CIT EXT POÀ

Rosso Marziano

l'alcool nello spazio

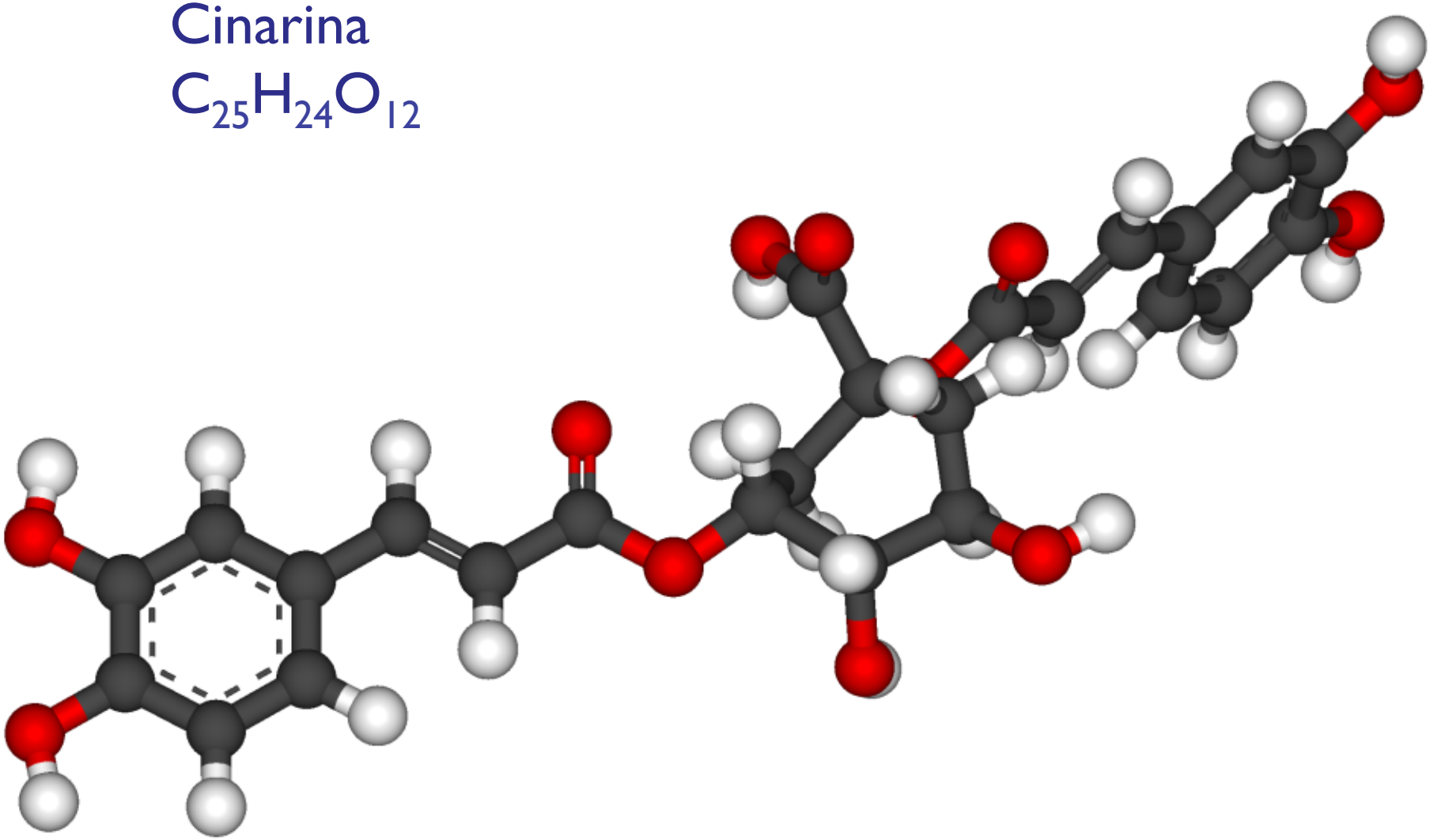
Anna Wolter
INAF – Osservatorio Astronomico di Brera
ESO Science Outreach Network

2015 Milano a place to BE

Il Vino

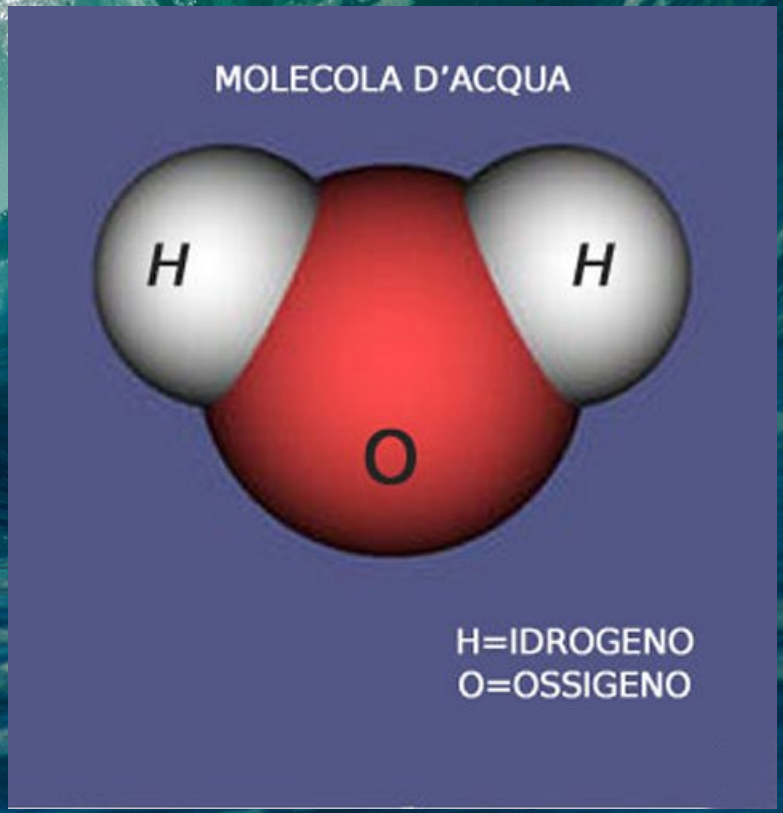
Cinarina

$C_{25}H_{24}O_{12}$

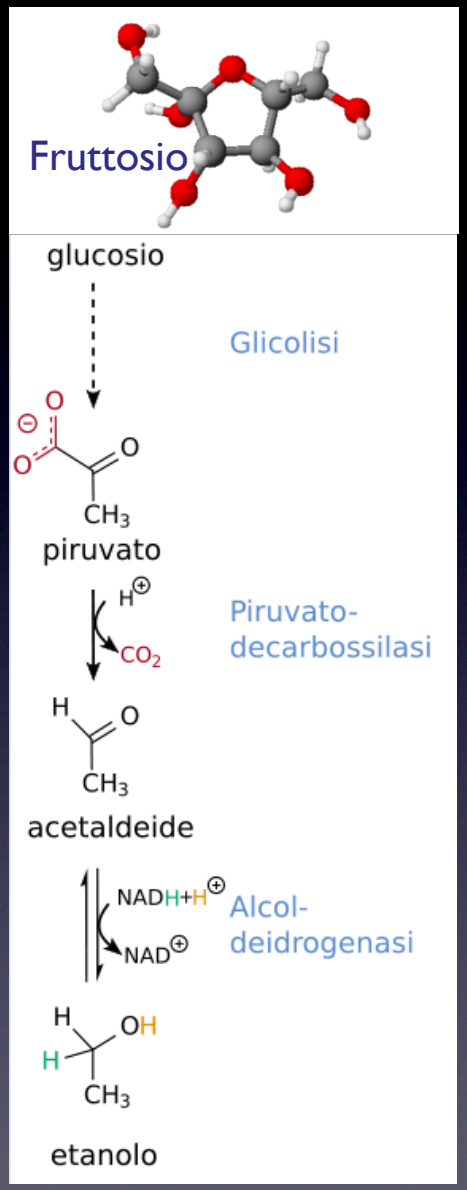


Acqua

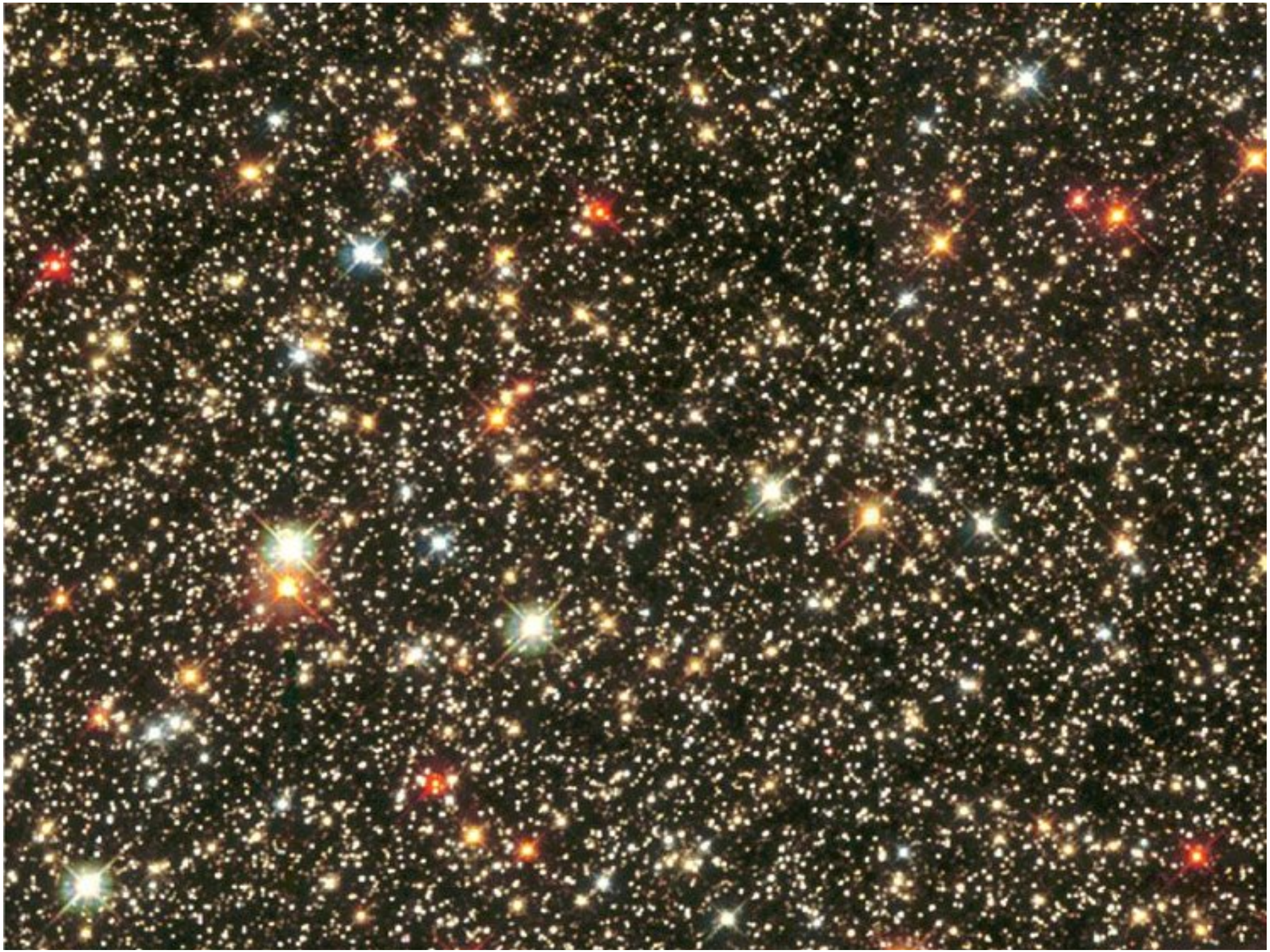
- Elemento fondamentale: lo rivedremo

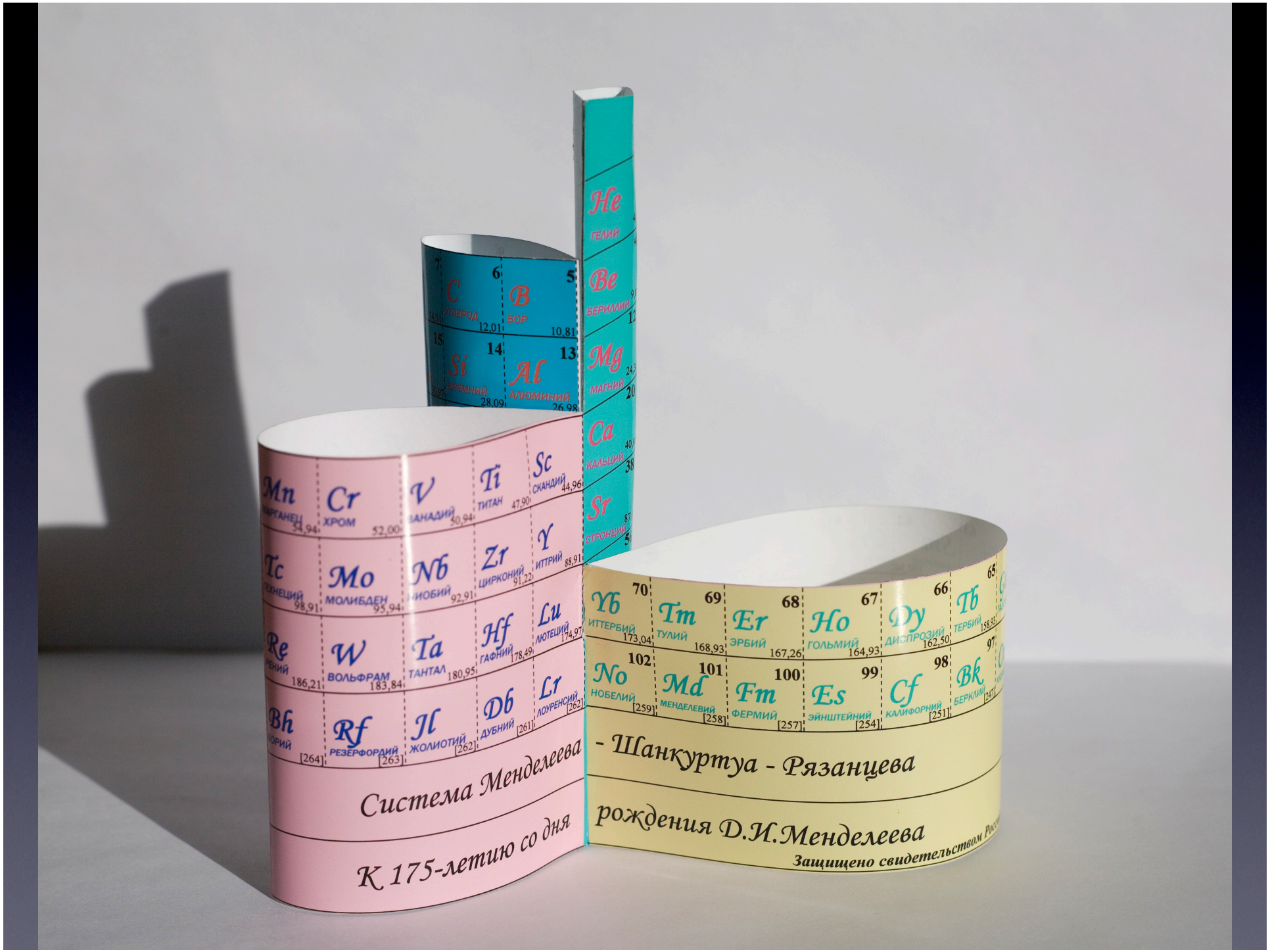


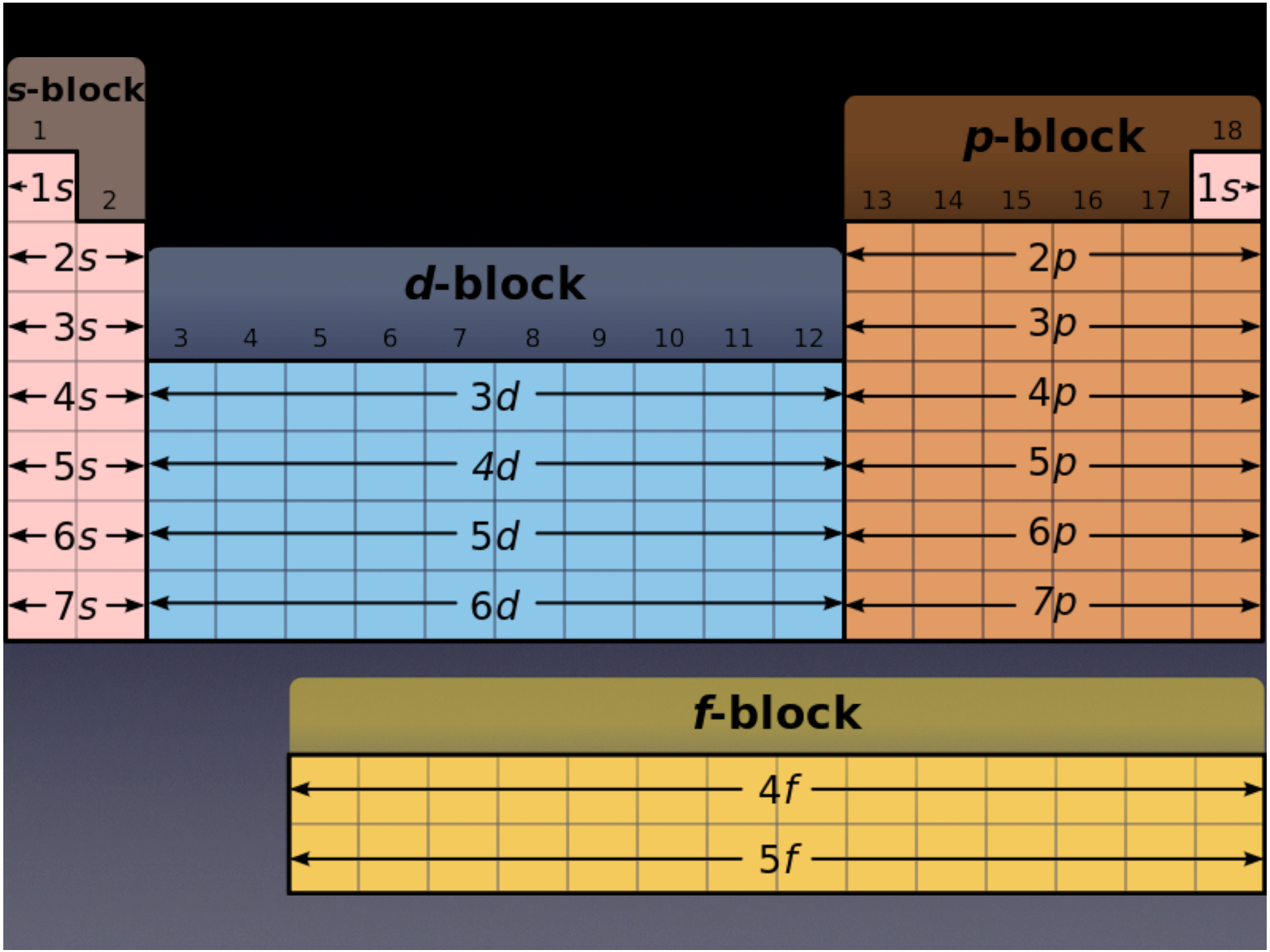
Alcol e zuccheri



Gli zuccheri si trasformano in alcoli per mezzo dell'azione di lieviti e batteri (saccaromiceti)




Система Менделеева
К 175-летию со дня
- Шанкуртуа - Рязанцева
рождения Д.И.Менделеева
Защищено свидетельством Рос
He ГЕЛИЙ
Be БЕРИЛЛИЙ
Mg МАГНИЙ
Ca КАЛЬЦИЙ
Sr СТРОНЦИЙ
C УГЛЕРОД 12,01
B БОР 10,81
Si КРЕМНИЙ 28,09
Al АЛЮМИНИЙ 26,98
Mn МАРГАНЕЦ 54,94
Cr ХРОМ 52,00
V ВАНАДИЙ 50,94
Ti ТИТАН 47,90
Sc СКАНДИЙ 44,96
Tc ТЕХНЕЦИЙ 98,91
Mo МОЛИБДЕН 95,94
Nb НИОБИЙ 92,91
Zr ЦИРКОНИЙ 91,22
Y ИТТРИЙ 88,91
Re РЕНИЙ 186,21
W ВОЛЬФРАМ 183,84
Ta ТАНТАЛ 180,95
Hf ГАФНИЙ 178,49
Lu ЛЮТЕЦИЙ 174,97
Bh БОРИЙ [264]
Rf РЕЗЕРФОРДИЙ [263]
Jl ЖОЛИОТИЙ [262]
Db ДУБНИЙ [261]
Lr ЛОУРЕНСИЙ [262]
Yb 70 ИТТЕРБИЙ 173,04
Tm 69 ТУЛИЙ 168,93
Er 68 ЭРБИЙ 167,26
Ho 67 ГОЛЬМИЙ 164,93
Dy 66 ДИСПРОЗИЙ 162,50
Tb 65 ТЕРБИЙ 158,93
No 102 НОБЕЛИЙ [259]
Md 101 МЕНДЕЛЕВИЙ [258]
Fm 100 ФЕРМИЙ [257]
Es 99 ЭЙНШТЕЙНИЙ [254]
Cf 98 КАЛИФОРНИЙ [251]
Bk 97 БЕРКЛИЙ [247]


s-block
1
2
1s
2s
3s
4s
5s
6s
7s
d-block
3
4
5
6
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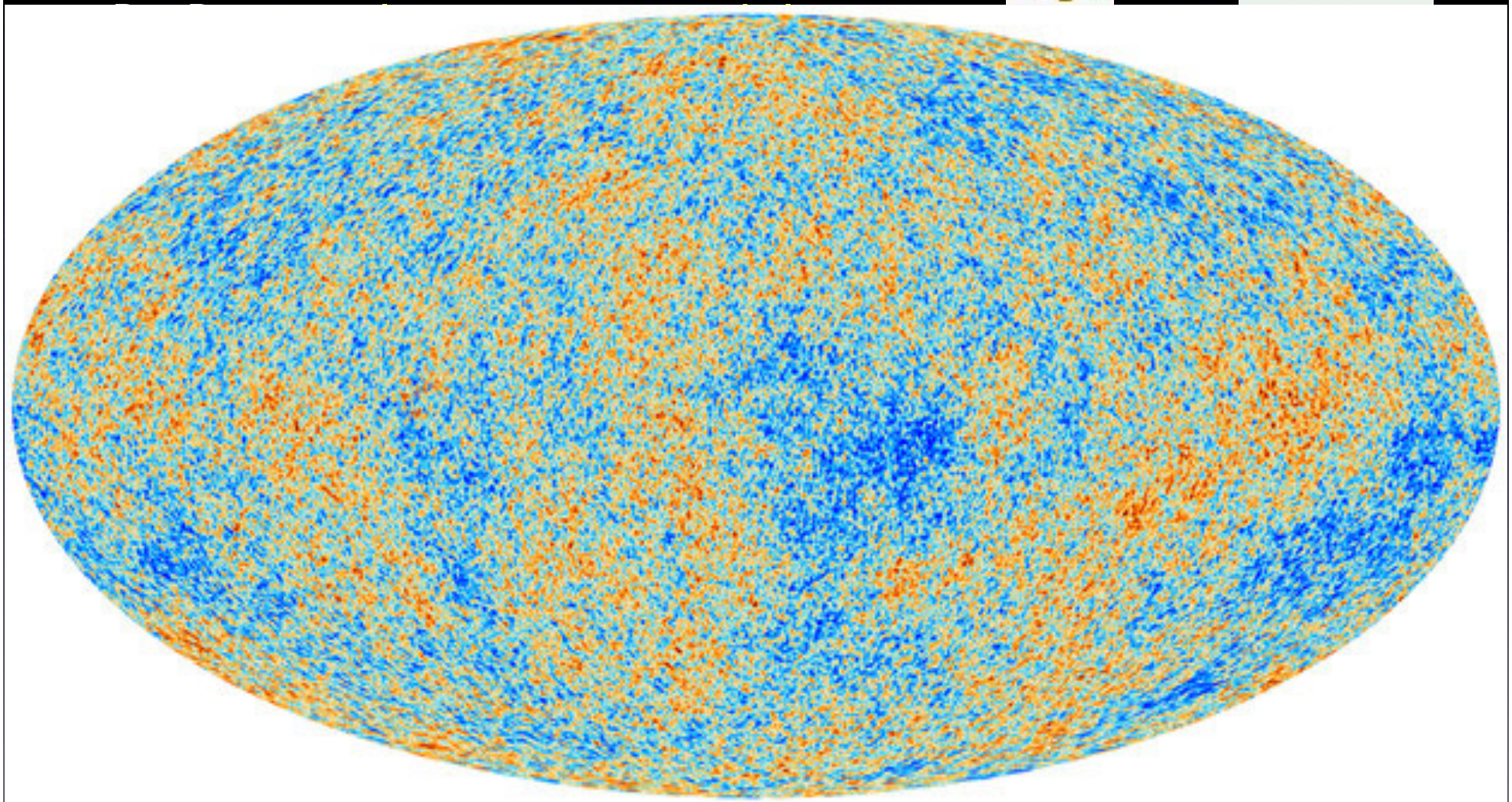
8
9
10
11
12
3d
4d
5d
6d
p-block
13
14
15
16
17
18
1s
2p
3p
4p
5p
6p
7p
f-block
4f
5f

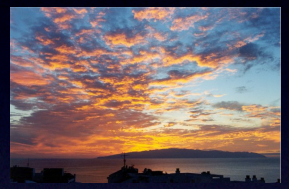
Ma come si formano gli elementi?

STEVEN WEINBERG
I PRIMI TRE MINUTI

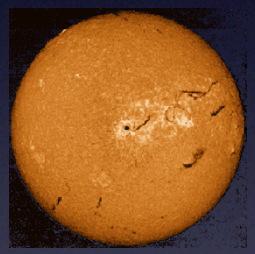


E il resto?

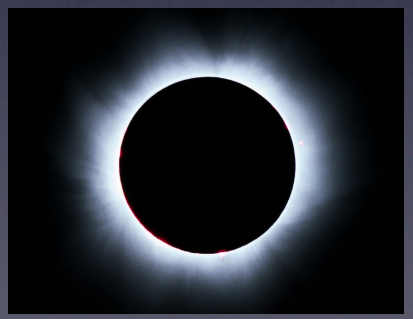
- Reazioni termonucleari:



luminoso



colorato



sferico

Stella:

corpo celeste costituito da gas caldo tenuto insieme dalla gravità e che emette luce propria
Dizionario della lingua italiana (Devoto –Oli)

La luminosità del Sole

La quantità di energia emessa dal Sole al secondo è:

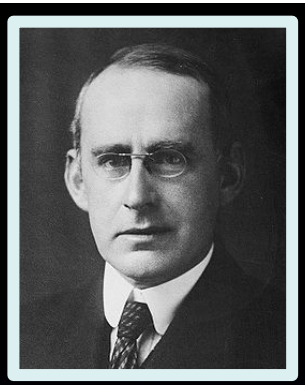
$$L_{sole} \approx 4 \times 10^{26}\ J/s = 4 \times 10^{26}\ W$$

Quella che raggiunge la Terra è circa 175 000 TW (TeraWatt)
Quella consumata in media sulla Terra è circa 13 TW (1TW =10^{12} W)
Una famiglia media consuma circa 20 MW h all'anno (1MW =10^{6} W = *10^{-6} TW)*

Qual è la sorgente di questa energia?

La contrazione no: vita del Sole troppo breve circa 20 milioni di anni

Ipotesi termonucleare: Eddington (ca 1920)



1957

REVIEWS OF
MODERN PHYSICS

VOLUME 29, NUMBER 4 OCTOBER, 1957

Synthesis of the Elements in Stars*

E. MARGARET BURBIDGE, G. R. BURBIDGE, WILLIAM A. FOWLER, AND F. HOYLE

Kellogg Radiation Laboratory, California Institute of Technology, and Mount Wilson and Palomar Observatories, Carnegie Institution of Washington, California Institute of Technology, Pasadena, California

"It is the stars, The stars above us, govern our conditions";
(*King Lear*, Act IV, Scene 3)

but perhaps

"The fault, dear Brutus, is not in our stars, But in ourselves,"
(*Julius Caesar*, Act I, Scene 2)

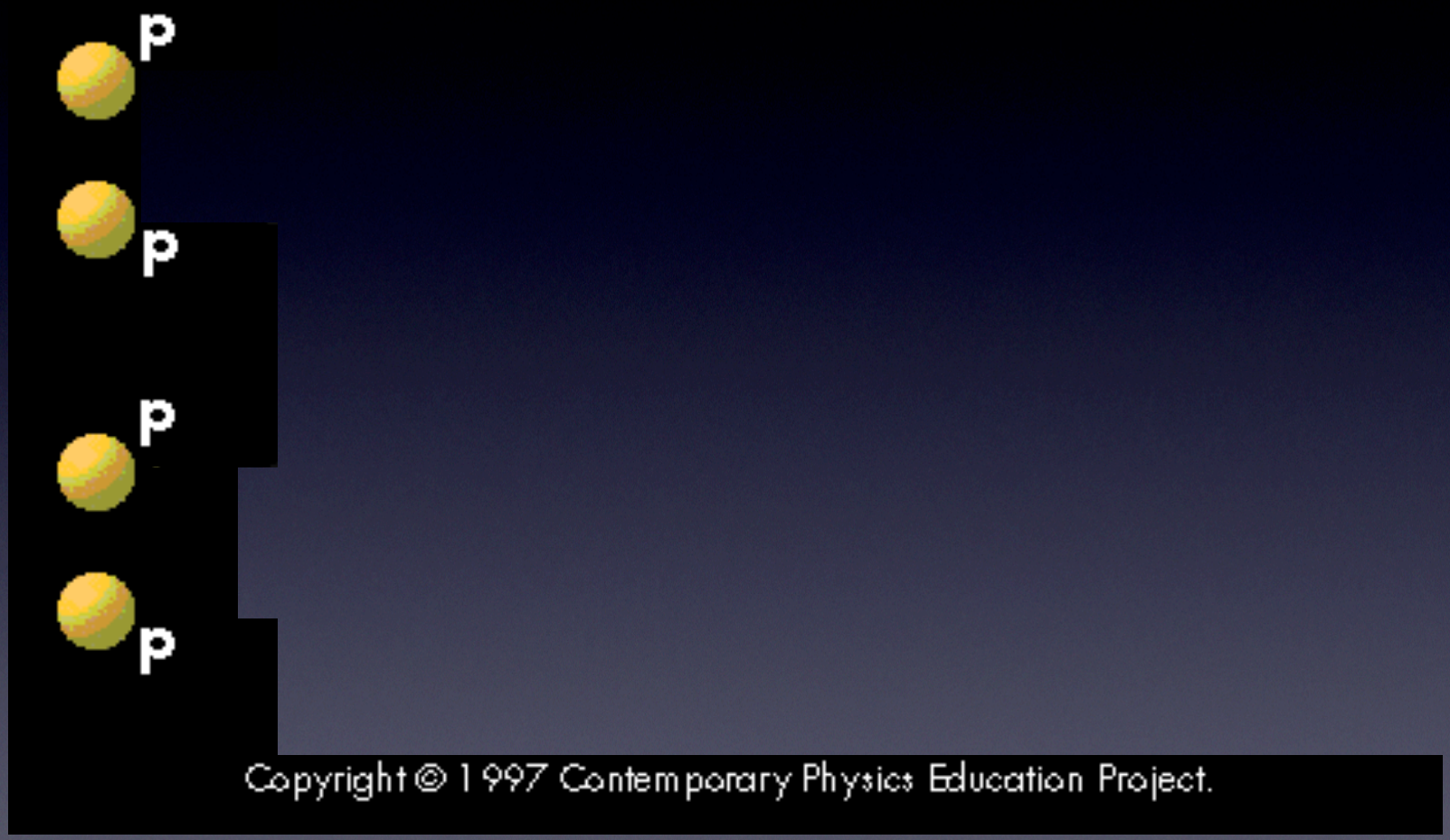
TABLE OF CONTENTS

* Supported in part by the joint program of the Office of Naval Research and the U. S. Atomic Energy Commission.

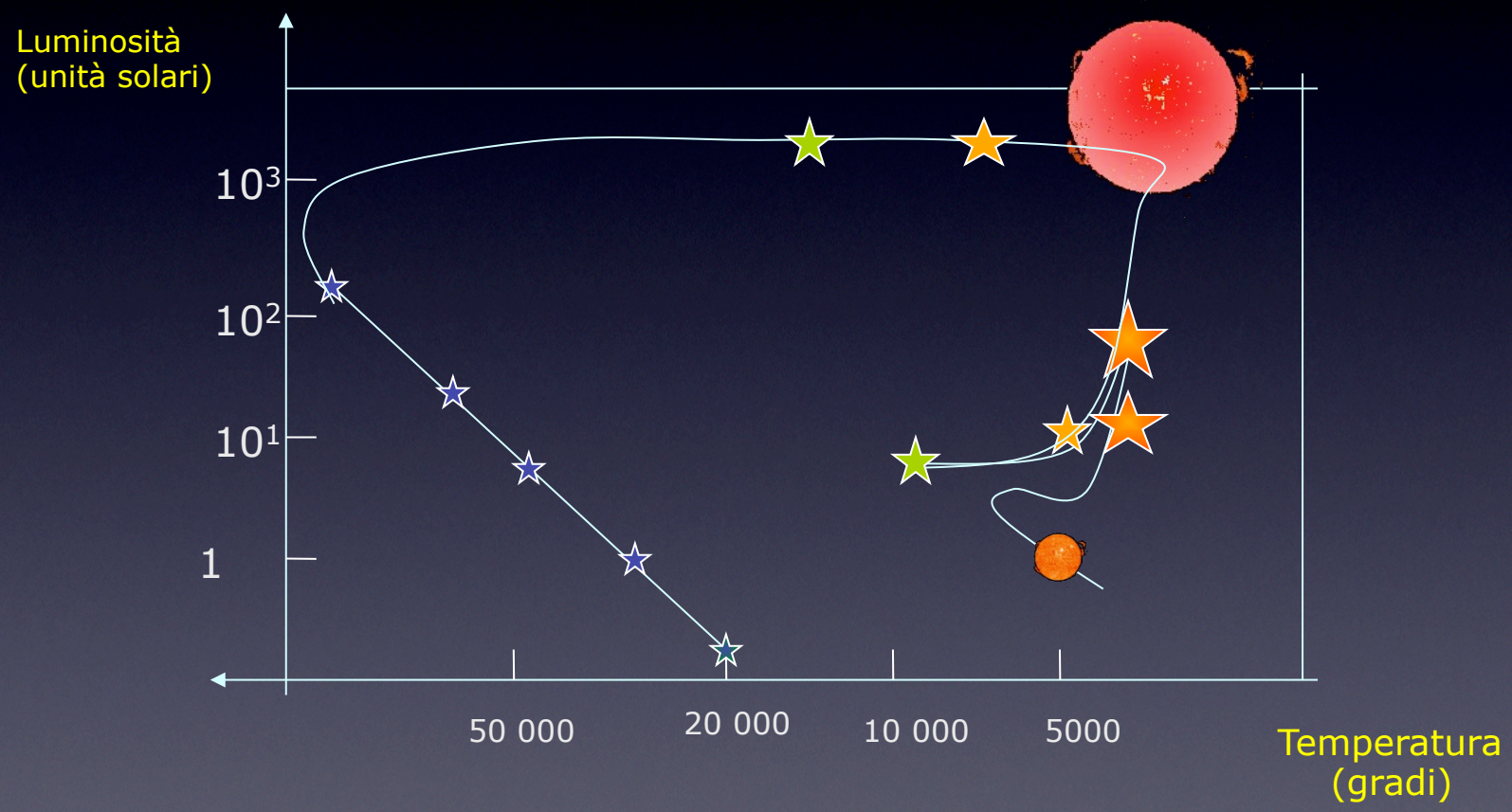
Sono le stelle! le stelle al di sopra di noi che governano la nostra condizione!

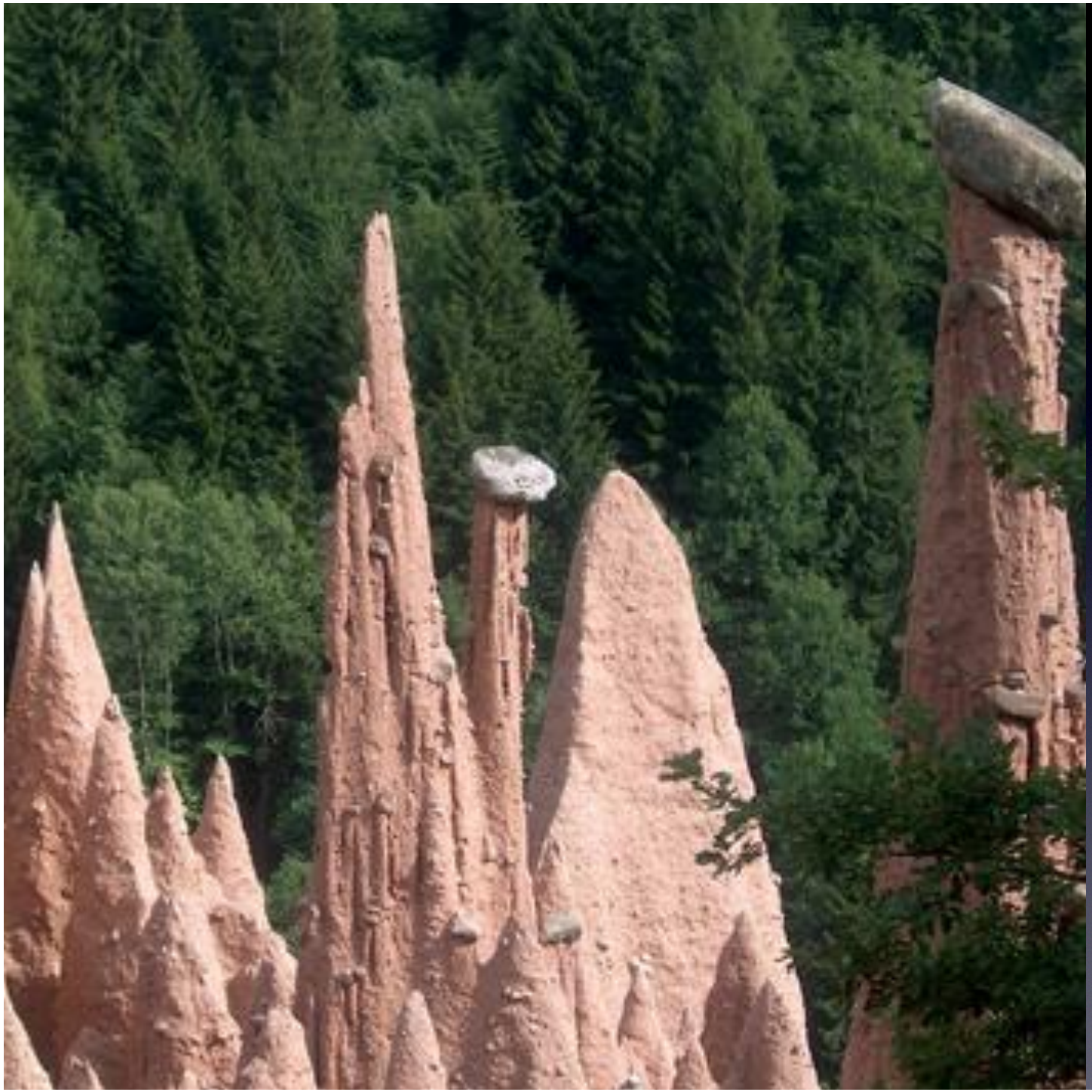
Re Lear atto IV scena III

La catena protone protone



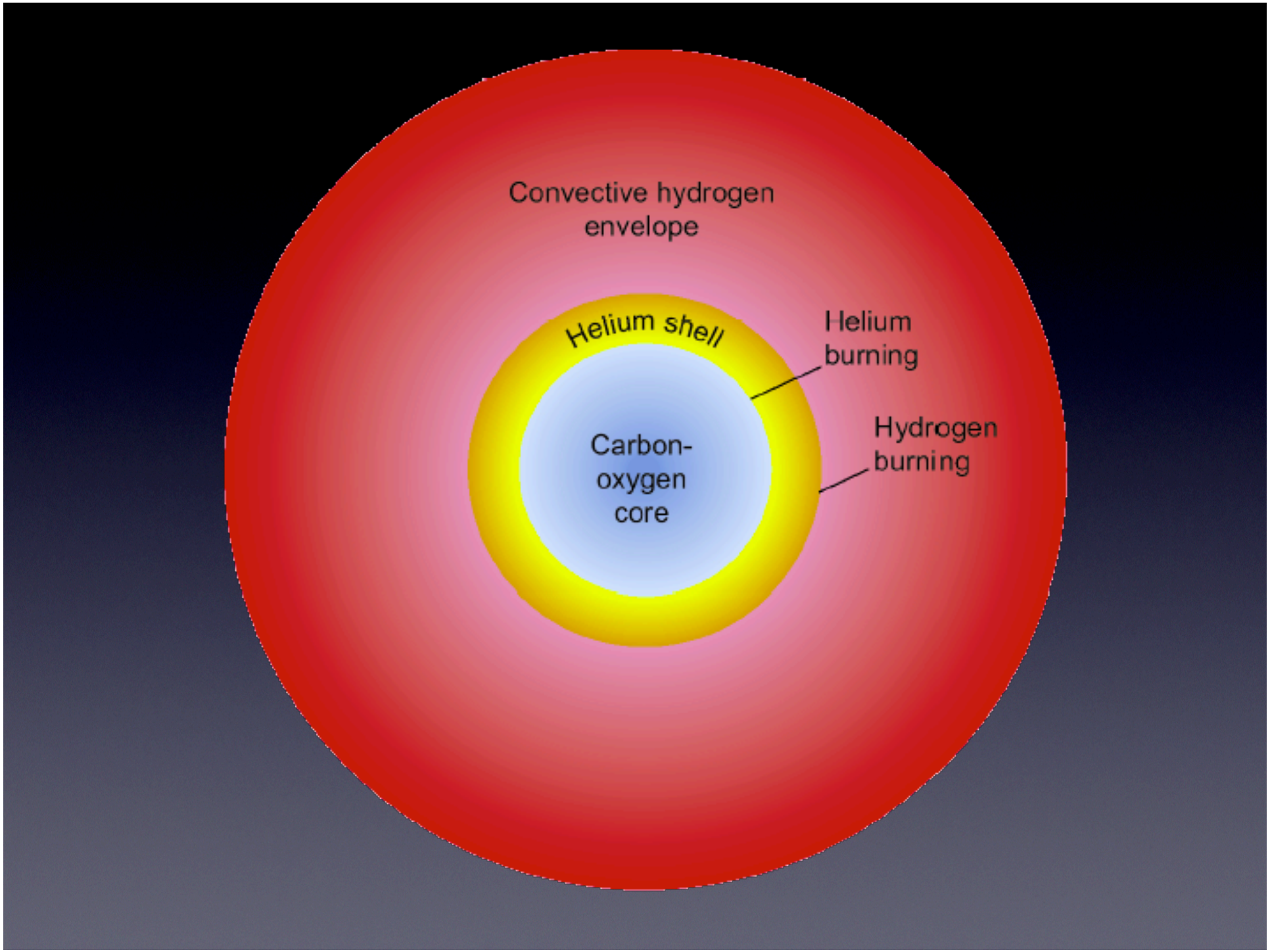
L'evoluzione di una stella come il Sole





Gas diffuso

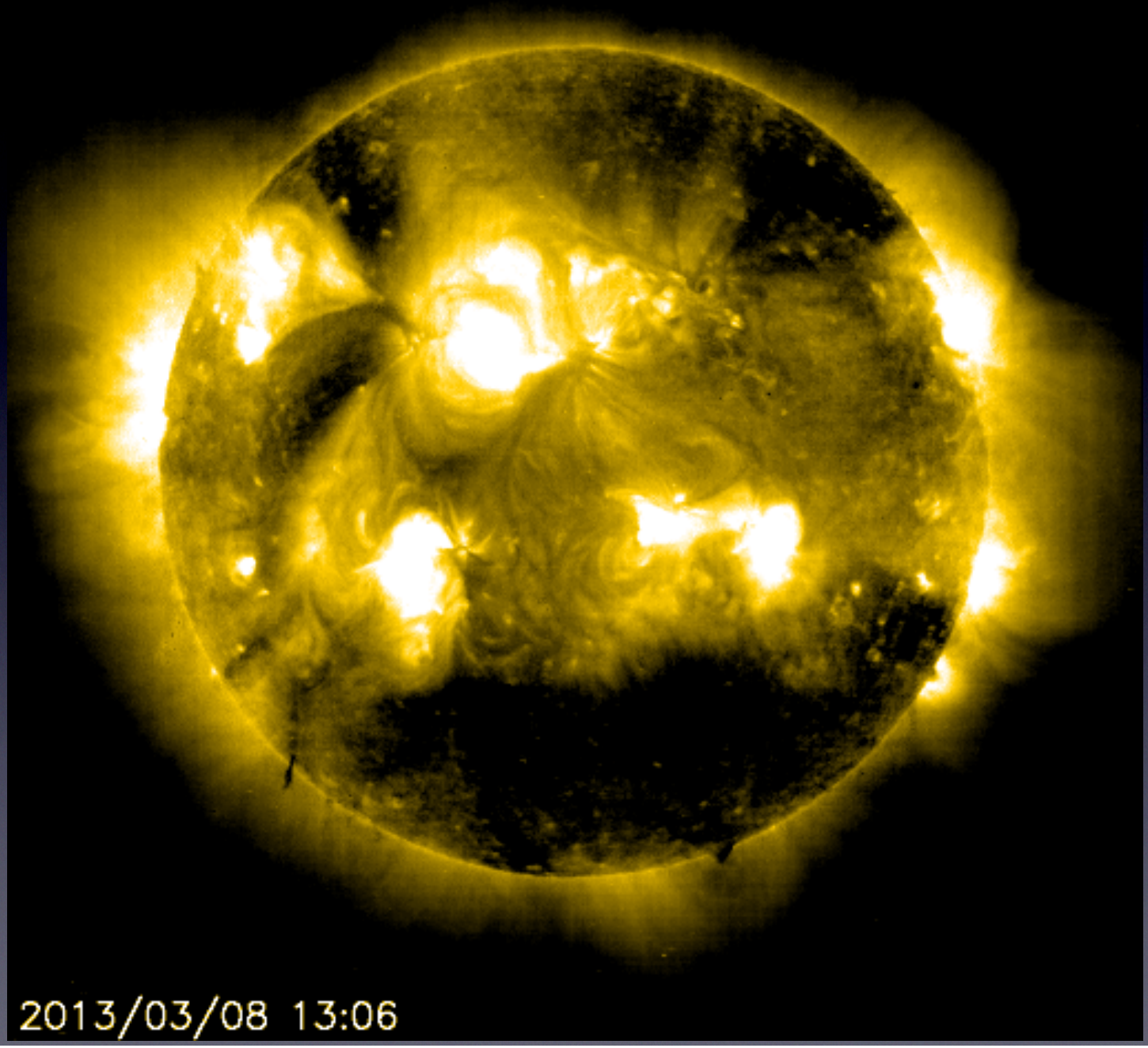
Nubi molecolari


Convective hydrogen envelope
Helium shell
Helium burning
Hydrogen burning
Carbon-oxygen core

La combustione dell'elio

$$^{4}He + {}^{4}He + {}^{4}He \longrightarrow {}^{12}C + luce$$

$$^{4}He + {}^{12}C \longrightarrow {}^{16}O + luce$$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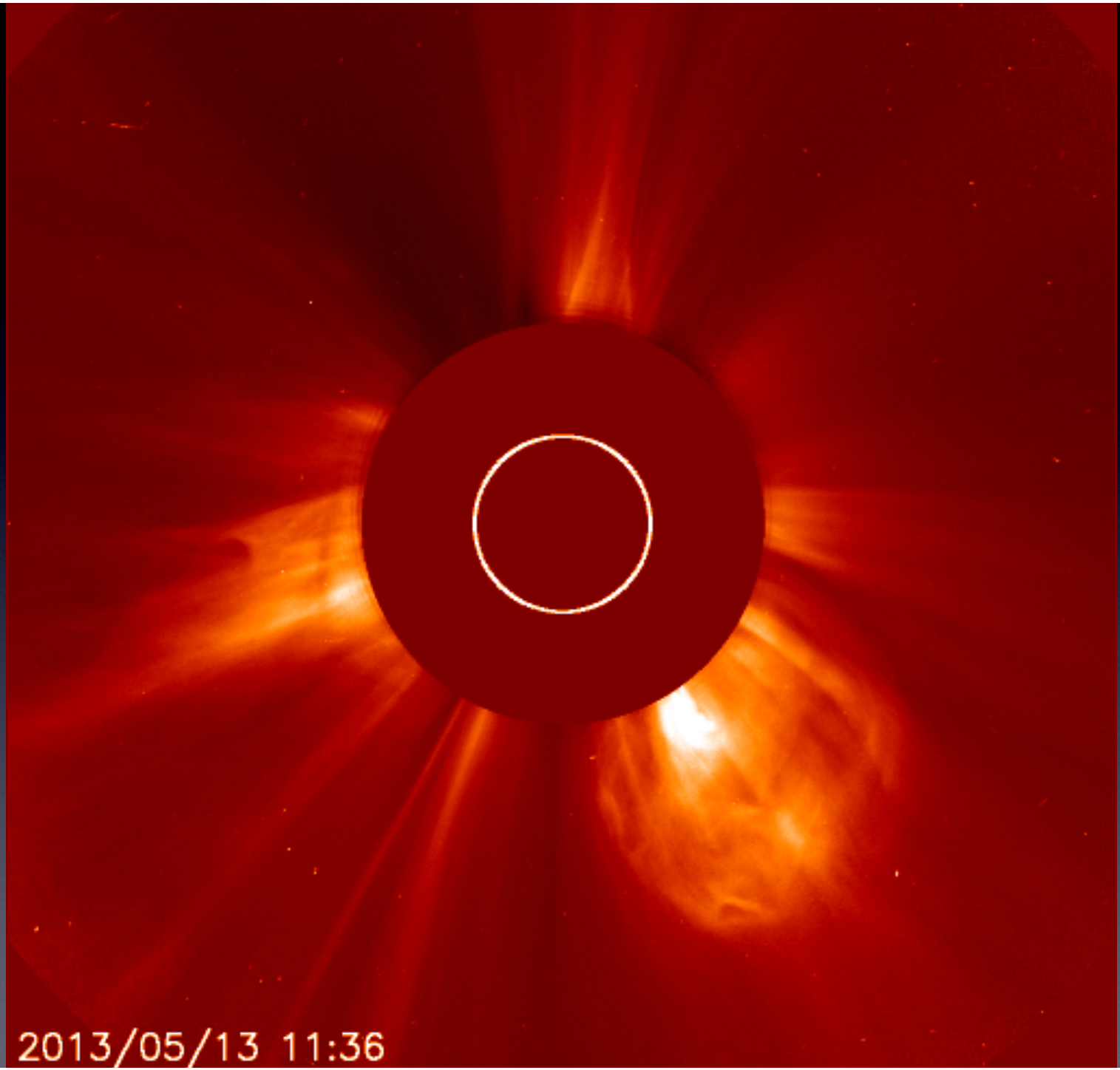
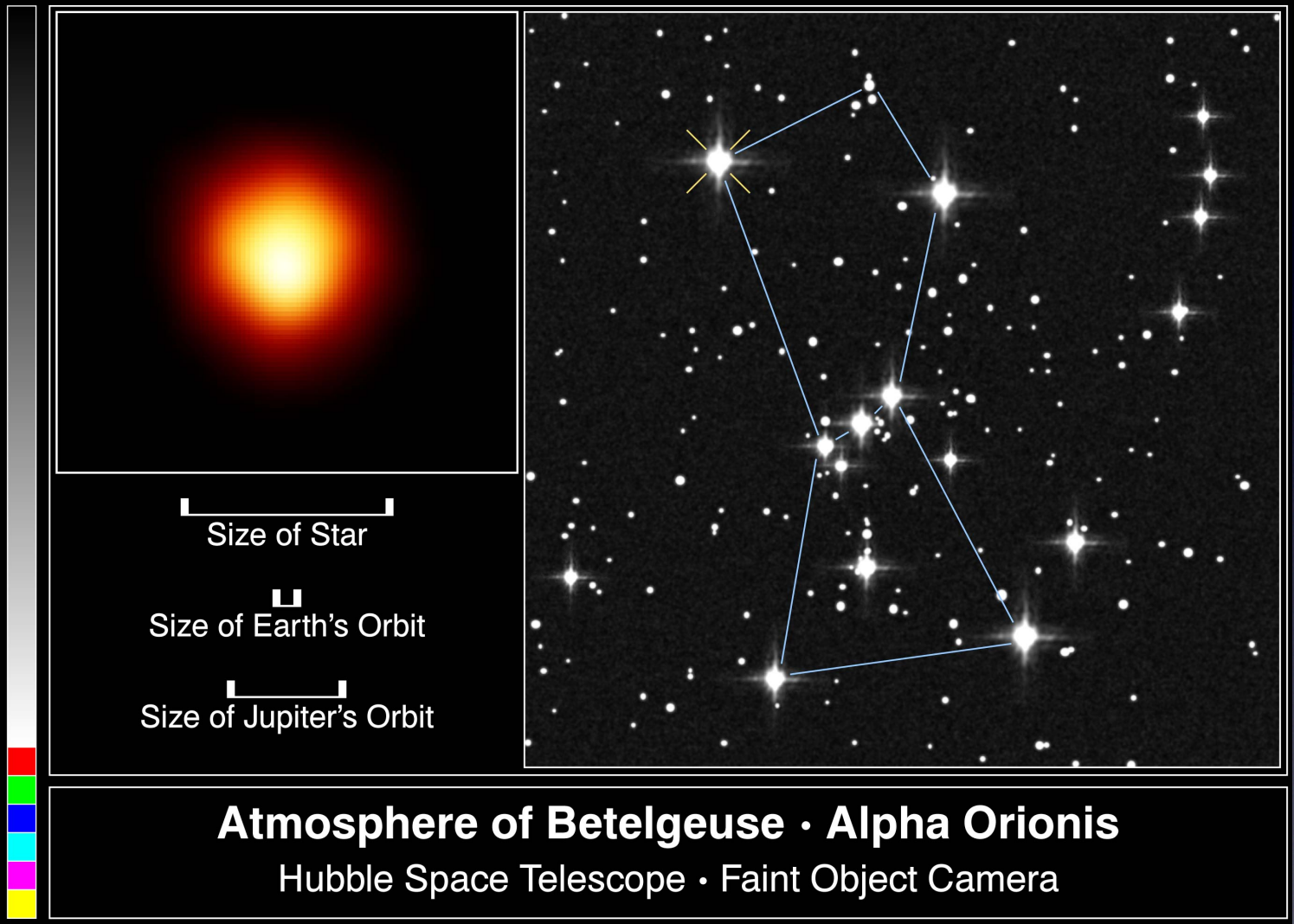
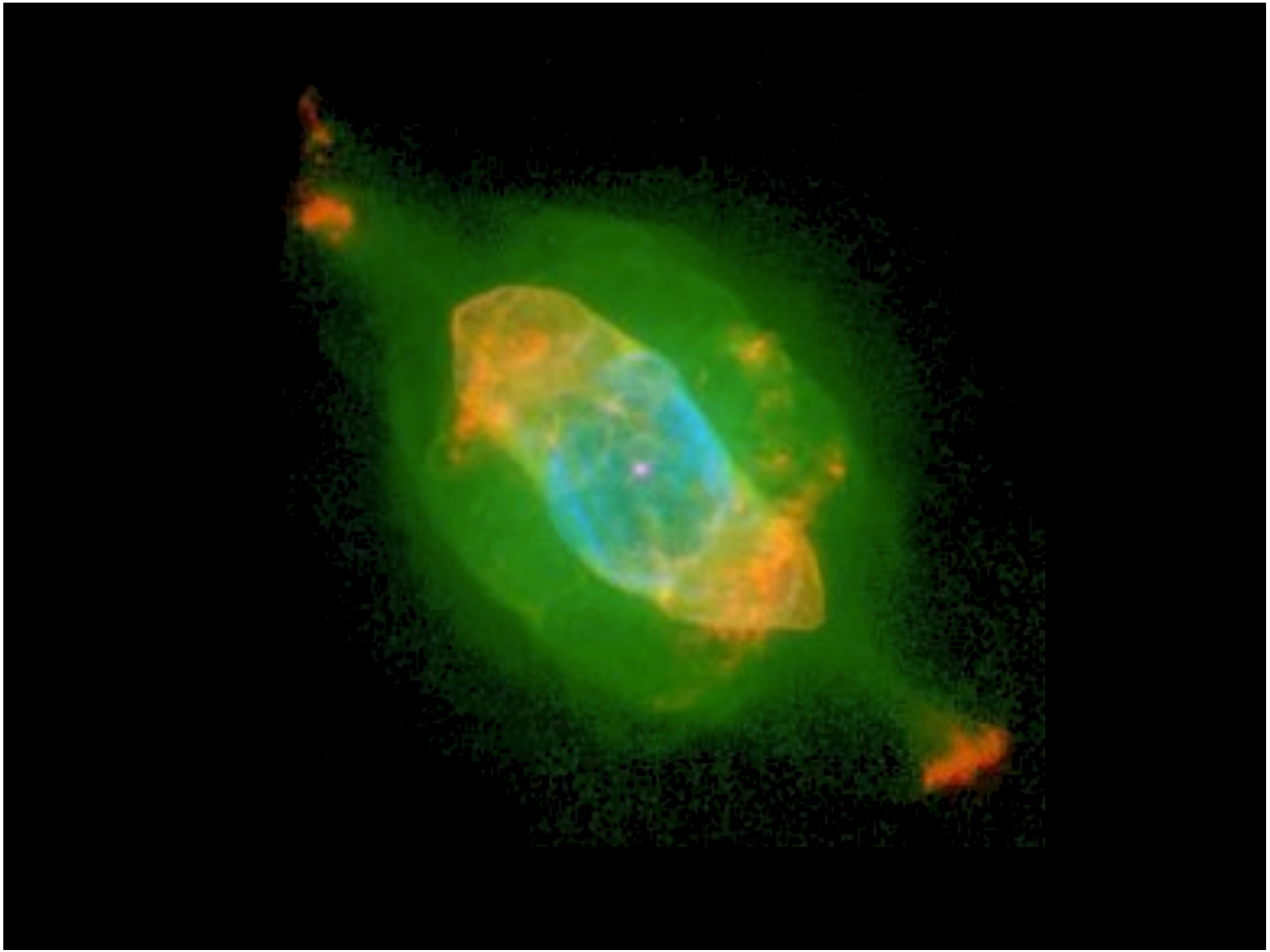
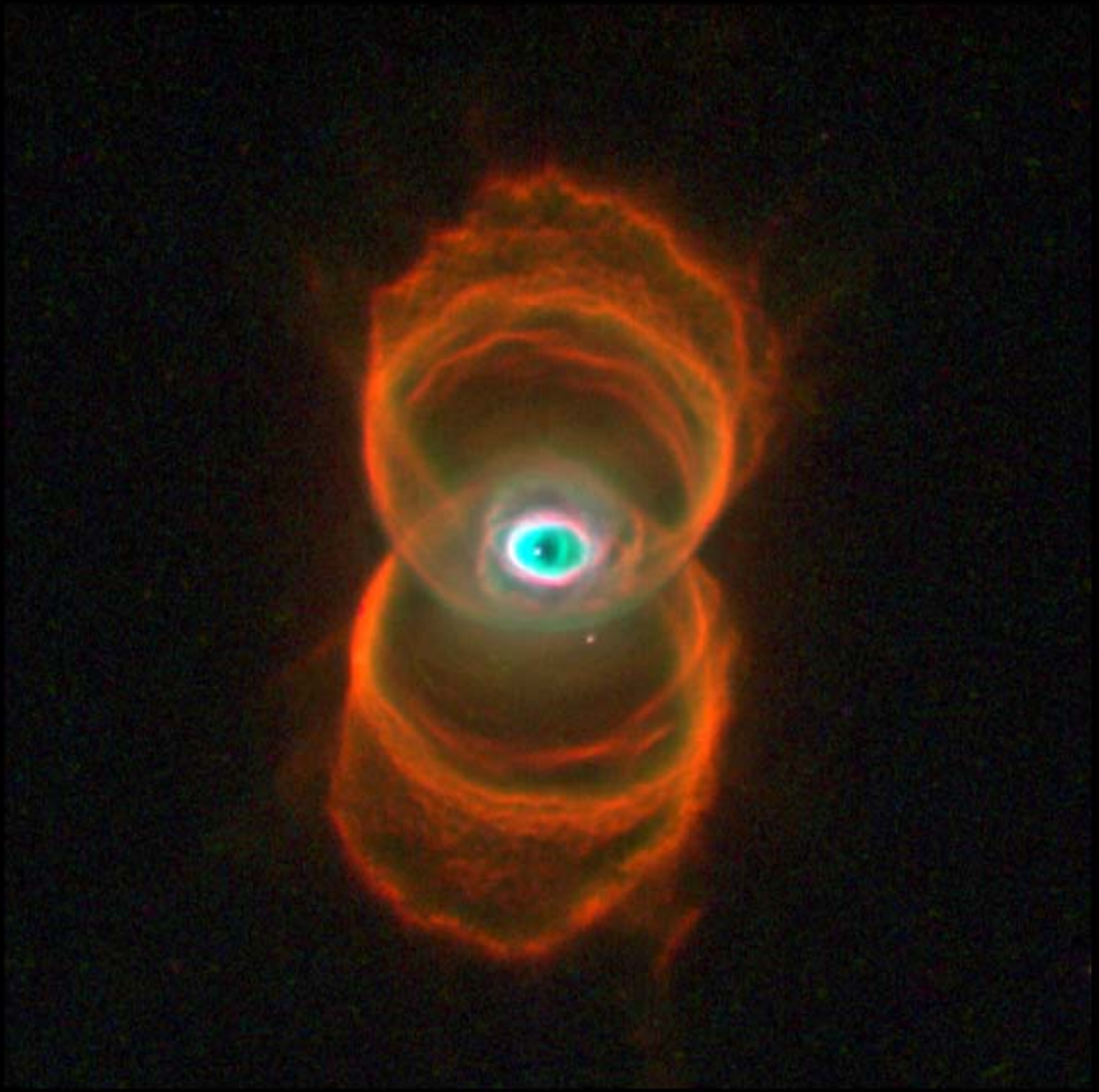

2013/05/13 11:36

Una gigante rossa



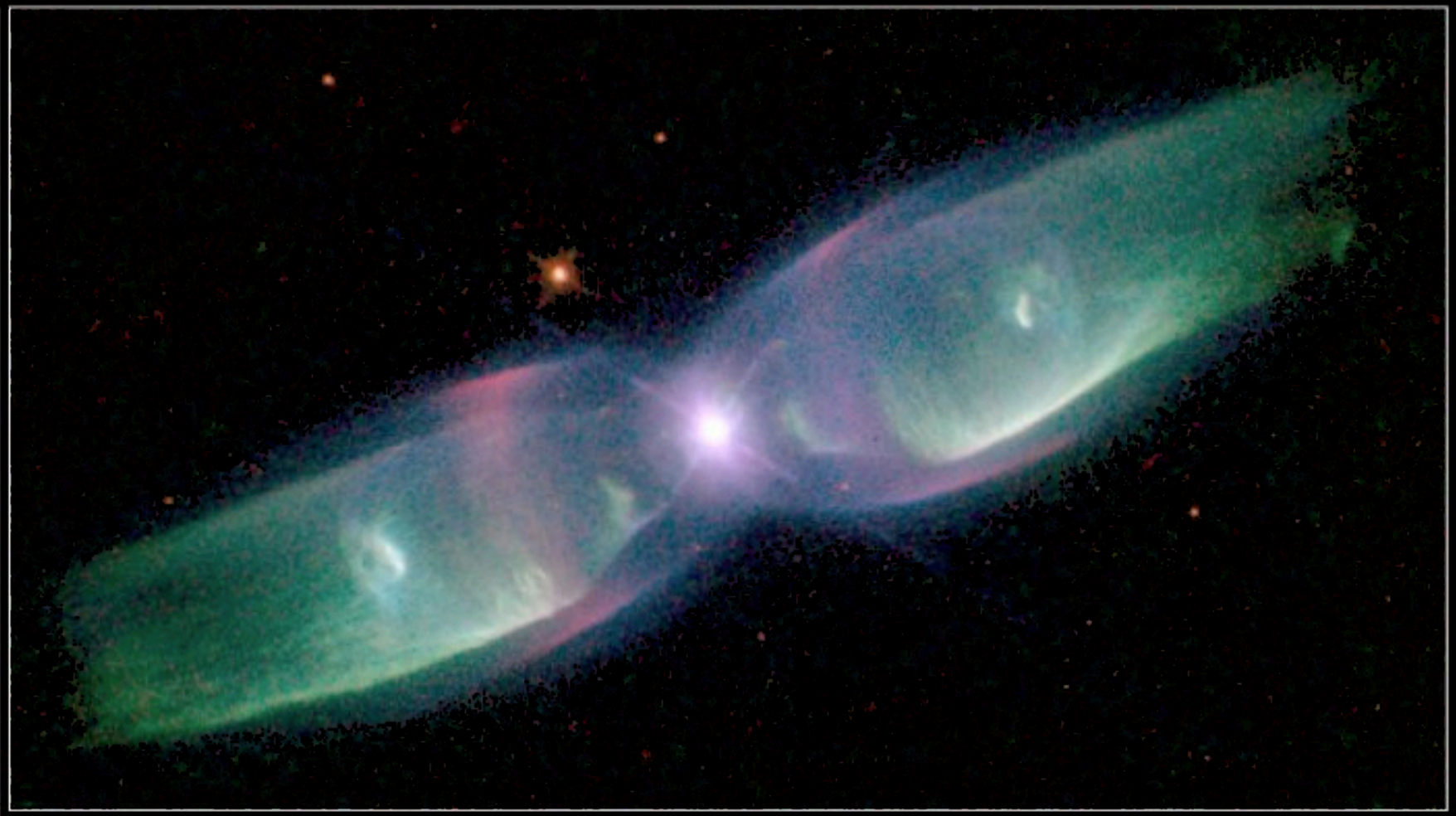




Hourglass Nebula · MyCn18 HST · WFPC2

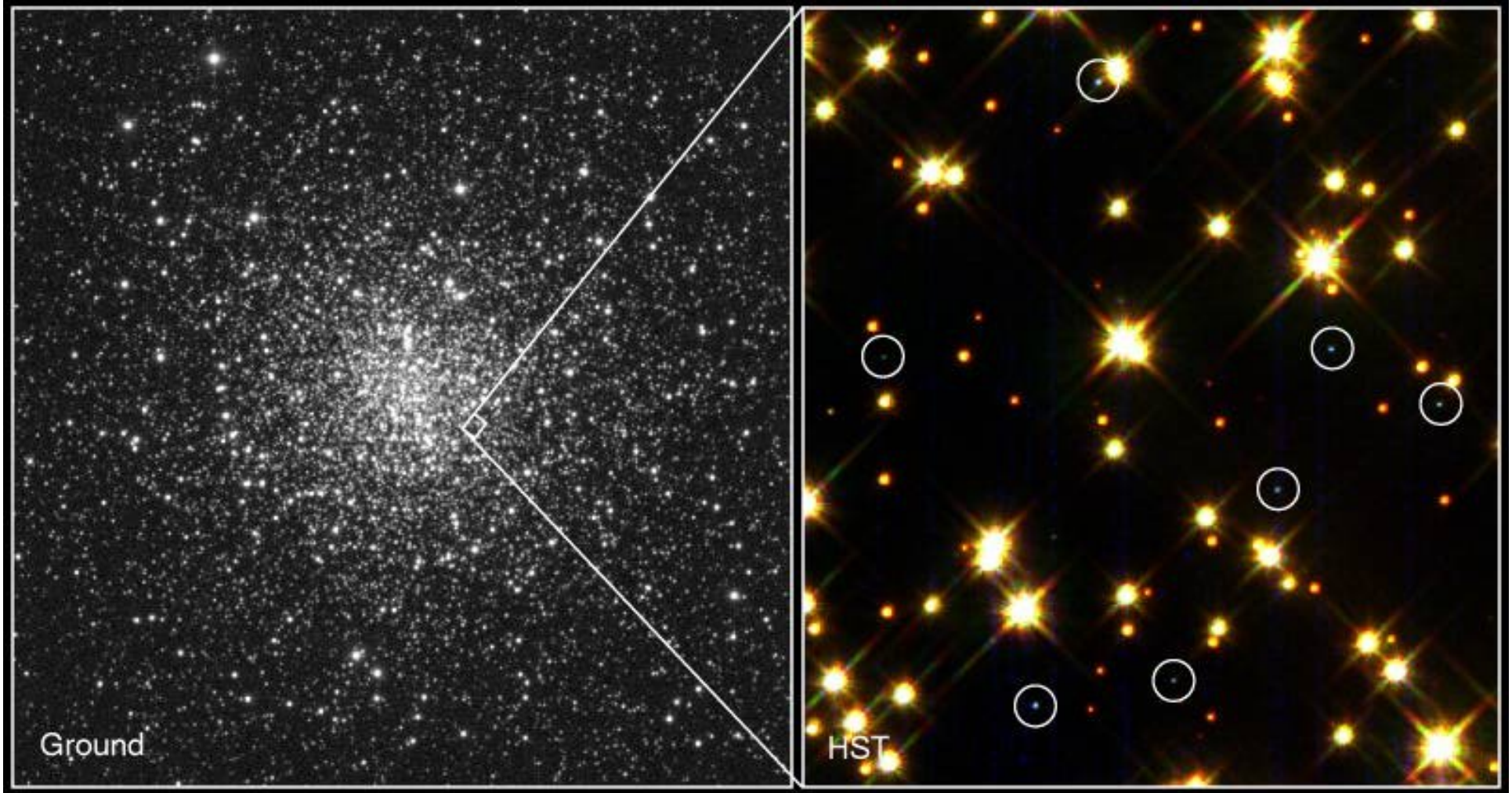
PRC96-07 · ST ScI OPO · January 16, 1996

R. Sahai and J. Trauger (JPL), the WFPC2 Science Team and NASA



Planetary Nebula M2-9
Hubble Space Telescope • WFPC2

PRC97-36a • ST ScI OPO • December 17, 1997 • B. Balick (University of Washington) and NASA



White Dwarf Stars in M4

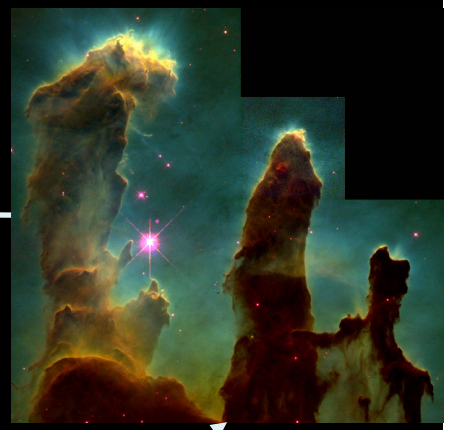
HST • WFPC2

PRC95-32 · ST ScI OPO · August 28, 1995 · H. Bond (ST ScI), NASA

L'evoluzione del Sole

Gigante rossa

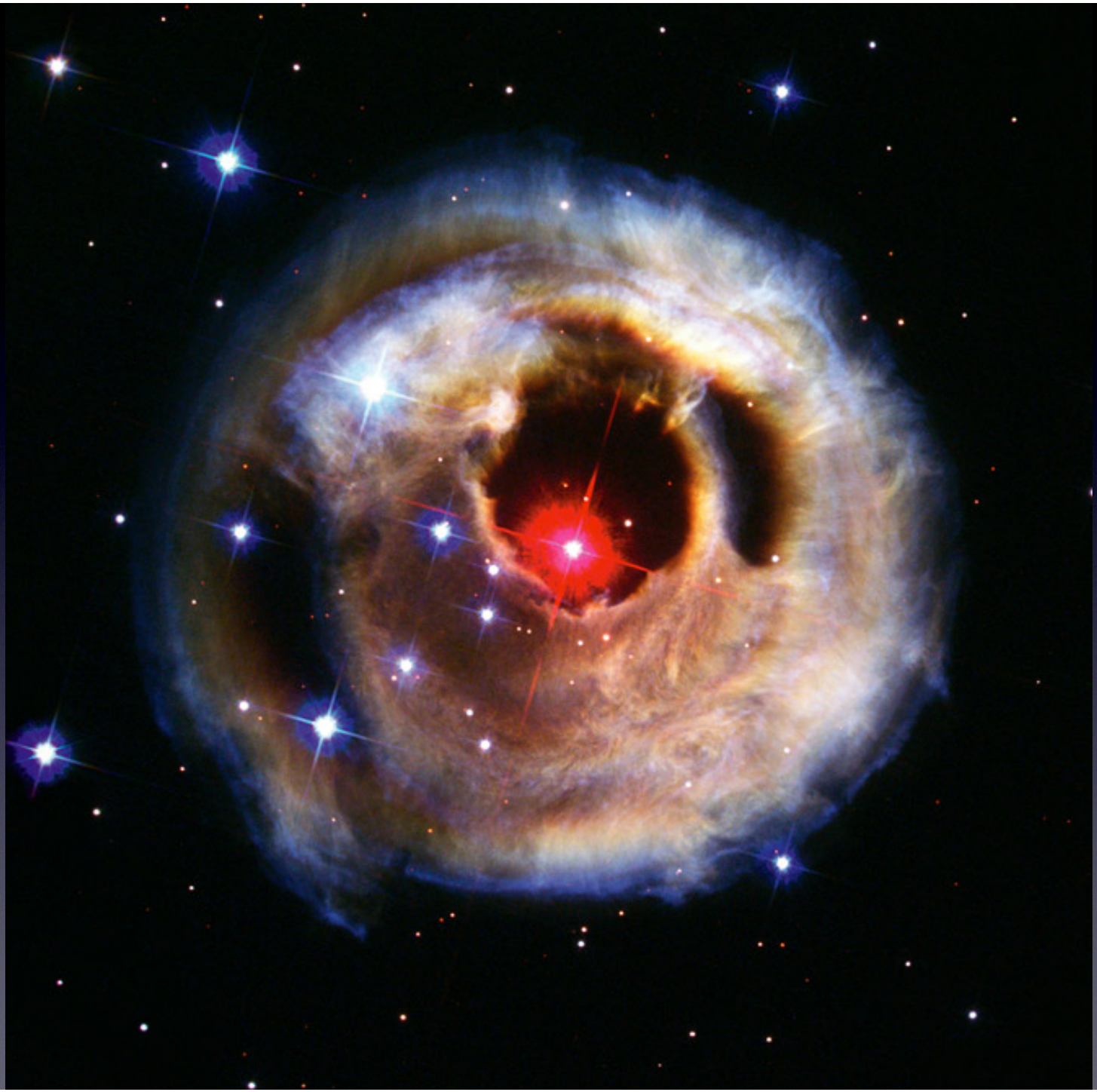
Sequenza principale



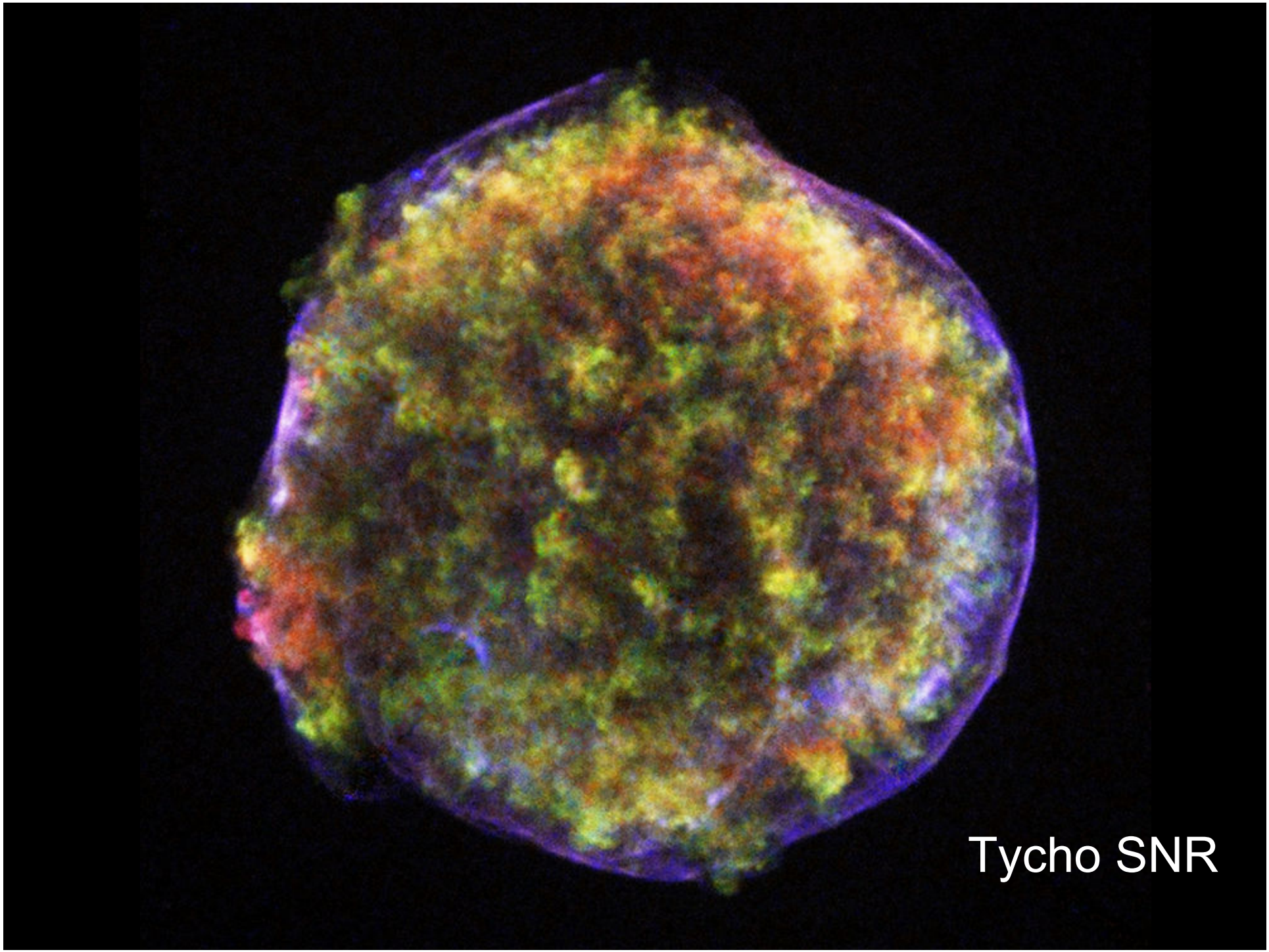
Vita media del processo
10 miliardi di anni = 70% età Universo

Nebulosa planetaria

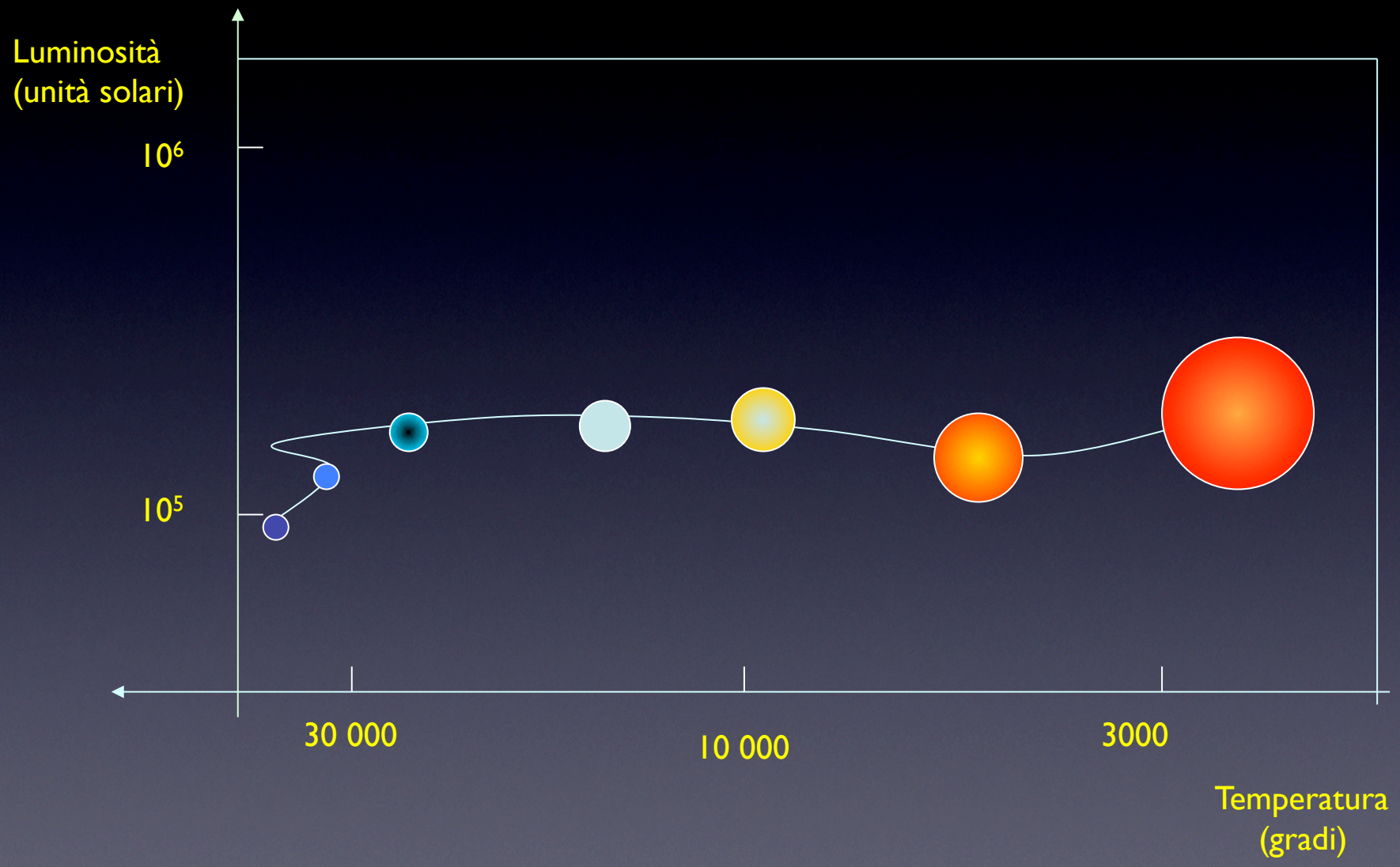
Nana bianca

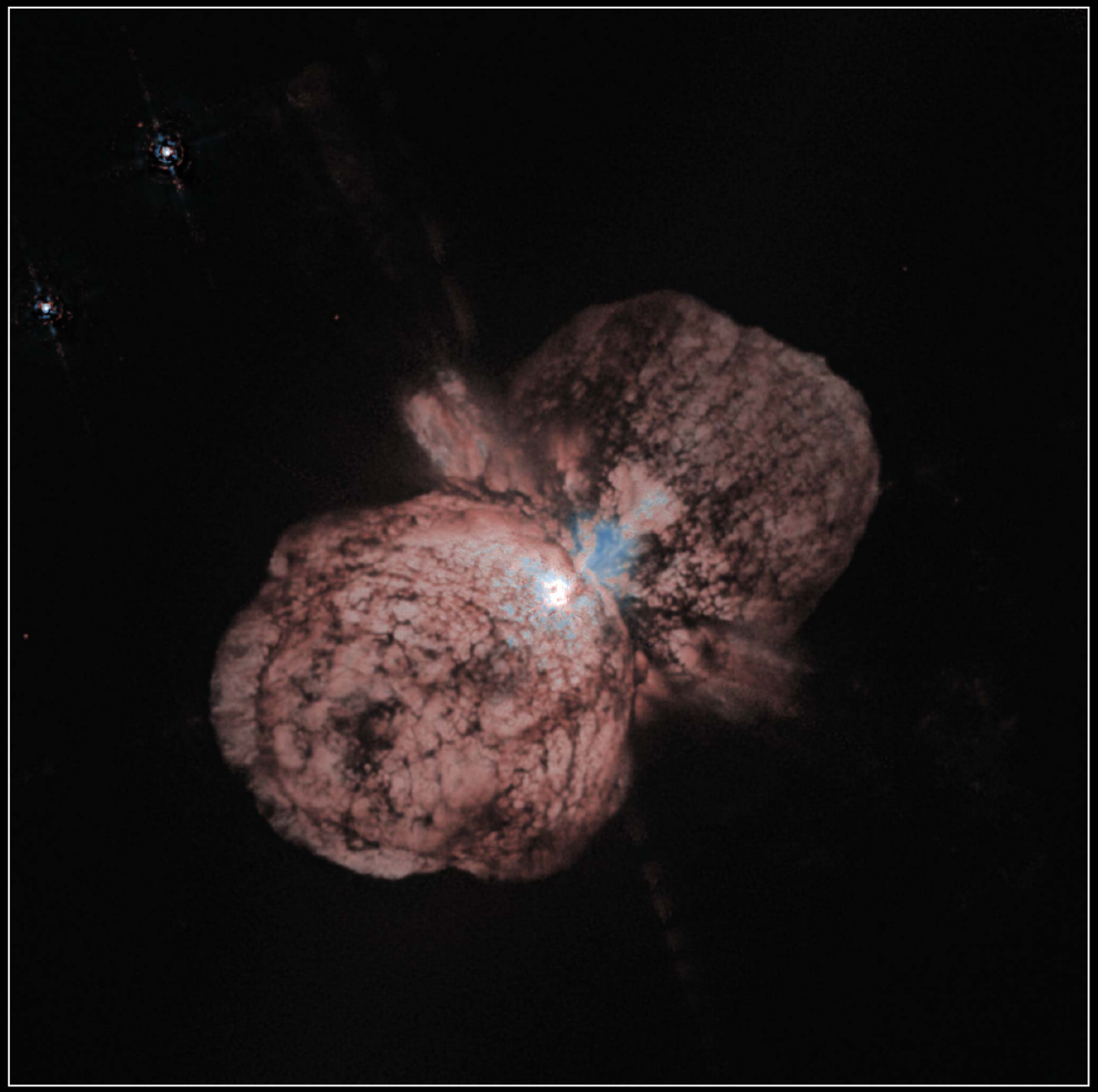



SN 185
3300 anni luce
direz Alfa Cen
SN Ia


Tycho SNR

L'evoluzione di una stella di 25 masse solari

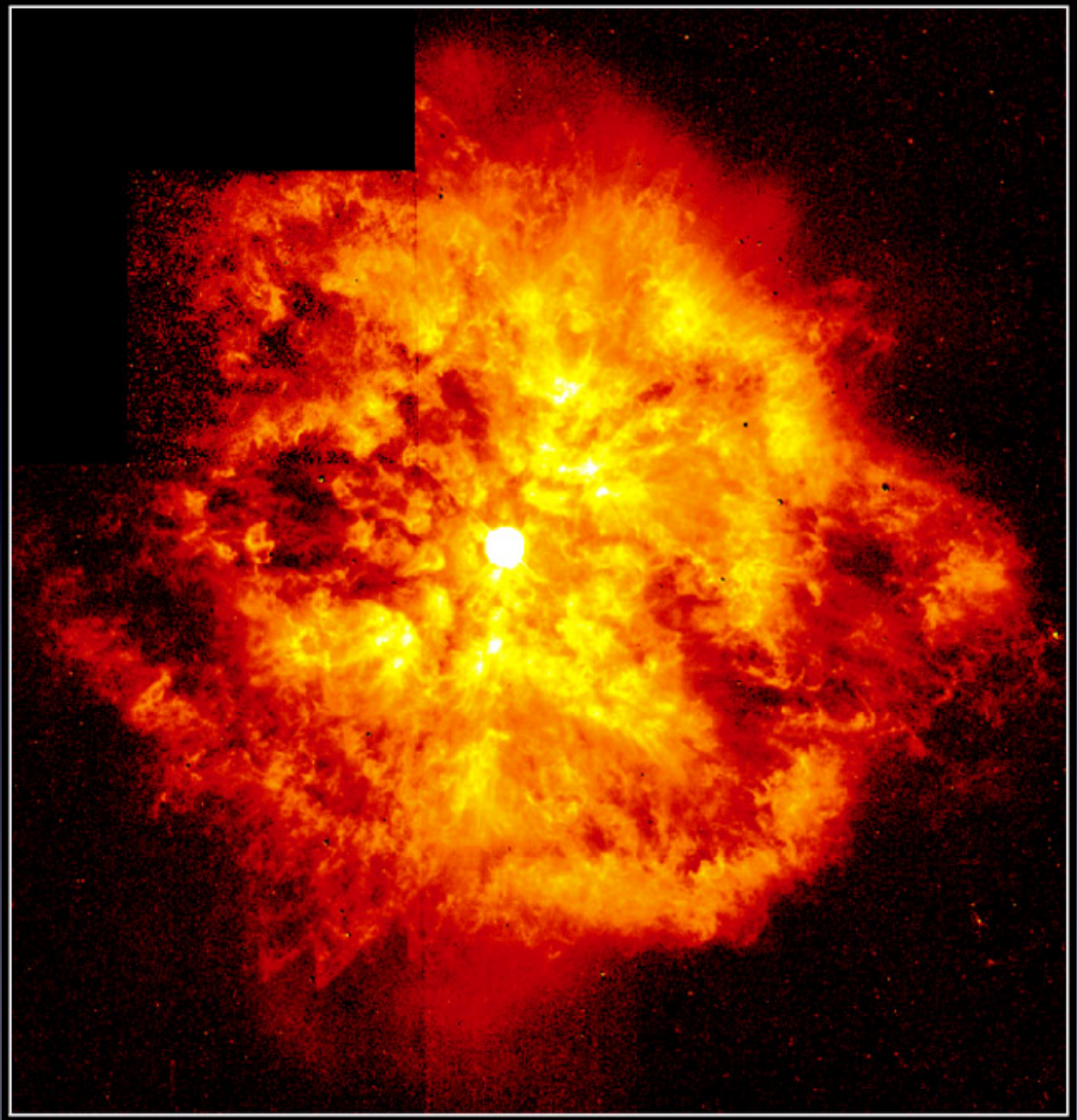




Eta Carinae

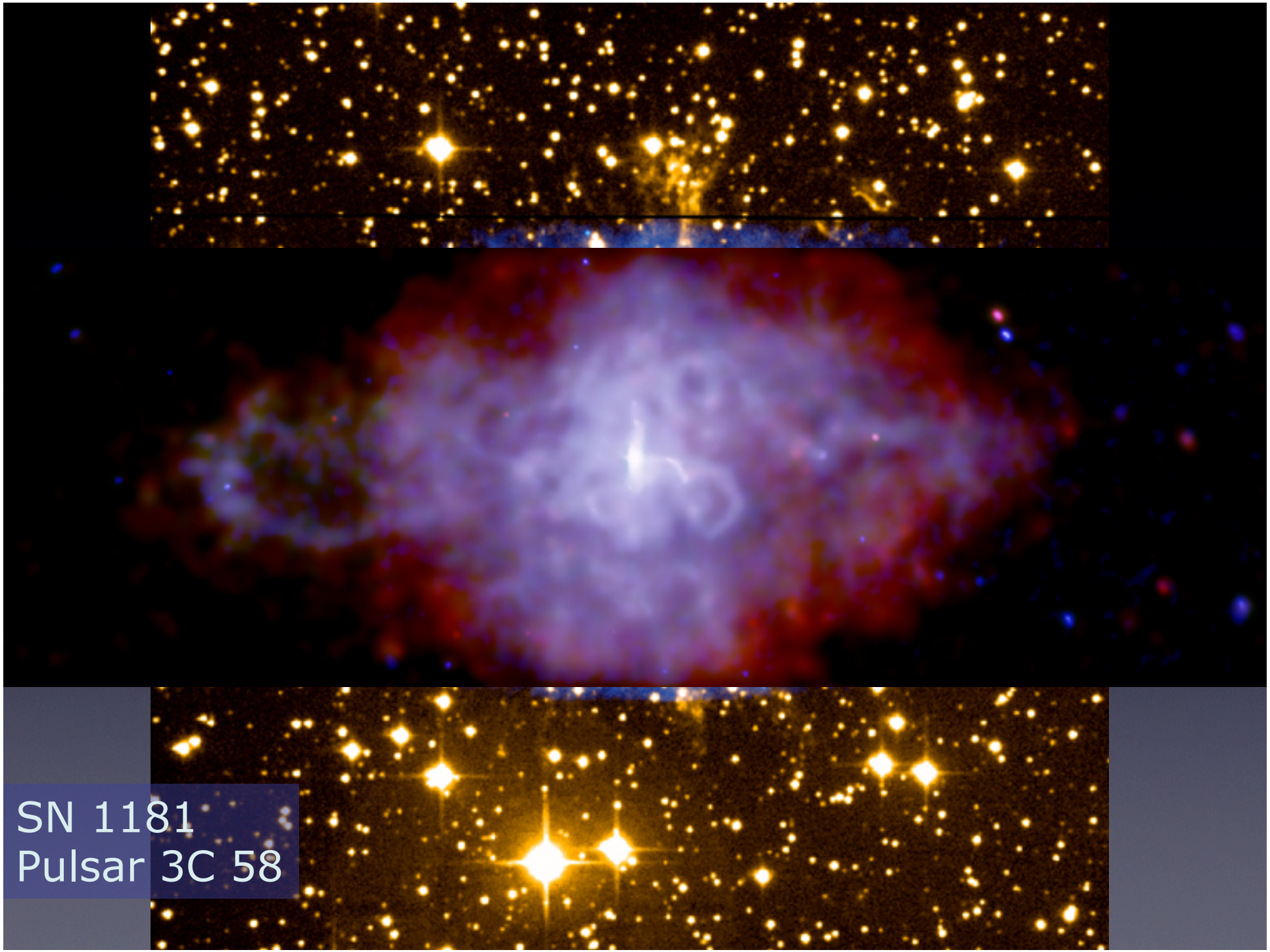
Hubble Space Telescope • WFPC2

PRC96-23a • ST ScI OPO • June 10, 1996 • J. Morse (U. CO), K. Davidson (U. MN) and NASA

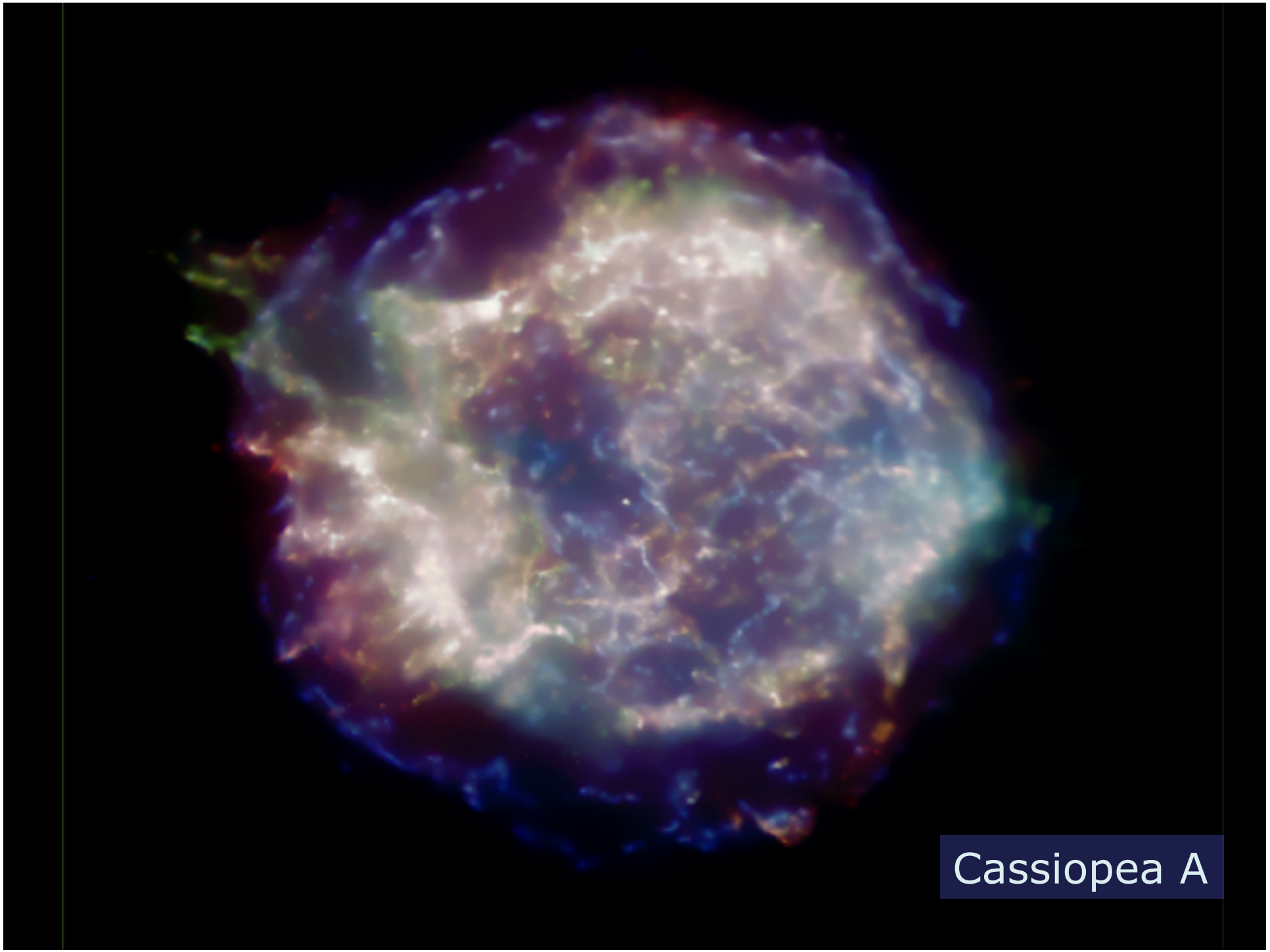


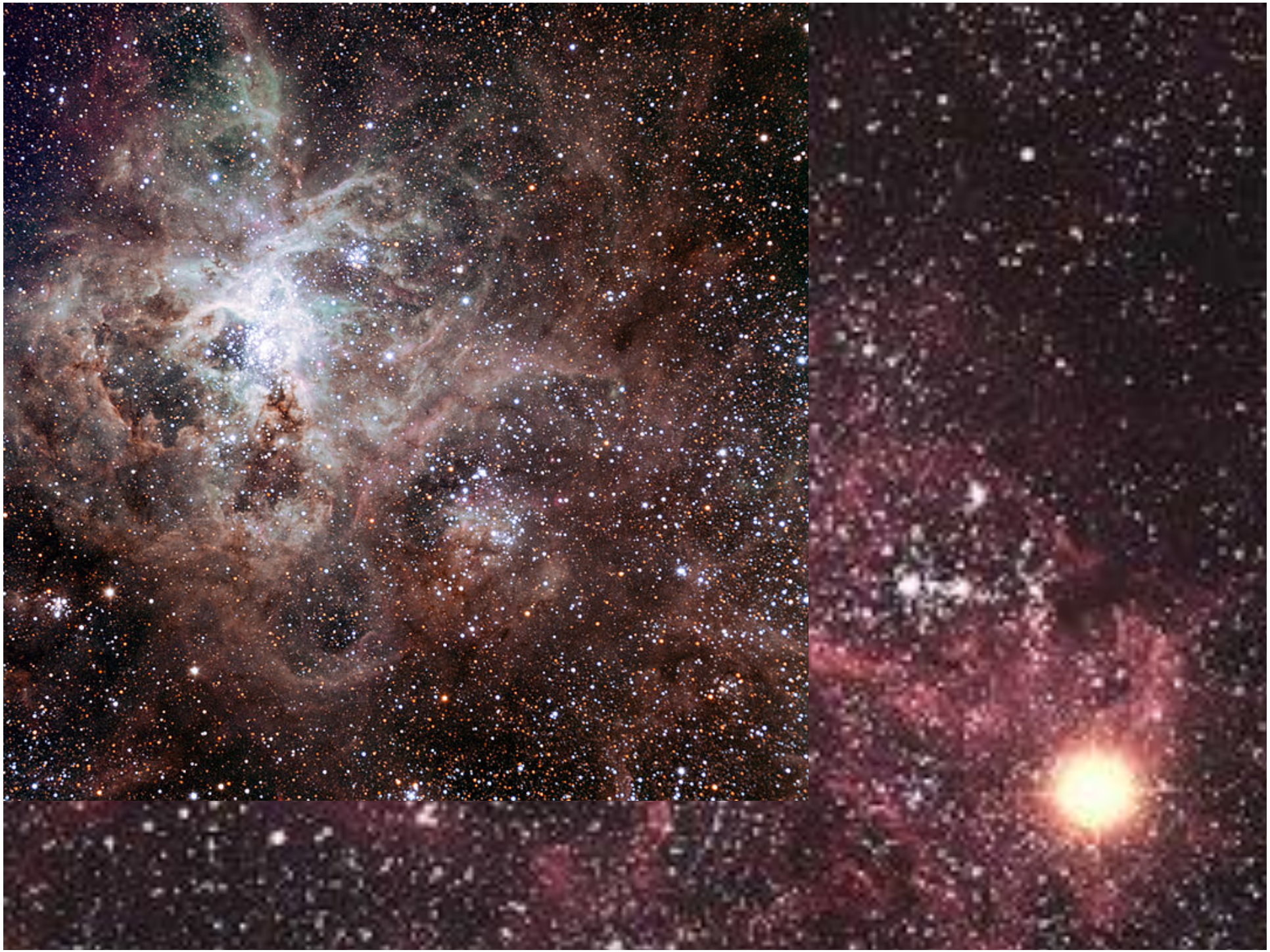
Nebula M1-67 around Star Wr224 **HST • WFPC2**

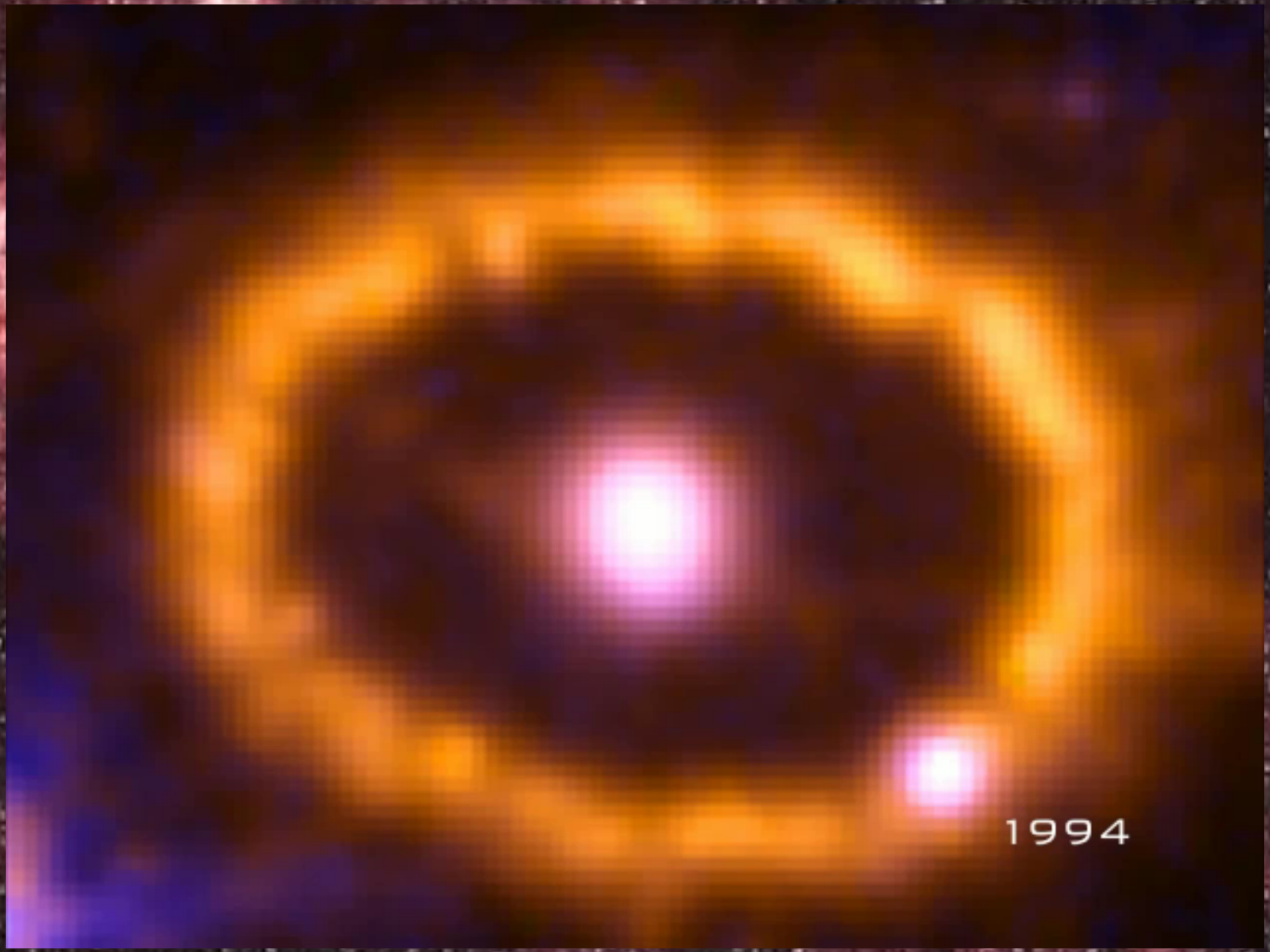
PRC98-38 • STScI OPO • November 3, 1998 • NASA


SN 1181
Pulsar 3C 58

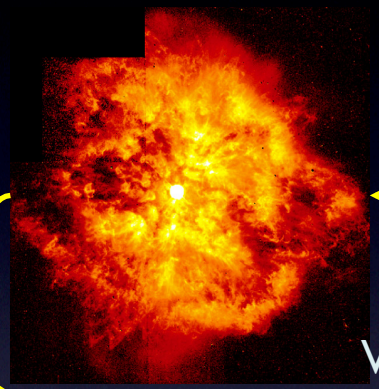

SN 1054
Nebulosa Granchio

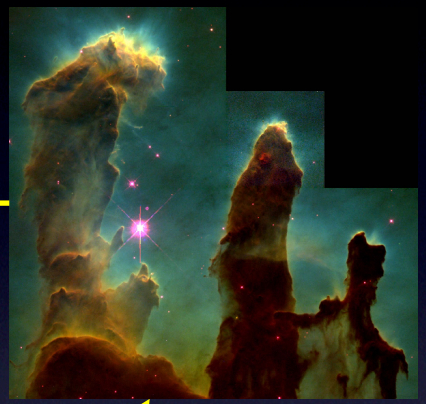

Cassiopea A



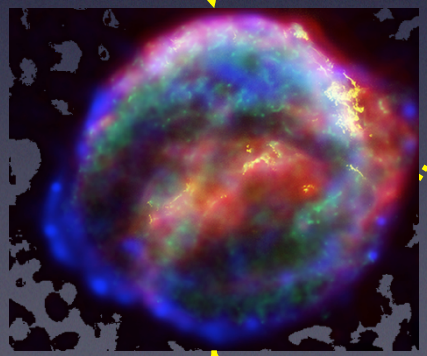

1994

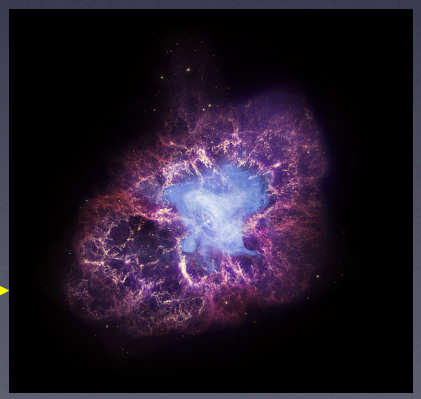
L'evoluzione di una stella di massa pari a 25 soli

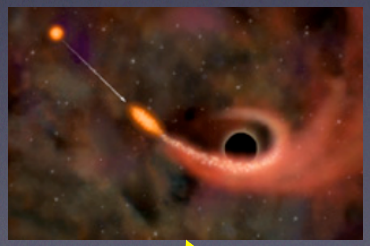




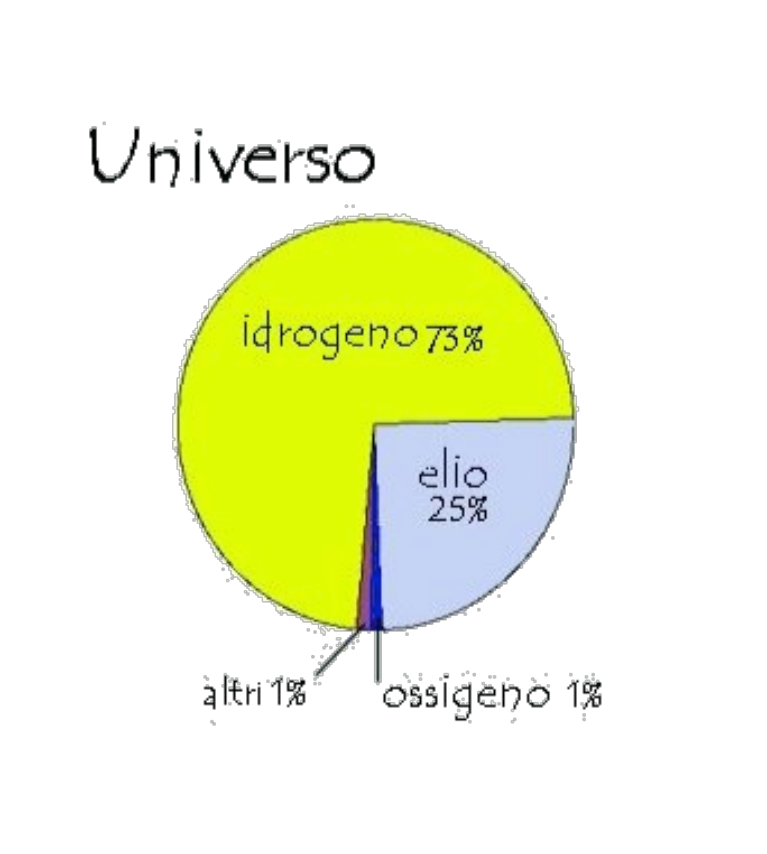
Vita media del processo
25 milioni di anni = 0,2% età Universo





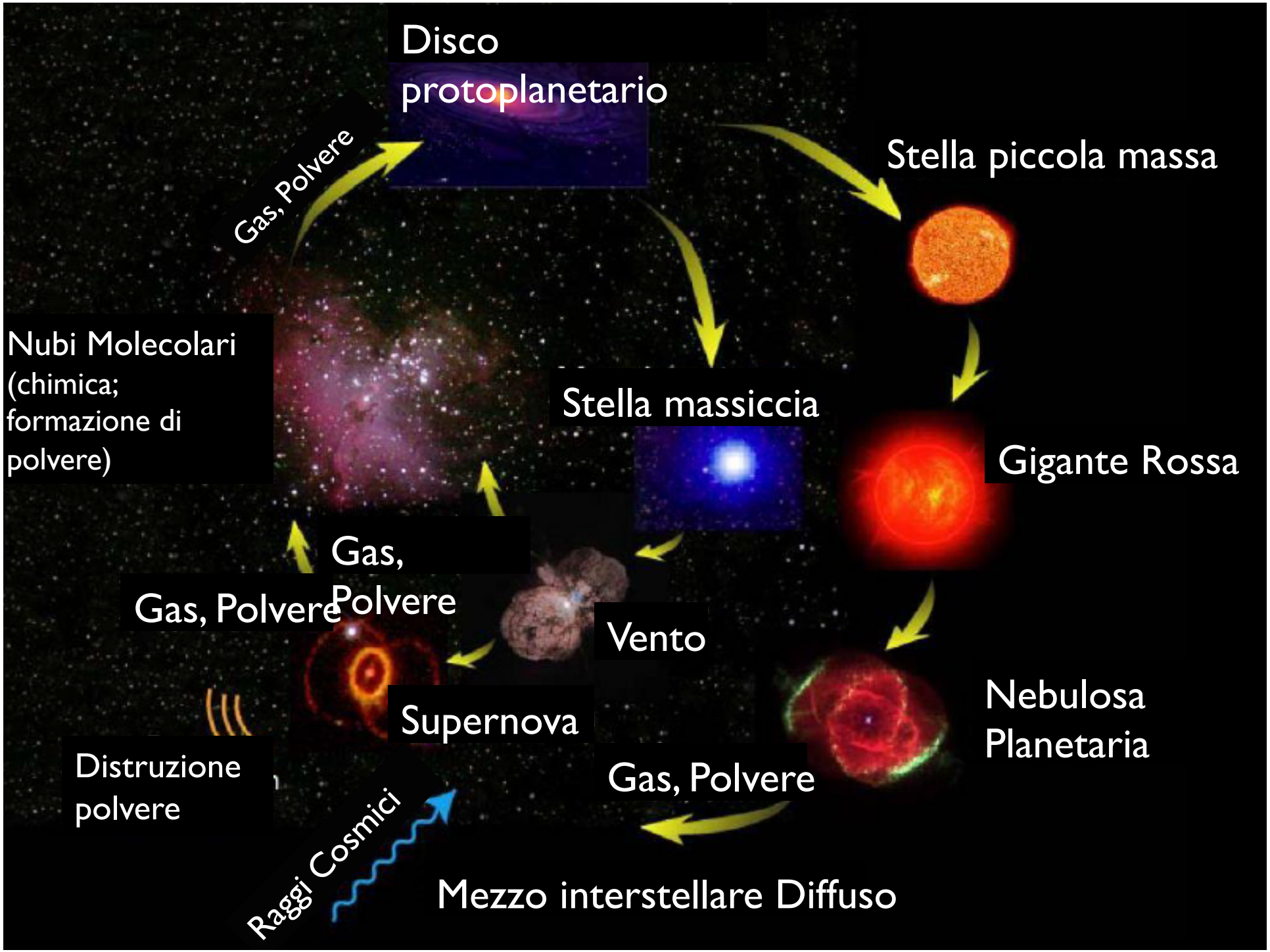


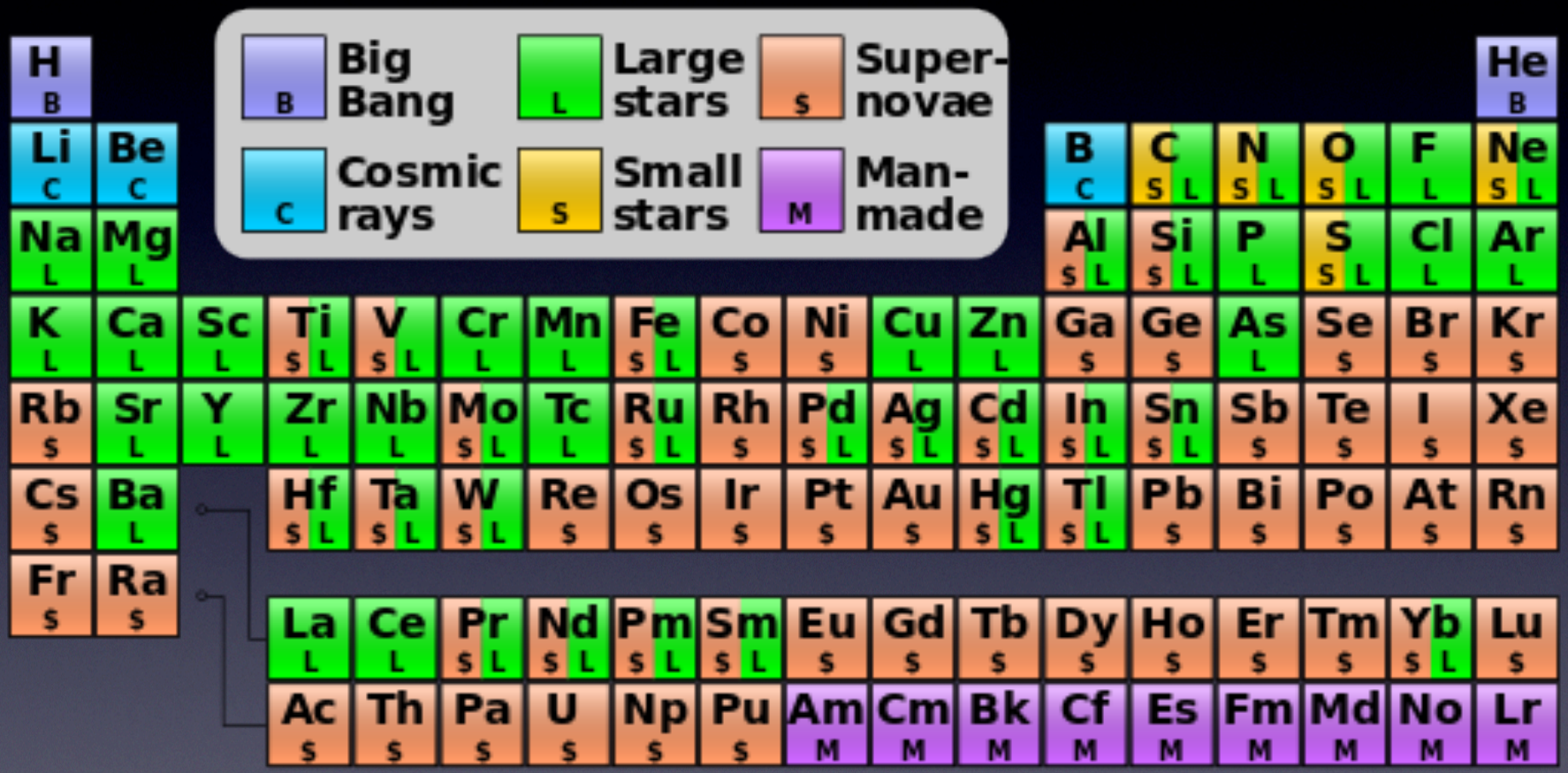

PARTENZA (VITA)
10 MILIARDI di ANNI
ARRIVO (MORTE)
ARRIVO (MORTE)
25 MILIONI di ANNI


Universo
idrogeno 73%
elio 25%
altri 1%
ossigeno 1%

Acqua ~ 90%


40 Kg
30 Kg
26 Kg OSSIGENO
7 Kg CARBONIO
4 Kg IDROGENO
4 gr FERRO
6 hg CALCIO
19,5 Kg OSSIGENO
5 Kg CARBONIO
3 Kg IDROGENO
4 gr FERRO
5 hg CALCIO
2


Disco protoplanetario
Gas, Polvere
Stella piccola massa
Nubi Molecolari (chimica; formazione di polvere)
Stella massiccia
Gigante Rossa
Gas, Polvere
Gas, Polvere
Vento
Supernova
Nebulosa Planetaria
Distruzione polvere
Gas, Polvere
Raggi Cosmici
Mezzo interstellare Diffuso



by Cmglee - Own work

Così si determina la presenza delle molecole

I "codici a barre" degli elementi e delle molecole

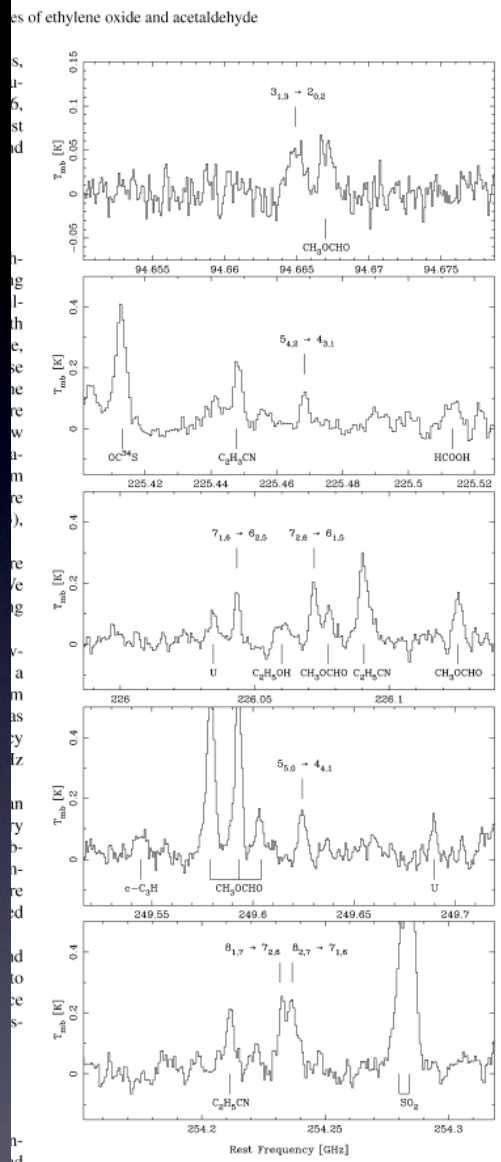


Fig. 1. Spectra towards NGC 6334F, with all seven detected c-C_2H_4O transitions indicated with their quantum numbers. Spectral lines of other molecules are labelled with the relevant species. The rest frequency scale is based on $V_{LSR} = -7$ km s^{-1}.

ovided by the NASA Astrophysics Data System

Nummelin et al 1998

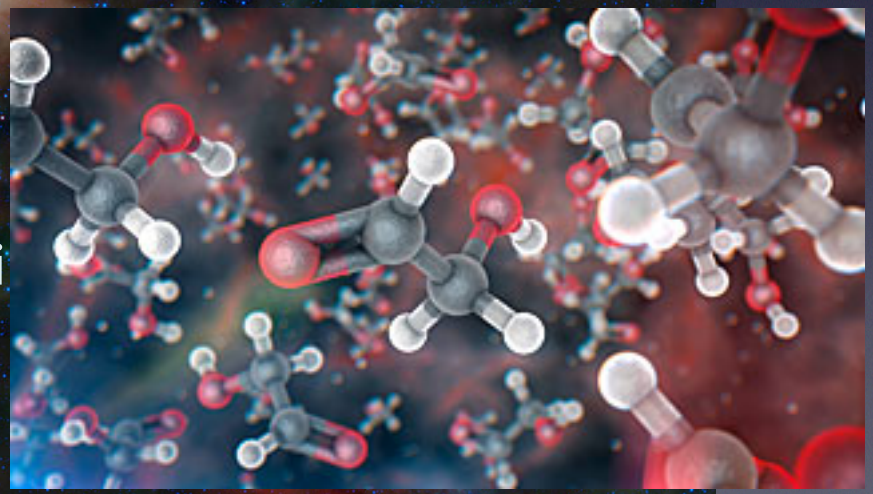
Il telescopio ALMA

Un “dolce” risultato per ALMA

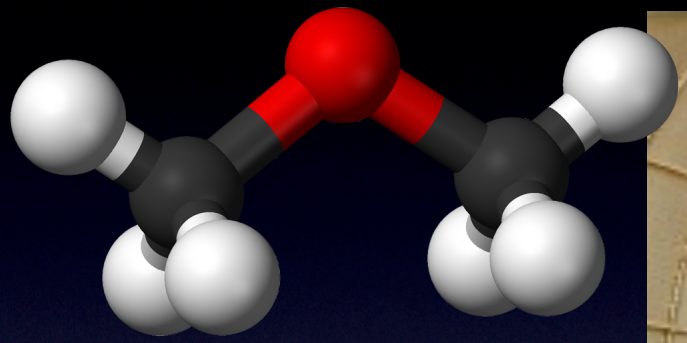
$C_2H_4O_2$

uno degli ingredienti per la formazione dell'RNA

Glicolaldeide in Rho Ophiuchi

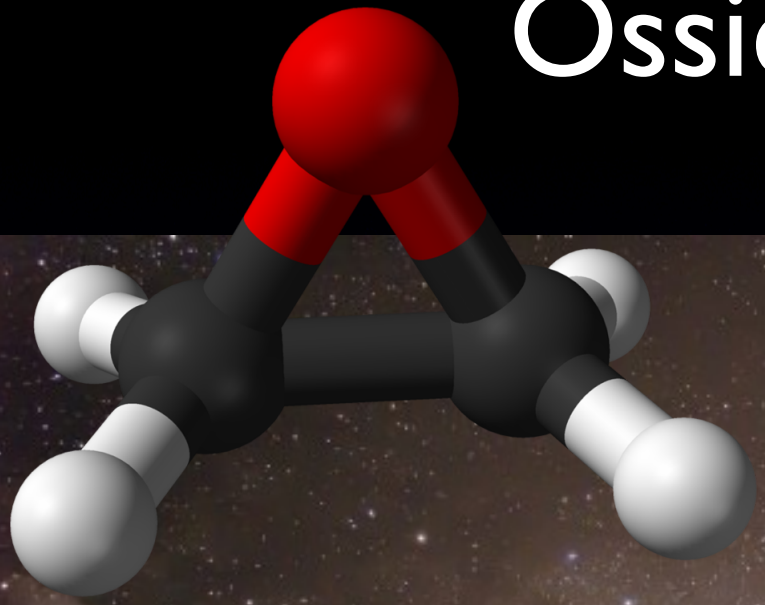


Etere dimetilico



Prima osservazione
Da Kitt Peak (AZ) 1974
nella Nebulosa di Orione

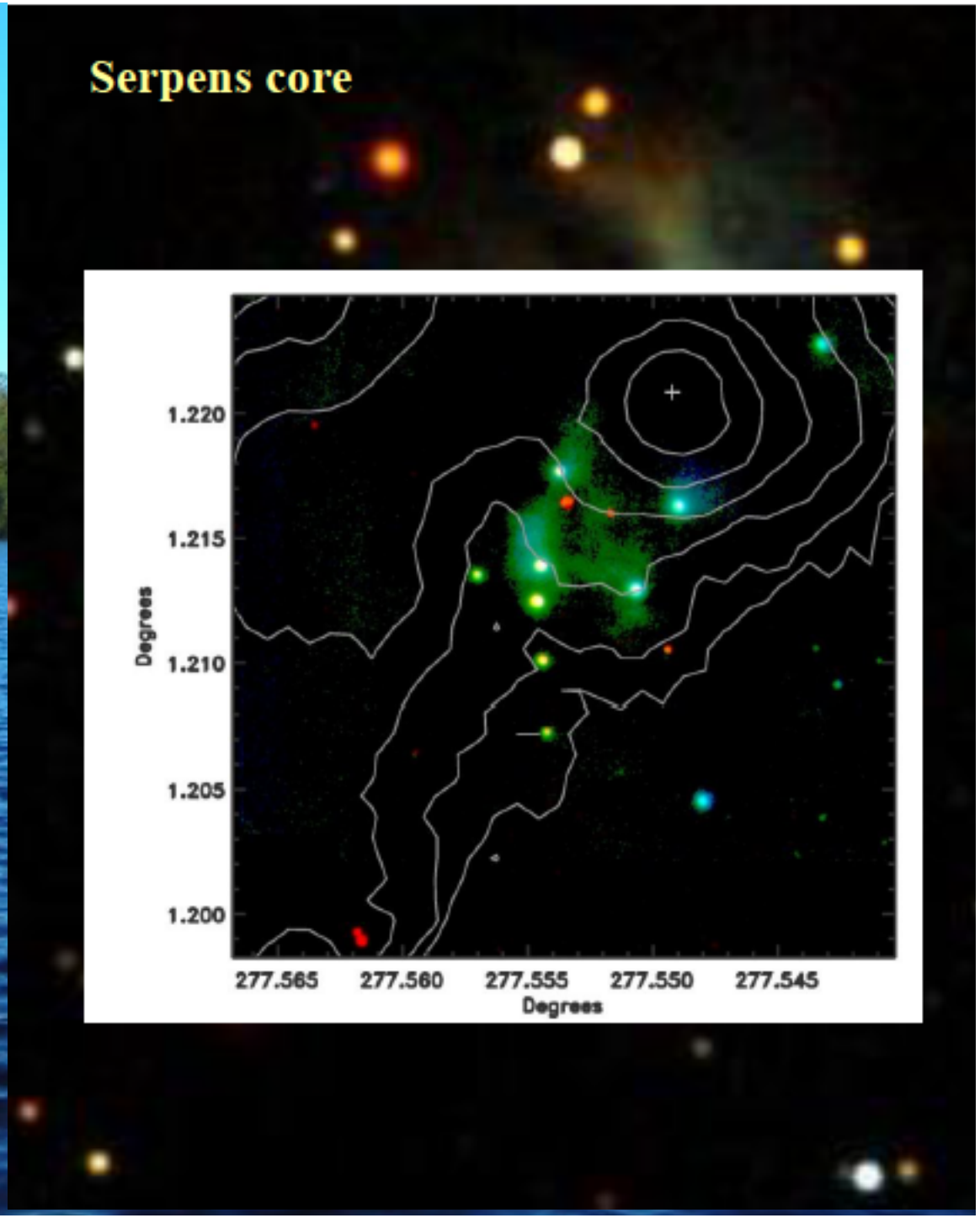
Ossido di etilene SgrB

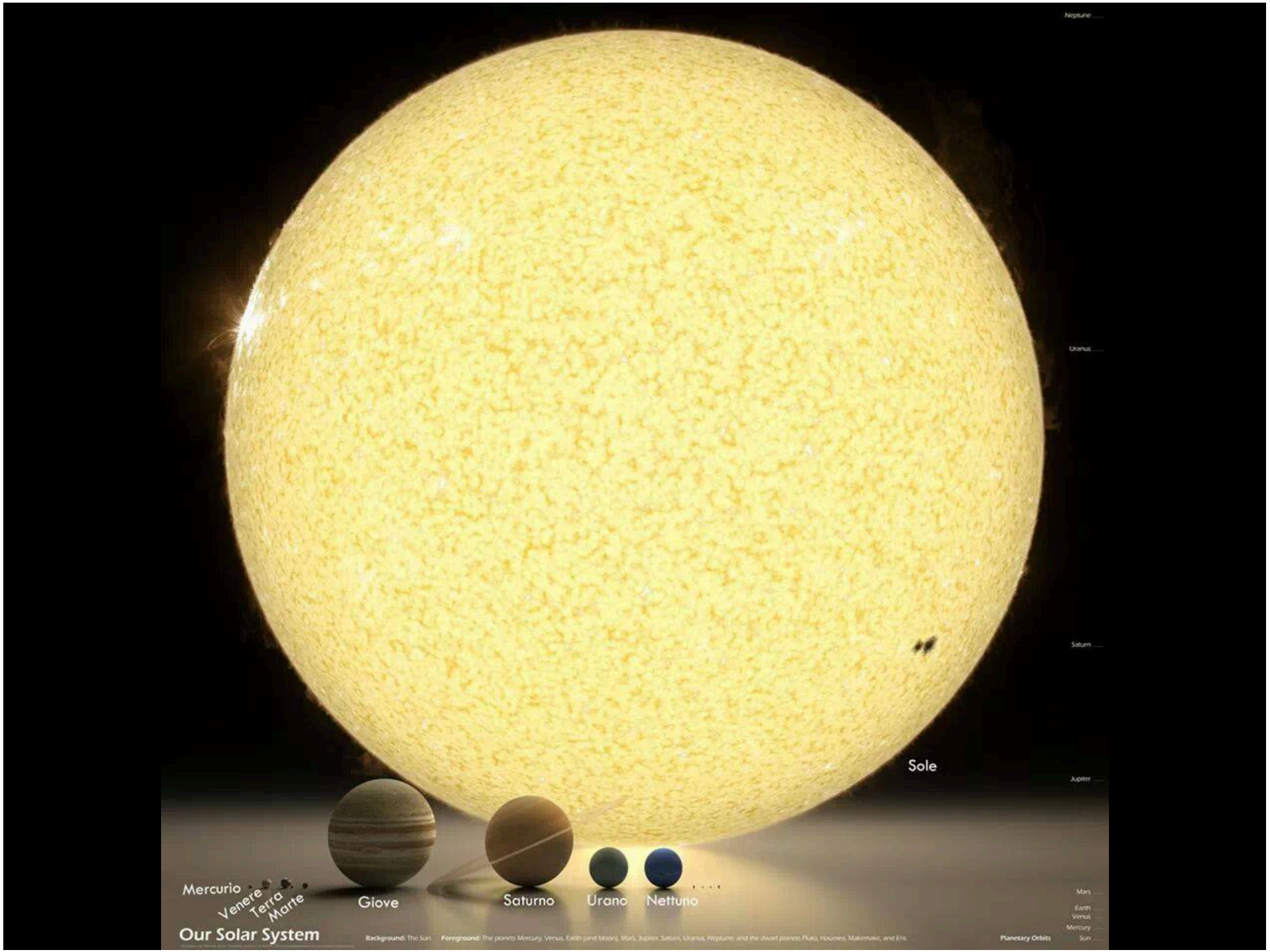


E l'acqua??

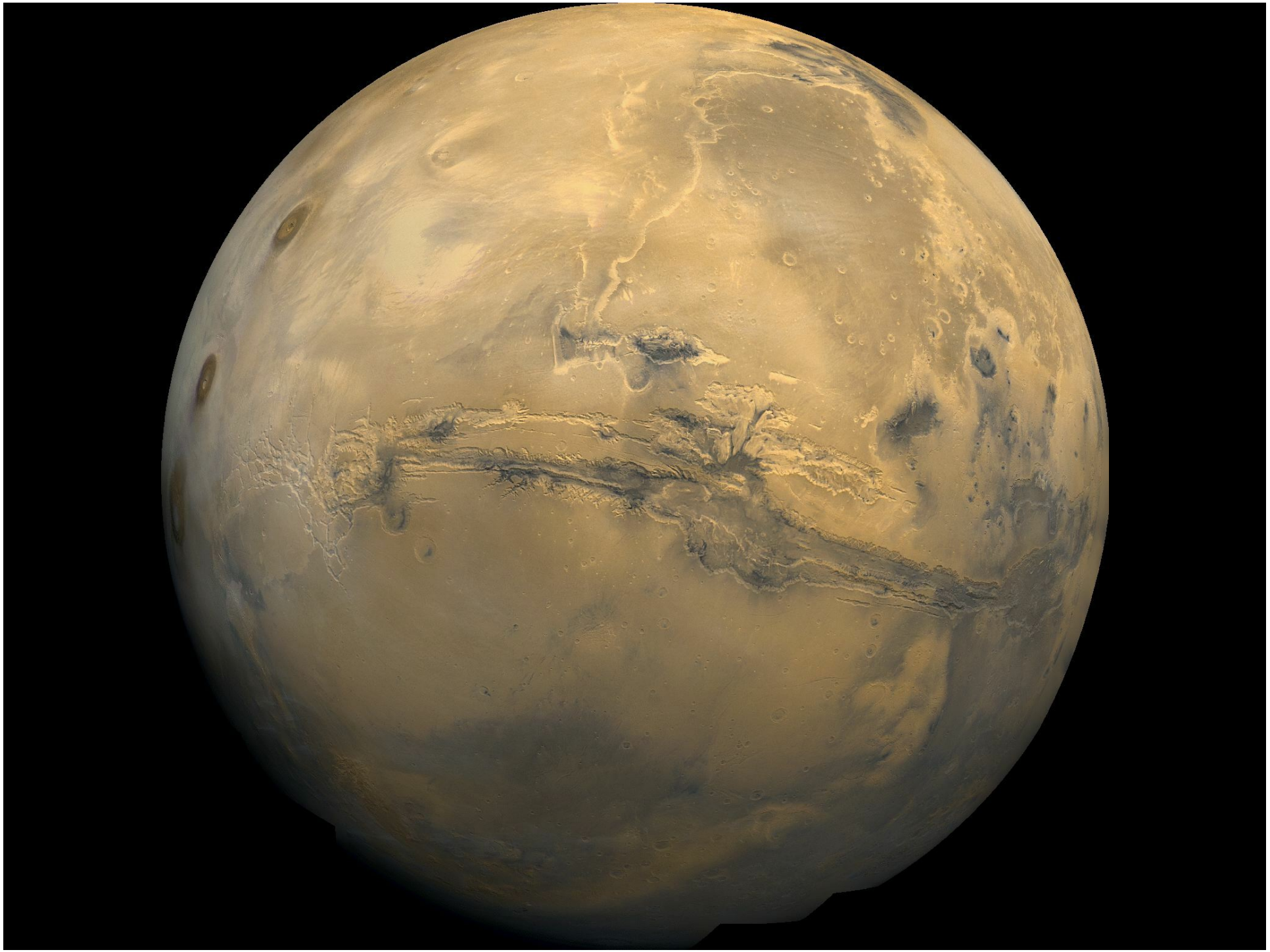
Grandi quantità di ghiaccio – mappa fino a 1000 A

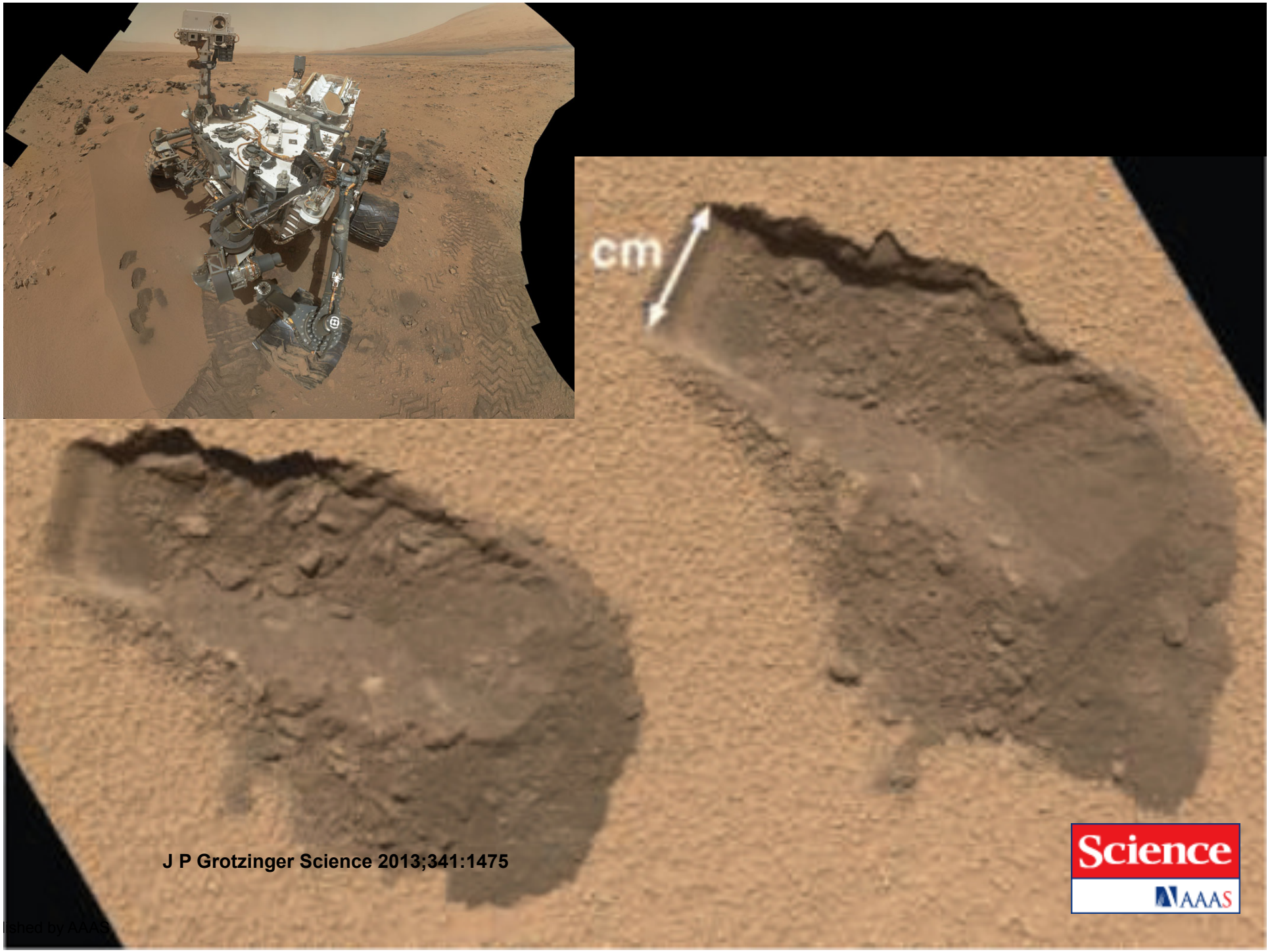
Metà dell'O è congelato – acqua ghiacciata



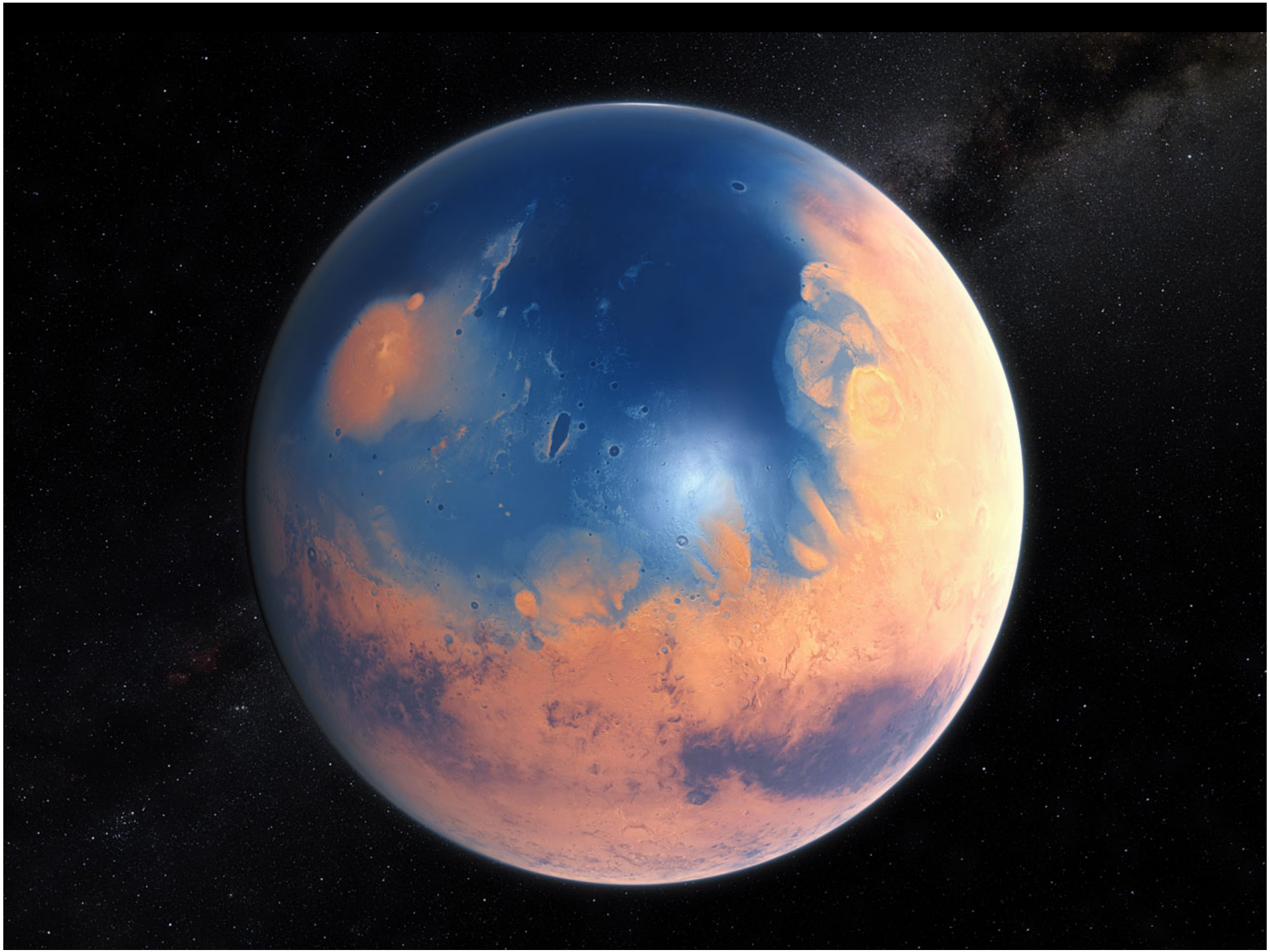

Neptune
Uranus
Saturn
Jupiter
Mars
Earth
Venus
Mercury
Sun
Sole
Mercurio
Venere
Terra
Marte
Giove
Saturno
Urano
Nettuno
Our Solar System
Background: The Sun
Foreground: The planets Mercury, Venus, Earth (and Moon), Mars, Jupiter, Saturn, Uranus, Neptune, and the dwarf planets Pluto, Haumea, Makemake, and Eris.
Planetary Orbits


©2007
MathiasPedersen.com





J P Grotzinger Science 2013;341:1475

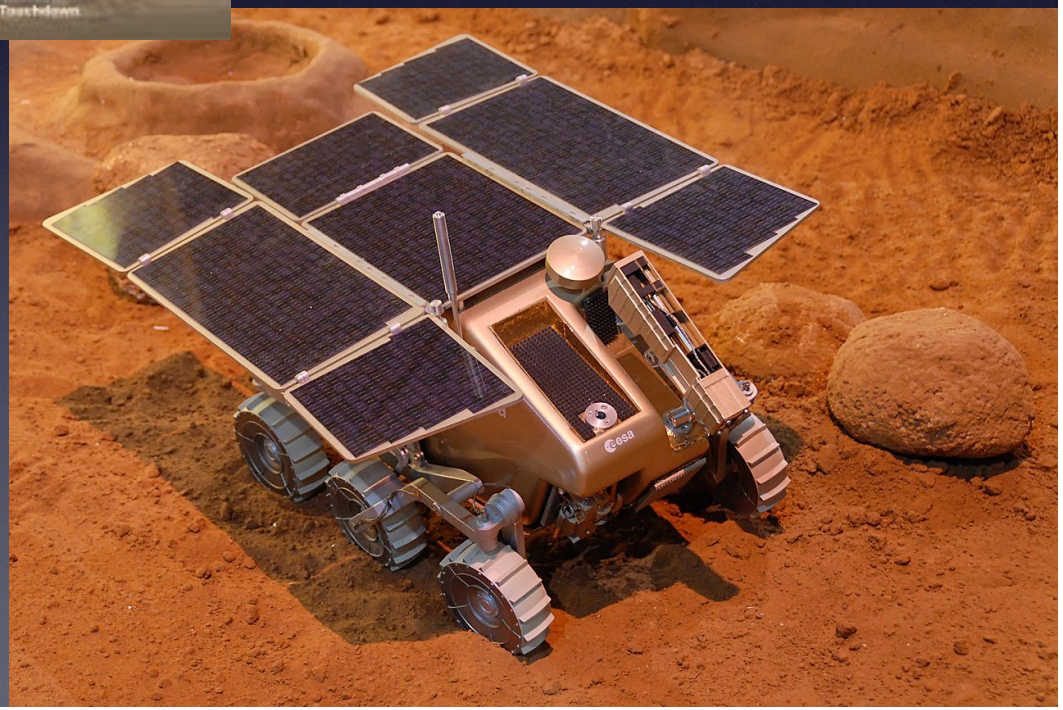


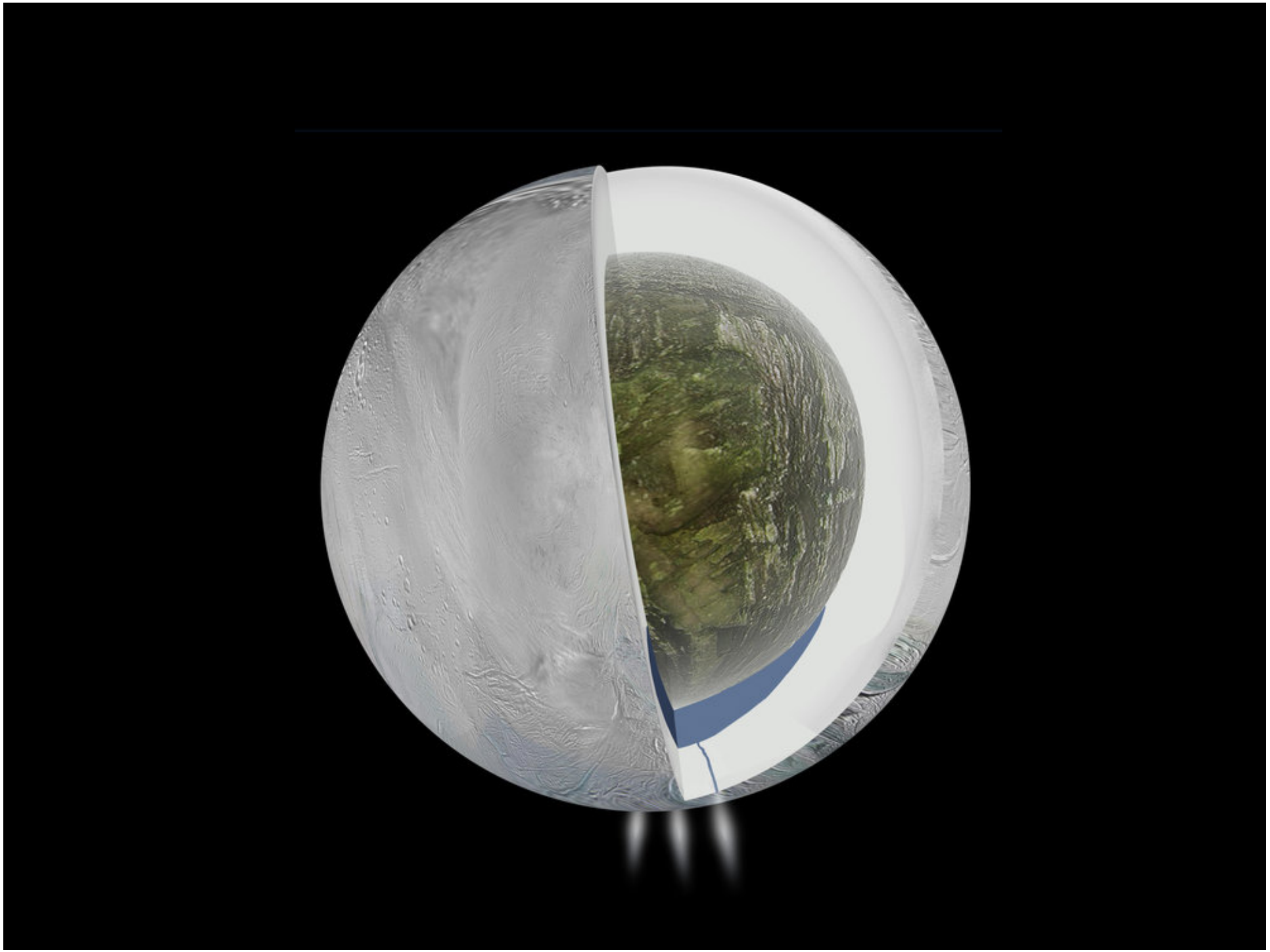
www.eso.org

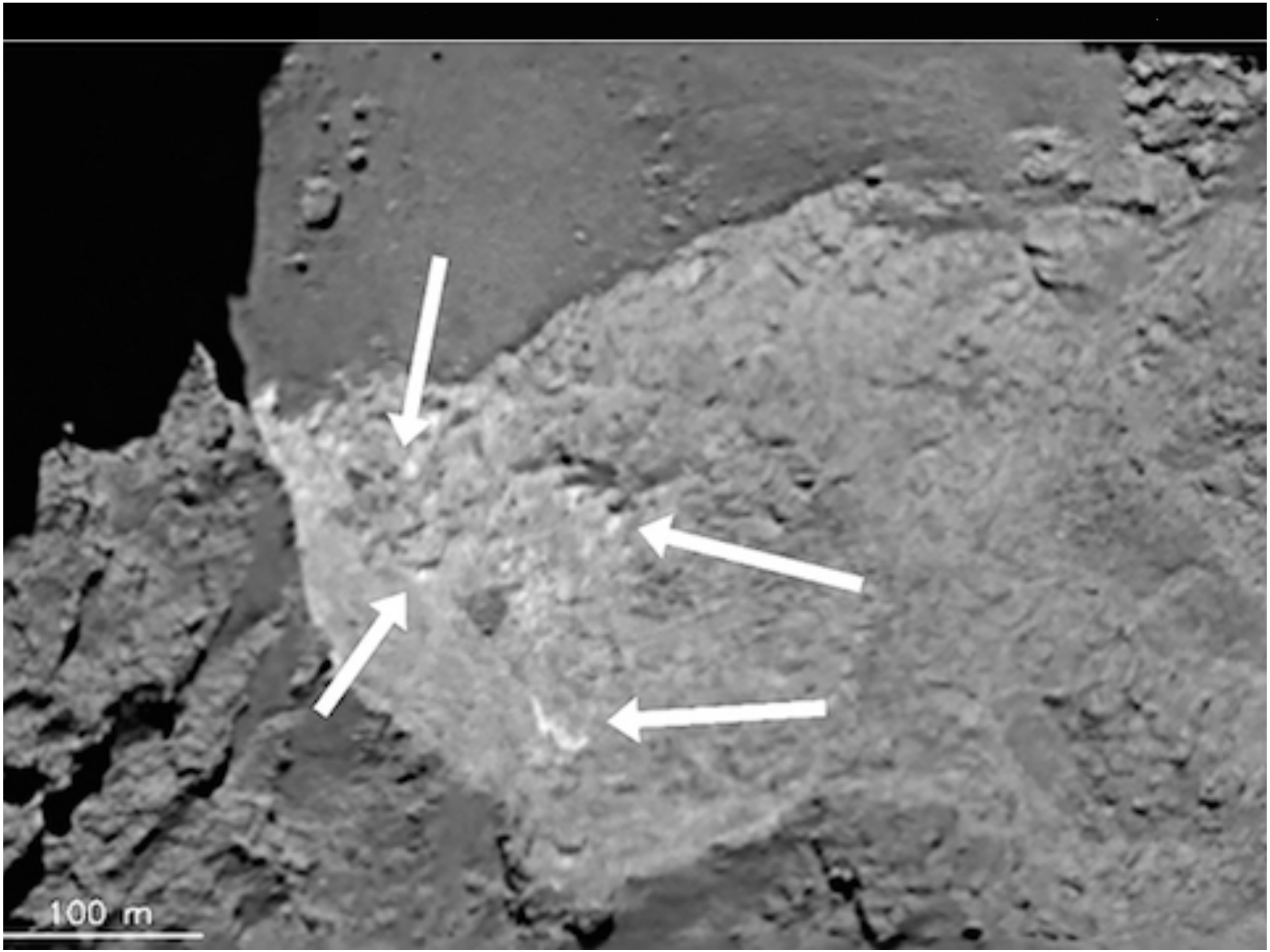
Missione **Aurora** dell'**ESA**

2016 **Schiaparelli: ExoMars Entry, Descent and Landing Demonstrator Module**
Alla ricerca di ematite

2018: **lander per esperimenti**
di esobiologia e geochimica






100 m

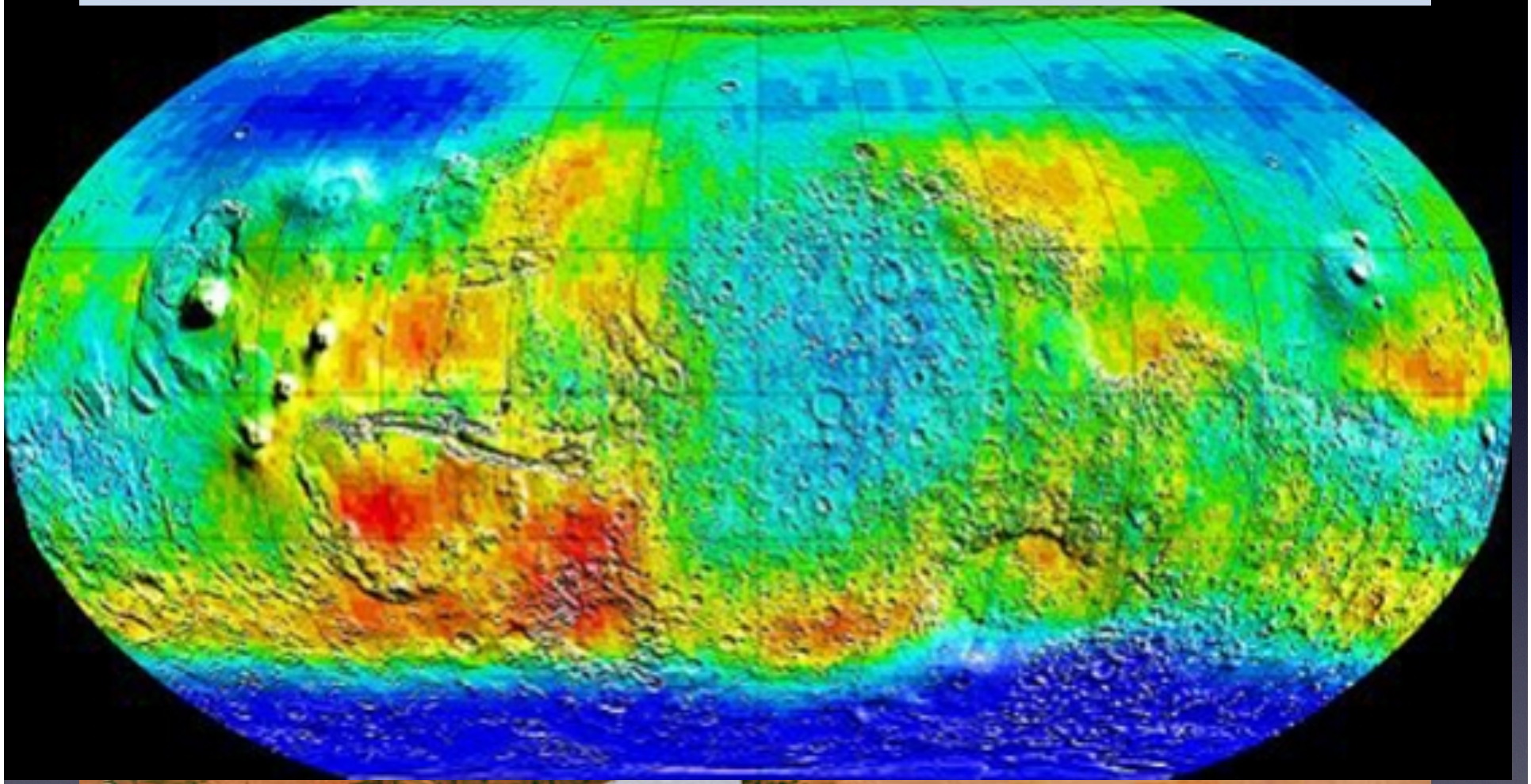
Giordano Bruno

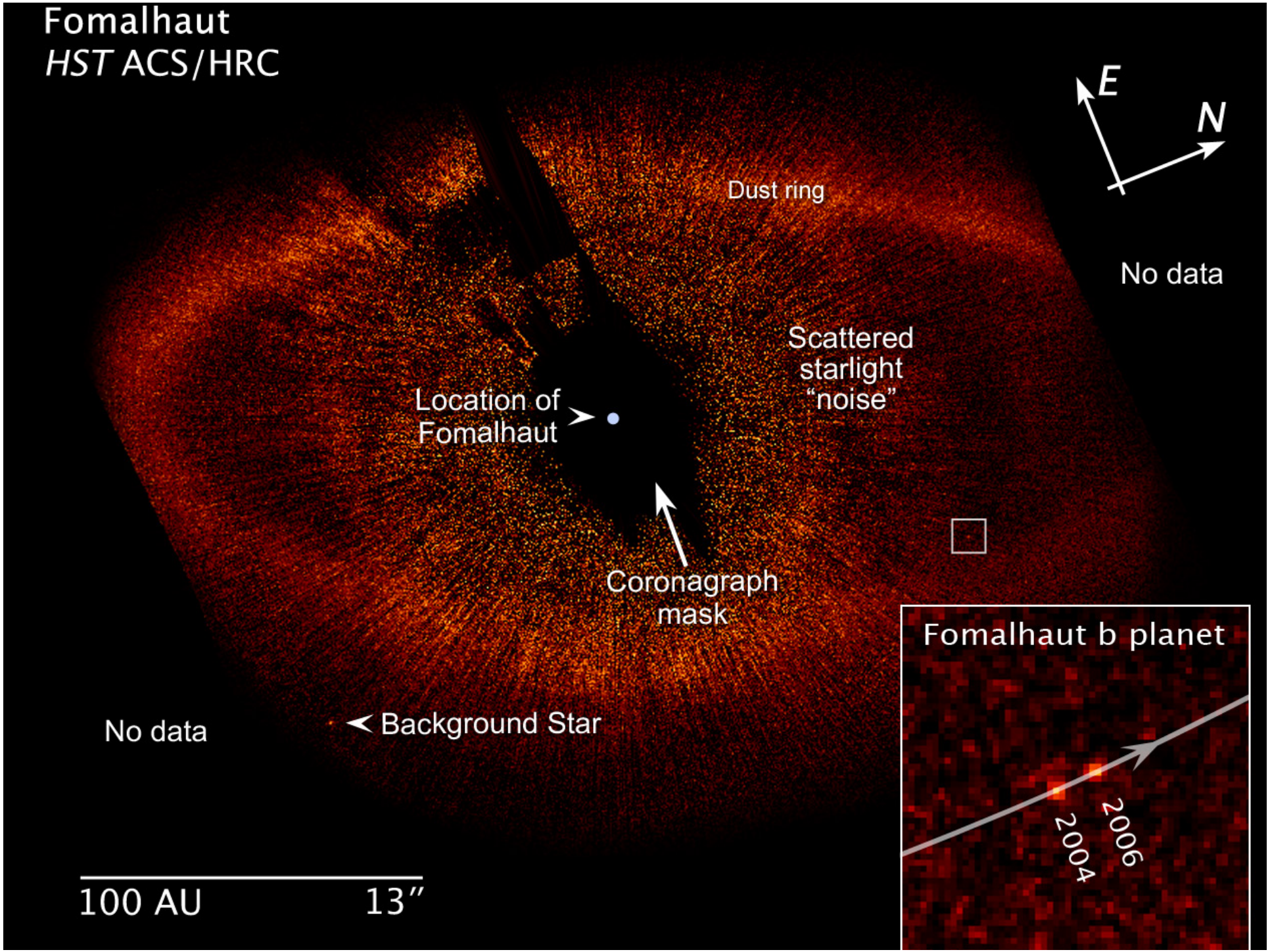
..... Sono dunque soli innumerabili, sono terre infinite, che similmente circuiscono quei soli; come veggiamo questi sette circuire questo sole a noi vicino.

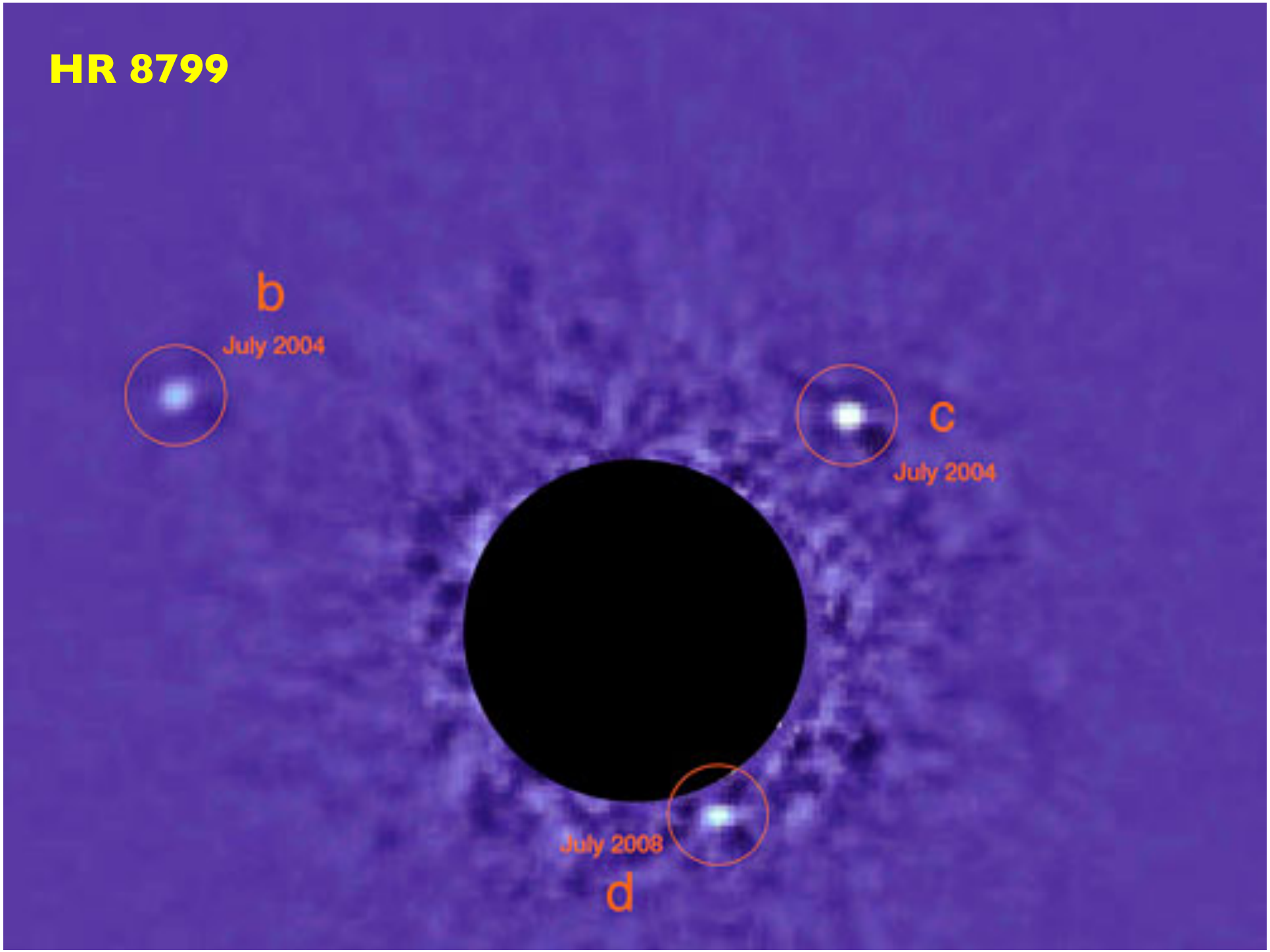
De l'infinito, universo e mondi – 3° dialogo (1584)

Photo: I. Král, National Library, Prague

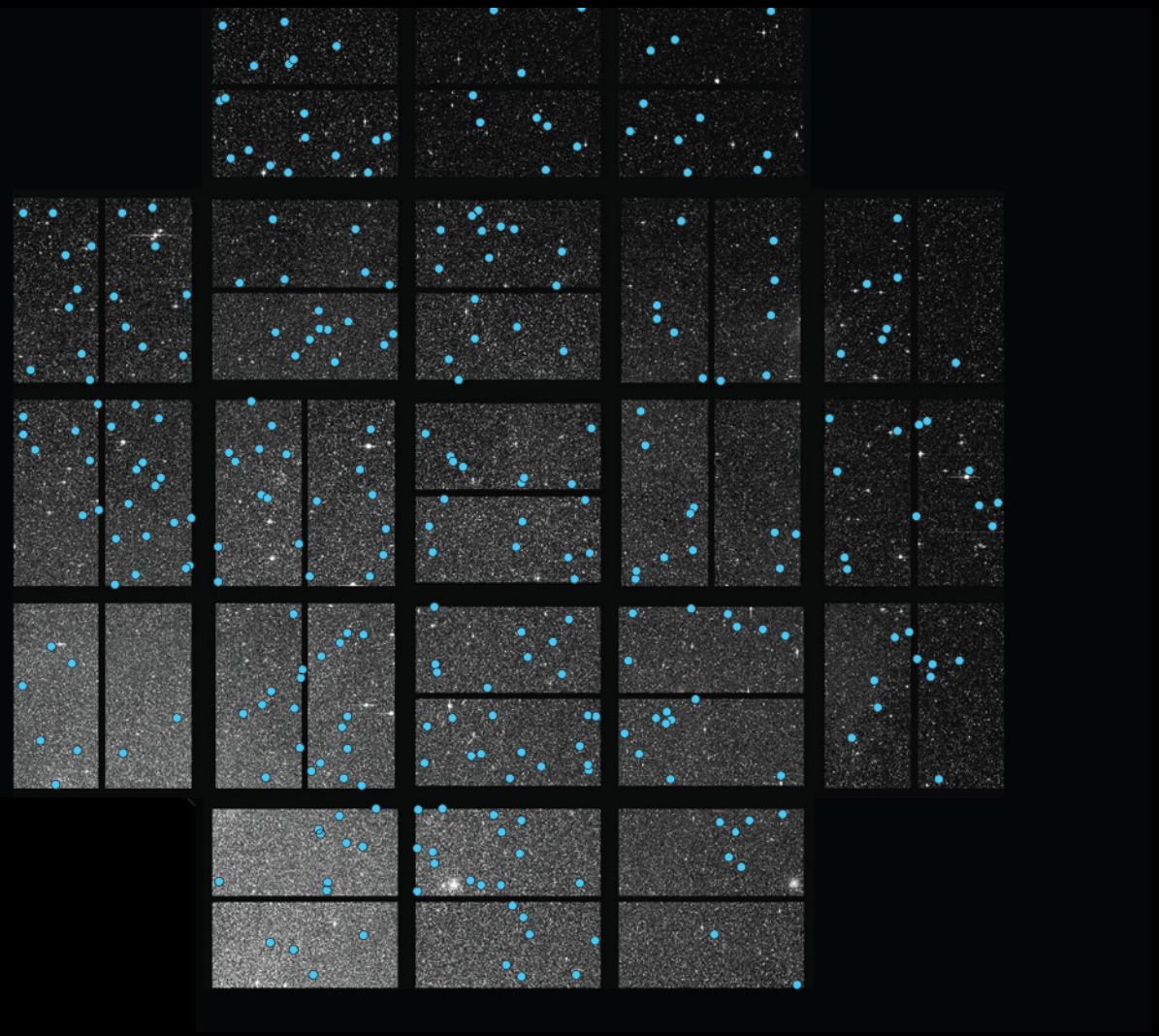
New Mathematical Hall ***Praga. Clementinum - affresco***

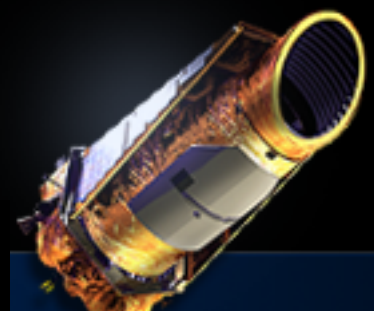



Fomalhaut
HST ACS/HRC
E
N
Dust ring
No data
Scattered
starlight
"noise"
Location of
Fomalhaut
Coronagraph
mask
Fomalhaut b planet
2006
2004
No data
Background Star
100 AU
13″


HR 8799
b
July 2004
c
July 2004
July 2008
d

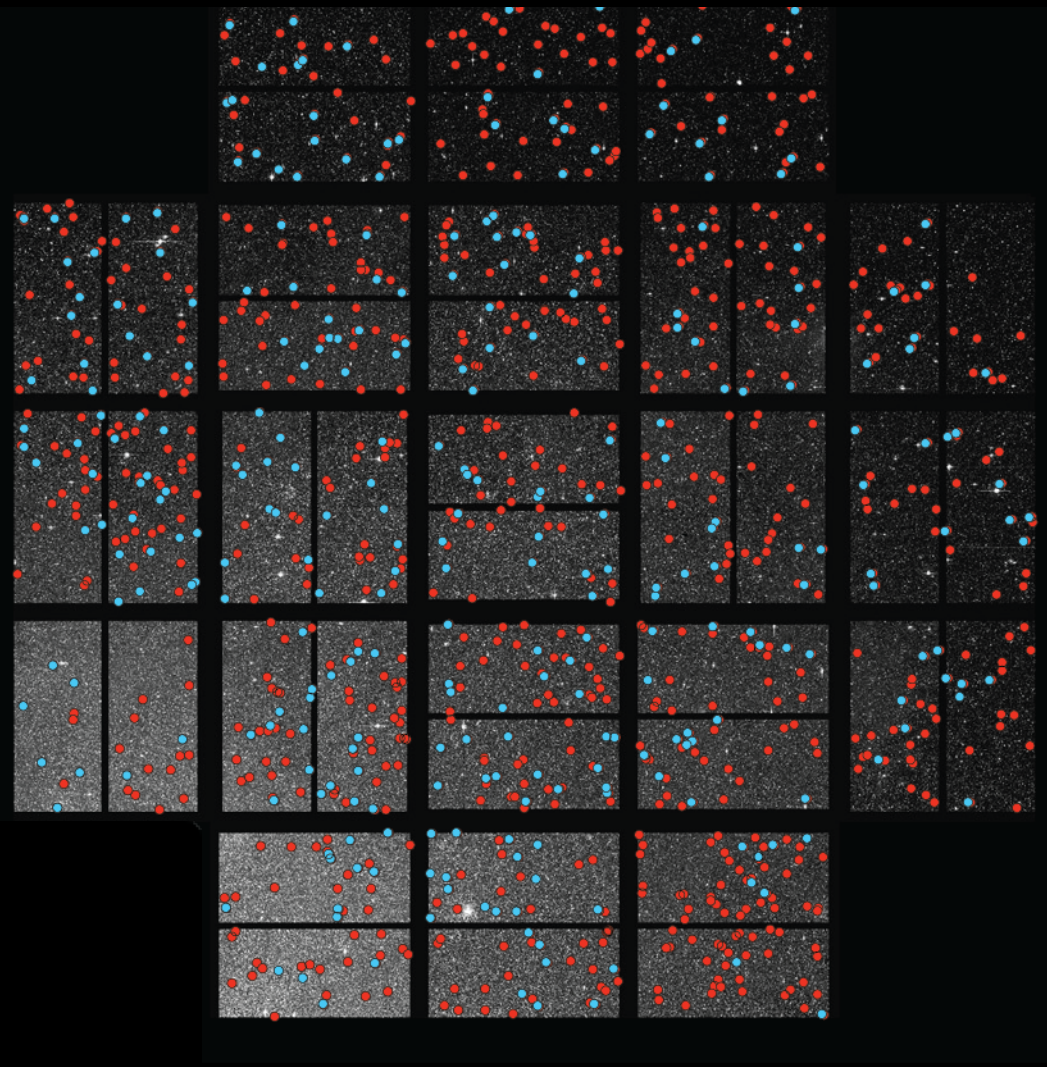
June 2010
Catalog Release

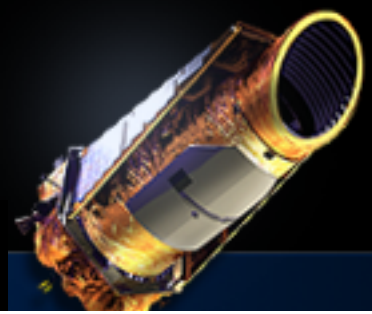




June 2010
Catalog Release

February 2011
Catalog Release

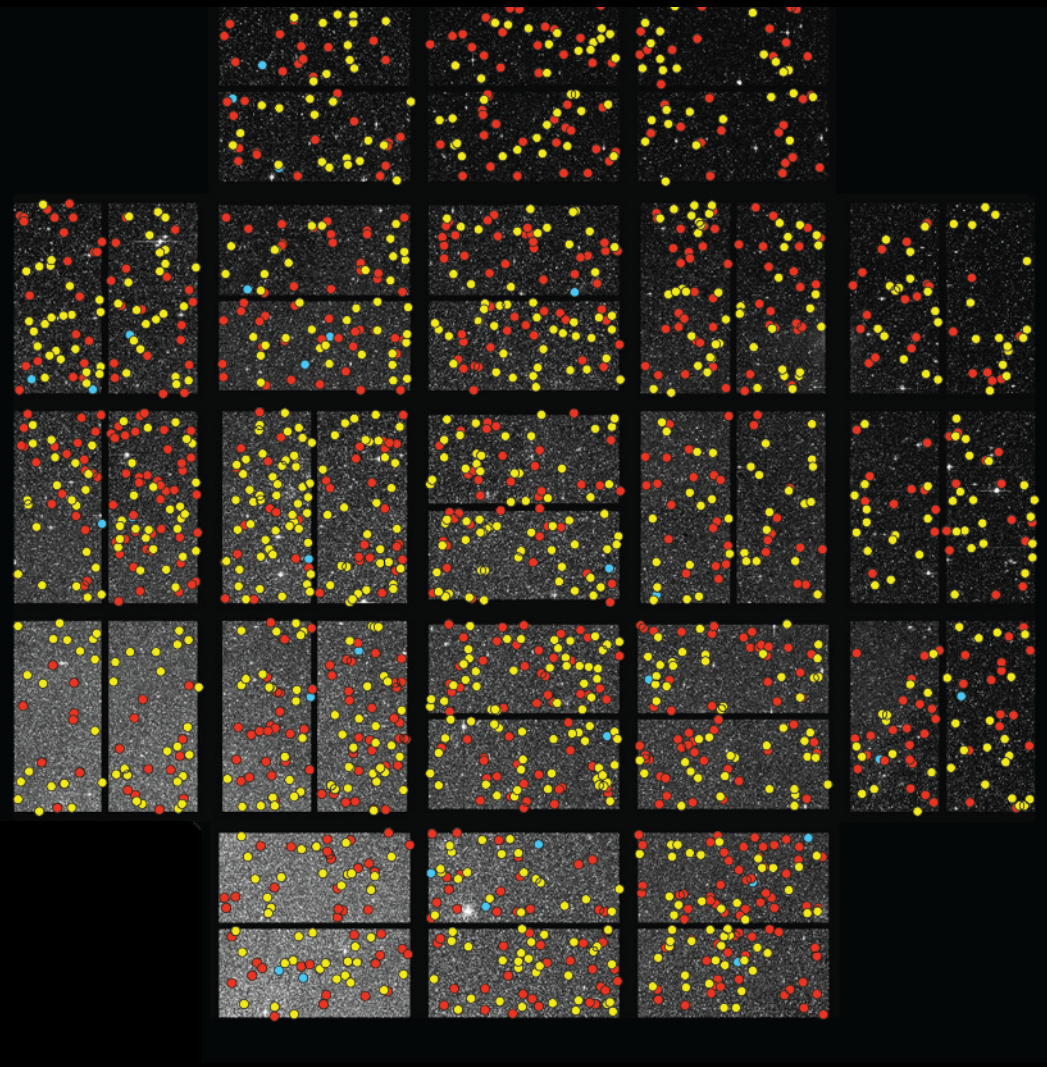


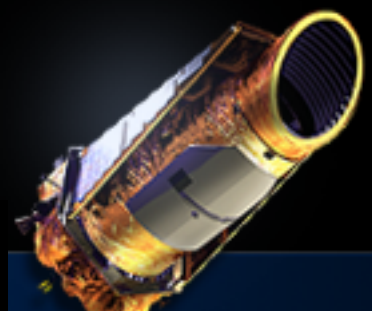


June 2010
Catalog Release

February 2011
Catalog Release

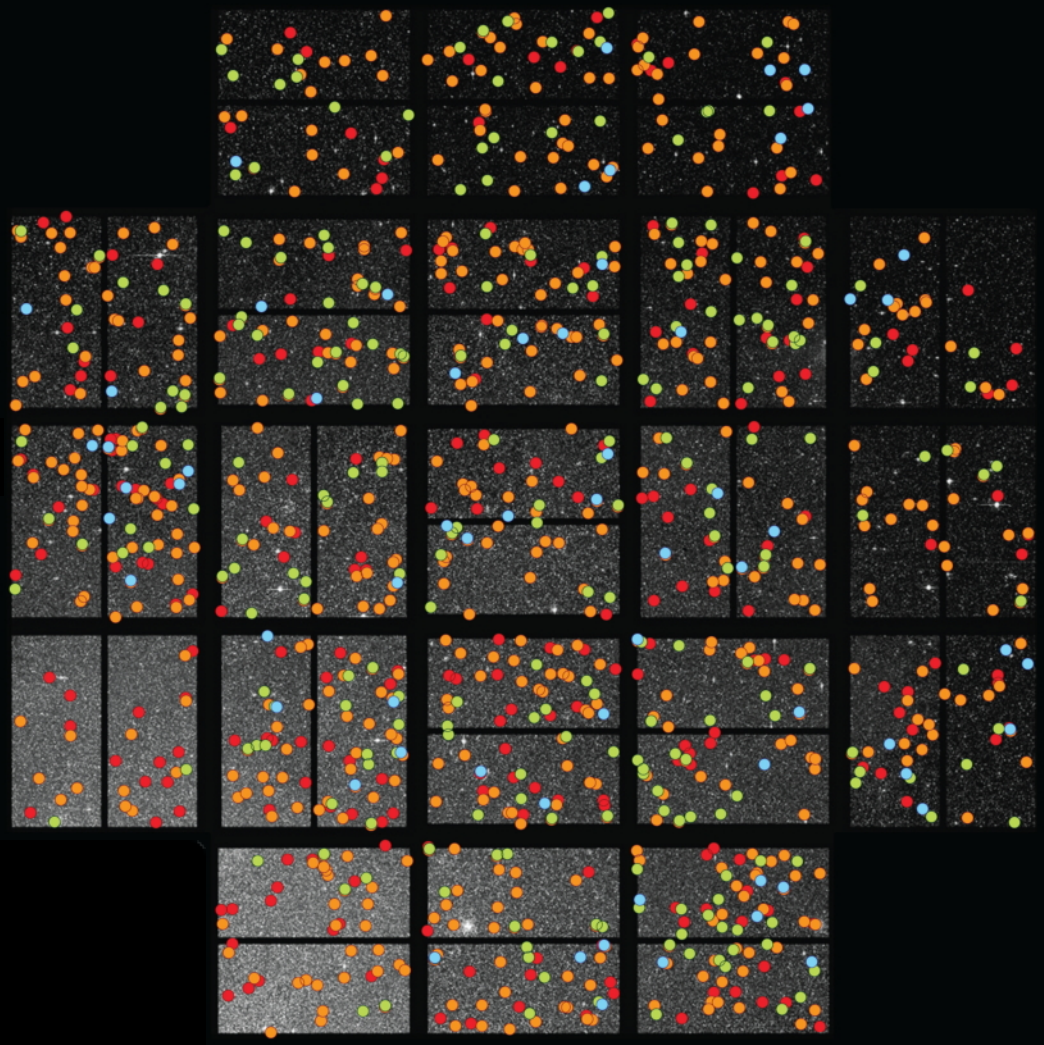
February 2012
Catalog Release



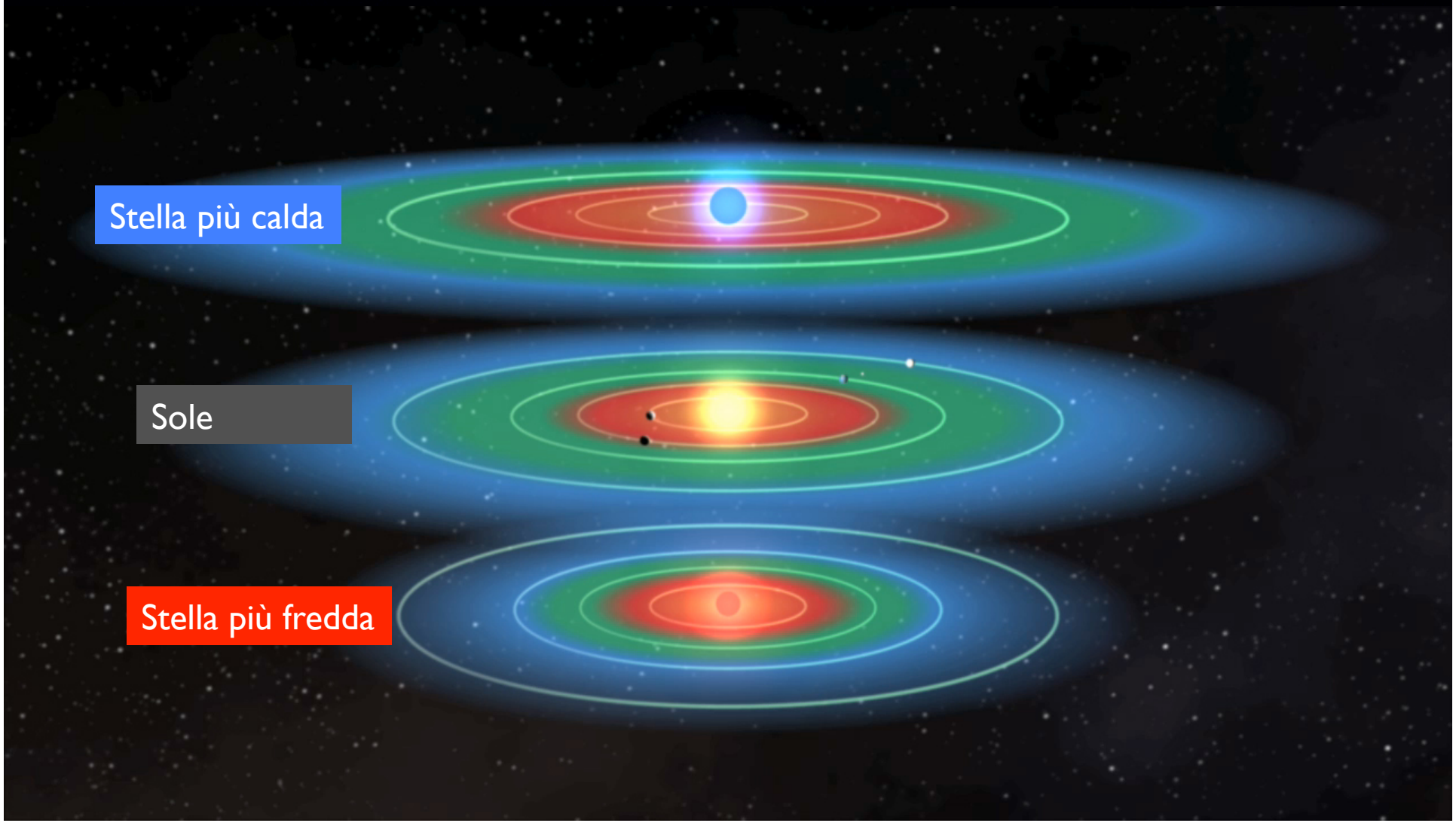


Candidati Pianeti

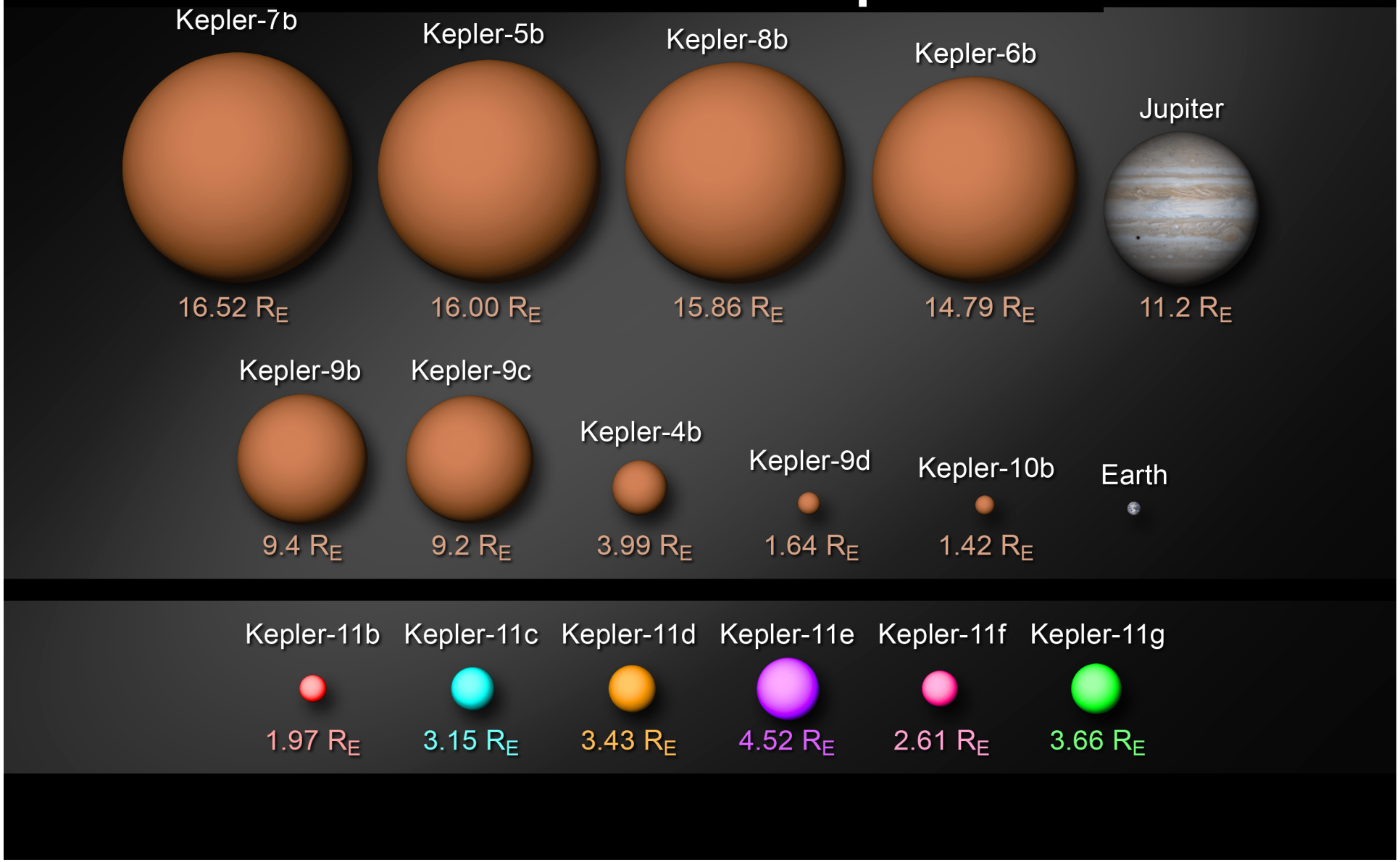
- Terrestri
- SuperTerre
- ~ Nettuno
- Giganti



Zona abitabile



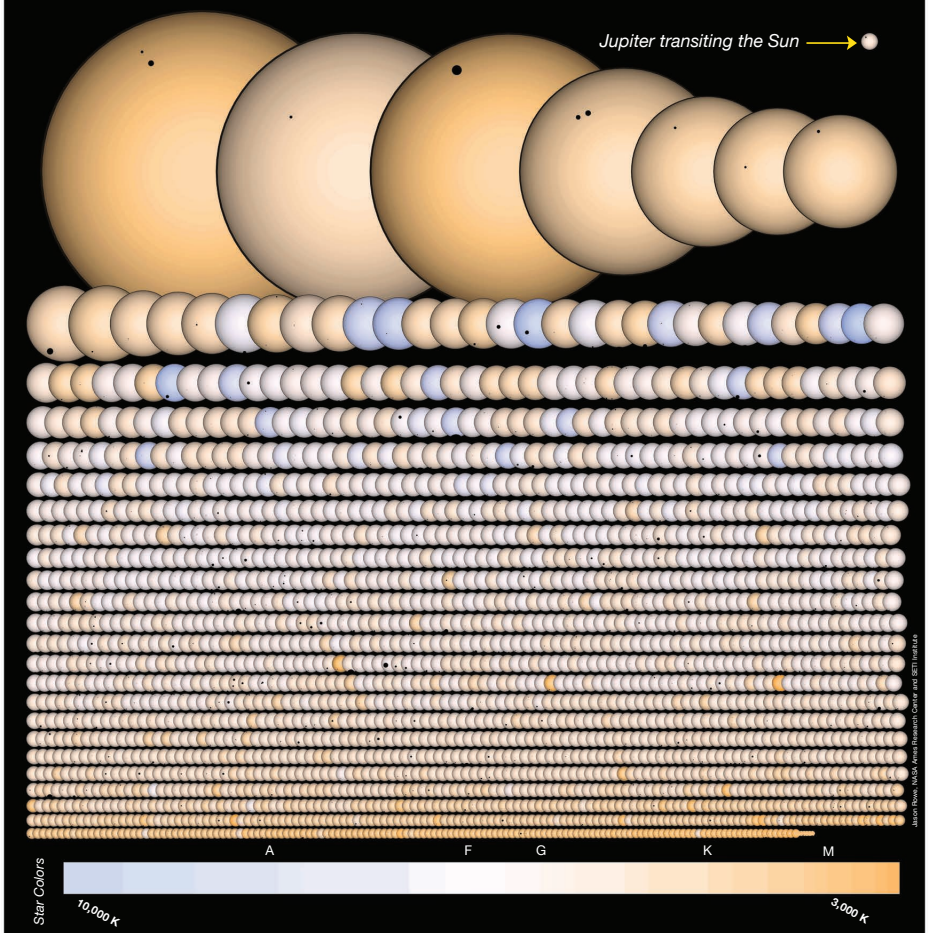
Dimensione dei pianeti



National Aeronautics and Space Administration

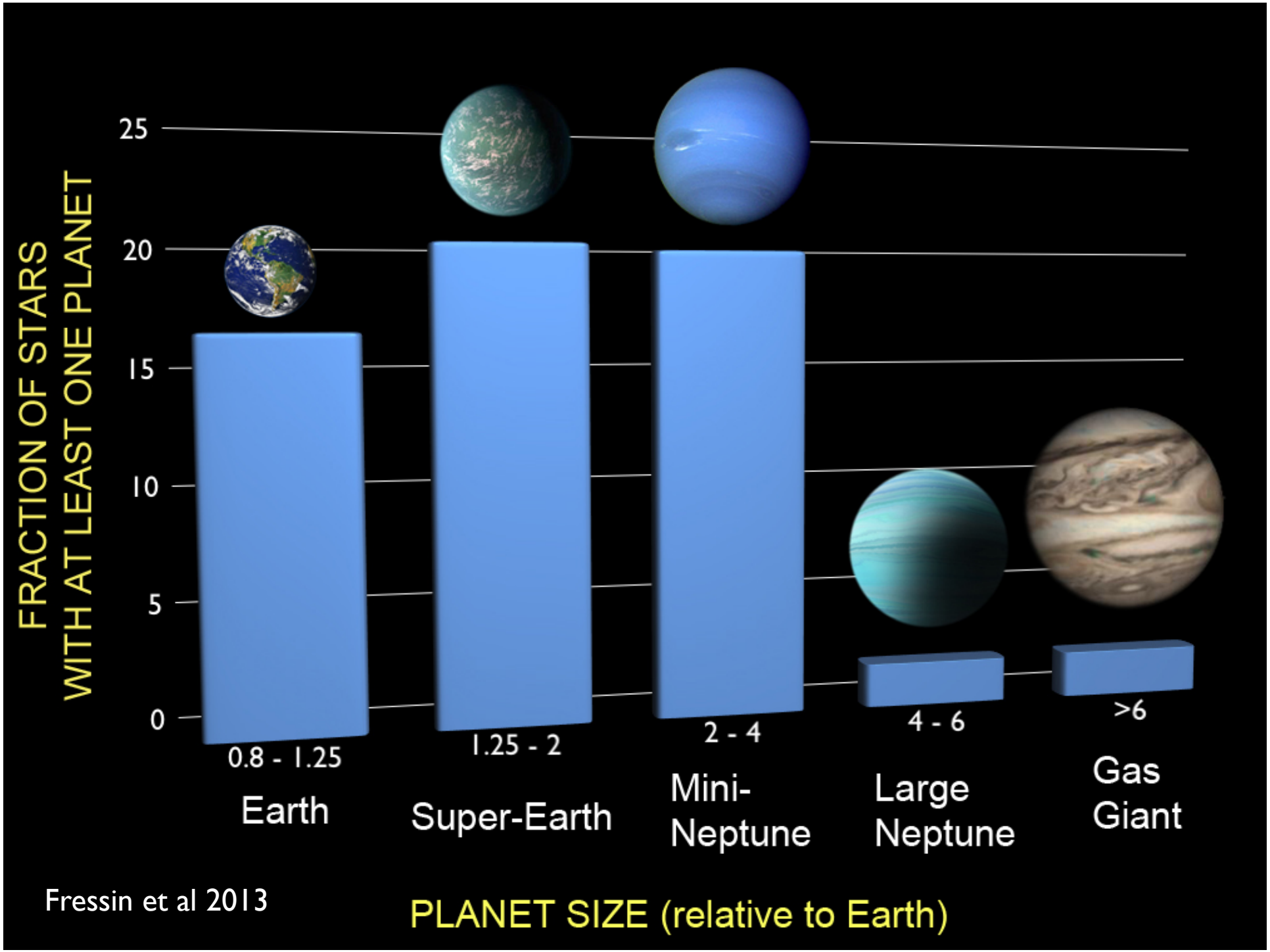
KEPLER'S PLANET CANDIDATES

2,740 AS OF JANUARY, 2013

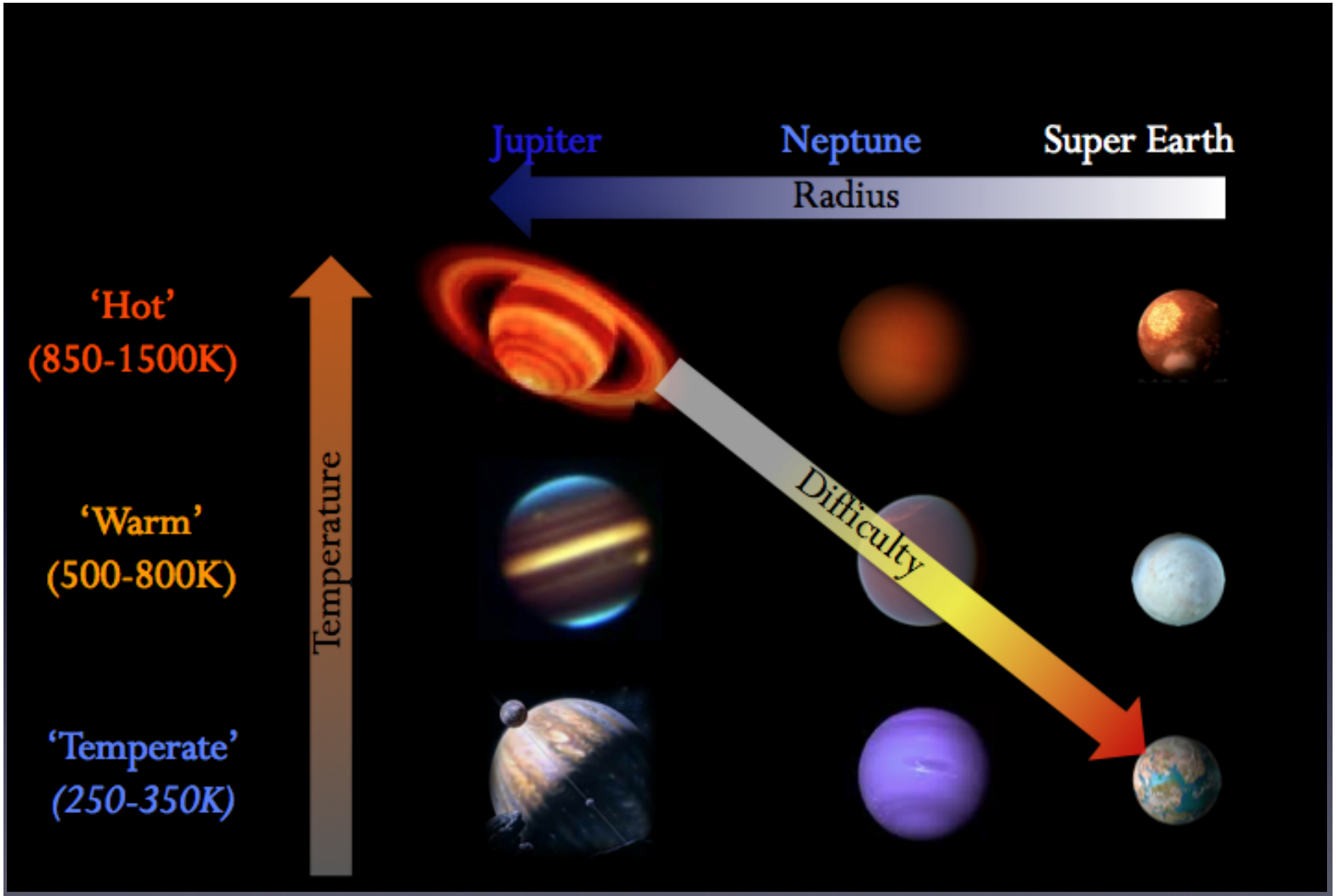


Using NASA's planet-hunting Kepler spacecraft, astronomers have discovered 2,740 planet candidates orbiting 2,036 other suns in a search for Earth-size worlds. The search began in 2009. Kepler monitors a rich star field for planetary transits, which cause a slight dimming of starlight when a planet crosses the face of its star. In "Kepler's Planet Candidates," the systems are ordered by star diameter. The star's color represents its temperature as shown in the lower scale, and the letters (A, F, G, K, M) designate star types. The simulated stellar disks and the planet silhouettes are shown at the same scale, with saturated star colors. Look carefully: some systems have multiple planets. For reference, Jupiter is shown transiting the Sun. Higher resolutions of this graphic are available at http://Kepler.NASA.gov/images/graphics

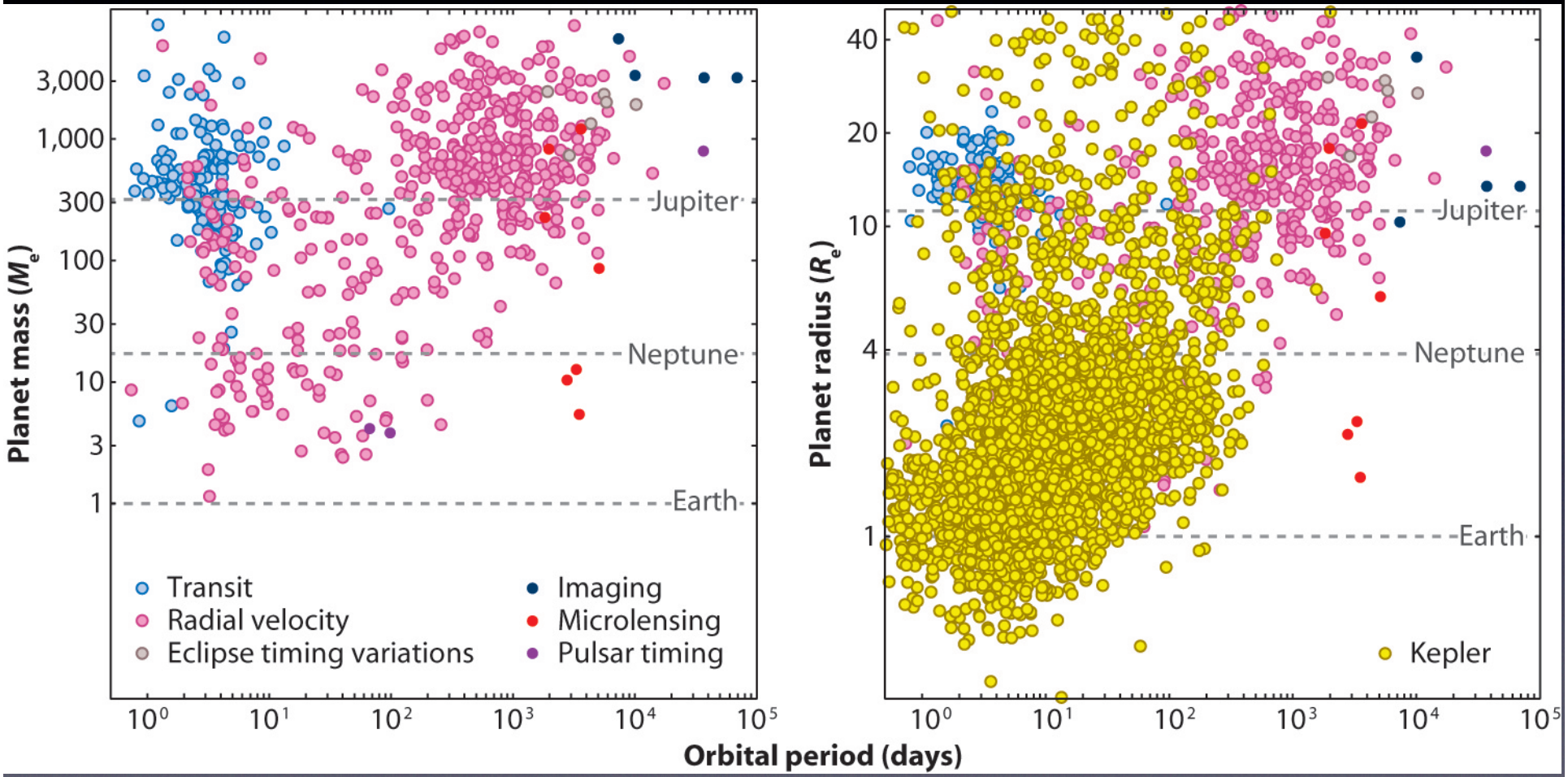
www.nasa.gov



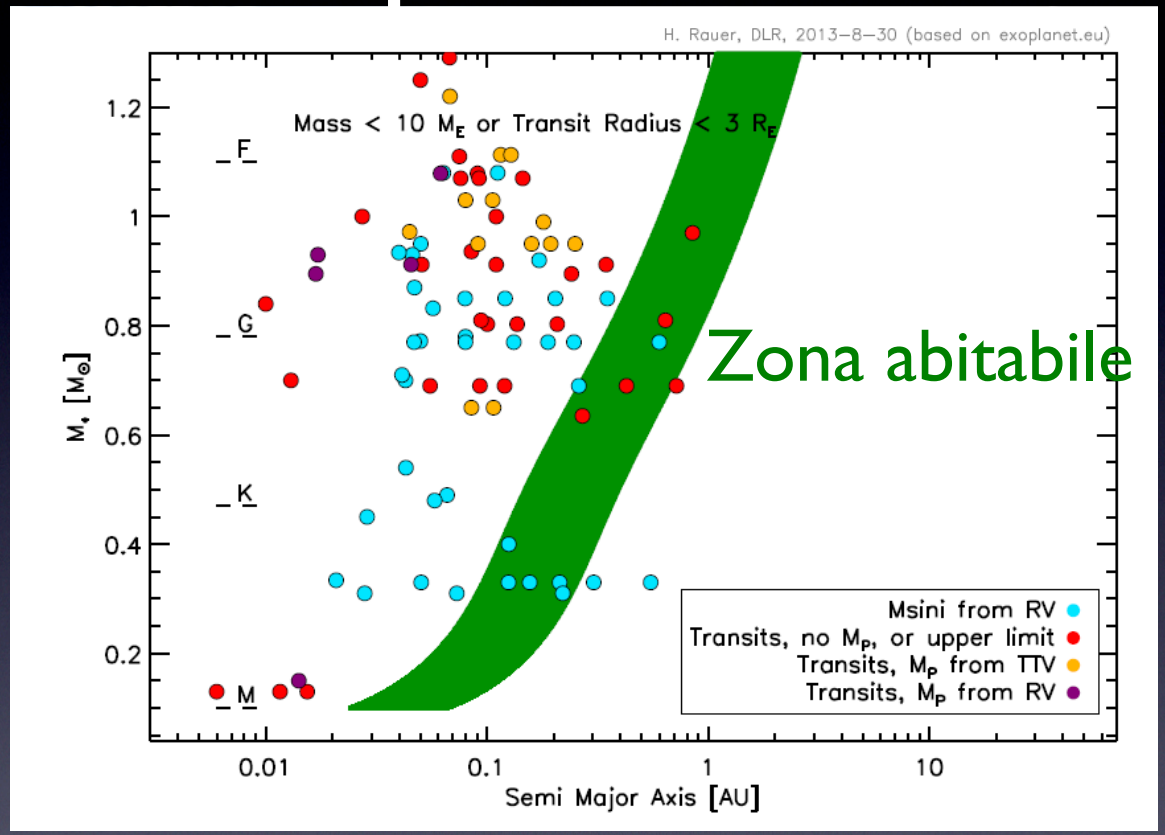
Fressin et al 2013


Jupiter
Neptune
Super Earth
Radius
'Hot'
(850-1500K)
'Warm'
(500-800K)
'Temperate'
(250-350K)
Temperature
Difficulty

Dimensioni


Planet mass (M_e)
3,000
1,000
300
100
30
10
3
1
Jupiter
Neptune
Earth
Transit
Radial velocity
Eclipse timing variations
Imaging
Microlensing
Pulsar timing
Planet radius (R_e)
40
20
10
4
1
Jupiter
Neptune
Earth
Kepler
10^0
10^1
10^2
10^3
10^4
10^5
Orbital period (days)

Super Terre

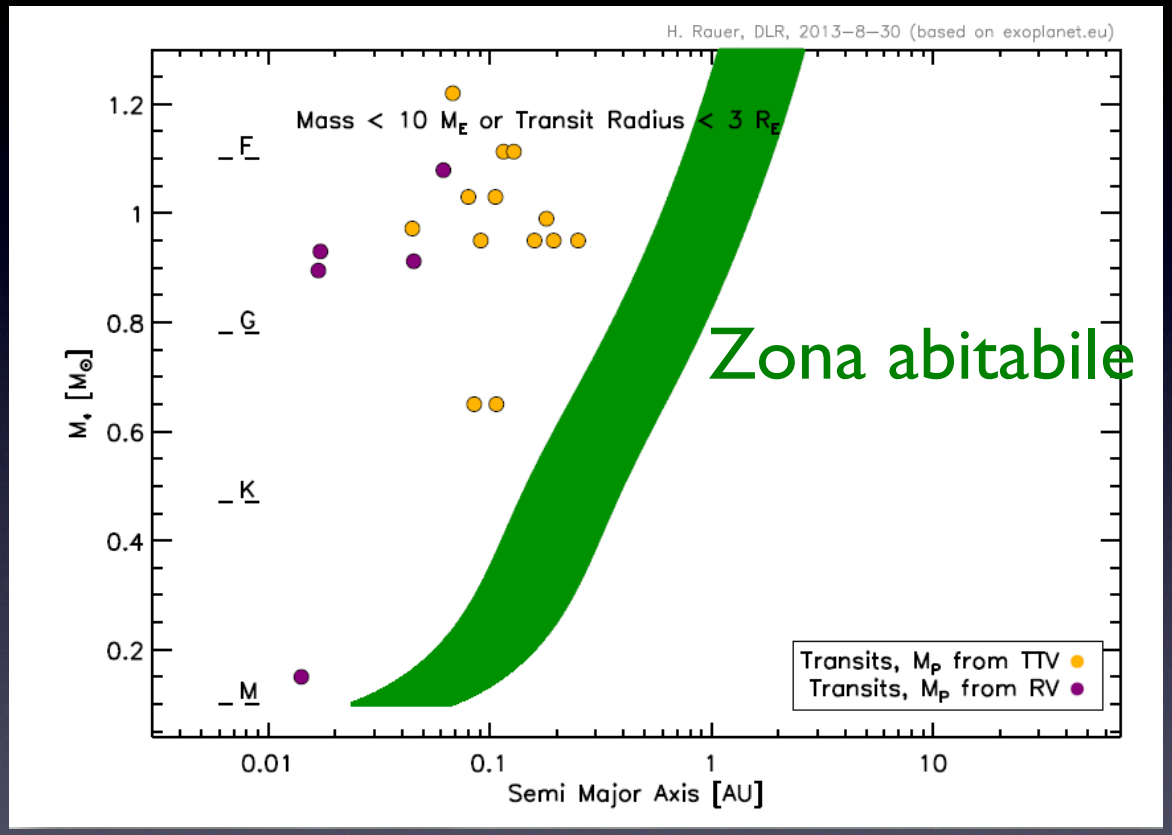


Massa

Semi asse maggiore dell'orbita

Massa e raggio noti

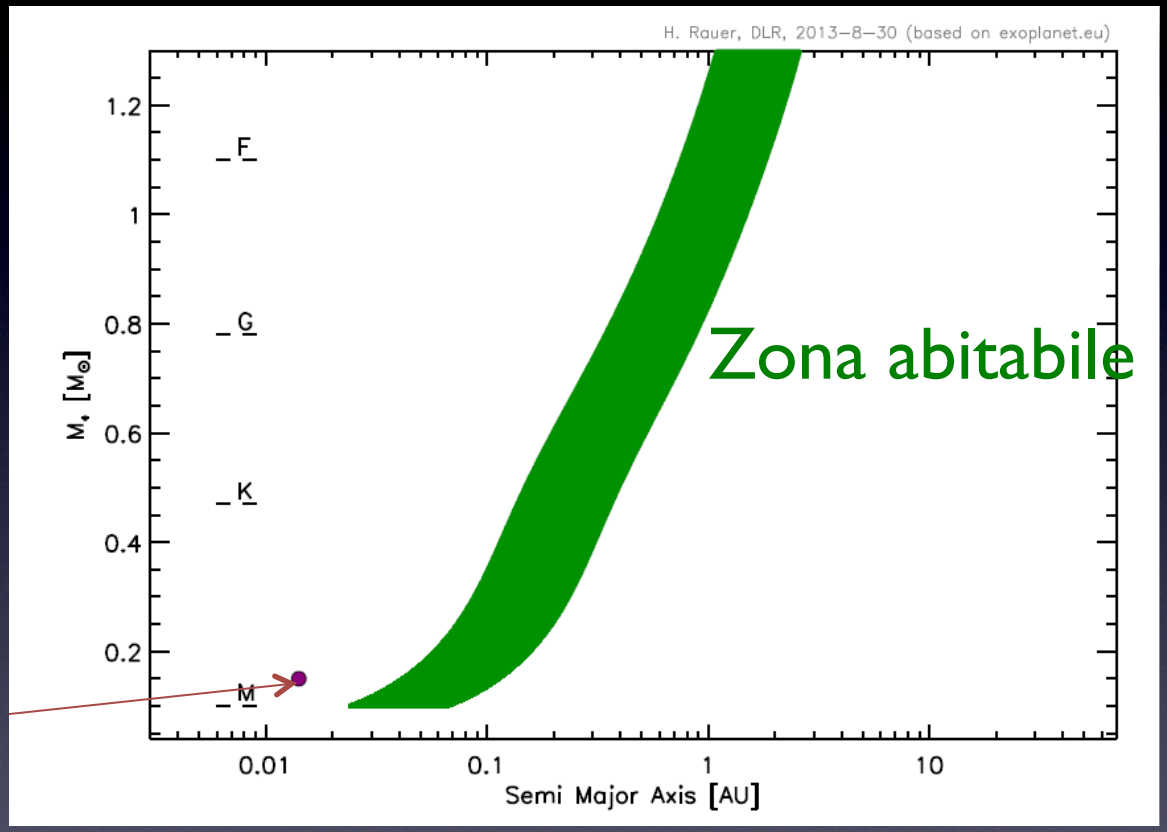
Massa



Semi asse maggiore dell'orbita

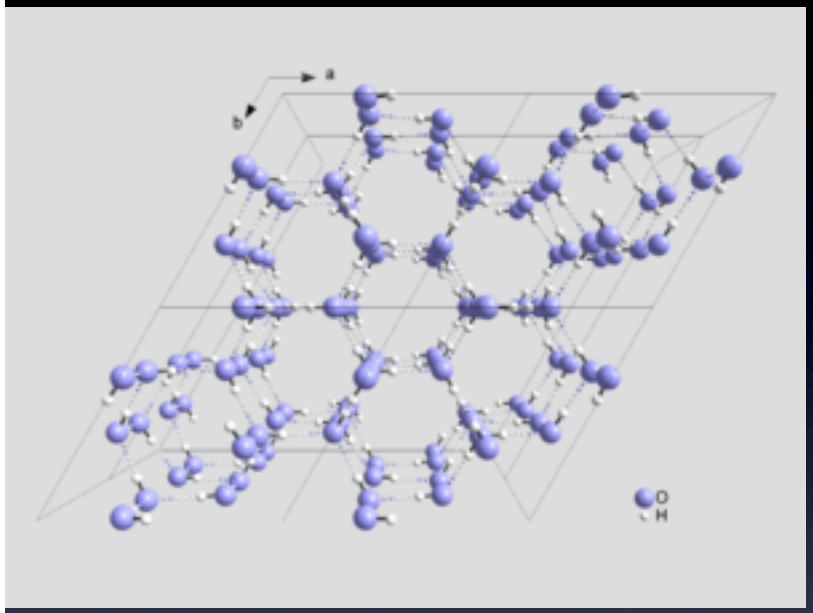
Brillanti per vedere atmosfera

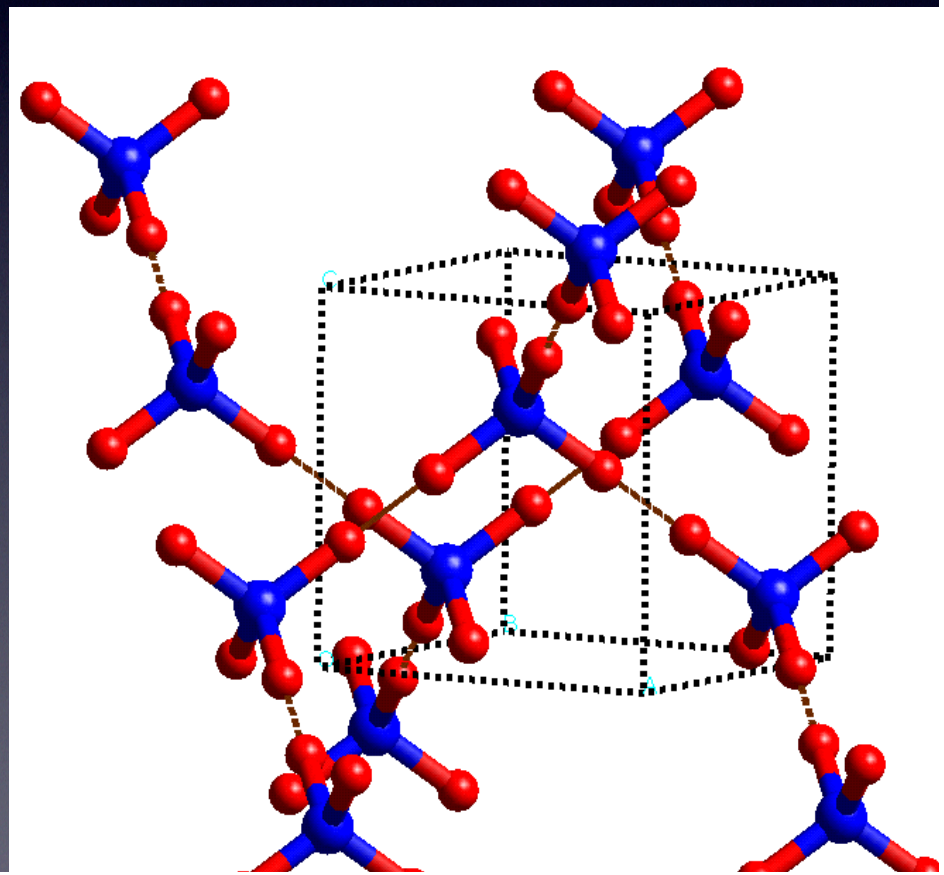
Massa



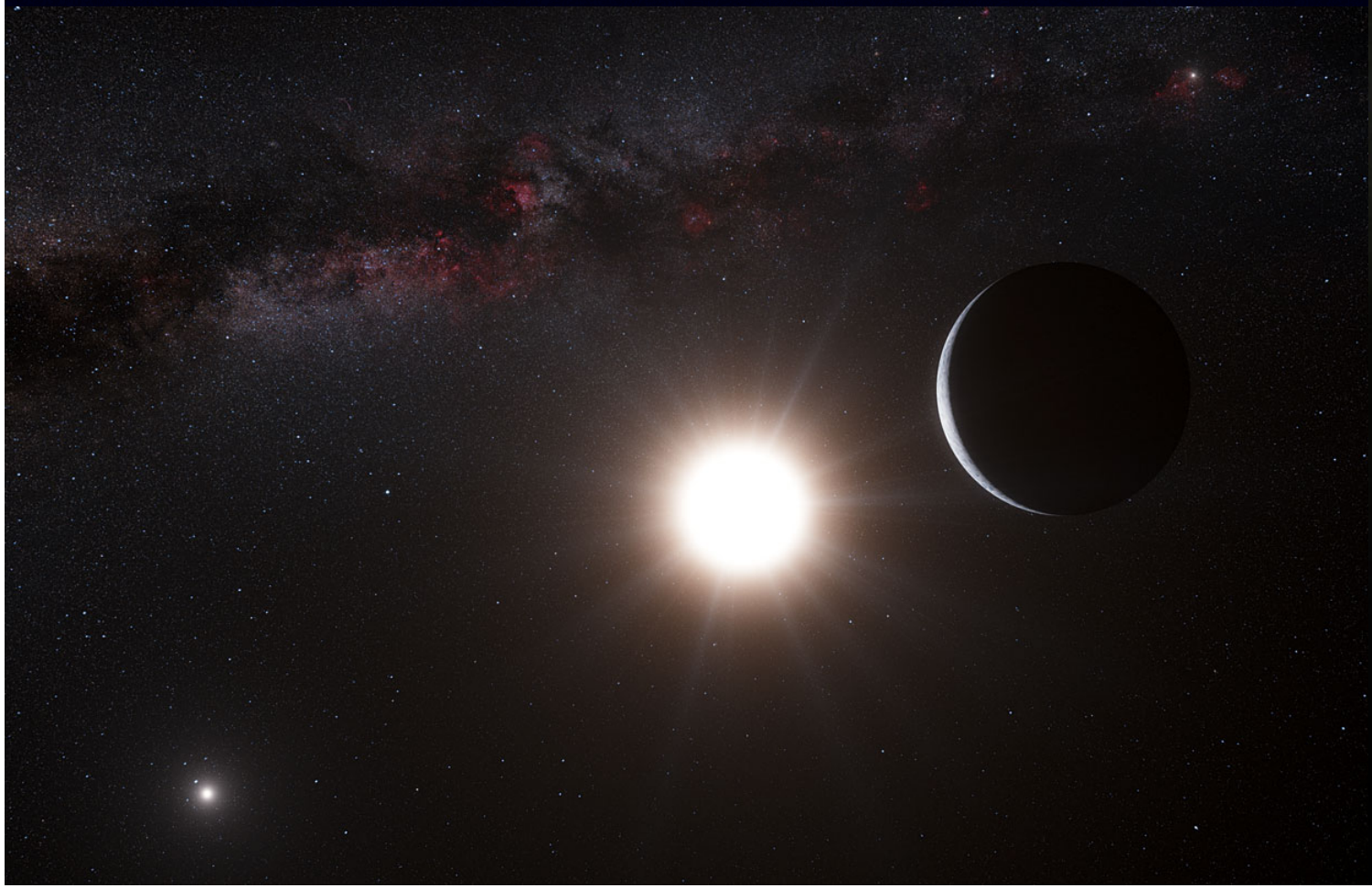
Semi asse maggiore dell'orbita

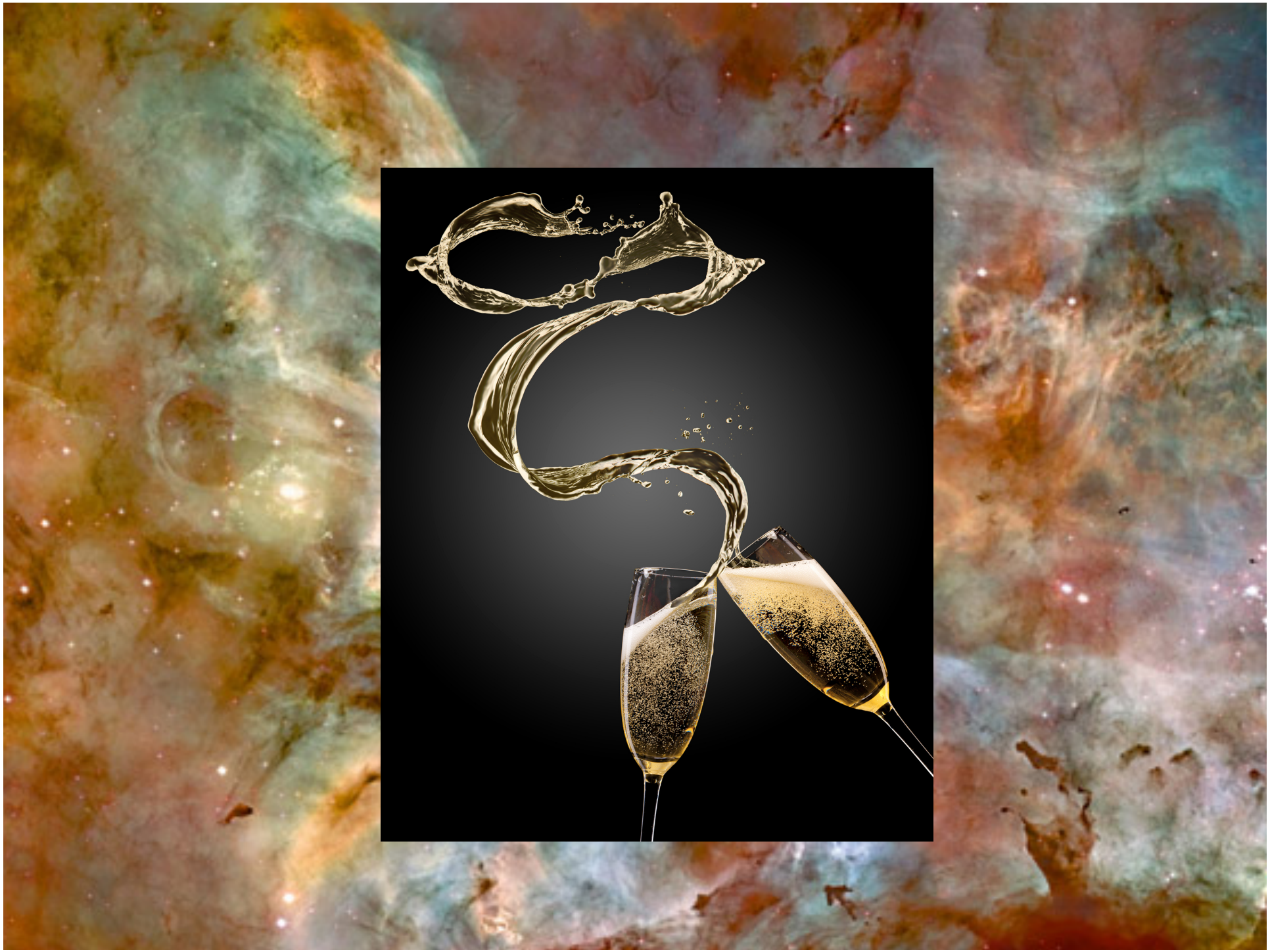
Ciclo del Carbonio

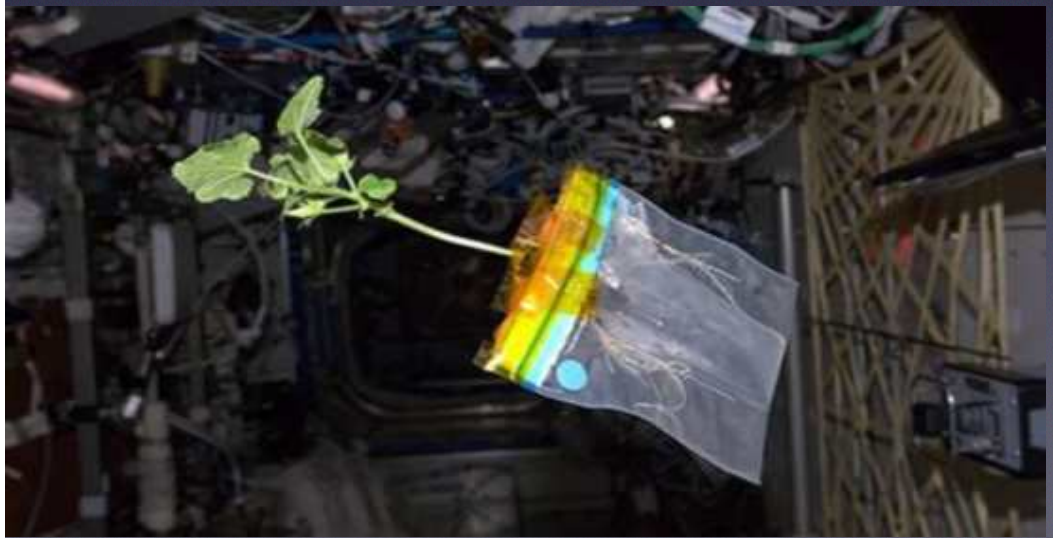




Un nuovo vino?

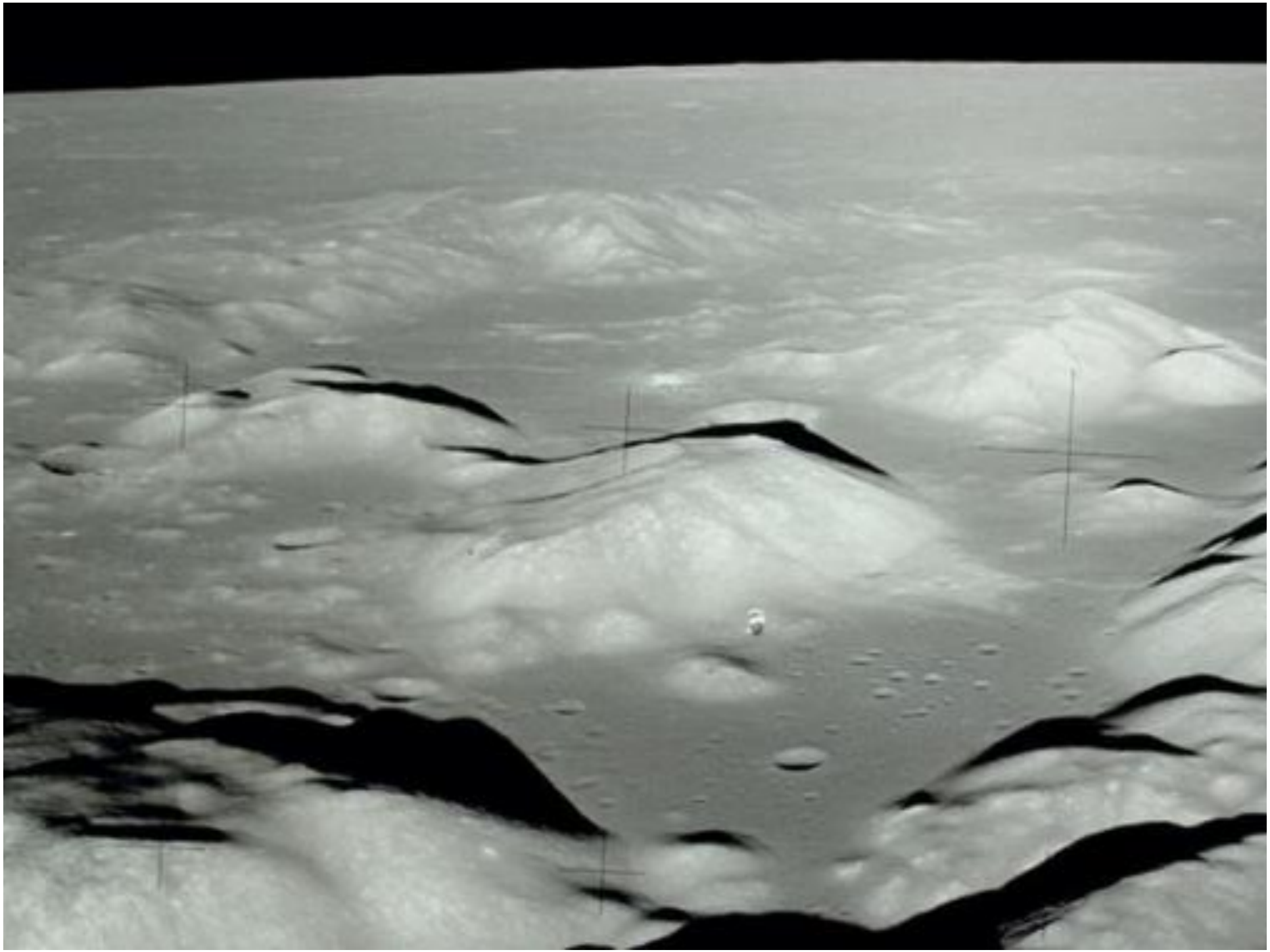




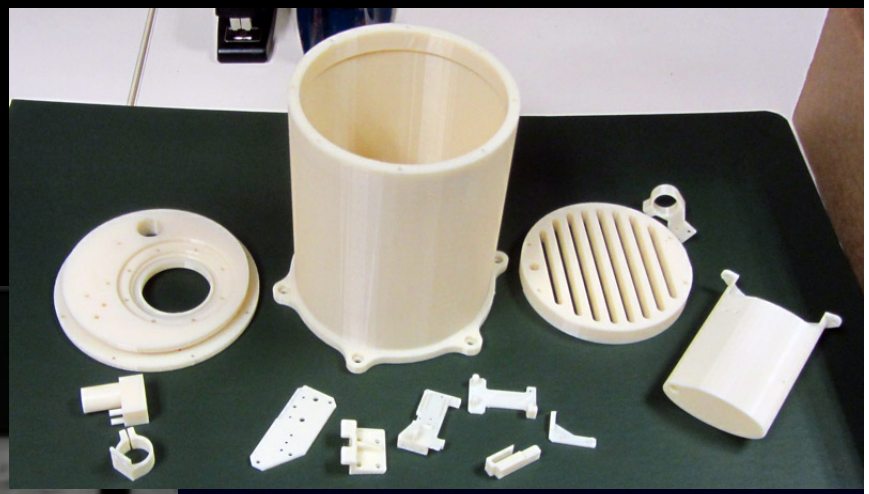


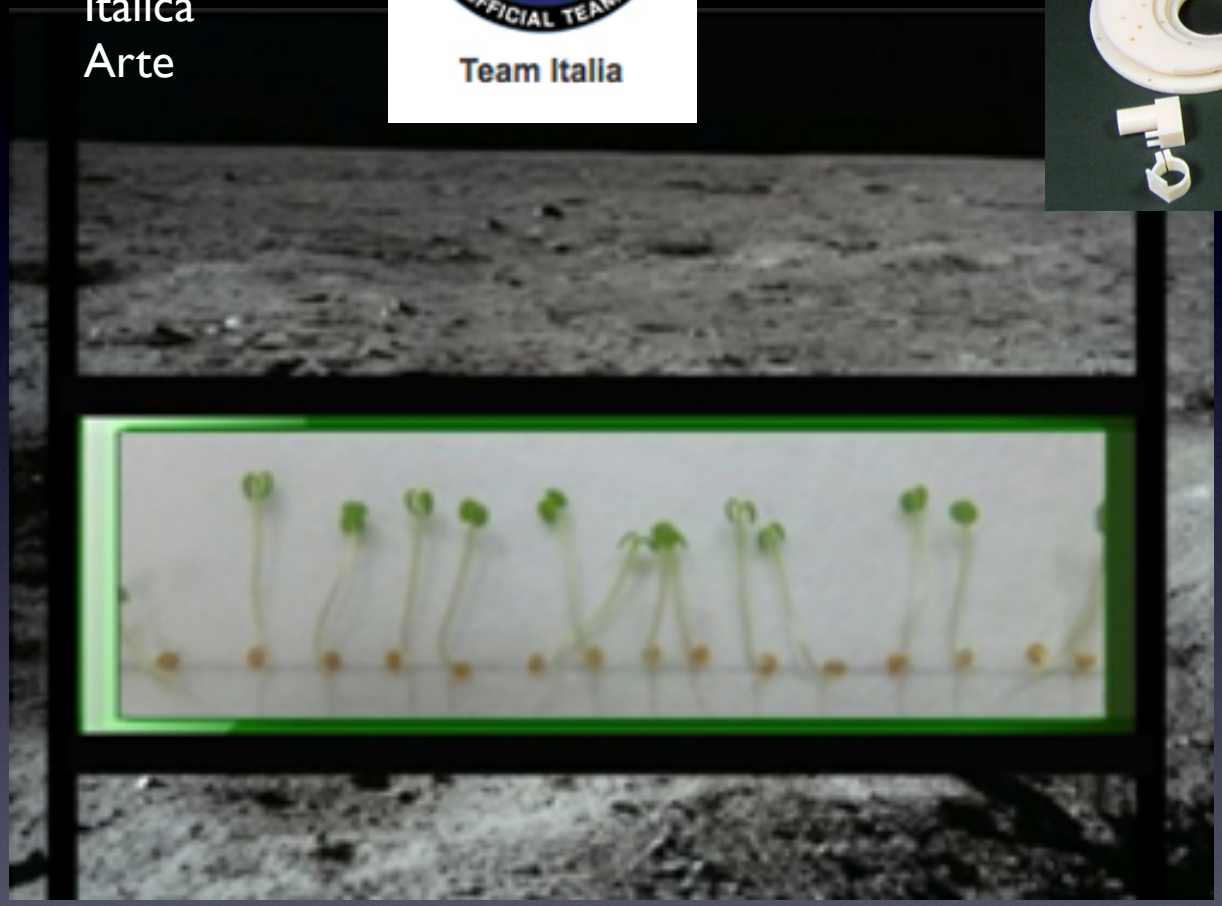
Piante sulla ISS

crescione basilico ..



Ascensio
Machinae
Ad
Lunam
Italica
Arte





Google Lunar X-Prize
Per il 2016