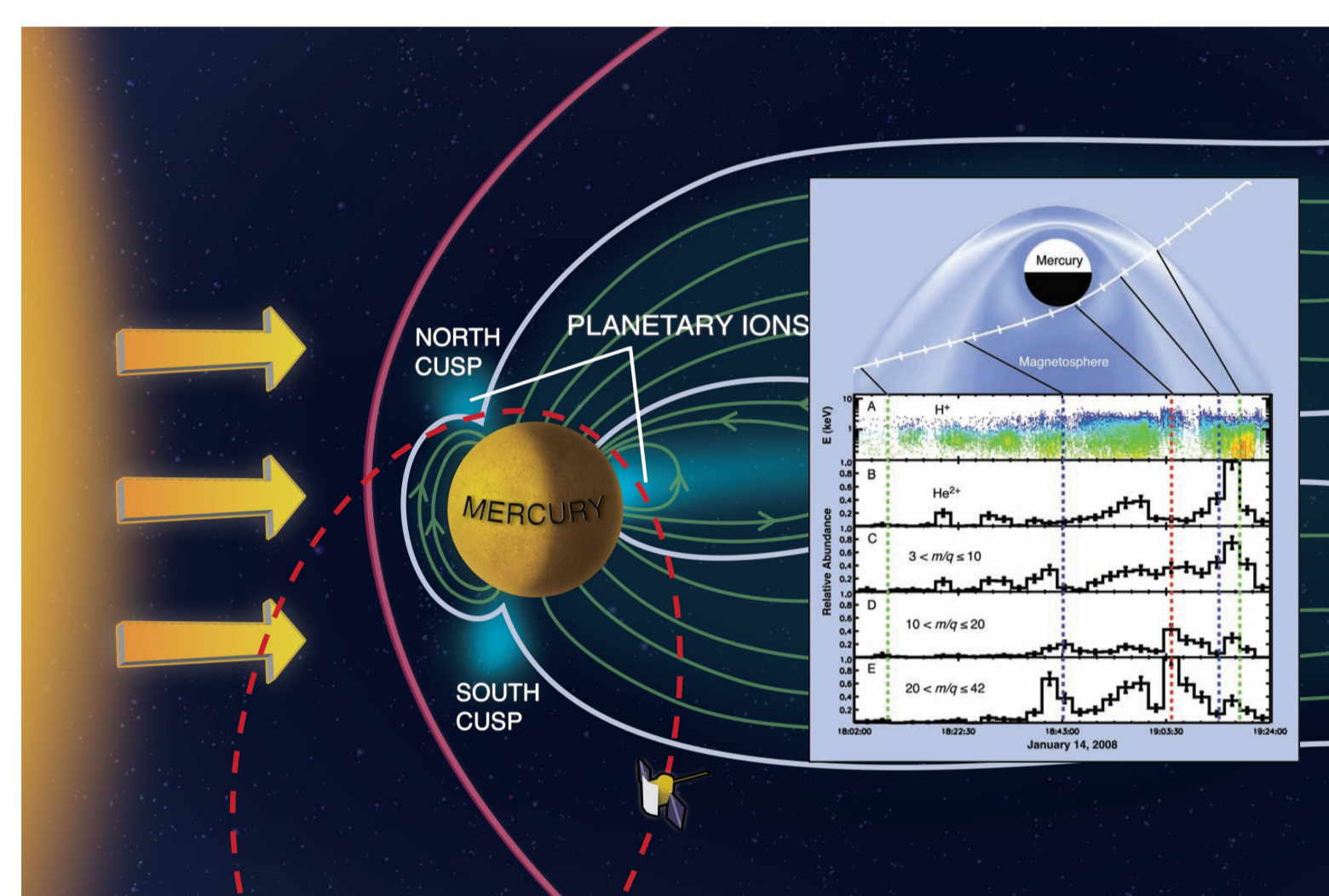




# Space Weather at other Planets

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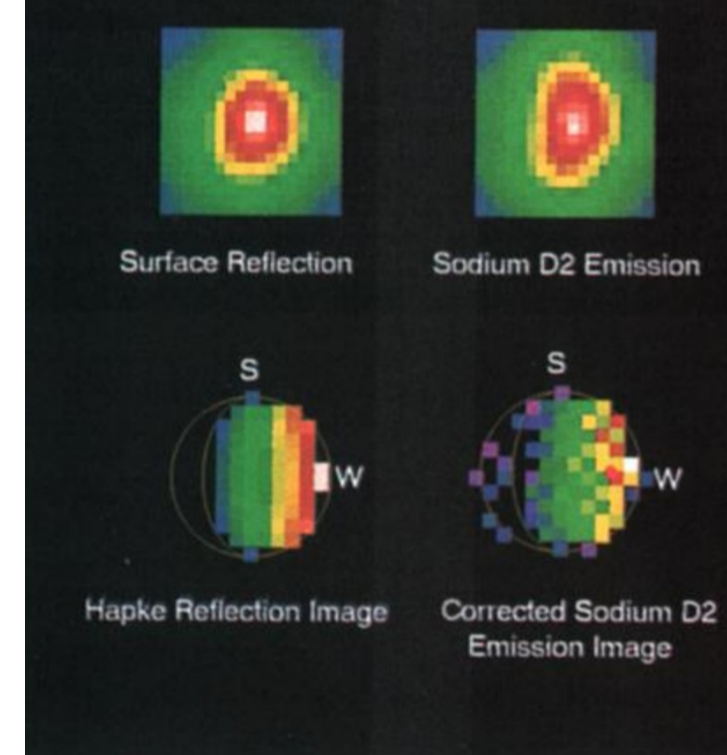
Space weather affects not only the Earth, but also other planets. With assets on Mars and circling other planets, we need to understand and be able to predict space weather at other locations than only Earth.



## Mercury: Magnetic, but airless

Space weathering at Mercury results in poleward transport of volatiles and an extended exosphere. Both can be observed remotely. Arecibo detected water deposits at the poles, Killen et al. the Na-exosphere.

(credit: Messenger)



(credit: Killen et al.)

Space weather needs to be accounted for when interpreting surface composition data. This is true for all airless bodies in the solar system. Space weathering also leads to reddening of surfaces (Hapke effect) which affects surface composition measurements and thus our understanding of the formation of the solar system.

Space Weathering will affect the interpretation of data from Rosetta and BepiColombo.

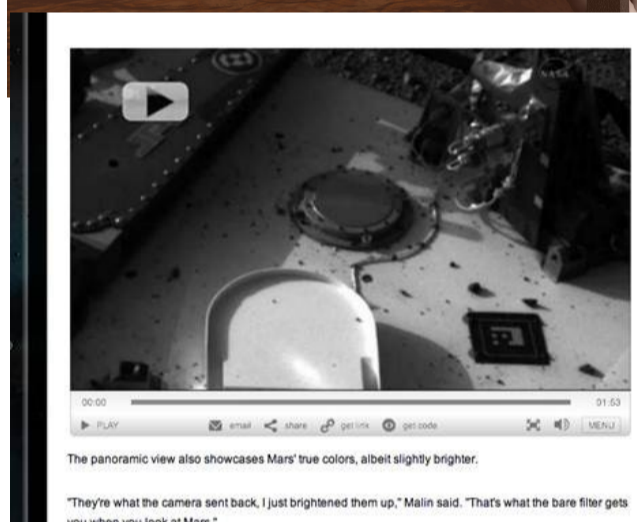


## Mars: Air, but not magnetic

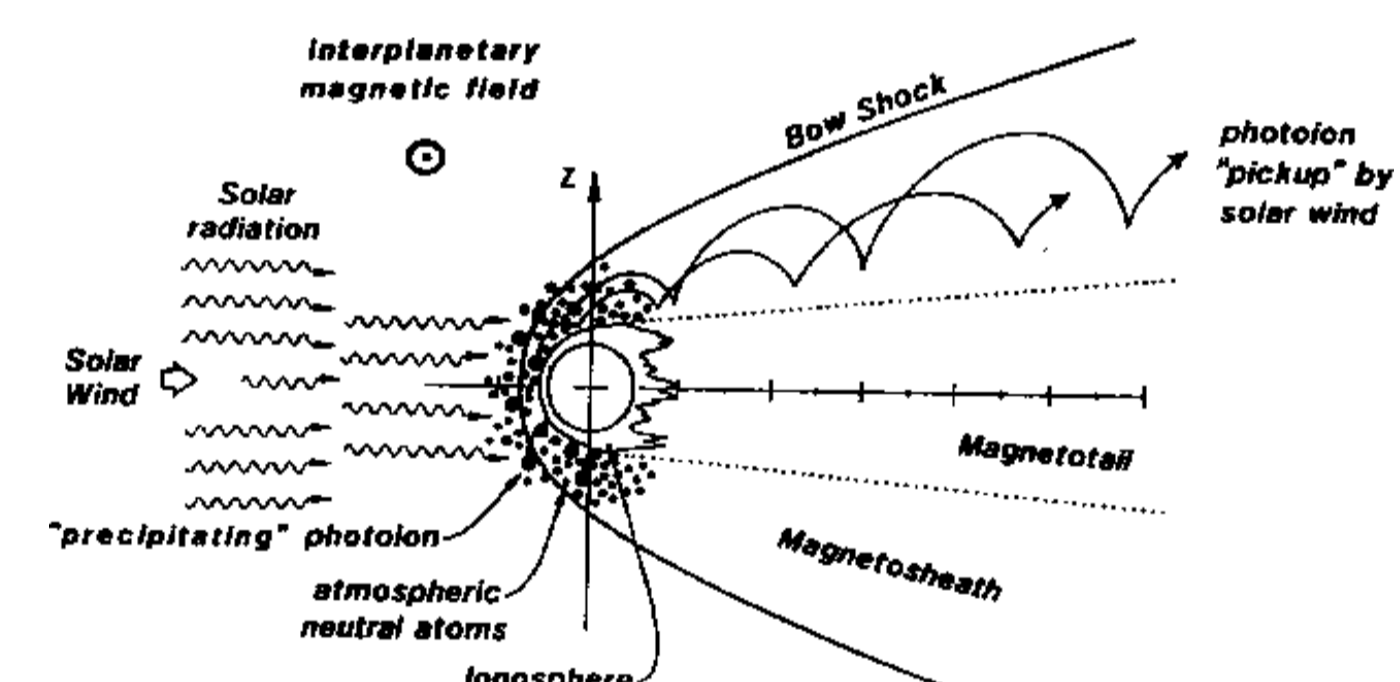
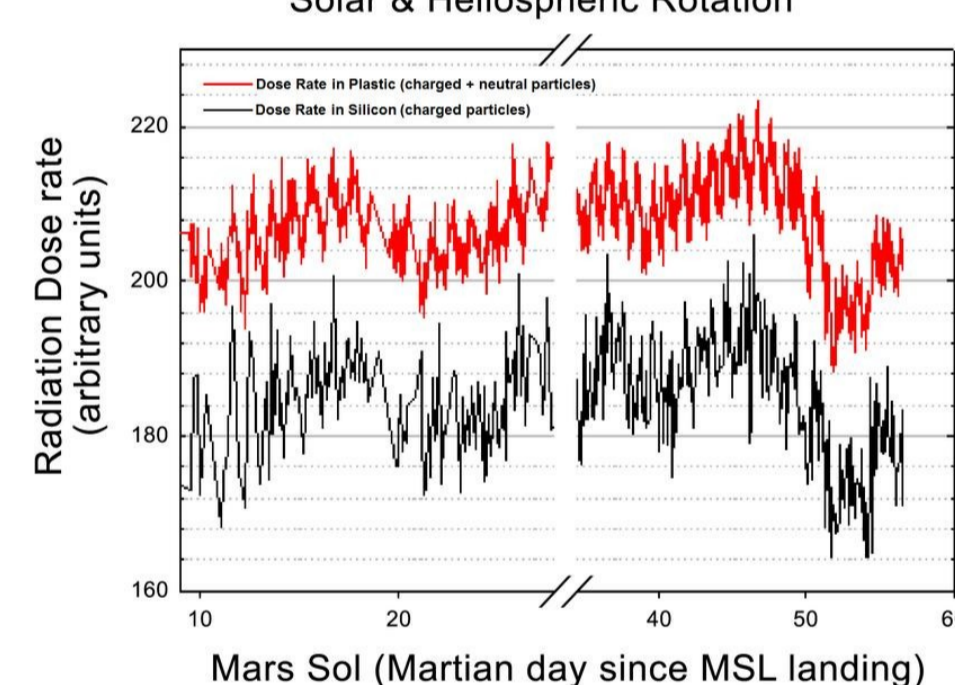
On Mars the interaction of galactic and solar cosmic rays with the atmosphere and soil lead to a 'Pfozter' maximum right at the surface of the planet. This is important for future manned missions, but also possible survival of life on Mars.

(credit: ESA)

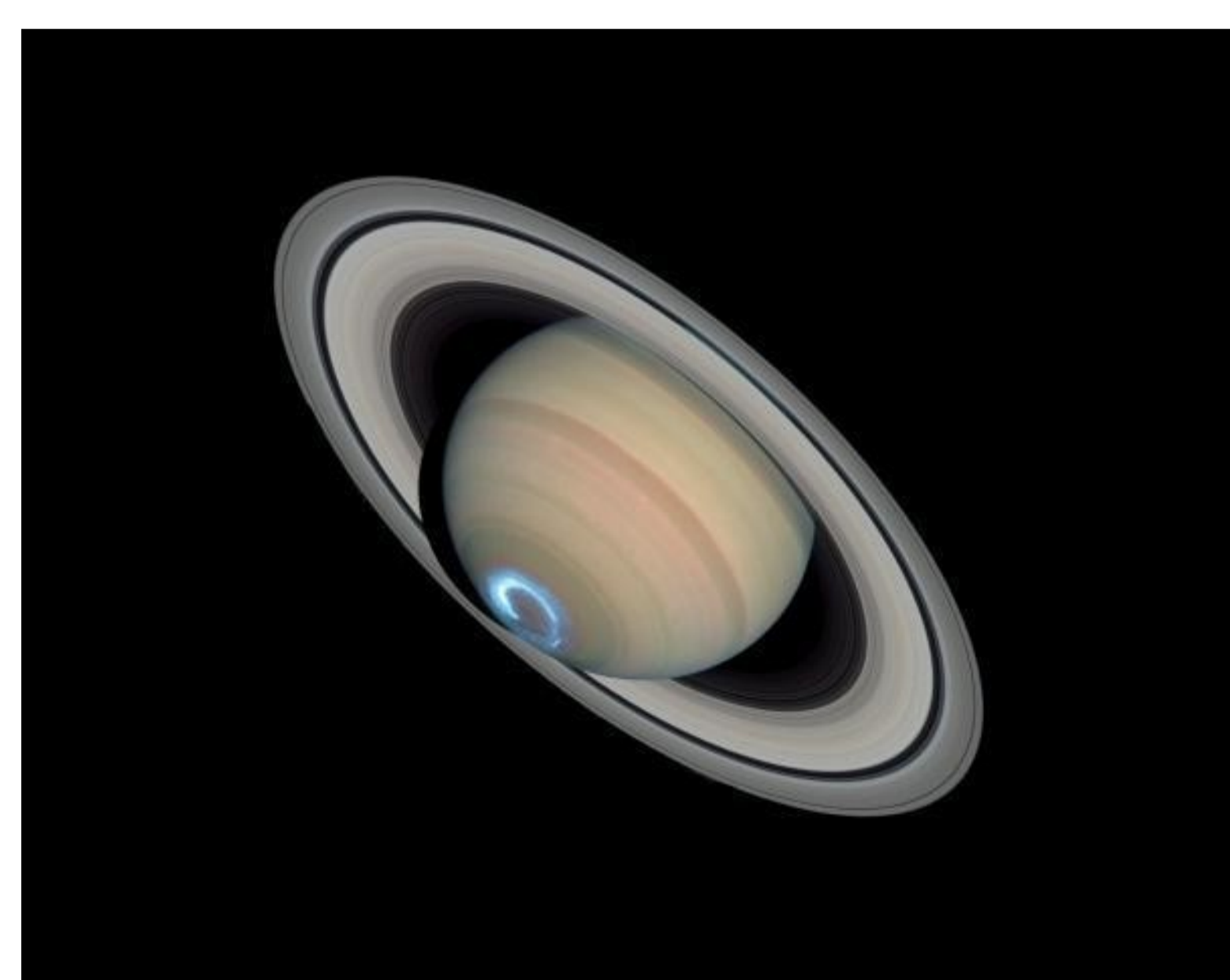
To the day 100 years after Victor Hess discovered the GCR, MSL/RAD measures them on the surface of an other planet (Mars). Space weather leads to gradual loss of atmosphere.



Longer Term Variations Due to Solar & Heliospheric Rotation



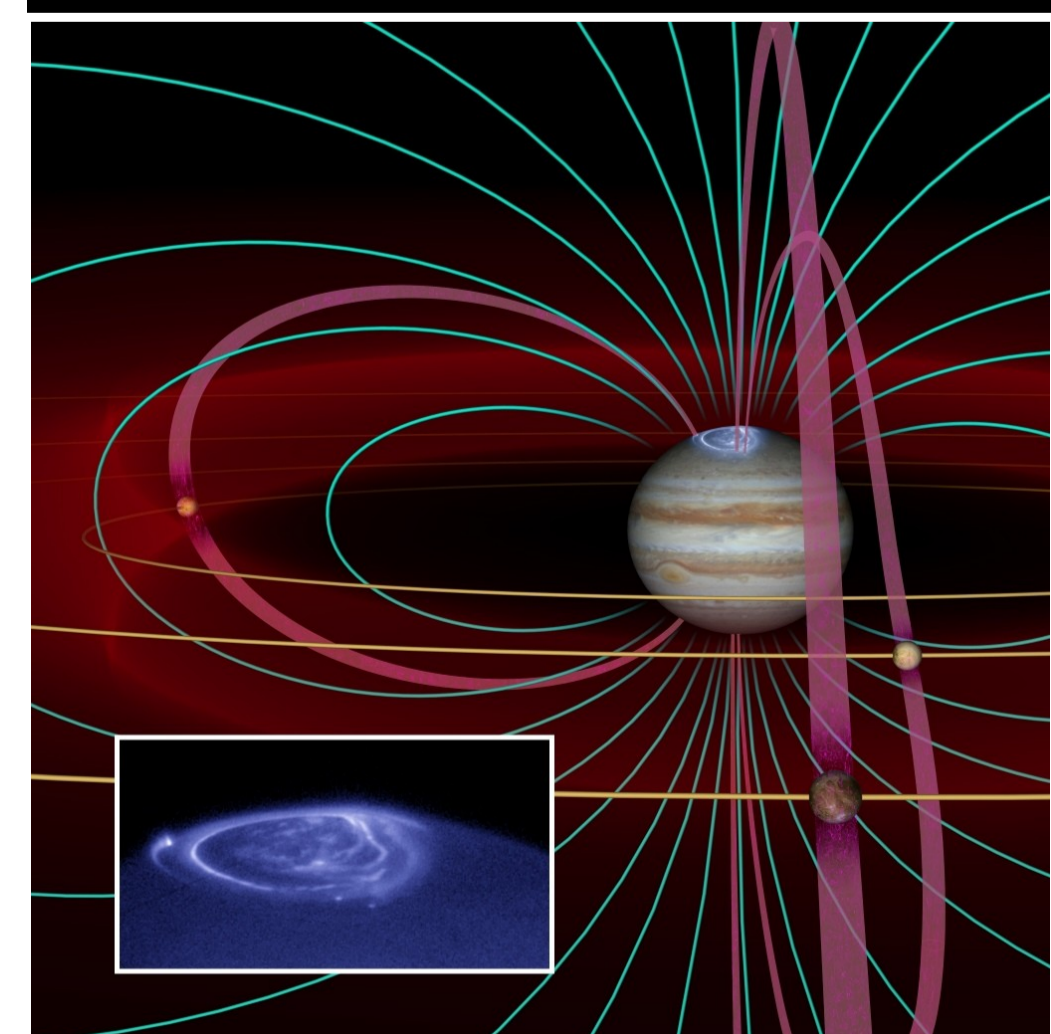
(credit: Luhmann et al.)



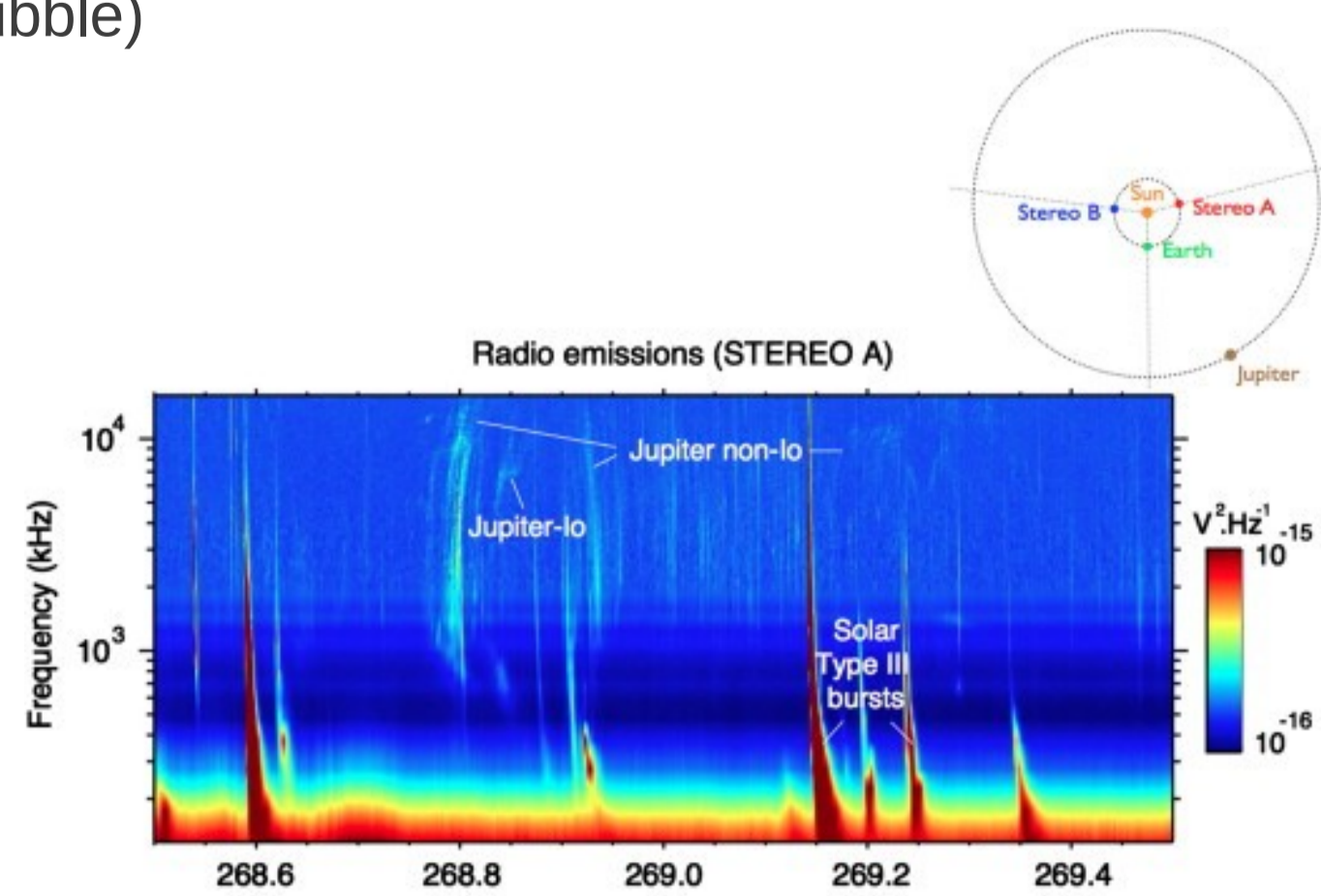
## Giant Planets -Giant magnetospheres

Space weather is also observed at the giant planets. Aurorae and radio emissions have been seen numerous. Space weather forcing has been observed to modulate Saturn's radio clock (Cecconi et al.).

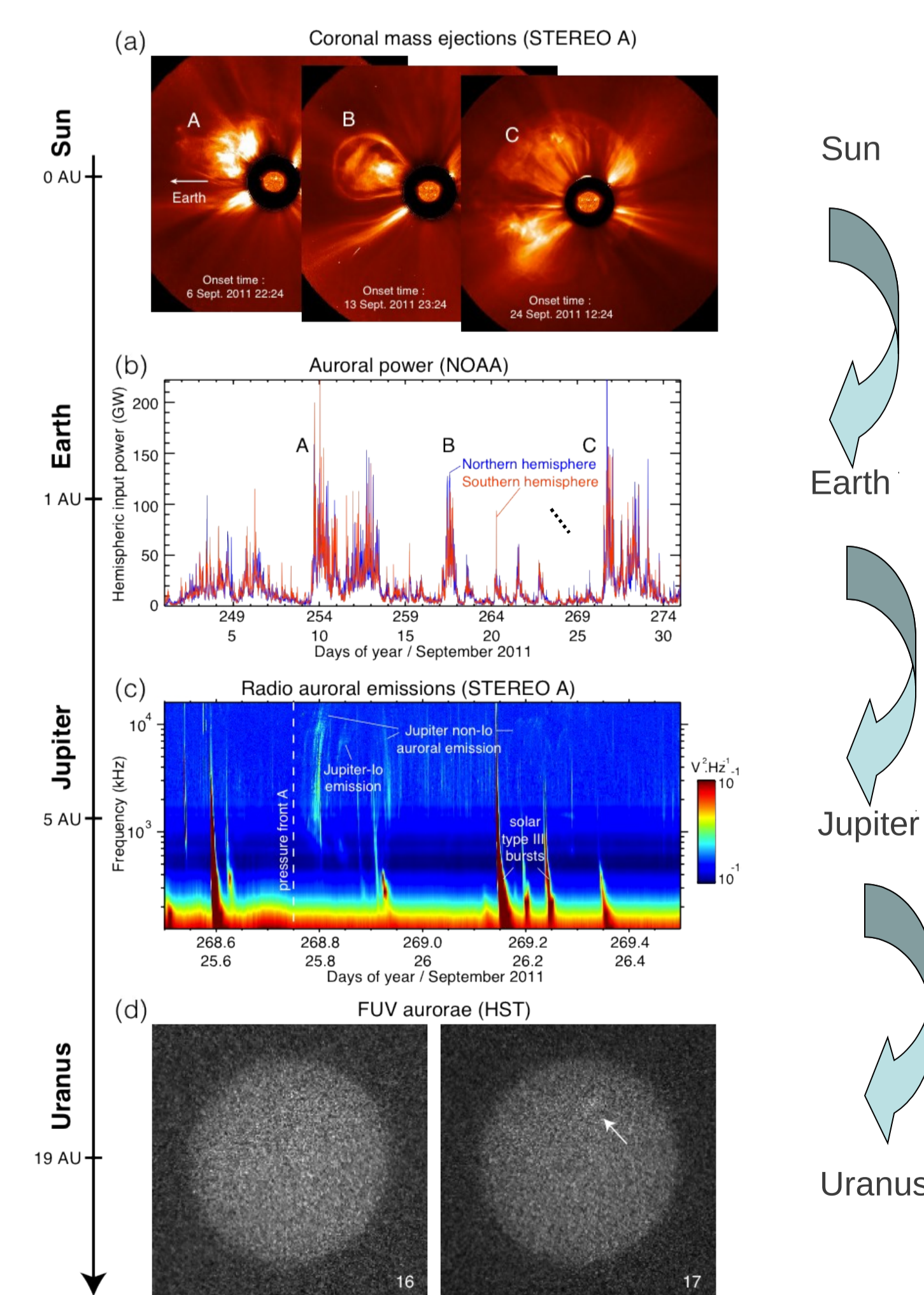
(credit: Hubble)



(credit: Khurana)



(credit: Zarka et al.)

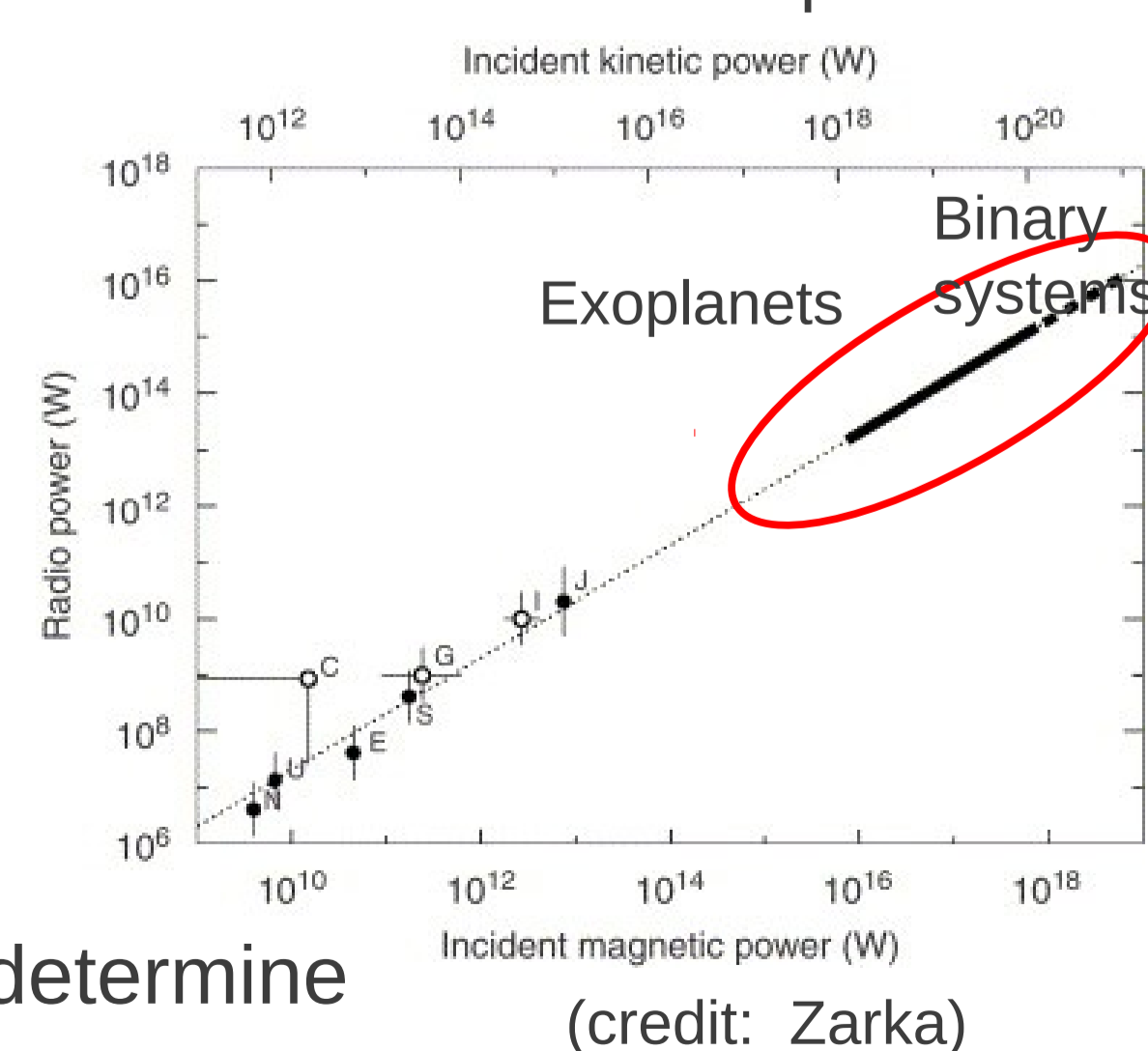


(credit: Lamy et al.)

This observation has also been used to determine Uranus' rotation period.

## From Giant Planets to Exoplanets!

Space weather has been tracked from Sun to Earth, and on to Jupiter and Uranus, see sequence at the left. In other words, space weather acts throughout the heliosphere. This is not surprising, space weather is a universal phenomenon and therefore should also be visible at exoplanets.



(credit: Zarka)

