

Meteors on other planets

Olivier Witasse

10/06/2016

ESA UNCLASSIFIED - For Official Use

- ❖ **Why studying meteors on other planet?**
- ❖ **Attempts and observations at Mars, Venus and Jupiter**
- ❖ **Possible investigations in future missions**

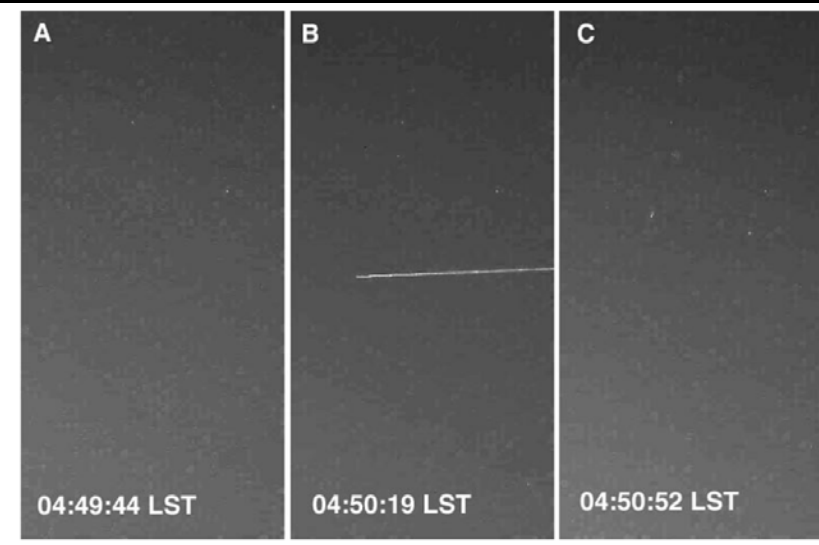
- ❖ **Tests knowledge / models / predictions to other conditions**
- ❖ **Dust fluxes and properties elsewhere in the solar system**
- ❖ **Information about planetary atmospheres**



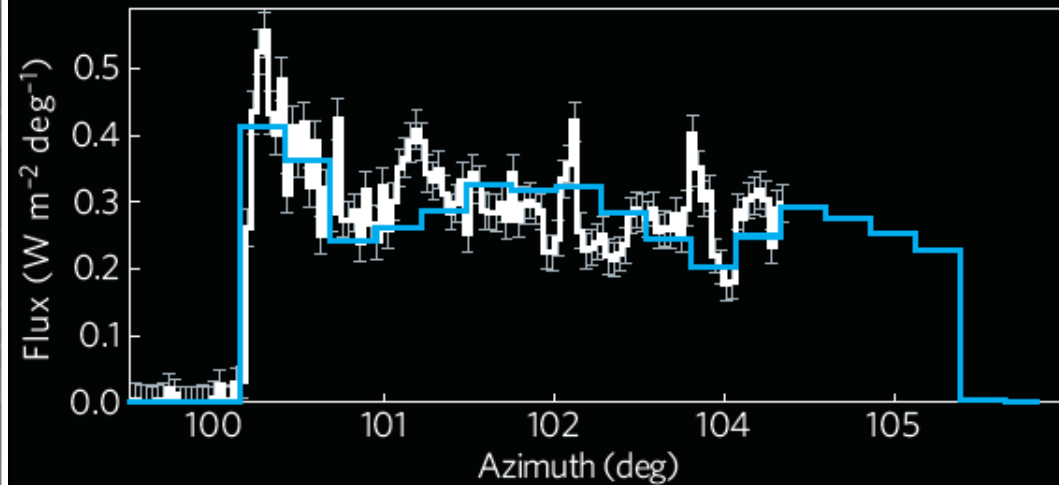
Mars

Attempts at Mars

Images and light curve from the Panoramic Camera, Spirit Rover



Bell et al., 2004



Selsis et al., 2005

→ Timing, orientation and shape consistent with a meteor shower associated with comet Wiseman-Skiff.

→ First martian meteor?

Domokos et al., 2007

- 350+ rover images analysed
- no conclusive meteor detections
- the 2005 claim is more likely a grazing cosmic ray impact

Encounter with the Siding Spring comet, October 2014.

Closest approach ~ 130,000 km

Relative velocity ~ 56 km/s

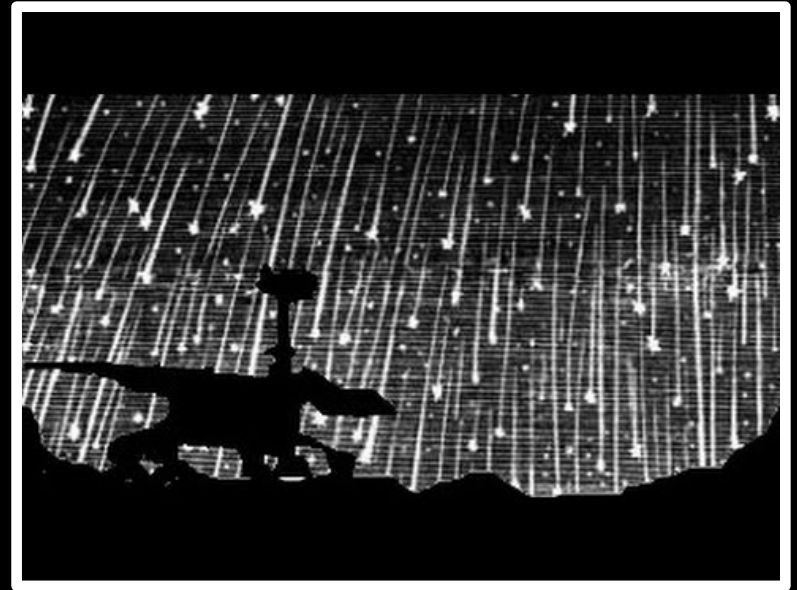
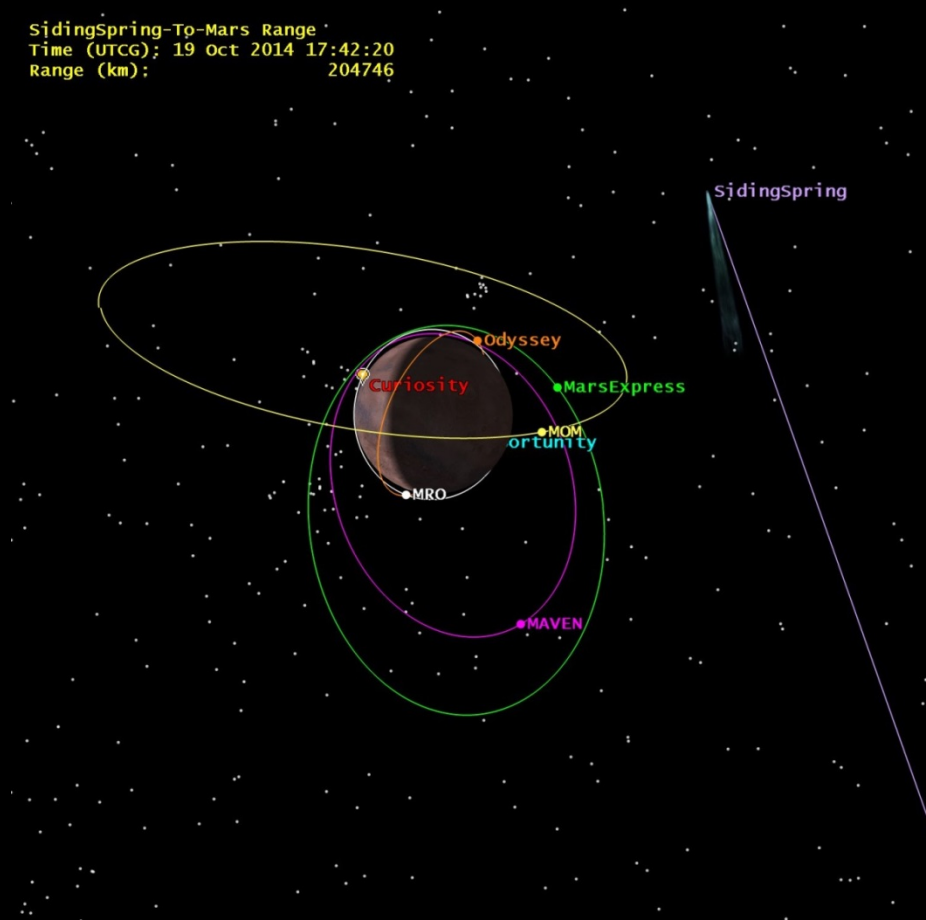
Moorhead et al. (2014), Vaubaillon et al. (2014a) → Cometary dust in the Mars' atmosphere

→ Prediction of a strong meteor shower (hurricane)

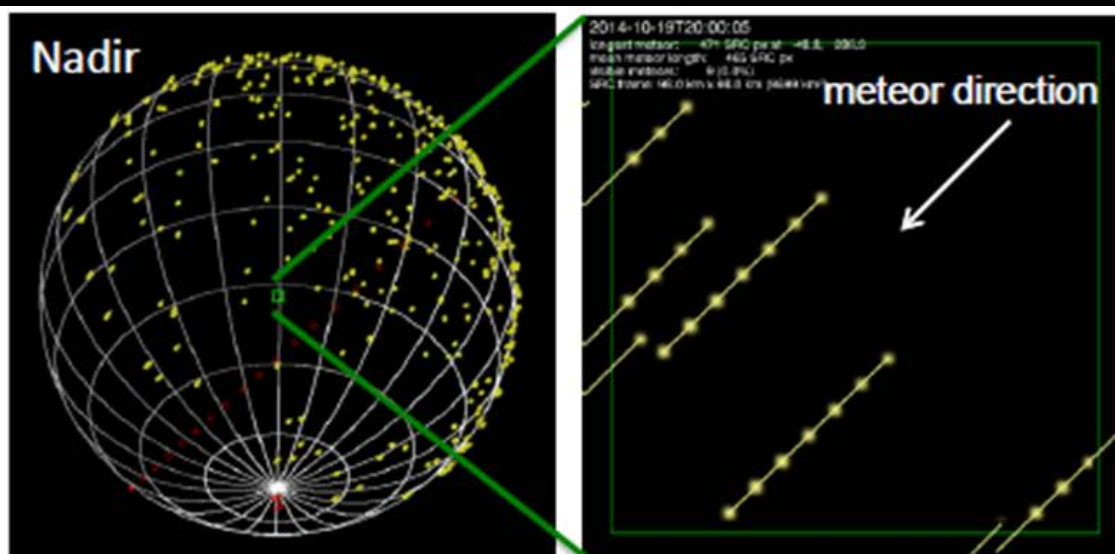
→ Concerns for spacecraft safety

Attempts at Mars

SidingSpring-To-Mars Range
Time (UTC): 19 Oct 2014 17:42:20
Range (km): 204746

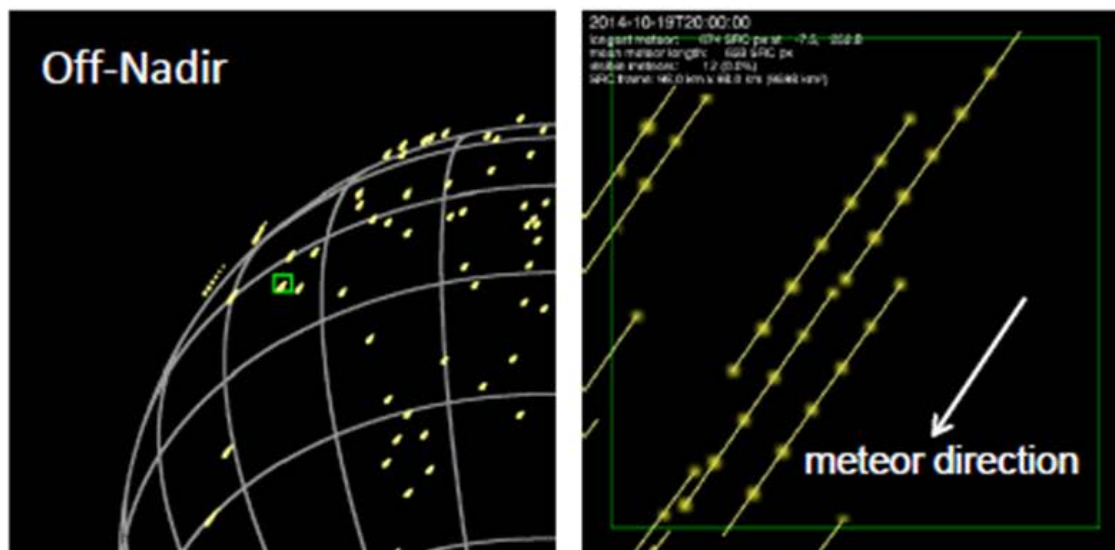


Attempts with Mars Express



Nadir

- Incidence angle: 48°
- Meteor length: 465 pixel (~ 60 km)
- Duration: 1.1 s



Off-nadir

- Incidence angle: 66°
- Meteor length: 658 pixel (~ 95 km)
- Duration: 1.7 s

SRC frame, example from distance: 10,500 km
Meteor speeds: ~ 56 km/s
Beginning height: 90 km
End height: 50 km

Duration of Meteor: ~ 1.5 s, i.e., meteor may be seen in 2-3 consecutive SRC frames

No meteor shower detected.

Farnocchia et al. (2014), Tricarico et al. (2014), Vaubaillon et al. (2014b)

**→ smaller nucleus, less dust
ejection**

→ no meteor shower are expected

→ Forecast made too early?

→ Context of spacecraft safety...

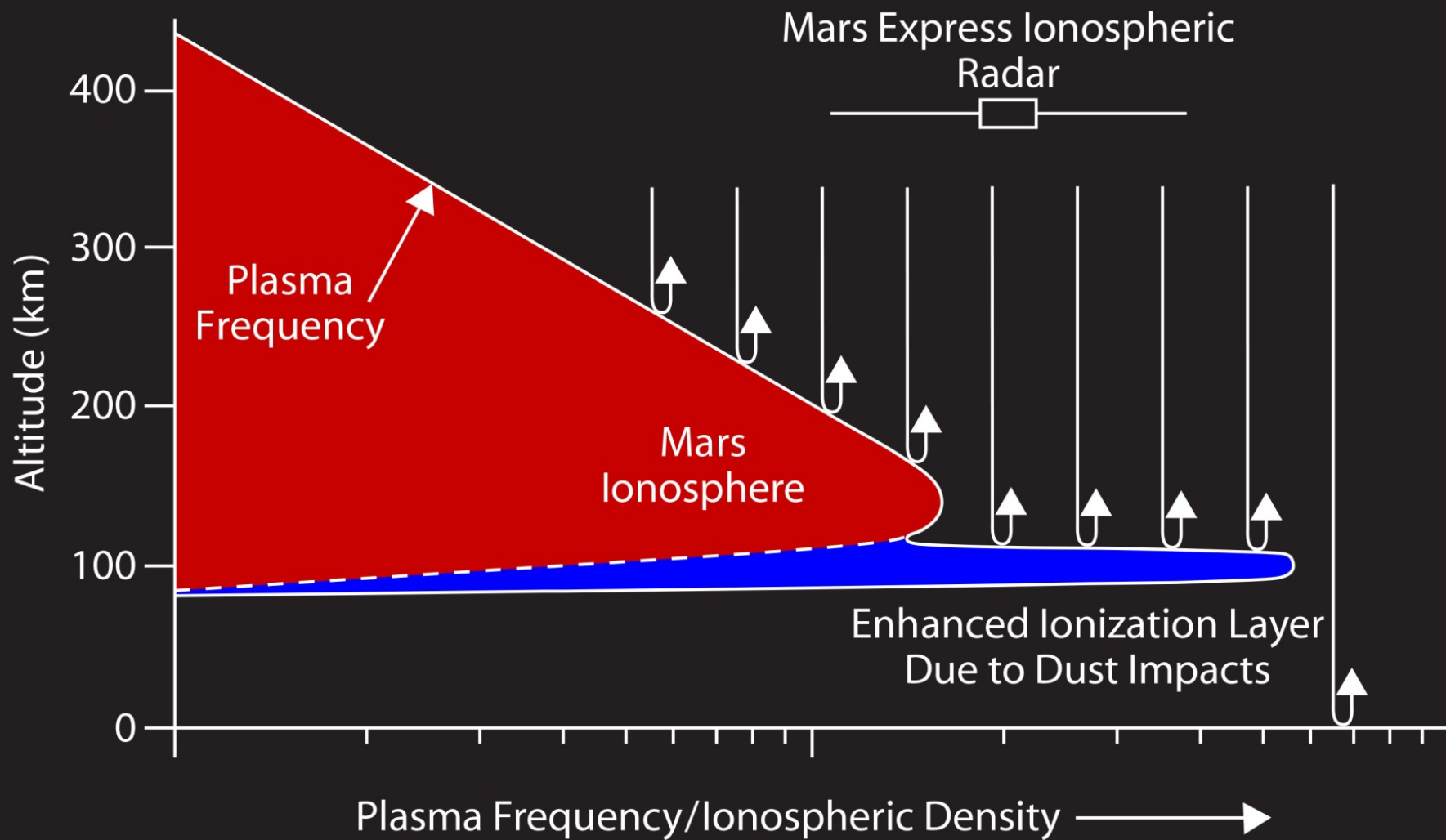
Complex science!

**No meteor shower detected,
but...**



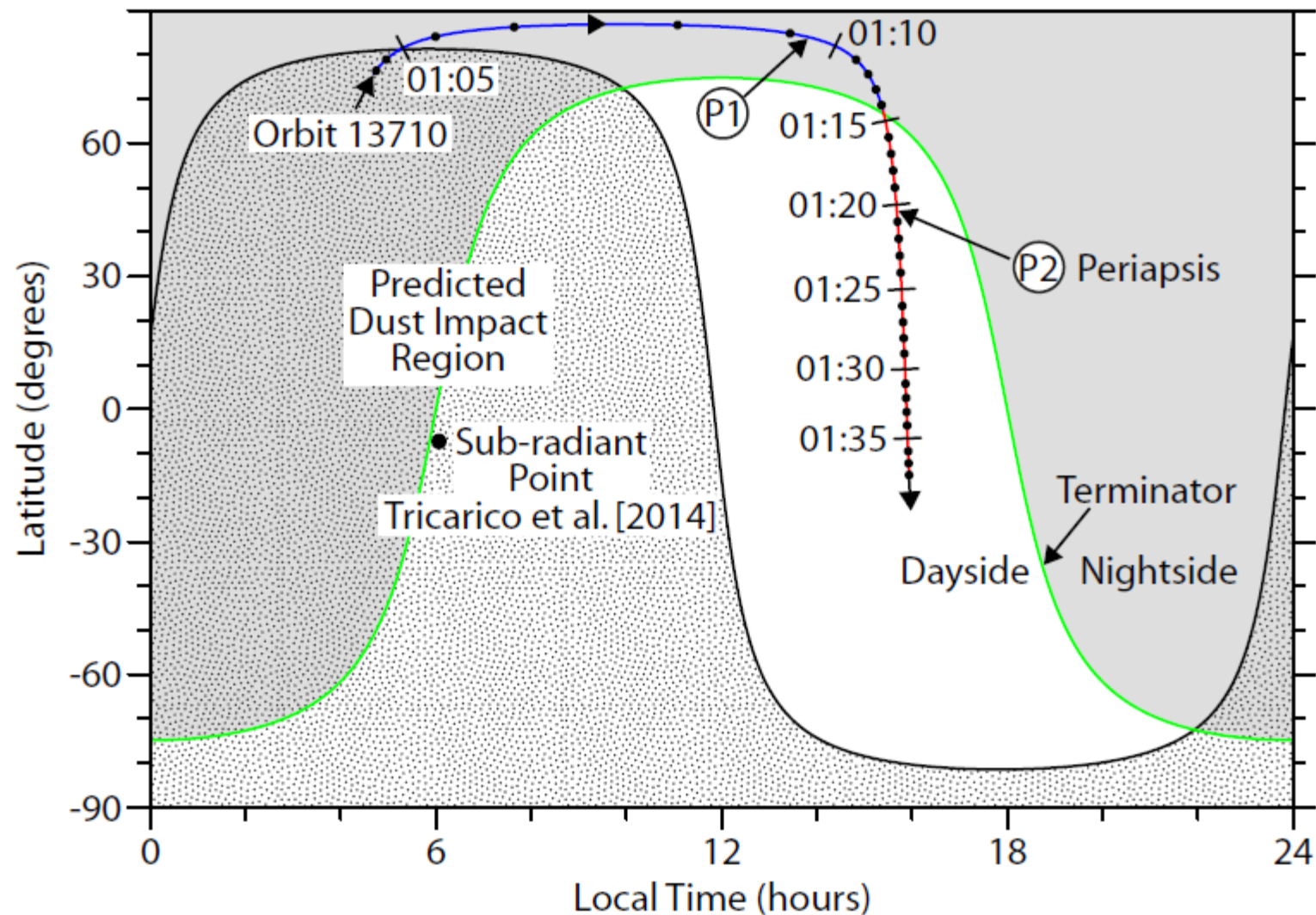
**Dust ablation → metals (Iron,
Magnesium...) in the upper
atmosphere → neutral-ion
chemistry + UV photoionisation →
Meteoric layer in the ionosphere**

Siding Spring observations

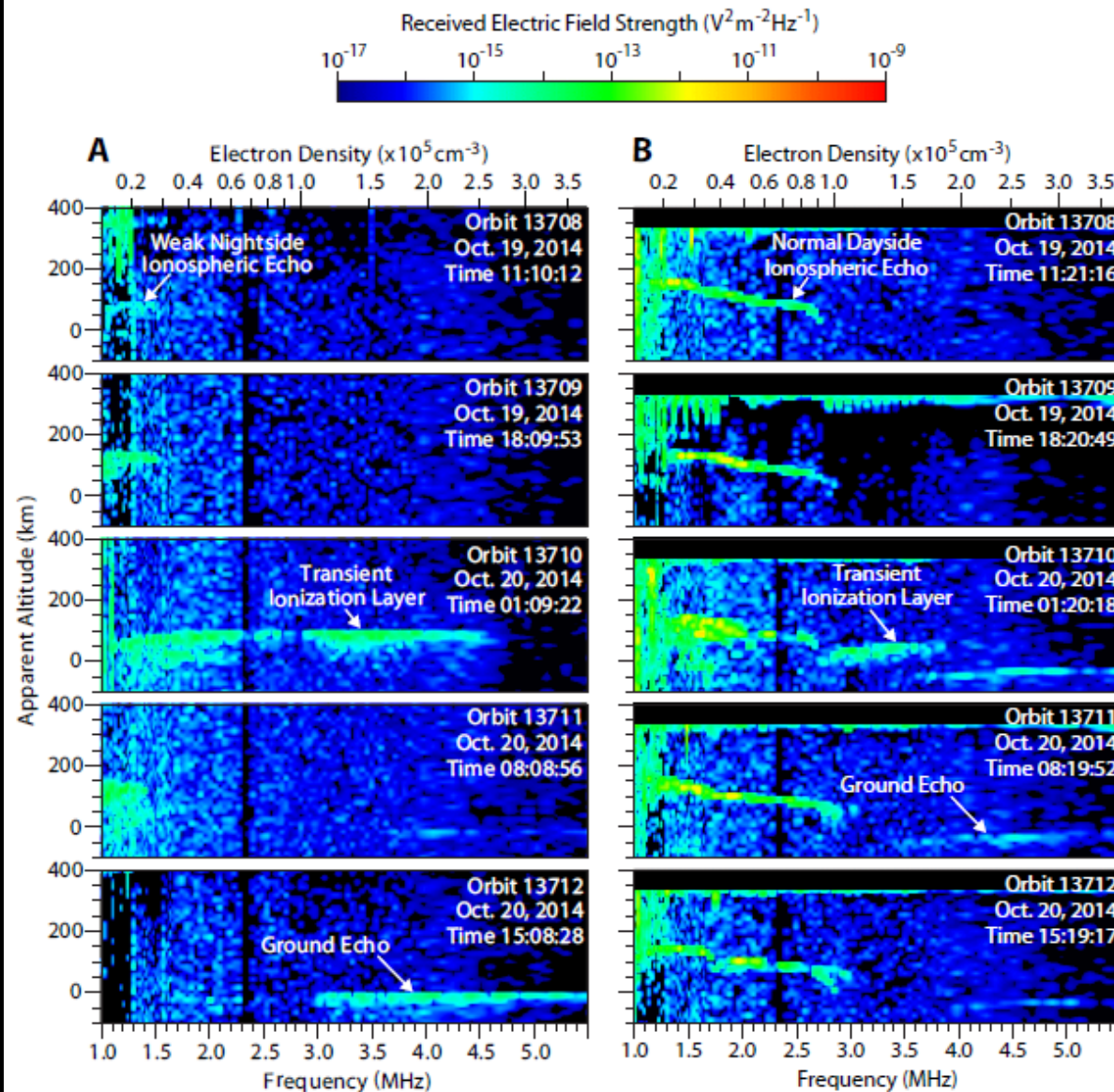


Siding Spring observations

A-D14-125-4

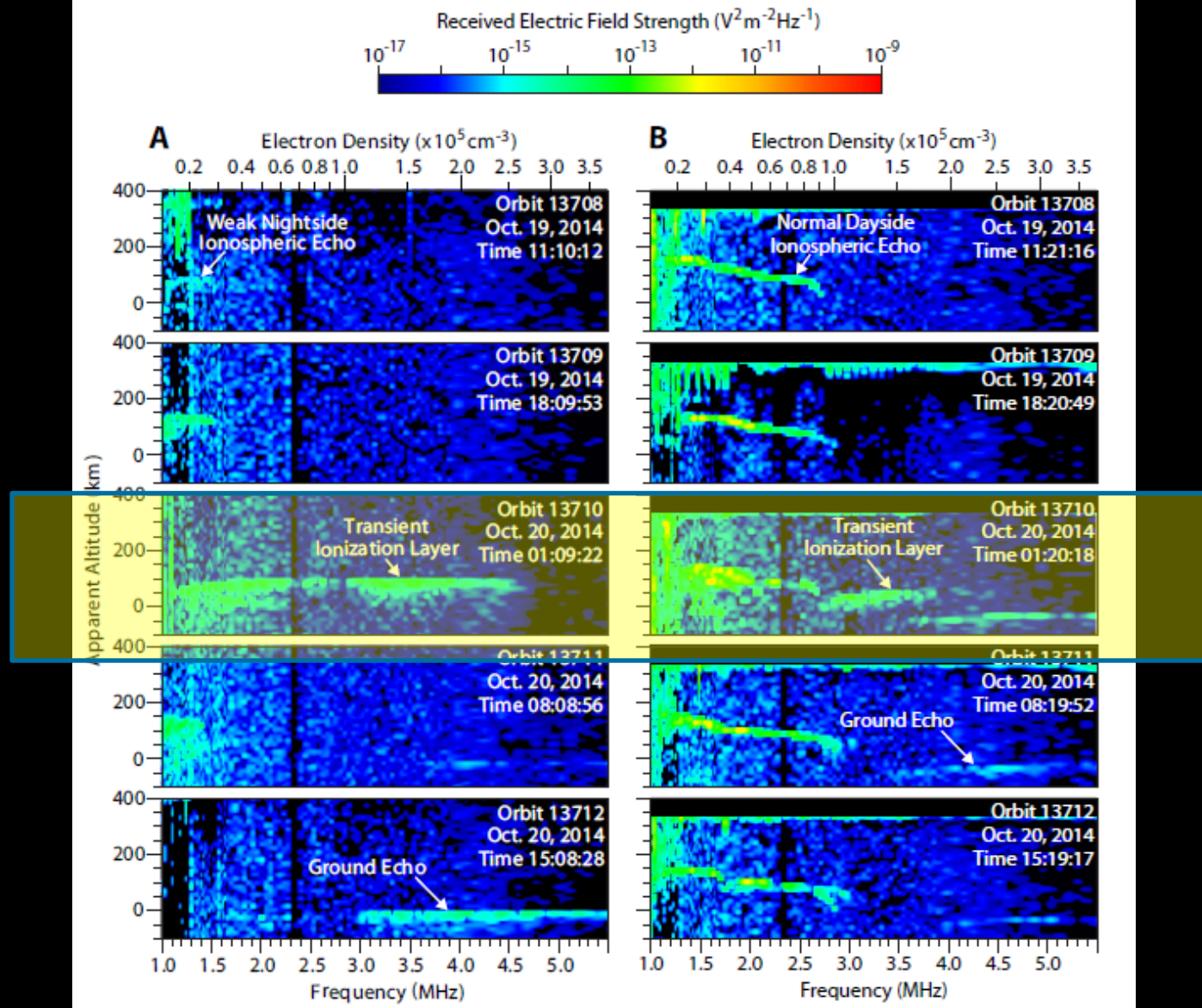


Siding Spring observations



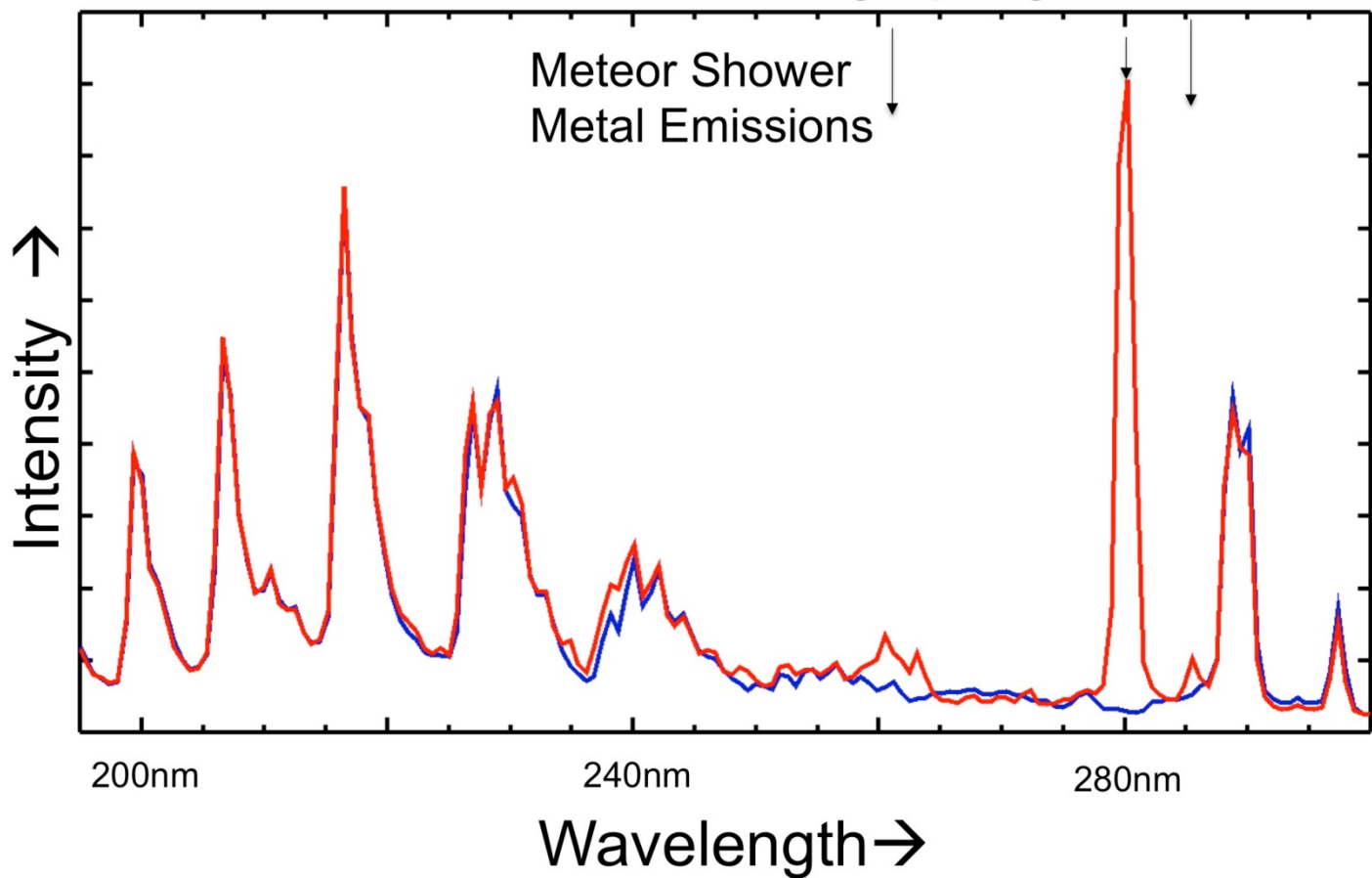
Gurnett et al., 2015

Siding Spring observations



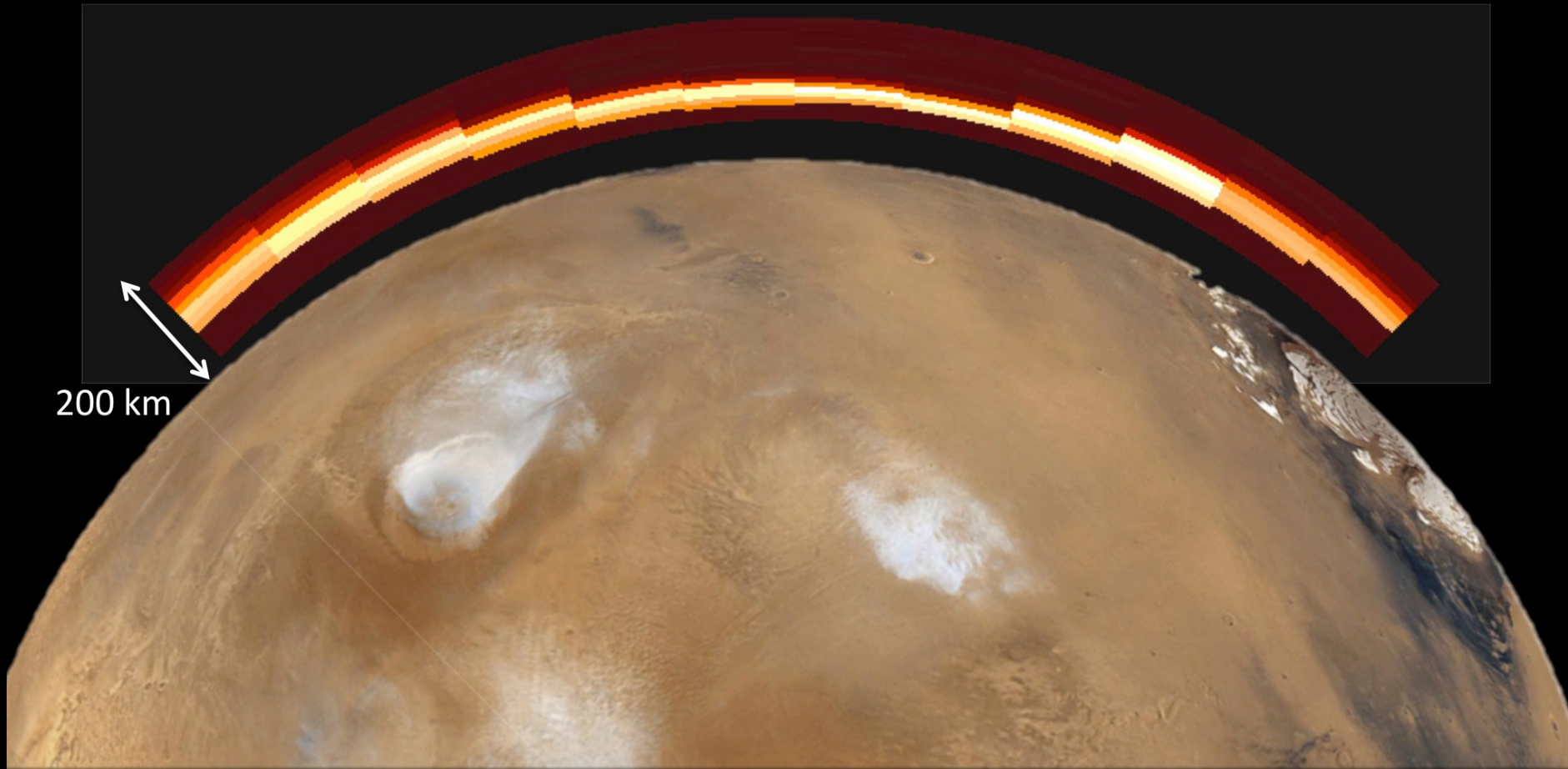
Gurnett et al., 2015

MAVEN/IUVS Spectrum of Mars Atmosphere After Comet Siding Spring



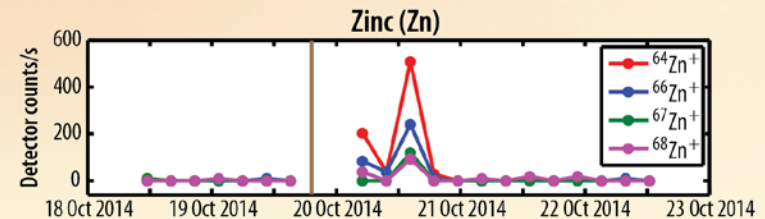
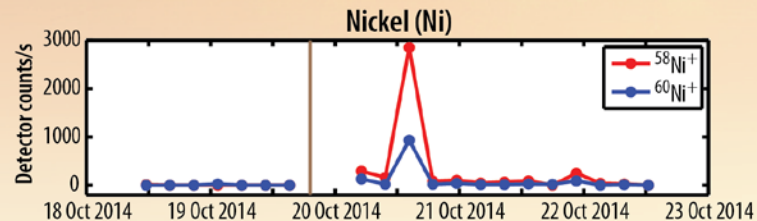
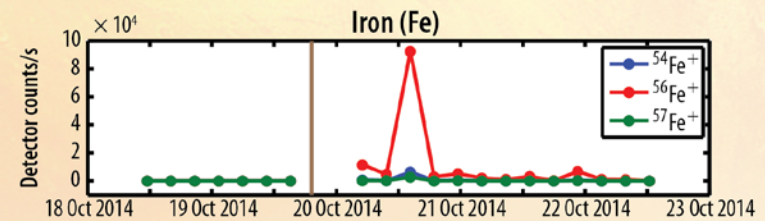
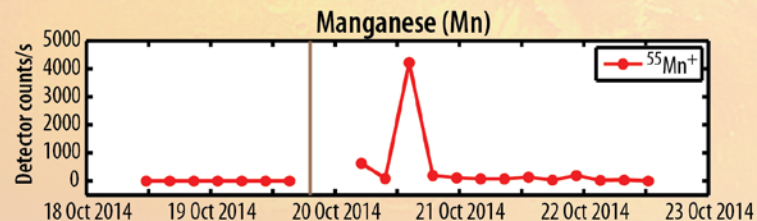
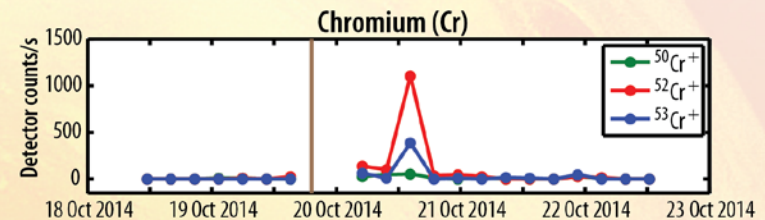
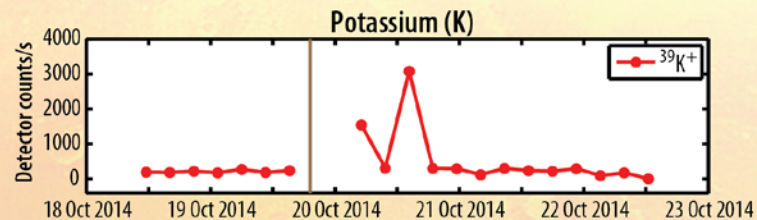
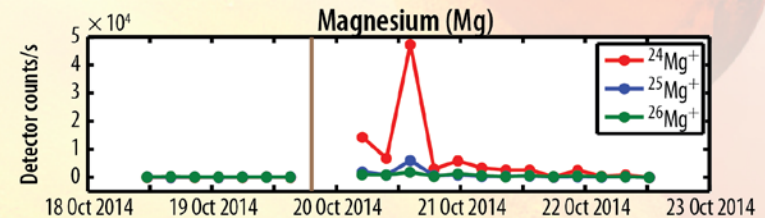
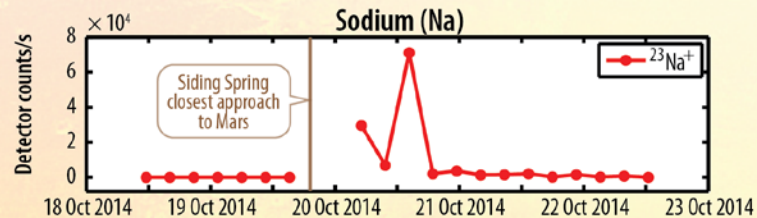
Siding Spring observations

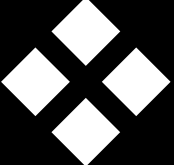
Geographic representation is conceptual.
Atmosphere not drawn to scale.



Siding Spring observations

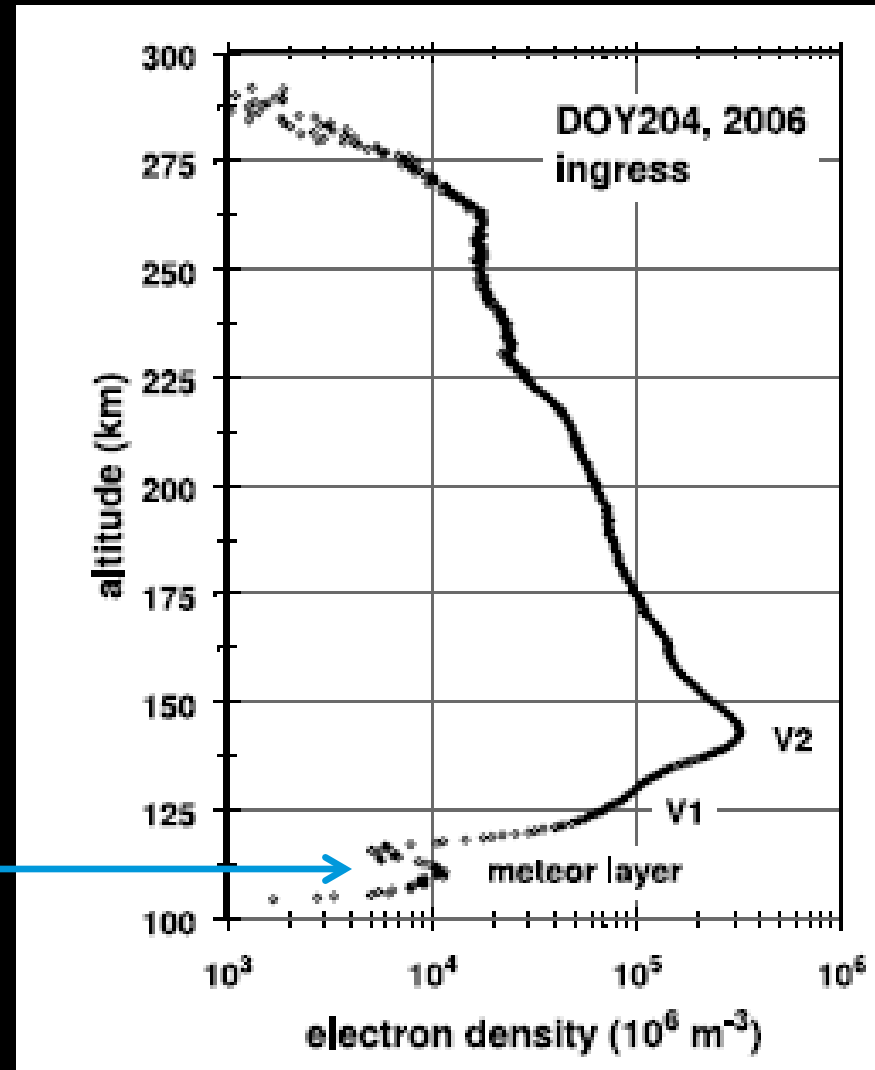
Eight different metal ions from comet Siding Spring were detected by NGIMS





Venus

**Meteoritic layer
due to dust**



Paetzold et al. (2009)

- Huestis and Slanger (1993)**
- Observations of the Venus nightglow in the UV range**
 - Nitric Oxide emissions: $N+O \rightarrow NO^*$**
 - Three correlated bright spectra observed on a particular orbit**
 - Interpretation: emitting area with dimensions on the order of 900 km in length and less than 5 km in width.**
 - Detection of a trail of a grazing meteor**

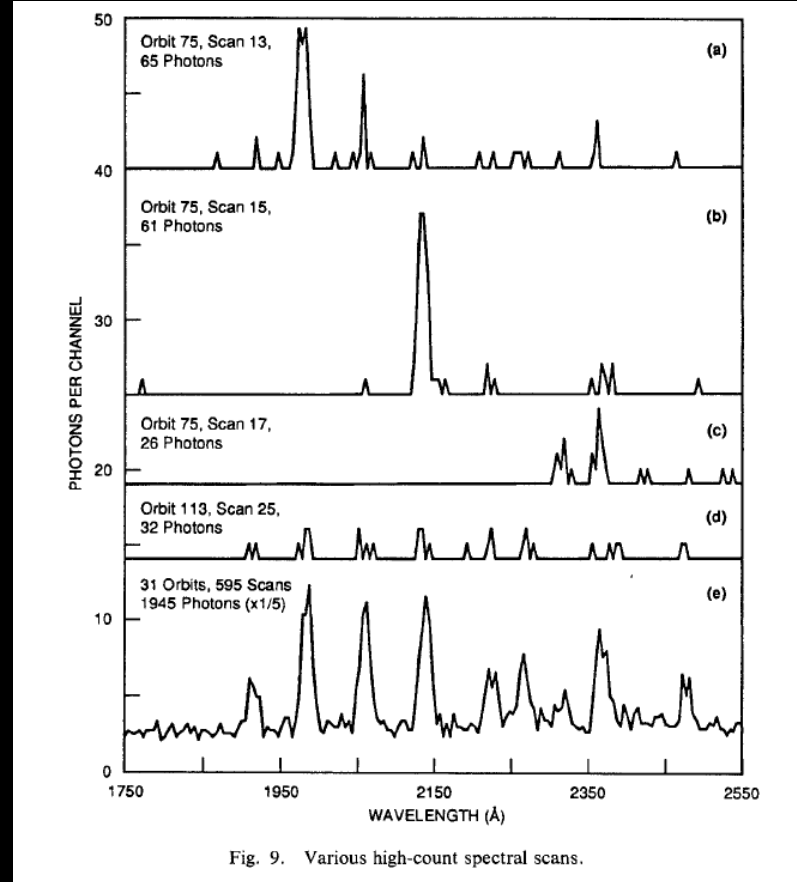
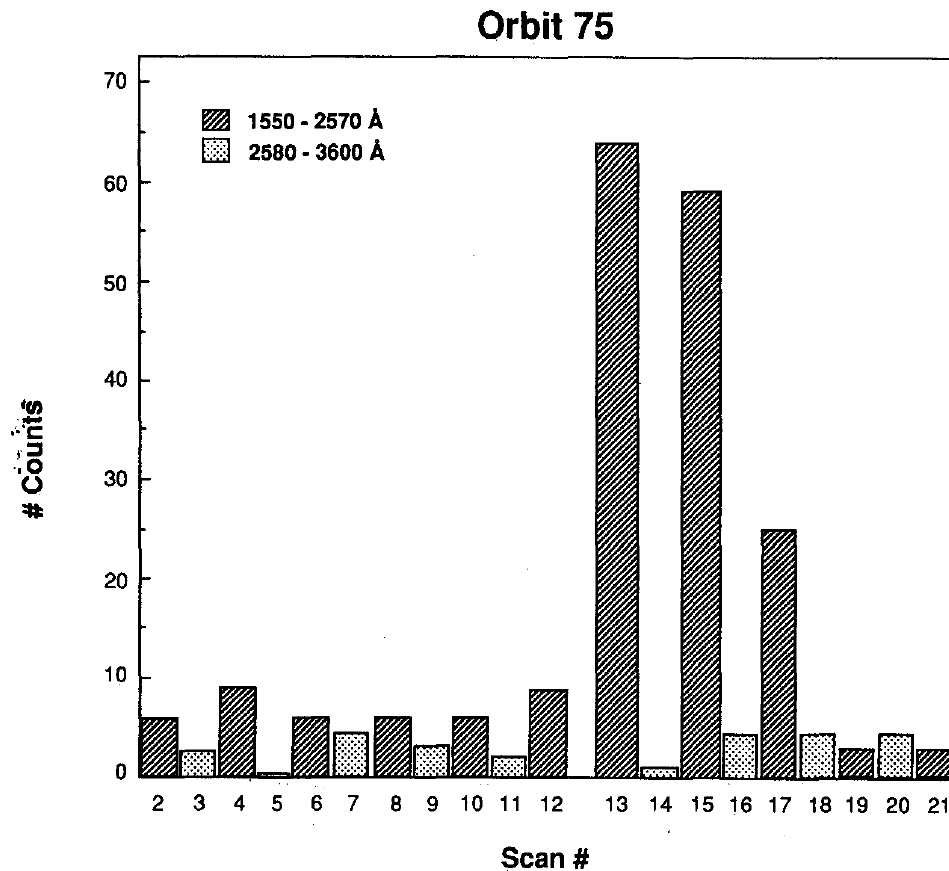
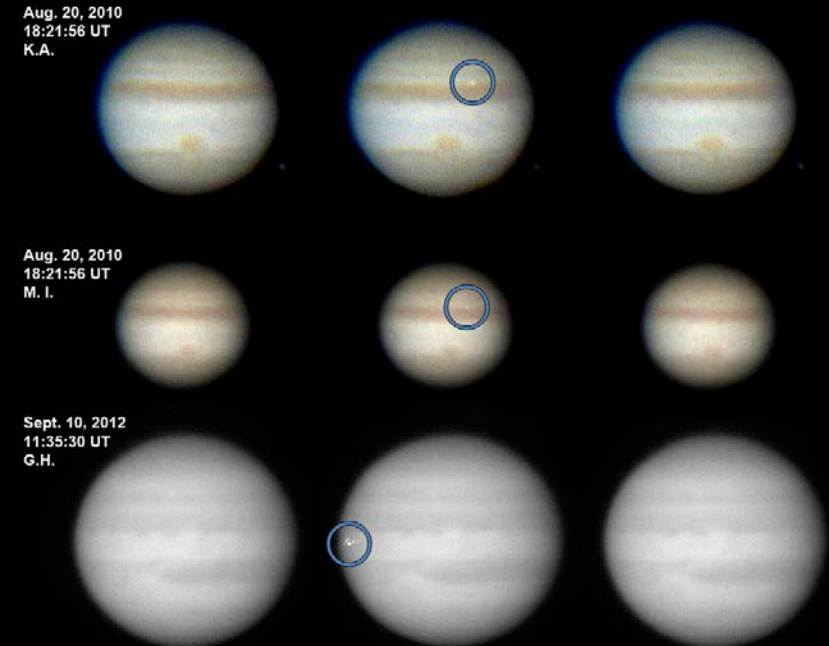
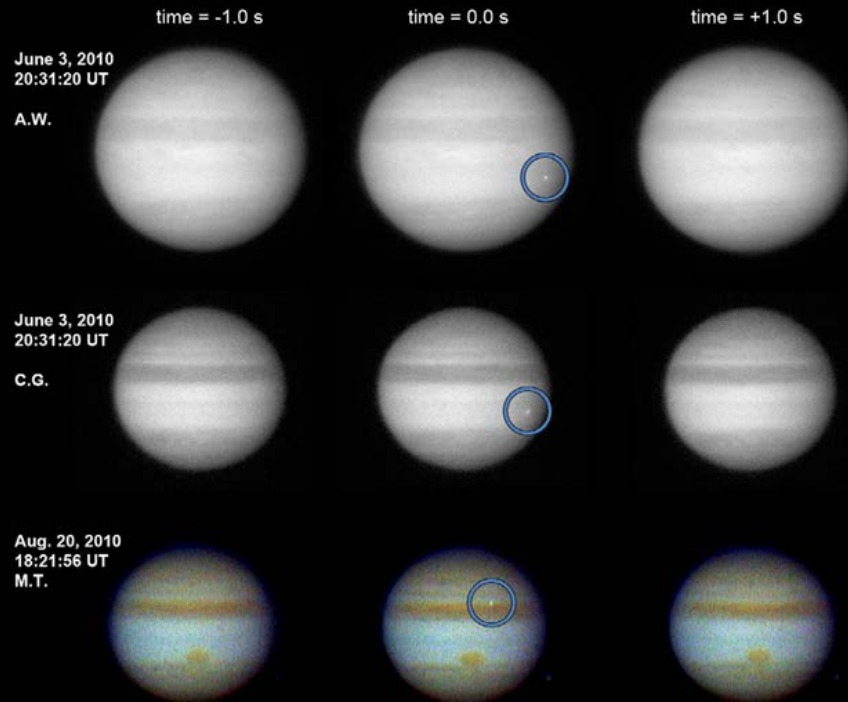


Fig. 9. Various high-count spectral scans.

Huestis and Slanger (1993)

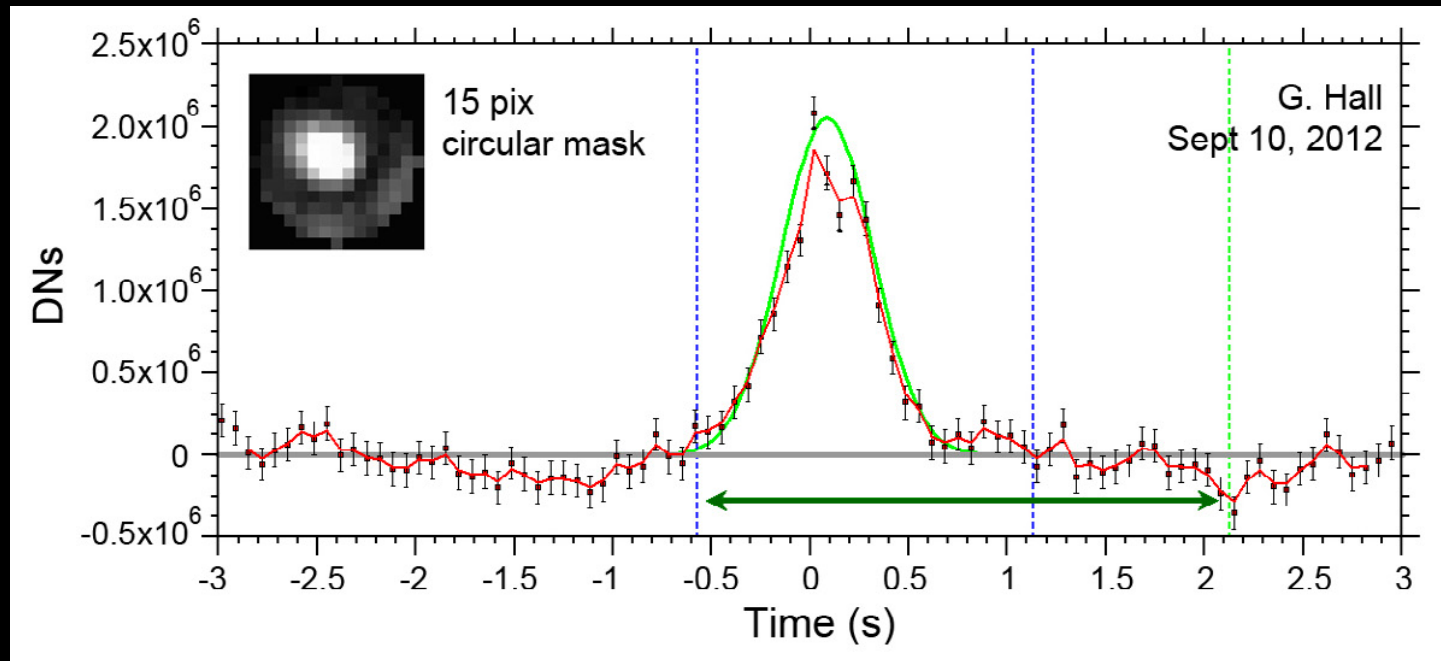
Jupiter

Jupiter observations



Jupiter observations





→ Size ~ 10-20 m

→ Estimated impact rate : 10–60 per year

❖ Future observations?

- ❖ **Develop hardware for future flight opportunities?**
 - ❖ **Wide angle cameras / spectroscopy**
 - ❖ **Surface ionosonde (Mars)**
 - ❖ **Infrasonic wave detection (Mars)**
 - ❖ **Radar (?)**
- ❖ **Nanosatellites**
- ❖ **(Permanent) station(s) on the martian moons**

A permanent station on Phobos (Deimos)



- ❖ **Mars:**
 - ❖ No meteors detected so far (?)
 - ❖ Study Siding Spring comet effects in more details: promising
 - ❖ link ionospheric effects -- dust population: to be studied
- ❖ **Venus:**
 - ❖ One meteor trail detected (?)
- ❖ **Jupiter:**
 - ❖ Good place to observe bolides.
“amateur” work