



Micro**A**RES

A promise ...
... and a demise

Grégoire Déprez ¹, F. Montmessin ¹, O. Witasse ², L. Lapauw ¹, F. Vivat ¹, S. Abbaki ¹
P. Granier ¹, D. Moirin ¹, R. Trautner ², R. Hassen-Khodja ¹, E. d'Almeida ¹
L. Charnenal ¹, J-J. Berthelier ¹, F. Esposito ³, S. Debei ⁴, S. Rafkin ⁵, E. Barth ⁵

¹ Laboratoire Atmosphère Terrestre, Millieux et Observations Spatiales (LATMOS), Guyancourt, France

² European Space Agency, ESTEC, Noordwijk, Netherlands

³ INAF - Osservatorio Astronomico di Capodimonte, Napoli, Italy

⁴ CISAS - Università degli Studi di Padova, Padova, Italy

⁵ SouthWest Research Institute (SwRI), Boulder (CO), USA

Exomars workshop, Saariselkä, March 2017





Pan

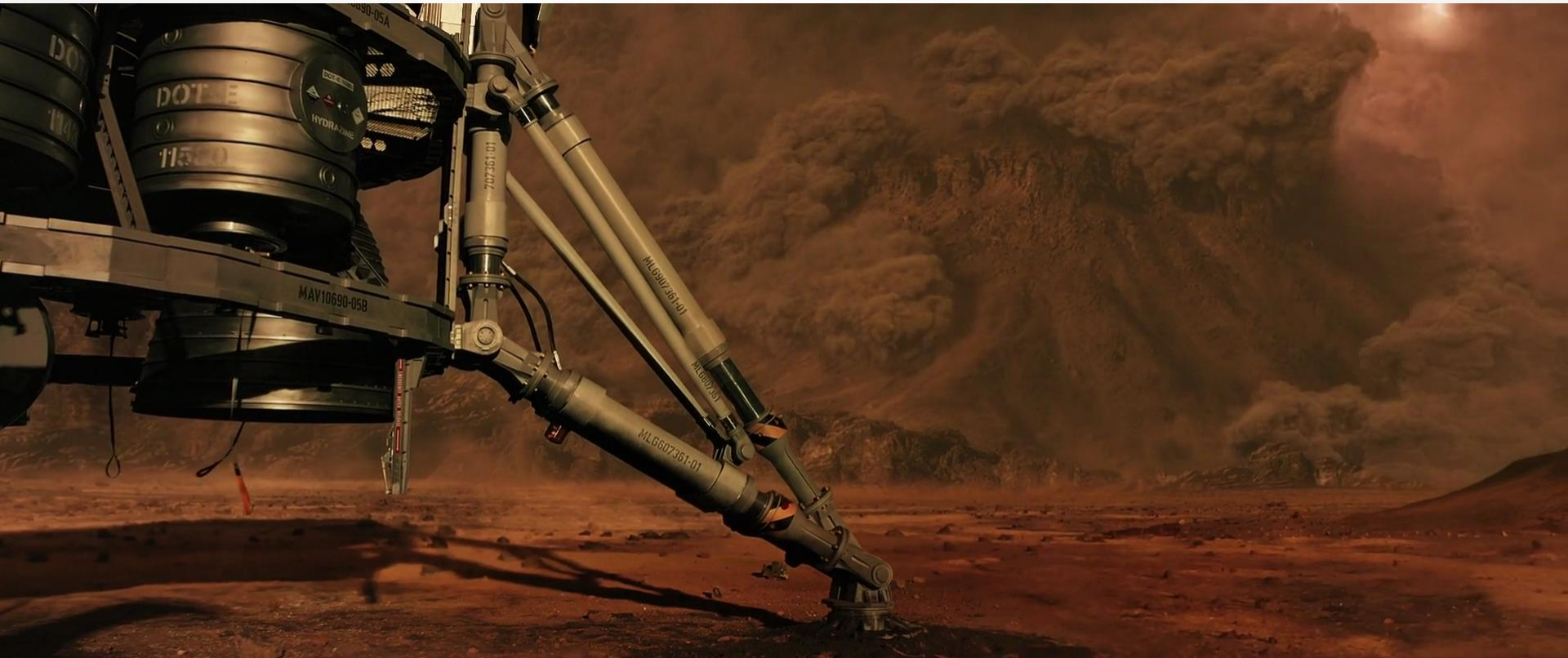


Stefnsson



Delory 2006

On Mars ?

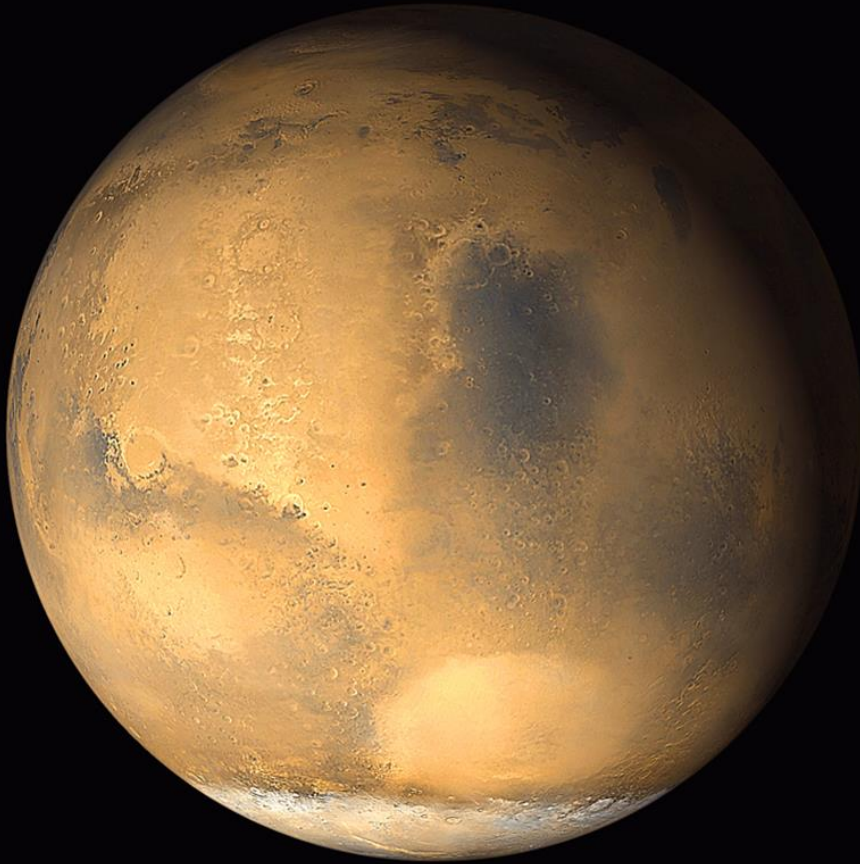


On Mars ?

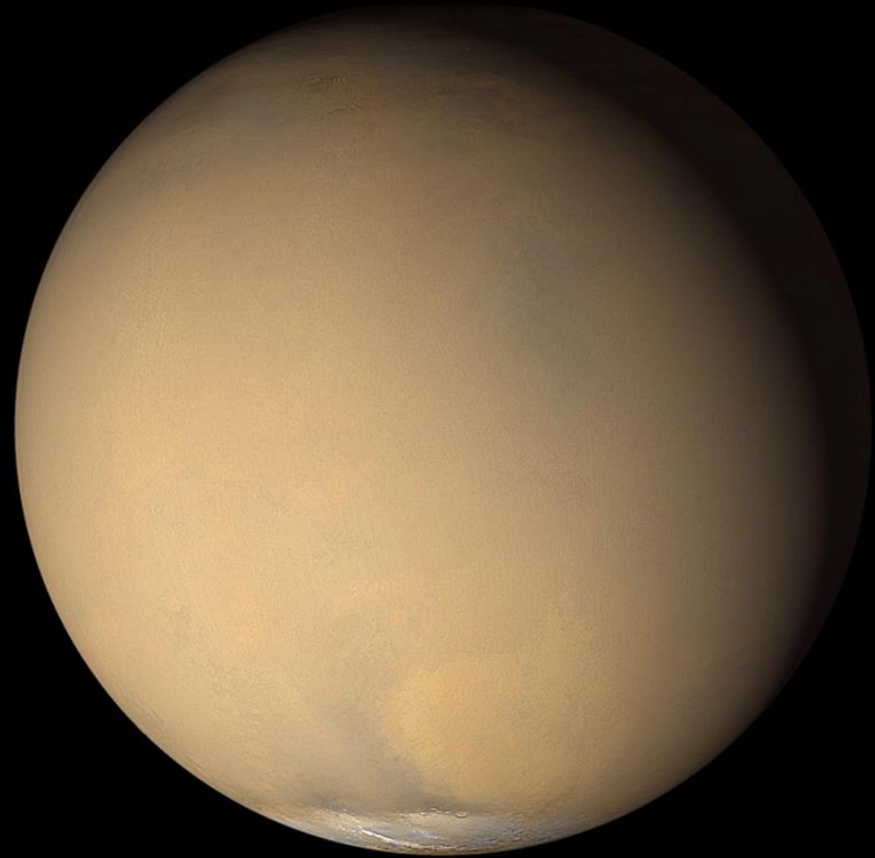
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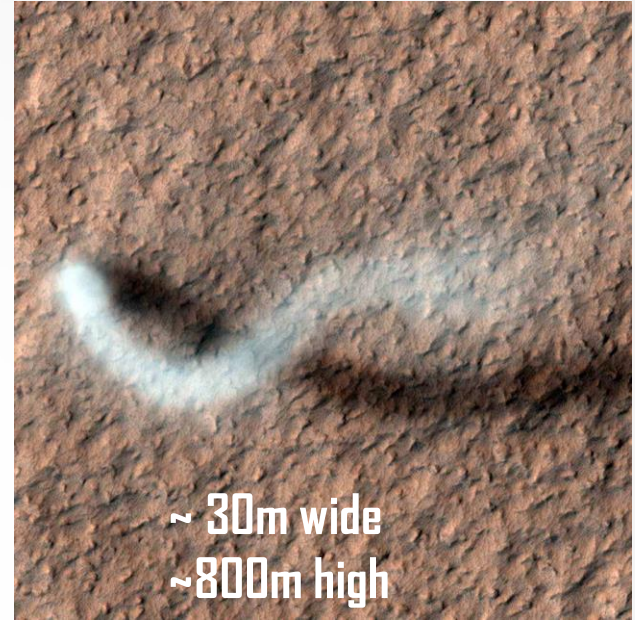
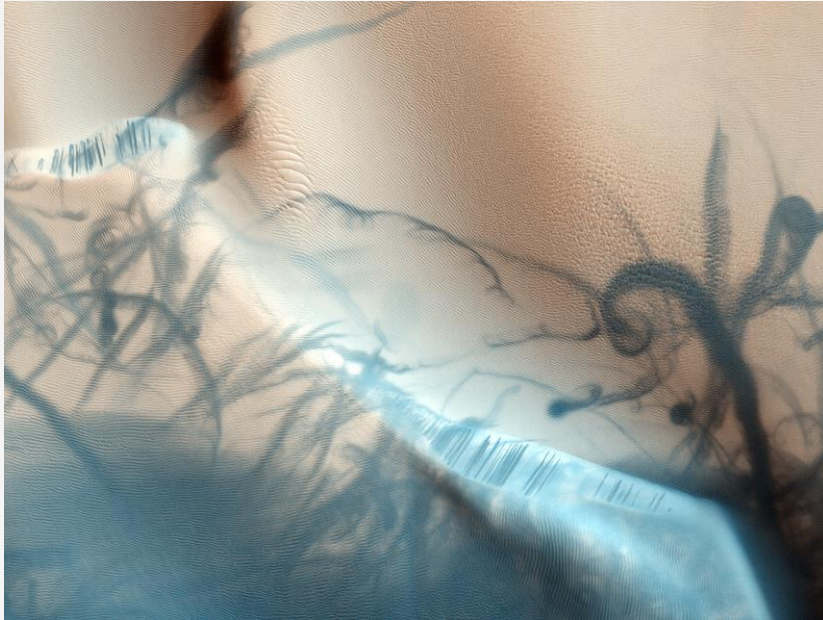
June 2001



July 2001

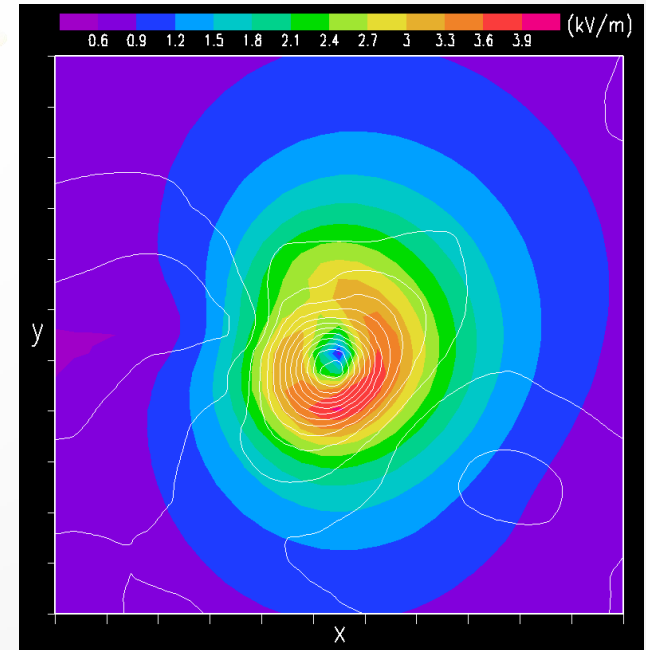
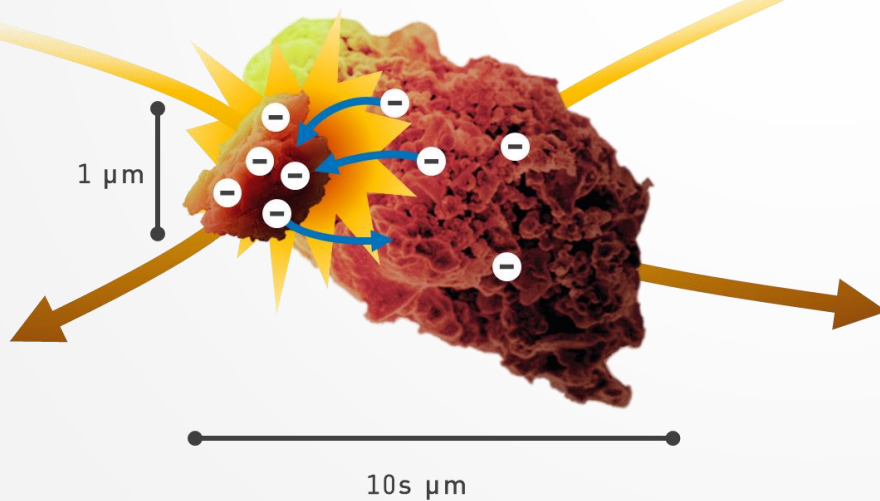
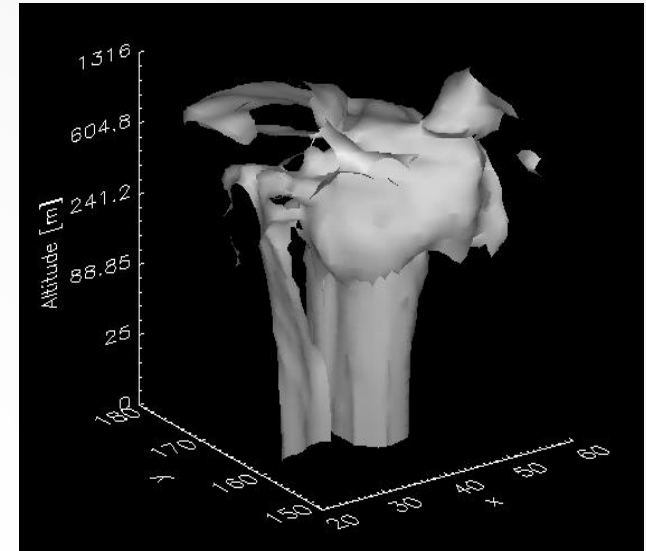


Martian dust events



The generator: triboelectricity

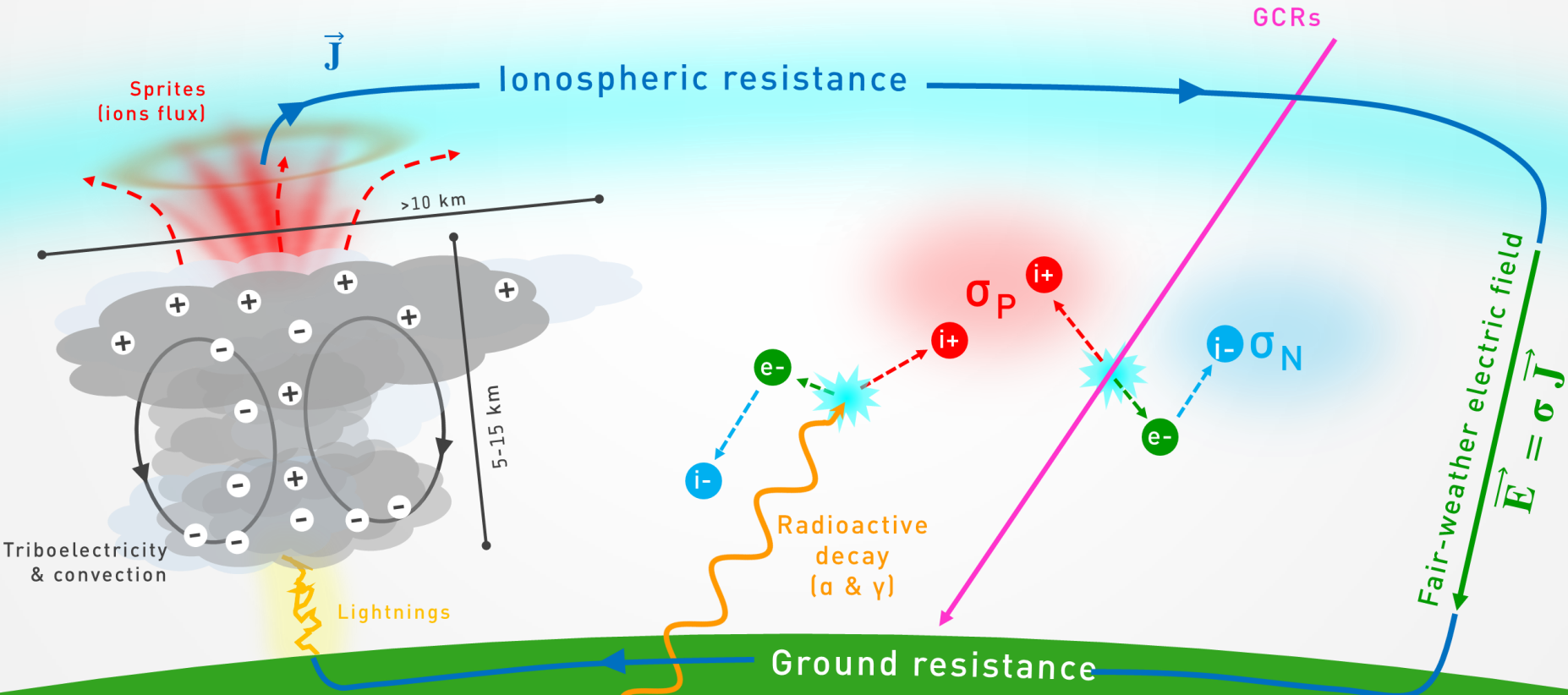
- ▶ Charging depending on
 - ▶ Grain size
 - ▶ Grain composition
- ▶ Photo-detachment
- ▶ Attachment with ions and electrons



The global circuit on Earth

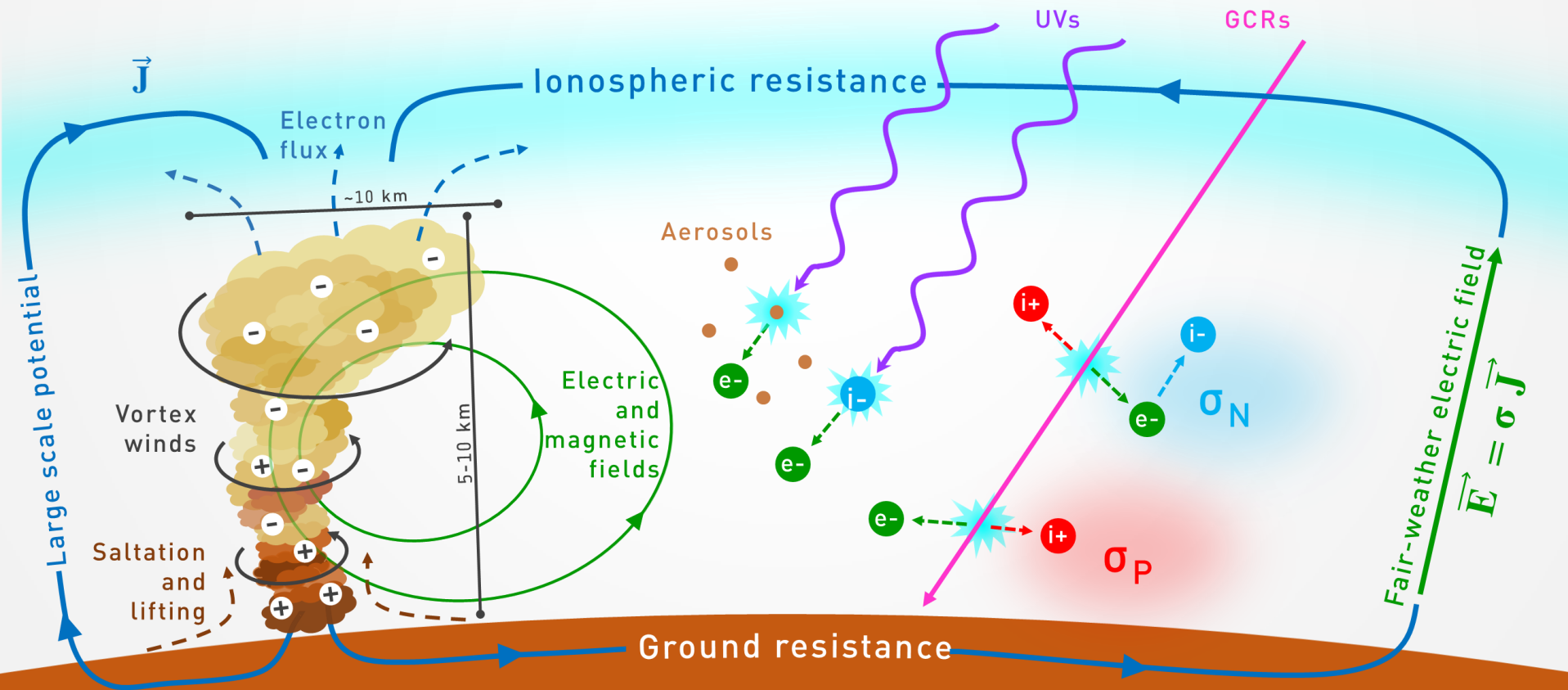
- ▶ Constant thunderstorm current
- ▶ Fair weather electric field $\sim -150\text{V/m}$
- ▶ Fair weather current $\sim 2\text{pA/m}^2$

} Conductivity

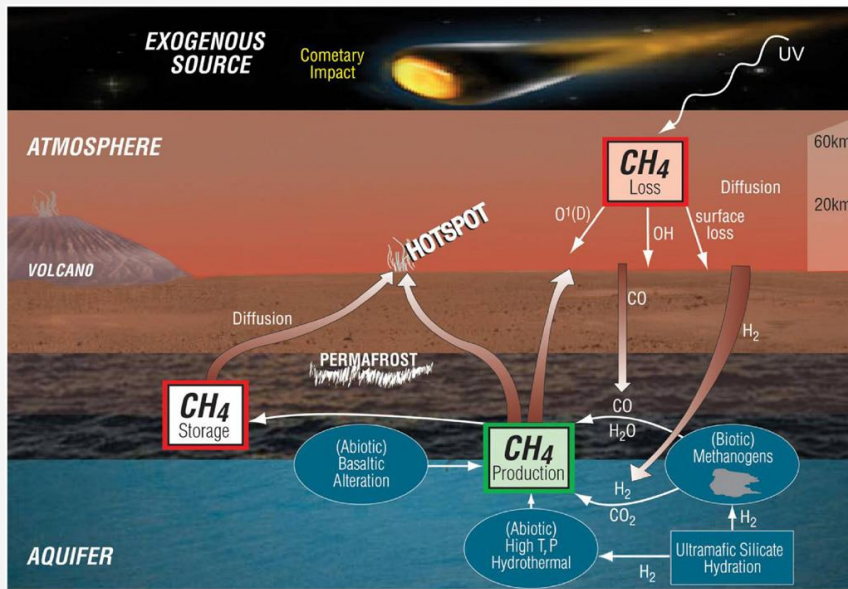


A Martian global circuit ???

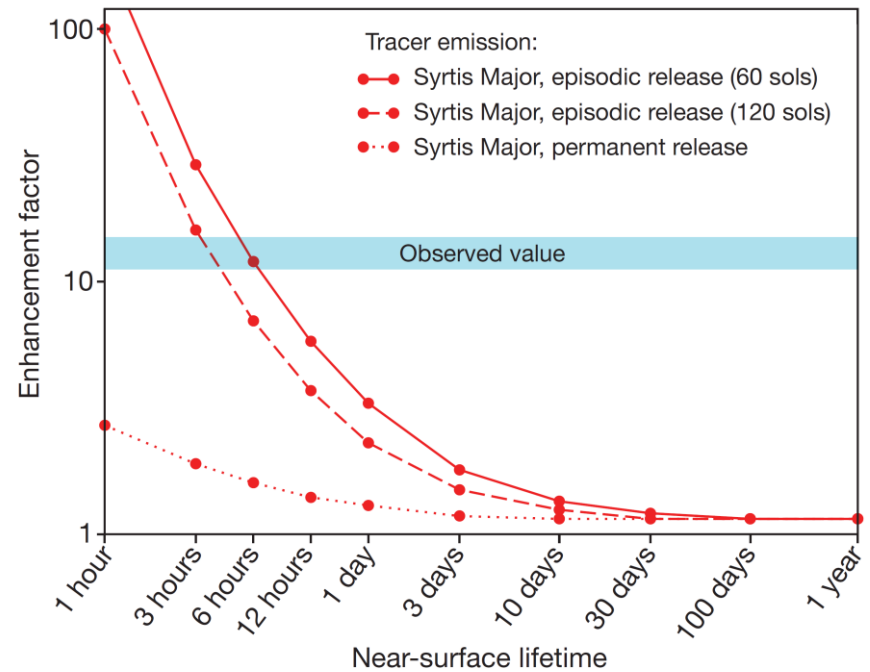
- ▶ More variability
 - ▶ 500 V/m with a regional/global dust storm
 - ▶ 0,1 V/m with only dust devils (Aplin 2006)
- ▶ Global measurement for a local value



► UV dissociation > short methane lifetime

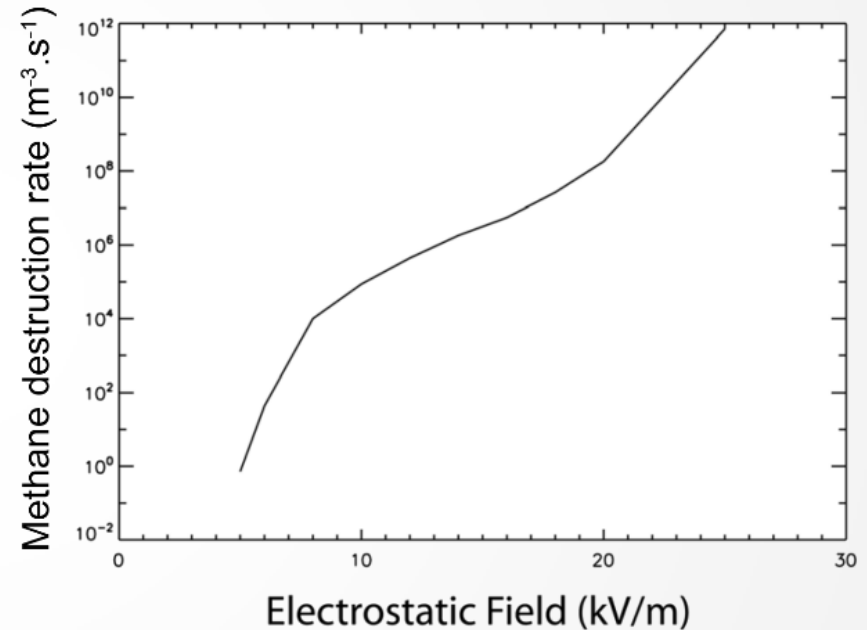
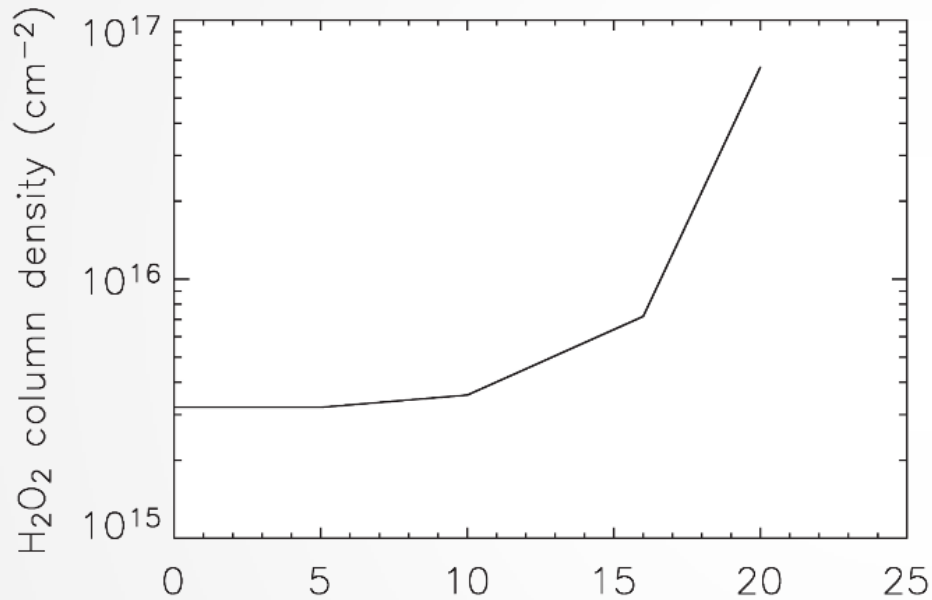


Atreya 2007

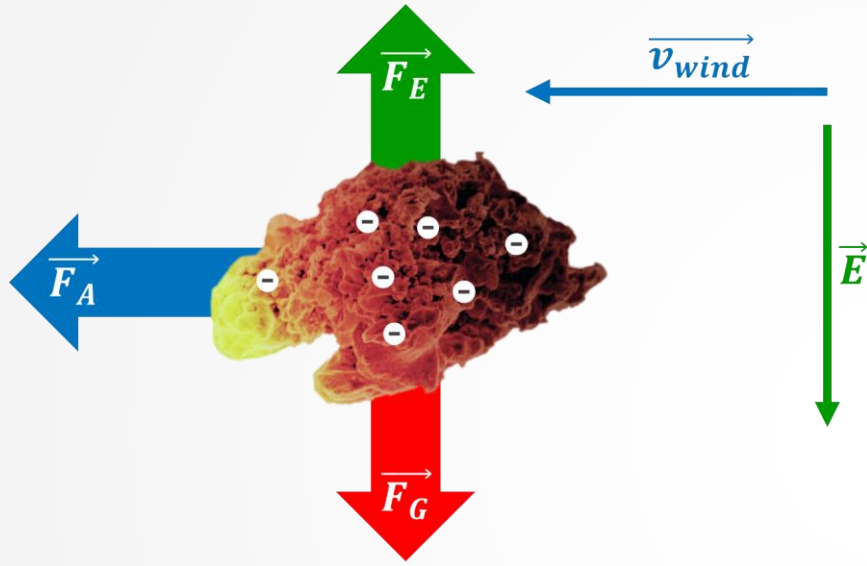


Lefèvre & Forget 2009

- ▶ Large e-fields > energized electrons > oxidants species > organics removal



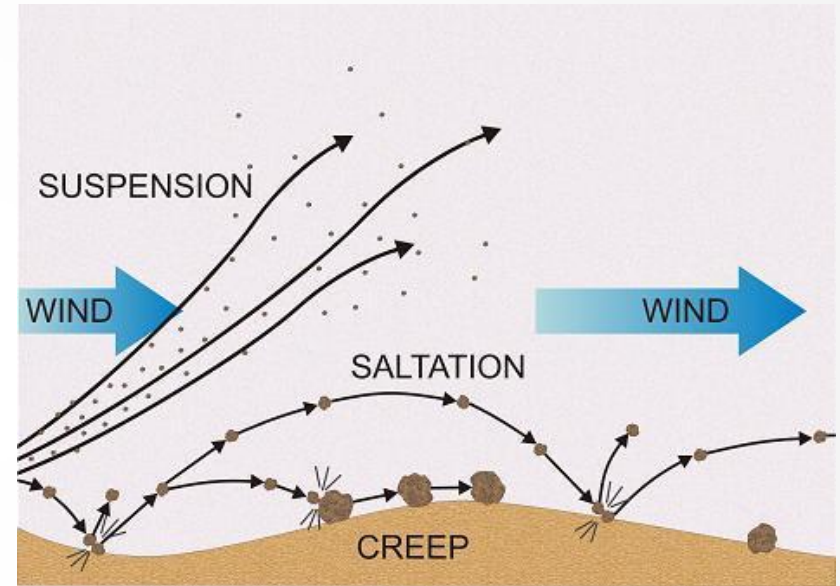
Atreya & Delory 2006



$$\vec{F}_A \approx \vec{F}_G \approx \vec{F}_E$$

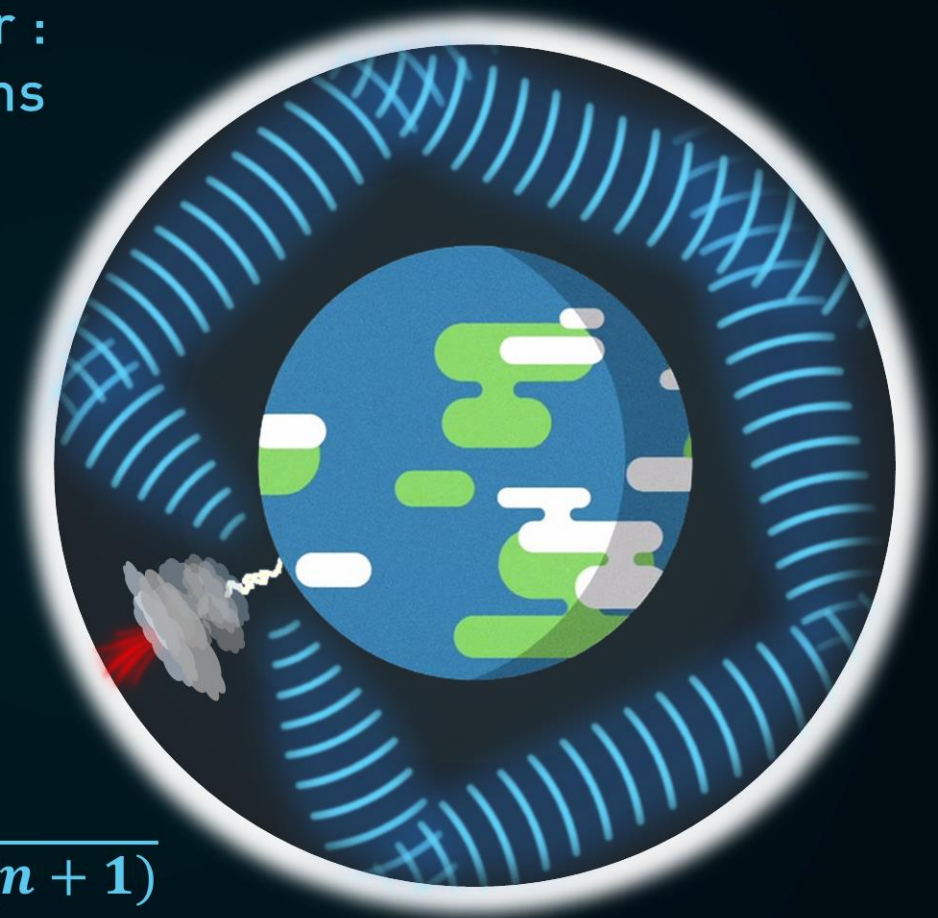
For $E=10$ kV/m and $Q=10^{-16}$ C

(Farrell 2006)



Generator :
thunderstorms

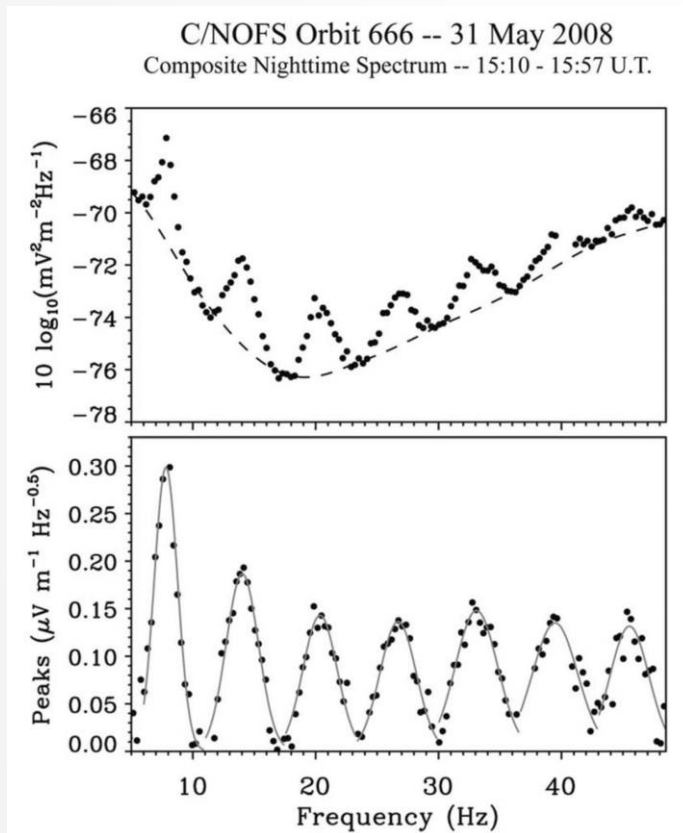
Low σ_{atm} &
~symmetric
ionosphere :
resonance
maintained



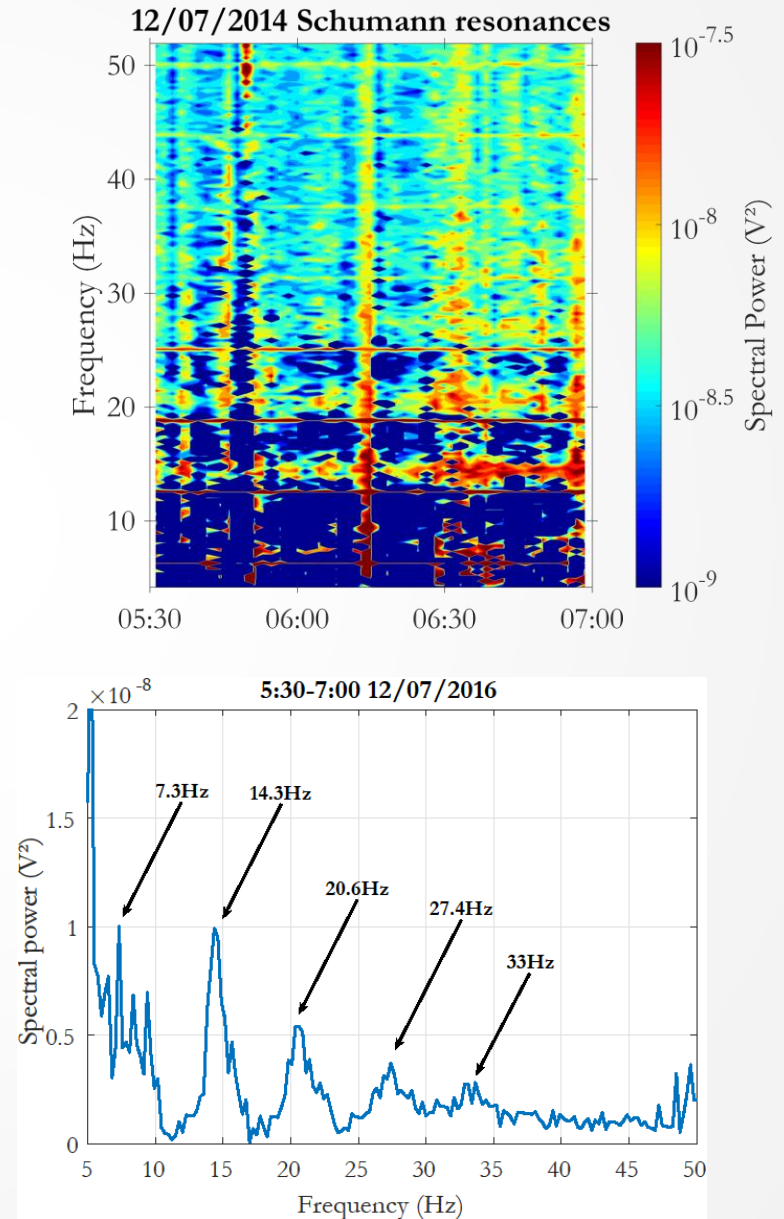
$$f_n = \frac{V_{ph}^{(n)}}{2\pi R_{planet}} \sqrt{n(n+1)}$$

Schumann resonances: on Earth

- ▶ Predicted in 1952 by *Schumann*
- ▶ Observed in 1960 by *Balser & Wagner*

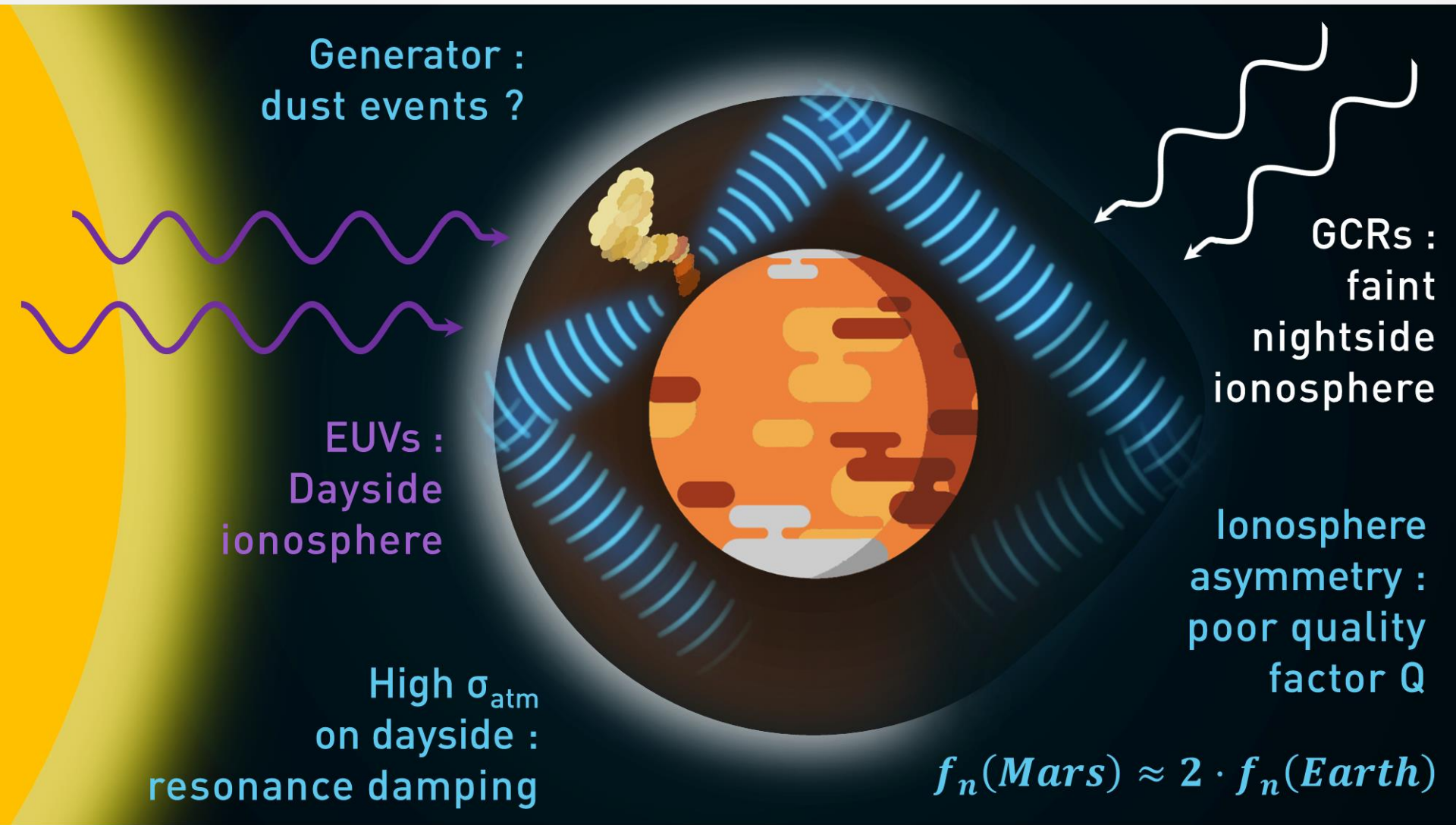


Simões 2011

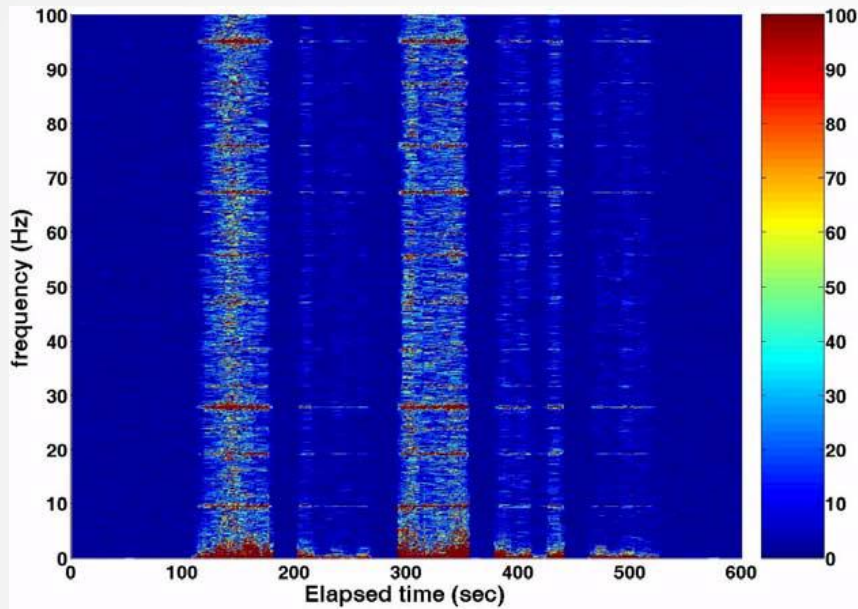


Schumann resonances: on Mars ???

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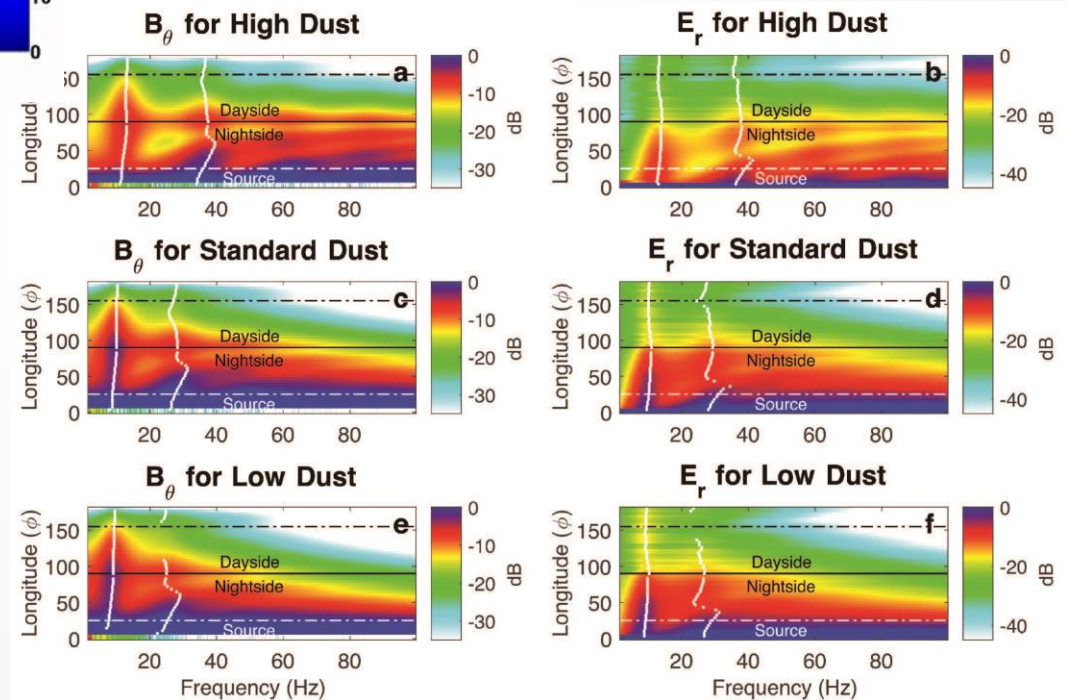
Schumann resonances: on Mars ???



Ruf 2009

► Observed ?

► Simulations

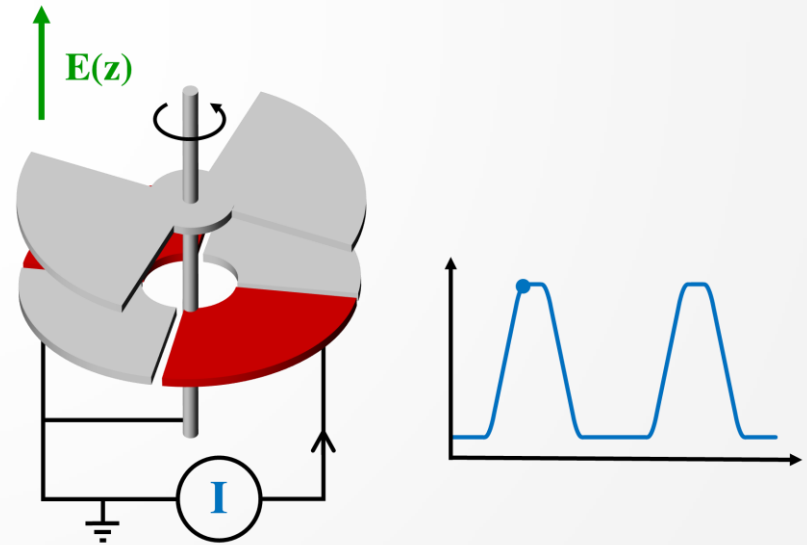
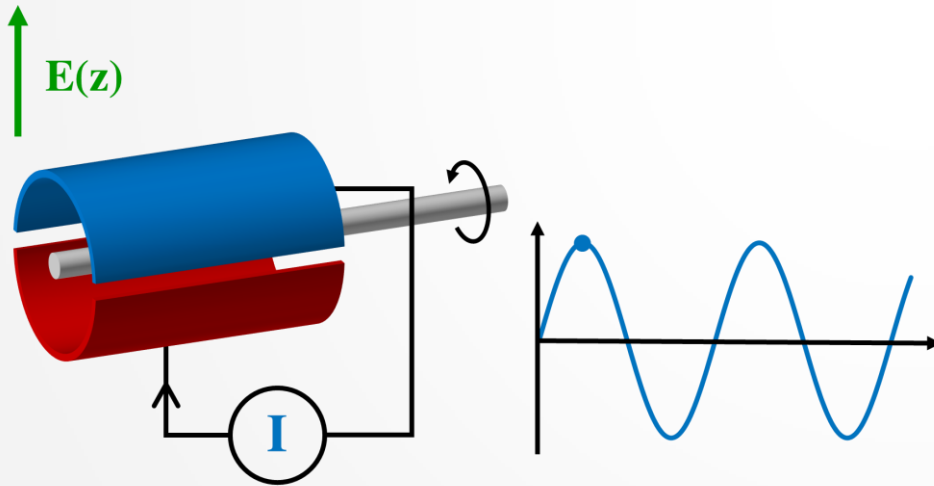


How to measure it ?

- ▶ For electric fields: field mills
- ▶ For high frequency (> 30Hz): antenna
- ▶ For the conductivity: conductivity probe

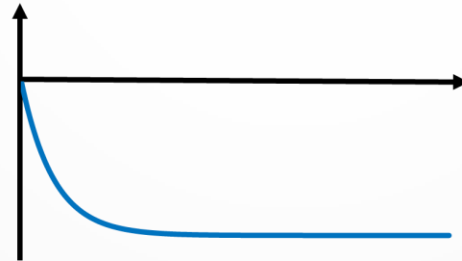
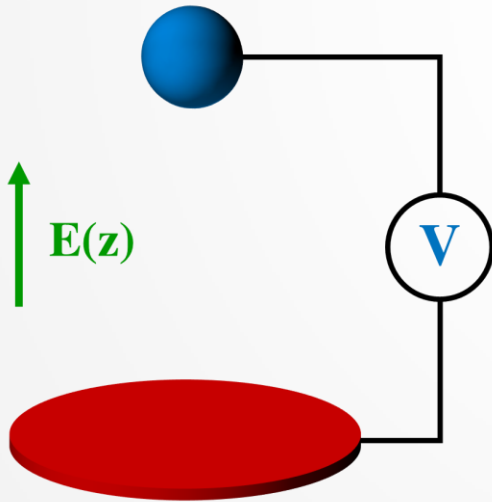
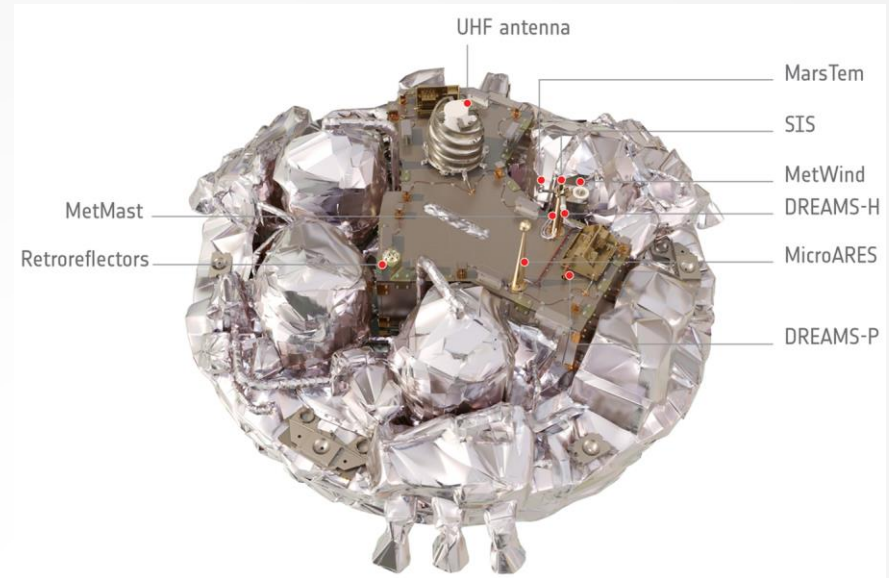


3 instruments
Heavy
Need for power



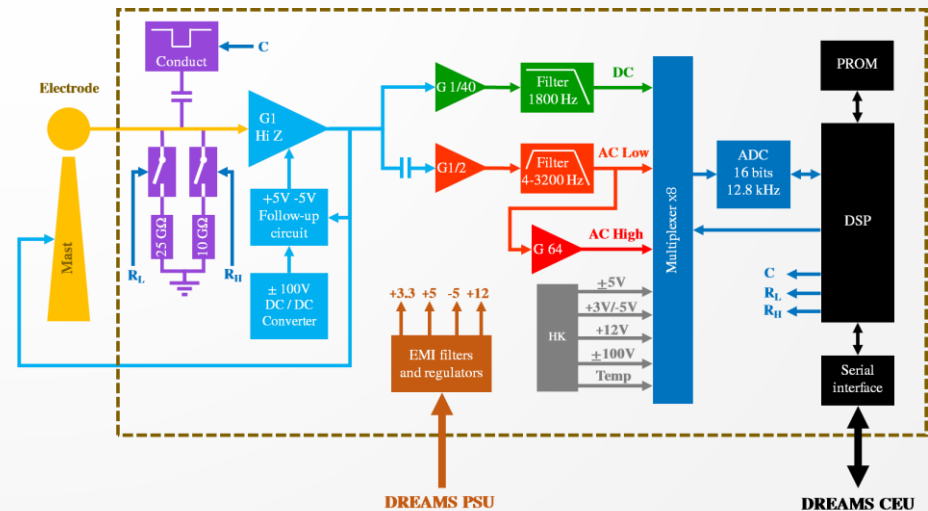
For ExoMars 2016

- ▶ Very limited power
- ▶ Strict mass budget
- ▶ 1 instrument for all 3

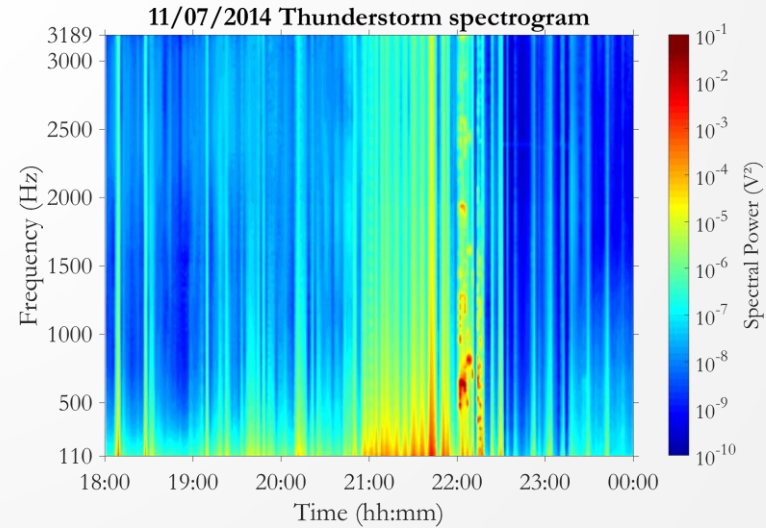
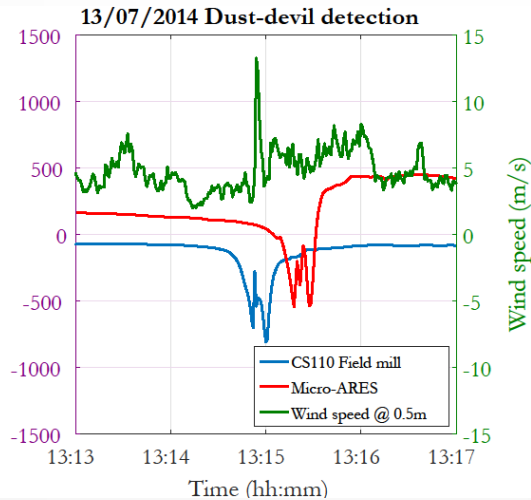
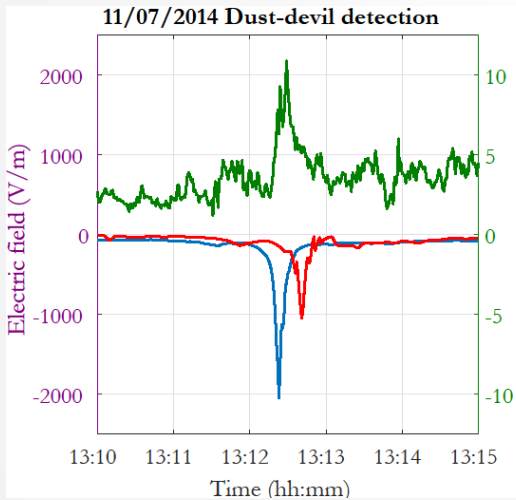
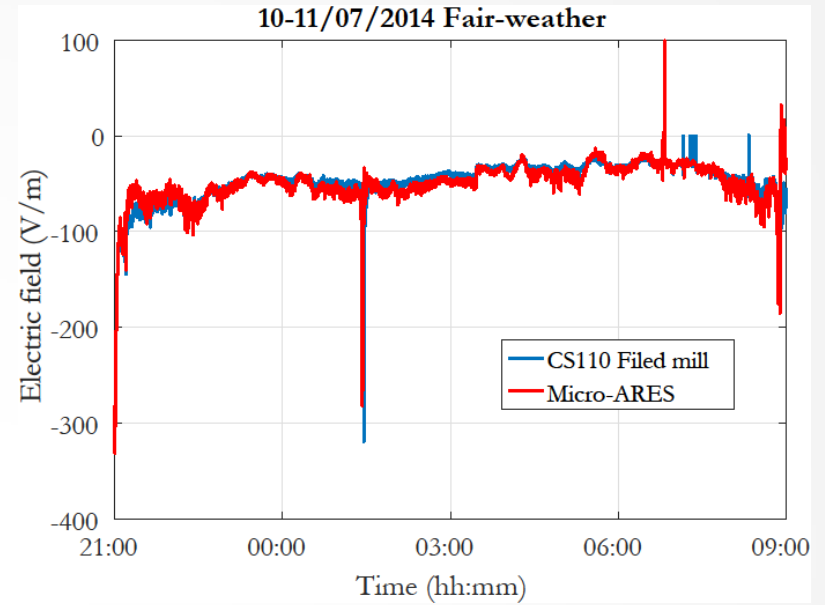
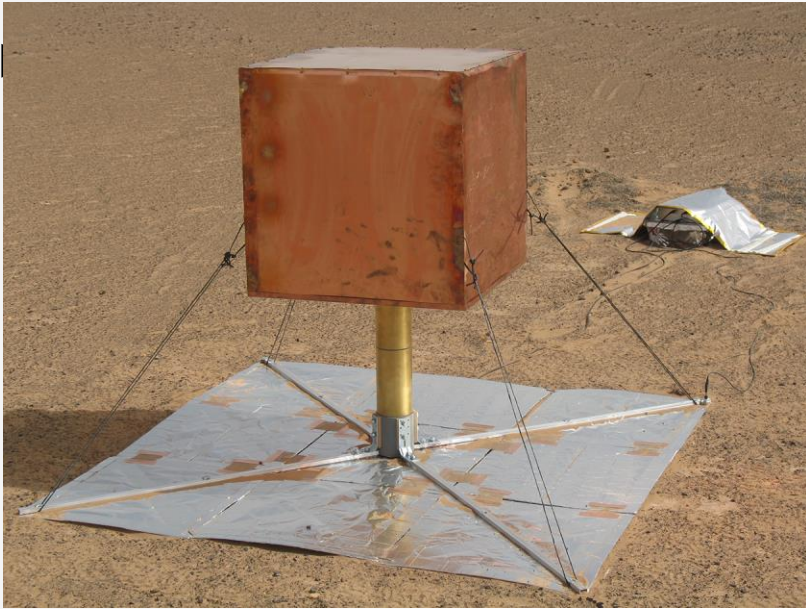


Micro-ARES: potential and relaxation

- ▶ Atmospheric Relaxation and Electric-field Sensor
- ▶ In the DREAMS package
- ▶ 300g and 300mW
- ▶ Electric field and conductivity interleaved
- ▶ Trickier to process
- ▶ On Schiaparelli > perturbations
- ▶ Modelling work

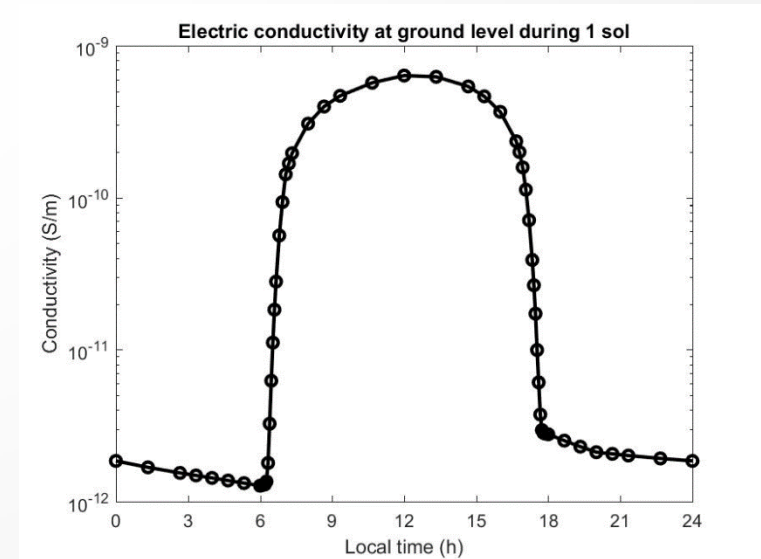
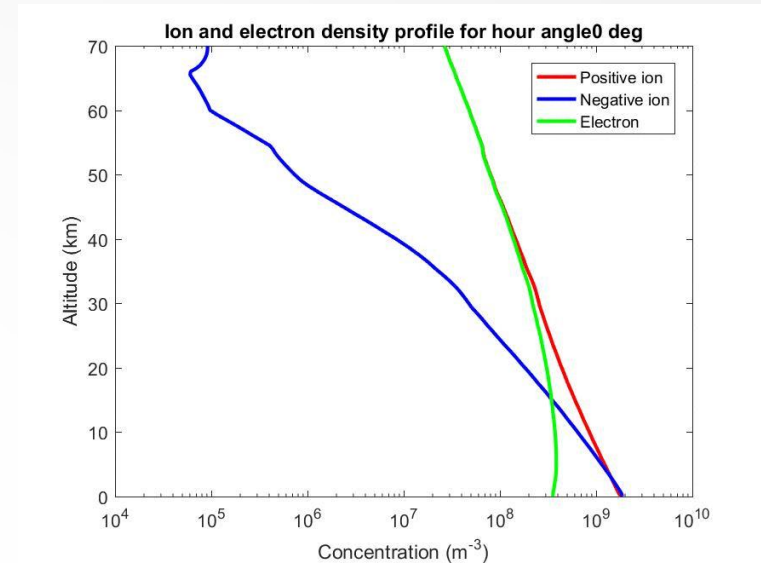


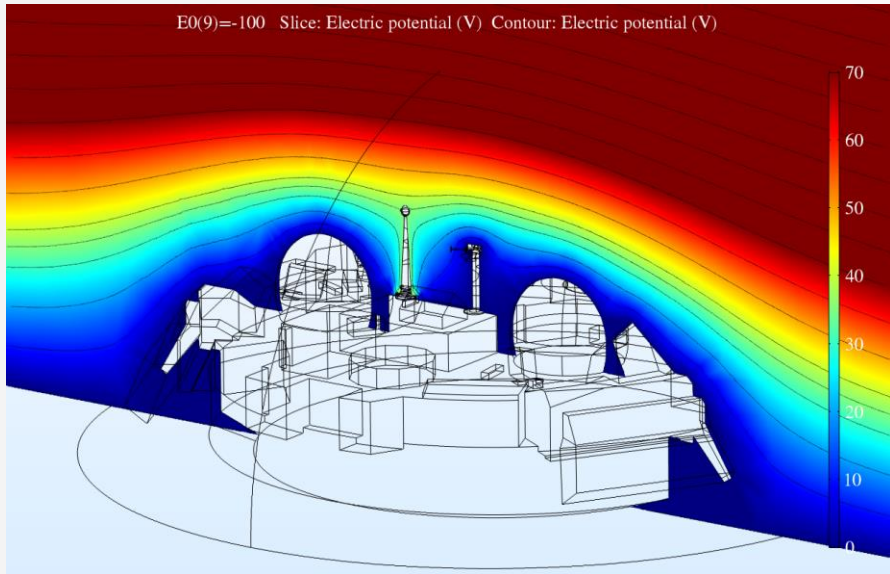
Micro-ARES: Field tests



The atmospheric conductivity

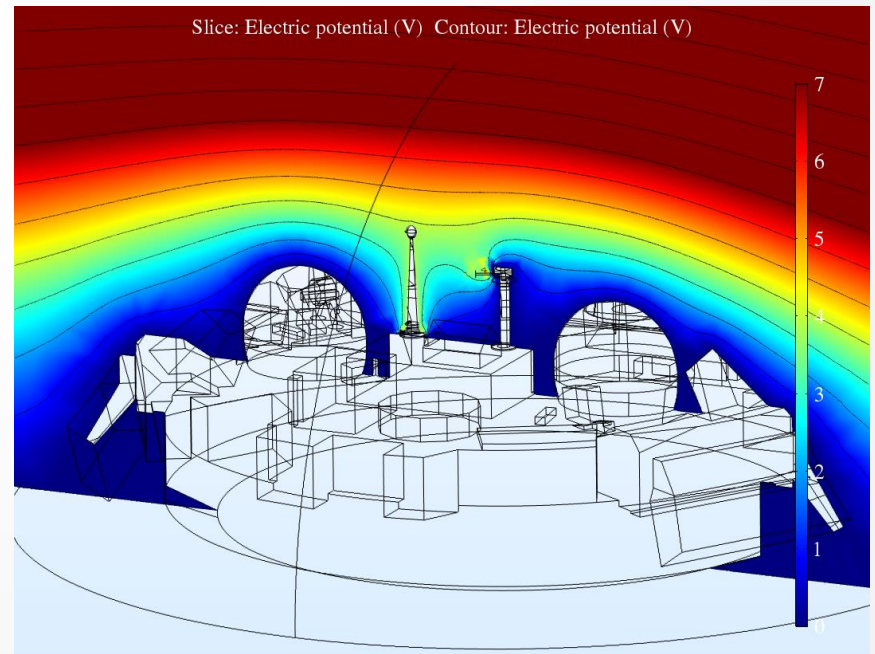
- ▶ Electro/photo chemistry
- ▶ Charge carriers content
 - ▶ Positive ions
 - ▶ Negative ions
 - ▶ Electrons
 - ▶ Charged aerosols





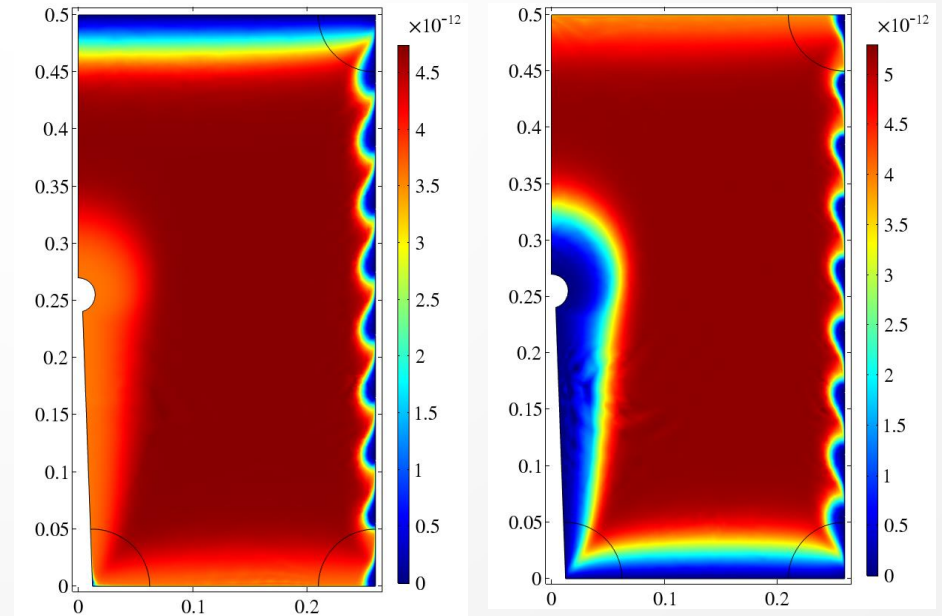
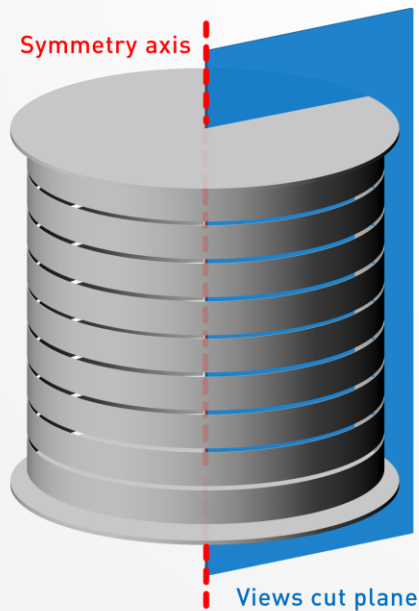
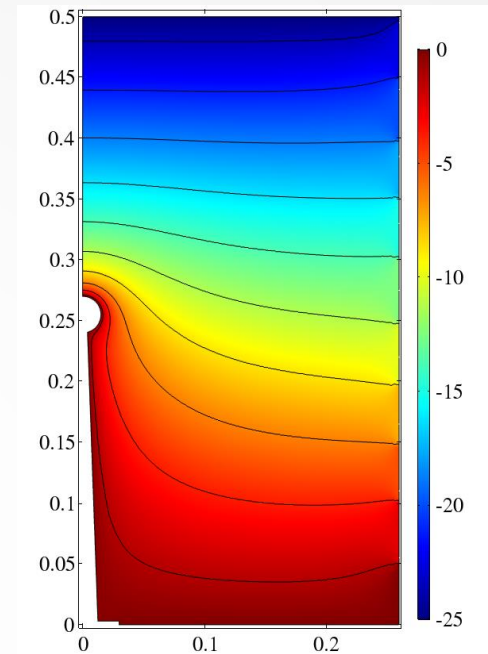
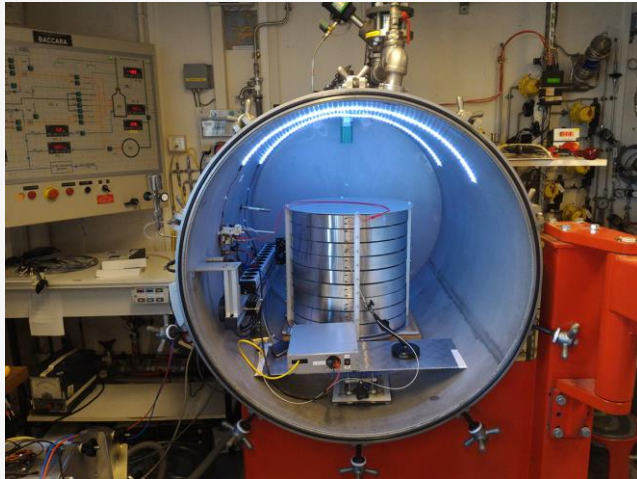
► Electrostatic modelling

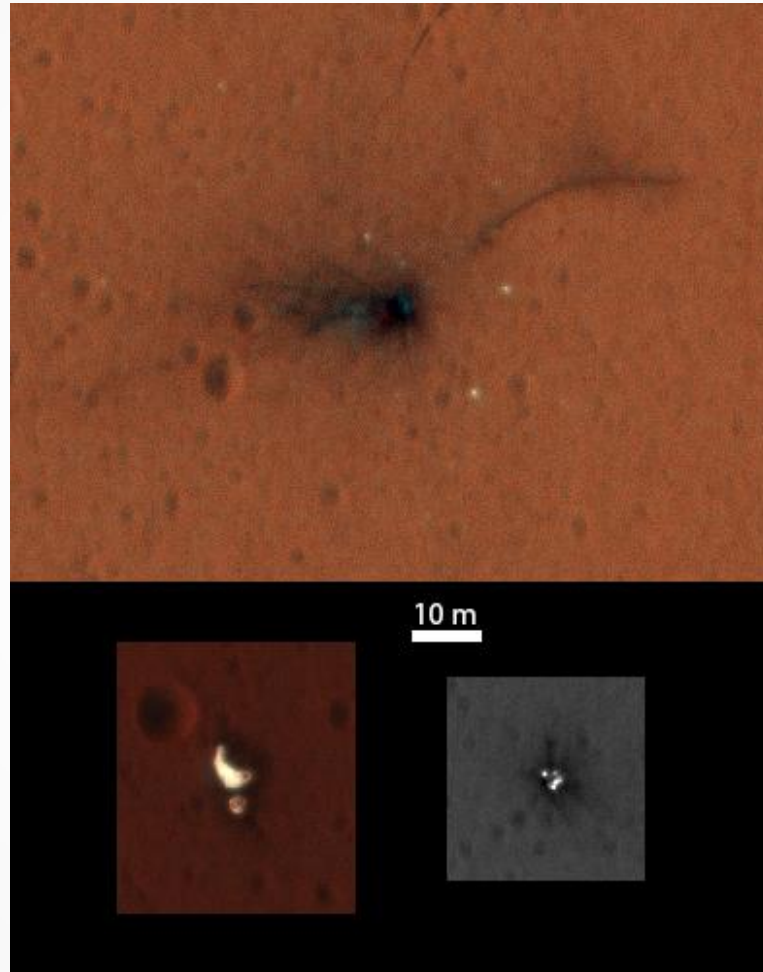
► But the medium charge carriers are left unperturbed



Micro-ARES: Plasma approach

- Model and experiment in Radon chamber

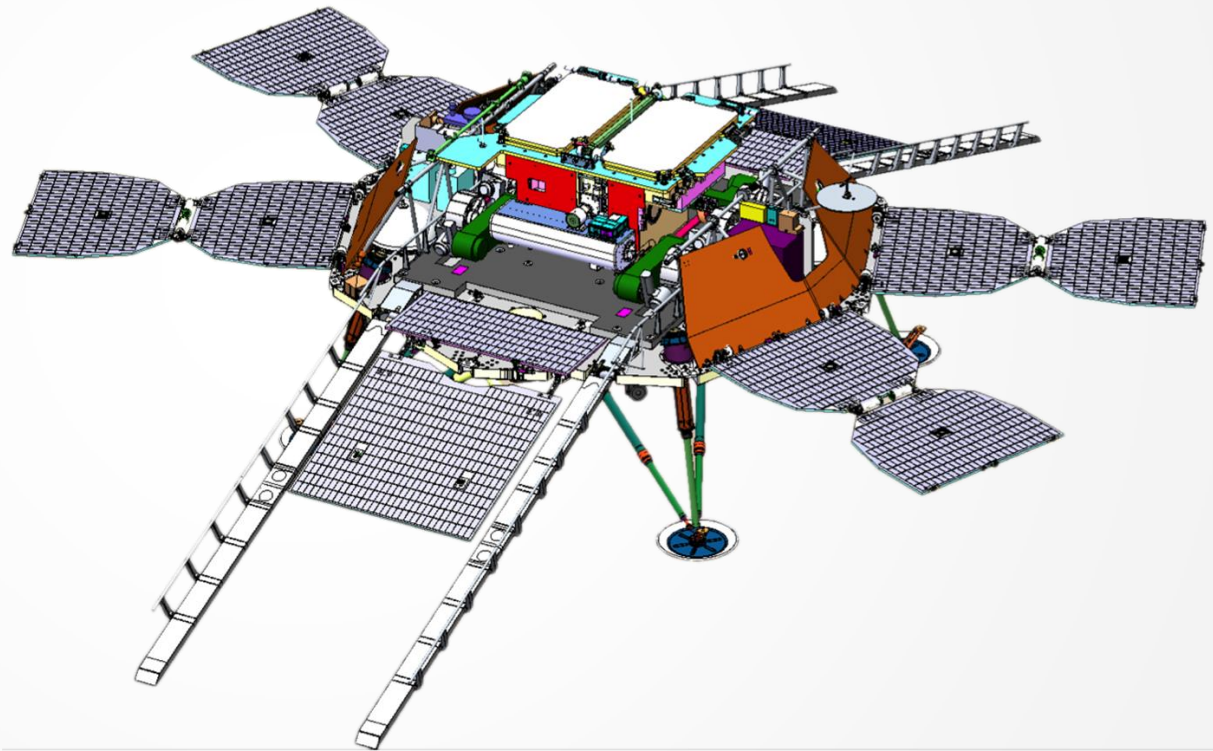




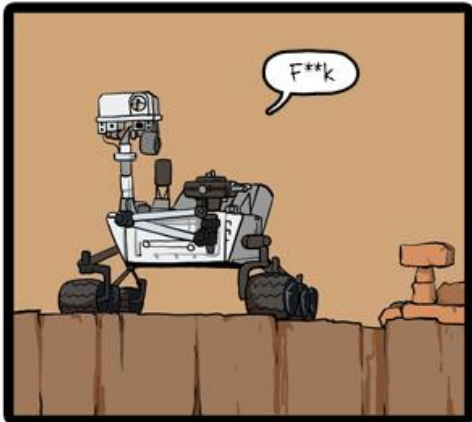
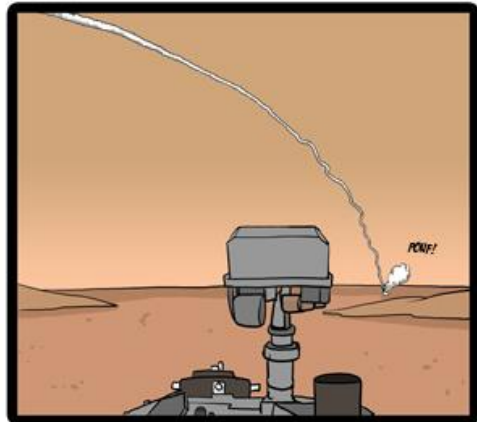
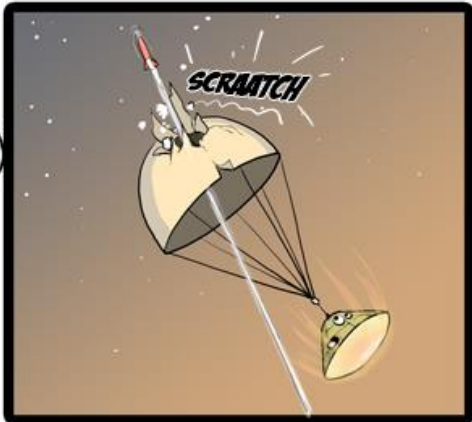
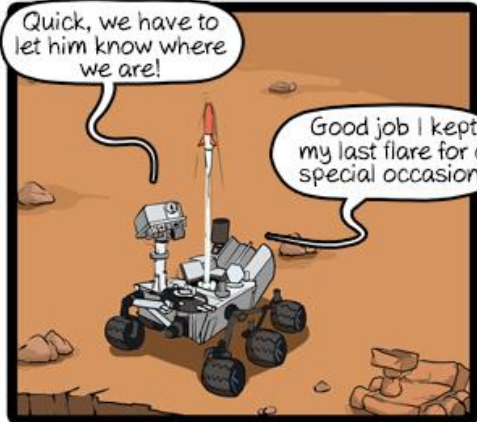
And after ?

- ▶ Instrument is developed and high TRL
- ▶ Dust package and Electric-field sensor on the ExoMars **2020** lander

- ▶ Less constraints
- ▶ Long survey



- ▶ **Electric fields will be unveiled**



Thank you
for your attention
Any questions ?