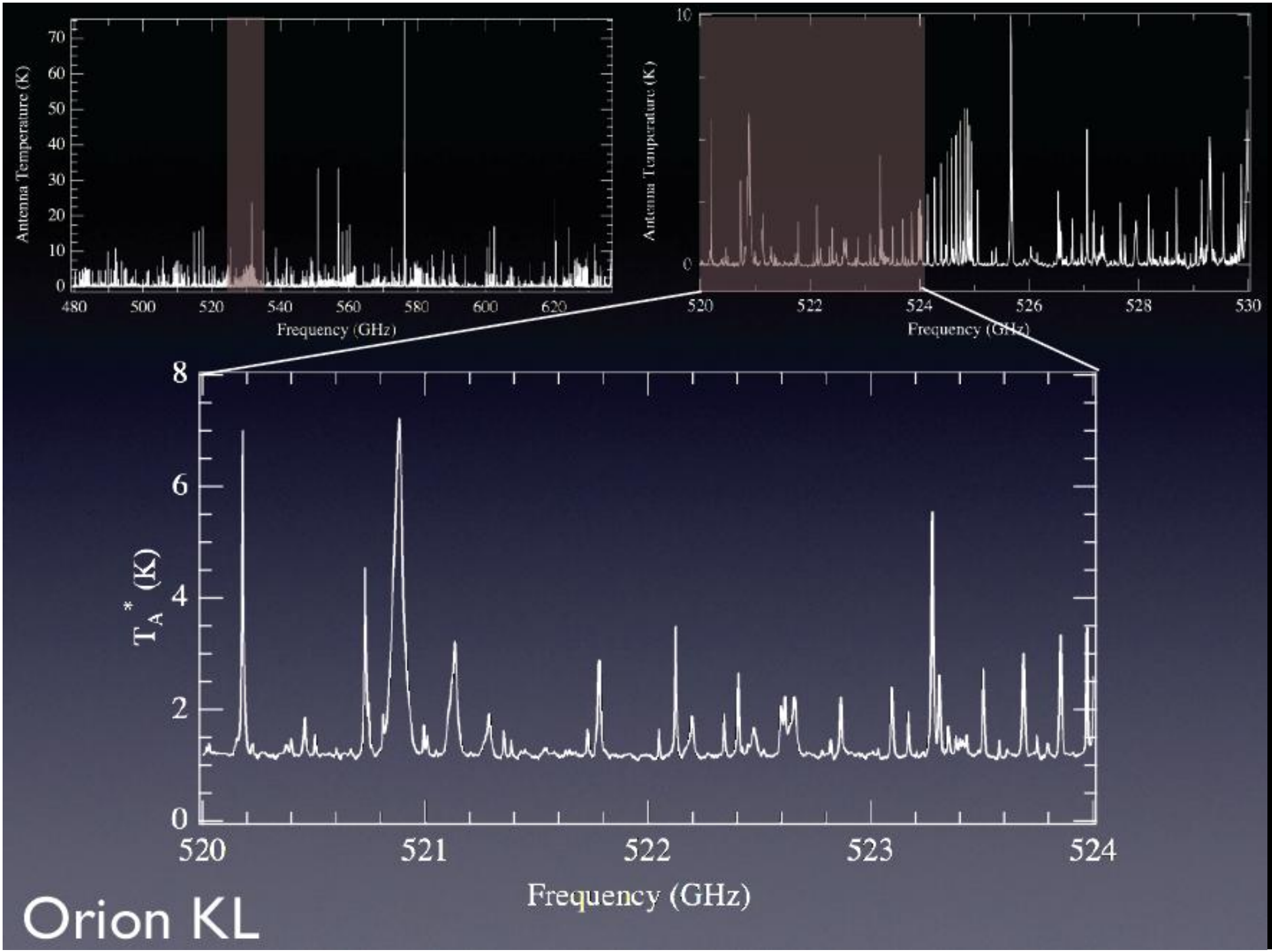
A Universal Size Scale for Filaments?



Chemical Output From a Dying Star

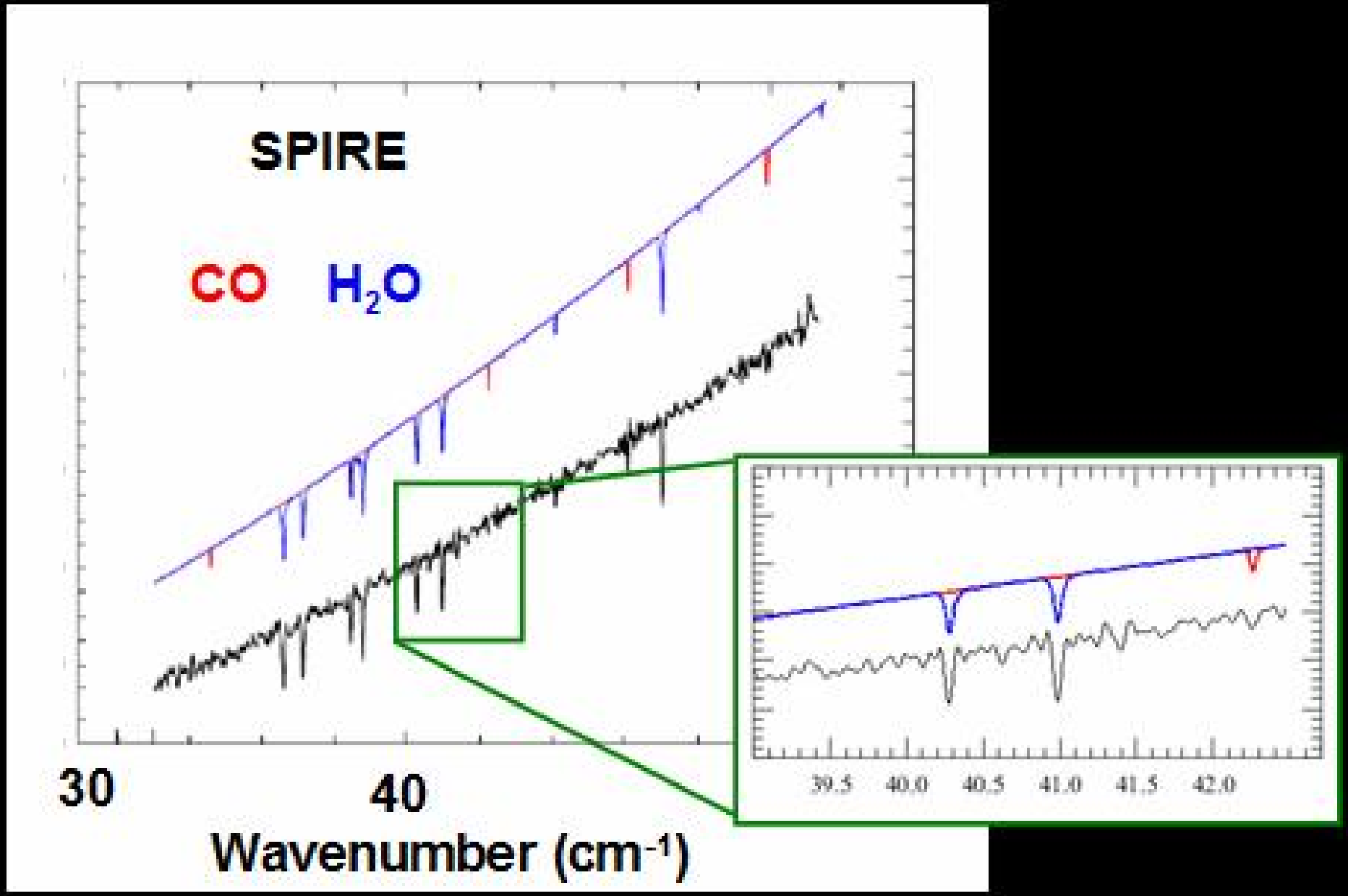


VY Canis Majoris

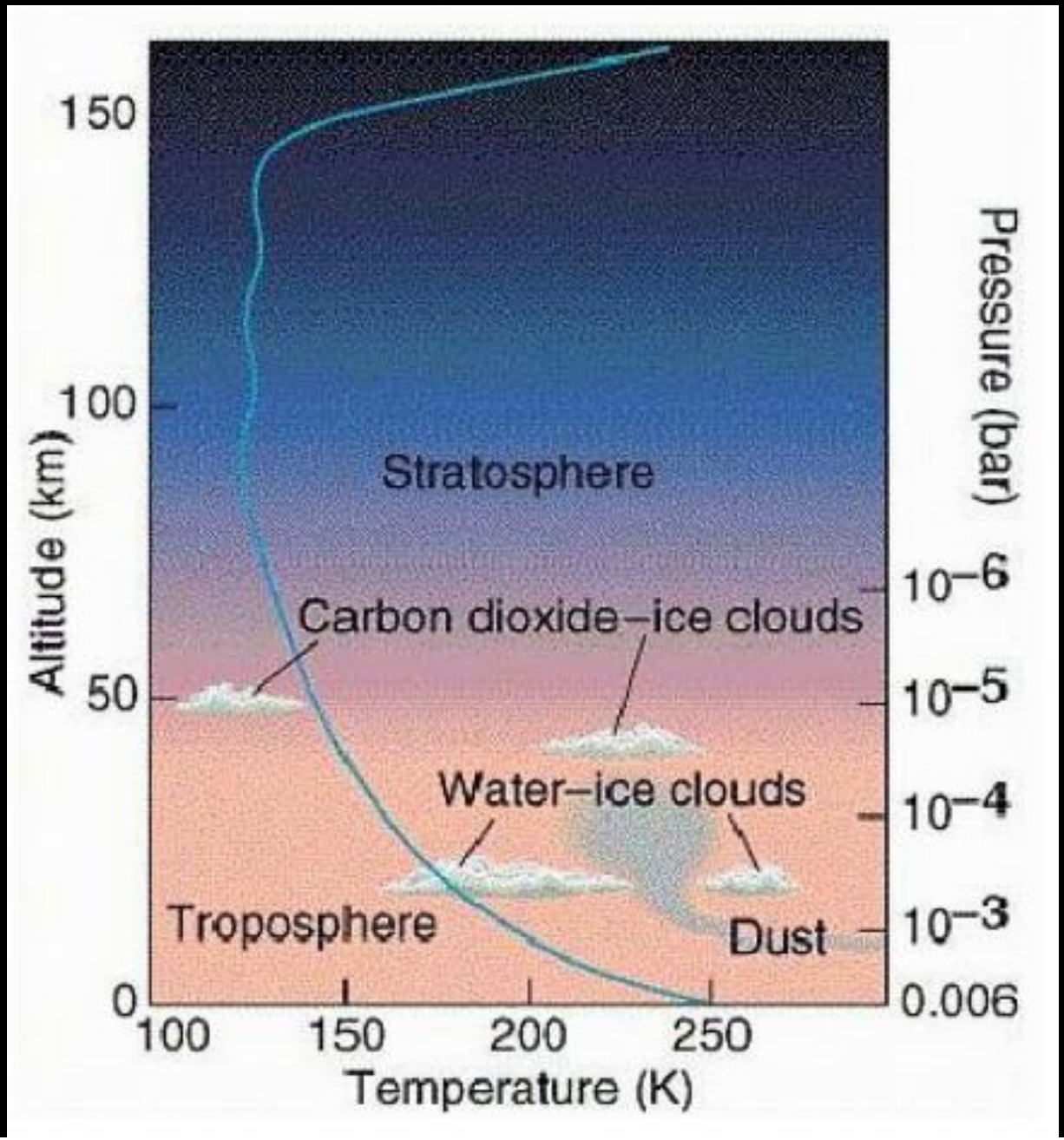

Antenna Temperature (K)
Frequency (GHz)
Antenna Temperature (K)
Frequency (GHz)
T_A^* (K)
Frequency (GHz)
Orion KL

Water on Mars

The Atmosphere of Mars



Martian Atmosphere



Model Composition

CO_2	95.3%
N_2	2.7%
Ar	1.6%
O_2	0.13%
CO	0.07%
H_2O	0.03%
CH_4	10 ppb

What’s Next?

SPICA

Launch ~ 2022

- **3.5-m telescope cooled to 5 K**

宇宙航空研究開発機構
Japan Aerospace Exploration Agency