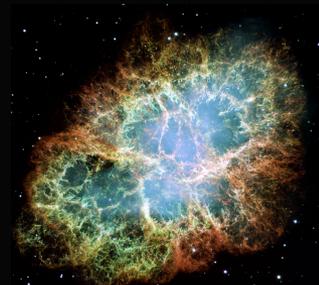
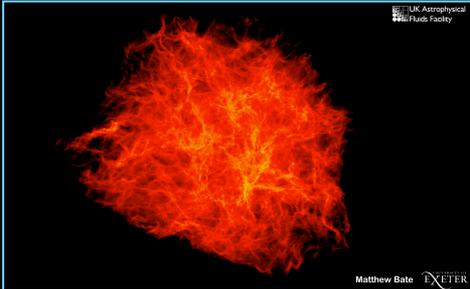
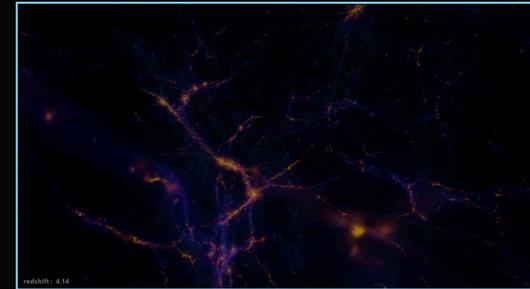
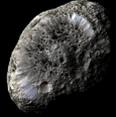
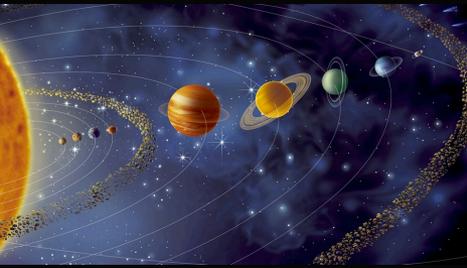


Wir sind nicht allein!

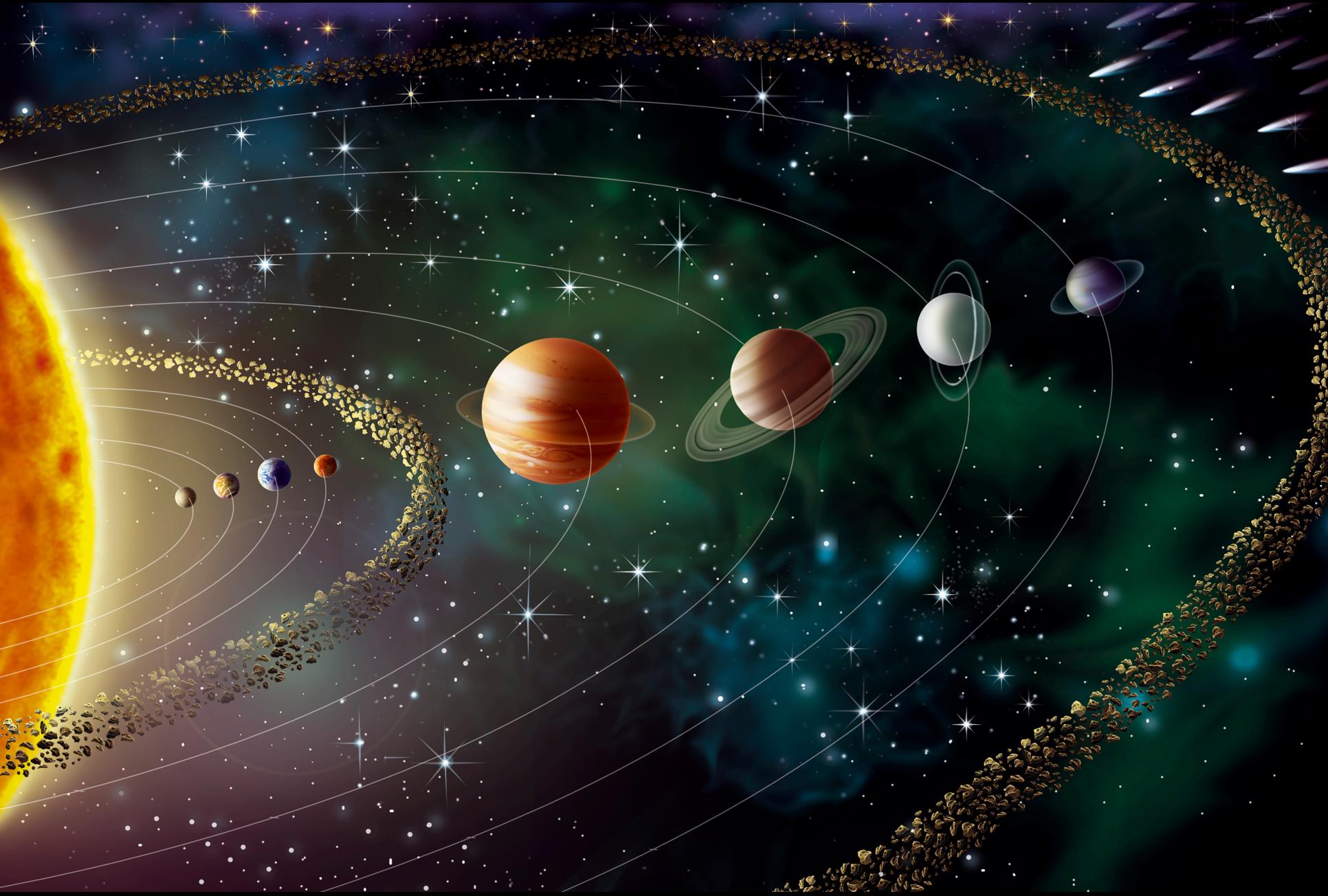


Clemens

Sind wir allein?



Das Sonnensystem, unsere kosmische Heimat

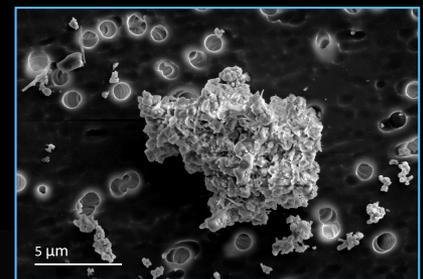




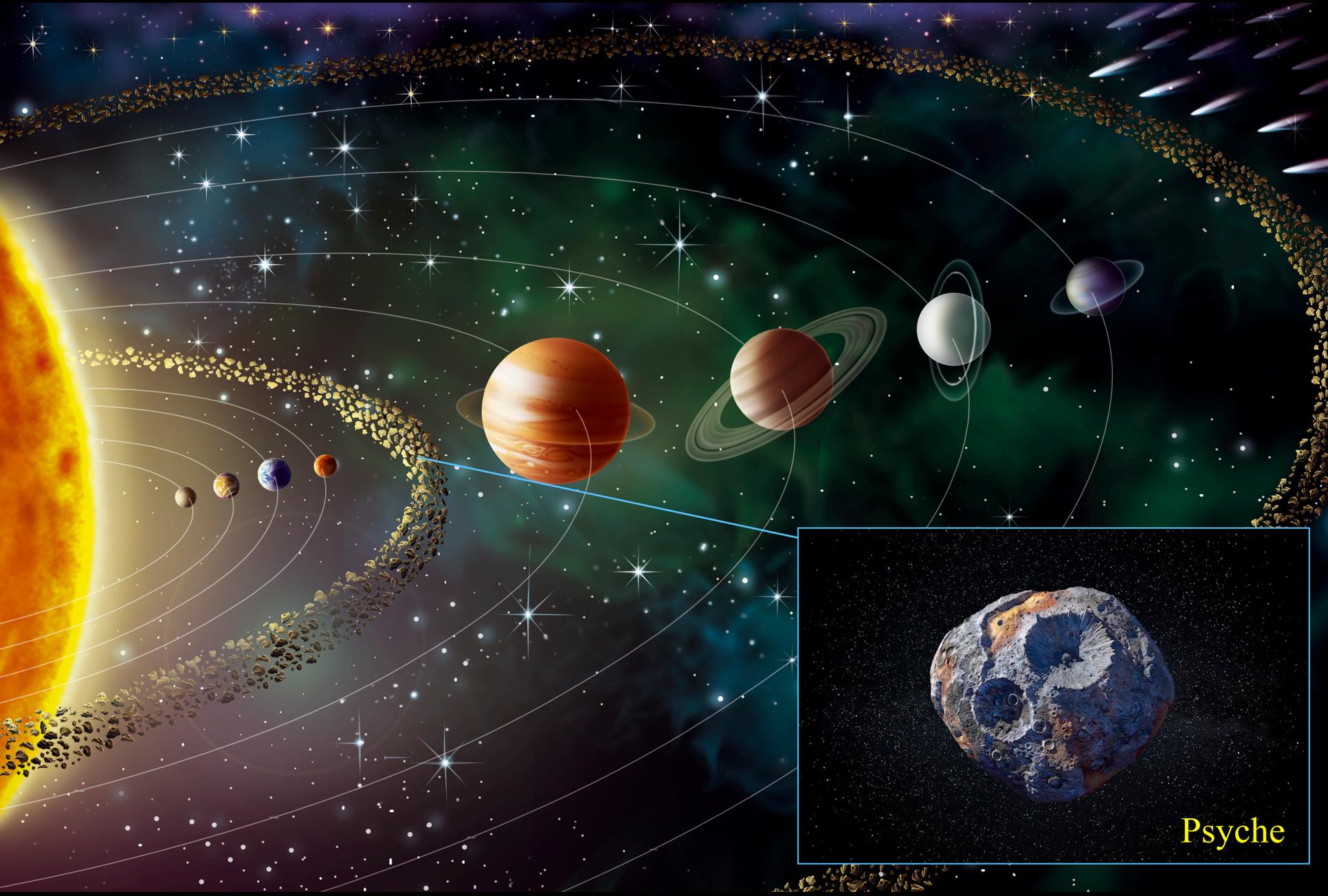


allisonpottersdesigns.com

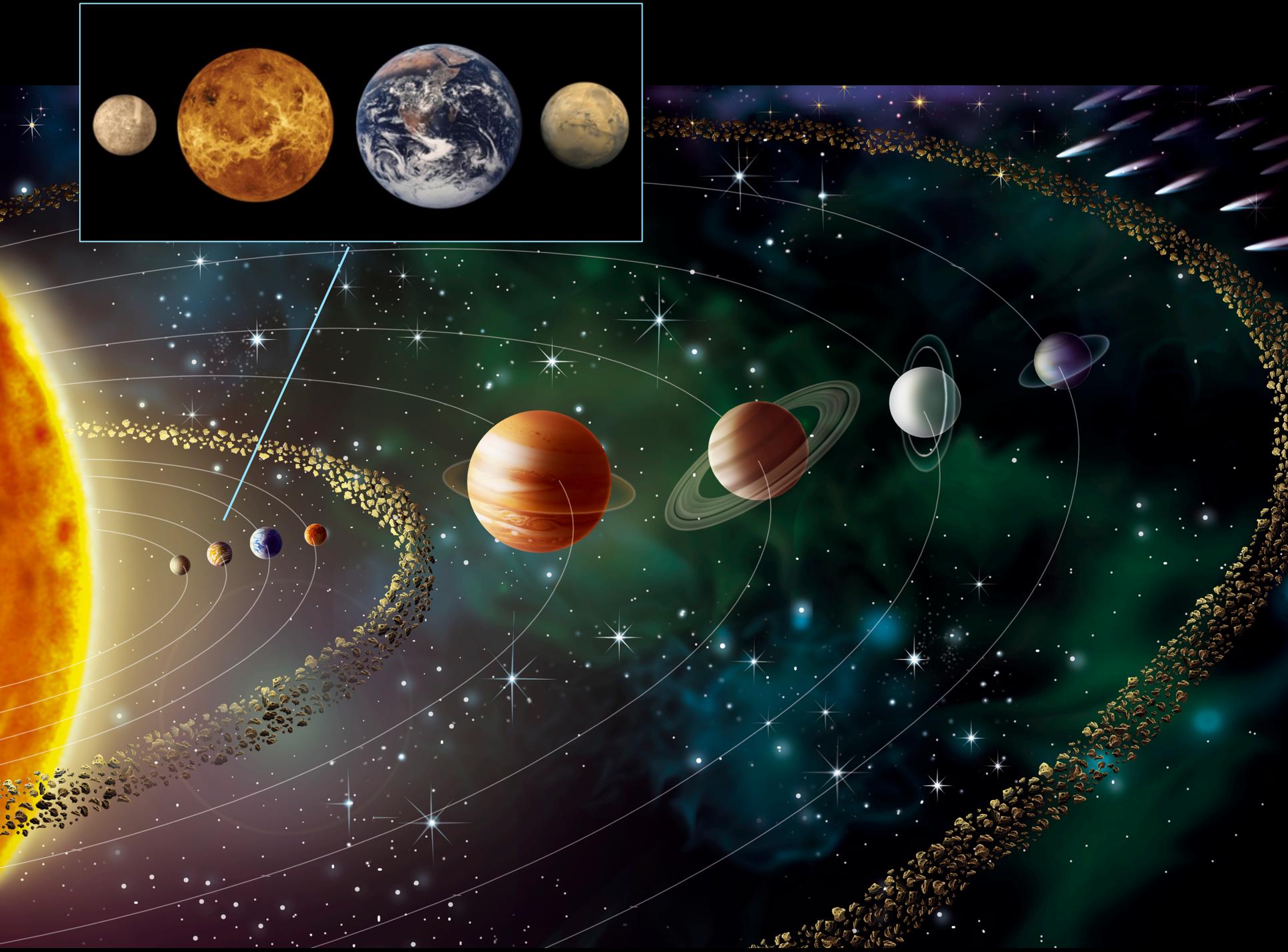
Sternenstaub: Baustein der Erde und des Lebens



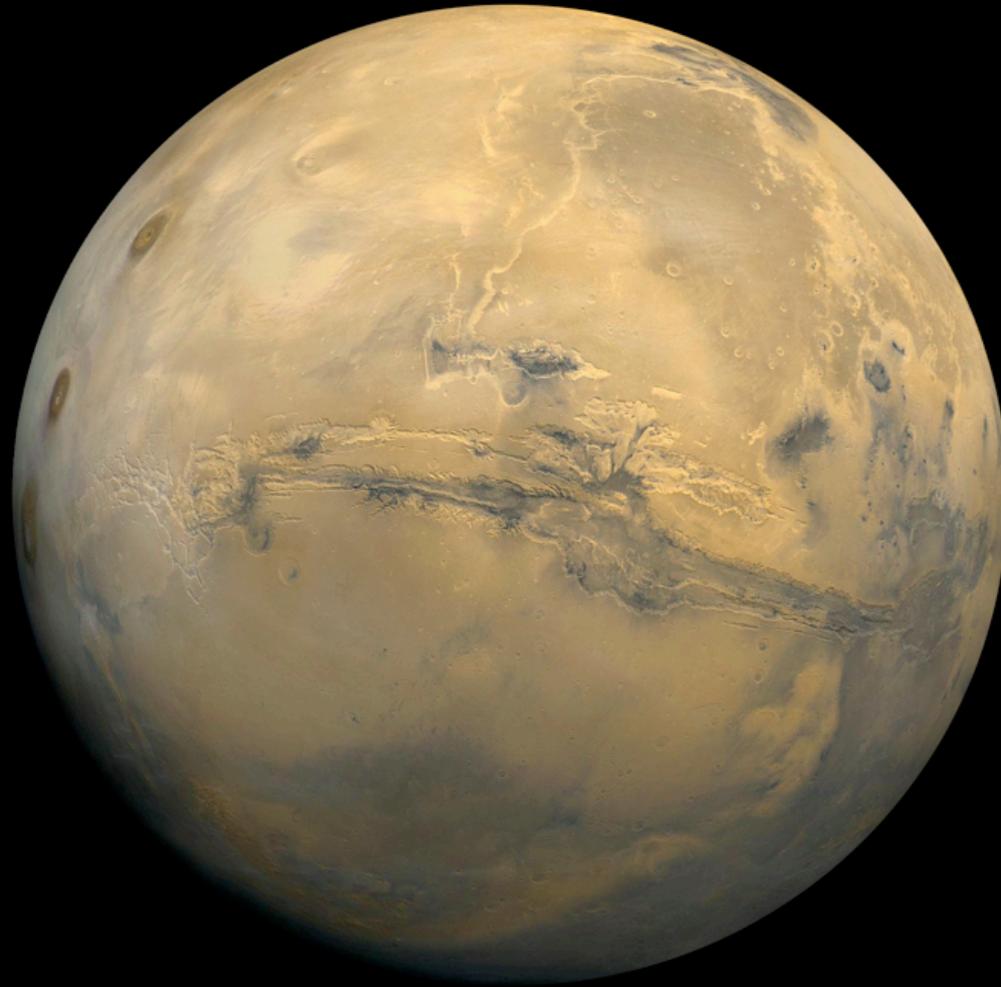
Sternenstaub



Psyche



Mars, der Wüstenplanet

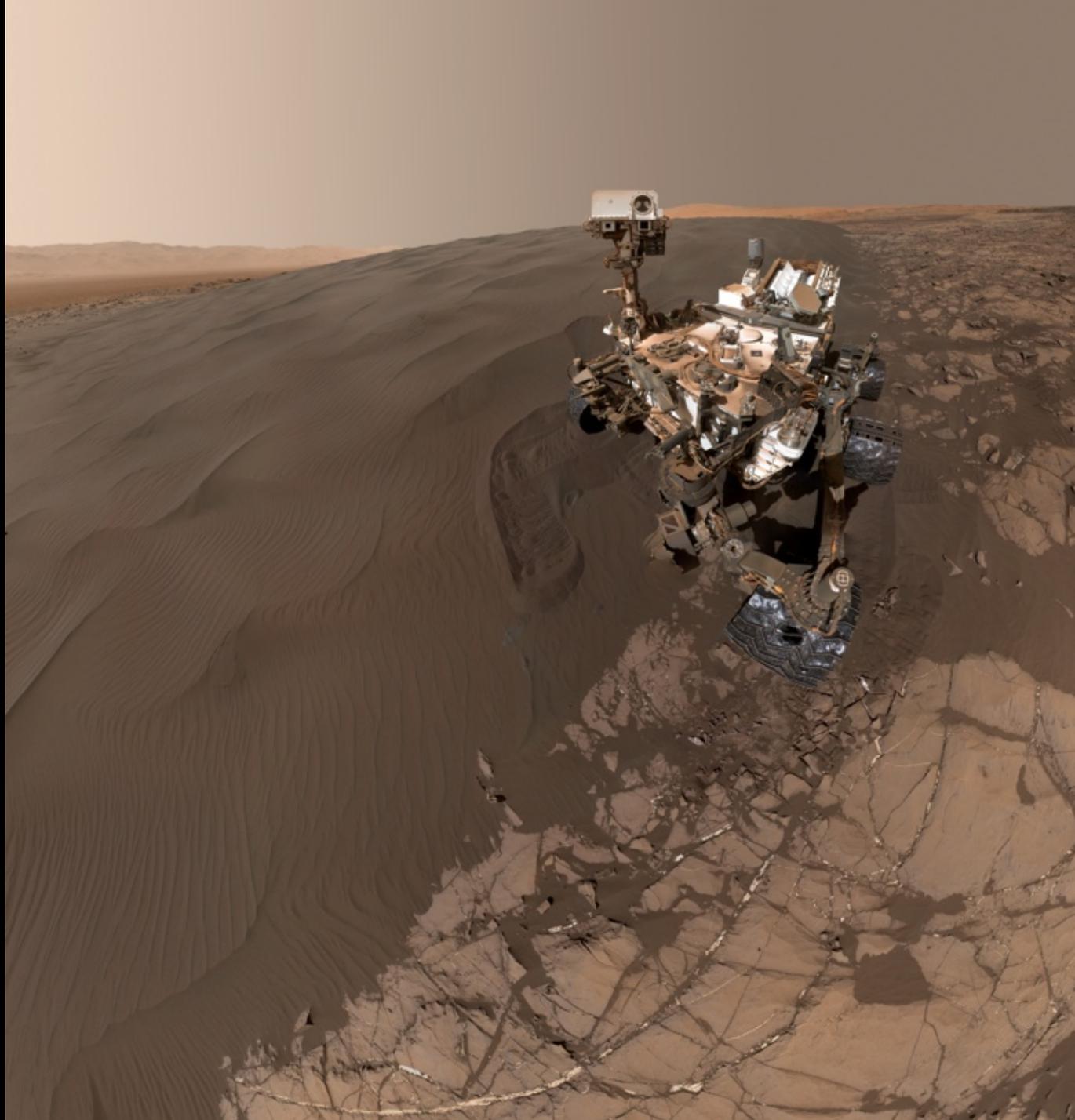


Curiosity

*Feine, rostrote
Sandpartikel*

*Vulkanisches
Basalt*

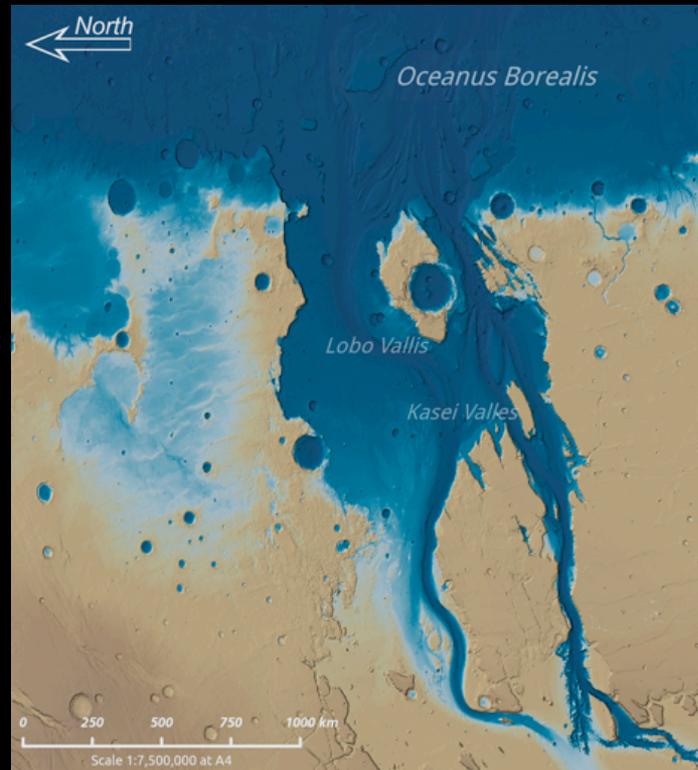
Eisenoxid (Rost)

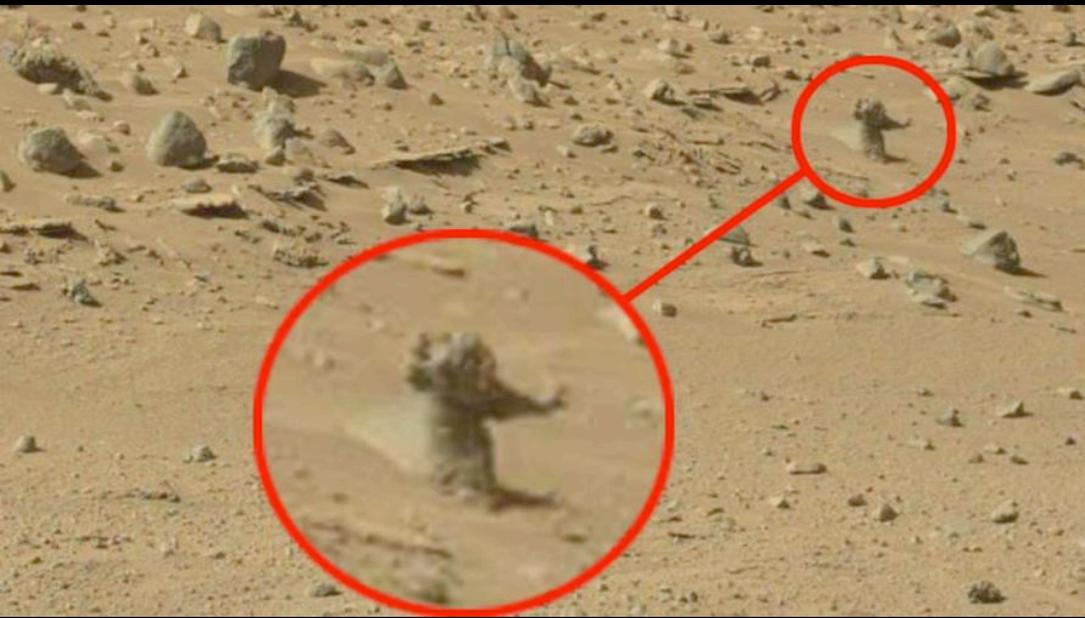


Curiosity findet einen alten See im Gale Krater



Der Urozean auf Mars vor 3-4 Milliarden Jahren



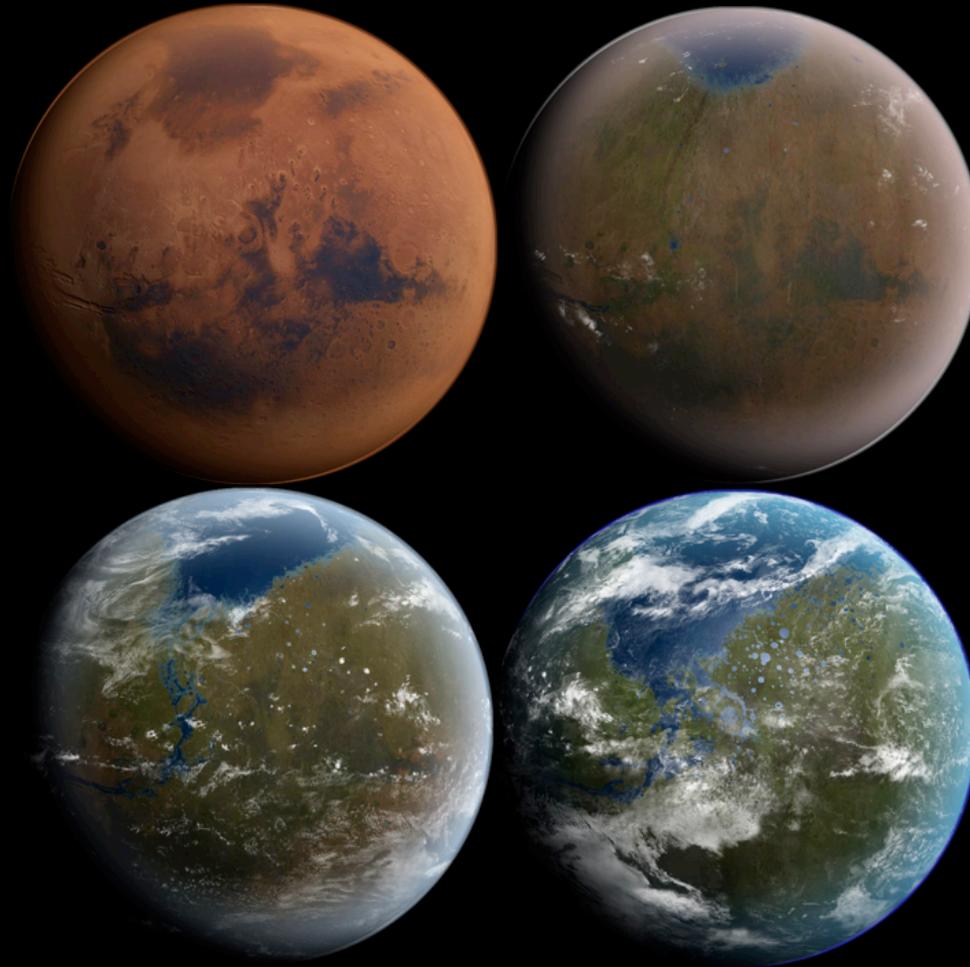


Leben auf dem Mars?



0 ... 1 ... Unendlich

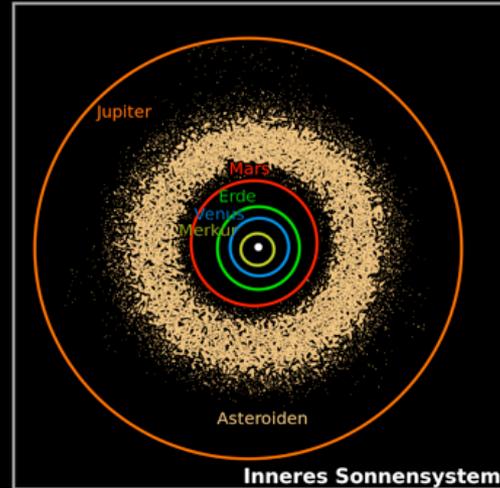
Ein „backup“ für die Erde ? (Terraforming)



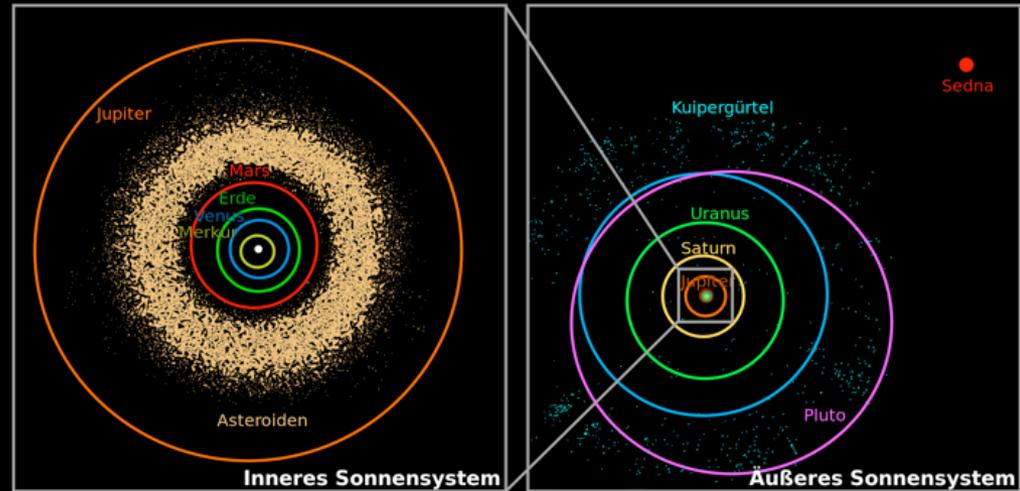
Kometen



Die Oortsche Wolke

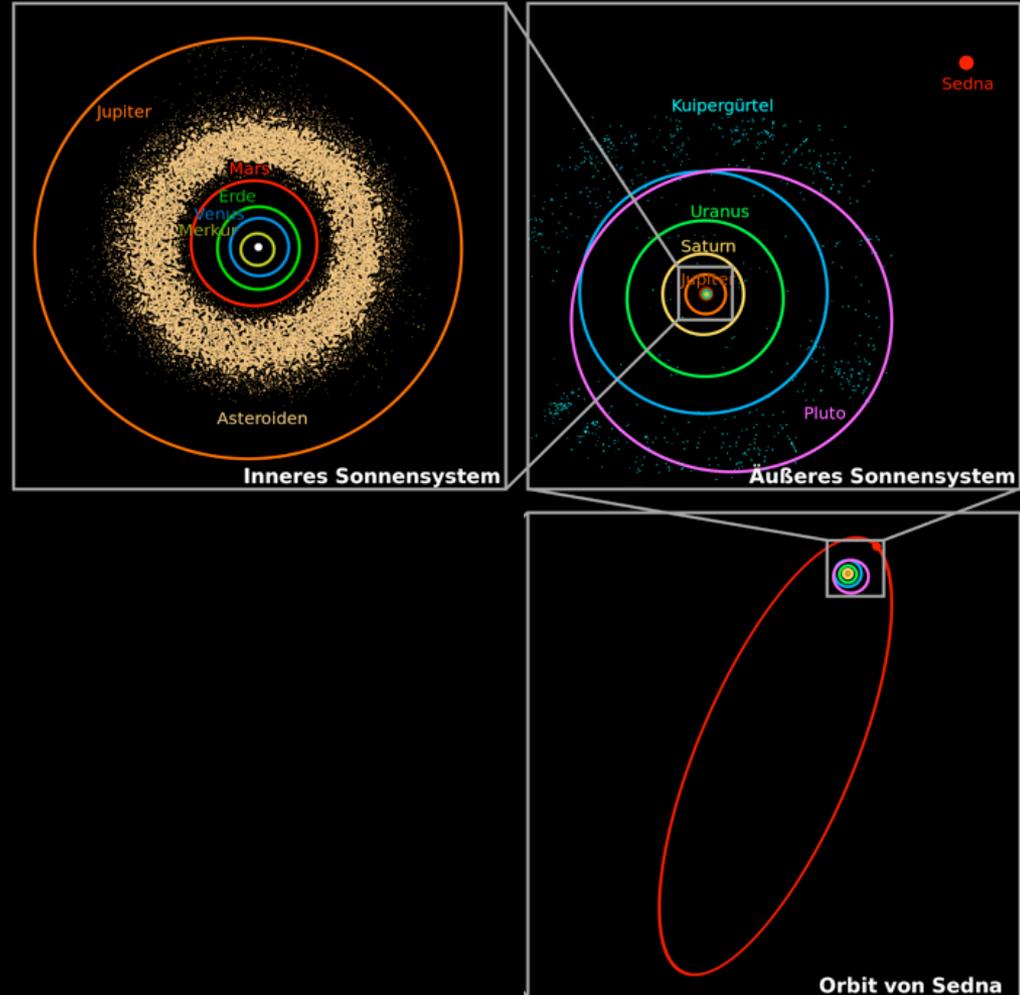


Die Oortsche Wolke

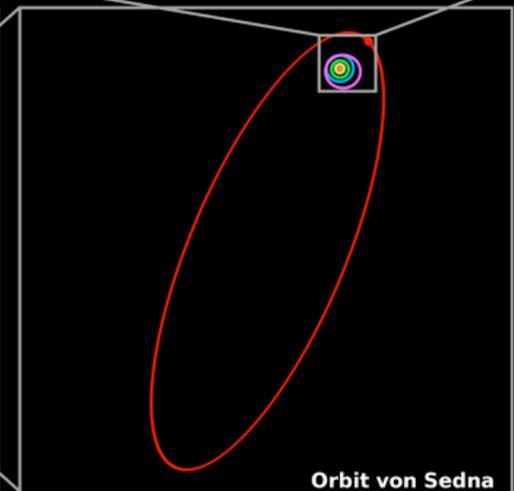
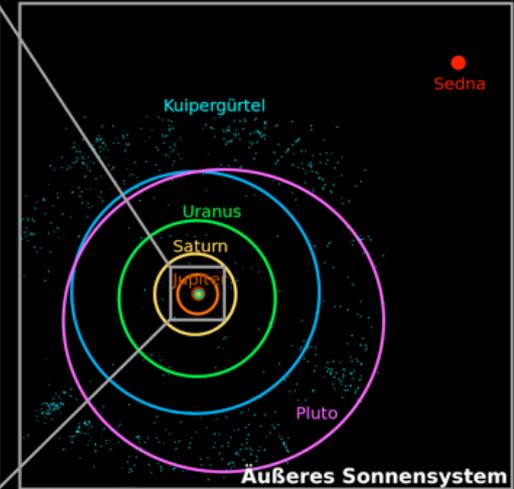
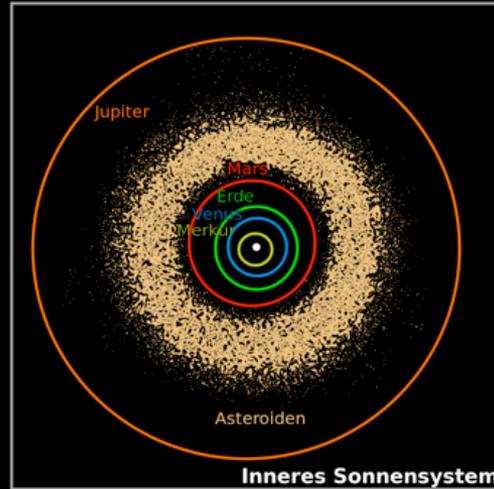


Die Oortsche Wolke

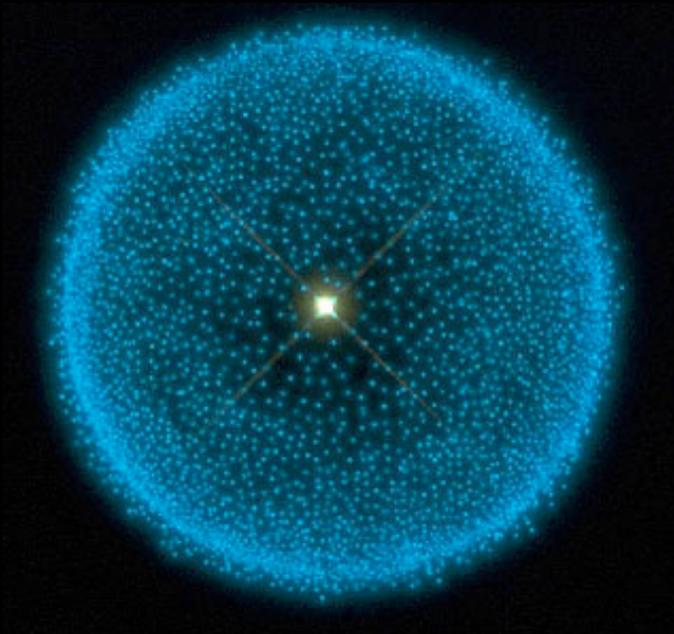
Die unglaubliche Leere des Sonnensystems



Die Oortsche Wolke

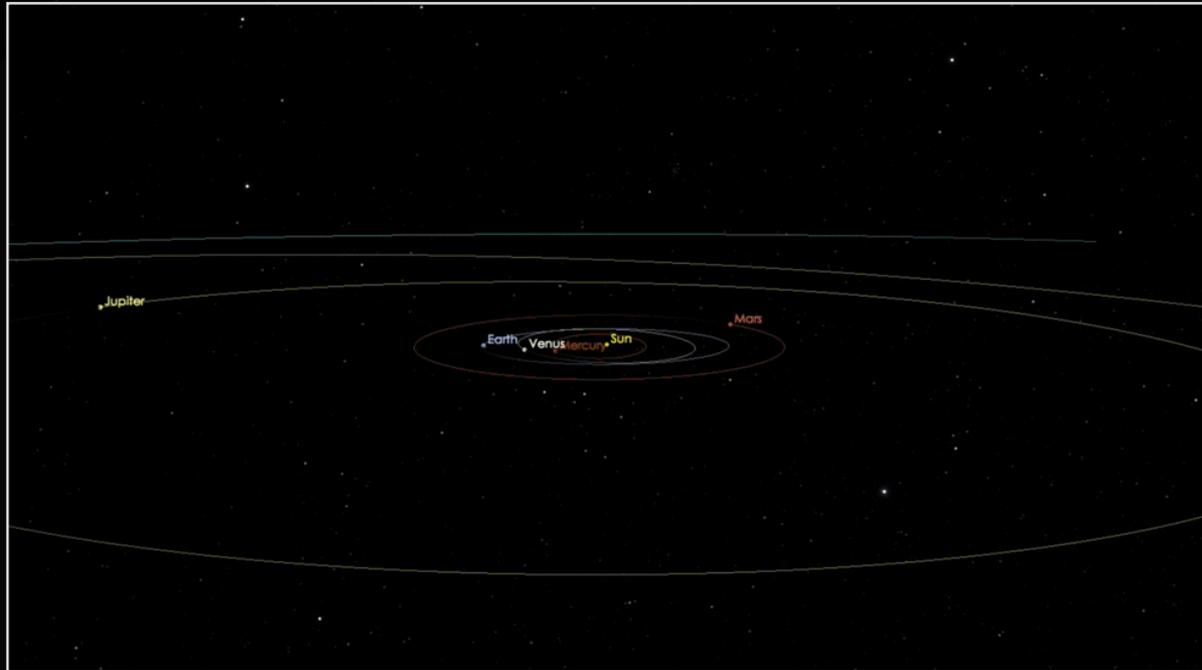
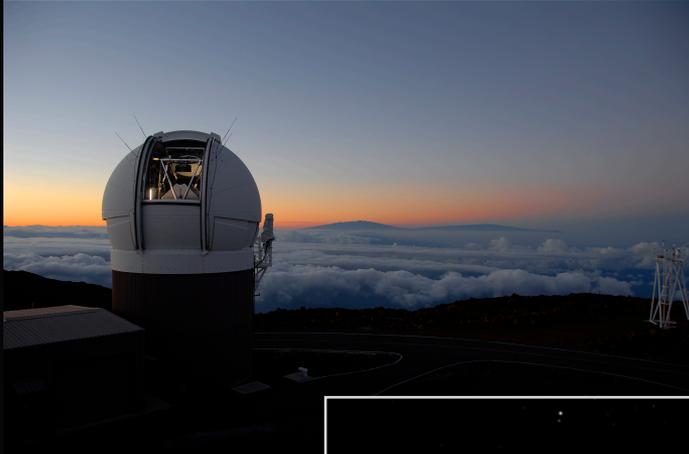


Die Welt der Kometen

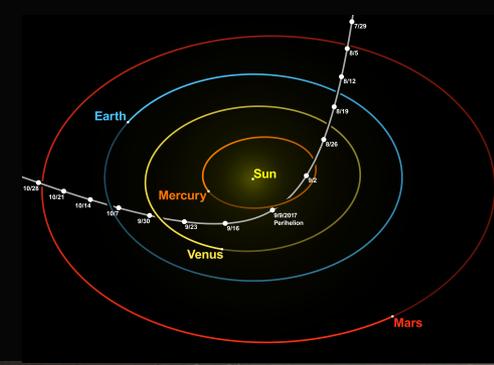


19.10.2017

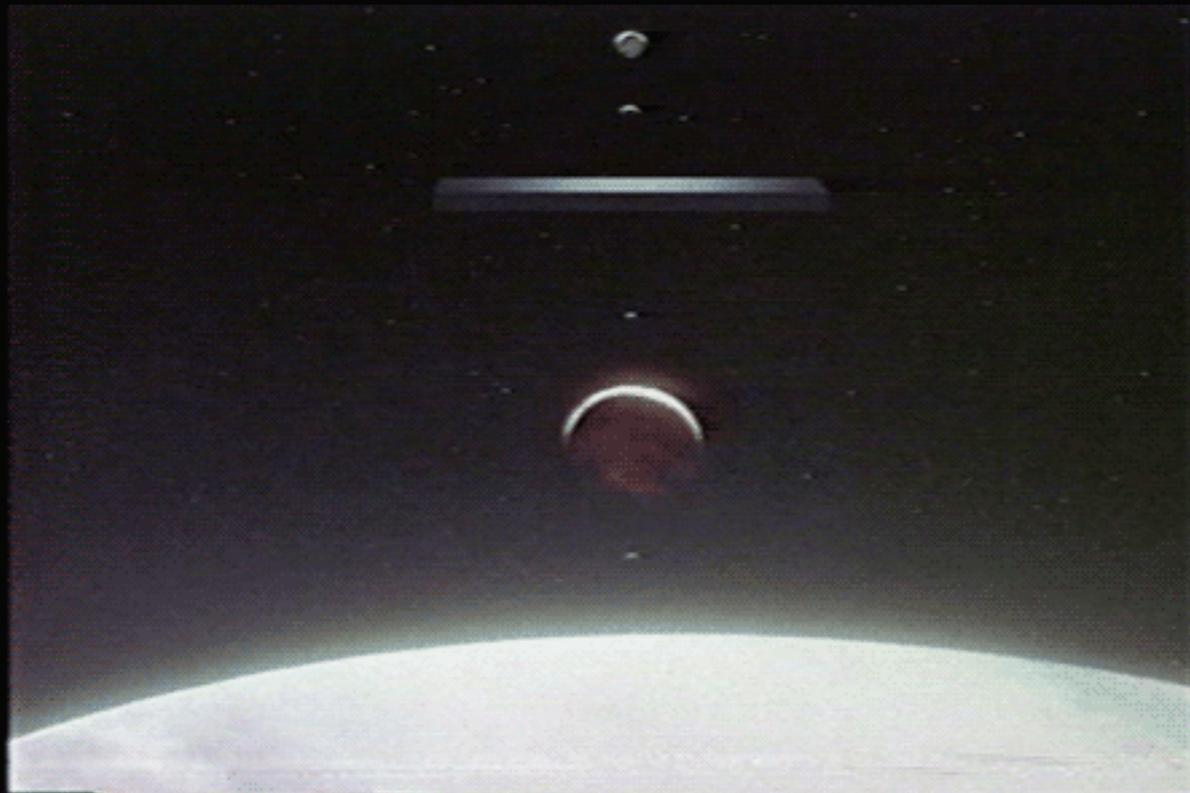
*Der interstellare Komet Oumuamua
(Scout+erster seiner Art): 400m*



Hundert Quadrillionen Kometen



*Stanley Kubricks (1968): **2001, Odyssee im Weltraum**
Monolith in Orbit um Jupiter*



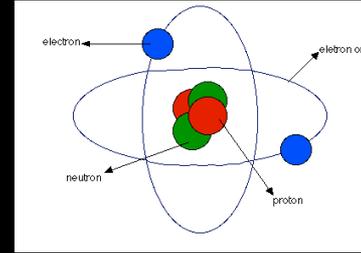
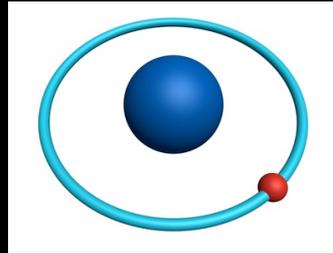
Clemens

Unser Stern

H

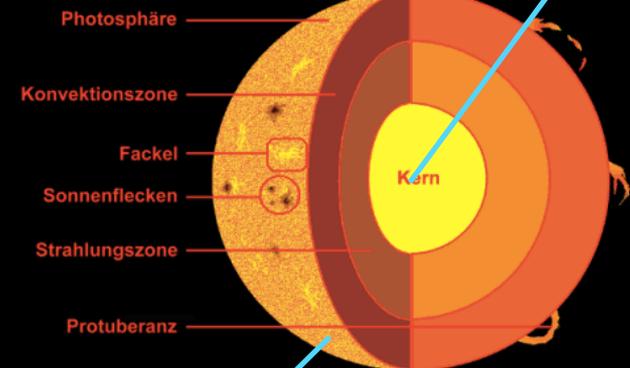
$$E = m c^2$$

He

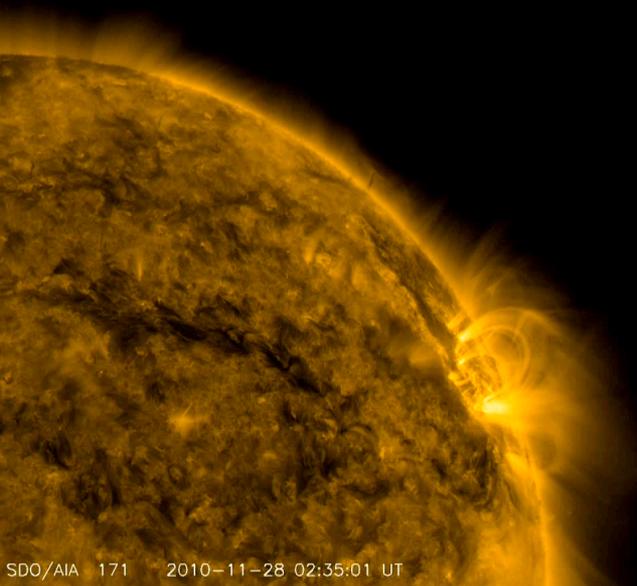


4 Mio Tonnen/s

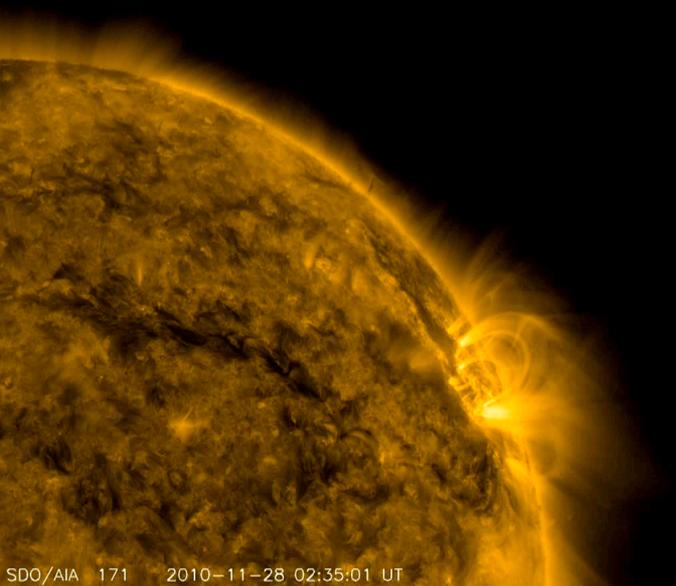
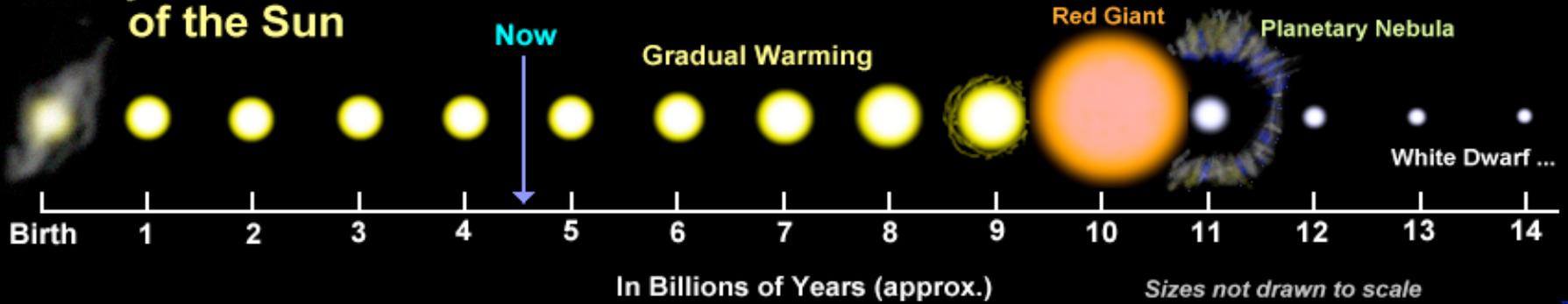
15 Millionen Grad



6400 Grad



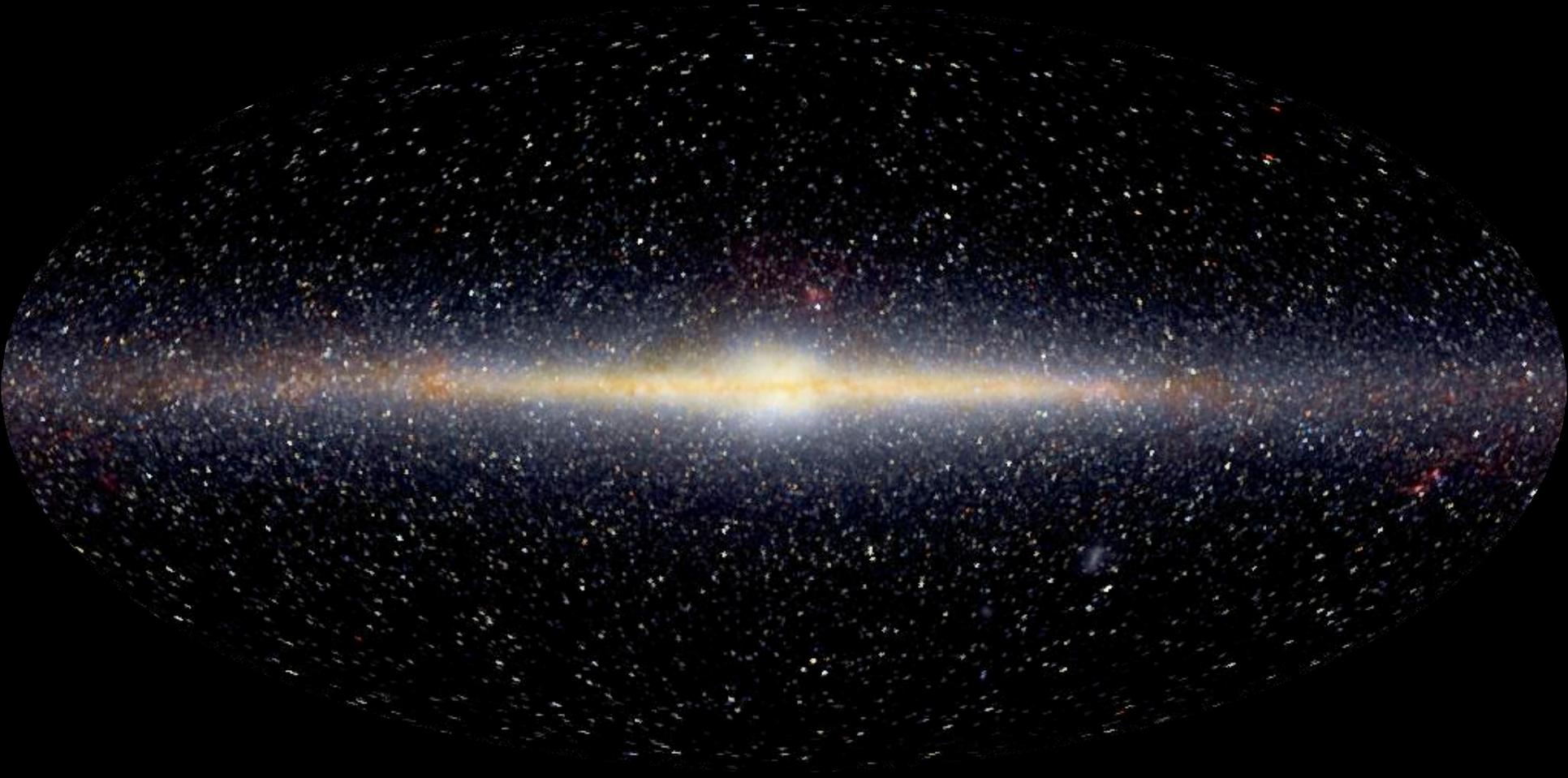
Life Cycle of the Sun



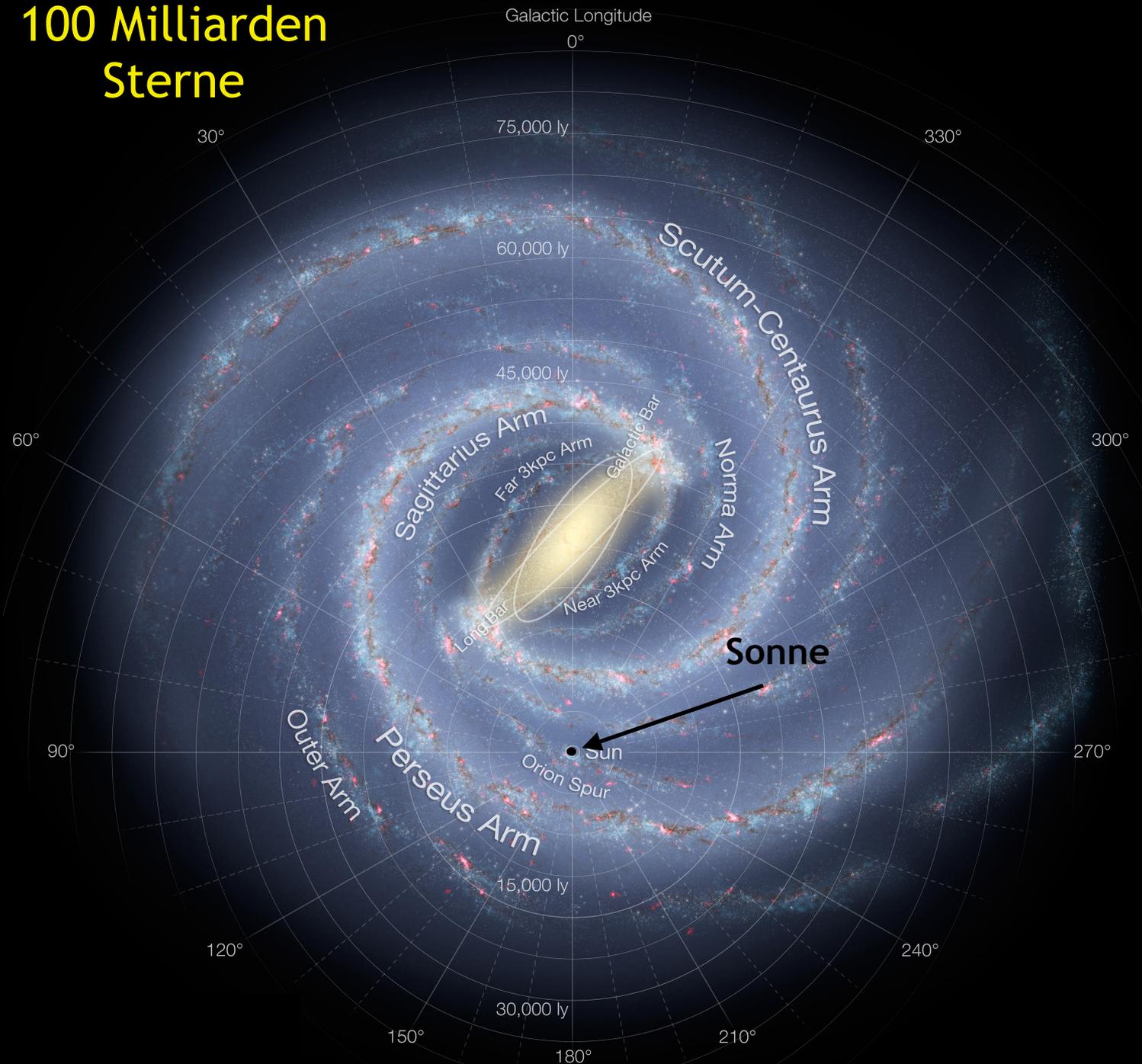




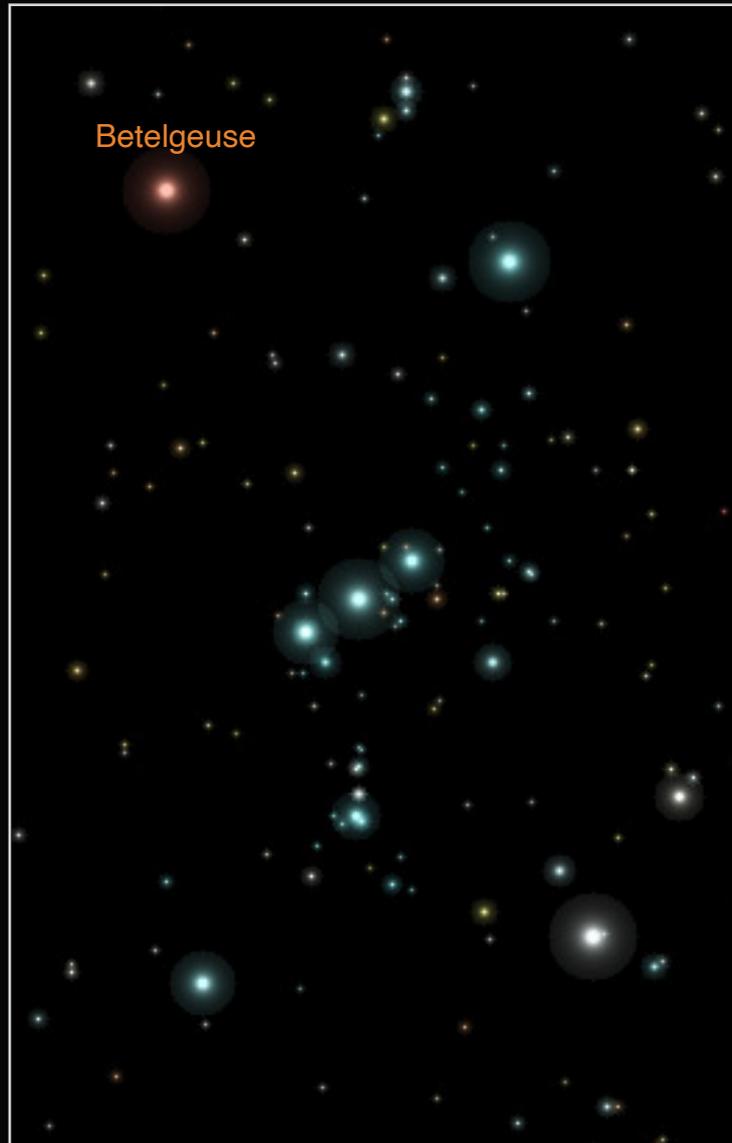
Die Milchstraße, unsere kosmische Welteninsel



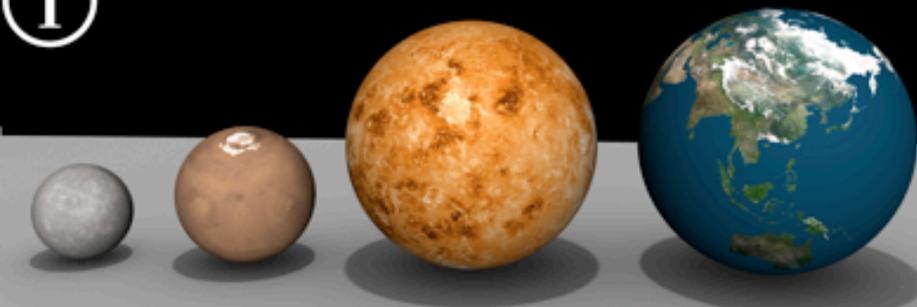
100 Milliarden Sterne



Die farbige Welt der Sterne



① Mercury < Mars < Venus < Earth



② Earth < Neptune < Uranus < Saturn < Jupiter



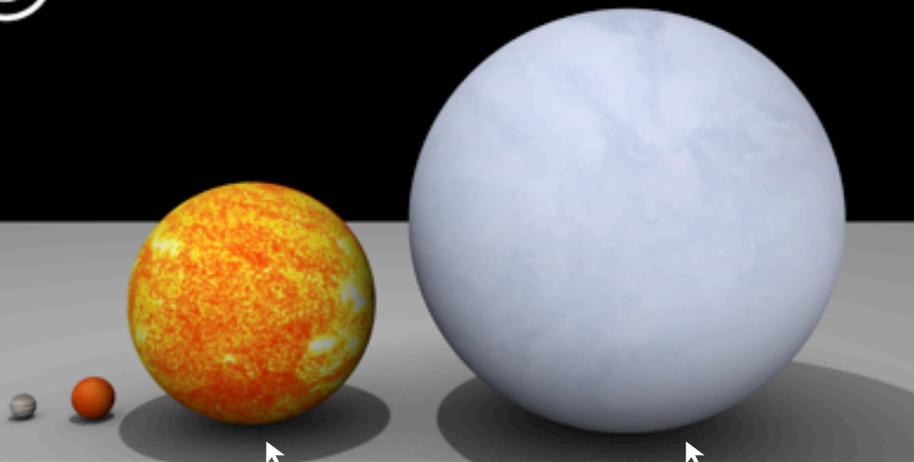
① Mercury < Mars < Venus < Earth



② Earth < Neptune < Uranus < Saturn < Jupiter



③ Jupiter < Wolf 359 < Sun < Sirius



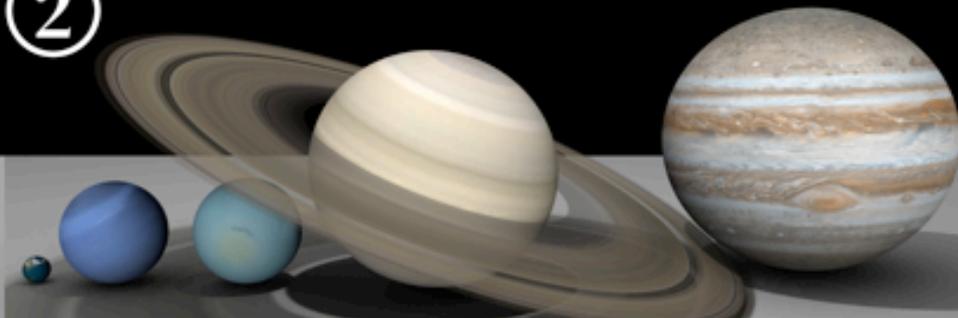
Sonne

*Sirius:
Hellste Stern; 2 Sonnenmassen*

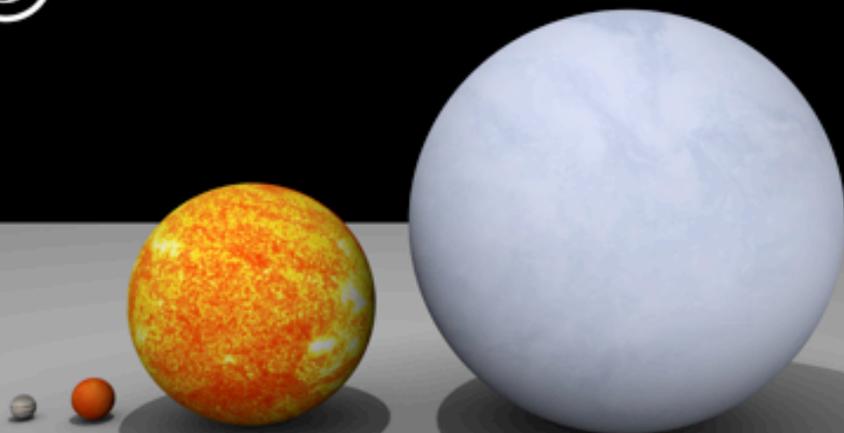
① Mercury < Mars < Venus < Earth



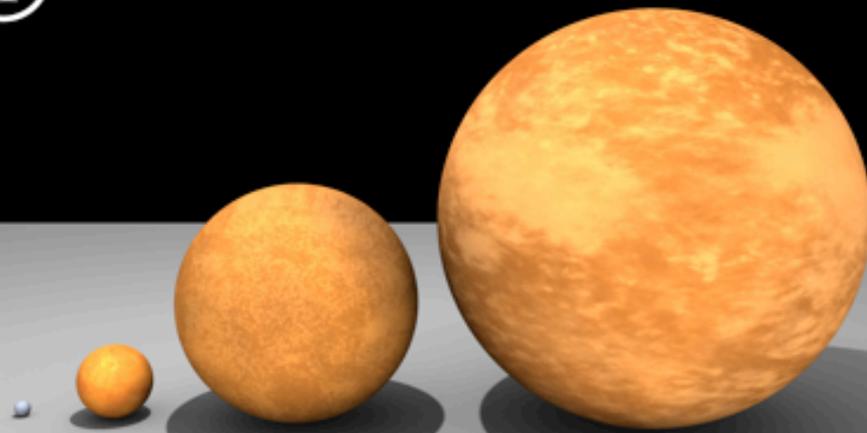
② Earth < Neptune < Uranus < Saturn < Jupiter



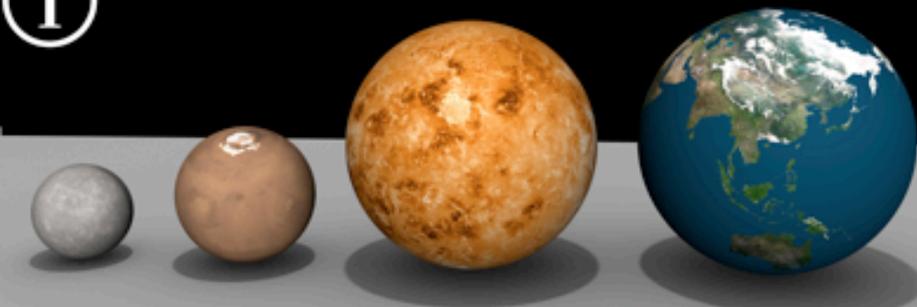
③ Jupiter < Wolf 359 < Sun < Sirius



④ Sirius < Pollux < Arcturus < Aldebaran



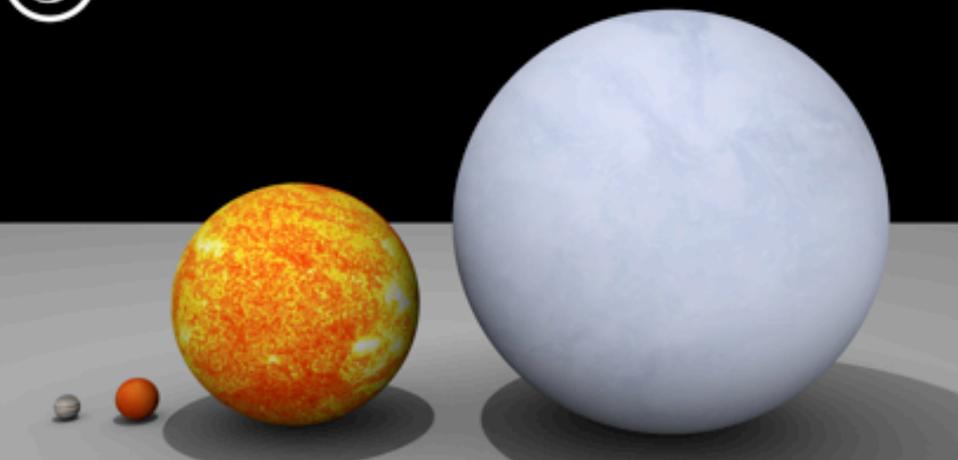
① Mercury < Mars < Venus < Earth



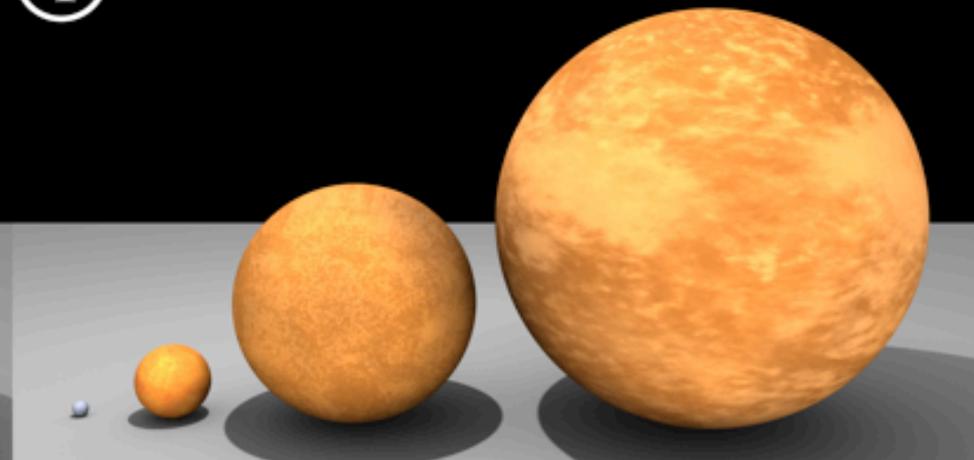
② Earth < Neptune < Uranus < Saturn < Jupiter



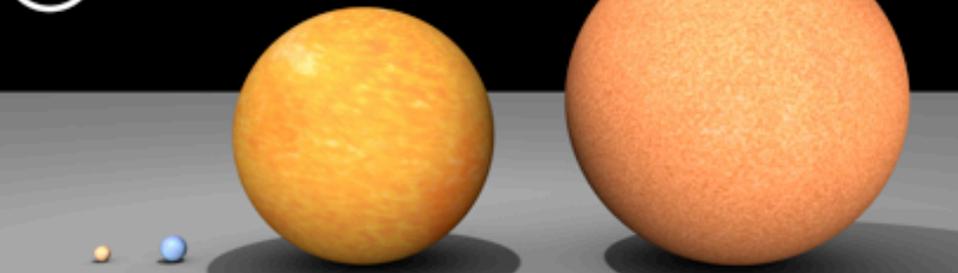
③ Jupiter < Wolf 359 < Sun < Sirius



④ Sirius < Pollux < Arcturus < Aldebaran



⑤ Aldebaran < Rigel < Antares < Betelgeuse



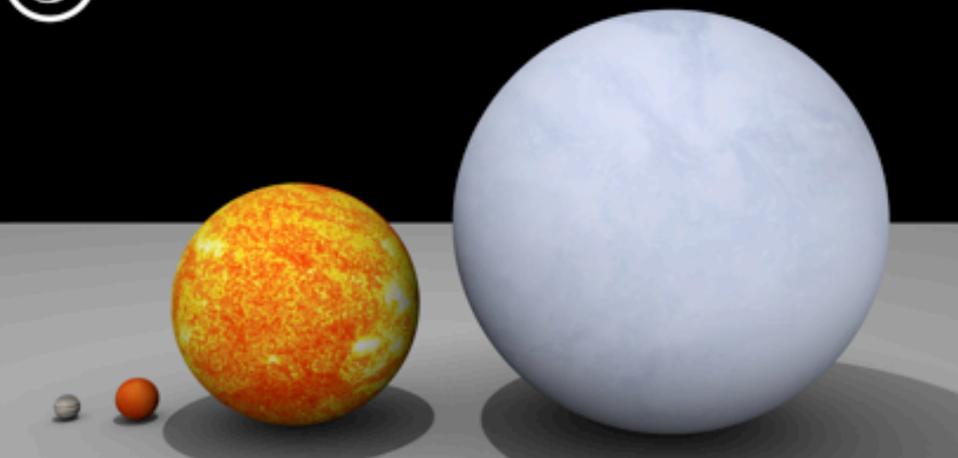
① Mercury < Mars < Venus < Earth



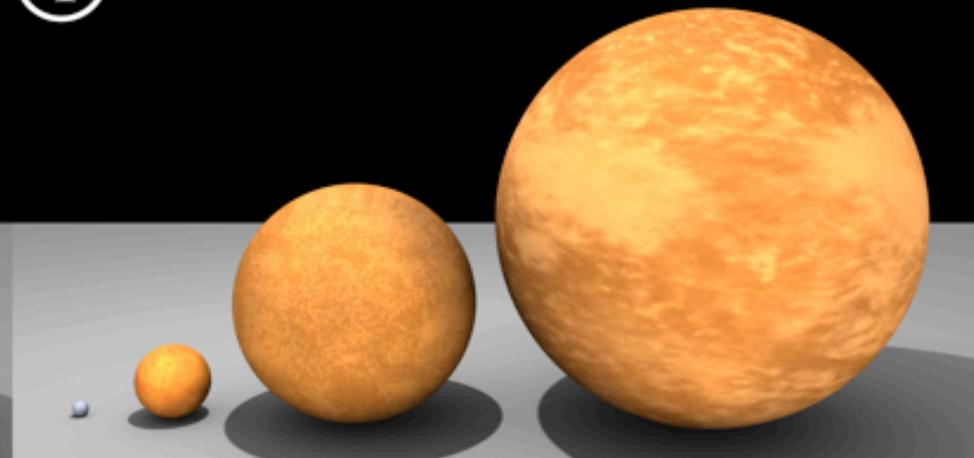
② Earth < Neptune < Uranus < Saturn < Jupiter



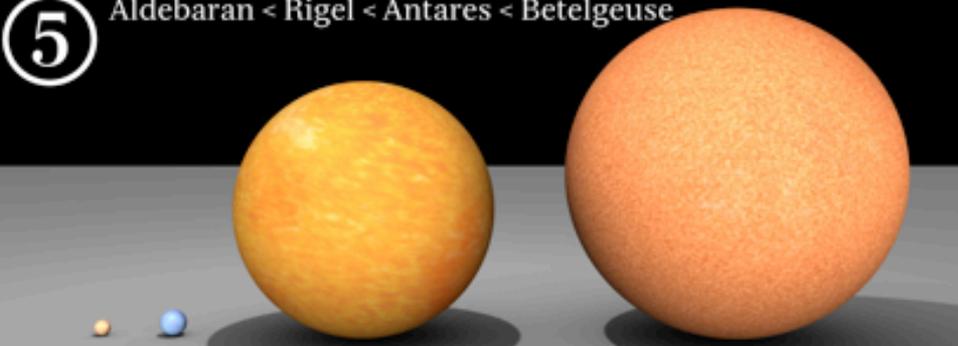
③ Jupiter < Wolf 359 < Sun < Sirius



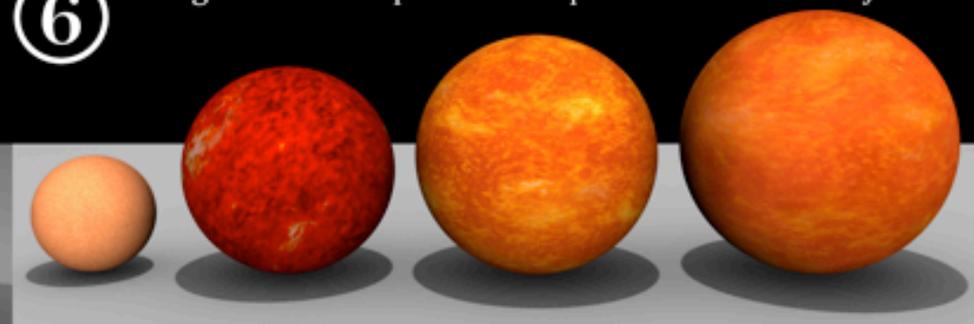
④ Sirius < Pollux < Arcturus < Aldebaran

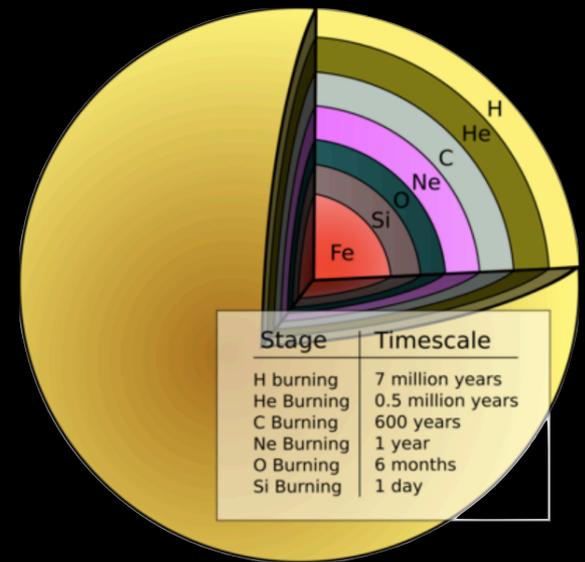
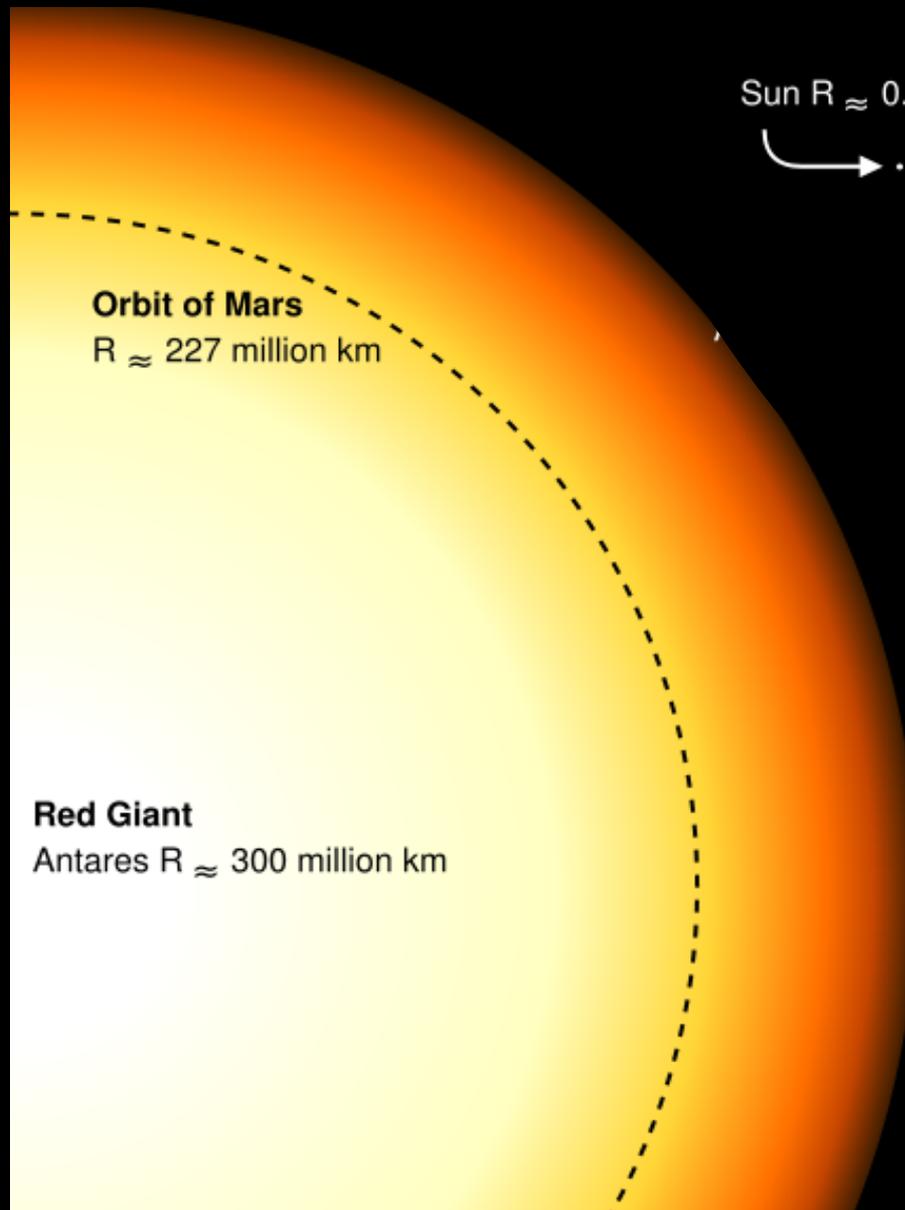


⑤ Aldebaran < Rigel < Antares < Betelgeuse

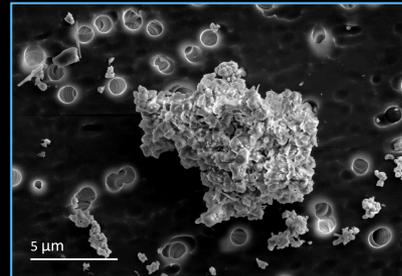
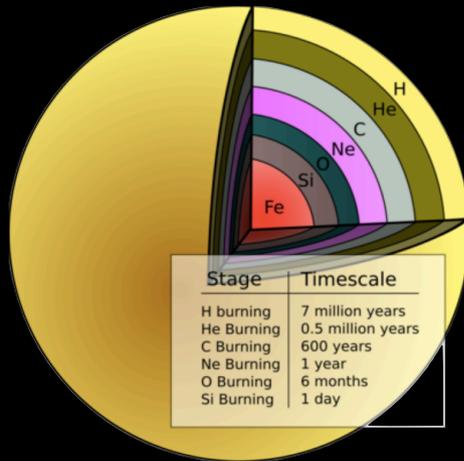


⑥ Betelgeuse < Mu Cephei < VV Cephei A < VY Canis Majoris





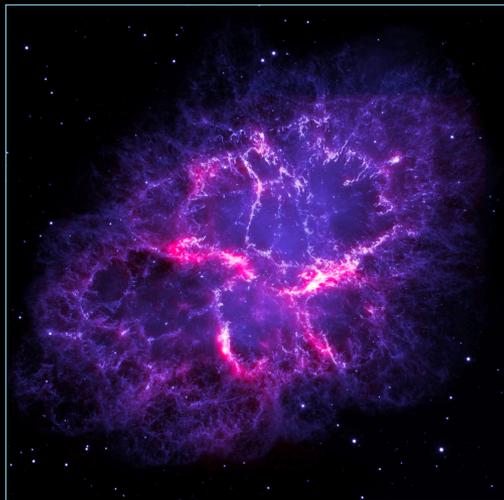
Der Ursprung des Sternenstaubs



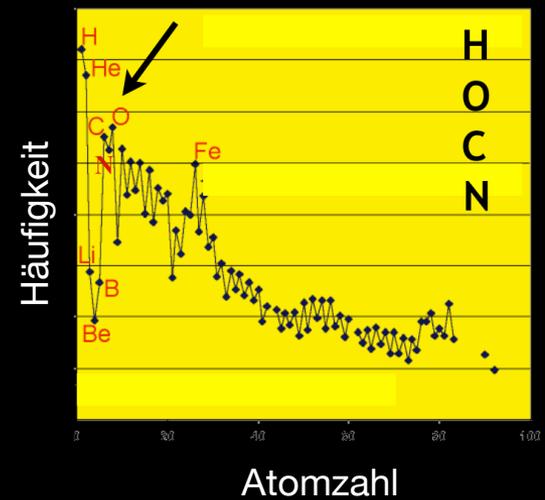
Chemie des Menschen

H:	63%
O:	25,5%
C:	9,5%
N:	1,4%
Rest:	0,6%

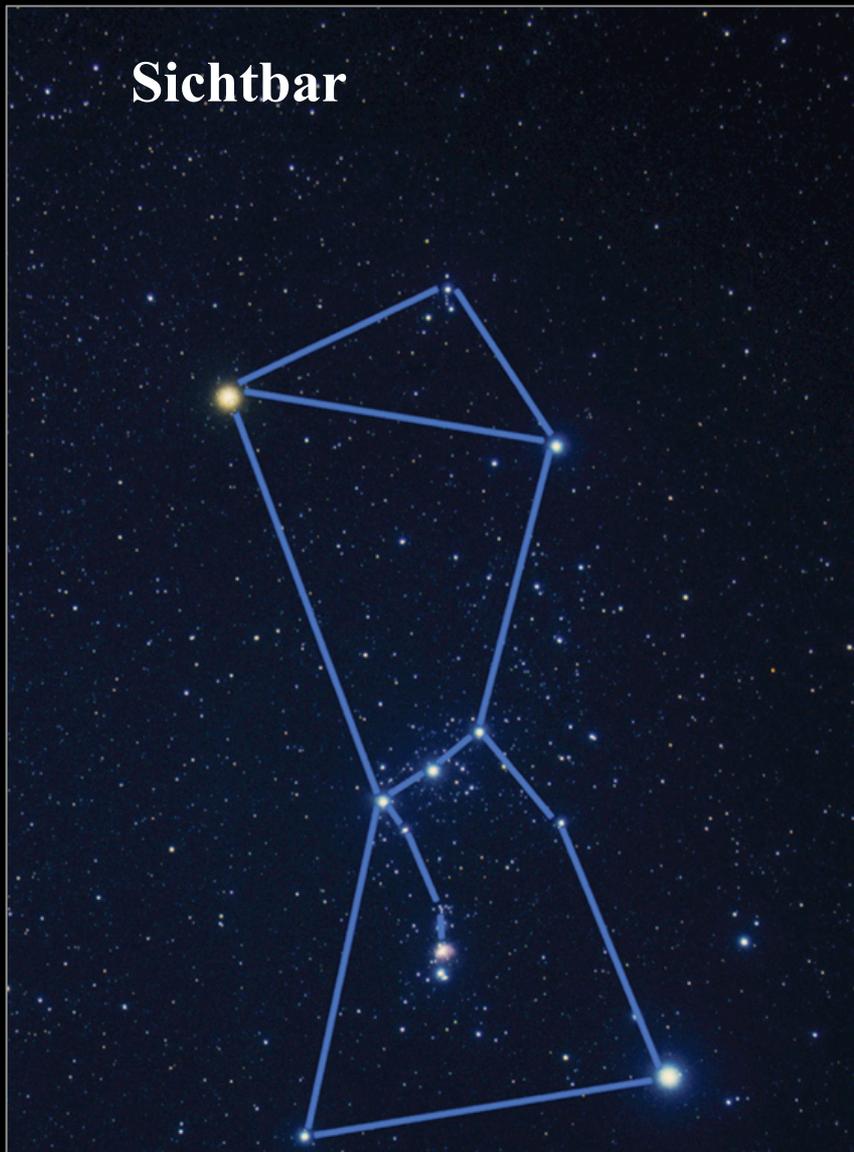
↓
Supernova



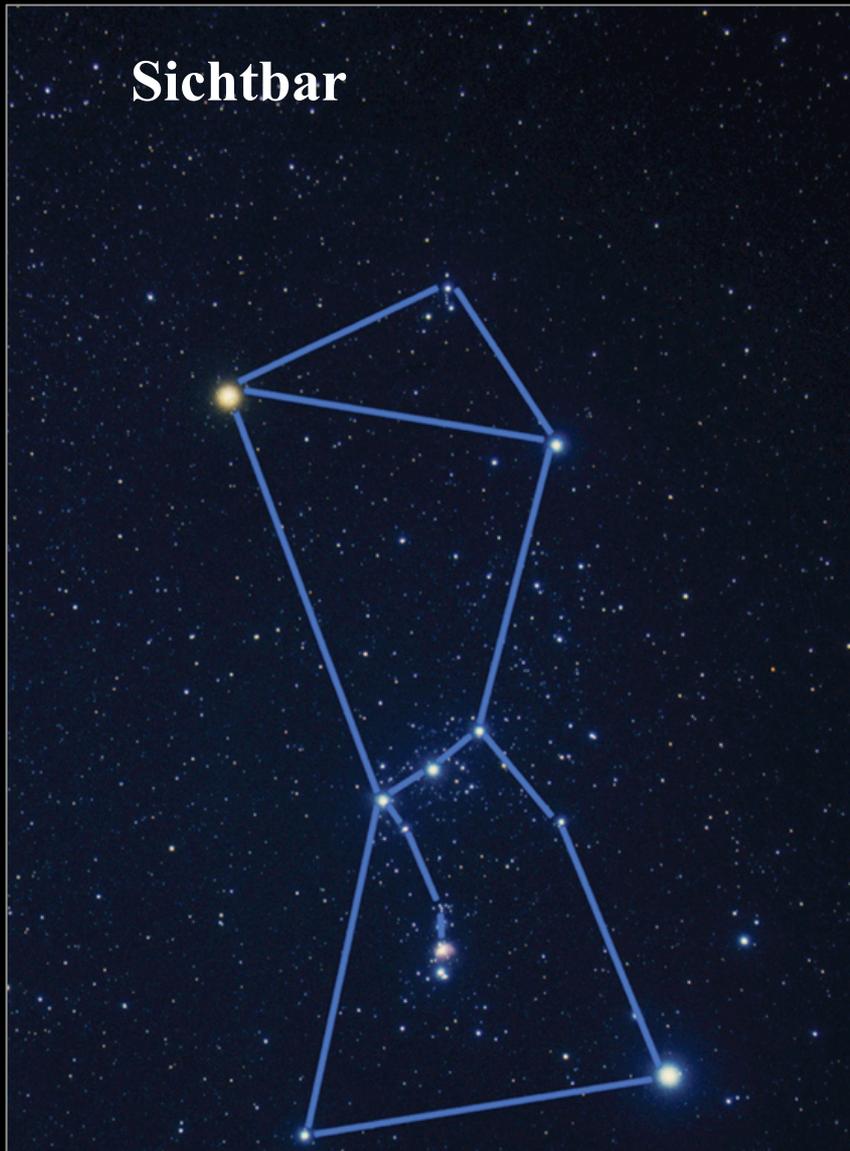
→
Sternenstaub



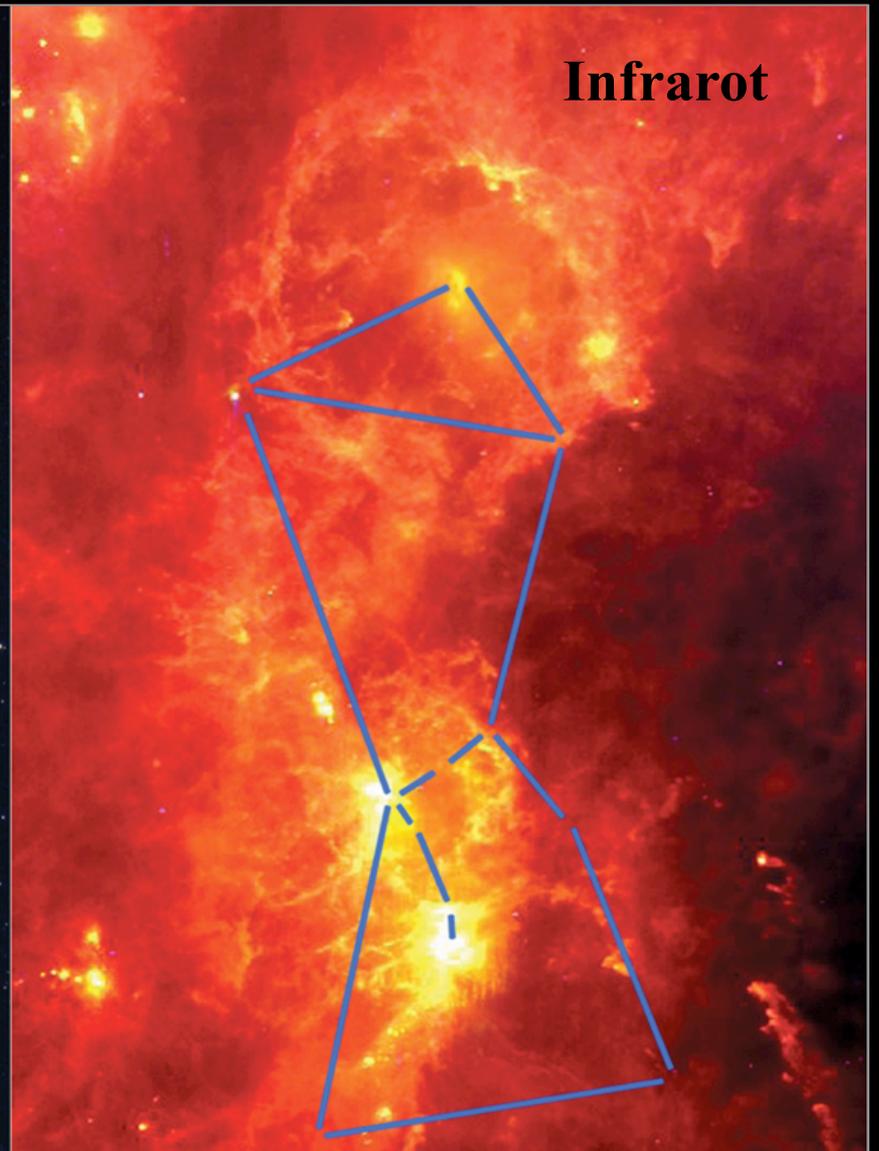
Sichtbar



Sichtbar



Infrarot

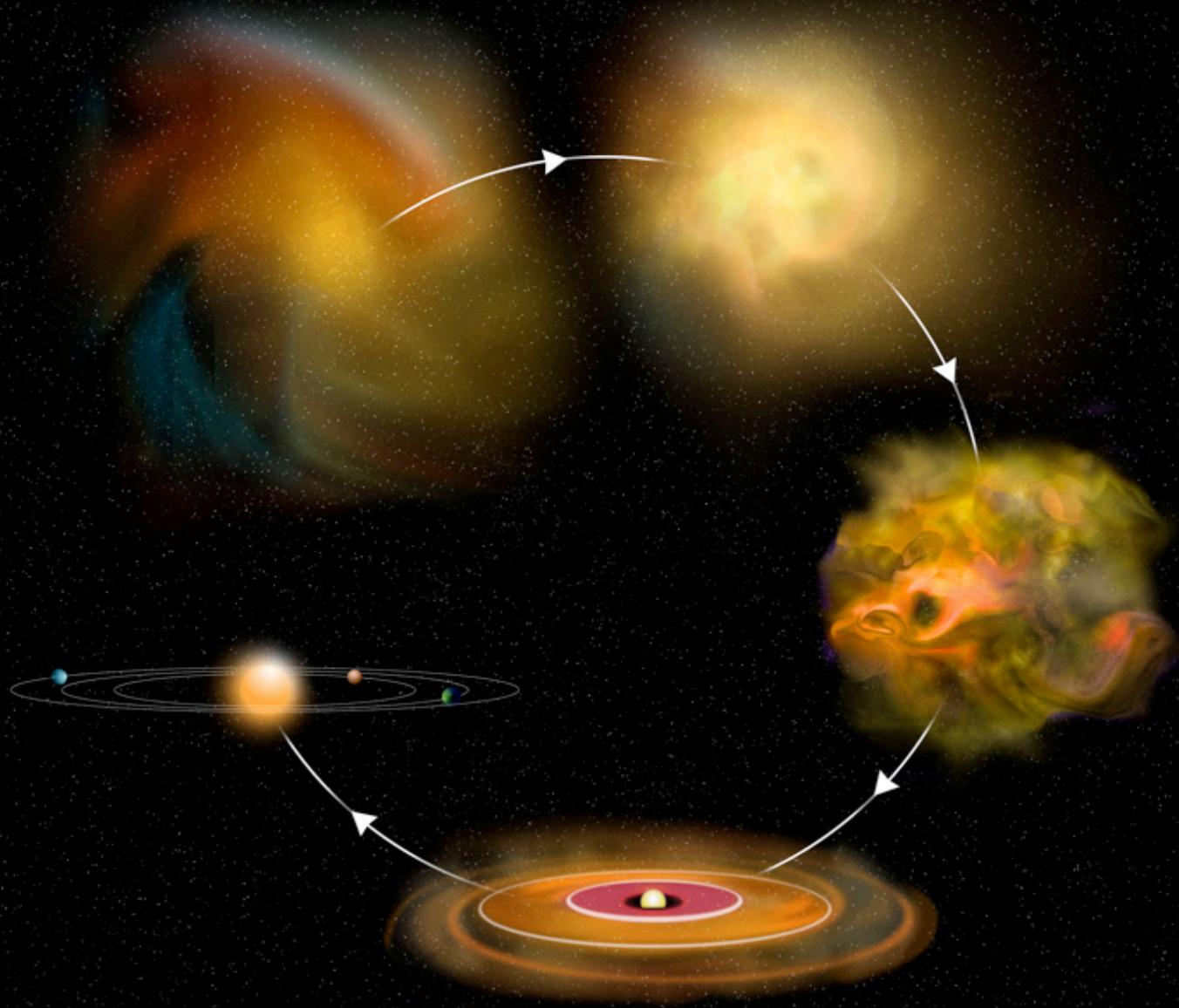






Clemens







Castor

Zwillinge

Pollux

Alhena

Krebs

Kleiner Hund

Prokyon

Einhorn

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π_{243}

π_{244}

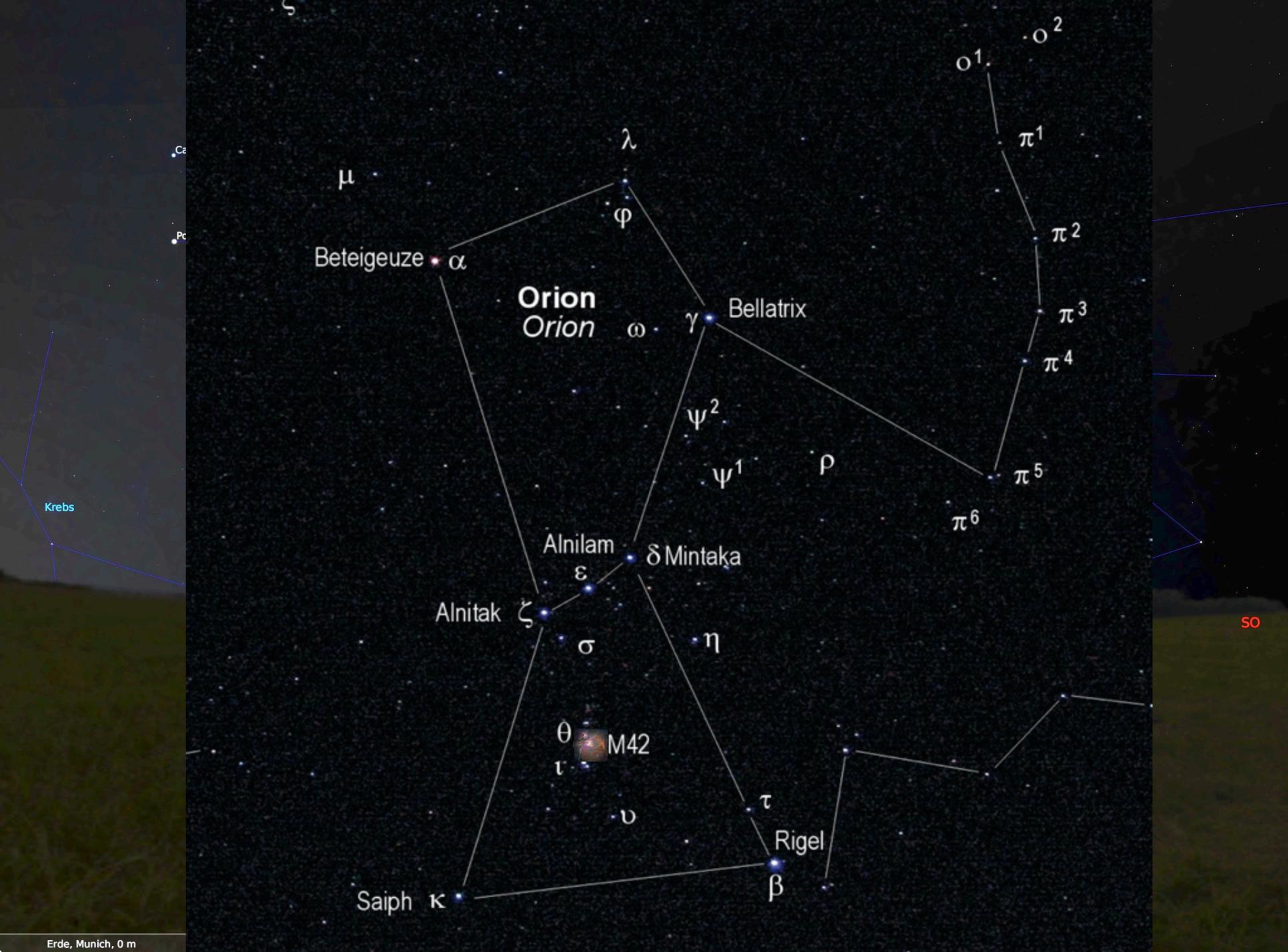
π_{245}

π_{246}

π_{247}

π_{248}

π_{249}



Beteigeuze α

Orion
Orion

Bellatrix γ

Alnilam ε
δ Mintaka

Alnitak ζ

Rigel τ
β

M42

Saiph κ

π¹

π²

π³

π⁴

π⁵

π⁶

Krebs

SO

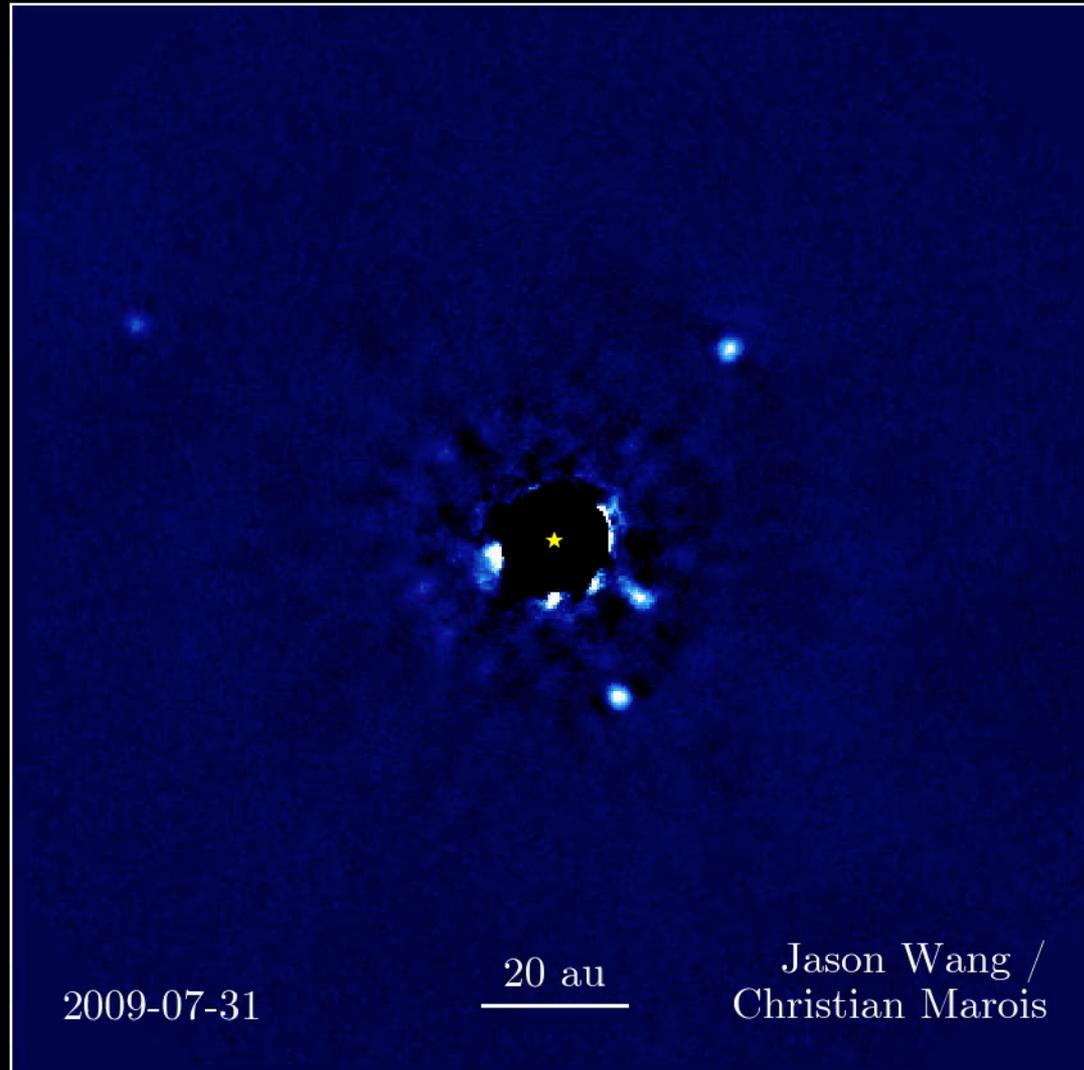




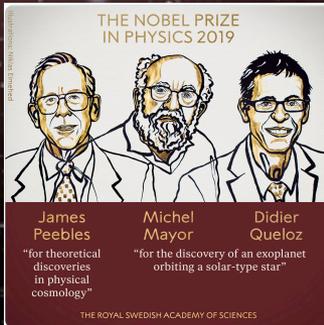




Direkte Beobachtung: HR 8799

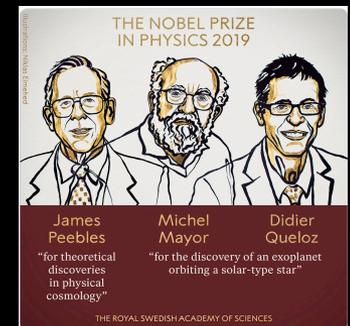


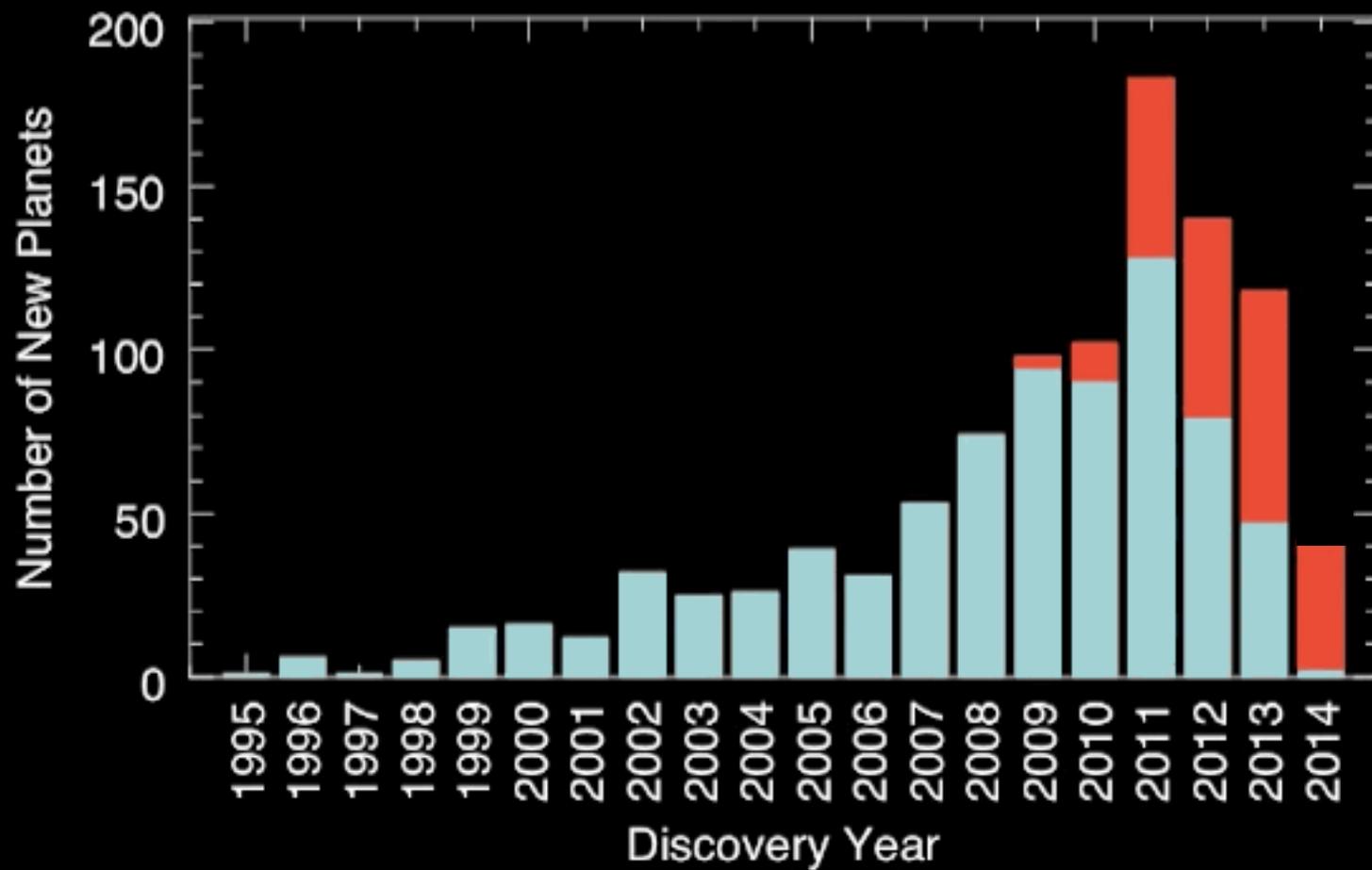
Die Entdeckung ferner Welten



1995

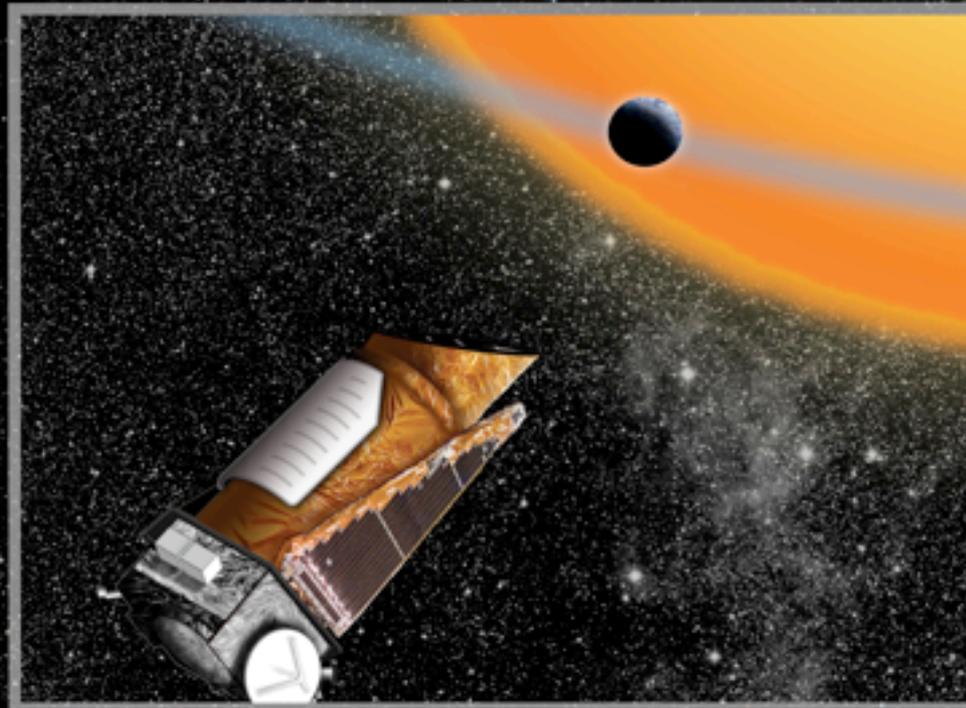
Die Entdeckung ferner Welten



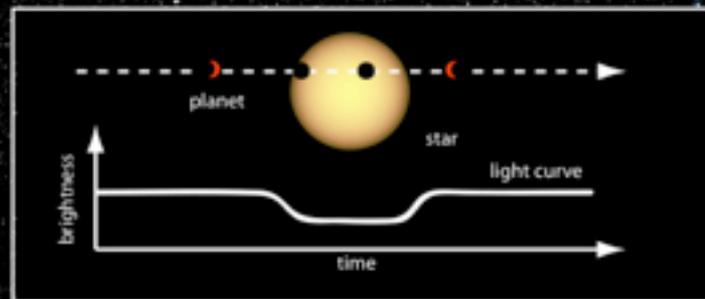


Kepler Mission

*The determination of the frequency of Earth-size & larger planets
in and near the habitable zone of solar-like stars*



2009 - 2013



Die Transit-Methode



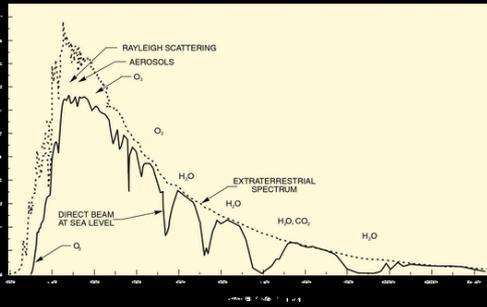
PLANET QUEST
THE SEARCH FOR ANOTHER EARTH

Die Transit-Methode

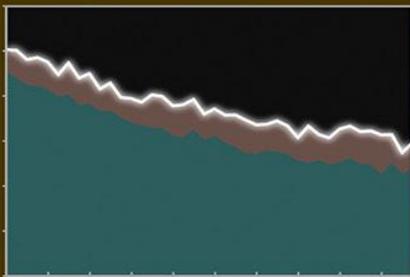
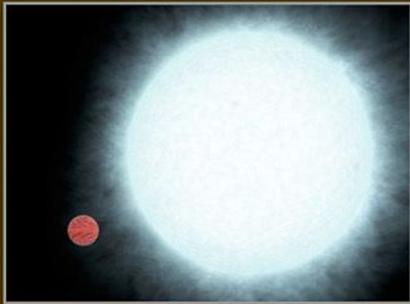


PLANET QUEST
THE SEARCH FOR ANOTHER EARTH

Untersuchung der Planeten-Atmosphäre

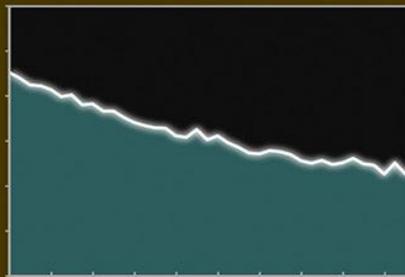
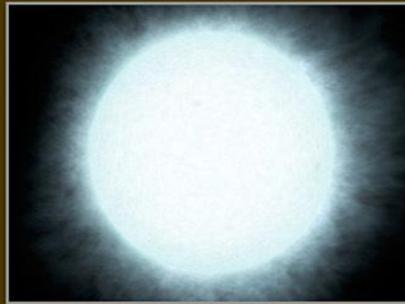


Star + Planet



Combined Spectrum

Star

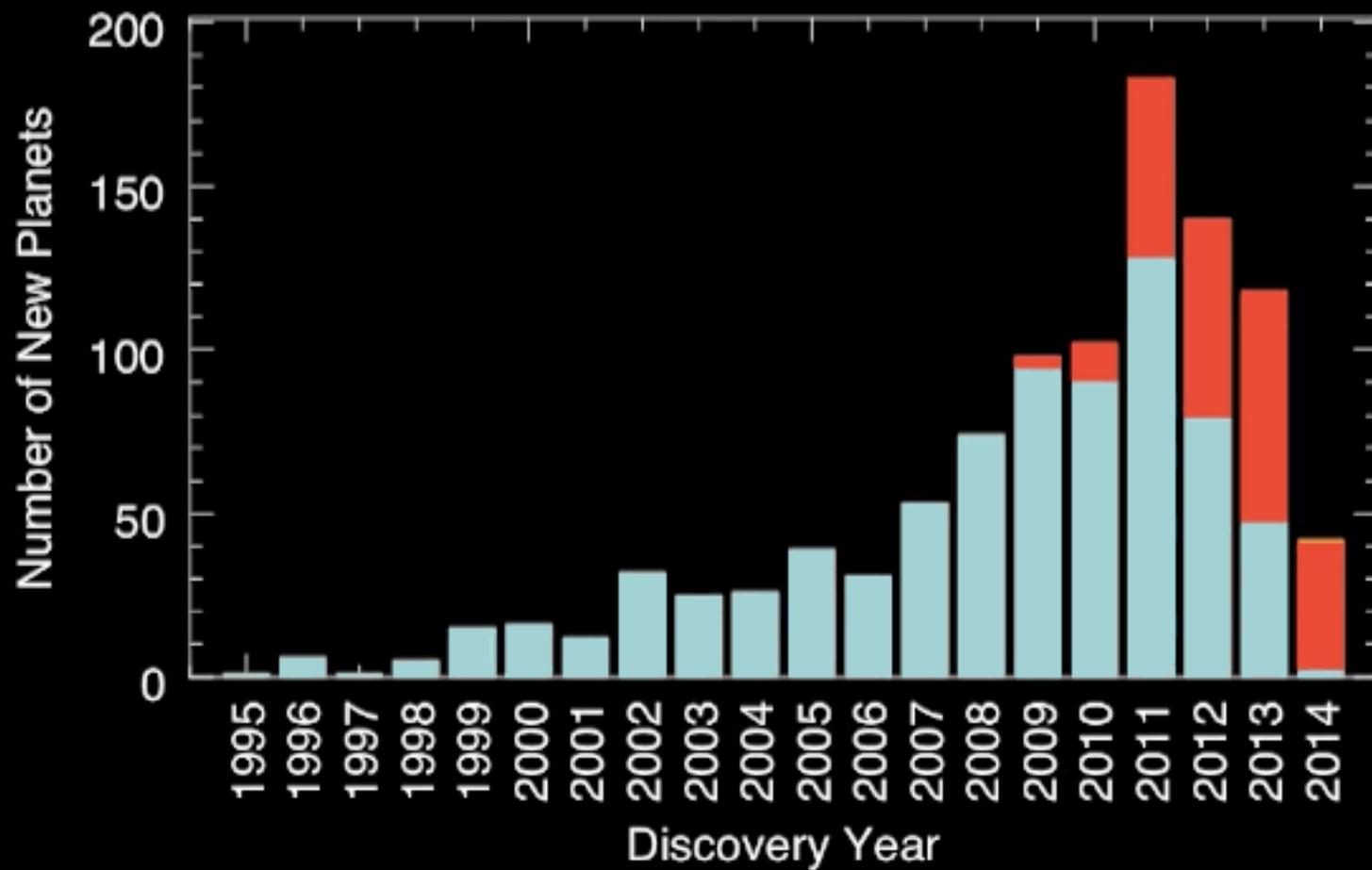


Eclipse Spectrum

Planet

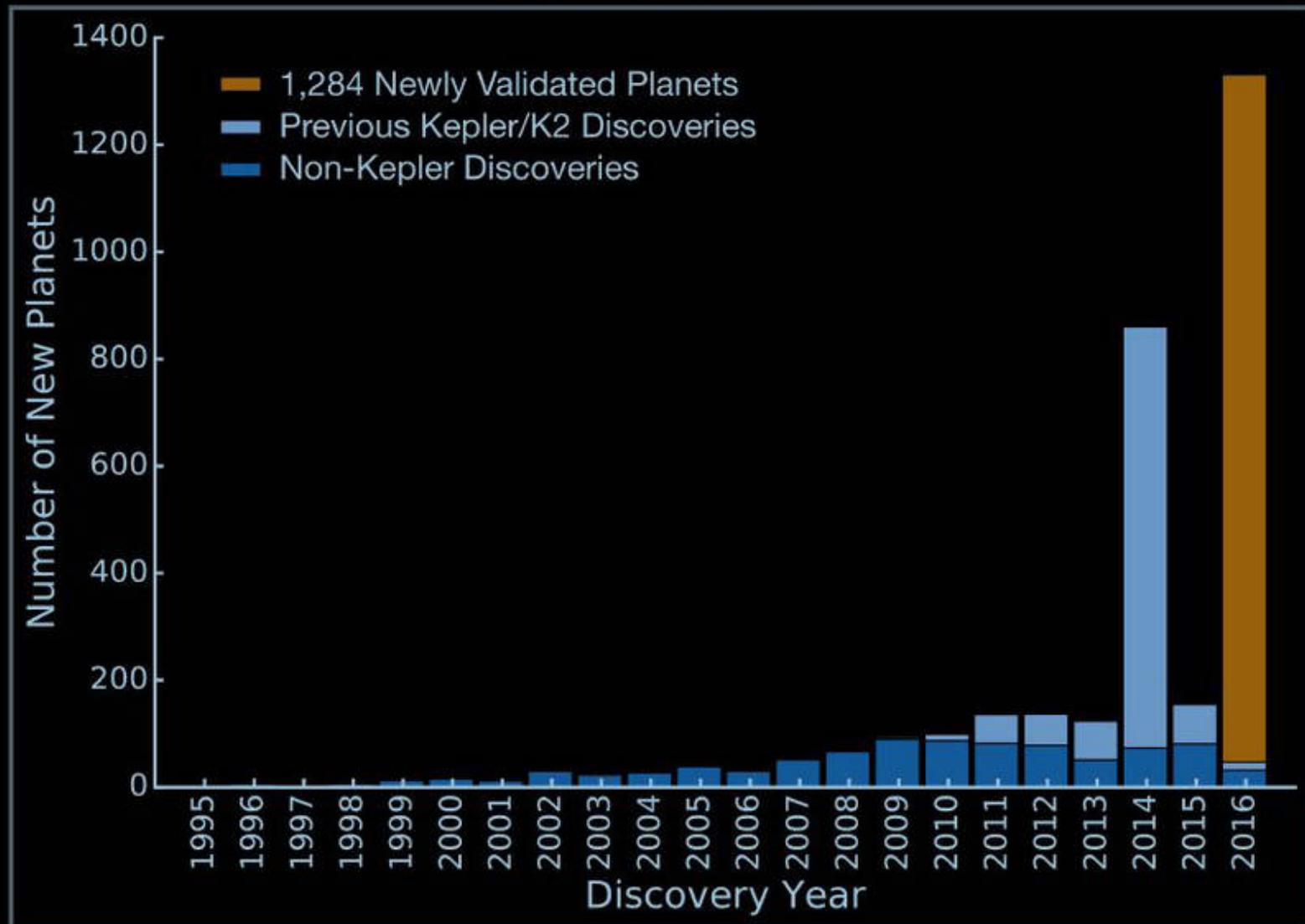


Planet Spectrum



Exoplanet Discoveries Through the Years

As of May 10, 2016

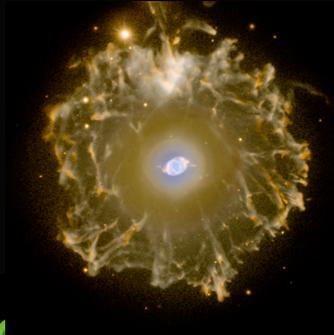


Ein Universum voller Planeten

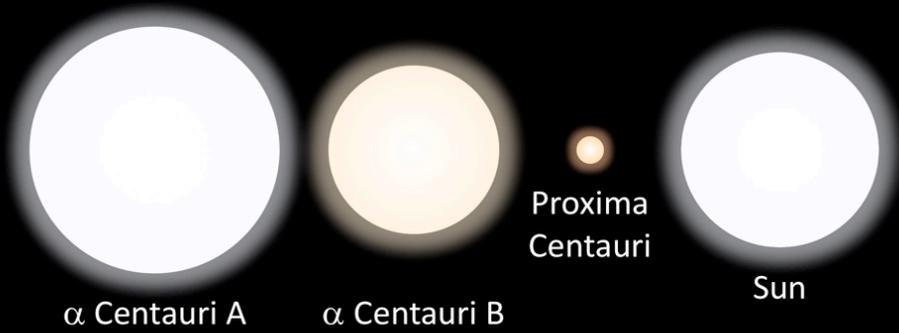
Weshalb der ganze Aufwand?



Clemens

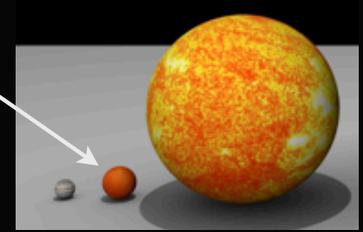


The Alpha Centauri Family

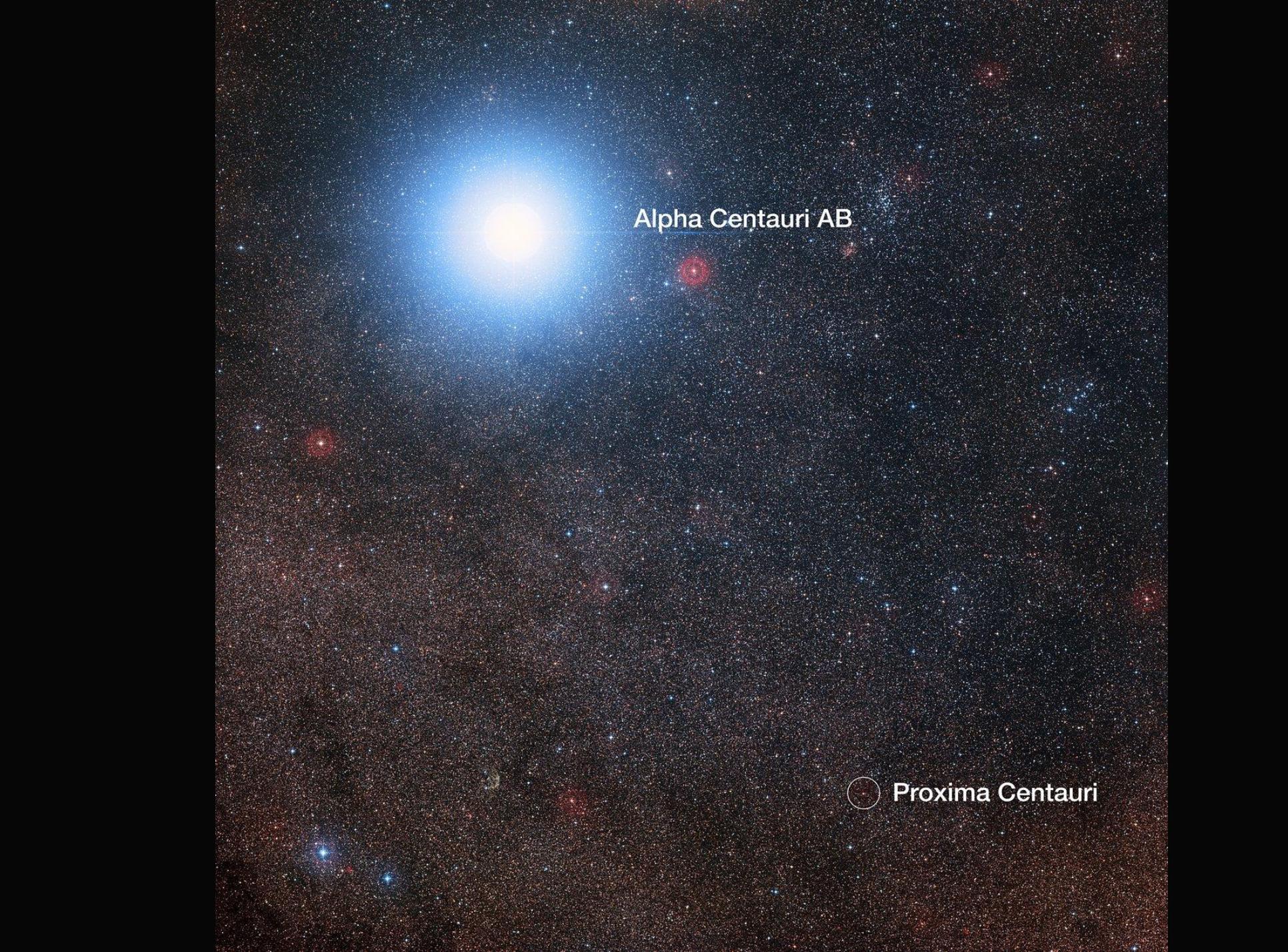


Credit: PHL @ UPR Arecibo

Der uns am nächsten
gelegene Stern
(roter Zwerg)



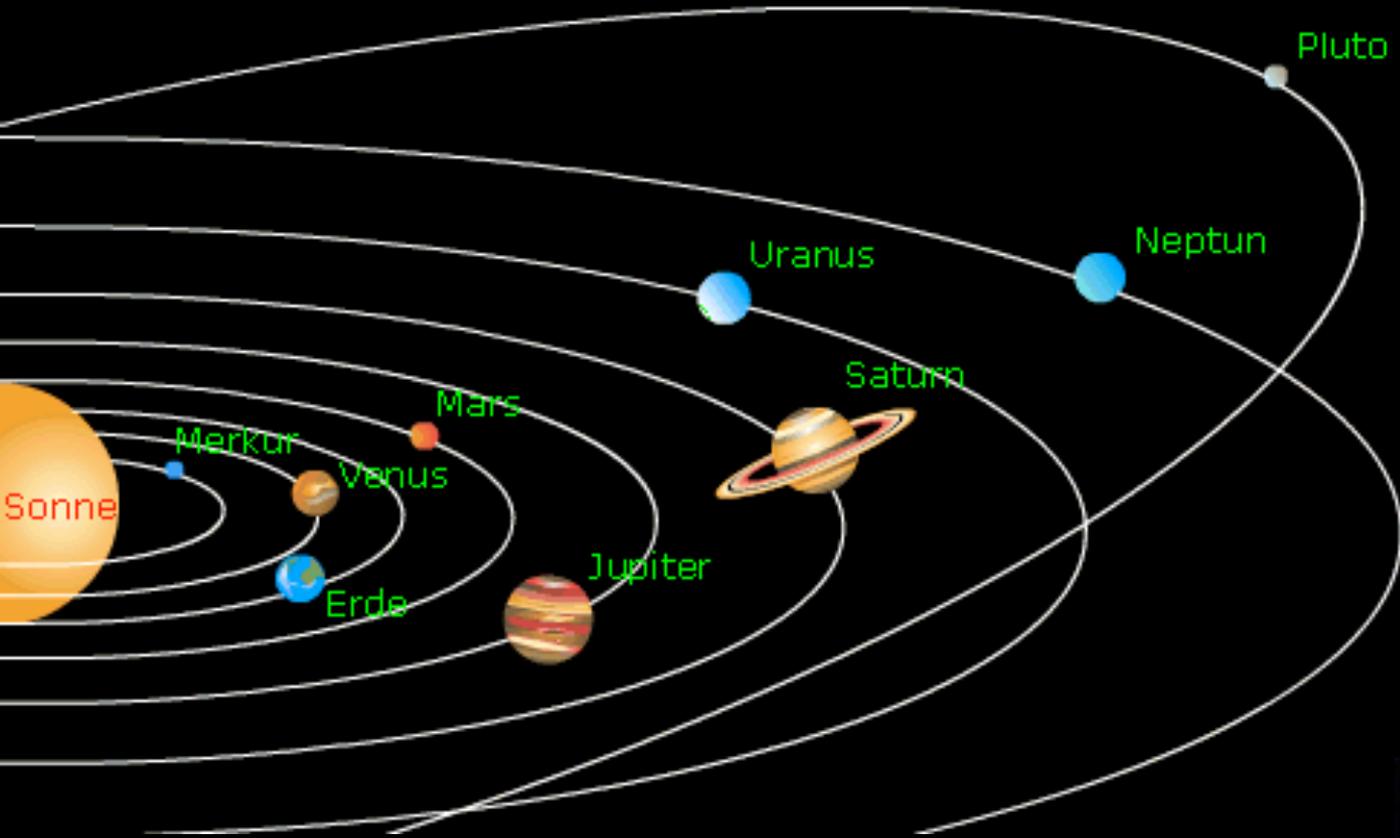
Der Planet um Proxima Centauri



Alpha Centauri AB

○ Proxima Centauri

Raum



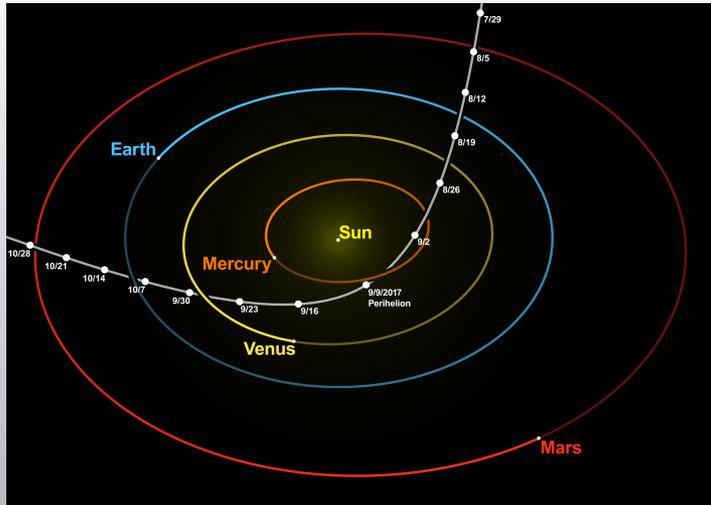
Voyager 1

(1977)



62,000 km/h

Sternkollision



Proxima Centauri



4.24 Lichtjahre

*74,000 Jahre
für
Voyager I*





Karl G. Jansky Very Large Array



**NRAO Very Large Array and
SETI Institute Collaboration**





100 Milliarden
Sterne

60,000 LJ

200 Mio Jahre

800,000 km/h

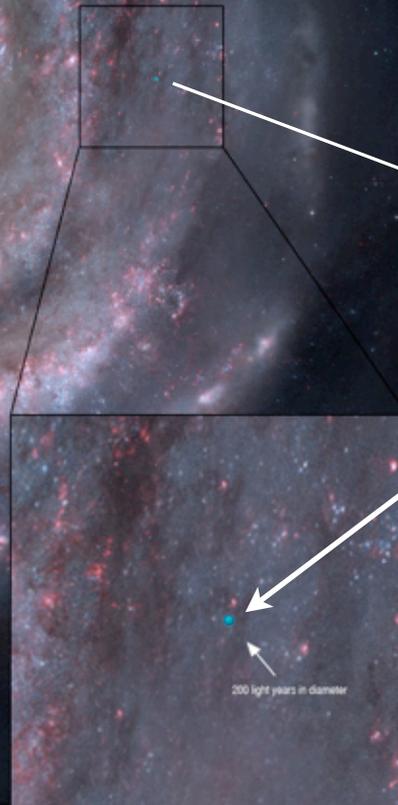


Sonne

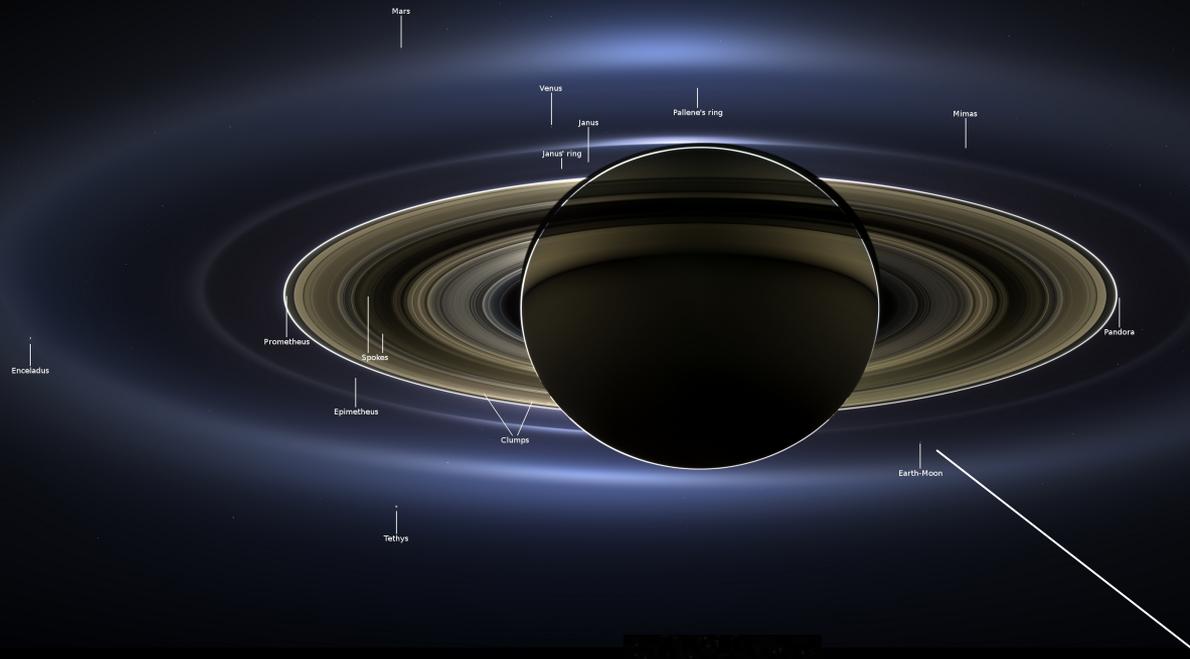
100 LJ

Ausdehnung

Radiosendungen



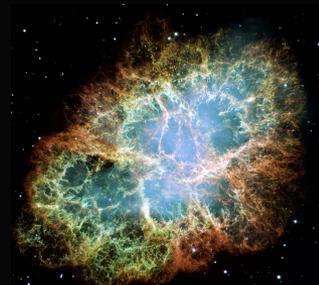
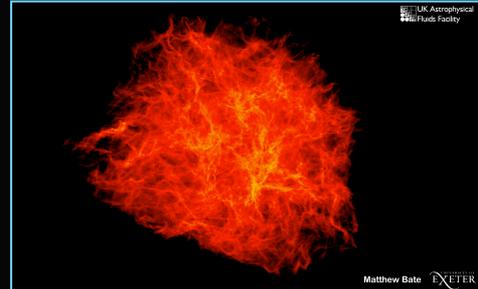
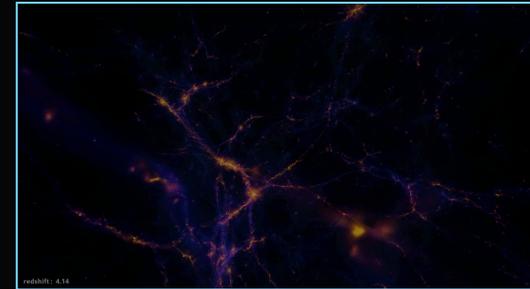
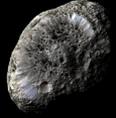
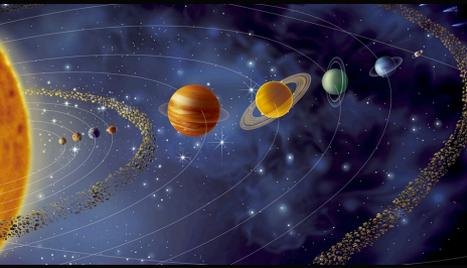
Selfie der Erde in 6 Milliarden km Entfernung



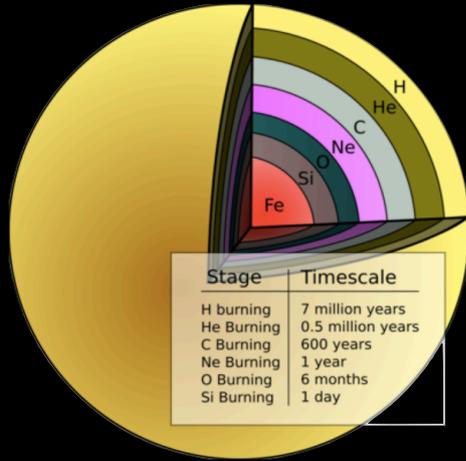
The day the Earth smiled

Cassini, ESA

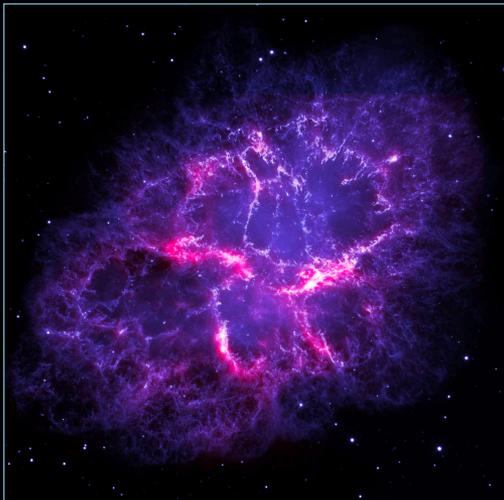
Wir sind nicht allein



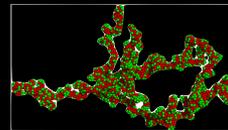
Der Ursprung des Sternenstaubs



↓
Supernova

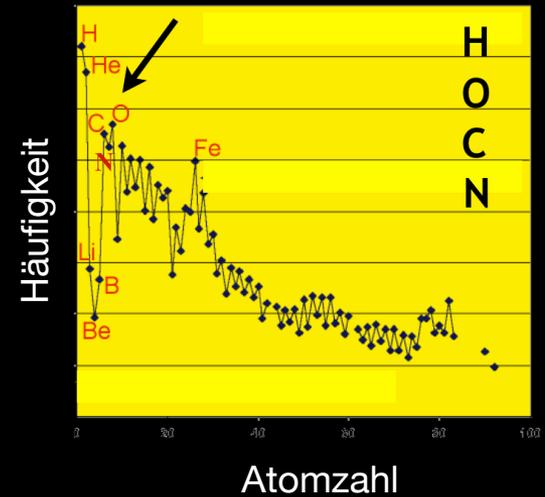


→
Sternenstaub

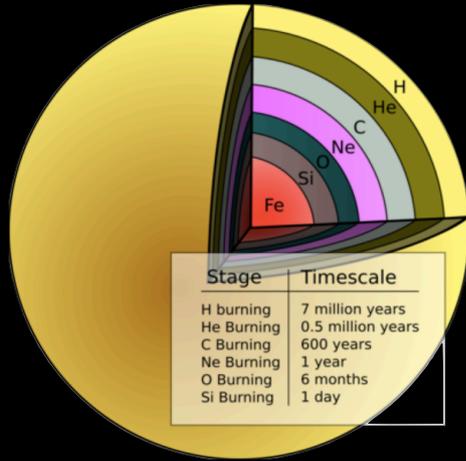


Chemie des Menschen

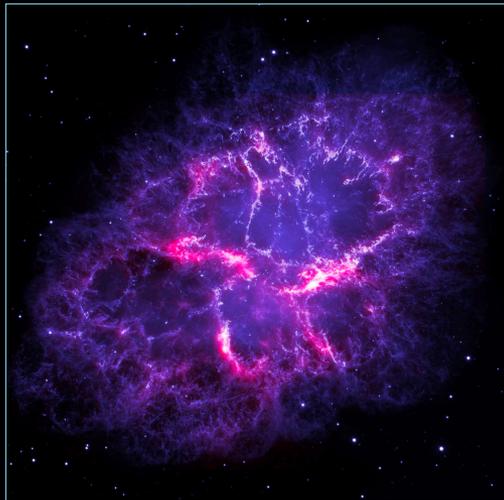
H: 63%
O: 25,5%
C: 9,5%
N: 1,4%
Rest: 0,6%



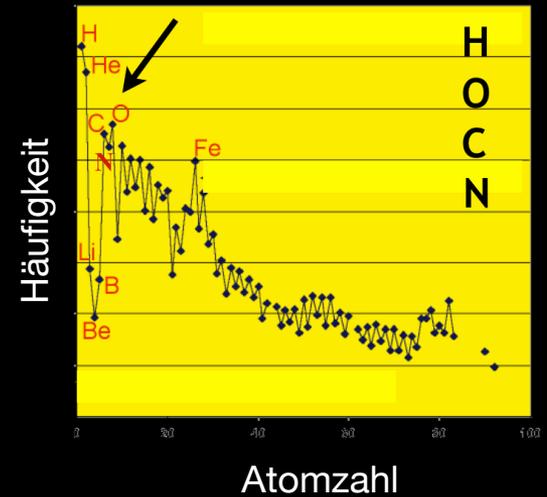
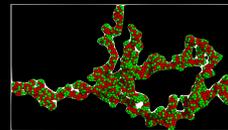
Der Ursprung der Planetensysteme



↓
Supernova

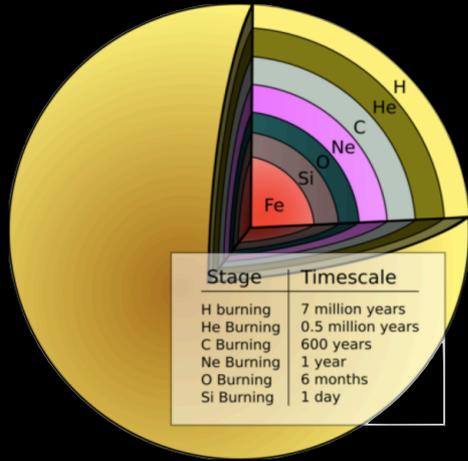


Sternenstaub

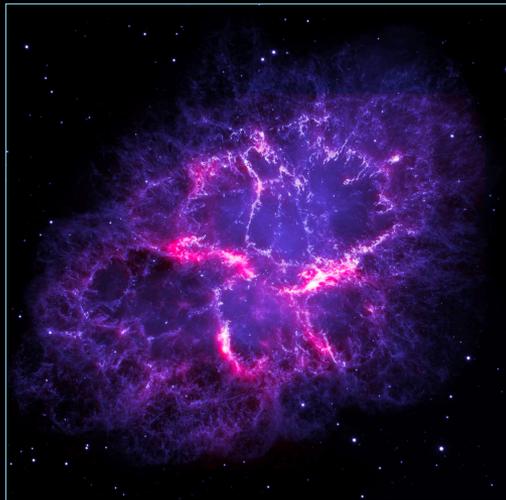


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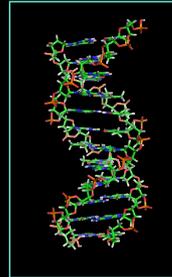
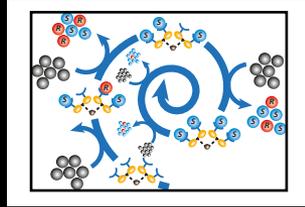
Der Ursprung des Lebens



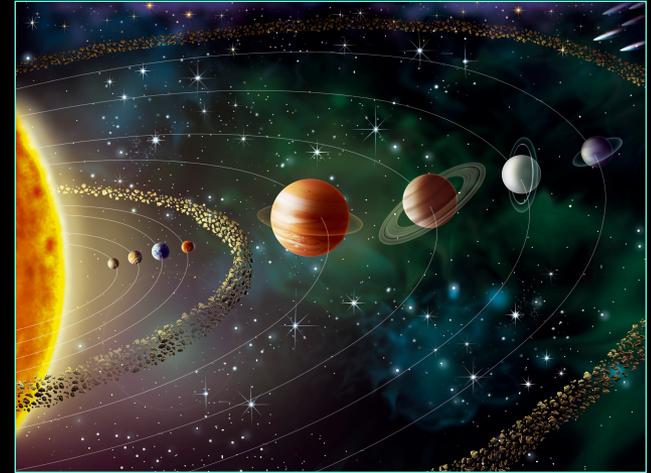
Supernova



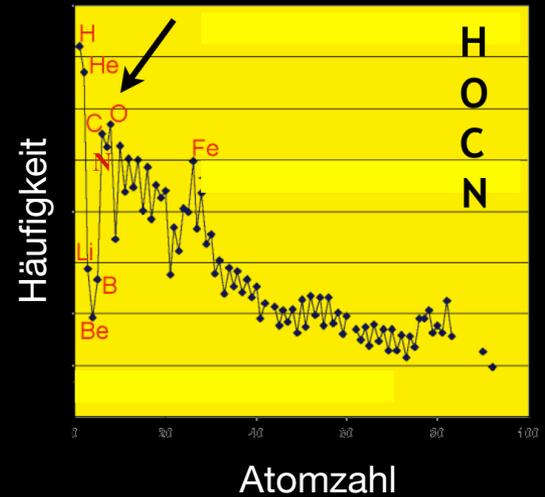
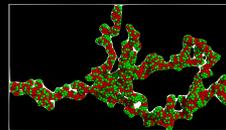
Molekulare
Informations-Replikation



?

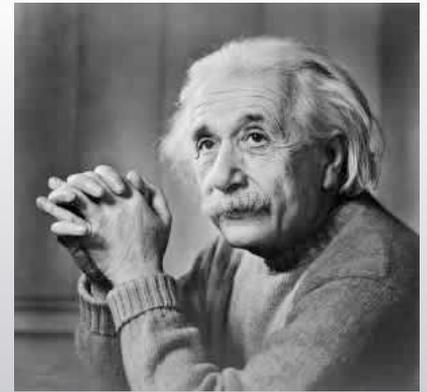


Sternenstaub



Clemens

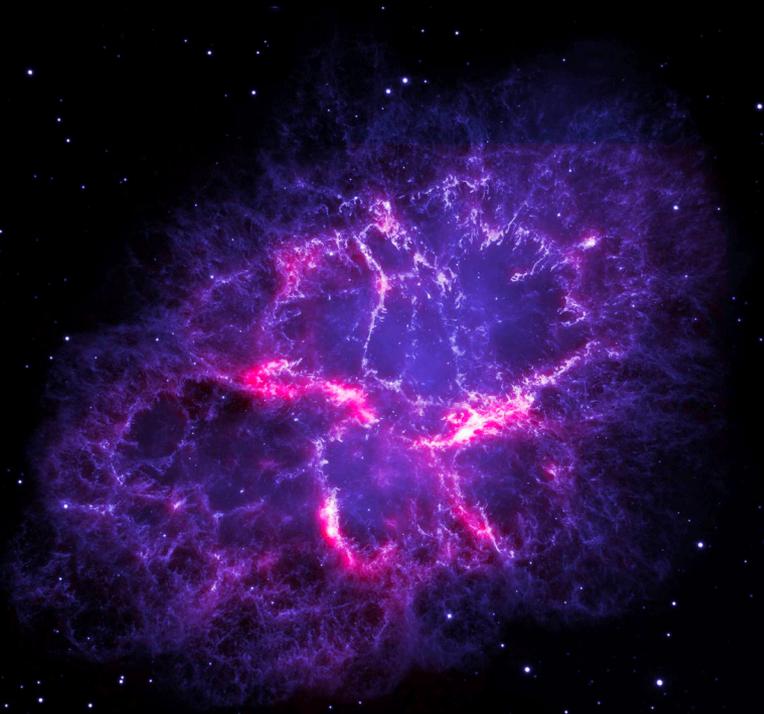
Ende



*Albert Einstein
(1879-1955)*

*Das unverständlichste am Universum ist,
dass wir es verstehen können.*

Die Elementhäufigkeit im Universum



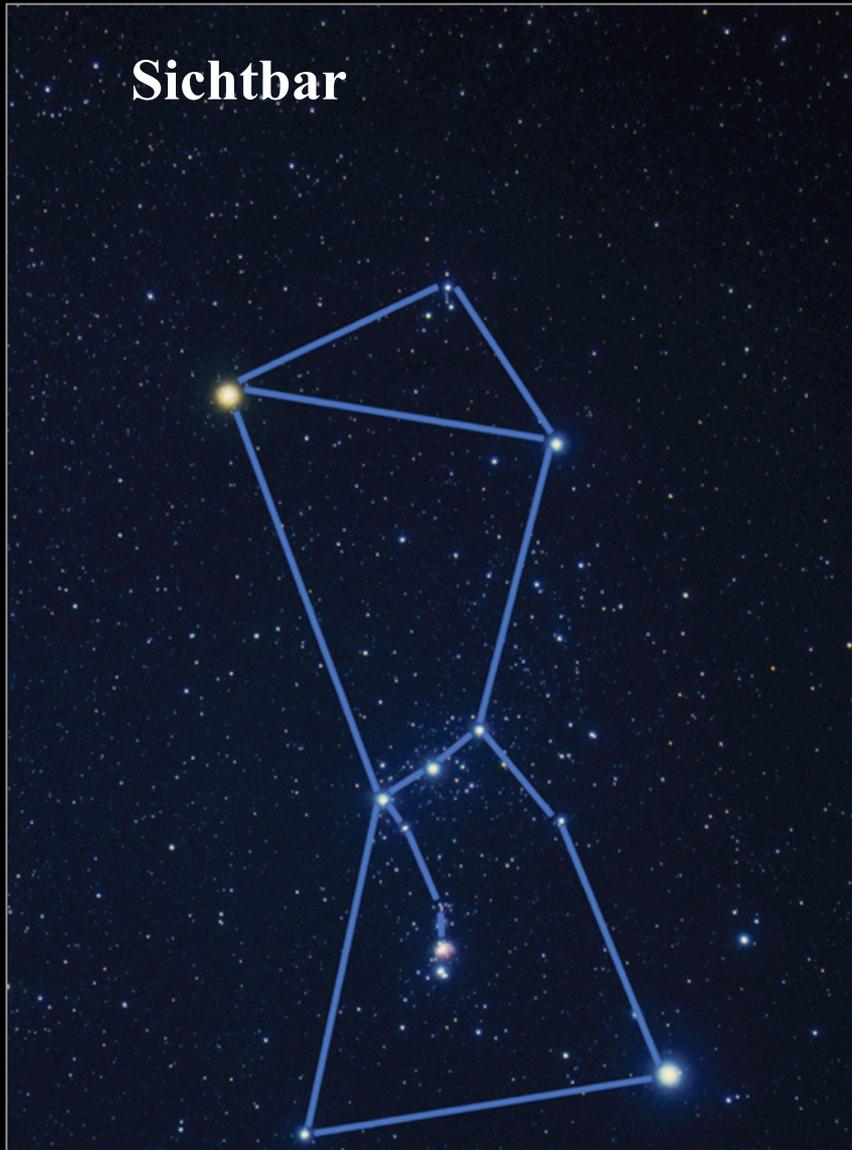
Chemie des Menschen

H:	63%
O:	25,5%
C:	9,5%
N:	1,4%
Rest:	0,6%



**Phosphor (0.7g/Tag)
(Knochen, Gewebe, Erbsubstanz)**

Sichtbar





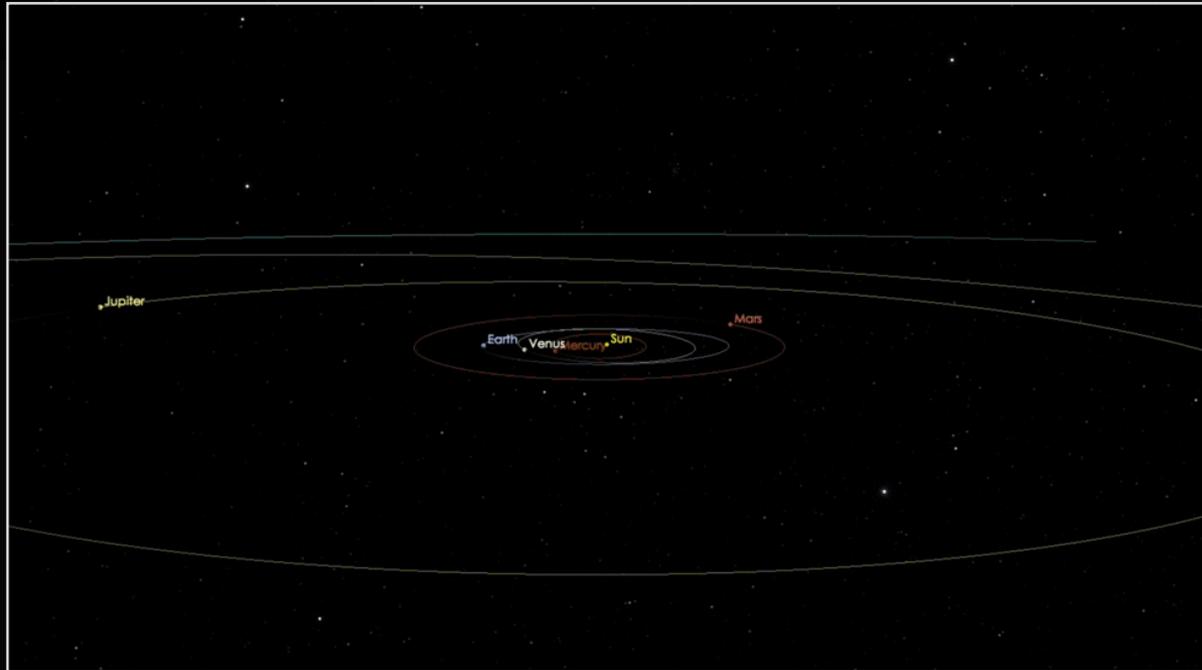
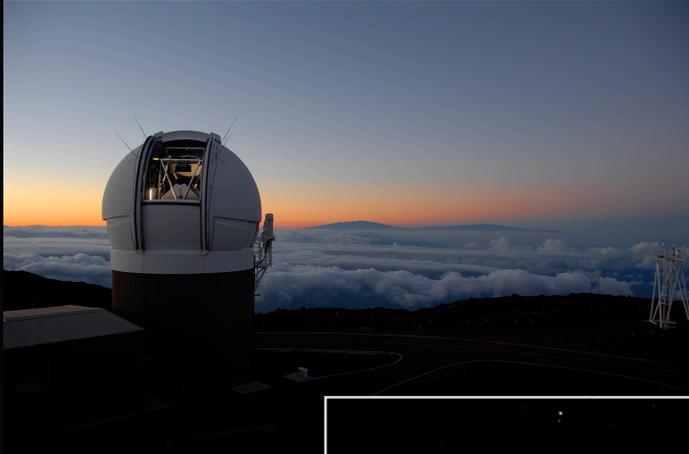
Life from Outer Space

19.10.2017



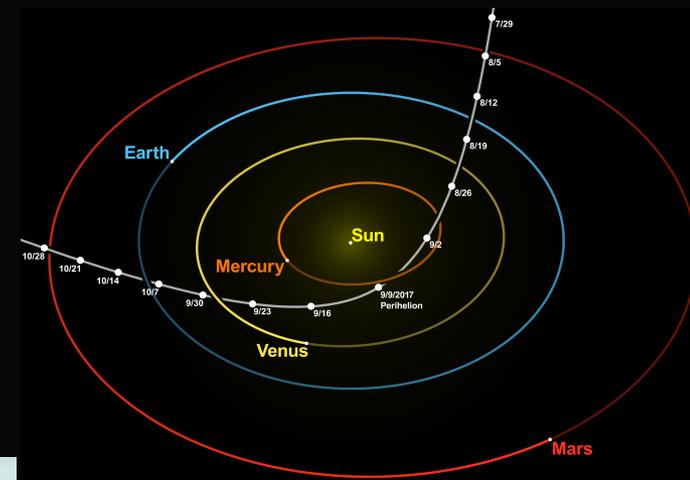
19.10.2017

*Der interstellare Komet Oumuamua
(Scout+erster seiner Art): 400m*



19.10.2017

Der interstellare Komet Oumuamua (Scout+erster seiner Art): 400m

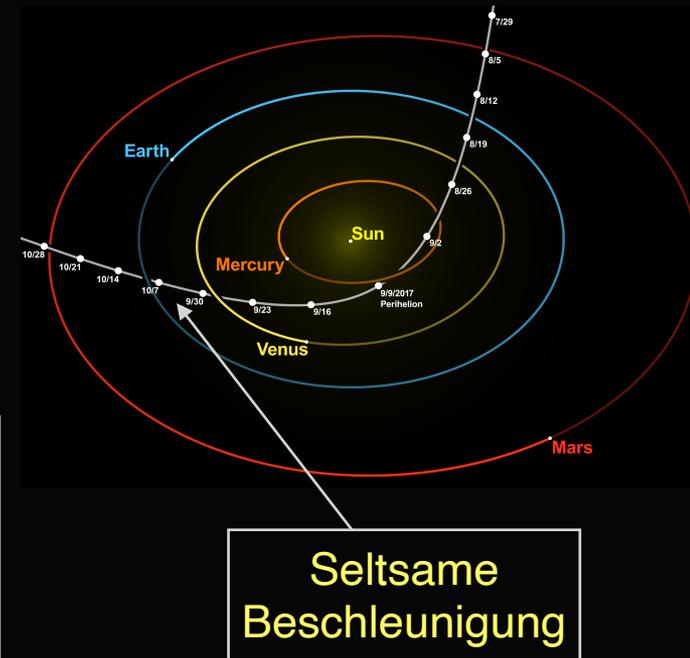
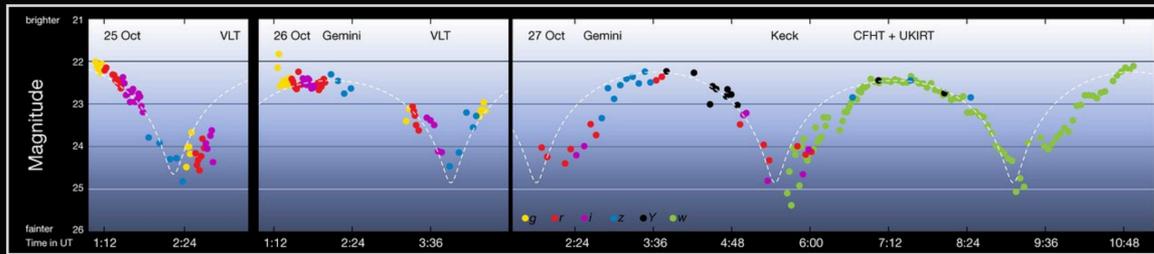


*Hundert Quadrillionen
Kometen*



19.10.2017

Der interstellare Komet Oumuamua (Scout+erster seiner Art): 400m



Green Bank Teleskop
(West Virginia, USA)

