

# Cosmic Dust Laboratory (CoDuLab)

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17 de junio de 2015

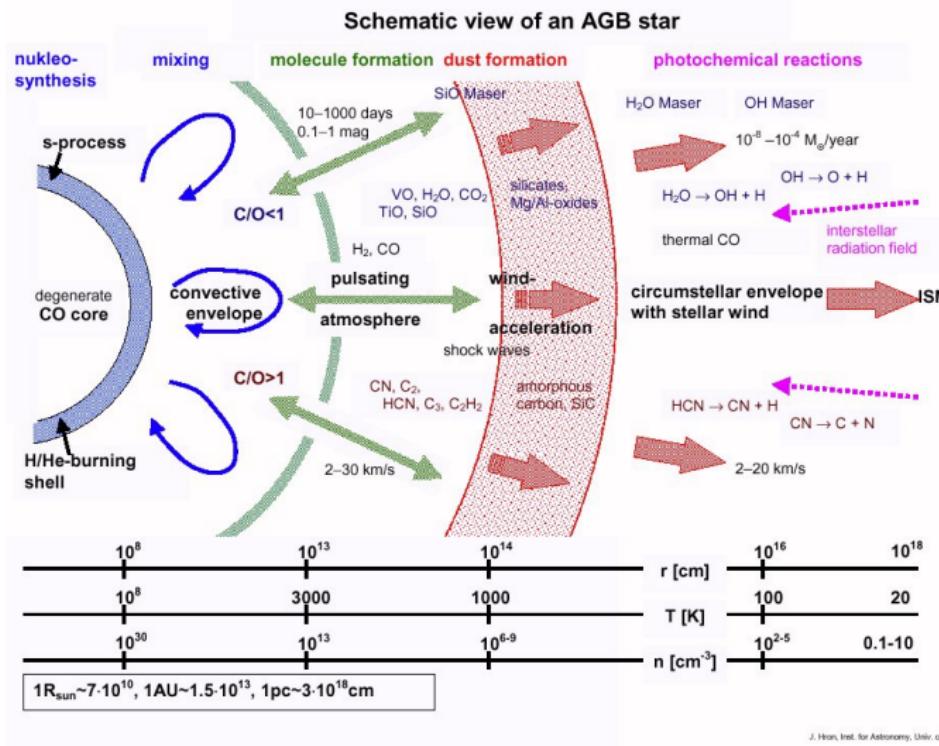
1 Polvo en astrofísica

2 Objetivos

## 1 Polvo en astrofísica

## 2 Objetivos

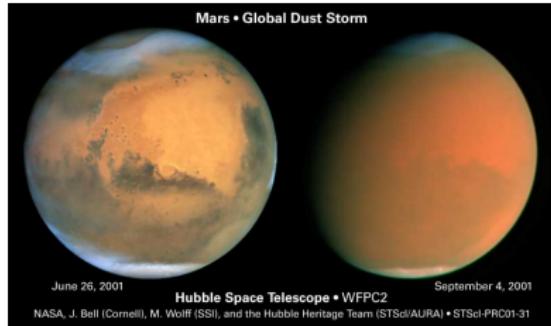
## Formación de polvo en las estrellas AGB



J. Hron, Inst. for Astronomy, Univ. of Vienna

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## En el sistema solar



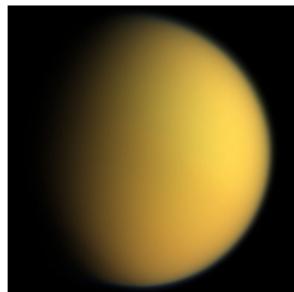
Tormenta de arena planetaria en Marte (Fuente: JPL (NASA)).



Cometa Hale-Bopp (1995) (Fuente: E. Kolmhofer, H. Raab; Johannes-Kepler-Observatory, Linz, Austria).

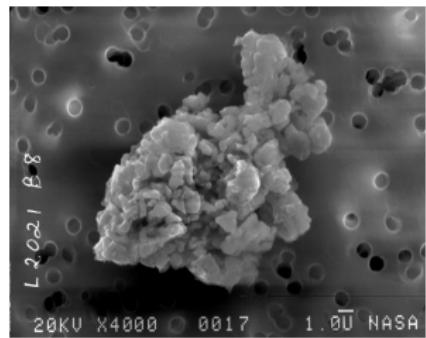
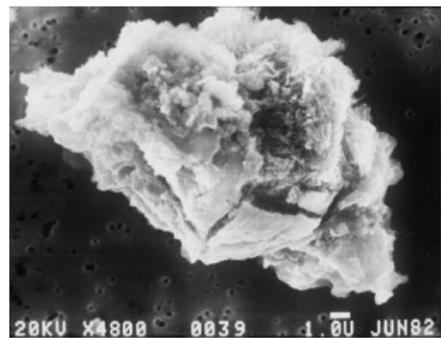


Cara visible de la Luna (Fuente: Gregory H. Revera/Wikimedia Commons).



Titán visto desde la sonda Cassini (Fuente: Jet Propulsion Laboratory (NASA)).

## Interplanetary dust particles(IDPs)



Imágenes de microscopio electrónico de IDP's (Fuente: NASA IDPs Database).

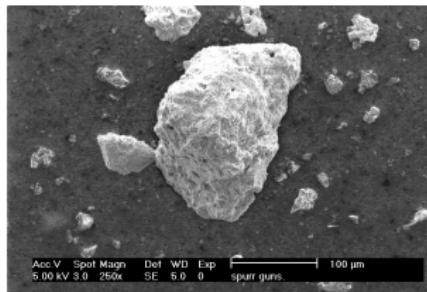
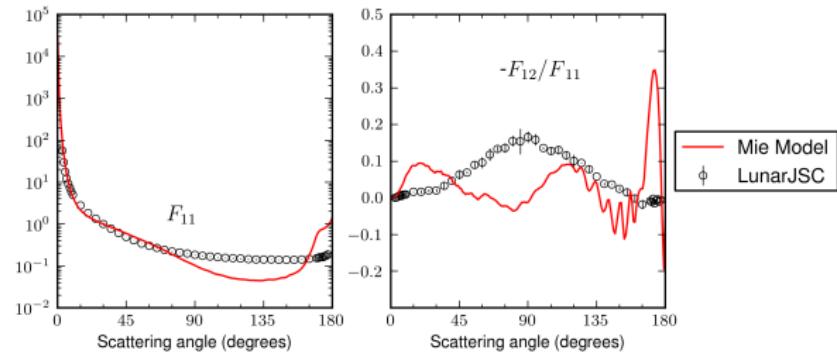


Imagen de microscopio electrónico de ceniza volcánica (Amsterdam-Granada light scattering Database).



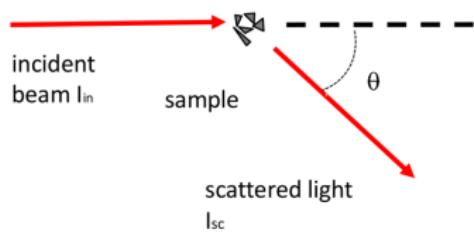
Medidas experimentales vs simulación de Mie.

## Scattering Matrix

$$\begin{pmatrix} I_{sc} \\ Q_{sc} \\ U_{sc} \\ V_{sc} \end{pmatrix} = \frac{\lambda^2}{4\pi^2 D^2} \begin{pmatrix} F_{11} & F_{12} & F_{13} & F_{14} \\ F_{21} & F_{22} & F_{23} & F_{24} \\ F_{31} & F_{32} & F_{33} & F_{34} \\ F_{41} & F_{42} & F_{43} & F_{44} \end{pmatrix} \begin{pmatrix} I_{in} \\ Q_{in} \\ U_{in} \\ V_{in} \end{pmatrix}$$

Scattering matrix depends on:

- Scattering angle
- Refractive index
- Size distribution
- Shape
- Orientation
- Wavelength

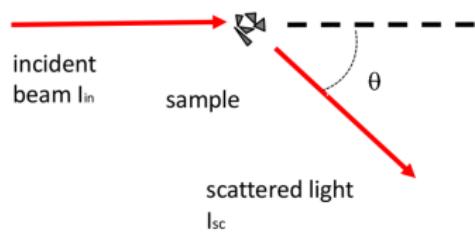


## Scattering Matrix

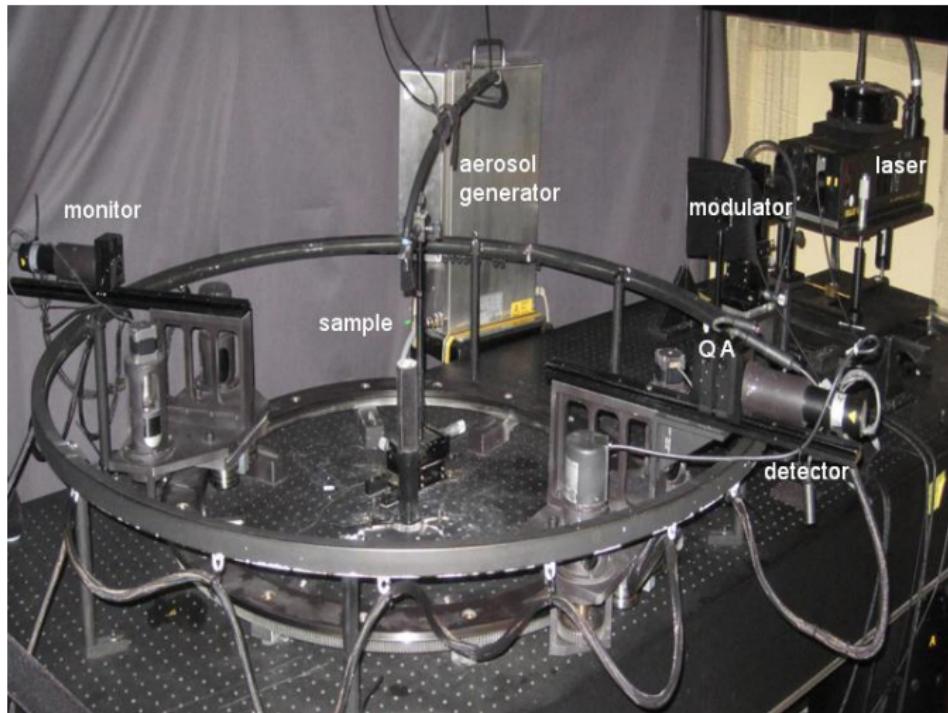
$$\begin{pmatrix} I_{sc} \\ Q_{sc} \\ U_{sc} \\ V_{sc} \end{pmatrix} = \frac{\lambda^2}{4\pi^2 D^2} \begin{pmatrix} F_{11} & F_{12} & 0 & 0 \\ F_{12} & F_{22} & 0 & 0 \\ 0 & 0 & F_{33} & F_{34} \\ 0 & 0 & -F_{34} & F_{44} \end{pmatrix} \begin{pmatrix} I_{in} \\ Q_{in} \\ U_{in} \\ V_{in} \end{pmatrix}$$

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## Cosmic Dust Laboratory (CoDuLab)

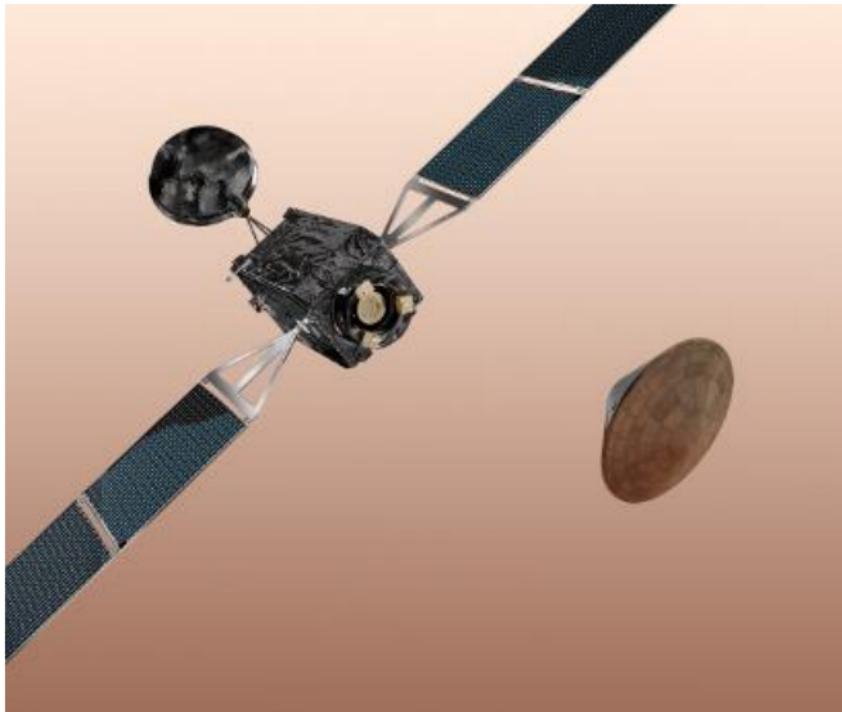


Montaje experimental del CoDuLab en el IAA.

1 Polvo en astrofísica

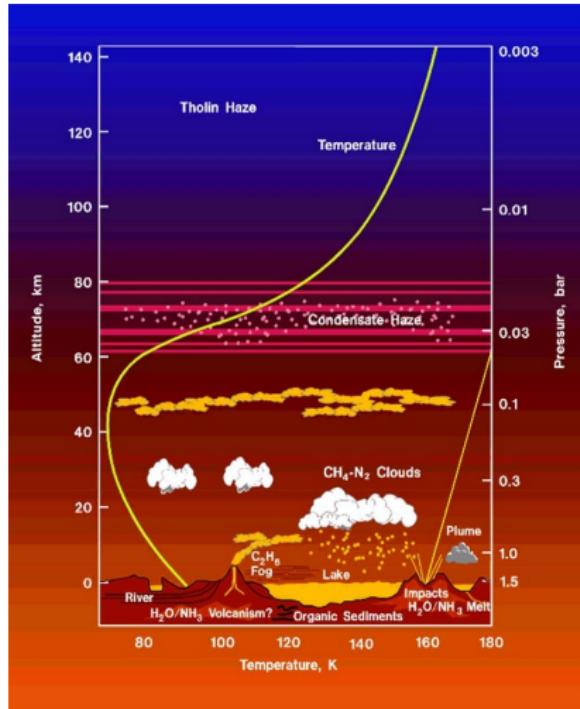
2 Objetivos

## Misión Exomars-NOMAD



Misión Exomars-NOMAD (Fuente: <https://udit.iaa.csic.es/content/nomad>).

## Tolines orgánicos en Titán



Modelo de la atmósfera de Titán (Fuente:  
NASA/JPL-Caltech).

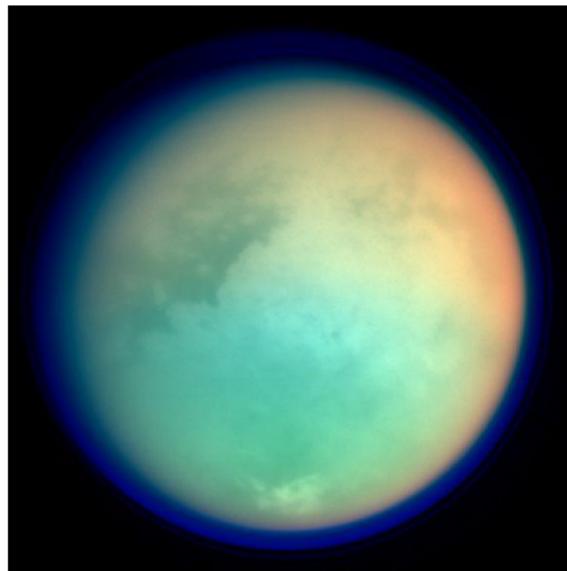
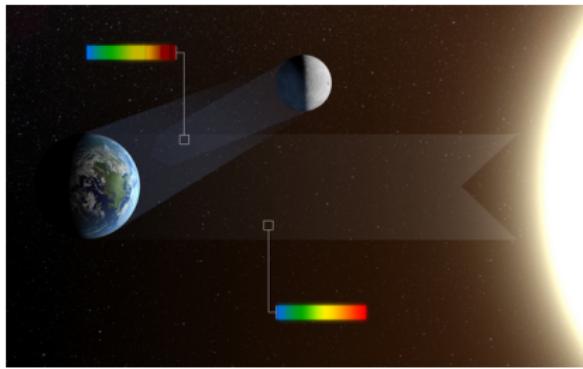


Imagen de la atmósfera de Titán en infrarrojo (Fuente:  
NASA/JPL/Space Science Institute by Alfred McEwen).

## Buscando vida en exoplanetas



"Earthshine" visto desde el European Southern Observatory (Fuente: ESO/B. Tafreshi/TWAN).

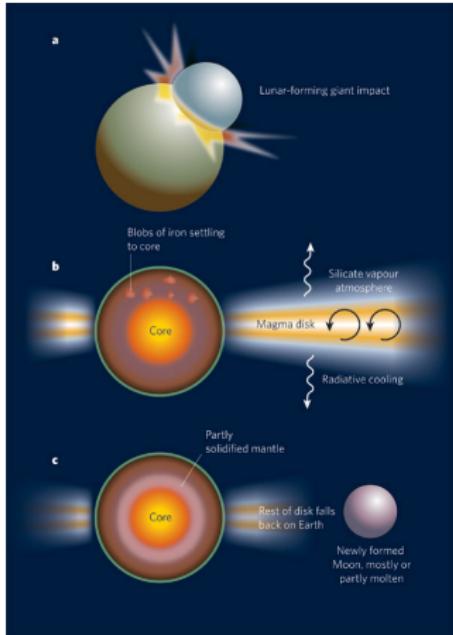


Esquema teórico (Fuente: ESO/L. Calçada).



Fuente: Gregory H. Revera/Wikimedia Commons.

## The Moon: Giant Impact Hypothesis and composition



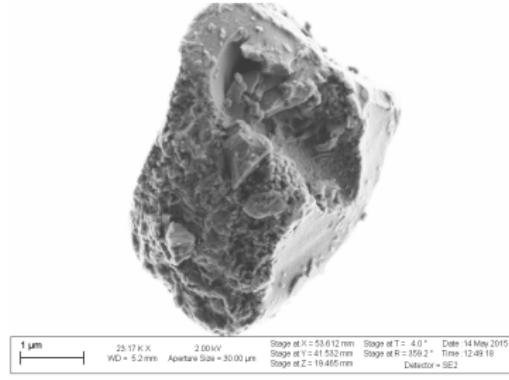
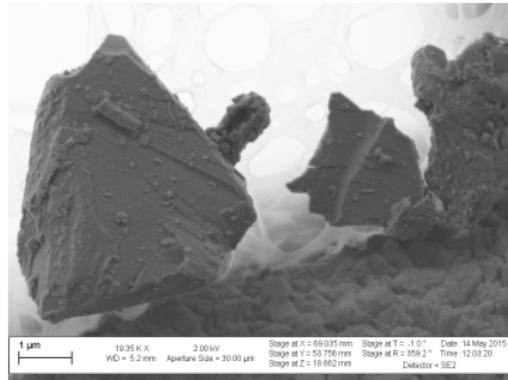
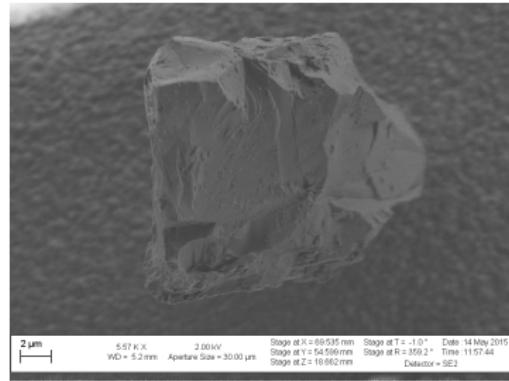
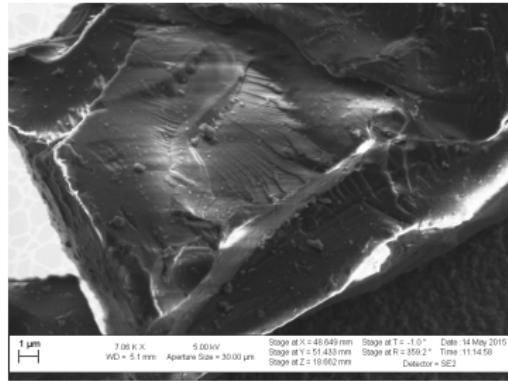
David J. Stevenson, Nature 451, 261-265 (2008).

	Apollo 17 sample 70051	JSC-1A lunar simulant	Mars analog basalt
$SiO_3$	42.2	45.7	43.9
$Al_2O_3$	15.7	16.2	8.4
$CaO$	11.5	10.0	6.3
$MgO$	10.3	8.7	7.0
$FeO$	12.4	-	-
$Fe_2O_3$	-	12.4	20.7
$Na_2O$	0.2	3.2	2.1
$K_2O$	0.1	0.8	0.7
$TiO_2$	5.1	1.9	0.8
$P_2O_5$	-	0.7	1.0
$MnO$	0.2	0.2	0.4



- **Mare** regolith simulant (low-Ti).
- Composition: basaltic ashes. No chemical treatment performed.
- Physical treatment: milling and sieving to reproduce size distribution.
- Refractive index (in the visible):  $1.65+0.003i$  (Goguen et al. (2010)).
- Size distribution:  $r_{eff}=17.68\mu m$ ,  $\nu_{eff}=1.59$

## JSC-1A: SEM images



- Muestras con las que trabajamos: arena desértica (Gobi, Sahara, Túnez, Libia...), análogos marcianos (mortmollinorita, basalto, JSC...), análogos lunares, calcita, cenizas volcánicas (Puyehue, Eyjafjallajökull, Santa Helena...)...
- Las medidas se realizan a tres longitudes de onda (488nm, 520nm y 633nm). Los datos son de dominio público y están disponibles en nuestra base de datos (<http://www.iaa.es/scattering/>).
- Tras las medidas experimentales se realizarán simulaciones computacionales de partículas irregulares (gaussian random shapes) en colaboración con Universidad de Helsinki.