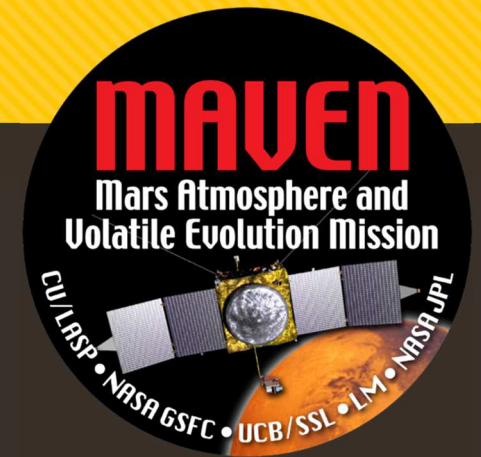


# Influence of EUV flux variations on the precipitating ion flux from MAVEN observations.

Presentation by Martinez Antoine - 3<sup>rd</sup> year Ph.D

Supervisor: François Leblanc and Ronan Modolo



# Summary

- Context and presentation of the subject
- Influence of EUV flux variations on the precipitating ion flux.

# Once upon a time...



Crédits: NASA/GSFC

- A dense atmosphere on Mars.
- This atmosphere has almost disappeared (and continues to disappear) due to the absence of a global magnetic field (magnetic shield) on Mars.
- So, Martian atmosphere is directly influenced by the solar wind (contrary to the Earth).
- The solar wind pushes the atmosphere away into space.
- Now, Mars has only a tiny atmosphere. (The end ?)



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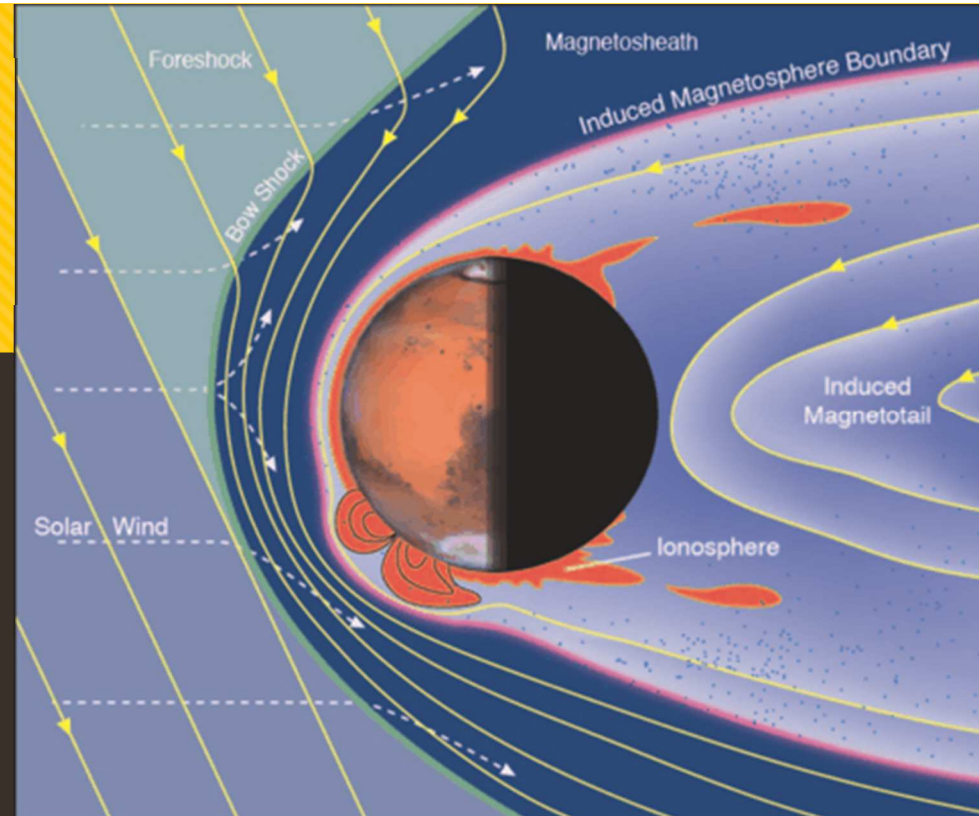
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# Context and presentation

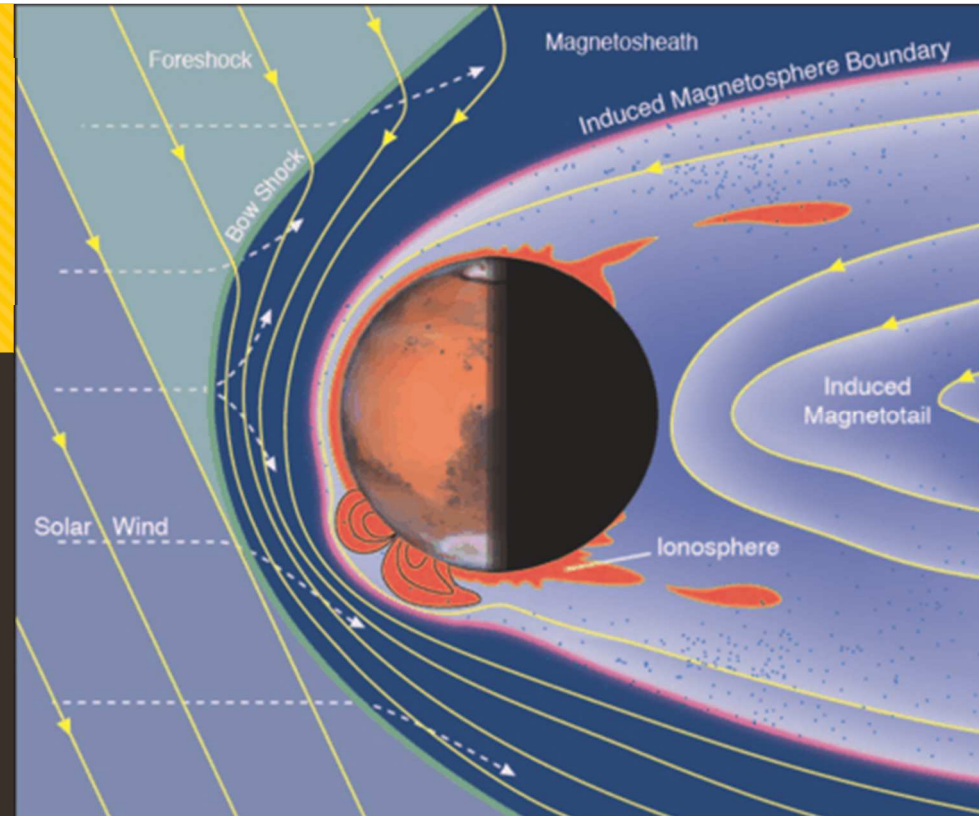
- **Mission Maven (MAVEN spacecraft)**
  - Since November 2014 around Mars
  - Study the interaction of the Martian atmosphere with the solar wind
  - Characterize the Martian atmospheric escape



Crédits: NASA/GSFC

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  - Neutral exhaust (Atmospheric sputtering)
  - Ion exhaust (pick-up ion, etc)

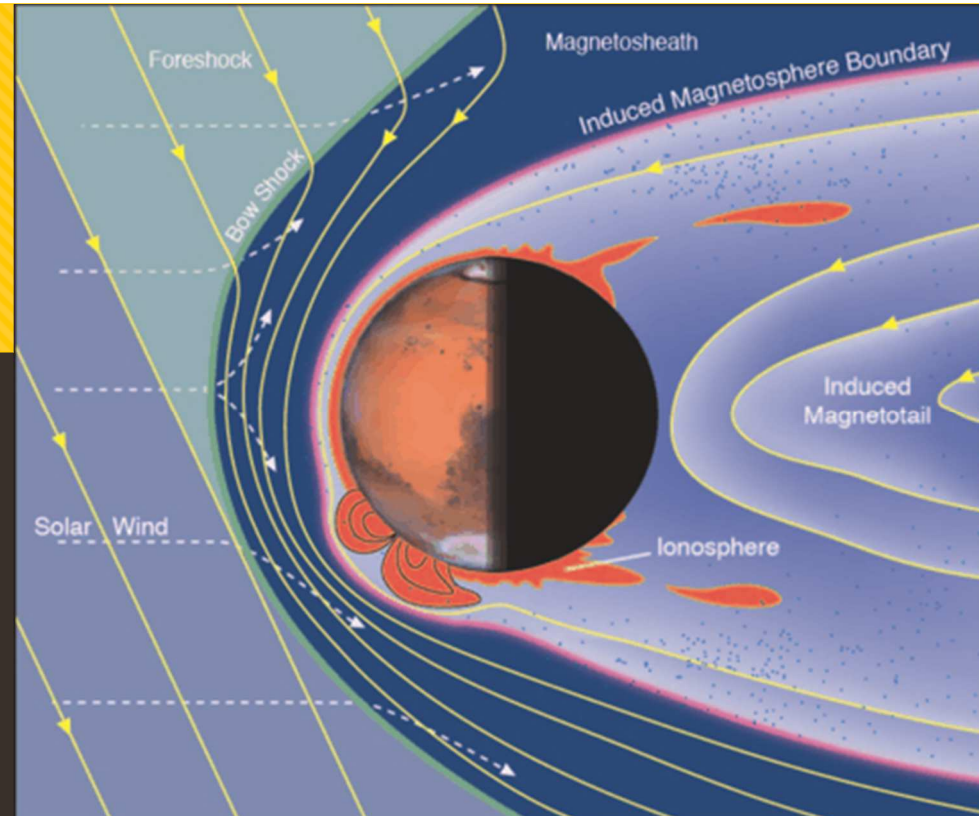


Crédits: NASA/GSFC



# Context and presentation

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Crédits: NASA/GSFC

**Criblage atmosphérique ou  
atmospheric sputtering**



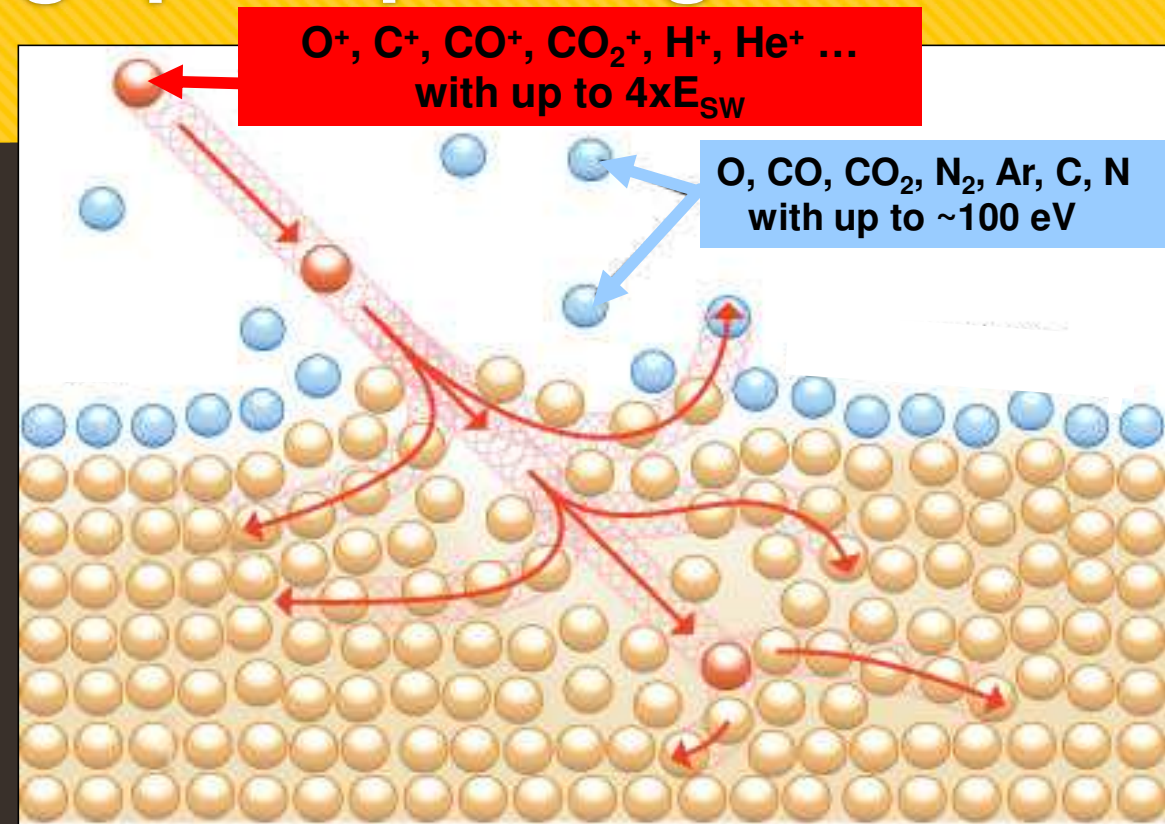
# Atmospheric sputtering- precipitating ion flux

Electric field:

$$\mathbf{E} = -\mathbf{V} \times \mathbf{B}$$

## ○ Atmospheric sputtering

- By ionization of heavy planetary atoms, accelerated by the convection electric field (E) of the solar wind and precipitating into the Martian atmosphere.
- They transfer enough energy to the atoms to escape from Mars.



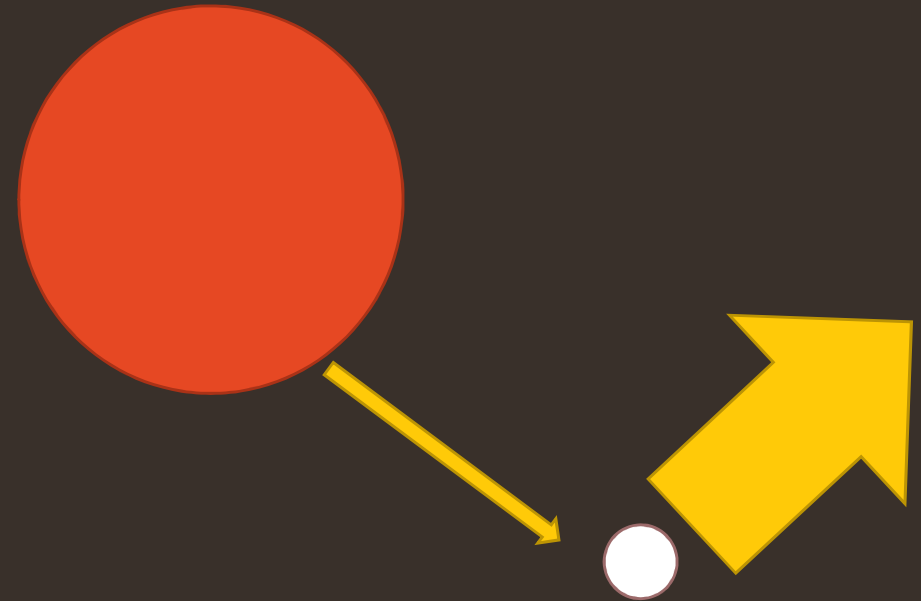
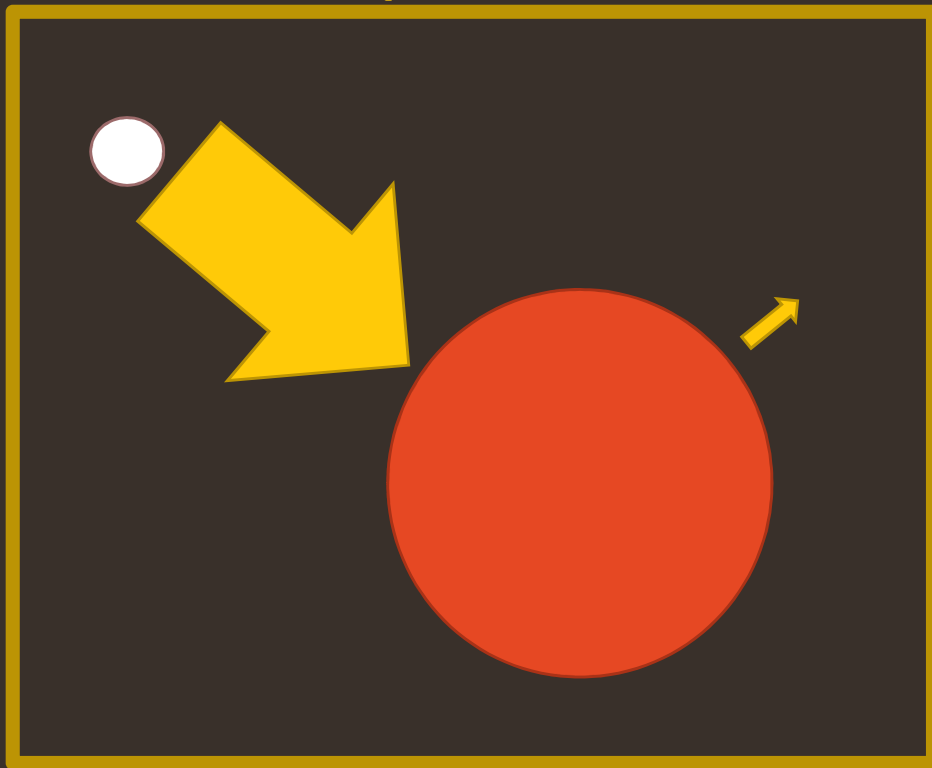
Crédits: NASA/GSFC

# Petanque (as a form of bowling)

- The perfect sport to explain and understand the atmospheric sputtering.
- A function of angle, energy, mass, number, skills launcher (Solar wind parameters)...

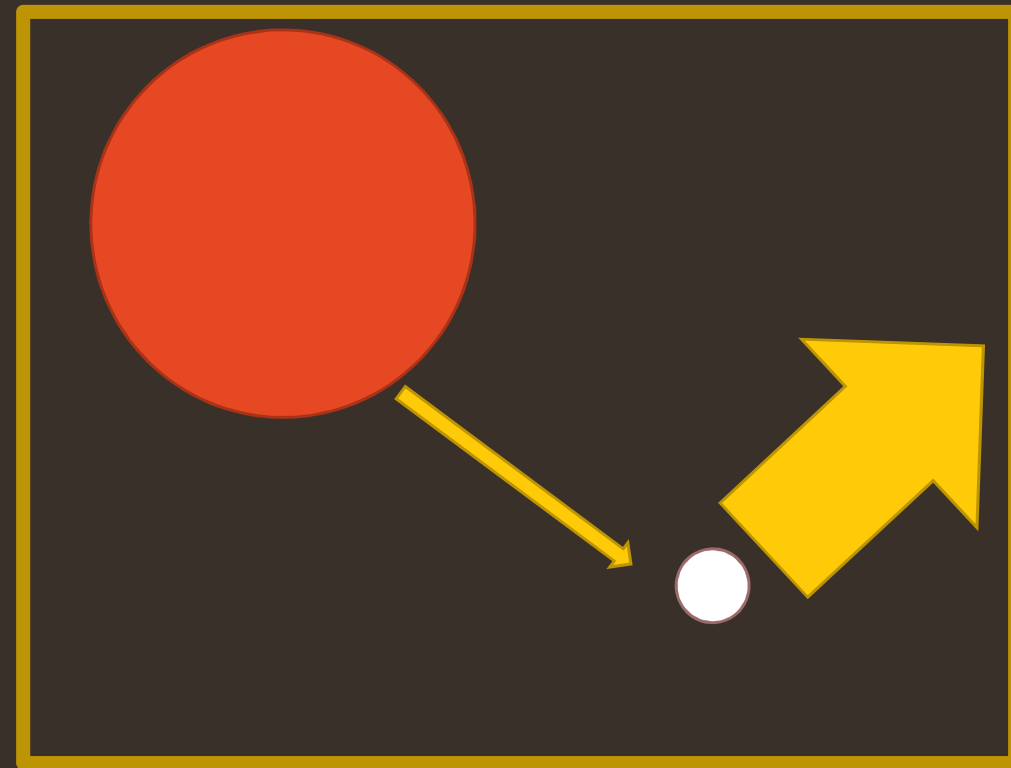


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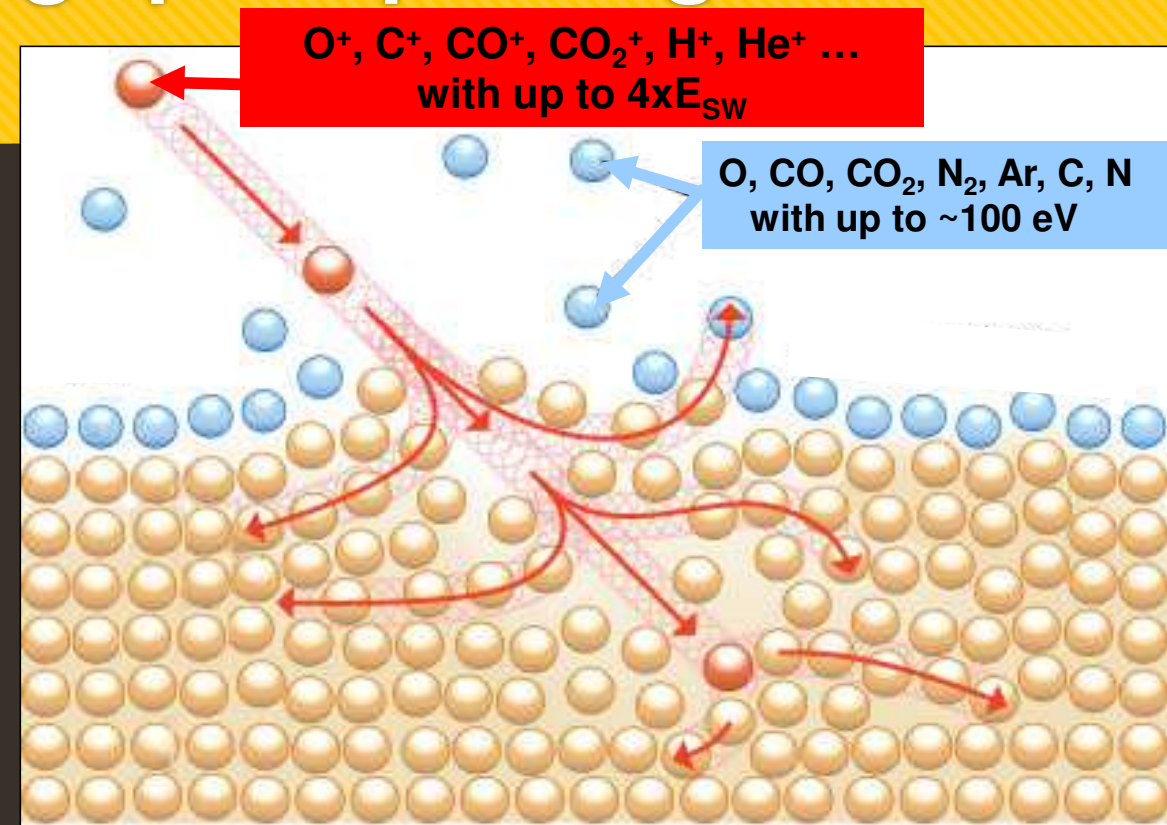
In Petanque we trust



# Atmospheric sputtering- precipitating ion flux

## ○ Study of the precipitating ion flux

- From MAVEN's instruments (SWIA, MAG, EUVM, SEP)
- Reconstruction of the flux of particles impacting the Martian atmosphere between 200 and 350 km.



Crédits: NASA/GSFC

Our ion energy range: [30 eV – 25 keV]

# Influence of EUV flux variations on the precipitating ion flux.

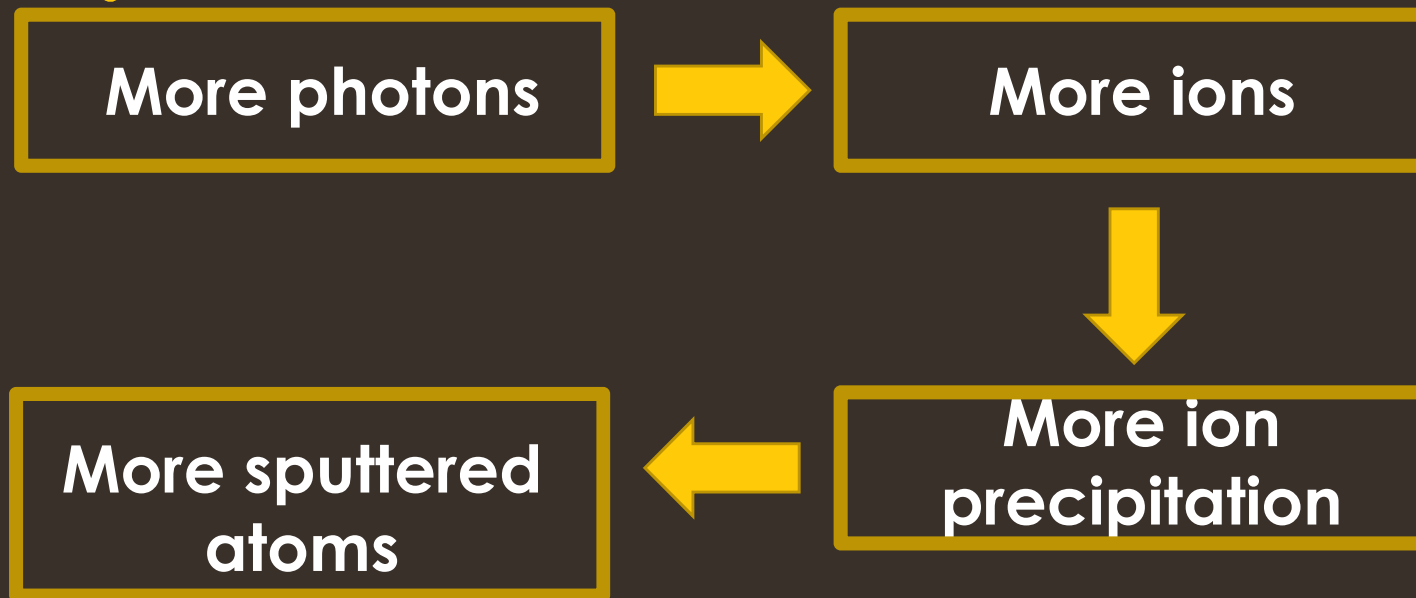
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- Constraining the precipitating ion flux helps to constrain the effect of atmospheric sputtering.

# Influence of EUV flux variations on the precipitating ion flux.

- Direct effect of sputtering that is difficult to measure directly.
- Constraining the precipitating ion flux helps to constrain the effect of atmospheric sputtering.
- My study: Influence of solar wind and planetary parameters on the precipitating ion flux.
- 1st article: Influence of the solar events of September 2017 on the precipitating ion flux. (Martinez et al., 2019)



# Influence of EUV flux variations on the precipitating ion flux.



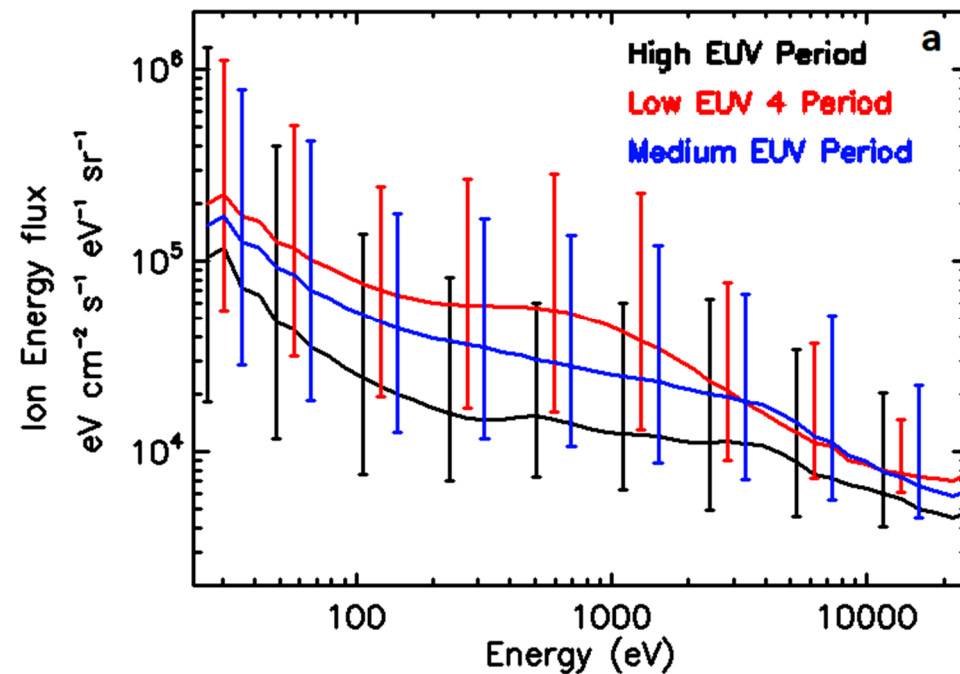
“The theory is a beautiful country because in theory everything is fine.”  
But there are many feedback processes that make it more complicated.  
We check this relation.

# Influence of EUV flux variations on the precipitating ion flux.

- Study of the EUV flux: Constraint all the planetary parameters and the solar wind parameters in order to vary only the EUV flux (our free parameter)

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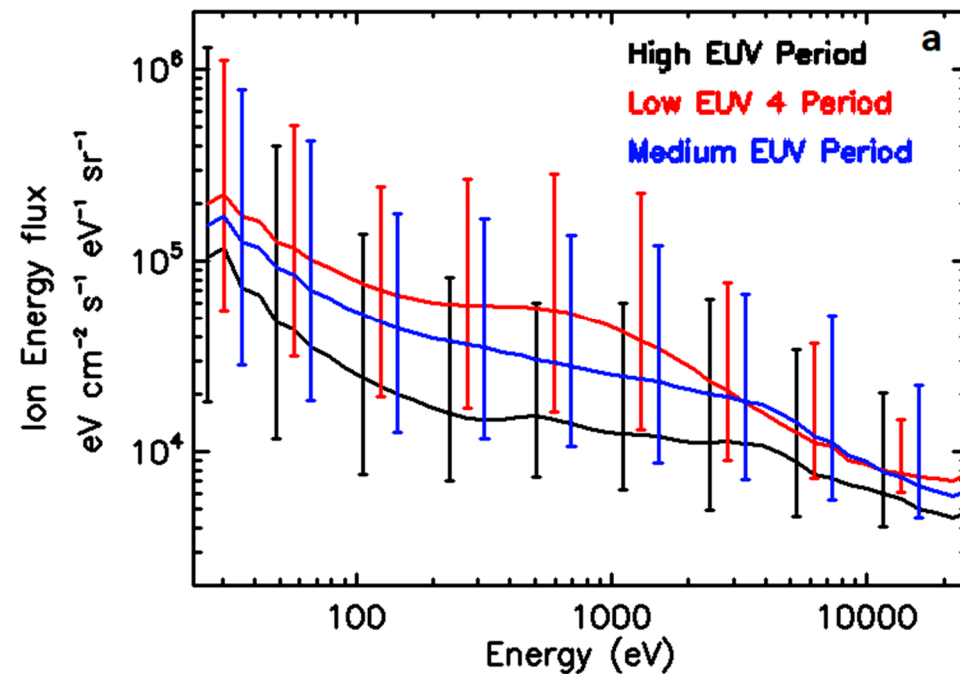
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Less photons



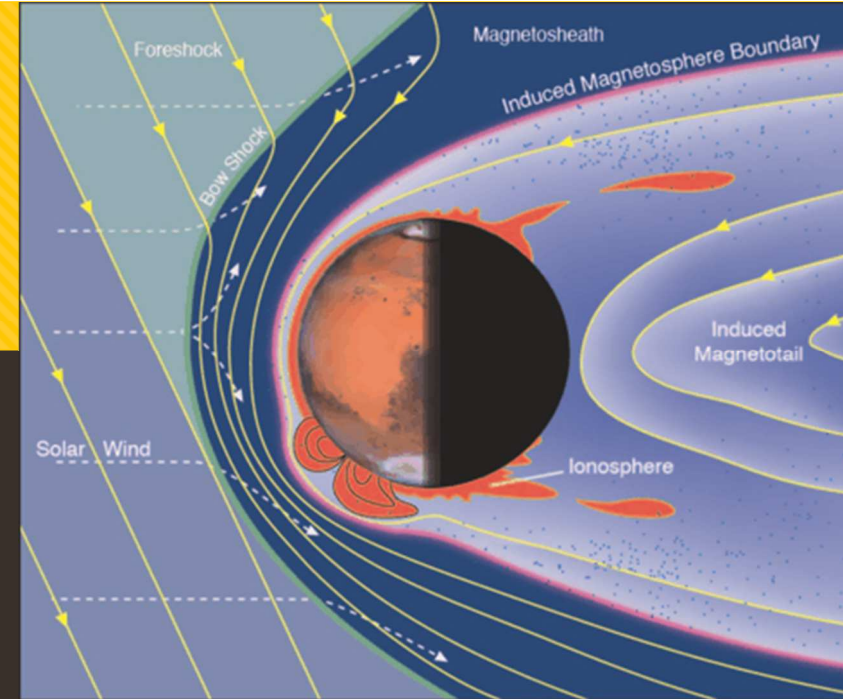
More ion precipitation

- Counter-intuitive evolution



# Possibilities:

- Most of the ionized atoms end up with an energy of less than 30 eV (outside our study interval)
- The solar wind is less deflected by the Mars atmosphere, increasing the energy of precipitating ions but decreasing their number at very low energy.
- What is next:
  - Study according to the mass of the ion
  - Deepening the link between EUV flux and precipitating ion (Why ? How ? Processes ?)



Crédits: NASA/GSFC



# Thank you very much

Crédits: NASA/GSFC

