Planetary Science / Ciencias planetarias

- Small bodies of the Solar System / Pequeños cuerpos del Sistema Solar (5)
- Planets of the Solar System / Planetas del Sistema Solar (11)
- Exoplanets / Exoplanetas (7)

Moderadores:

- Ricardo Hueso
- Ignasi Ribas
- Paula Benavidez

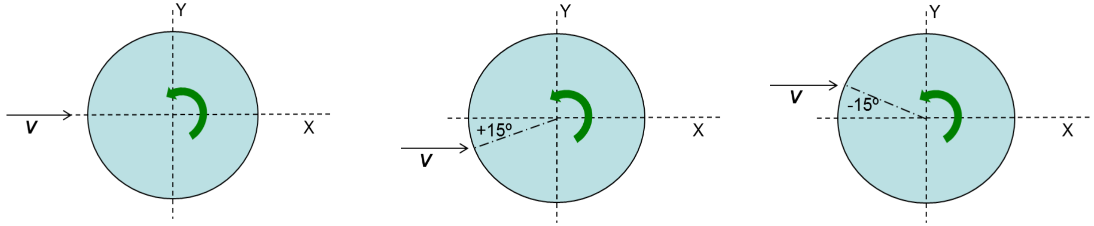
Small Bodies of the Solar System

Possible reaction of Dimorphos to the DART (NASA) collision

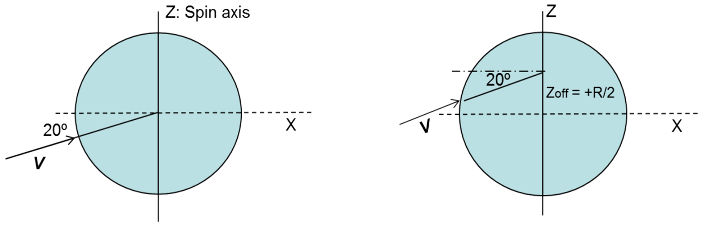
Paula Benavidez[1,2], Adriano Campo Bagatin[1,2], Derek C. Richardson[3], Antonio Santana-Ros[1], Álvaro Álvarez-Candal[2,4]
[1]DFISTS (UA), [2]IUFACyT (UA), [3]Dept. of Astronomy (UMD), [4]Obs. Nacional (Rio de Janeiro, BR)

AIDA (Asteroid Impact & Deflection Assessment) DART (Double Asteroid Redirection Test, NASA)
Hera (ESA) missions.

Impact geometry



Y-offset impact dir.: ± 15º



Z-offset impact dir.: ± R/2

First results:

Spin period and **axis orientation** change depending on impact geometry and target structure:

- Spin period: -39’ to +11’ change.
- Spin axis: up to 2.9 deg. change.
- Velocity component normal to Dimorrphos orbital plane: 0.23 mm/s.

Photon-induced desorption of large species at low temperature in TNOs

H. Carrascosa[1], G. A. Cruz-Díaz[2,3], G. M. Muñoz Caro[1], E. Dartois[4], Y. –J. Chen[5]

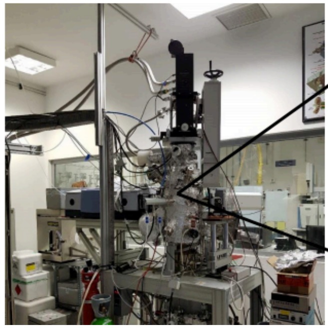
[1]CAB, [2]NASA Ames, [3]Bay Area, [4]ISMO, [5]NCU

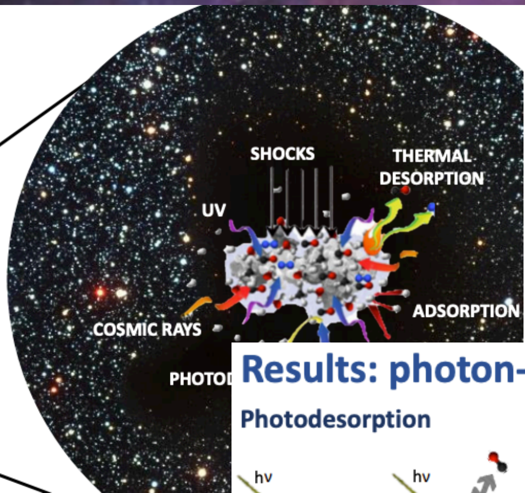
MNRAS, 493, 821-829 (2020). DOI: 10.1093/mnras/staa334

Methodology: ISAC

Reproduces the conditions in the ISM:

UHV → 10^{-11} mbar
T → 8 K
UV → MDHL

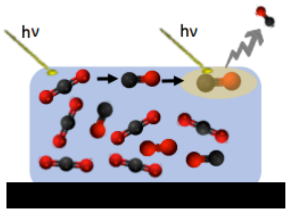




Results: photon-induced desorption mechanisms

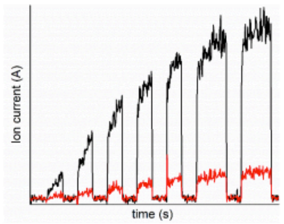
EXCELENCIA MARÍA DE MAEZTU

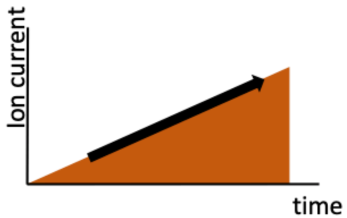
Photodesorption



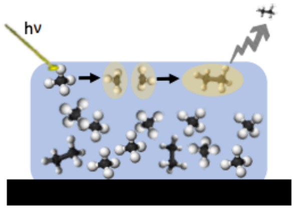
Molecules in the surface **receiving photon energy** to break intermolecular forces and desorb

CO and O_2 from CO_2 ice



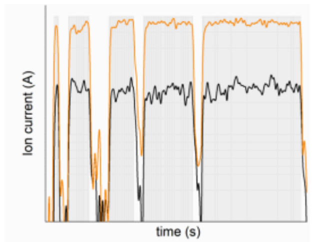


Photochemical desorption



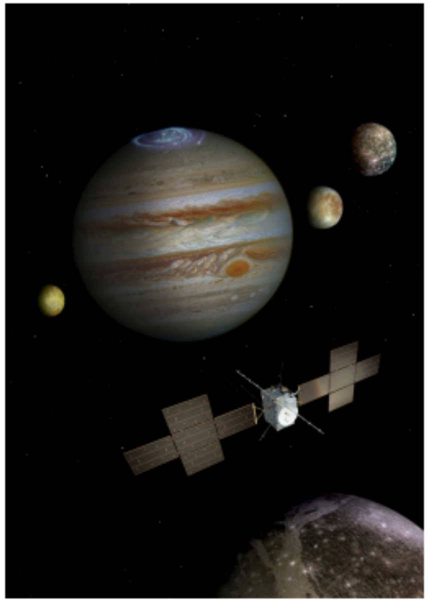
Molecules formed in the surface **releasing their formation energy** to break intermolecular forces and desorb

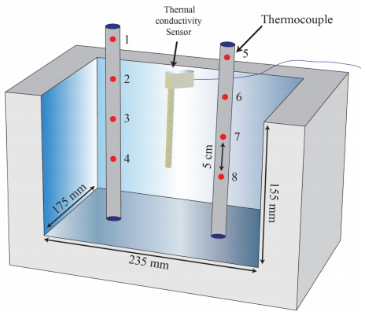
C_2H_6 and C_3H_8 from CH_4 ice



Thermal conductivity measurements of salt-bearing ice analogs for the Jovian moons to interpret future JUICE mission

Cristóbal González Díaz[1], Guillermo M. Muñoz Caro[1], Héctor Carrascosa de Lucas[1], Sofía Aparicio Secanellas[2], Margarita González Hernández[2], José J. Anaya Velayos[2], Guillermo Anaya Catalán[2], Victoria Muñoz-Iglesias[1, 3], Olga Prieto-Ballesteros[1, 3], Oscar Ercilla Herrero[1], Javier Sánchez-Benítez[3, 4], Alberto Rivera-Calzada[5], Rosario Lorente[6], Nicolas Altobelli[6], Anezina Solomonidou[6], Claire Vallat[6], Olivier Witasse[7]



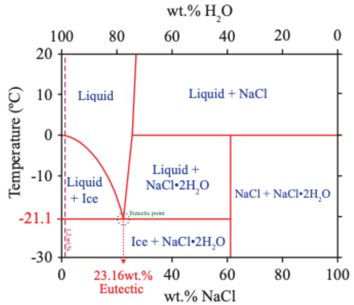


Satellite: JUICE

Artist's impression of the JUICE mission exploring the Jupiter system

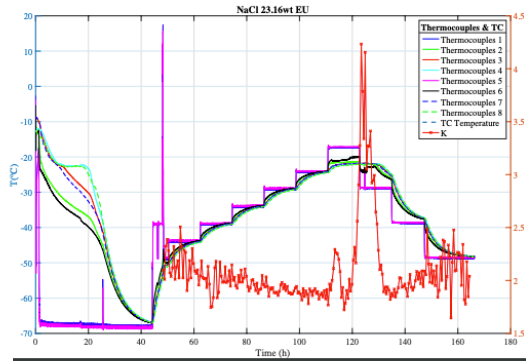
Results

$NaCl + H_2O$ (Sodium chloride)

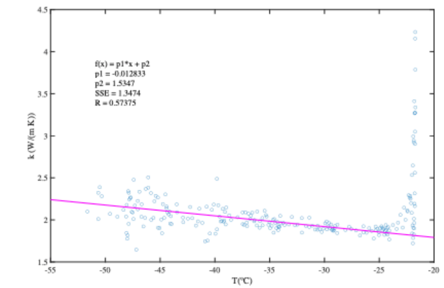


Thermal conductivity measurements:

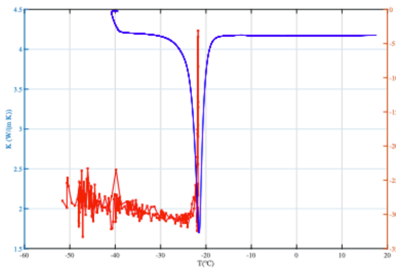
- 0.6 wt.% $NaCl + H_2O$
- 1.2 wt.% $NaCl + H_2O$
- EUTECTIC: 23.16 wt.% $NaCl + H_2O$



Thermal conductivity measurements

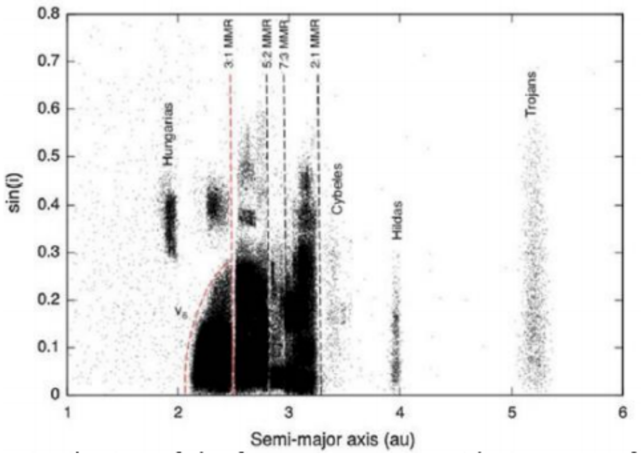


Calorimetry & Thermal conductivity measurements



Mid-infrared spectroscopy of primitive asteroids in the outer edge of the main belt

Diego Moral Pombo[1], Javier Licandro Goldaracena[2]
(1) Facultad de Ciencias, Universidad de La Laguna (diegomoral94@gmail.com)
(2) Instituto de Astrofísica de Canarias.



Observed asteroids

- 11 Cybeles
- 3 Hildas

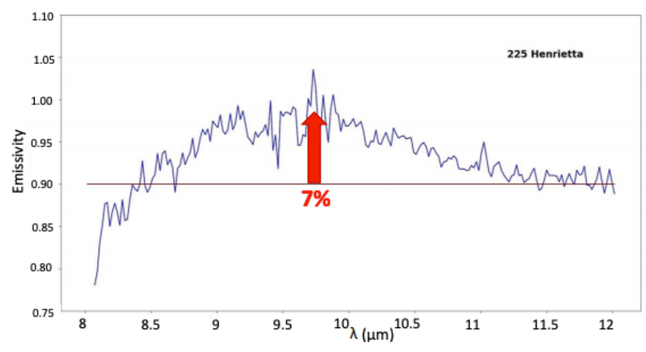
Results

Main feature:

Emissivity plateau (9-11.5 μm), due to the presence of regolith covering its surface, found in the 10 asteroids with good SNR.

Polynomical fitting to calculate the **contrast** (height) of the plateau → Average : **10.8 ± 3.5 %**

→ λ_{max}: **9.5 ± 0.2 μm**

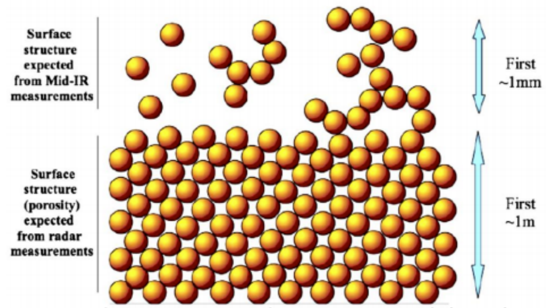


Conclusions:

- Determination of parameters (D, pv, η)
- Existence of emissivity plateau

Surface infra-dense structure:

- **"Fairy castle" structure**: under dense regolith. Unknown mechanism: transparent matrix? Electrostatic forces? Solar radiation pressure?
- **High contrast (very fine dust)**. More similar to Trojans than to main belt families (Themis, Veritas)
- Possibly **cometary-like** dust mantle



Fairy castle structure. Credit: Vernazza et al. (2012).

X-ray tomography: A valuable tool to study chondritic meteorites

Kelly G. Padilla[1,2], Joan Carles Melgarejo[1], Jordi Llorca[2,*]

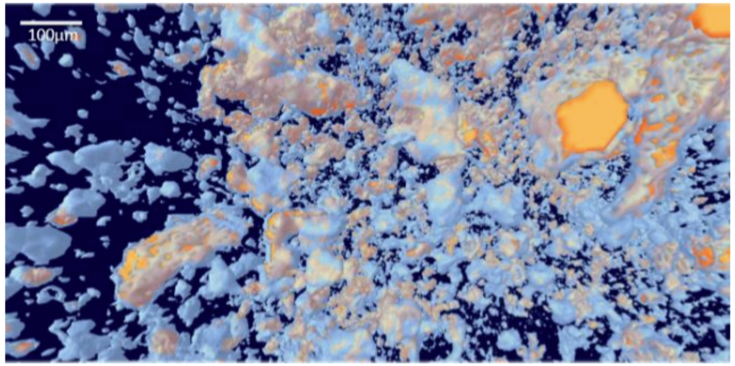
[1]Universitat de Barcelona

[2]Universitat Politècnica de Catalunya – BarcelonaTech

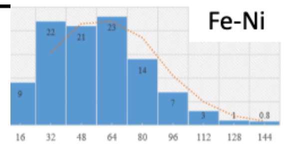
UNIVERSITAT DE BARCELONA
Facultat de Ciències de la Terra

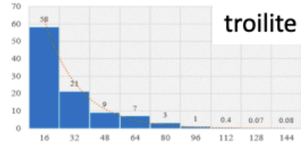
UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola d'Enginyeria de Barcelona Est

X-ray tomography

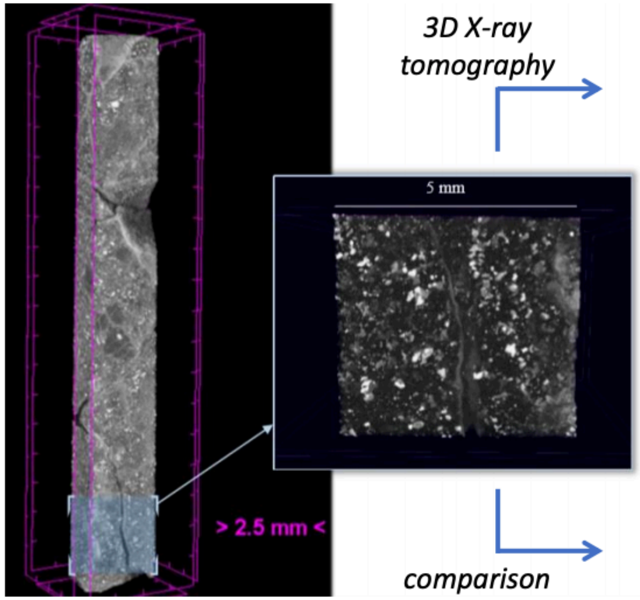


Fe-Ni metal (orange) is embedded in troilite (blue)

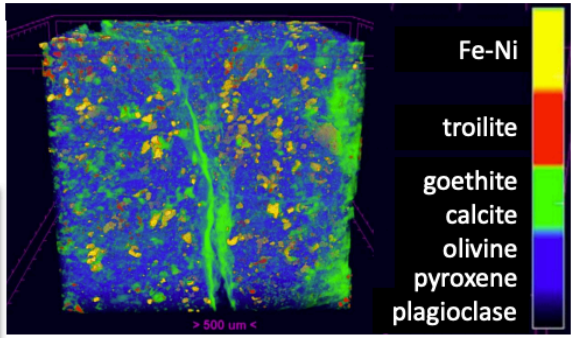




size distribution of Fe-Ni metal and troilite

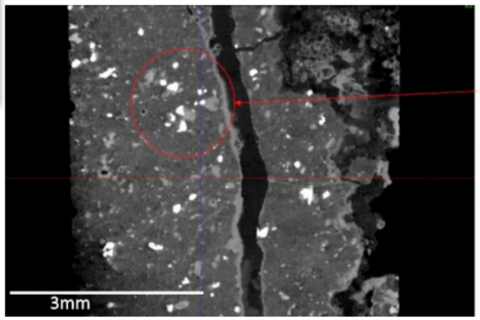


3D X-ray tomography

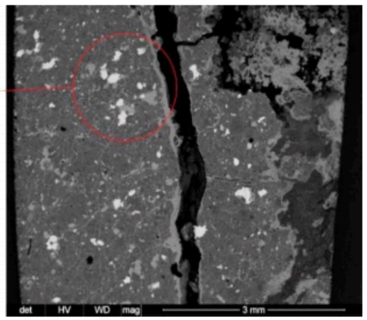


identification and distribution of phases by X-ray tomography

X-ray tomography



SEM



comparison between SEM and X-ray tomography

PLANETS

And their geology, atmospheres and exploration

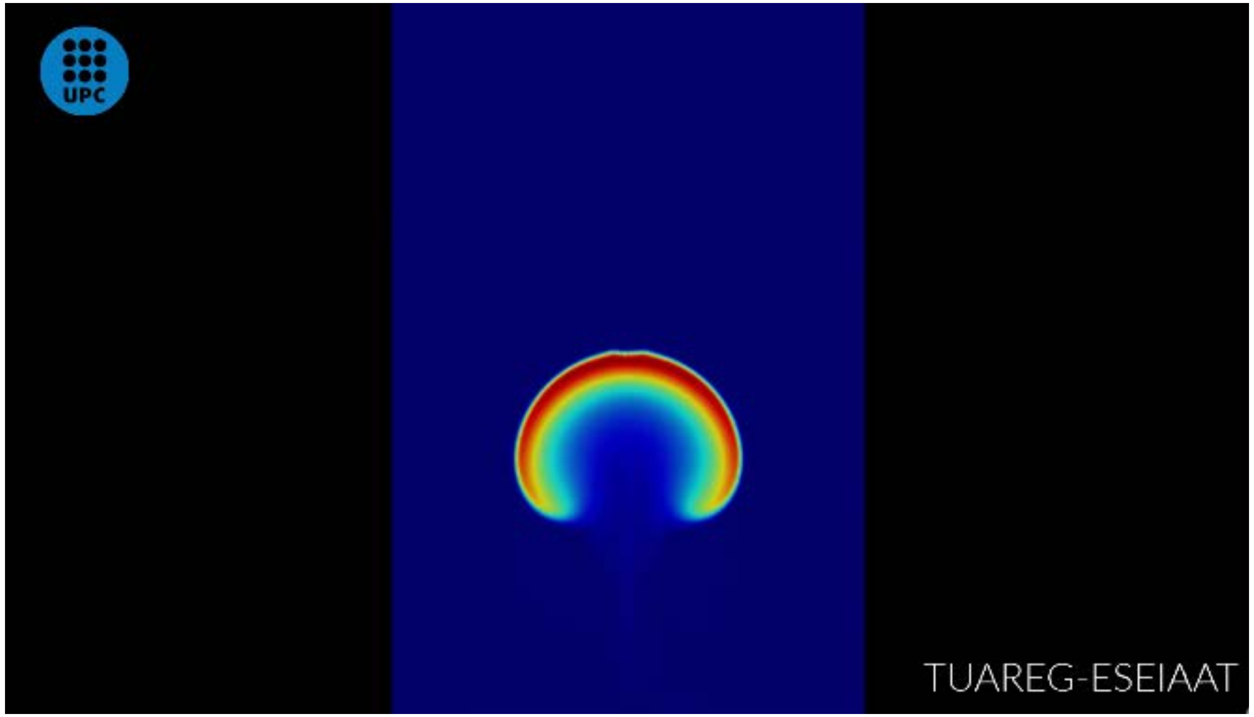
Solar System planets

CP001	Andrés-Carcasona, M. et al.	*Comparison of different advection schemes for 3D atmospheric codes*
CP002	Anguiano-Arteaga, A. et al.	*Variations in the spectral reflectivity of Jupiter's Great Red Spot*
CP004	Cardesín-Moinelo, A. et al.	*Venus atmospheric cloud opacity, particle size and top temperature mapped in the nightside with VIRTIS Venus Express*
CP009	Chen-Chen, H. et al.	*Retrieval of Martian dust particle size, shape, and optical depth during the 2018/MY34 global dust storm with MSL rover Navigation Cameras*
CP012	Hernández-Bernal, J. et al.	*Dynamics of the extremely elongated cloud on Mars Arsia Mons volcano*
CP013	Hueso, R. et al.	*Monitoring Neptune's atmosphere with a combination of small and large telescopes: The role of Spanish Telescopes in a global international campaign*
CP015	Lopez-Valverde, M.A. et al.	*Observing the upper atmosphere of Mars with NOMAD/TGO*
CP020	Sánchez-Bayton, M. et al.	*Morphological study of landforms on The Norther Polar Region of Mars*
CP021	Sánchez-García, M.M. et al.	*Earth to Mars areostationary mission optimization analysis*
CP022	Sanz Requena, J.F. et al.	*Hazes and clouds in Saturn's atmosphere from HST*

COMPARISON OF DIFFERENT ADVECTION SCHEMES FOR 3D ATMOSPHERIC CODES

M. Andrés-Carcasona[(1)], M. Soria[(1)], A. Miró[(1,2)], E. García-Melendo[(1,3)], L.A. Moya[(1)]

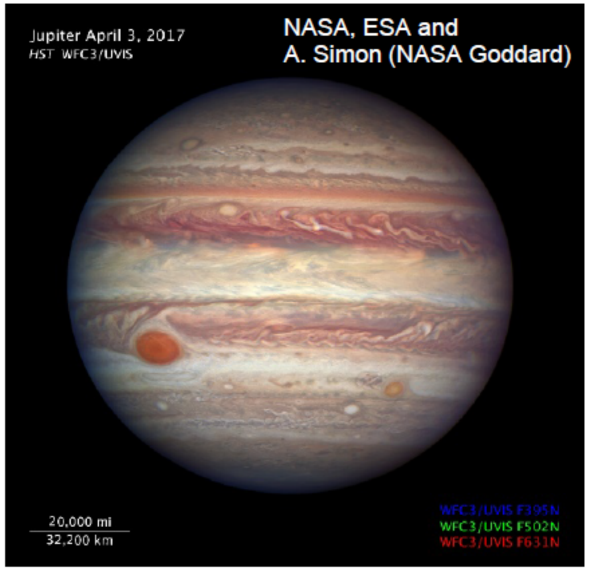
(1) Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual, UPC, Terrasa, Spain
(2) Istituto Nazionale di Oceanografia e di Giofisica Sperimentale, Italia
(3) Serra Hunter Fellow, Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual, UPC, Terrasa, Spain

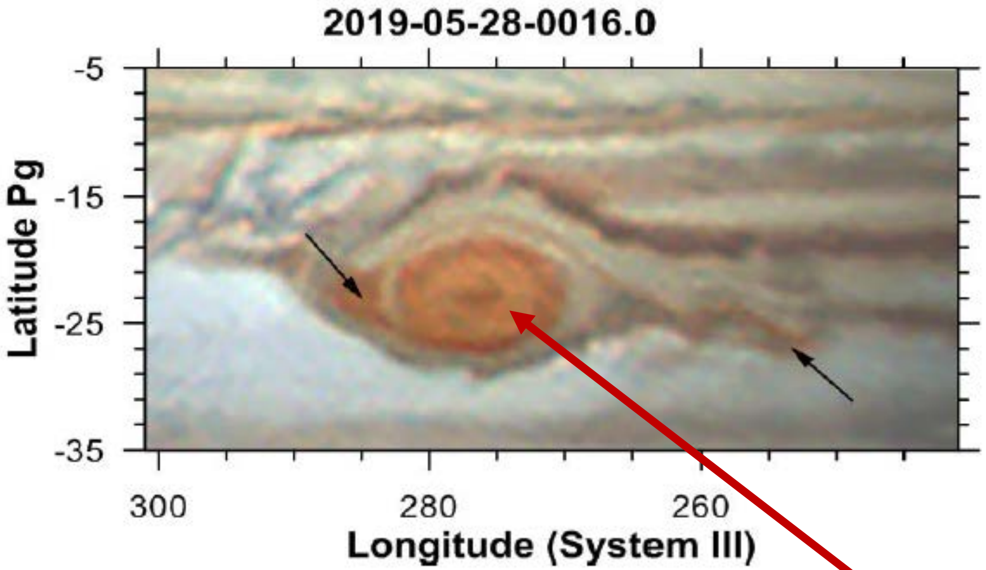


Trabajo numérico fundamental para el desarrollo de aplicaciones en el estudio de la convección atmosférica en múltiples planetas.

Importantes retos computacionales. Examen exhaustivo de esquemas numéricos y aproximaciones (Boussinesq, anelástica)

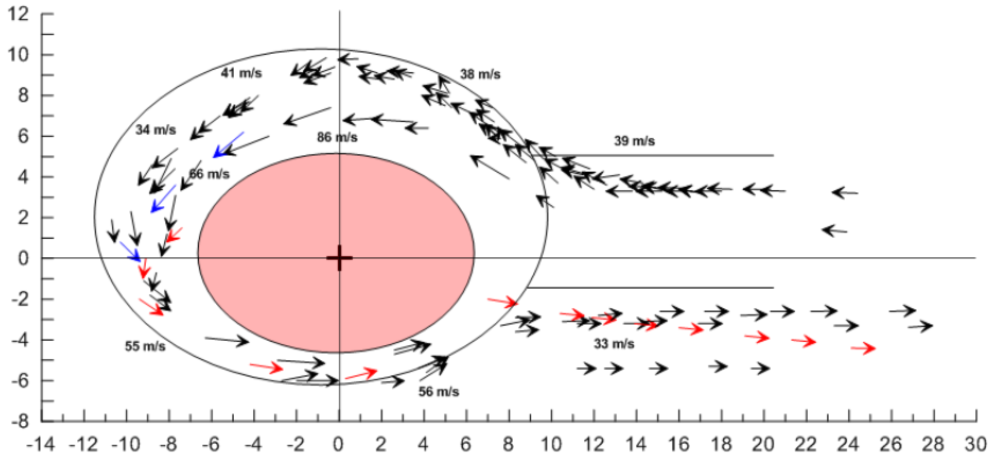
Variations in the spectral reflectivity of Jupiter's Great Red Spot





Asier Anguiano-Arteaga, Santiago Pérez-Hoyos, Agustín Sánchez-Lavega

Dpto. Física Aplicada I, EIB, Universidad del País Vasco UPV/EHU, 48013 Bilbao, Spain



2015

2017

2019

Gradual dicrease in the brightness of the central core in red wavelengths

Recovery of dynamical properties of the GRS after its interaction with several vórtices.

An astronomer fan of Mark Twain would say: "Rumours of the close dissaaperance of the GRS have been greatly exagerated."

Venus atmospheric cloud opacity, particle size and cloud top temperature mapped in the nightside with VIRTIS Venus Express

A. Cardesín-Moinelo[1], G. Piccioni[2], A. Migliorini[2], D. Grassi[2], V. Cottini[3], D. Titov[4], R. Politi[2], F. Nuccilli[2], P. Drossart[5]
[1]*ESA-ESAC*, [2]*INAF-IAPS*, [3]*NASA Goddard*, [4]*ESA-ESTEC*, [5]*Obs.Paris Meudon*

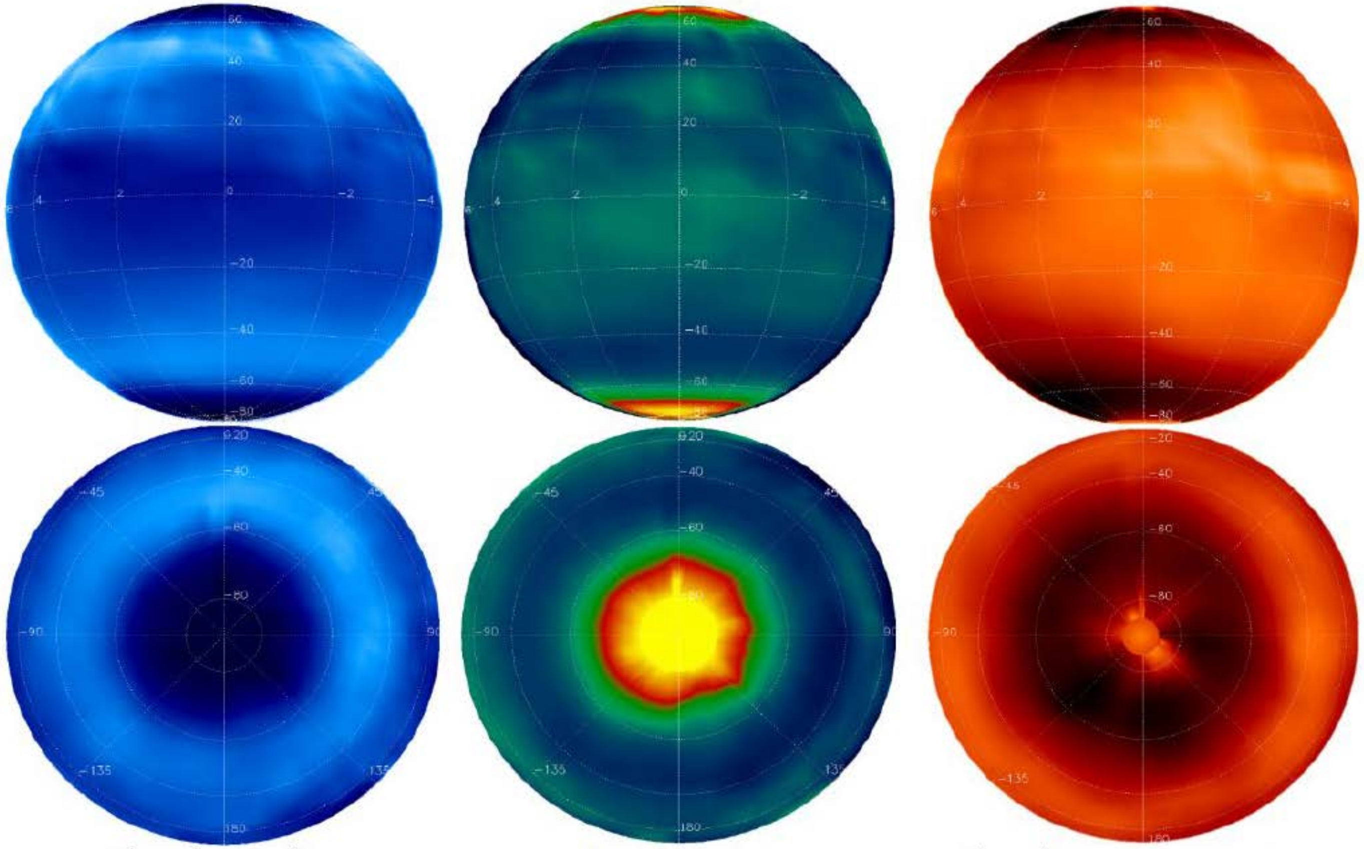
Published June 2020 Icarus Vol. 343, https://doi.org/10.1016/j.icarus.2020.113683

Integrated maps of Venus nightside atmosphere from years of data acquired with the VIRTIS instrument on Venus Express (2006-2008)

1.74, 2.30, -→ Lower clouds & Particle size

3.8, 5.0 μm → Upper clouds & Temperature

Global views and views of the South Polar region and its warm vortex (with large particles)



Cloud opacity — Particle size — Cloud top temperature

A legacy set of results from VEX that opens questions worth of future research
How does it compare with Akatsuki? 2015-2020 and GCMs?

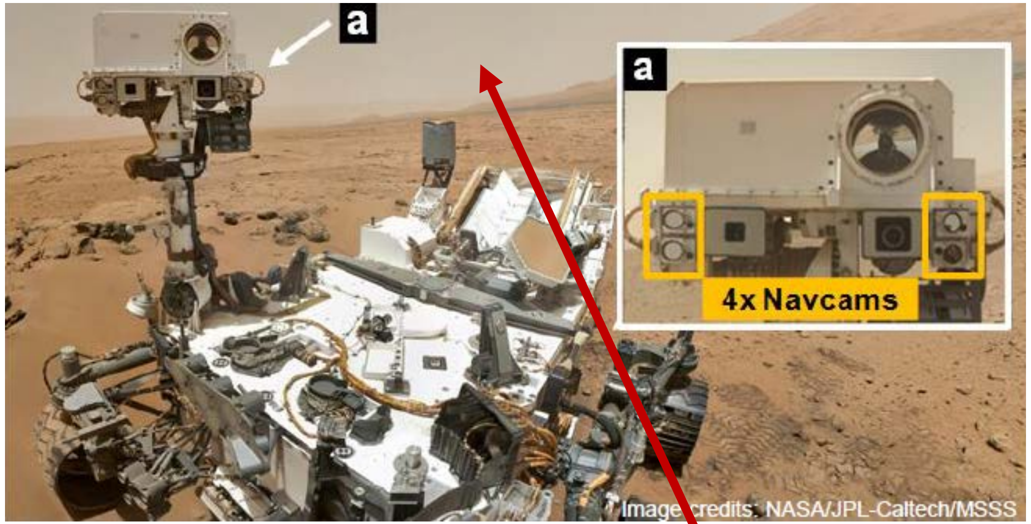
Retrieval of Martian dust particle size, shape, and optical depth during the 2018/MY34 global dust storm *with* MSL rover Navigation Cameras

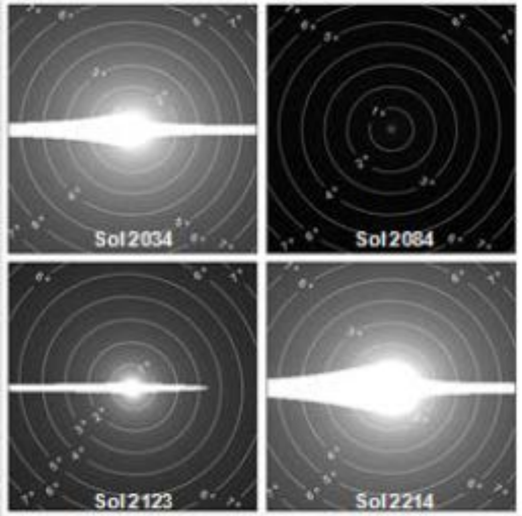
H. Chen-Chen (hao.chen@ehu.eus), S. Pérez-Hoyos, and A. Sánchez-Lavega

Dept. Física Aplicada I, Escuela de Ingeniería de Bilbao, Universidad del País Vasco (UPV/EHU), 48013, Bilbao, Spain.

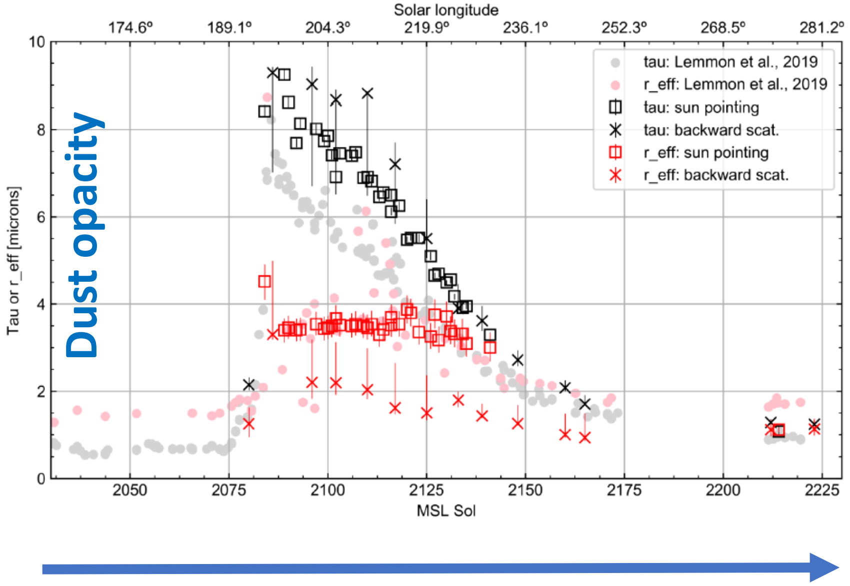
Objectives:

- MSL Navigation Cameras **image-data review** and **processing** (calibration)
- **Radiative transfer** modelling of Mars' atmosphere
- Retrieval of **atmospheric dust loading** and **particles' properties**



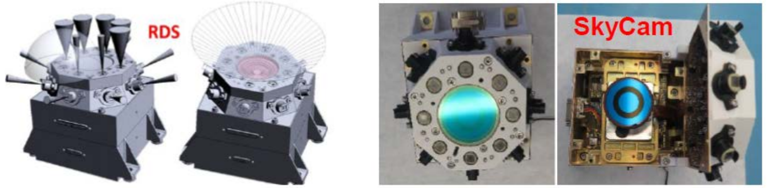


Characterization of the global 2018 Dust Storm



How does Sunlight diffuses in the Martian sky?
Well it depends on the atmospheric dust!
Observations of diffuse light characterize the dust

Mars 2020 rover MEDA RDS and SkyCam instruments

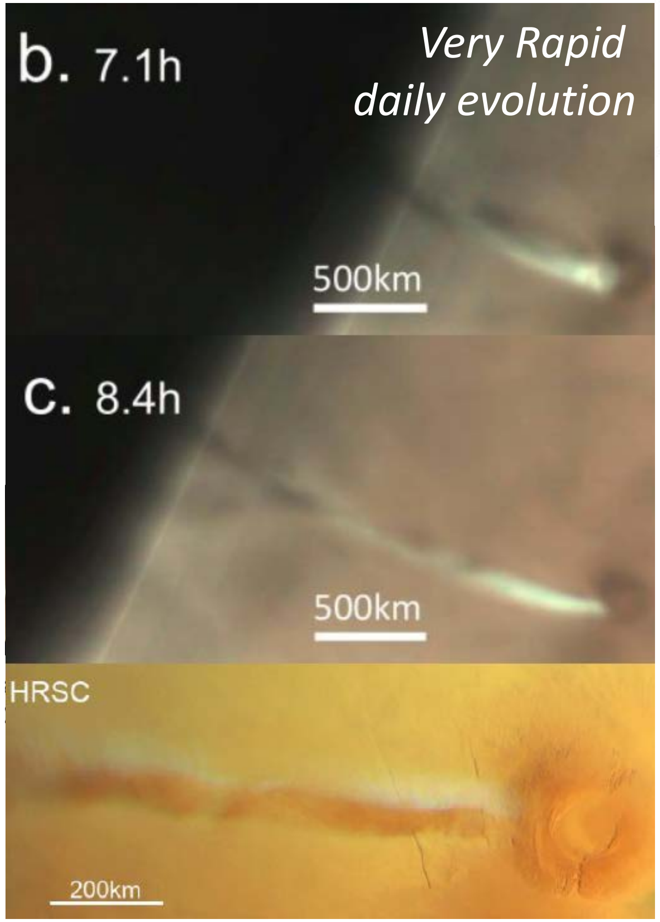


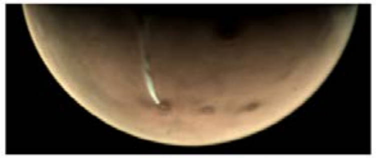
Source: Rodriguez-Manfredi (2017), Arruego (2018)

FUTURE: MARS2020 PERSEVERANCE rover with specific instruments to characterize the dust

Dynamics of the extremely elongated cloud on Mars Arsia Mons volcano

J. Hernández-Bernal (1,2), A. Sánchez-Lavega (1), T. del Río-Gaztelurrutia (1), E. Ravanis (3), A. Cardesín-Moinelo (3,4), K. Connour (5), D. Tirsch (6), I. Ordóñez-Etxeberria (1), B. Gondet (7), S. Wood (8), D. Titov (9), N. M. Schneider (5), R. Hueso (1), R. Jaumann (10), E. Hauber (6)





Arsia Mons Elongated Cloud
AMEC, This work

Ascraeus Mons Elongated Cloud
AsMEC

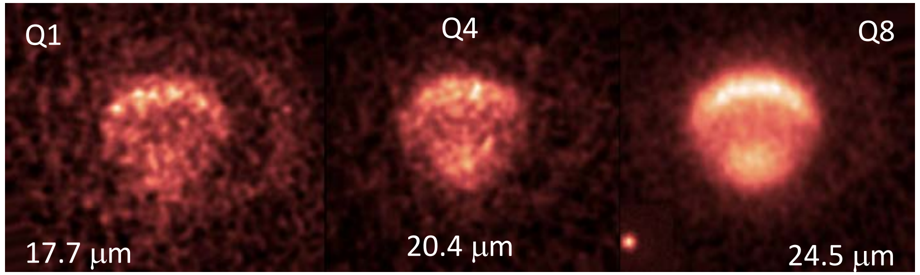
Valles Marineris Cloud Trails
VMCT, Clancy et al. (2009)

Orographic driven -seasonally dependent water cloud above the Arsia Mons volcano at z of 45 km approx.

FUTURE: Characterize other cases of orographic clouds

Monitoring Neptune's atmosphere with a combination of small and large telescopes: The role of Spanish Telescopes in a global international campaign

Ricardo Hueso[1] e-mail: (ricardo.hueso@ehu.es) & Agustín Sánchez-Lavega[1]

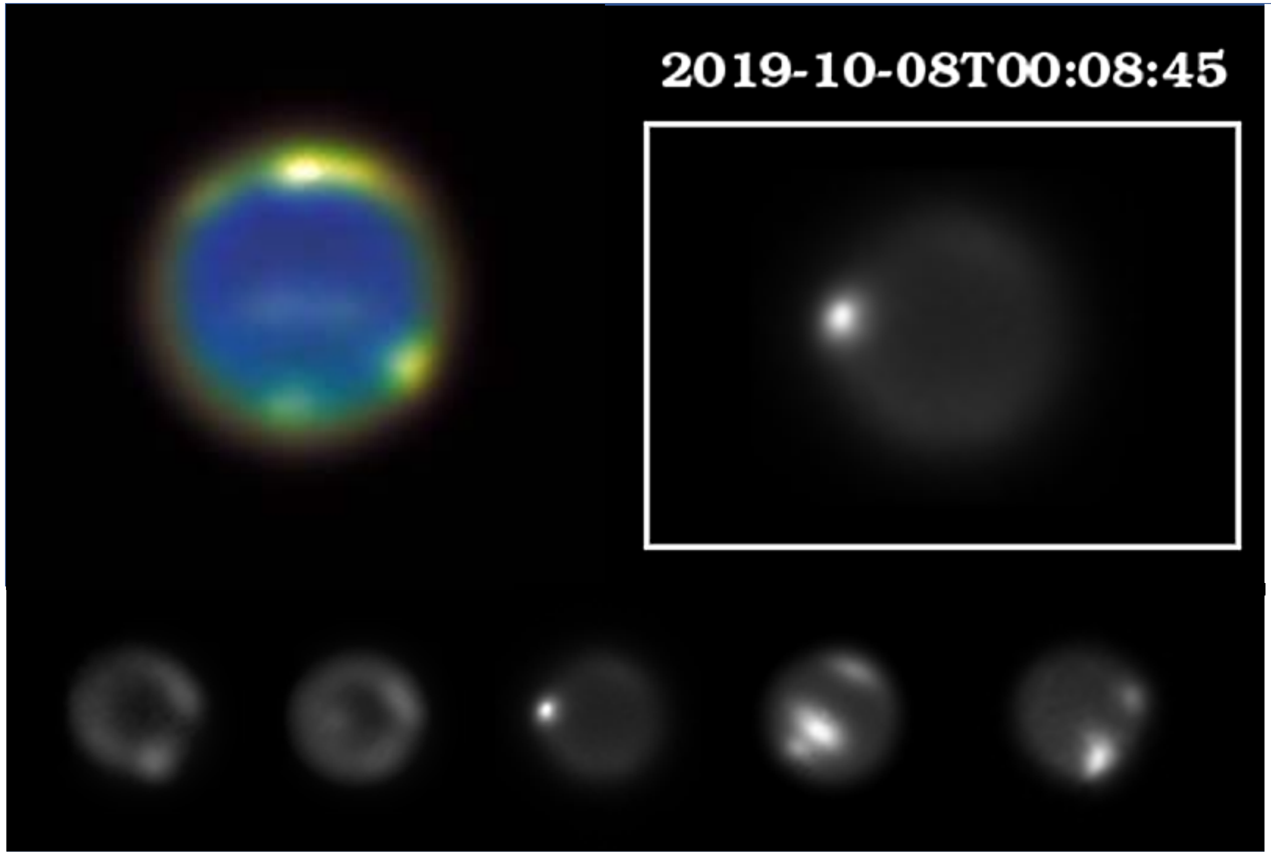


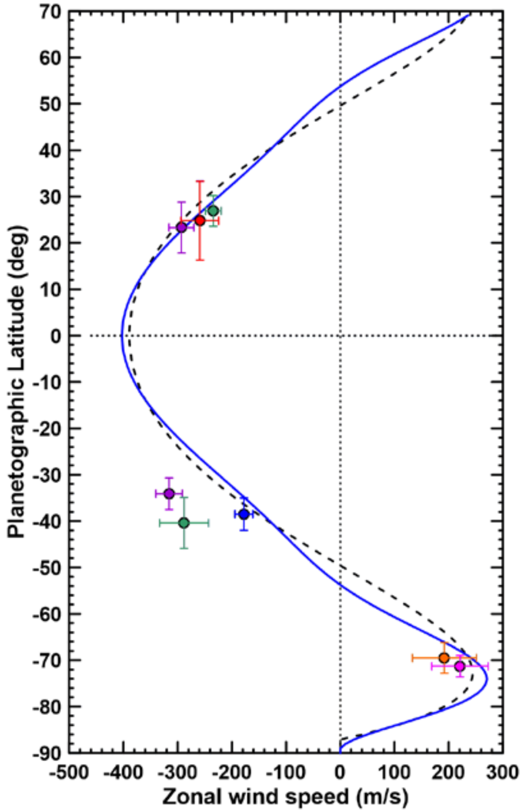
Bonus: Uranus with CanariCam on GTC

Can we study Neptune's atmosphere with telescopes in Spain?

Yes: PlanetCam@ Calar Alto & GTC (with HiperCam or CanariCam)

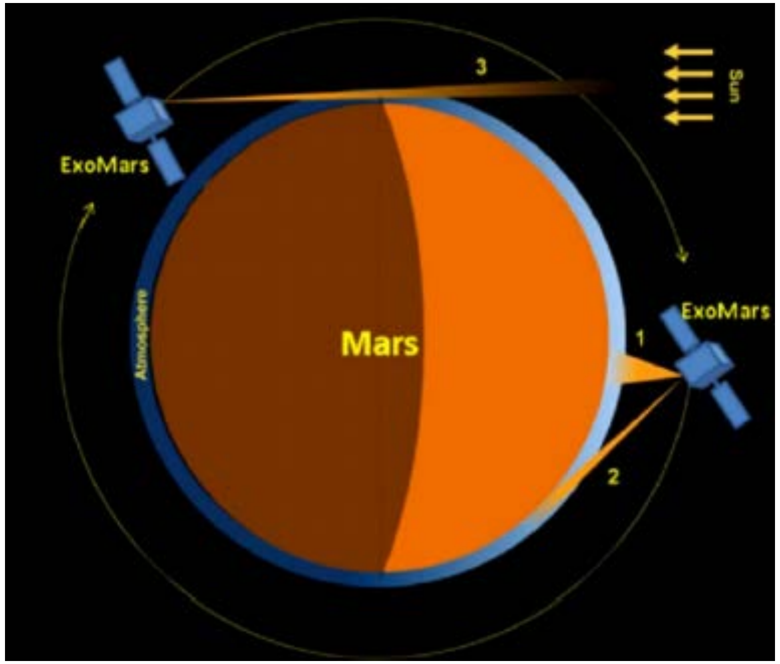
Since 2015 we collaborate with other teams with HST, Keck, Gemini and even amateurs





Observing the upper atmosphere of Mars with NOMAD/TGO

Miguel A. Lopez-Valverde [1], S. Aoki [2], G.C.Gerard [3], F. González-Galindo [1], B. Hill [1], B. Funke [1]
M. Lopez-Puertas [1] , M: Garcia-Comas [1] , J.J. López-Moreno [1],J. Rodríguez [1], A.C. Vandaele[2],
I. Thomas[2], F. Daerden[1], M. Patel[4], G. Bellucci[5], G. Villanueva[6] and the NOMAD Team
[1] IAA/CSIC, Granada, Spain [2] IASB , Brussels, Belgium [3] Université de Liège, Belgium
[4] Open Univ., UK [5] INAF, Rome, Italy [6] NASA Goddard, USA



Gerard et al.
Nat.Astro. 2020

Many Scientific results:

Recent novel results discussed in the presentation:

- **Retrievals of CO_2 Density profiles**
- **Water escape linked to Great Dust Storms that heat the atmosphere**
- **Discovery of the oxygen "Green" line (day airglow)**

Great capacities of the instrument to study the elusive atmospheric methane.

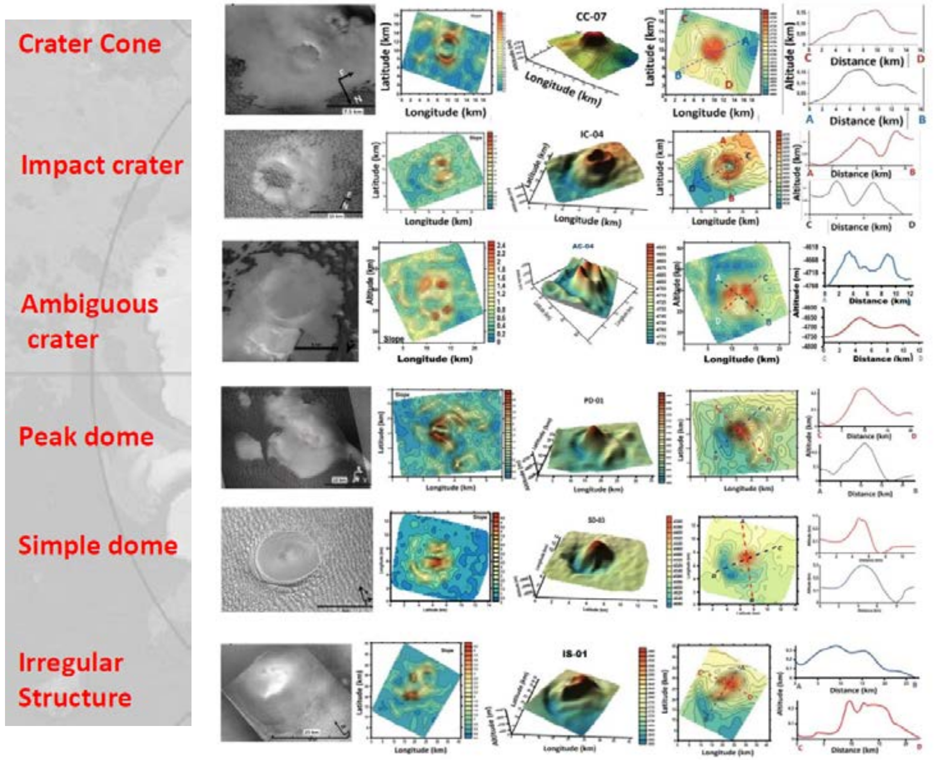
Morphological study of landforms on The Norther Polar Region of Mars.

Marina Sánchez-Bayton[1] , Erwan Tréguier[2], Miguel Herraiz [1,3], Patrick Martin[4], Akos Kereszturi[5, 6], Beatriz Sánchez-Cano[6].

[1] Department of Physics of the Earth and Astrophysics, Universidad Complutense de Madrid (UCM), Madrid, Spain
[2] Formerly at ESAC (European Space Astronomy Centre), Villanueva de la Cañada, Spain
[3] Instituto de Matemática Interdisciplinar (IMI), Madrid, Spain
[4] ESAC (European Space Astronomy Centre), Villanueva de la Cañada, Spain
[5] Research Centre for Astronomy and Earth Sciences, Konkoly Thege Miklos Astronomical Institute, Hungary
[6] Radio and Space Plasma Physics Group, School of Physics and Astronomy, University of Leicester, University Road, Leicester LE1 7RH, UK.
[7] European Astrobiology Institute

This study focuses on the characteristics and origin of geologic features close to the northern polar cap of Mars. They have an especial interest, because they can cast light on the geological evolution of the area, the existence of volcanism and the gypsum formation. The study is based in images from Mars Express and Mars Reconnaissance Orbiter, and topographic information from Mars Global Surveyor.

201 landforms that were classified into 6 groups: cratered cones CC, impact craters IC, ambiguous craters AC, simple and peaked domes SD, PD, and irregular structures SD.



Earth to Mars areostationary mission optimization analysis

M. M. Sánchez-García, G. Barderas and P. Romero
Instituto de Matemática Interdisciplinar. U. D. Astronomía y Geodesia, Facultad de Ciencias Matemáticas, Universidad Complutense de Madrid, Madrid, Spain
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In this work, we analyze the optimization of an areostationary mission. We first determine the launch and arrival dates for an optimal minimum energy Earth-Mars transfer trajectory. Then, the minimum thrust maneuvers to capture the spacecraft from the hyperbolic arrival trajectory to Mars and place it in the areostationary orbit are analyzed.

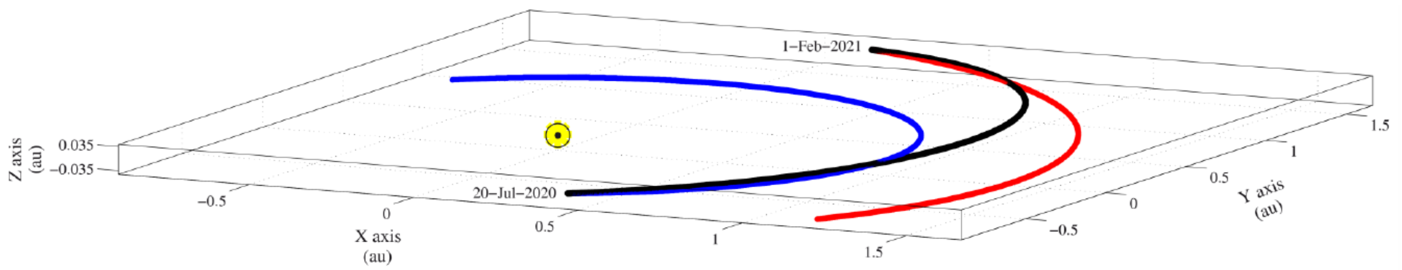

Figure 4: *Optimal transfer orbit from Earth to Mars from 20th July 2020 to 1st February 2021.*

Examples of methods used:

- **Genetic algorithms to obtain the minimum energy Earth-Mars trajectory.**
- **Additional examen of the manoeuvres optimization at Mars arrival.**

The results of the analysis lead to an optimal choice of departure and arrival dates that minimize the impulses for an Earth to Mars. Once solved, the optimal hyperbolic arrival trajectory about Mars, optimal necessary maneuvers in order to capture the orbiter and to and place it the areostationary orbit are analyzed.

Hazes and clouds in Saturn's atmosphere from HST

J.F. Sanz Requena (1,2), S. Pérez Hoyos (3), A. Sánchez Lavega (3), A. García-Muñoz (6), T. del Rio-Gaztelurrutia (3) , E. García-Melendo (4) , J. Legarreta (3), R. Hueso (3), J. M. Gómez-Forrellad (5), J.Peralta (7).

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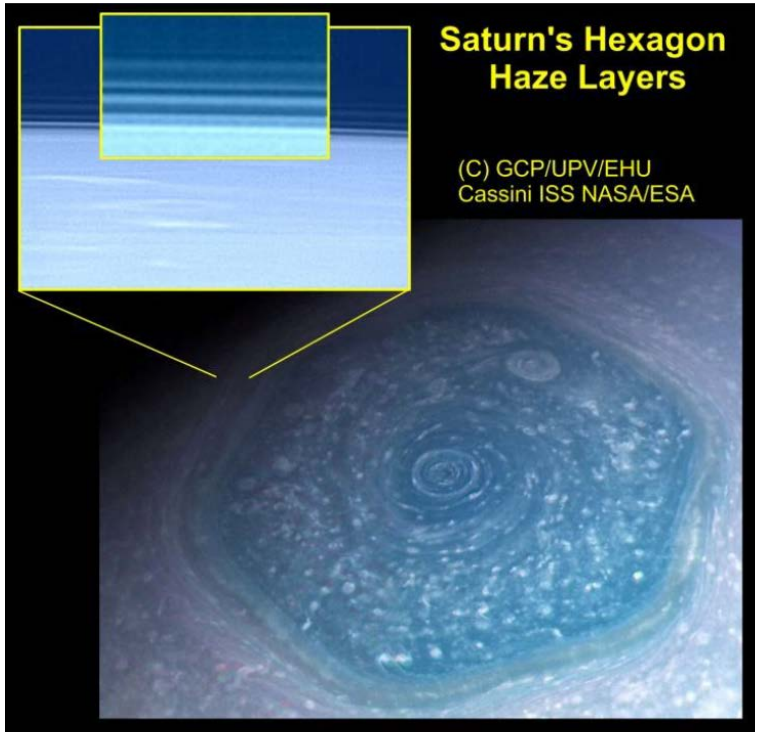
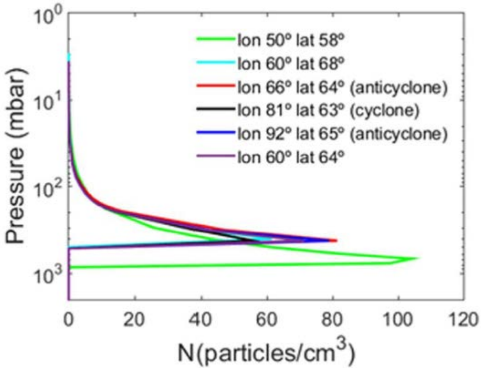
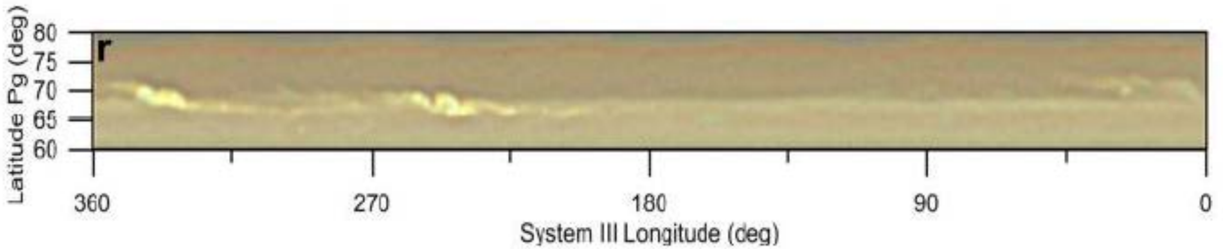
(2) Dpto. de Física Teórica, Atómica y Optica. Universidad de Valladolid, Spain
(3) Dpto. De Física Aplicada I. E.T.S. Ingenieros. Universidad del País Vasco. Bilbao.
(4) Serra Hunter Fellow, Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual, UPC, Terrasa, Spain
(5) Fundació Observatory Esteve Duran, Barcelona, Spain
(6) Zentrum für Astronomie und Astrophysik, Technische Universität Berlin, Berlin, 9 Germany.
(7) Algeciras(Spain)



Radiative transfer analysis of HST to study the cloud structures in:



- **Polar Vortices developing a "planetary-scale" disturbance in 2015.**
- **Polar storms in 2018 also developing a planetary-scale disturbance.**
- **Saturn's Hexagon and its multilayered hazes**



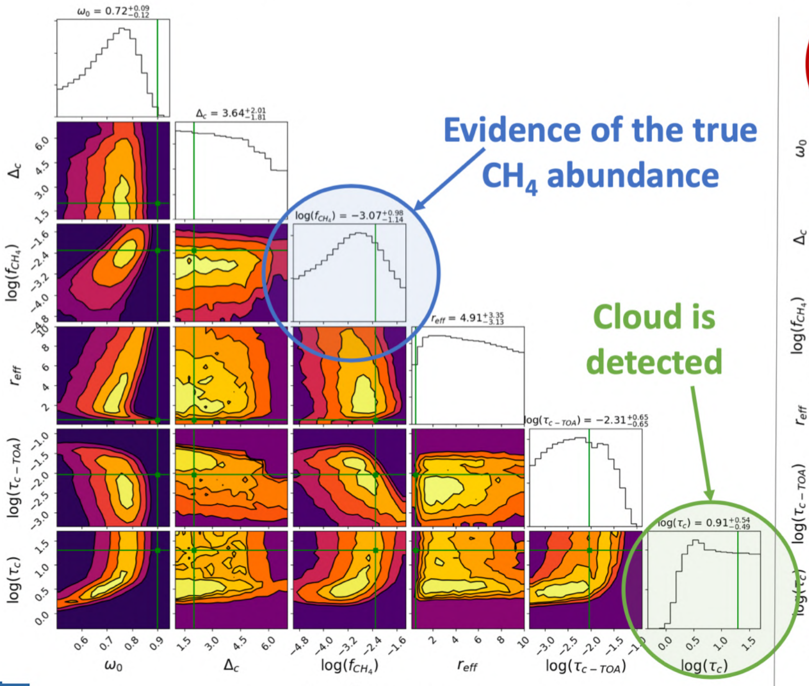
EXOPLANETS

Directly imaged exoplanets in reflected starlight: The importance of knowing the planet radius

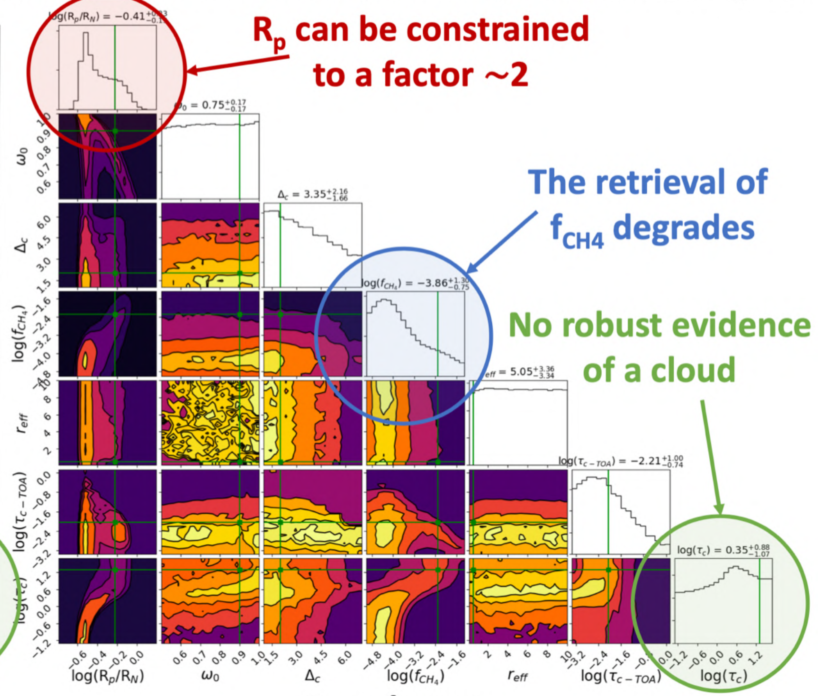
Ó. Carrión-González[1], A. García Muñoz[1], J. Cabrera[2], Sz. Csizmadia[2], N. C. Santos[3,4], H. Rauer[1,2,5]

Results

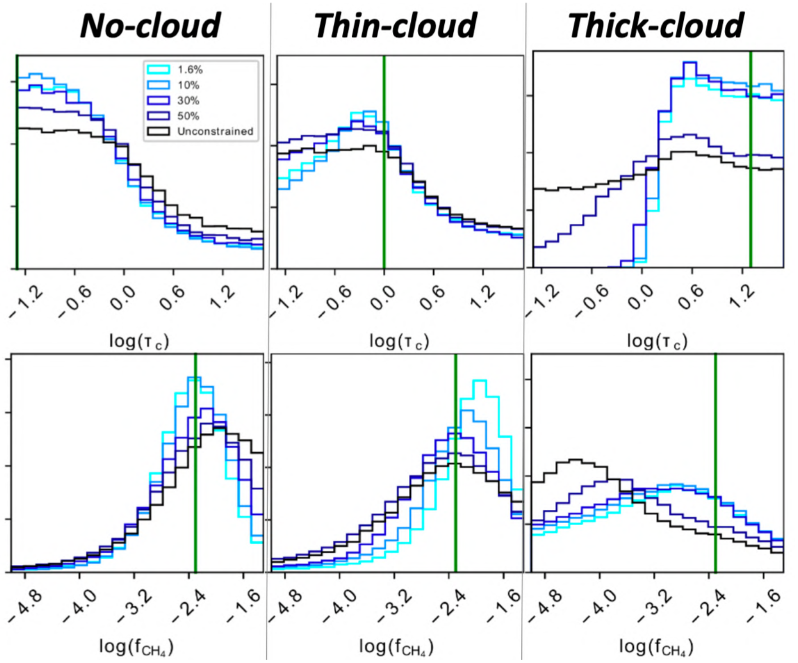
Retrievals for a *thick-cloud* scenario. That is, the *true* atmospheric configuration (green lines in the plots) includes a cloud layer with optical thickness **τ_c=20**.



R_p known
(6D param. space)



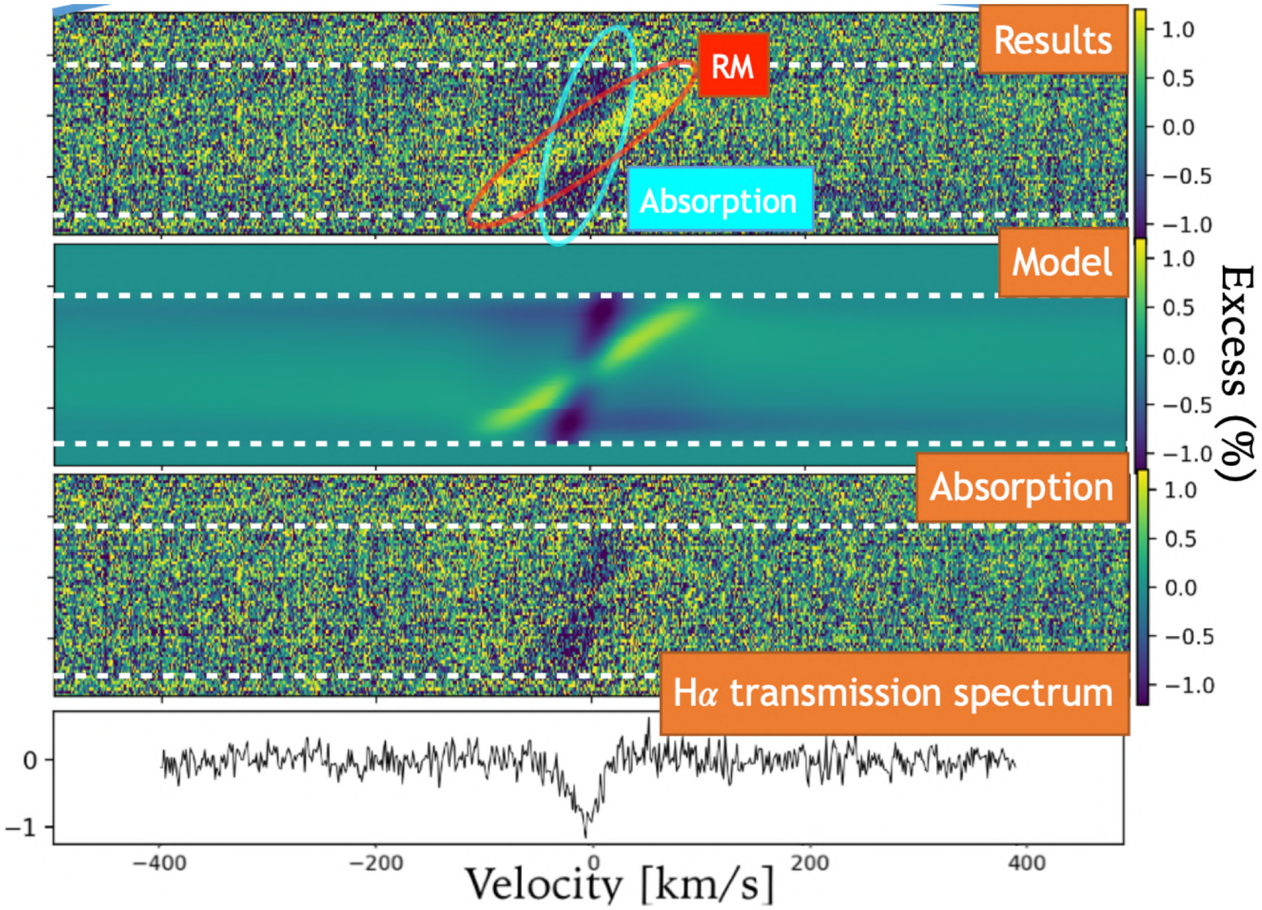
R_p unknown
(7D param. space)

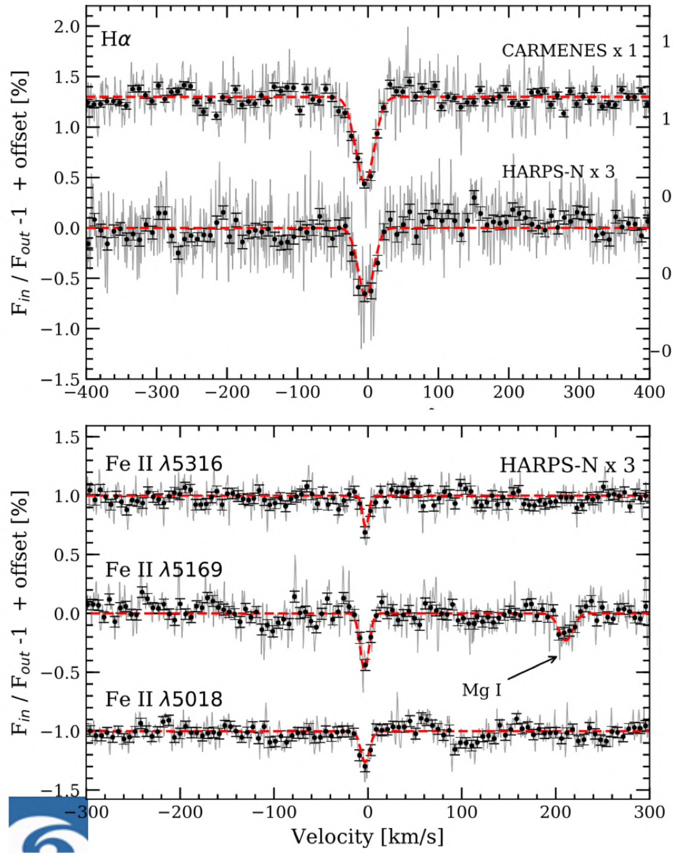


Characterising the atmosphere of ultra hot Jupiters: MASCARA-2b

Results pub… Casasayas-B…

N. Casasayas-Barris[1, 2], E. Pallé[1, 2], M. Stangret[1, 2], F. Yan[3], G. Chen[4]

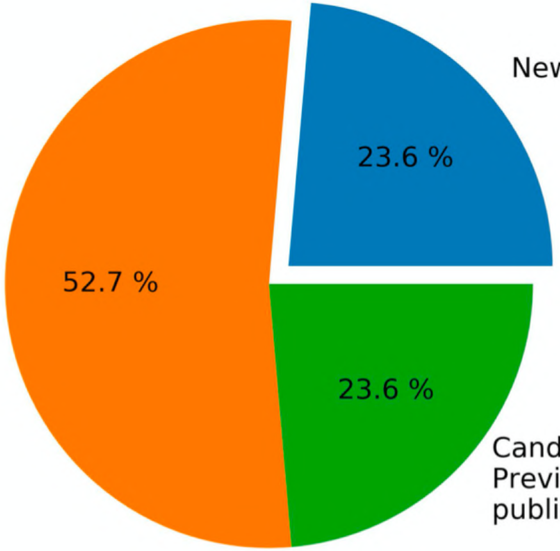


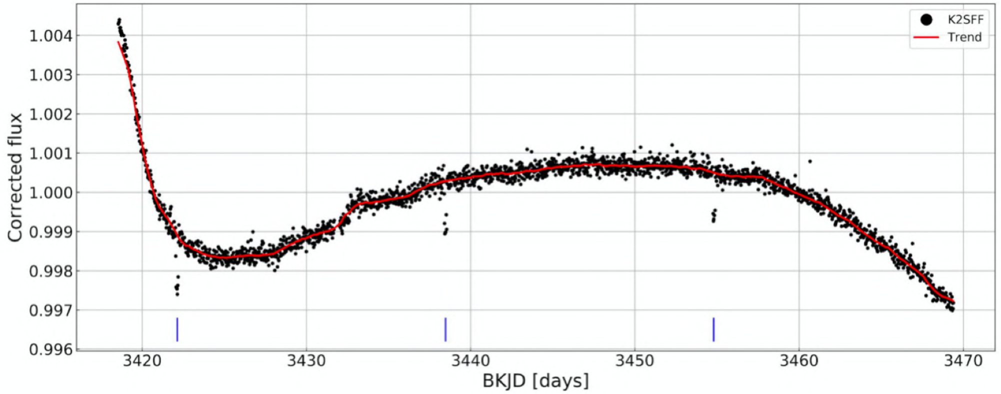


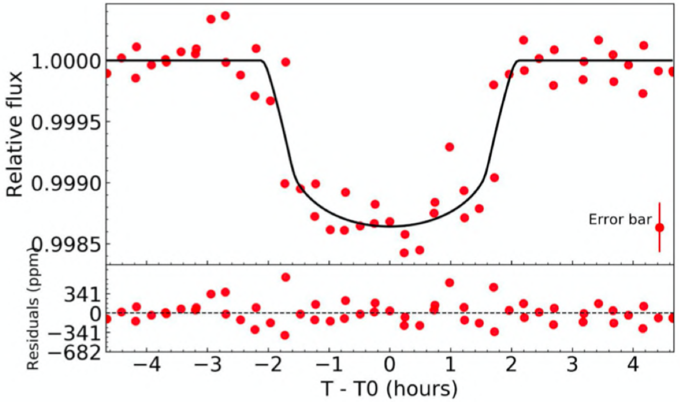
Exoplanets and variable stars in K2 data. A Pro-Am collaboration

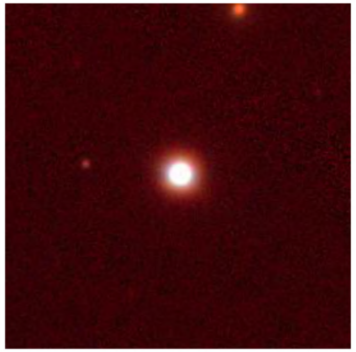
A. Castro González[1], A. Coya Lozano[2], F. García de la Cuesta[2], N. Gómez Hernández[2], R. Hevia Díaz[2], J. Menéndez Blanco[2], P. Padilla Tijerin[2], R. Pardo Silva[2], S. Pérez Acevedo[2], J. Polancos Ruiz[2], D. Vázquez García[2], J.R. Vidal Blanco[2], F. García Riesgo[1], C. González Gutiérrez[1], S.L. Suárez Gómez[1], E. Díez Alonso[1], F.J. de Cos Juez[1]

Fig 2



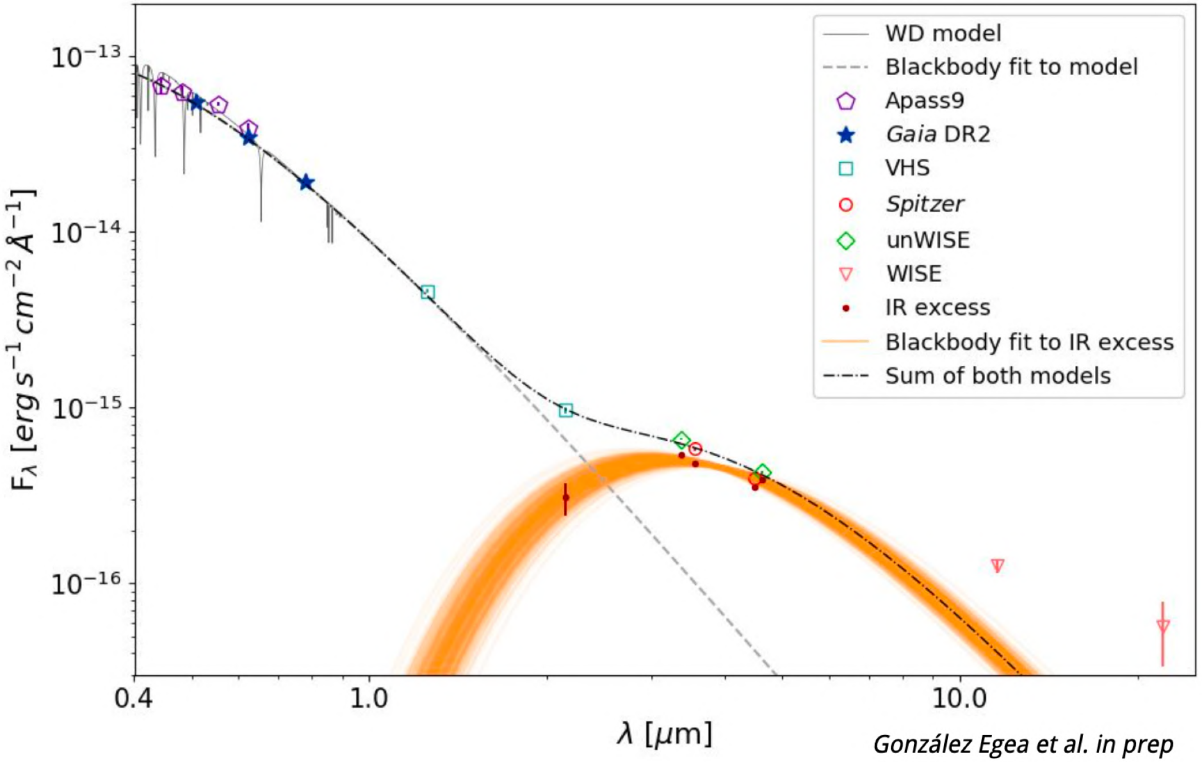




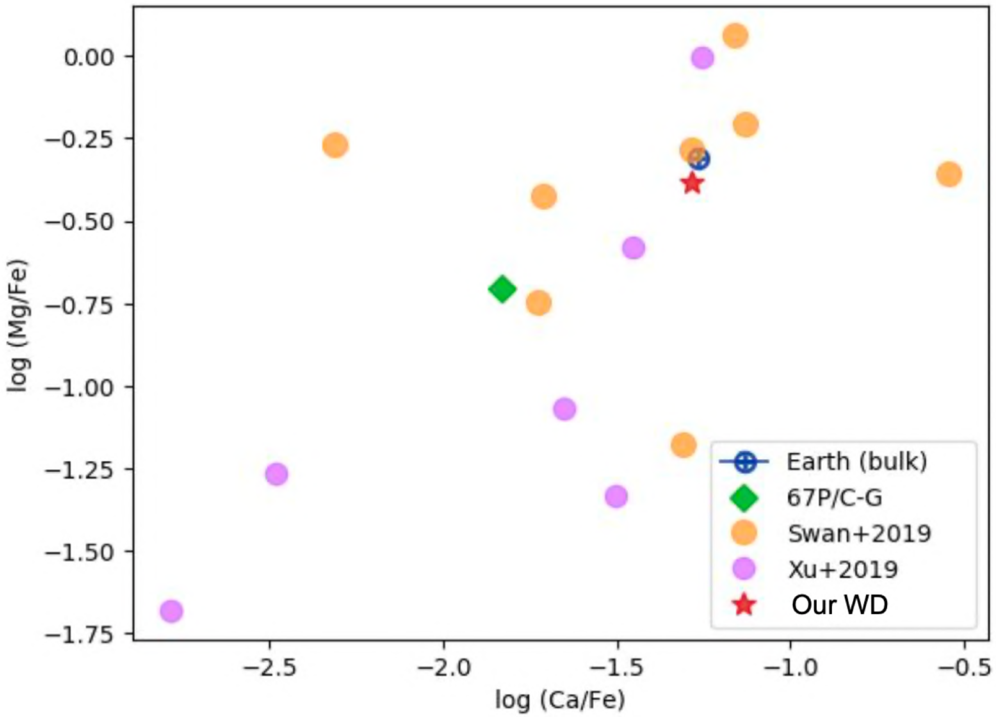


Serendipitous discovery of a dusty disk around a DAZ white dwarf

Elena González Egea*, *University of Hertfordshire*
Dr. Roberto Raddi, *Universitat Politecnica de Catalunya*
Dr. Federico Marocco, *California Institute of Technology*
Dr. Ben Burningham, *University of Hertfordshire*
Prof. Dr. Detlev Koester, *University of Kiel*



González Egea et al. in prep

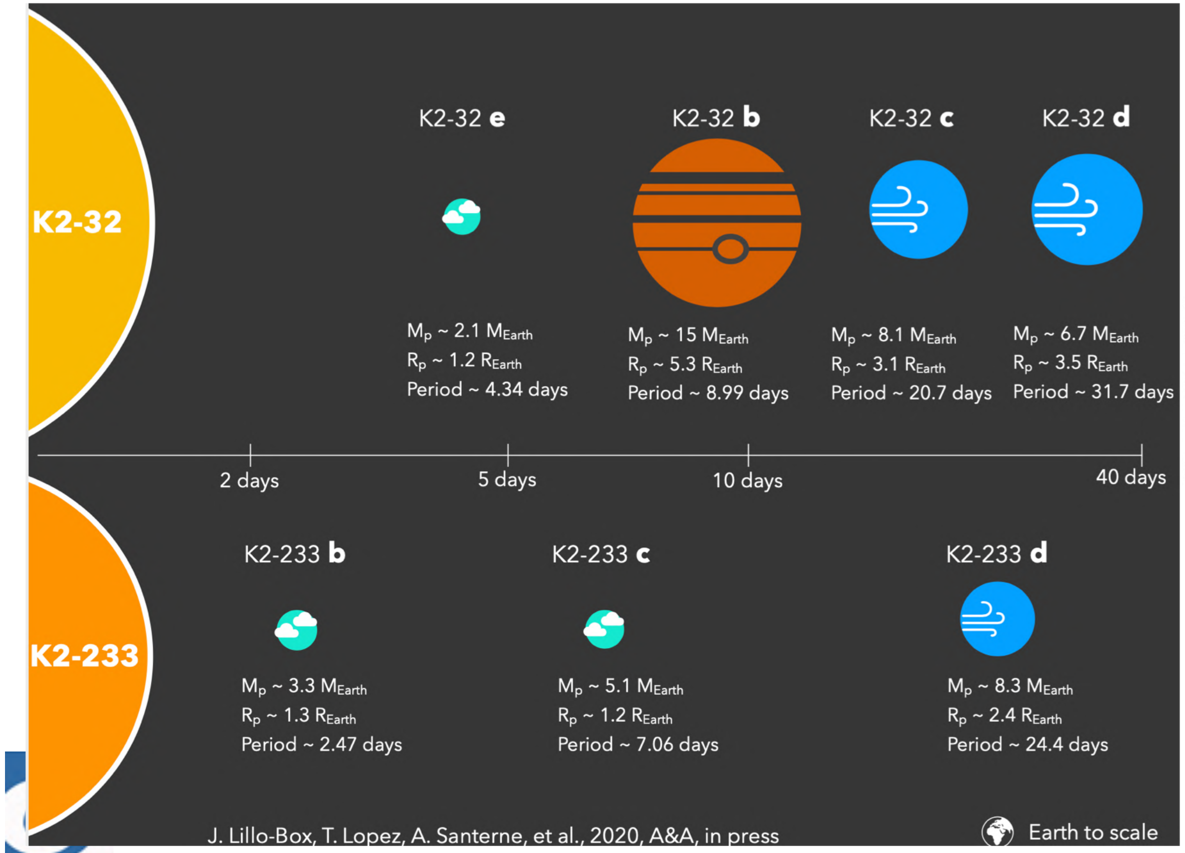


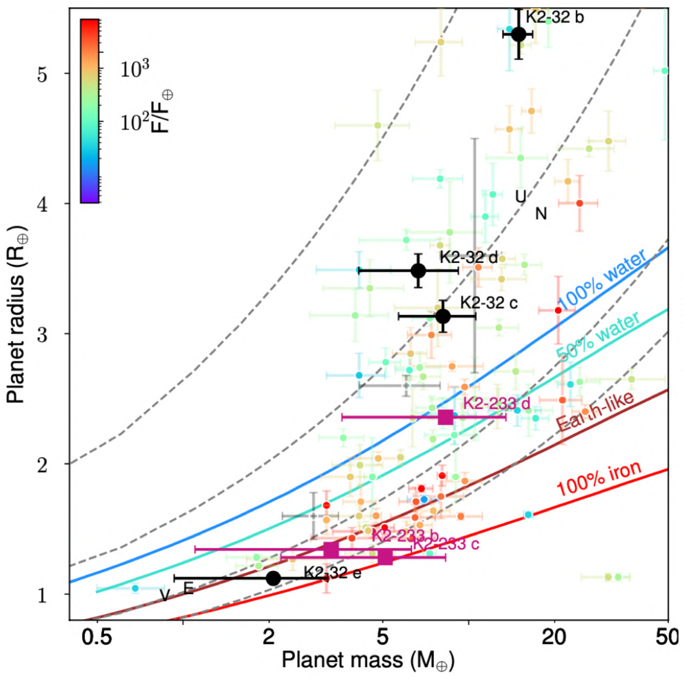
González Egea et al. in prep, with data from Swan et al. 2019 and Xu et al. 2019

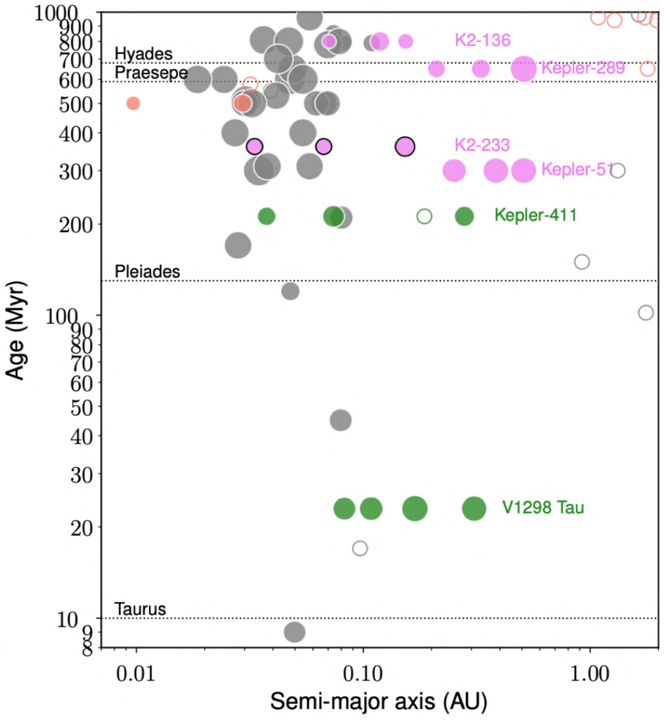
Masses for the seven planets in K2-32 and K2-233.

Four diverse planets in resonant chain and the first young rocky worlds

J. Lillo-Box, T. A. Lopez, A. Santerne, L. D. Nielsen, S.C.C. Barros, M. Deleuil, L. Acuña, O. Mousis, S. G. Sousa, V. Adibekyan, D. J. Armstrong, D. Barrado, D. Bayliss, D. J. A. Brown, O.D.S. Demangeon, X. Dumusque, P. Figueira, S. Hojjatpanah, H. P. Osborn, N. C. Santos, S. Udry



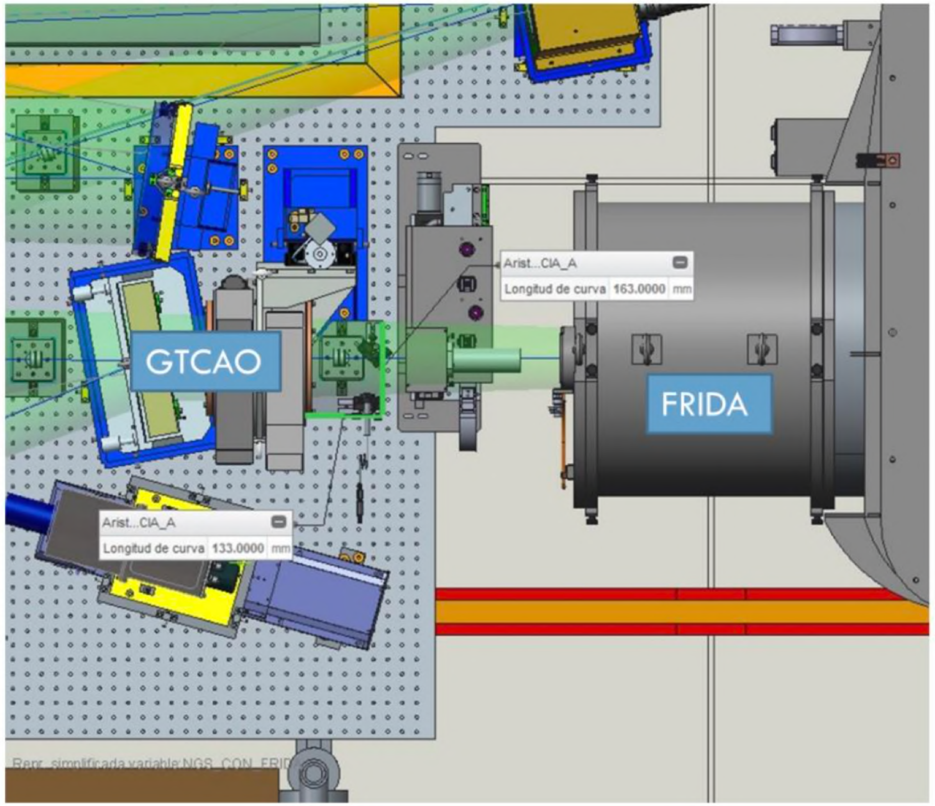




NEREA (Near Earths and high-Res Exoplanet Atmospheres): a red/near-IR spectrograph concept for the GTC

Enric Palle & NEREA team

Instituto de Astrofísica de Canarias



Property	Technical Requirement	Goal
Input	Fibre-fed spectrograph with a front-end throughput efficiency of >70%.	Fibre-fed spectrograph with a front-end throughput efficiency of >80%.
Spectral Resolving Power	>70,000, sufficient to resolve atomic and molecular spectral lines on main sequence stars and planets. This resolution is also sufficient to resolve the signature of Earth atmospheric molecular gases.	110,000.
Wavelength Coverage	800-1700nm.	700-1700nm.
Efficiency (From Input To Detector)	>10% for 800-1700nm, comparable with existing echelle spectrometers.	>15% for 700-1700nm.
Abs. Wave-length Calib.	<2m/s hard-ware stability.	<50cm/s sky stability.
Adaptive Optics Requirement	Moderate AO requirement with an input image size: 0.3 arcsec.	
Size	1.5mX1.5mX1m.	1mX1mX0.5m.
Hard-ware Budget	€3million.	€2million.
Other Requirements	Compact design, behind an AO system, also able to operate under seeing limited conditions (R4∼30 000, or 70,000 with high losses).	

EXOCOMETS A STUDY OF THE GASEOUS ENVIRONMENT OF A-TYPE MAIN-SEQUENCE STARS

Isabel Rebollido[1], Eva Villaver[1], Benjamín Montesinos[2], Carlos Eiroa[1]

[1]Departamento de Física Teórica, UAM
[2]Centro de Astrobiología-CSIC