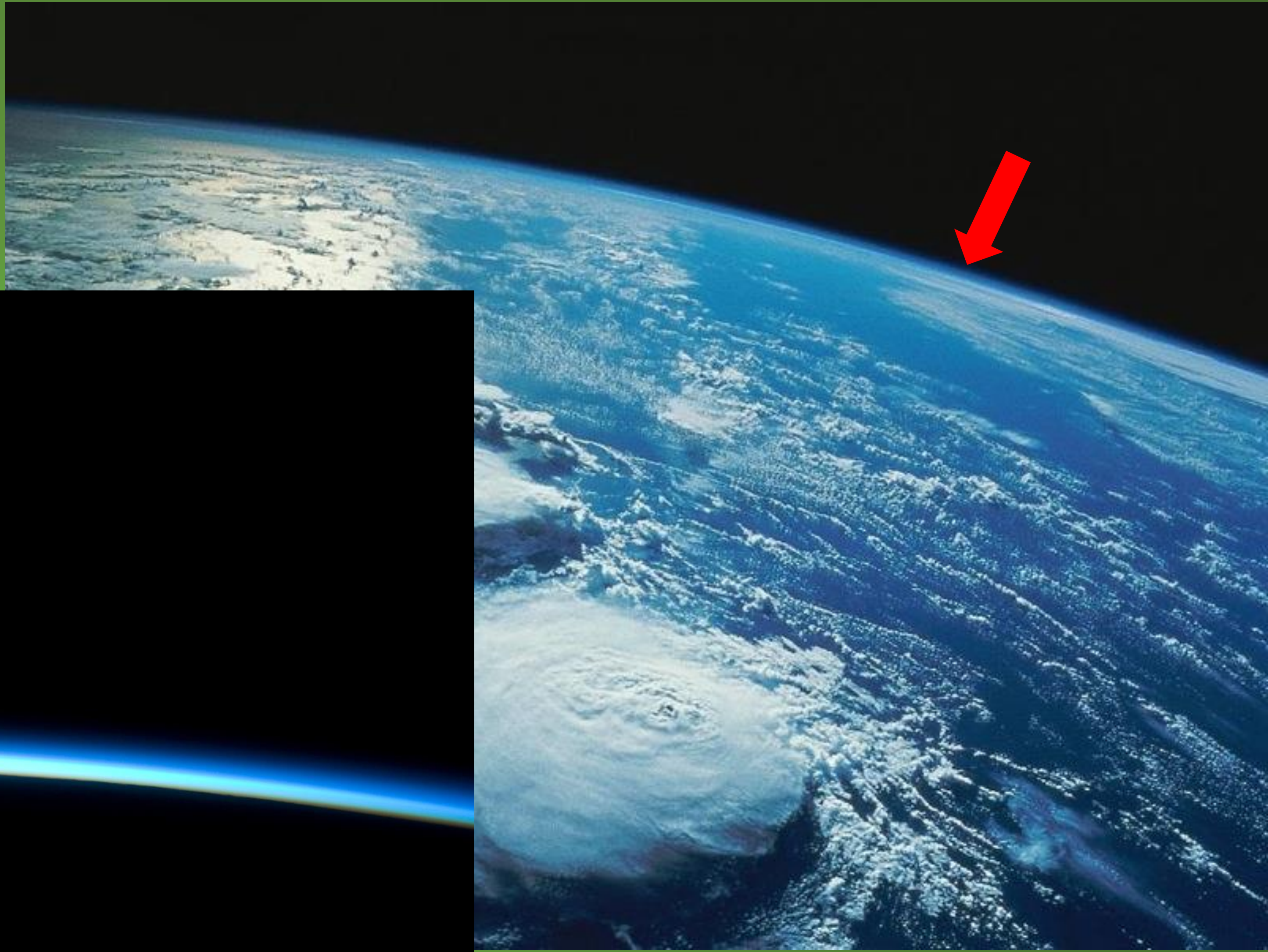
ATMÓSFERAS PLANETARIAS

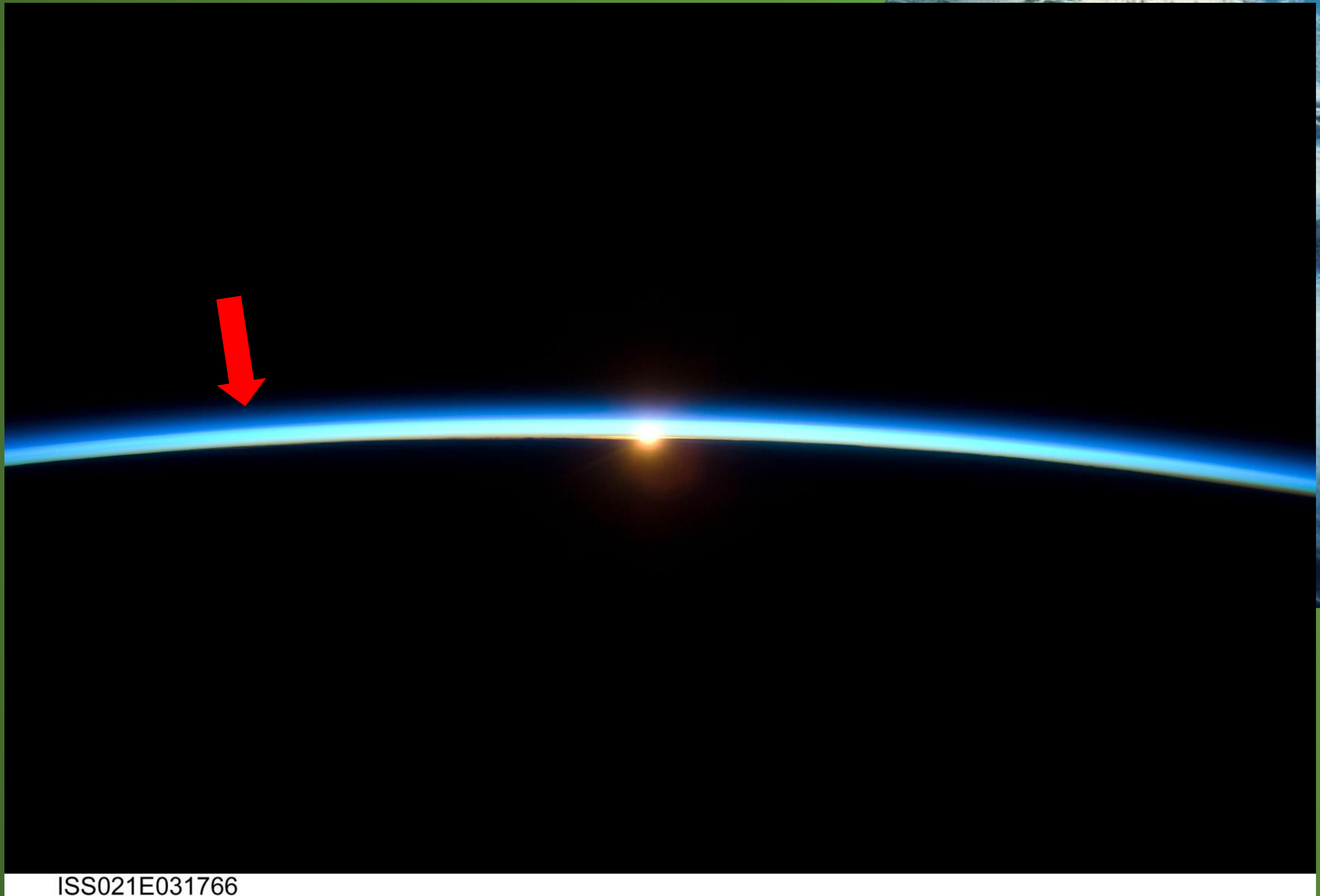
BÚSQUEDA DE VIDA MÁS ALLÁ DE NUESTROS LÍMITES

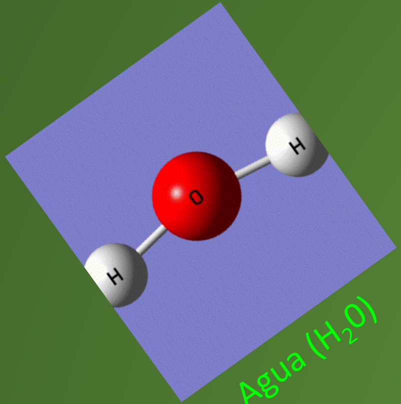
¿Cuál es la importancia de las atmósferas?

Nuestro planeta posee una fuerza de gravedad suficiente para retener los gases de su atmósfera y el agua de sus océanos ...

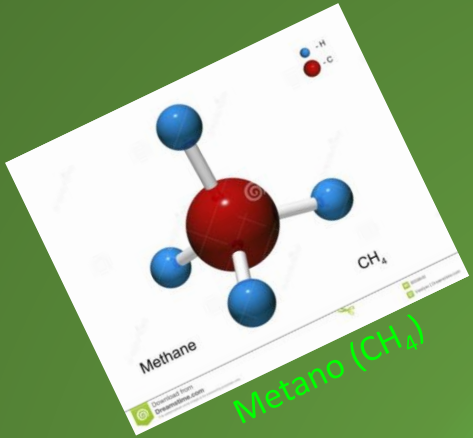
En la atmósfera se encuentran moléculas de gases …



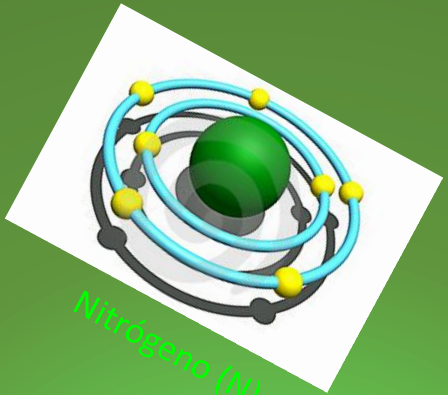




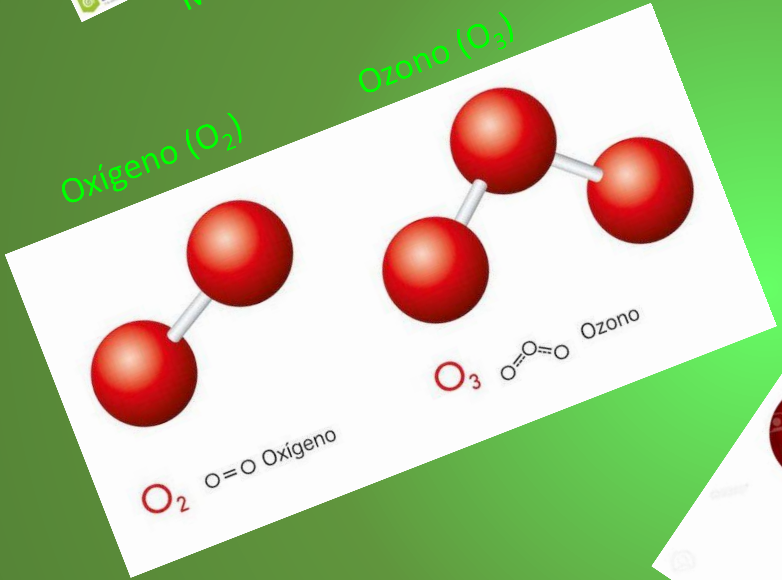
Agua (H_2O)



Metano (CH_4)


Nitrógeno (N)

Oxígeno I (O^+)



Oxígeno (O_2)

Ozono (O_3)


Dióxido de Carbono (CO_2)

Y a éstos se les conoce como

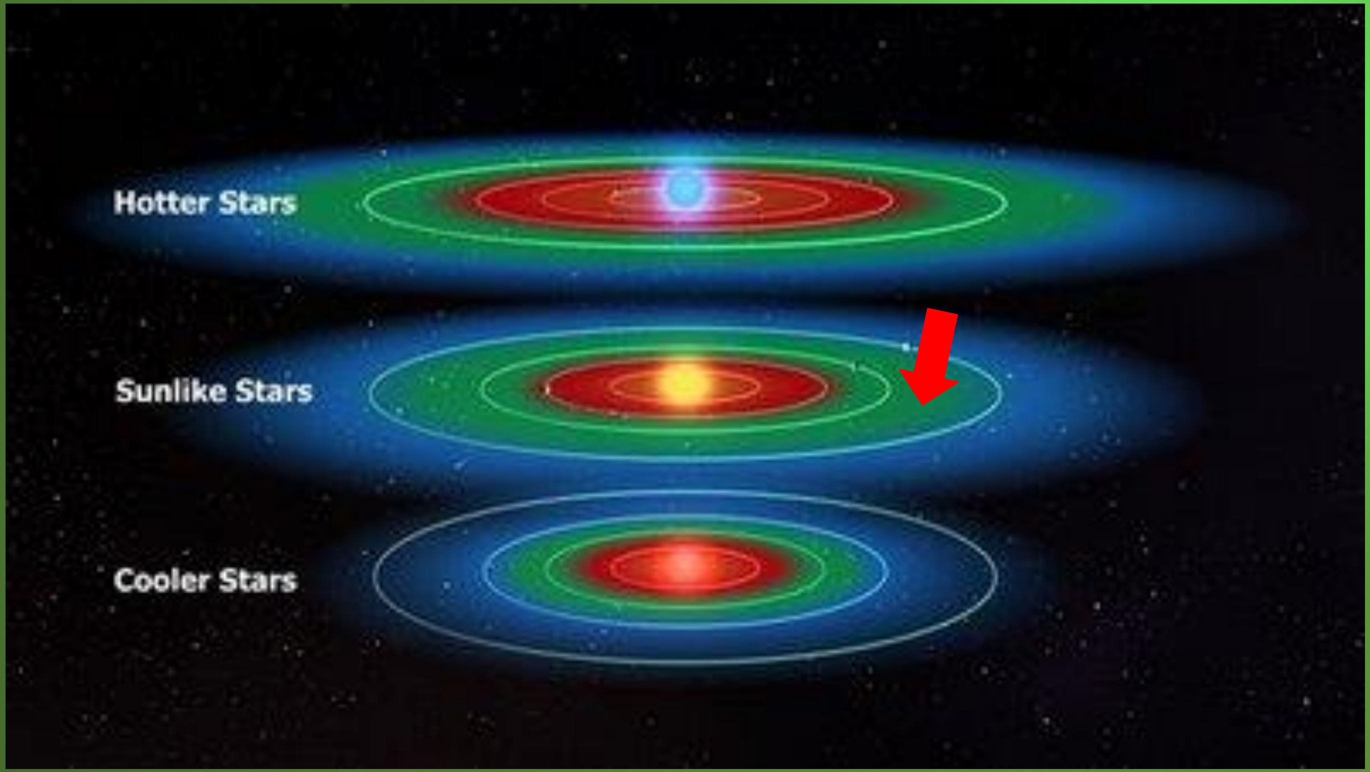
BIOMARCADORES

… porque indican la presencia de vida en el planeta, ya sea presente o pasada.

. . . Por otro lado, este planeta AZUL gira en torno a su estrella en la

¡¡ ZONA HABITABLE !! . . .

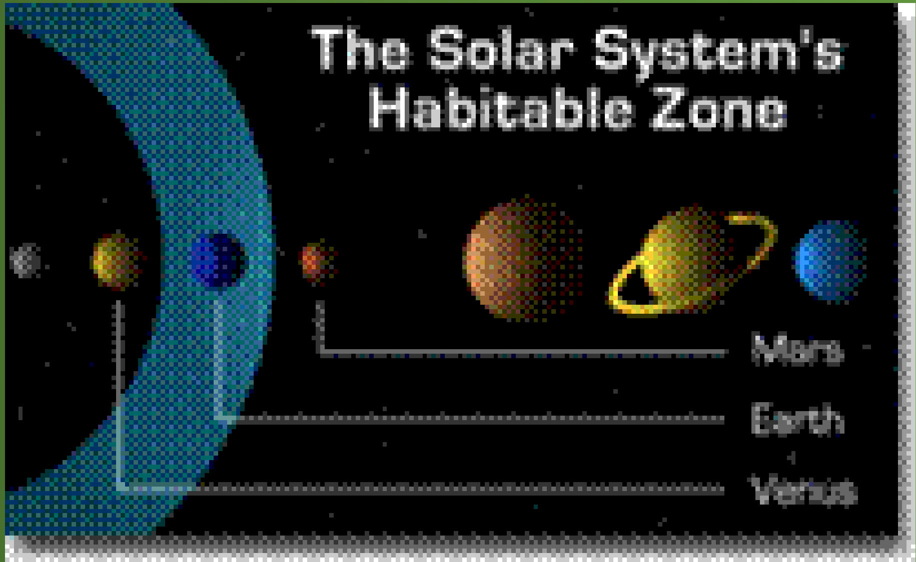
El calor proveniente del Sol permite que el agua se encuentre en estado líquido …



Así es que tenemos lo siguiente:

Planeta en la

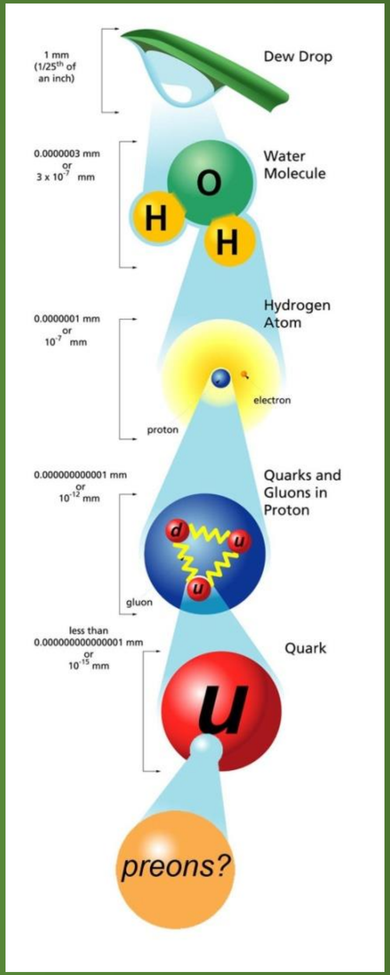
¡¡ ZONA HABITABLE !!

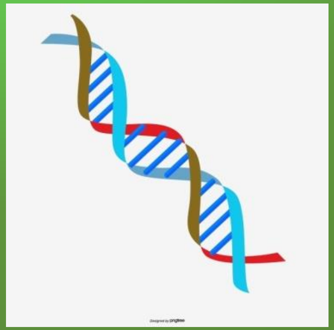


Biomarcadores, en especial

¡¡ AGUA EN ESTADO **LÍQUIDO**!!

¡¡PRESENCIA DE VIDA!!





Para saber si hay vida en otro planeta tenemos que mirar su **ATMÓSFERA** en búsqueda de biofirmas.

En el Universo se ve agua por todos lados, hidrógeno y también carbono, por lo tanto, la vida como la conocemos se basa en el carbono y el agua.

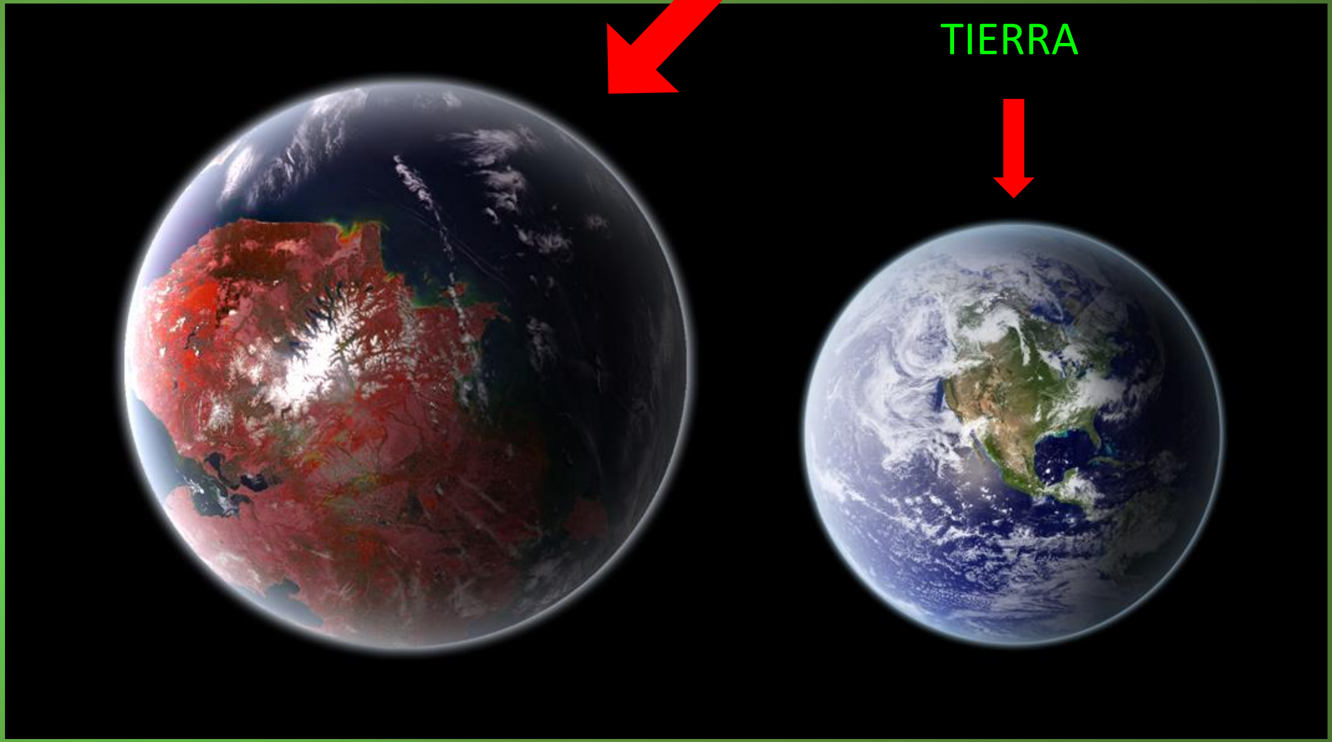
Pero también hay que estar alertas a otras señales interesantes teniendo en cuenta que la vida también puede estar basada en otros entornos y elementos, como el **silicio**.

Si el propósito es encontrar alguna expresión de vida en planetas más allá de nuestro sistema, los esfuerzos se centran en estudiar planetas con estas características:

Masa = 5 a 10 veces M_{Tierra}
Radio = 1,5 a 2,5 R_{Tierra}

- De composición rocosa.
- Capaces de mantener el agua líquida en su superficie.
- Masivos para que la gravedad retenga los gases de su atmósfera.
- Orbitar en la zona habitable de su estrella.

A éstos se les llama "SÚPER TIERRAS" …



Veamos ...

URL: phl.upr.edu/hec

phl.upr.edu

PHL

Planetary Habitability Laboratory

University of Puerto Rico at Arecibo

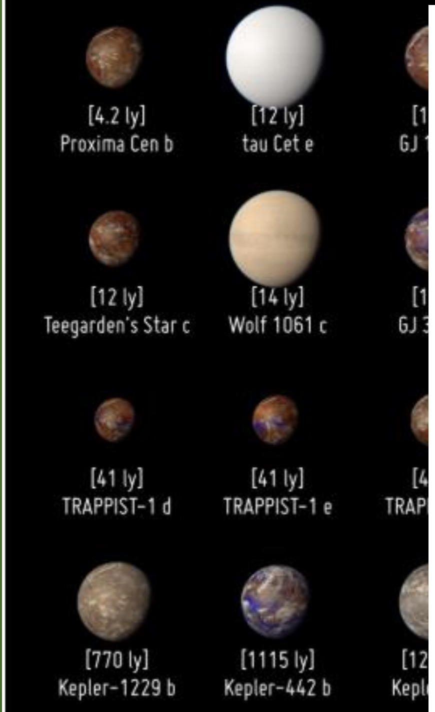
MAPPING THE HABITABLE UNIVERSE

Busca este sitio

Potentially Habitable Exoplanets

Ranked by Distance from Earth (light years)

PHL



Artistic representations. Earth, Mars, Jupiter, ar

Name	Type	Mass (M_E)	Radius (R_E)	Flux (S_E)	T_{eq} (K)	Period (days)	Distance (ly)	ESI
001. Teegarden's Star b	M-Warm Terran	≥1.05	–	1.21	267	4.9	12	0.93
002. K2-72 e	M-Warm Terran	–	1.29	1.11	261	24.2	217	0.90
003. GJ 3323 b	M-Warm Terran	≥2.02	–	1.23	265	5.4	17	0.90
004. TRAPPIST-1 d	M-Warm Subterran	0.41	0.77	1.21	267	4.0	41	0.89
005. GJ 1061 c	M-Warm Terran	≥1.75	–	1.35	275	6.7	12	0.88
006. TRAPPIST-1 e	M-Warm Terran	0.62	0.92	0.70	233	6.1	41	0.87
007. GJ 667 C f	M-Warm Terran	≥2.54	–	0.85	245	39.0	22	0.87
008. Proxima Cen b	M-Warm Terran	≥1.27	–	0.69	227	11.2	4.2	0.87
009. Kepler-442 b	K-Warm Terran	–	1.35	0.72	235	112.3	1115	0.85
010. GJ 273 b	M-Warm Terran	≥2.89	–	1.19	266	18.6	12	0.84
011. GJ 1061 d	M-Warm Terran	≥1.68	–	0.57	221	13.0	12	0.80
012. Wolf 1061 c	M-Warm Terran	≥3.41	–	1.36	275	17.9	14	0.79
013. GJ 667 C c	M-Warm Terran	≥3.81	–	1.33	274	28.1	22	0.78
014. tau Cet e	G-Warm Terran	≥3.93	–	1.61	285	162.9	12	0.74
015. Kepler-1229 b	M-Warm Terran	–	1.40	0.49	213	86.8	769	0.73
016. GJ 667 C e	M-Warm Terran	≥2.54	–	0.46	210	62.2	22	0.71
017. TRAPPIST-1 f	M-Warm Terran	0.68	1.04	0.40	203	9.2	41	0.70
018. Teegarden's Star c	M-Warm Terran	≥1.11	–	0.39	202	11.4	12	0.69
019. Kepler-62 f	K-Warm Terran	–	1.41	0.42	205	267.3	1200	0.69
020. TRAPPIST-1 g	M-Warm Terran	1.34	1.13	0.27	184	12.4	41	0.59
021. Kepler-186 f	M-Warm Terran	–	1.17	0.26	182	129.9	561	0.58

nets Catalog

RECURSOS ACERCA DE

ltima actualización: 16 de enero de 2020

al. (2020) y Feng et al. (2020) .

e habitables

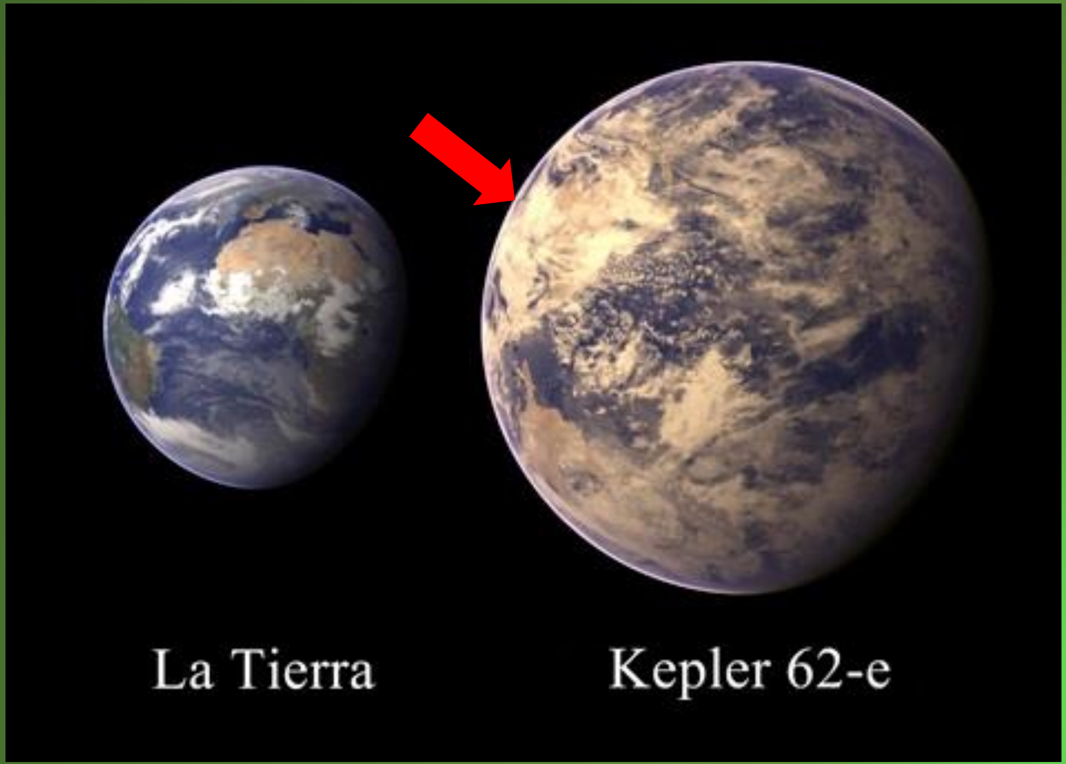
n

eptunes)

Total

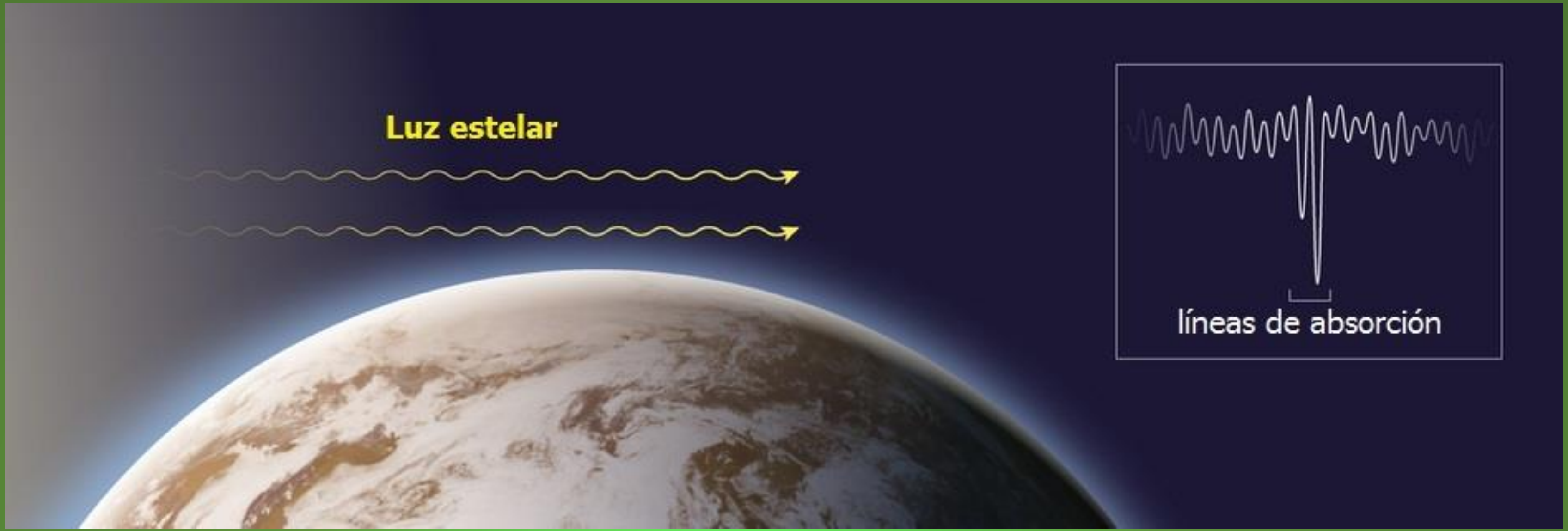
55

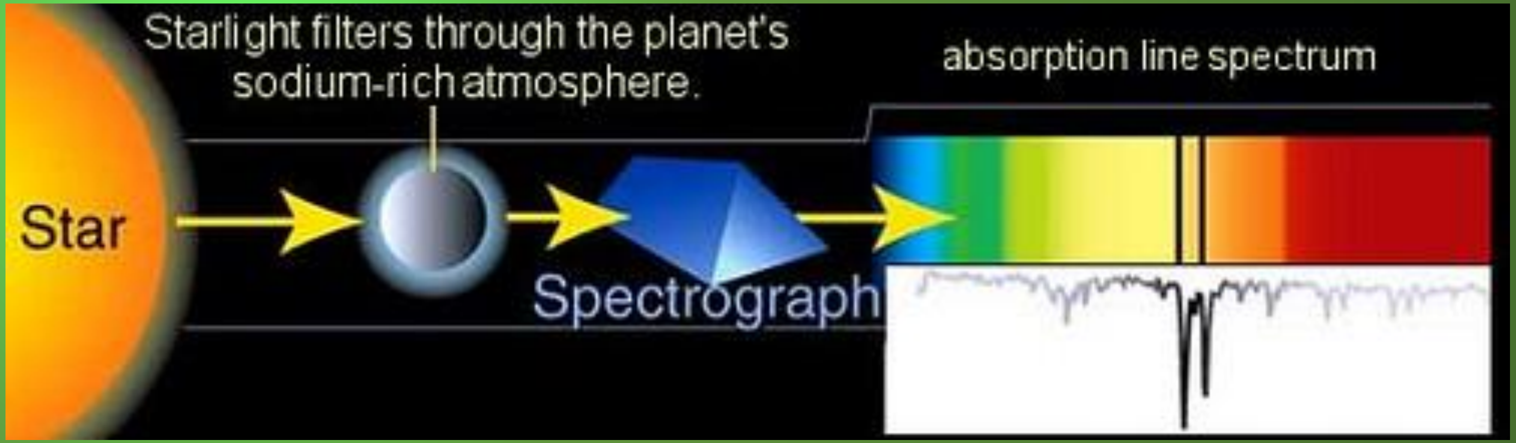
o 1.5 a 2.5 R_E. M_E = masas terrestres, y R_E = radios



El interés se centra en sus atmósferas, que son observadas durante los eventos de *tránsito del planeta por frente de su estrella* . . .

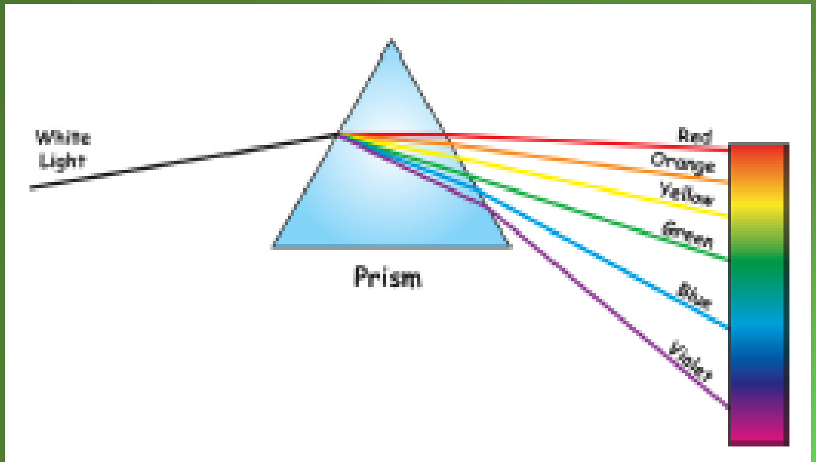
. . . y los biomarcadores en su mayoría son detectados por ***ESPECTROSCOPÍA DE TRANSMISIÓN.***

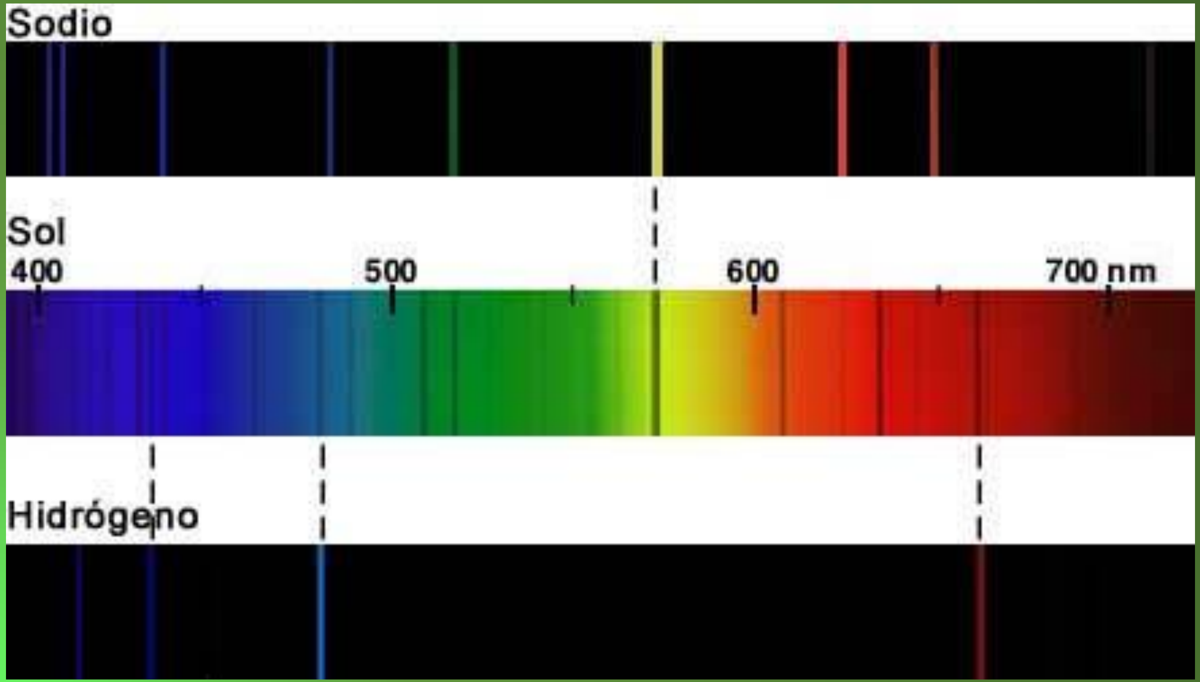




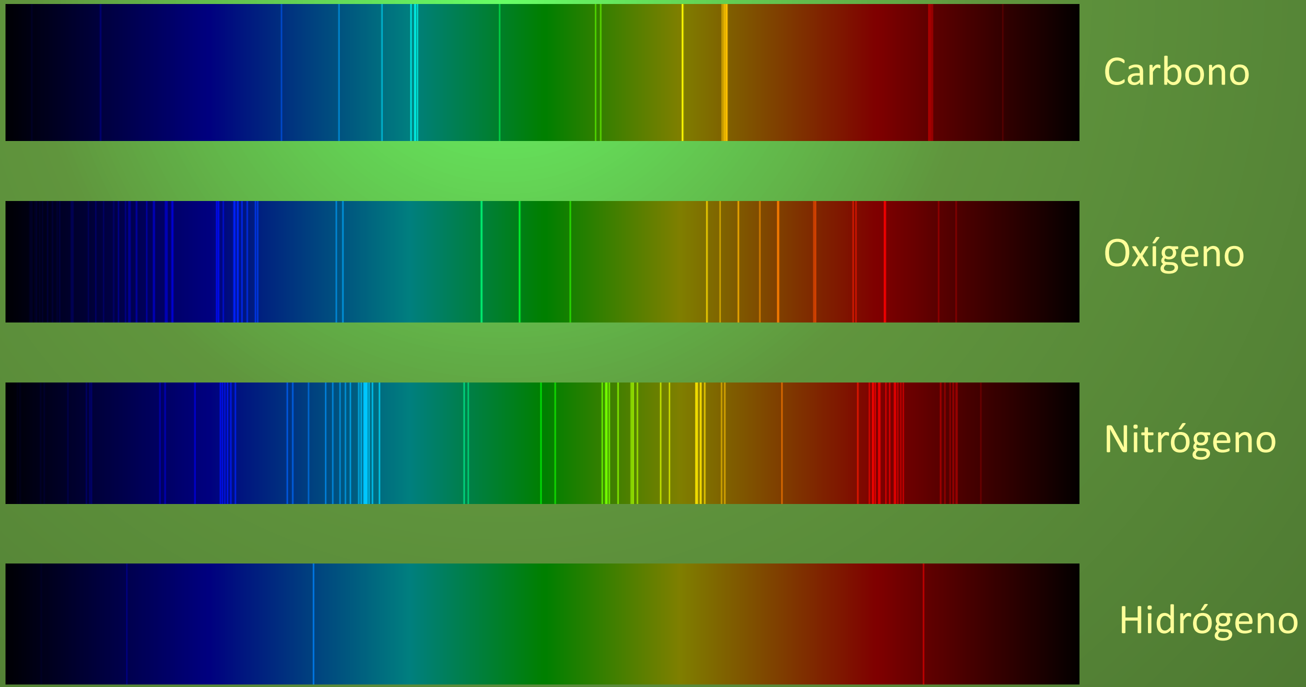
La espectroscopía de las atmósferas de planetas extrasolares permite explorar su medio ambiente; distinguir planetas gaseosos de Súper Tierras rocosas; …

… explorar la composición de las atmósferas, así como la búsqueda de indicadores para la habitabilidad.

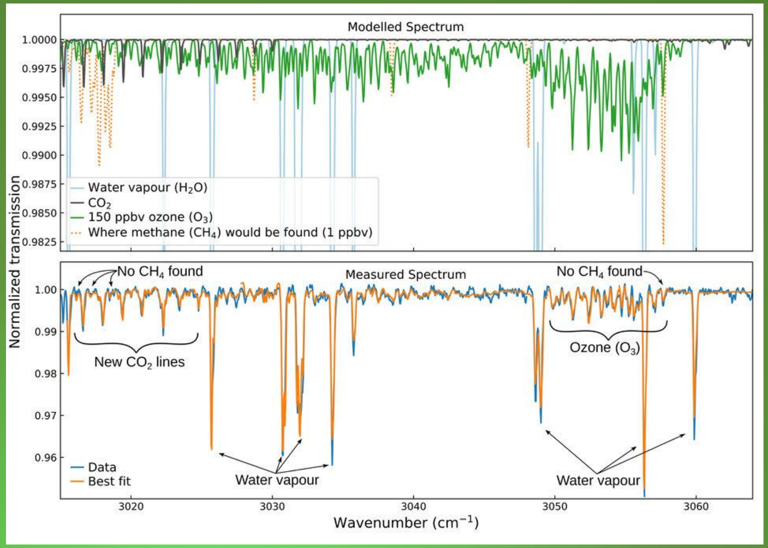


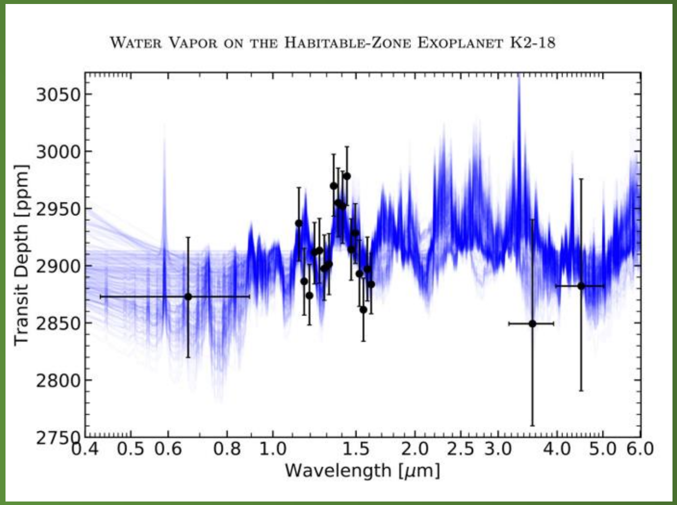


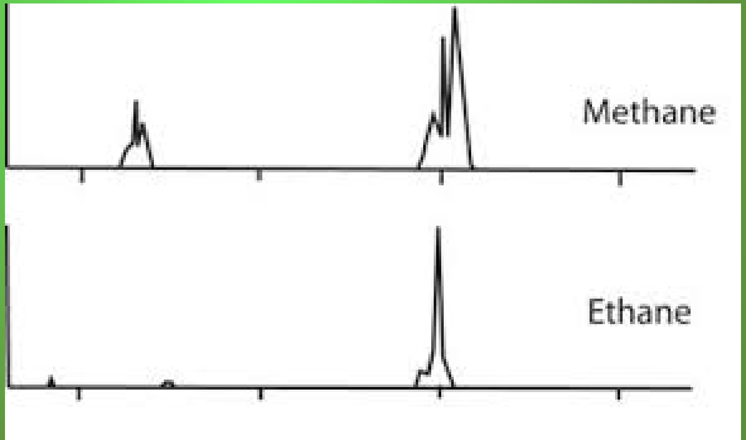
Espectroscopía: técnica en la cual se usa la luz que es absorbida por los átomos cuando ésta incide en ellos.

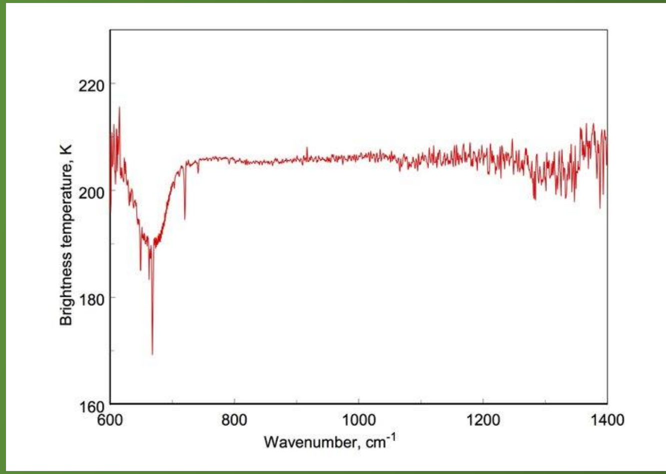


Firmas espectrales de diversos biomarcadores captadas mediante ondas de radio



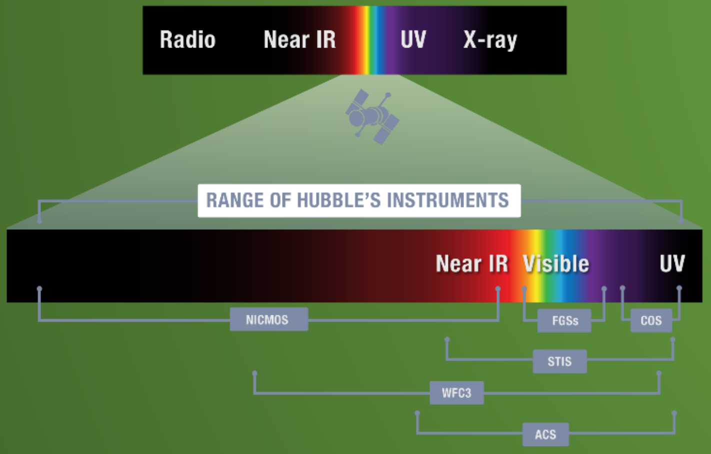


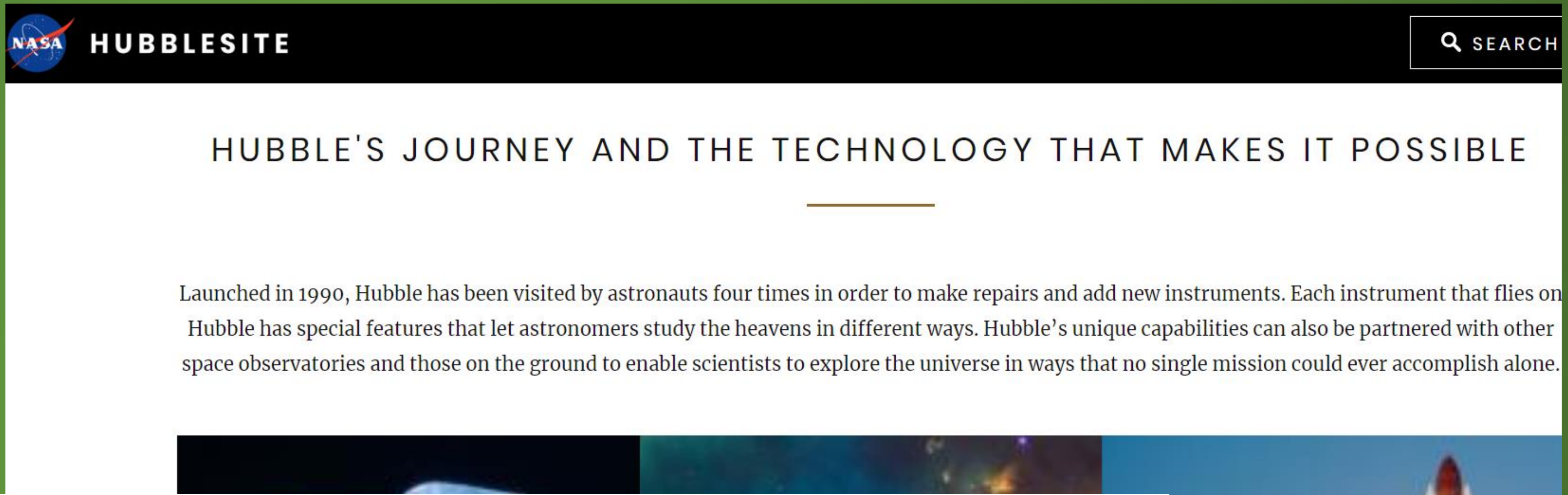


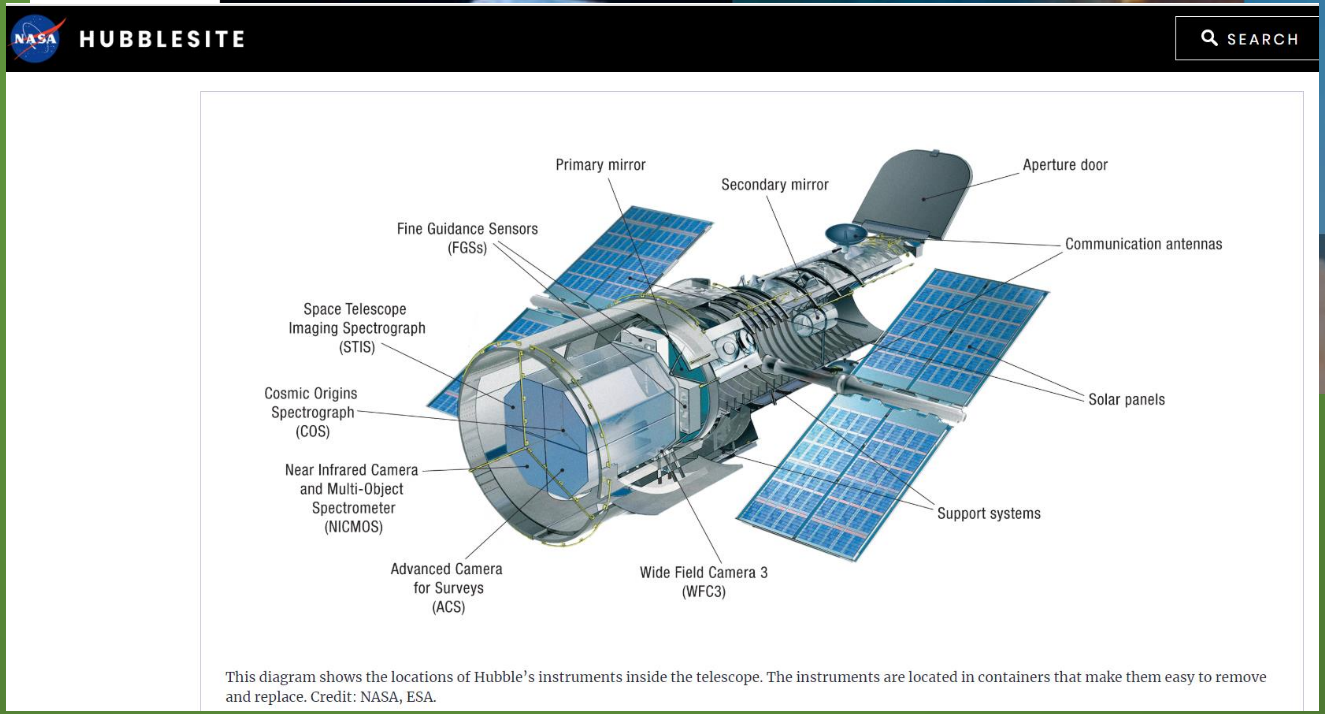


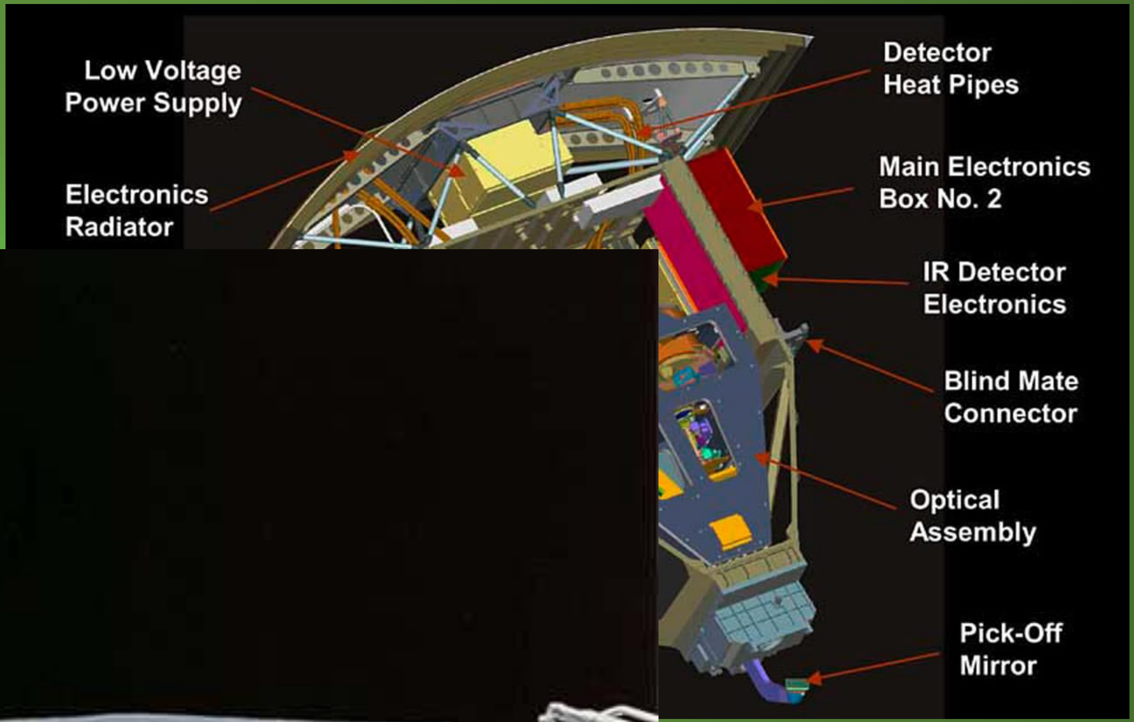
INSTRUMENTACIÓN → ESPECTRÓGRAFOS

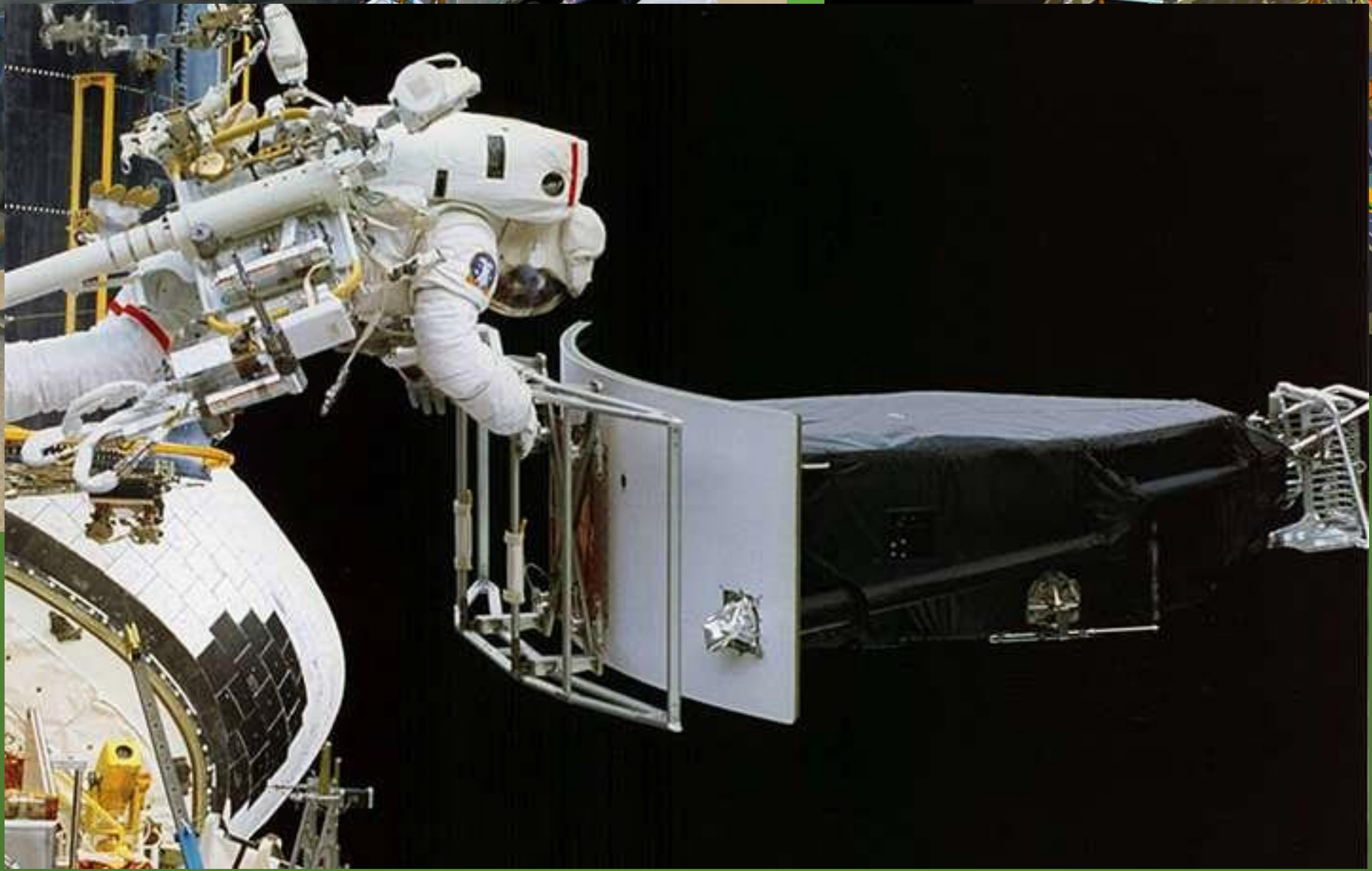
URL: hubblesite.org







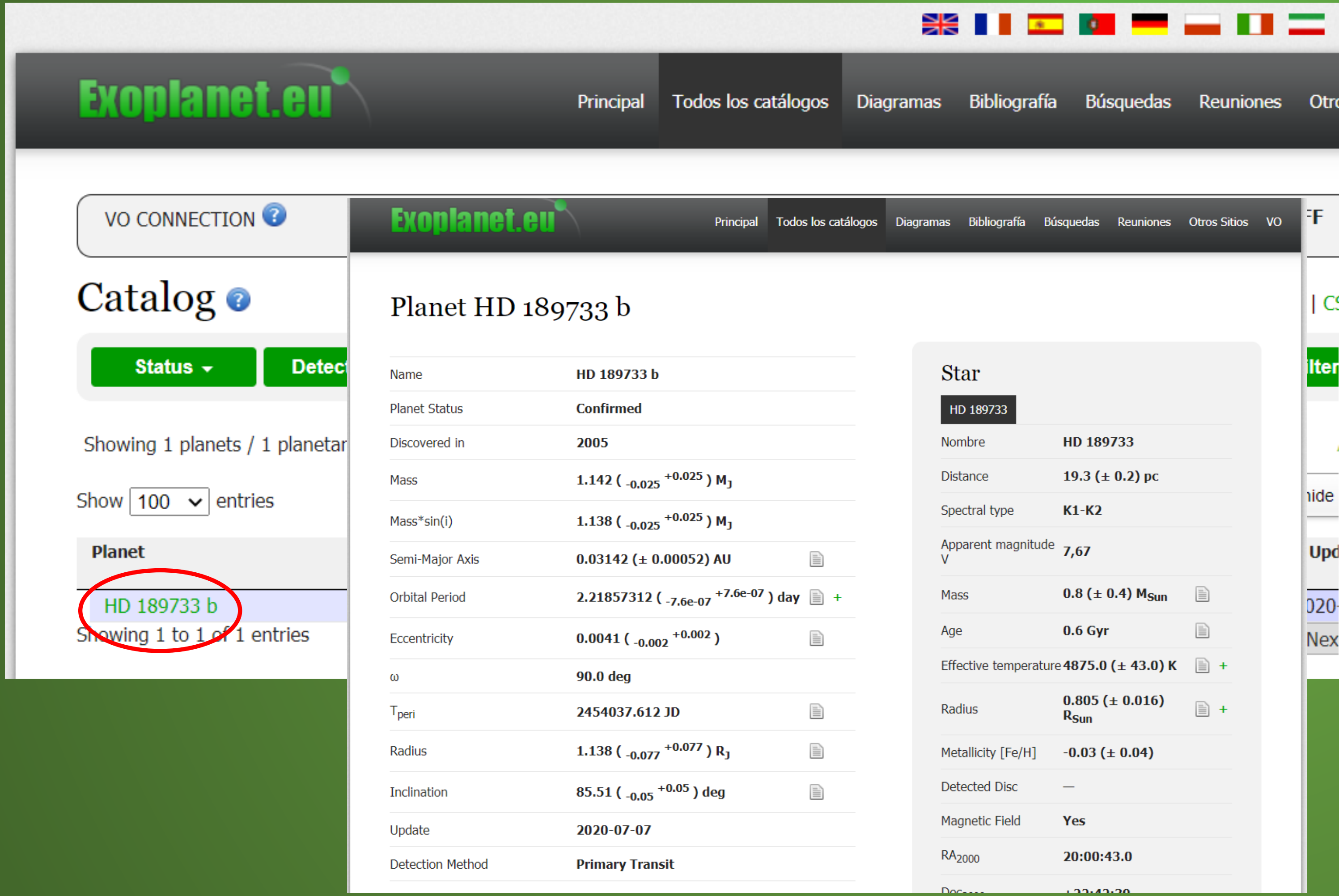

Low Voltage Power Supply
Detector Heat Pipes
Electronics Radiator
Main Electronics Box No. 2
IR Detector Electronics
Blind Mate Connector
Optical Assembly
Pick-Off Mirror



EJEMPLO: Biomarcas en HD 189733 b – WFC3 del HST detectó CH_4 en su atmósfera

URL: exoplanet.eu/catalog/

Estudios posteriores detectaron otras moléculas: carbono, monóxido de carbono, dióxido de carbono, hidrógeno, vapor de agua, helio, potasio, sodio, oxígeno y ozono.

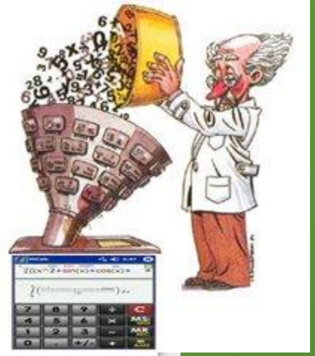


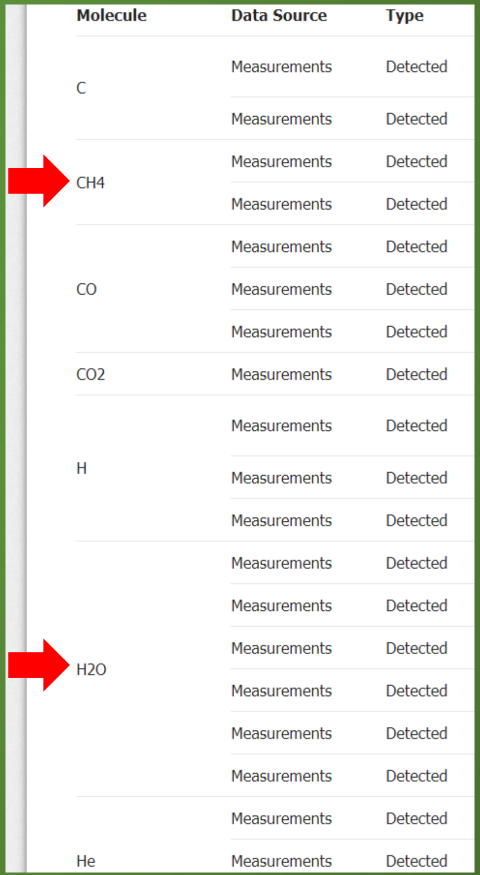
Name	HD 189733 b
Planet Status	Confirmed
Discovered in	2005
Mass	1.142 ($_{-0.025}^{+0.025}$) M_J
Mass*sin(i)	1.138 ($_{-0.025}^{+0.025}$) M_J
Semi-Major Axis	0.03142 (± 0.00052) AU
Orbital Period	2.21857312 ($_{-7.6e-07}^{+7.6e-07}$) day
Eccentricity	0.0041 ($_{-0.002}^{+0.002}$)
ω	90.0 deg
T_{peri}	2454037.612 JD
Radius	1.138 ($_{-0.077}^{+0.077}$) R_J
Inclination	85.51 ($_{-0.05}^{+0.05}$) deg
Update	2020-07-07
Detection Method	Primary Transit

Star

HD 189733

Nombre	HD 189733
Distance	19.3 (± 0.2) pc
Spectral type	K1-K2
Apparent magnitude V	7,67
Mass	0.8 (± 0.4) M_{Sun}
Age	0.6 Gyr
Effective temperature	4875.0 (± 43.0) K
Radius	0.805 (± 0.016) R_{Sun}
Metallicity [Fe/H]	-0.03 (± 0.04)
Detected Disc	—
Magnetic Field	Yes
RA_{2000}	20:00:43.0





Molecule	Data Source	Type
C	Measurements	Detected
	Measurements	Detected
CH4	Measurements	Detected
	Measurements	Detected
	Measurements	Detected
CO	Measurements	Detected
	Measurements	Detected
CO2	Measurements	Detected
	Measurements	Detected
H	Measurements	Detected
	Measurements	Detected
	Measurements	Detected
	Measurements	Detected
H2O	Measurements	Detected
	Measurements	Detected
	Measurements	Detected
	Measurements	Detected
	Measurements	Detected
He	Measurements	Detected

URL: var.astro.cz/ETD

Variable Star and Exoplanet Section
of Czech Astronomical Society

B.R.N.O. MEDÚZA TRESCA HERO

ETD ... complete ... worldwide ... continuously growing ...
Exoplanet Transit Database
http://var.astro.cz/ETD

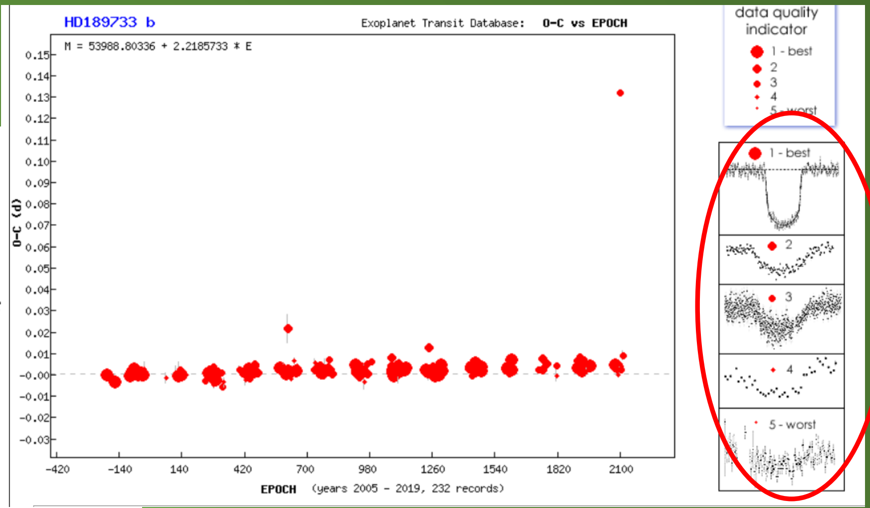
Known transiters:
CoRoT-1 b
CoRoT-10 b
CoRoT-11 b
CoRoT-12 b
CoRoT-13 b
CoRoT-17 b
CoRoT-18 b
CoRoT-19 b
CoRoT-2 b
CoRoT-20 b
CoRoT-3 b
CoRoT-4 b
CoRoT-5 b
CoRoT-6 b
CoRoT-8 b
CoRo

	OBJECT	CONST	# OF DATA	TIME SPAN FROM - TILL		LAST CHANGES (DAYS) Red if less than 1 week ago
1	HD189733 b	Vul	248			

RA	DE	PERIOD (d)
20 00 43.713	+22 42 39.07	2.2185733

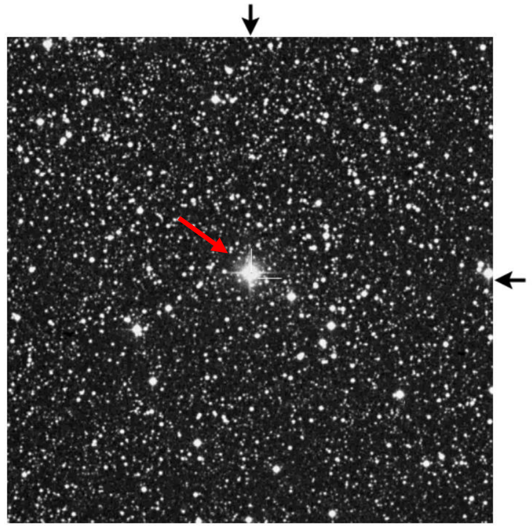
> Show transit predictions for next 365

Plot user data ...



HD189733 b (Vul)

RA (J2000): **20 00 43.713**, DE (J2000): **+22 42 39.07**,
V = **7.67 mag**, dV = **0.0282 mag**, duration = **109.6 minutes**
Per = 2.2185733 d, T0(HJD) = 2453988.80336 compute



Cornell University

arXiv.org > astro-ph > arXiv:0802.1030

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Astrophysics

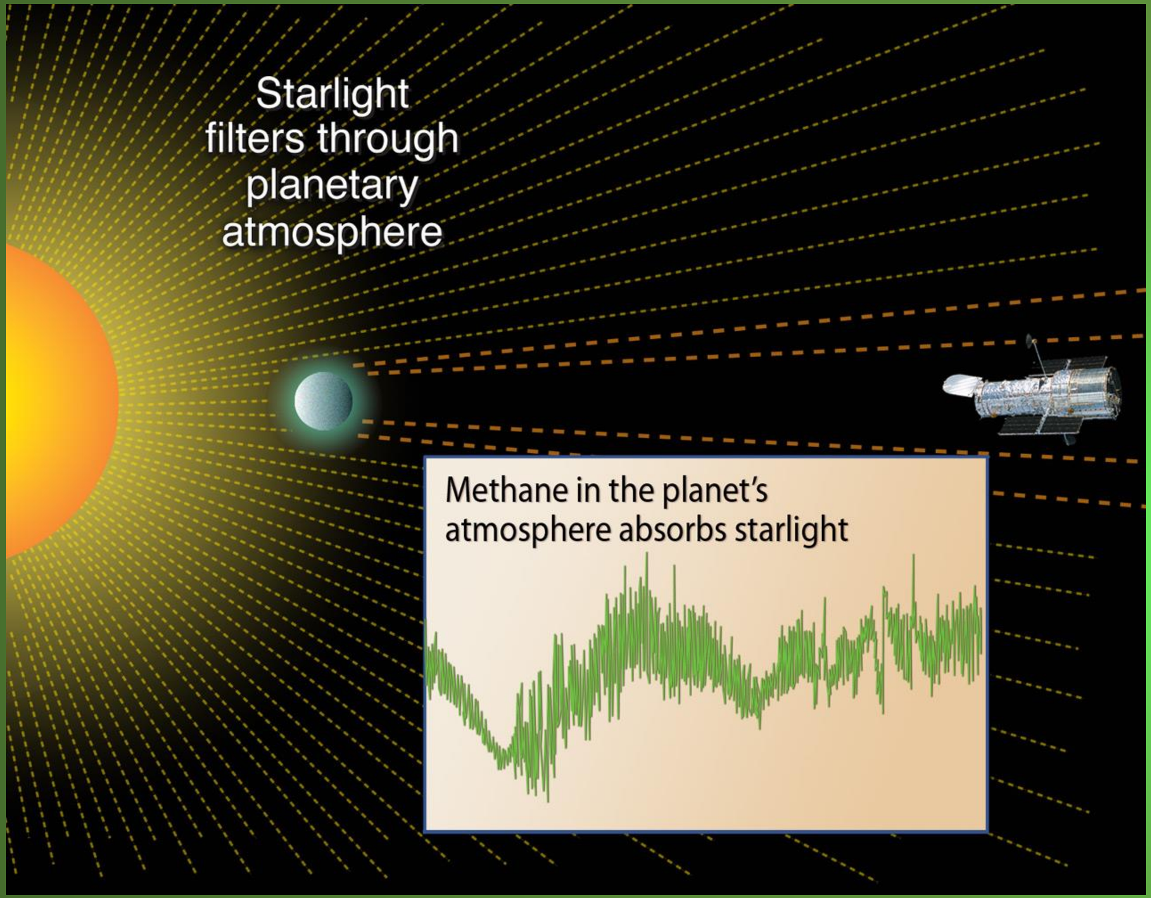
[Submitted on 7 Feb 2008]

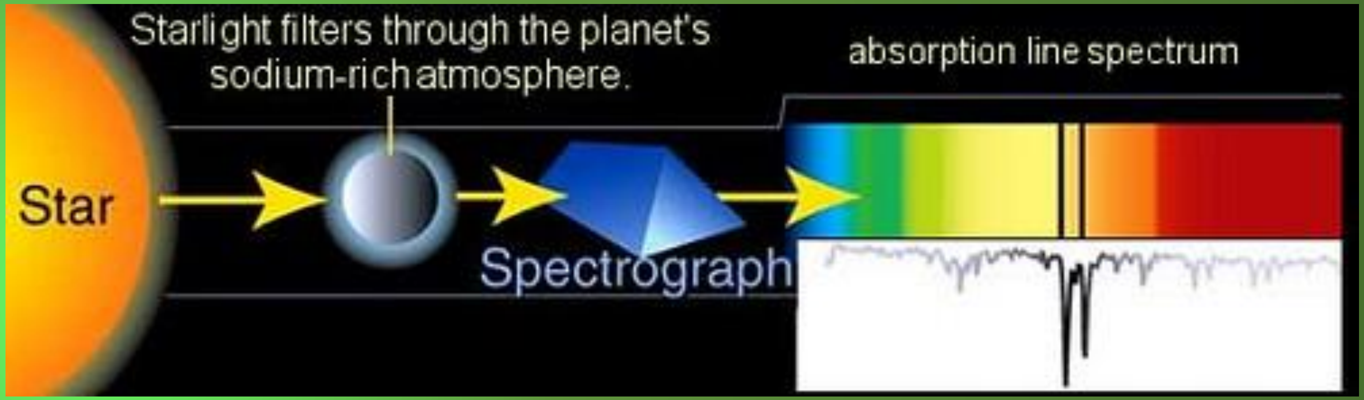
Methane present in an extrasolar planet atmosphere

Mark R. Swain, Gautam Vasisht, Giovanna Tinetti

Molecules present in exoplanetary atmospheres are expected to strongly influence the atmospheric radiation balance, trace dynamical and chemical processes, and indicate the presence of disequilibrium effects. Since molecules have the potential to reveal the exoplanet atmospheric conditions and chemistry, searching for them is a high priority. The rotational-vibrational transition bands of water, carbon monoxide, and methane are anticipated to be the primary sources of non-continuum opacity in hot-Jovian planets. Since these bands overlap in wavelength, and the corresponding signatures from them are weak, decisive identification requires precision infrared spectroscopy. Here we report on a near-infrared transmission spectrum of the planet HD 189733b showing the presence of methane. Additionally, a resolved water-vapour band at 1.9 microns confirms the recent claim of water in this object. On thermochemical grounds, carbon-monoxide is expected to be abundant in the upper atmosphere of hot-Jovian exoplanets; thus the detection of methane rather than carbon-monoxide in such a hot planet could signal the presence of a horizontal chemical gradient away from the permanent dayside, or it may imply an ill-understood photochemical mechanisms that leads to an enhancement of methane.

La luz de la estrella se filtra a través de la atmósfera del planeta ...

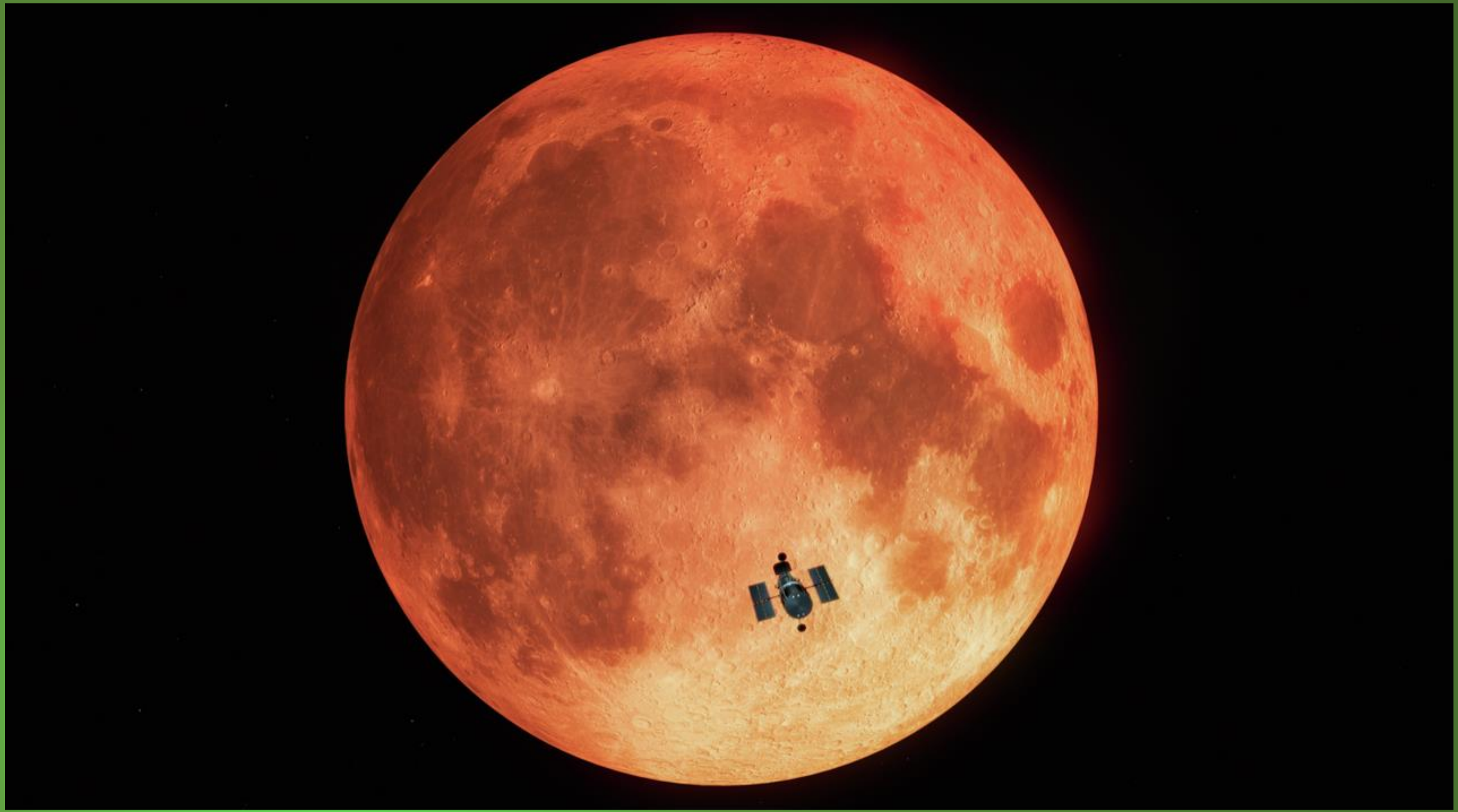




El metano presente en la atmósfera absorbe la luz de la estrella y se observa en su espectro ...

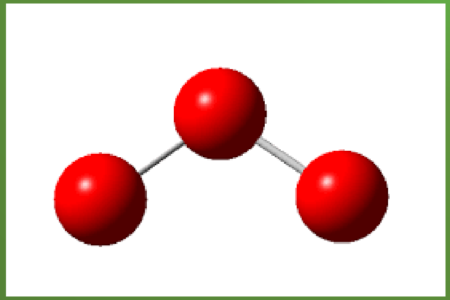
06/08/2020 – NOTICIA:

HUBBLE UTILIZA LA LUNA PARA SONDEAR LA ATMÓSFERA DE LA TIERRA DURANTE UN ECLIPSE LUNAR



Aprovechando un eclipse lunar total, los astrónomos que utilizan el HST han detectado ozono en la atmósfera de la Tierra al observar la luz de la Tierra reflejada en la Luna.

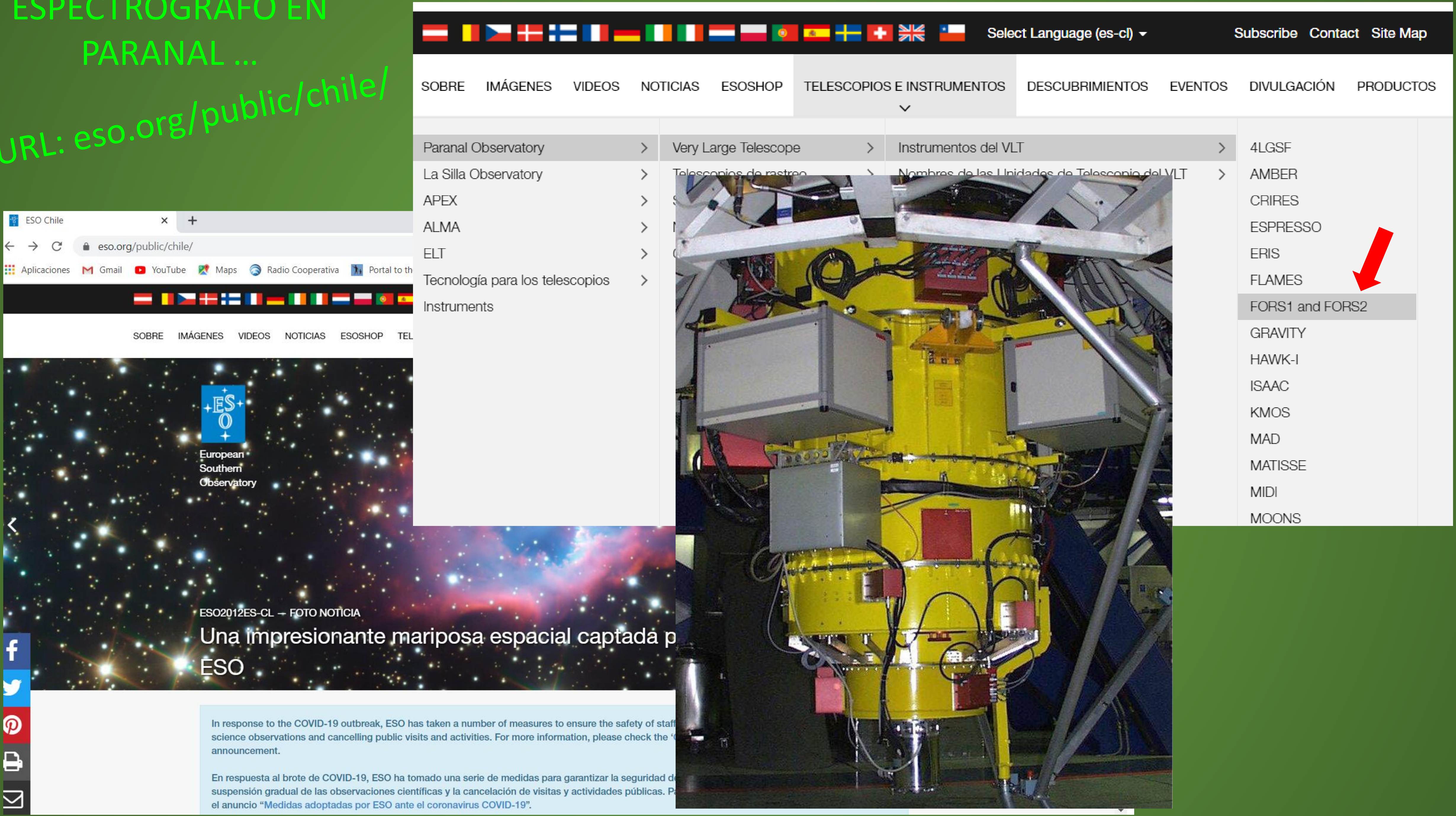
En la Tierra, la fotosíntesis durante miles de millones de años, es la responsable de los altos niveles de oxígeno y la gruesa capa de ozono de nuestro planeta.



Encontrar ozono es importante porque es un subproducto fotoquímico del oxígeno molecular, que en sí mismo es un subproducto de la vida.

ESPECTRÓGRAFO EN PARANAL …

URL: eso.org/public/chile/



URL: exoplanet.eu/catalog/

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ESO European Southern Observatory

eso1047es-cl — Comunicado científico

Primer Análisis de Atmósfera de un Súper-Tierra

1 de Diciembre de 2010

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Status Detection Filter

g 1 planets / 1 planetary systems / 0 multiple planet systems

All fields

1214 b Show / hide columns

Ang. dist. (arcsec)	Discovery	Update
0.001077	2009	2019-09-04

First Previous 1 Next Last

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Planet GJ 1214 b

Name	GJ 1214 b
Planet Status	Confirmed
Discovered in	2009
Mass	0.0203253311519 (-0.00311487273071 +0.00311487273071) M_J
Mass*sin(i)	—
Semi-Major Axis	0.01411 (± 0.00032) AU
Orbital Period	1.580404497 (± 3e-08) day
Eccentricity	0.27 (-0.27 +0.0)
ω	—
T_{peri}	—
Radius	0.238201870286 (-1.07057020353 +1.07057020353) R_J
Inclination	88.17 (± 0.54) deg

Star

GJ 1214

Nombre

Distance

Spectral type

Apparent magni V

Mass

Age

Effective tempe

Radius

Metallicity [Fe/H

Detected Disc

Magnetic Field

Atmospheric parameters

Temperatures

Data Source	Type	Result Value	Result Figure	Notes	Reference

Molecules

Molecule	Data Source	Type	Result Value	Result Figure	Notes	Reference
He	Measurements	Detected				2019 - CROSSFIELD I.

Observability Predictor

Remarks

3 Dec 2010: The planet may transit spots of the stellar surface (Berta et al. 2010)

Related publications

Non-detection of Helium in the Upper Atmospheres of Three Sub-Neptune Exoplanets
2020 KASPER D., BEAN J., OLOPCIC A., MALSKY I., KEMPTON E. et al.
Astron. J., submitted
arxiv

Diverse outcomes of planet formation and composition around low-mass stars and brown dwarfs
2020 MIGUEL Y., CRIDLAND A., ORMEL C., FORTNEY J. & IDA S.
MNRAS, 491, 1998
paper arxiv

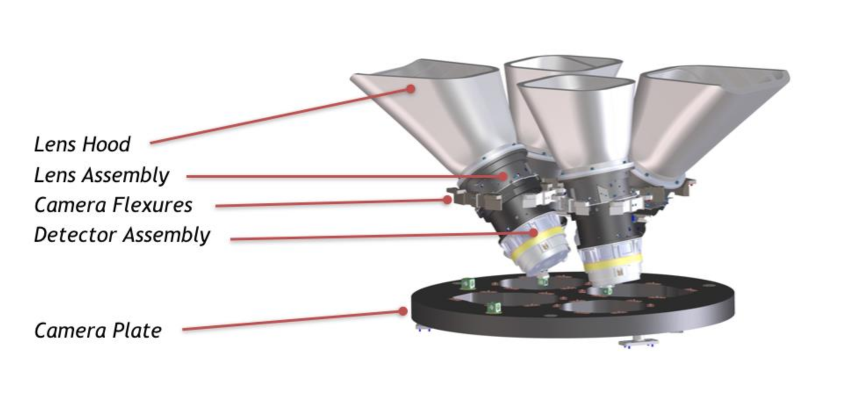
Extremely long convergence times in a 3D GCM simulation of the sub-Neptune Gliese 1214b
2020 WANG H. & WORDSWORTH R.

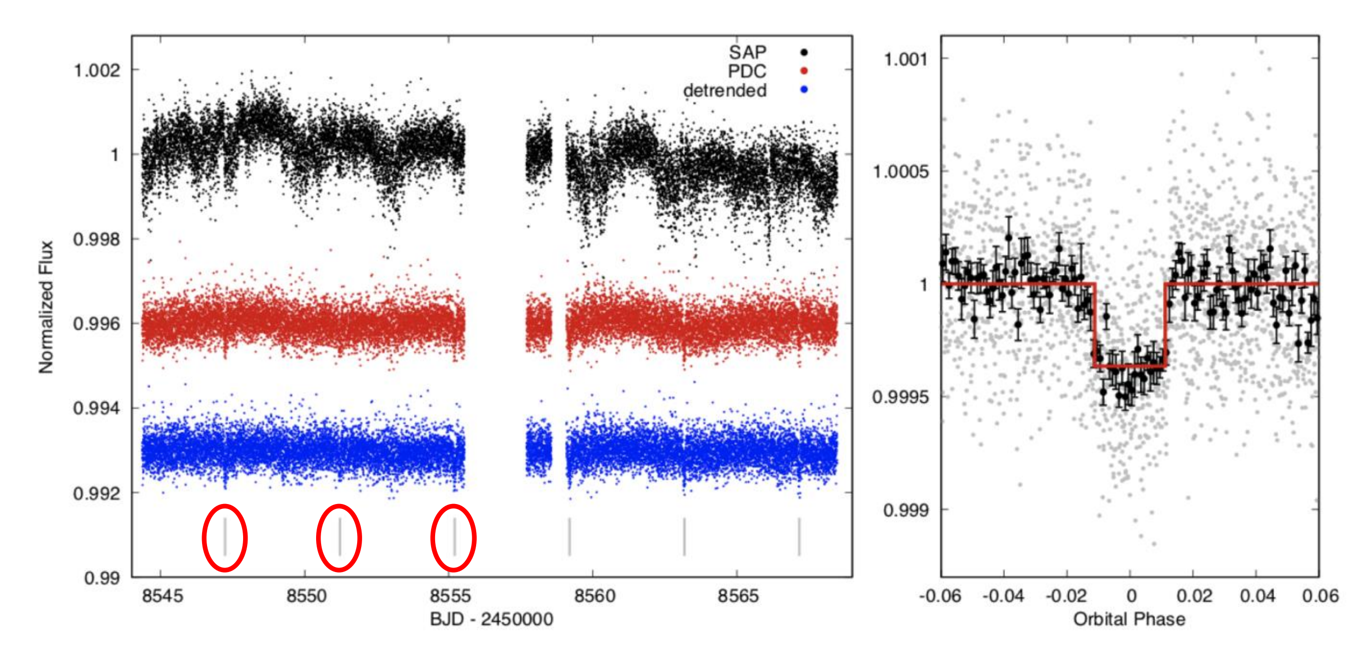
LO ÚLTIMO: Espectrógrafo a bordo del TESS
(Transiting Exoplanet Survey Satellite)

Observaciones espectroscópicas que pueden entregar masas de planetas y composición de sus atmósferas.

También detecta cambios en la curva de luz de las estrellas.

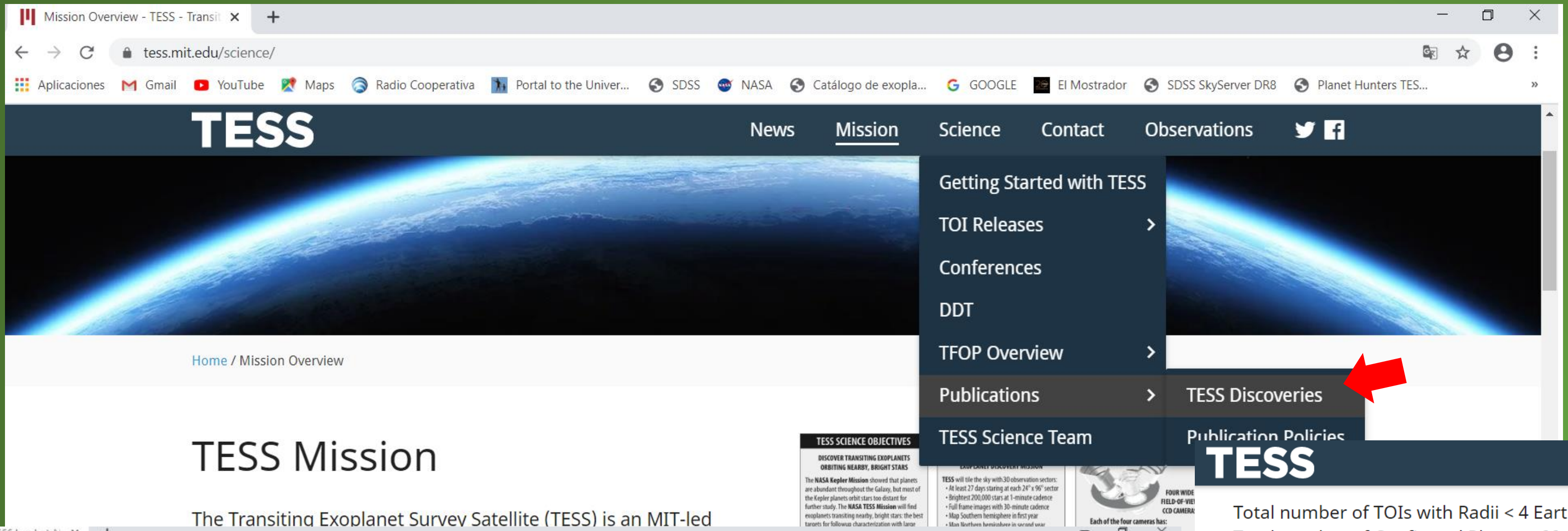
TESS detecta planetas de tamaño terrestre y súper tierras orbitando enanas rojas en el vecindario solar: masa, tamaño, densidad y propiedades atmosféricas.

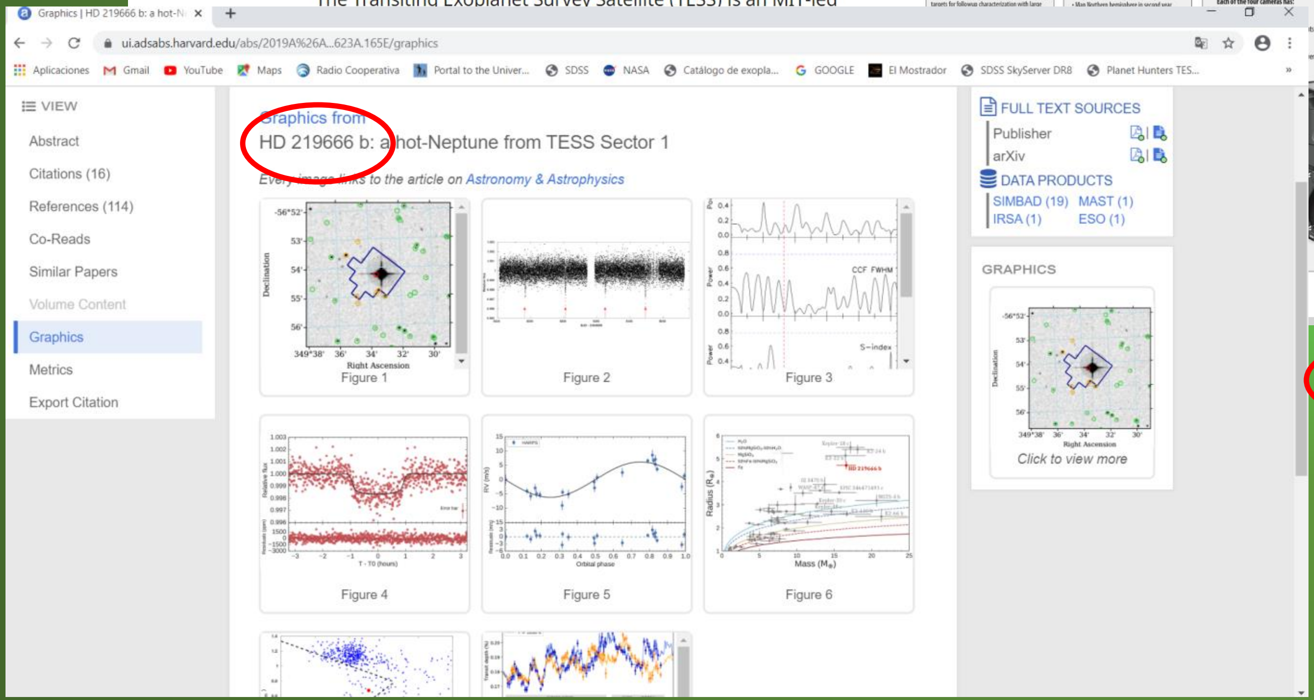


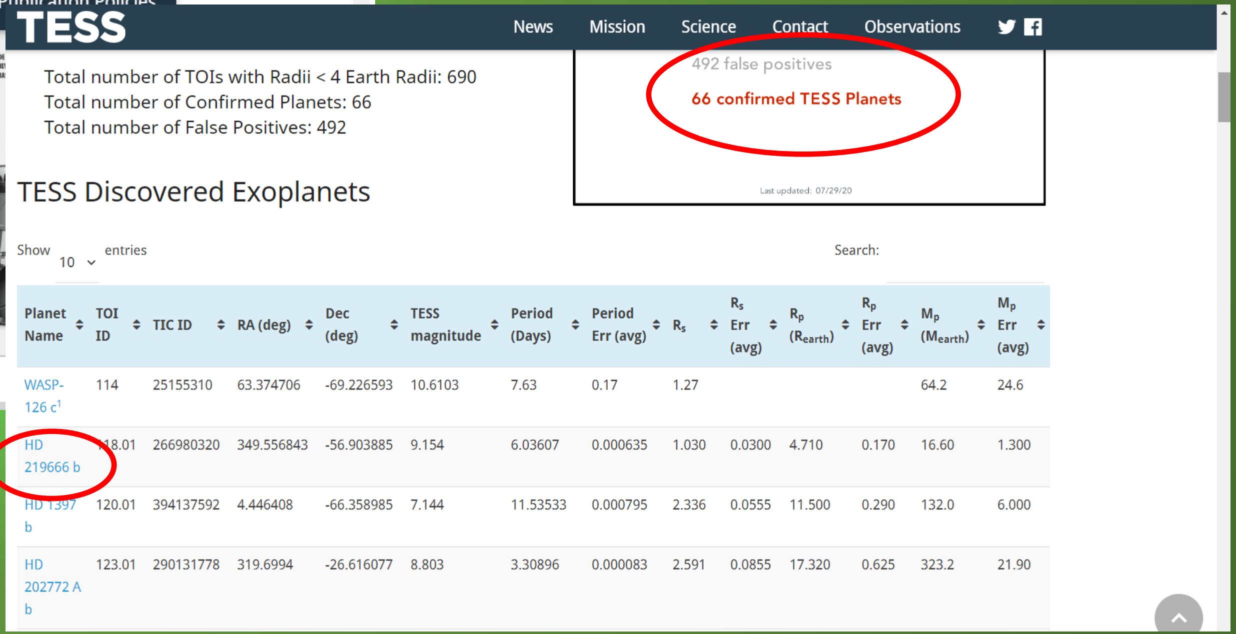


Visitemos el sitio del TESS …

URL: tess.mit.edu/science/



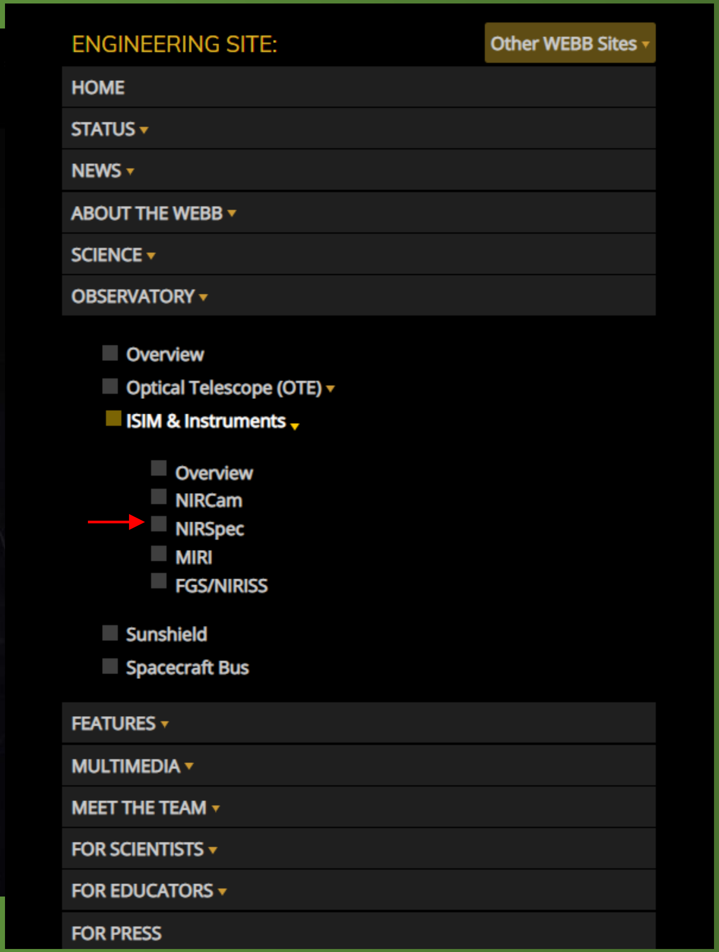




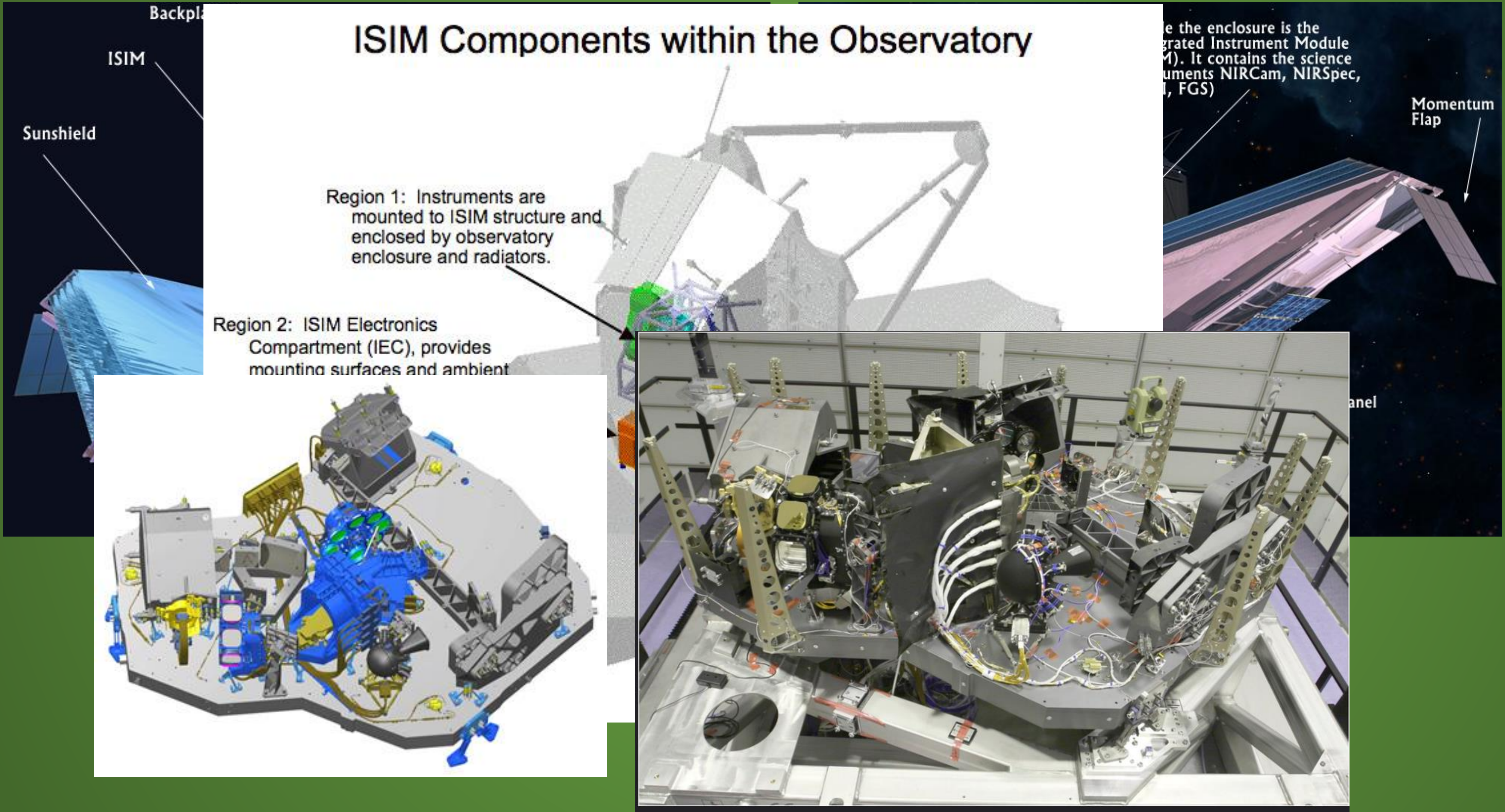
LO QUE SE VIENE: Futuras misiones . . .

URL: jwst.nasa.gov

El JWST Permitirá sondear planetas similares al nuestro para caracterizar atmósferas que indiquen condiciones de habitabilidad.



NIRSpec: espectrógrafo



SUGERENCIAS WEBGRÁFICAS:

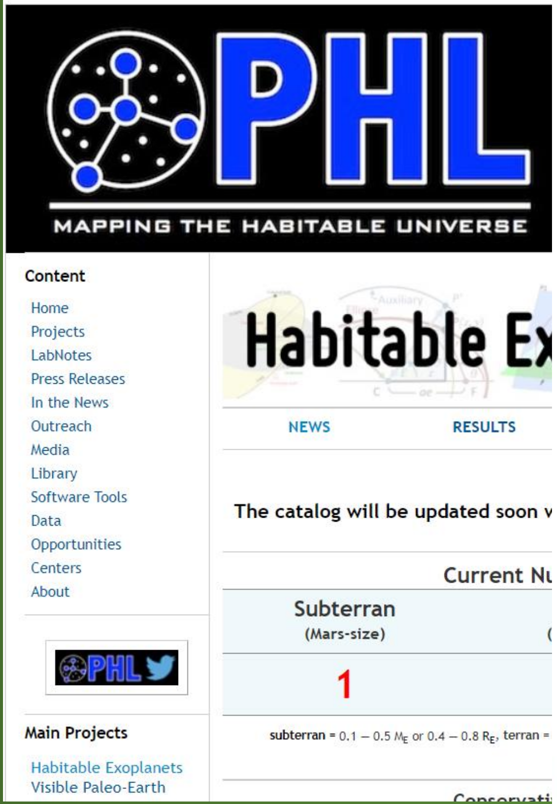
URL:

- eso.org/public/chile/
- jwst.nasa.gov
- heasarc.gsfc.nasa.gov/docs/tess/gallery.html
- tess.mit.edu/science/
- hubblesite.org
- var.astro.cz/ETD
- cas.sdss.org/dr16/en/home.aspx

DESAFÍO 1: Caso de estudio

URL: phl.upr.edu

Estrella GJ 273 (Luyten) – Enana roja a 12 años-luz con sistema planetario; GJ 273b marca presencia de **agua**.



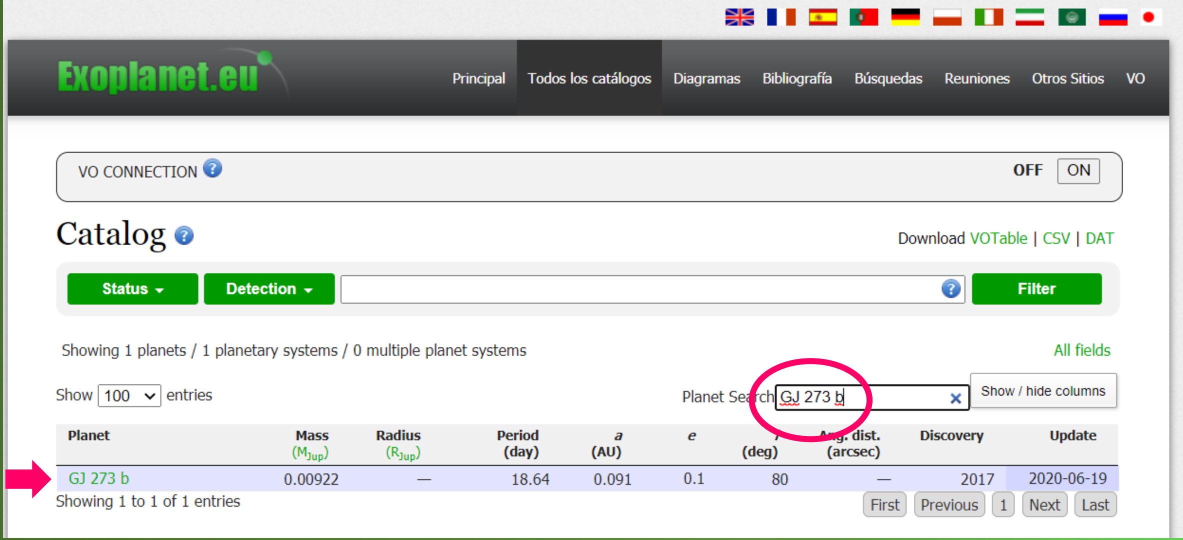
This is a list of the exoplanets that are more likely to have a rocky com
Radius ≤ 1.5 Earth radii or 0.1 < Planet Minimum Mass ≤ 5 Earth masses

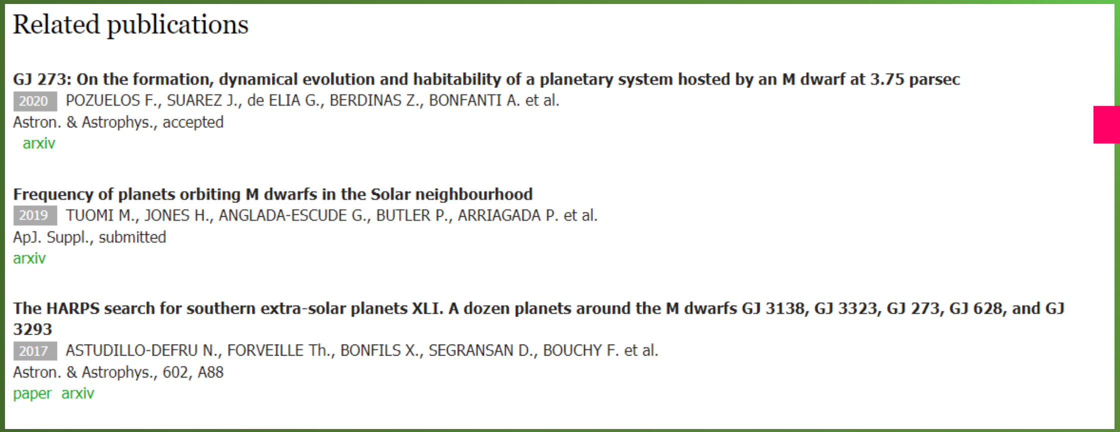
Name	Type	Mass (M_E)	Radius (R_E)	Flux (S_E)	T_{eq} (K)	Period (days)	Distance (ly)	ESI
001. Teegarden's Star b	M-Warm Terran	≥1.05	–	1.21	267	4.9	12	0.93
002. K2-72 e	M-Warm Terran	–	1.29	1.11	261	24.2	217	0.90
003. GJ 3323 b	M-Warm Terran	≥2.02	–	1.23	265	5.4	17	0.90
004. TRAPPIST-1 d	M-Warm Subterran	0.41	0.77	1.21	267	4.0	41	0.89
005. GJ 1061 c	M-Warm Terran	≥1.75	–	1.35	275	6.7	12	0.88
006. TRAPPIST-1 e	M-Warm Terran	0.62	0.92	0.70	233	6.1	41	0.87
007. GJ 667 C f	M-Warm Terran	≥2.54	–	0.85	245	39.0	22	0.87
008. Proxima Cen b	M-Warm Terran	≥1.27	–	0.69	227	11.2	4.2	0.87
009. Kepler-442 b	K-Warm Terran	–	1.35	0.72	235	112.3	1115	0.85
010. GJ 273 b	M-Warm Terran	≥2.89	–	1.19	266	18.6	12	0.84
011. GJ 1061 d	M-Warm Terran	≥1.68	–	0.57	221	13.0	12	0.80
012. Wolf 1061 c	M-Warm Terran	≥3.41	–	1.36	275	17.9	14	0.79
013. GJ 667 C c	M-Warm Terran	≥3.81	–	1.33	274	28.1	22	0.78
014. tau Cet e	G-Warm Terran	≥3.93	–	1.61	285	162.9	12	0.74
015. Kepler-1229 b	M-Warm Terran	–	1.40	0.49	213	86.8	769	0.73
016. GJ 667 C e	M-Warm Terran	≥2.54	–	0.46	210	62.2	22	0.71
017. TRAPPIST-1 f	M-Warm Terran	0.68	1.04	0.40	203	9.2	41	0.70
018. Teegarden's Star c	M-Warm Terran	≥1.11	–	0.39	202	11.4	12	0.69
019. Kepler-62 f	K-Warm Terran	–	1.41	0.42	205	267.3	1200	0.69
020. TRAPPIST-1 g	M-Warm Terran	1.34	1.13	0.27	184	12.4	41	0.59
021. Kepler-186 f	M-Warm Terran	–	1.17	0.26	182	129.9	561	0.58

Name	Type	Mass (M_E)	Radius (R_E)	Flux (S_E)	T_{eq} (K)	Period (days)	Distance (ly)	ESI
001. Teegarden's Star b	M-Warm Terran	≥1.05	–	1.21	267	4.9	12	0.93
002. K2-72 e	M-Warm Terran	–	1.29	1.11	261	24.2	217	0.90
003. GJ 3323 b	M-Warm Terran	≥2.02	–	1.23	265	5.4	17	0.90
004. TRAPPIST-1 d	M-Warm Subterran	0.41	0.77	1.21	267	4.0	41	0.89
005. GJ 1061 c	M-Warm Terran	>1.75	–	1.35	275	6.7	12	0.88

Búsqueda de más antecedentes ...

URL: exoplanet.eu/catalog



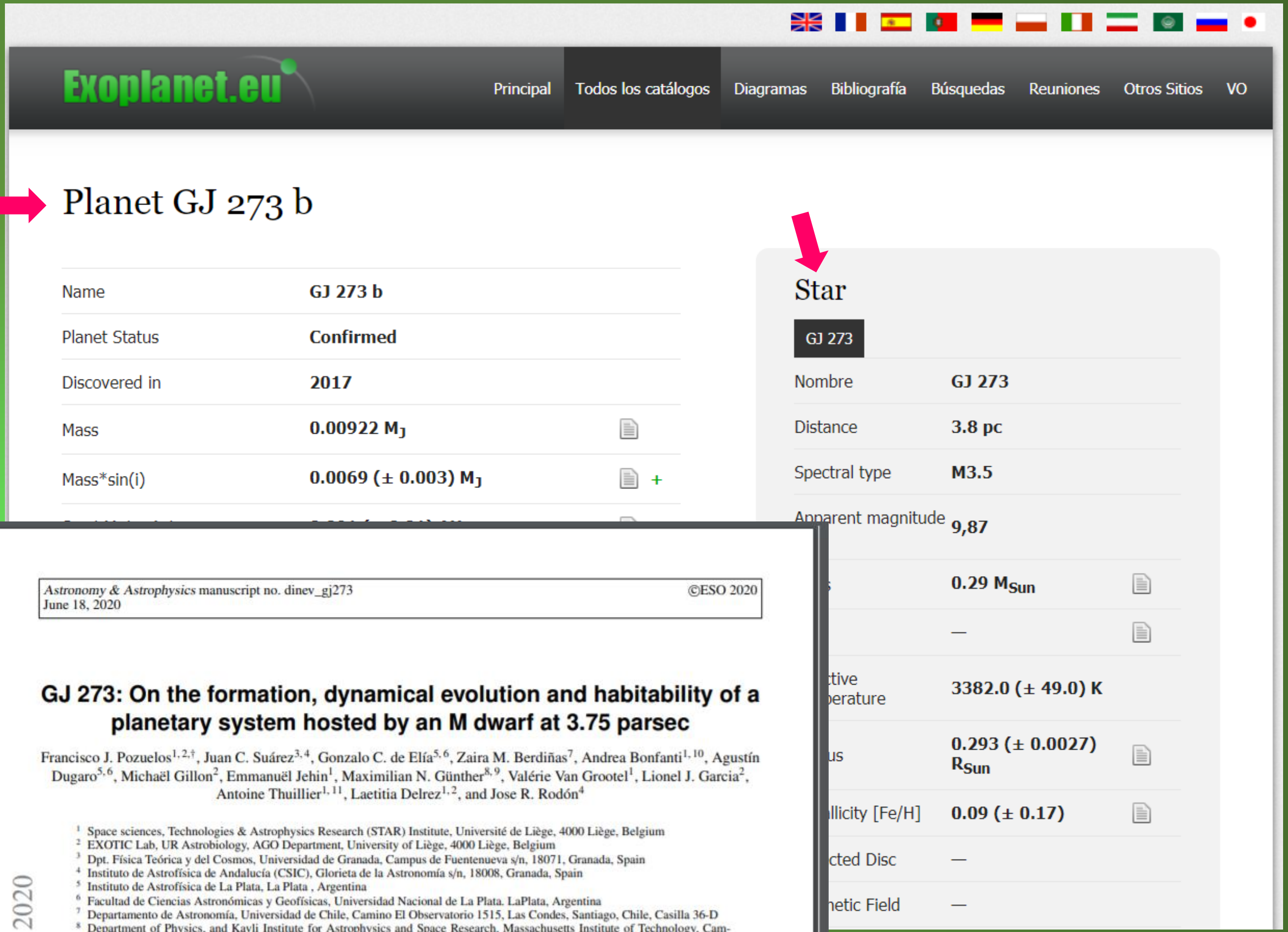


Related publications

GJ 273: On the formation, dynamical evolution and habitability of a planetary system hosted by an M dwarf at 3.75 parsec
2020 POZUELOS F., SUAREZ J., de ELIA G., BERDINAS Z., BONFANTI A. et al.
Astron. & Astrophys., accepted
arxiv

Frequency of planets orbiting M dwarfs in the Solar neighbourhood
2019 TUOMI M., JONES H., ANGLADA-ESCUDE G., BUTLER P., ARRIAGADA P. et al.
ApJ. Suppl., submitted
arxiv

The HARPS search for southern extra-solar planets XLI. A dozen planets around the M dwarfs GJ 3138, GJ 3323, GJ 273, GJ 628, and GJ 3293
2017 ASTUDILLO-DEFRU N., FORVEILLE Th., BONFILS X., SEGRANSAN D., BOUCHY F. et al.
Astron. & Astrophys., 602, A88
paper arxiv



Astronomy & Astrophysics manuscript no. dinev_gj273
June 18, 2020

GJ 273: On the formation, dynamical evolution and habitability of a planetary system hosted by an M dwarf at 3.75 parsec

Francisco J. Pozuelos[1,2,†], Juan C. Suárez[3,4], Gonzalo C. de Elía[5,6], Zaira M. Berdiñas[7], Andrea Bonfanti[1,10], Agustín Dugaro[5,6], Michaël Gillon[2], Emmanuël Jehin[1], Maximilian N. Günther[8,9], Valérie Van Grootel[1], Lionel J. Garcia[2], Antoine Thuillier[1,11], Laetitia Delrez[1,2], and Jose R. Rodón[4]

1 Space sciences, Technologies & Astrophysics Research (STAR) Institute, Université de Liège, 4000 Liège, Belgium
2 EXOTIC Lab, UR Astrobiology, AGO Department, University of Liège, 4000 Liège, Belgium
3 Dpt. Física Teórica y del Cosmos, Universidad de Granada, Campus de Fuentenueva s/n, 18071, Granada, Spain
4 Instituto de Astrofísica de Andalucía (CSIC), Glorieta de la Astronomía s/n, 18008, Granada, Spain
5 Instituto de Astrofísica de La Plata, La Plata , Argentina
6 Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata. LaPlata, Argentina
7 Departamento de Astronomía, Universidad de Chile, Camino El Observatorio 1515, Las Condes, Santiago, Chile, Casilla 36-D
8 Department of Physics, and Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology, Cambridge, MA 02139, USA
9 Juan Carlos Torres Fellow
10 Space Research Institute, Austrian Academy of Sciences, Schmiedlstrasse 6, A-8042 Graz, Austria
11 Observatoire de Paris, 61 Avenue de l'Observatoire 75014 Paris, France
† e-mail: fjpozuelos@uliege.be

Received ; accepted

ABSTRACT

Context. Planets orbiting low-mass stars such as M dwarfs are now considered a cornerstone in the search for life-harbouring planets. GJ 273 is a planetary system orbiting an M dwarf only 3.75 pc away, composed of two confirmed planets, GJ 273b and GJ 273c, and two promising candidates, GJ 273d and GJ 273e. Planet GJ 273b resides in the habitable zone. Currently, due to a lack of observed planetary transits, only the minimum masses of the planets are known: $M_b \sin i_b = 2.89\,M_\oplus$, $M_c \sin i_c = 1.18\,M_\oplus$, $M_d \sin i_d = 10.80\,M_\oplus$, and $M_e \sin i_e = 9.30\,M_\oplus$. Despite being an interesting system, the GJ 273 planetary system is still poorly studied.
Aims. We aim at precisely determine the physical parameters of the individual planets, in particular to break the mass–inclination degeneracy to accurately determine the mass of the planets. Moreover, we present thorough characterisation of planet GJ 273b in terms of its potential habitability.
Methods. First, we explored the planetary formation and hydration phases of GJ 273 during the first 100 Myr. Secondly, we analysed the stability of the system by considering both the two- and four-planet configurations. We then performed a comparative analysis between GJ 273 and the Solar System, and searched for regions in GJ 273 which may harbour minor bodies in stable orbits, i.e. main asteroid belt and Kuiper belt analogues.
Results. From our set of dynamical studies, we obtain that the four-planet configuration of the system allows us to break the mass–inclination degeneracy. From our modelling results, the masses of the planets are unveiled as: $2.89 \le M_b \le 3.03\,M_\oplus$, $1.18 \le M_c \le 1.24\,M_\oplus$, $10.80 \le M_d \le 11.35\,M_\oplus$ and $9.30 \le M_e \le 9.70\,M_\oplus$. These results point to a system likely composed of an Earth-mass planet, a super-Earth and two mini-Neptunes. From planetary formation models, we determine that GJ 273b was likely an efficient water captor while GJ 273c is probably a dry planet. We found that the system may have several stable regions where minor bodies might reside. Collectively, these results are used to comprehensively discuss the habitability of GJ 273b.

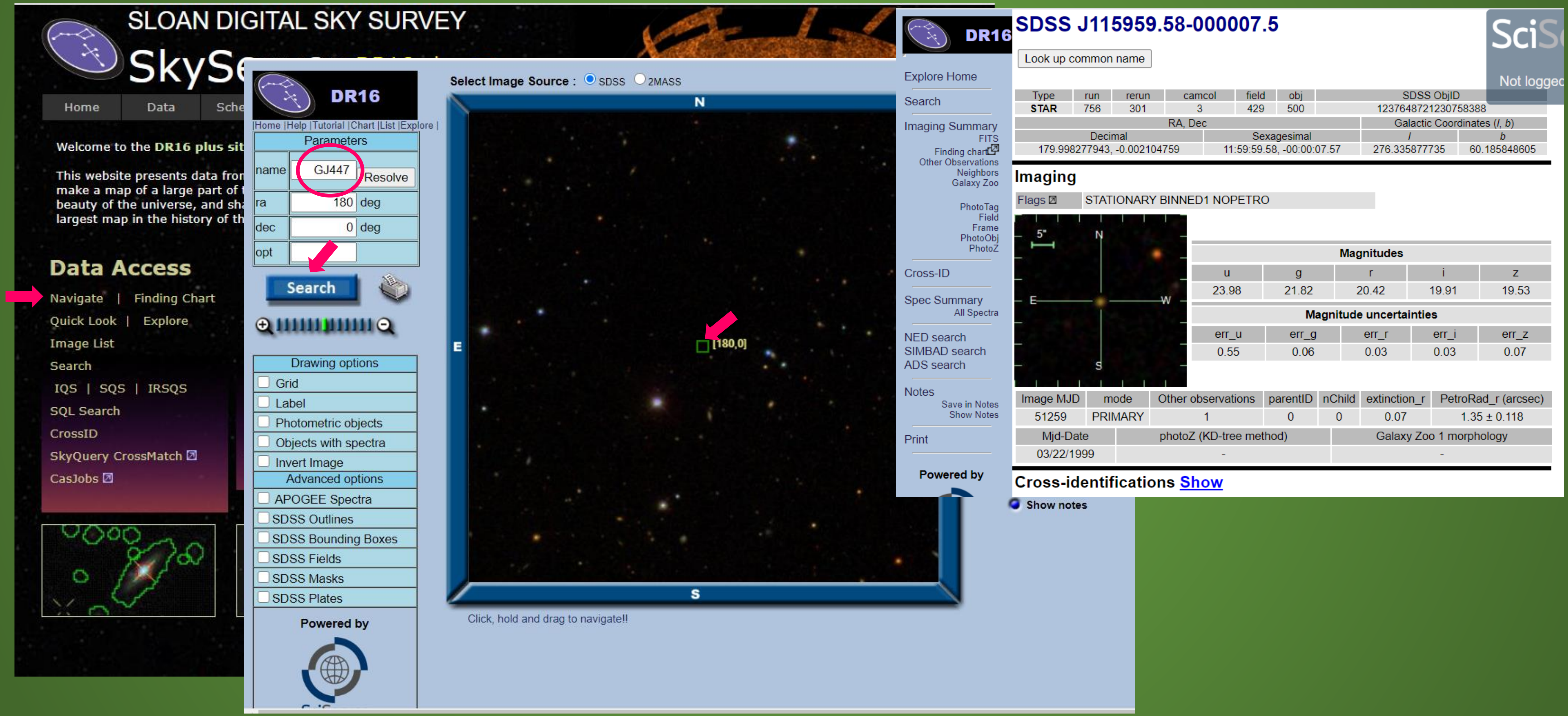
Key words. GJ 273 – M dwarfs – Planetary systems – Planetary dynamics – Tides – Minor-body reservoir analogues – Habitability

DESAFÍO 2: Caso de estudio

Planeta GJ 447 b

Busquemos la estrella en . . .

URL: cas.sdss.org/dr16/en/home.aspx



Encontraremos más datos en . . .

URL: phl.upr.edu

En cuyo catálogo el planeta GJ 447 b está como Ross 128 b

Exoplanet.eu

Principal | Todos los catálogos | Diagramas | Bibliografía | Búsquedas | Reuniones | Otros Sitios | VO

Planet Ross 128 b

Name	Ross 128 b
Planet Status	Confirmed
Discovered in	2017
Mass	—

Star

Ross 128

Nombre	Ross 128
Distance	3.3806 (± 0.0064) pc

Impact of Stellar Superflares on Planetary Habitability
2019 YAMASHIKI Y., MAEHARA H., AIRAPETIAN V., NOTSU Y., SATO T. et al.
ApJ, accepted
arxiv

Lessons from early Earth: UV surface radiation should not limit the habitability of active M star systems
2019 O'MALLEY-JAMES J. & KALTENEGGER L.
MNRAS, accepted
arxiv

Habitability of exoplanet waterworlds
2018 KITE E. & FORD E.
ApJ, 864, 75
arxiv paper

Stellar and Planetary Characterization of the Ross 128 Exoplanetary System from APOGEE Spectra
2018 SOUTO D., UNTERBORN C., SMITH V., CUNHA K., TESKE J. et al.
ApJL, 860, L15
paper arxiv

A temperate exo-Earth around a quiet M dwarf at 3.4 parsecs
2017 BONFILS X., ASTUDILLO-DEFRU N., DIAZ R., ALMENARA J.-M., FORVEILLE Th. et al.
Astron. & Astrophys., in press
paper arxiv

A temperate exo-Earth around a quiet M dwarf at 3.4 parsecs*

X. Bonfils[1], N. Astudillo-Defru[2], R. Díaz[3,4], J.-M. Almenara[2], T. Forveille[1], F. Bouchy[2], X. Delfosse[1], C. Lovis[2], M. Mayor[2], F. Murgas[5,6], F. Pepe[2], N. C. Santos[7,8], D. Ségransan[2], S. Udry[2], and A. Wünsche[1]

1 Univ. Grenoble Alpes, CNRS, IPAG, 38000 Grenoble, France
2 Observatoire de Genève, Université de Genève, 51 ch. des Maillettes, 1290 Sauverny, Switzerland
3 Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales. Buenos Aires, Argentina.
4 CONICET - Universidad de Buenos Aires. Instituto de Astronomía y Física del Espacio (IAFE). Buenos Aires, Argentina.
5 Instituto de Astrofśica de Canarias (IAC), E-38200 La Laguna, Tenerife, Spain
6 Dept. Astrofísica, Universidad de La Laguna (ULL), E-38206 La Laguna, Tenerife, Spain
7 Instituto de Astrofísica e Ciências do Espaço, Universidade do Porto, CAUP, Rua das Estrelas, 4150-762 Porto, Portugal
8 Departamento de Física e Astronomia, Faculdade de Ciências, Universidade do Porto, Rua do Campo Alegre, 4169-007 Porto, Portugal

Received 20 September 2017 / Accepted 26 October 2017

ABSTRACT

The combination of high-contrast imaging and high-dispersion spectroscopy, which has successfully been use to detect the atmosphere of a giant planet, is one of the most promising potential probes of the atmosphere of Earth-size worlds. The forthcoming generation of extremely large telescopes (ELTs) may obtain sufficient contrast with this technique to detect O_2 in the atmosphere of those worlds that orbit low-mass M dwarfs. This is strong motivation to carry out a census of planets around cool stars for which habitable zones can be resolved by ELTs, i.e. for M dwarfs within ~5 parsecs. Our HARPS survey has been a major contributor to that sample of nearby planets. Here we report on our radial velocity observations of Ross 128 (Proxima Virginis, GJ447, HIP 57548), an M4 dwarf just 3.4 parsec away from our Sun. This source hosts an exo-Earth with a projected mass $m \sin i = 1.35 M_\oplus$ and an orbital period of 9.9 days. Ross 128 b receives ~1.38 times as much flux as Earth from the Sun and its equilibrium ranges in temperature between 269 K for an Earth-like albedo and 213 K for a Venus-like albedo. Recent studies place it close to the inner edge of the conventional habitable zone. An 80-day long light curve from K2 campaign C01 demonstrates that Ross 128 b does not transit. Together with the All Sky Automated Survey (ASAS) photometry and spectroscopic activity indices, the K2 photometry shows that Ross 128 rotates slowly and has weak magnetic activity. In a habitability context, this makes survival of its atmosphere against erosion more likely. Ross 128 b is the second closest known exo-Earth, after Proxima Centauri b (1.3 parsec), and the closest temperate planet known around a quiet star. The 15 mas planet-star angular separation at maximum elongation will be resolved by ELTs (> $3\lambda/D$) in the optical bands of O_2.

SÍNTESIS DE APRENDIZAJE

- Una atmósfera con la adecuada mezcla de elementos químicos es necesaria para nutrir y sostener la vida. La atmósfera terrestre incluye oxígeno, nitrógeno, metano y dióxido de carbono que han ayudado a mantener la vida la vida por miles de millones de años.
- La abundancia de oxígeno en la Tierra es una pista de que el contenido de oxígeno de nuestra atmósfera se está reponiendo mediante procesos biológicos.
- Los astrónomos han empleado una variedad de telescopios terrestres y espaciales para analizar cómo los ingredientes de la atmósfera de la Tierra se ven desde el espacio, usando nuestro planeta como un procurador para estudiar las atmósferas de planetas extrasolares.
- Para buscar señales de vida se necesita comprender cómo las atmósferas trabajan física y químicamente.
- Conocer las temperaturas y radios planetarios es crucial para la comprensión general de los procesos físicos y químicos que están ocurriendo en el planeta.
- Estos parámetros, así como una indicación de la habitabilidad, pueden ser determinados con espectroscopía de transmisión.
- Con los espectrógrafos de los futuros proyectos JWST y ELT se espera caracterizar las atmósferas de las súper tierras, con la esperanza de encontrar biomarcadores que indicarían la presencia de vida pasada o presente.