The interaction of the solar wind with planets

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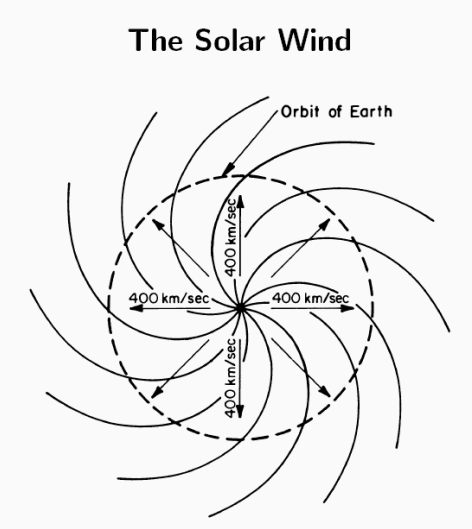
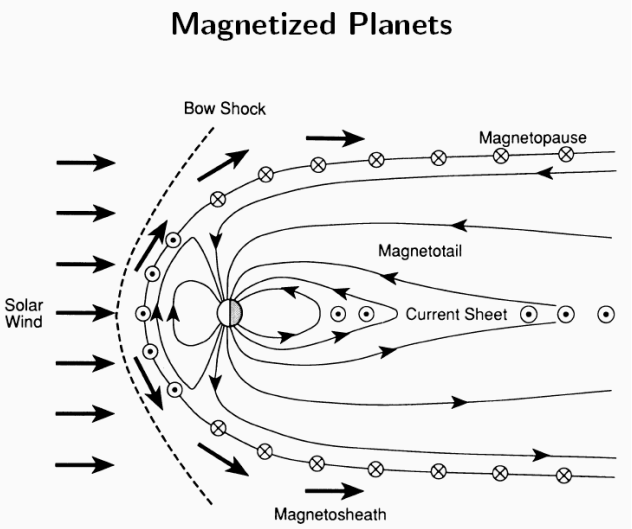
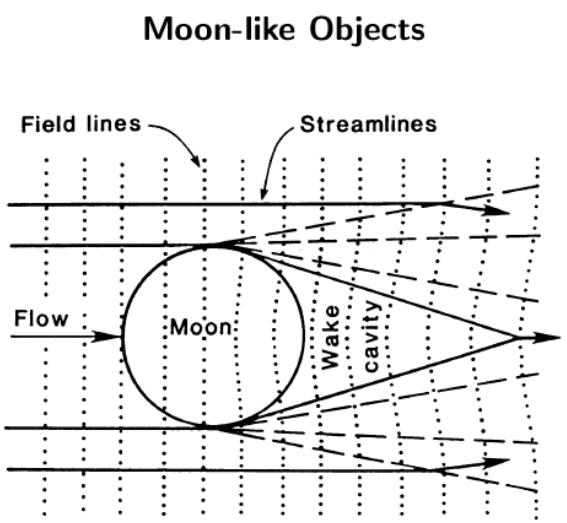
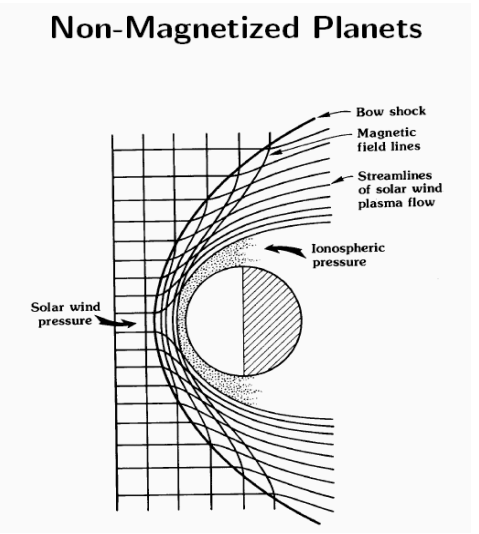
Interactions between the solar wind and solar system objects









[Kivelson and Russel]

Detectors ...

- ... of ions, electrons, and neutrals

Missions

- Mars Express
- Venus Express
- Rosetta
- Chandrayaan-1
- Phobos Grunt and Yinghuo-1
- BepiColombo (MPO and MMO)
- Jupiter? (Laplace/EJSM)

Apollo SIDE observations

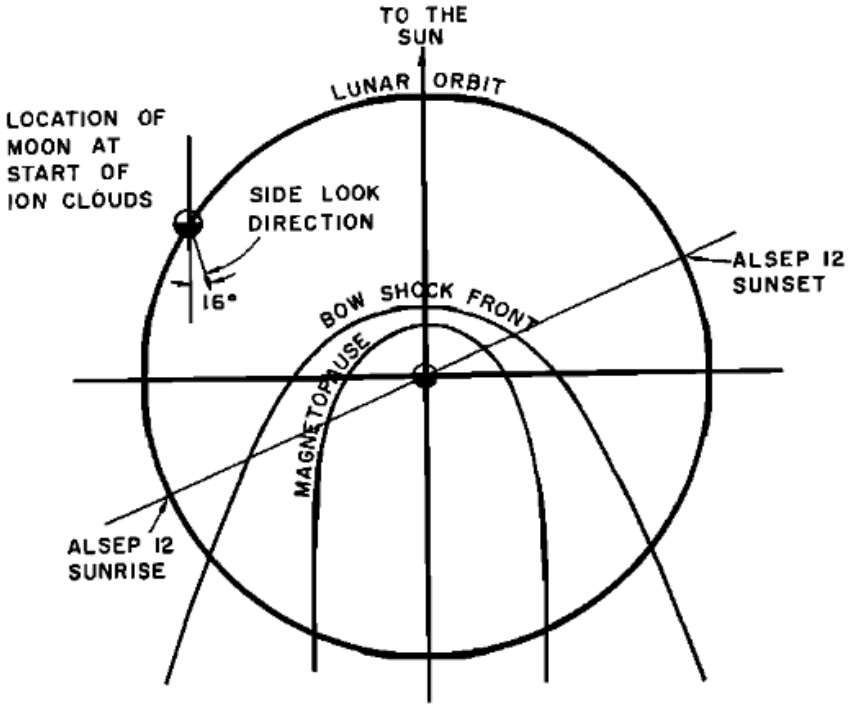


Fig. 1. Location of the moon in its orbit at the onset of the December series of ion bursts.

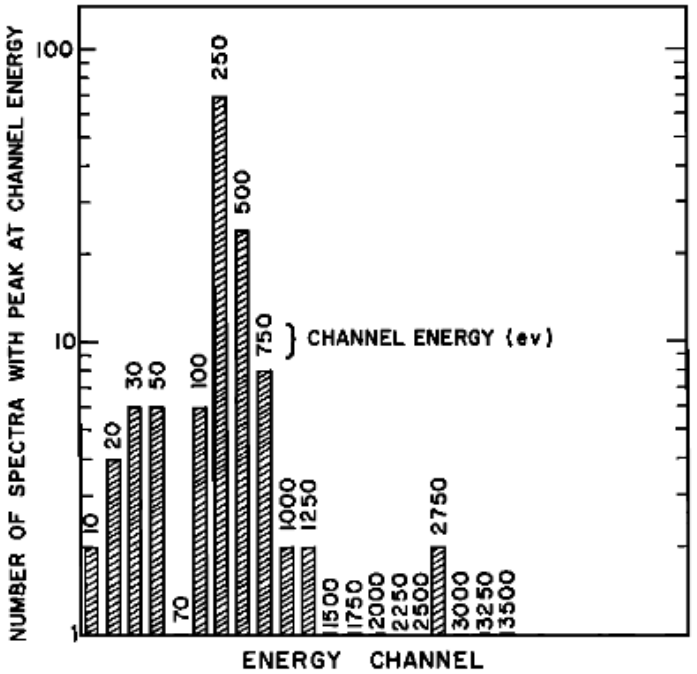
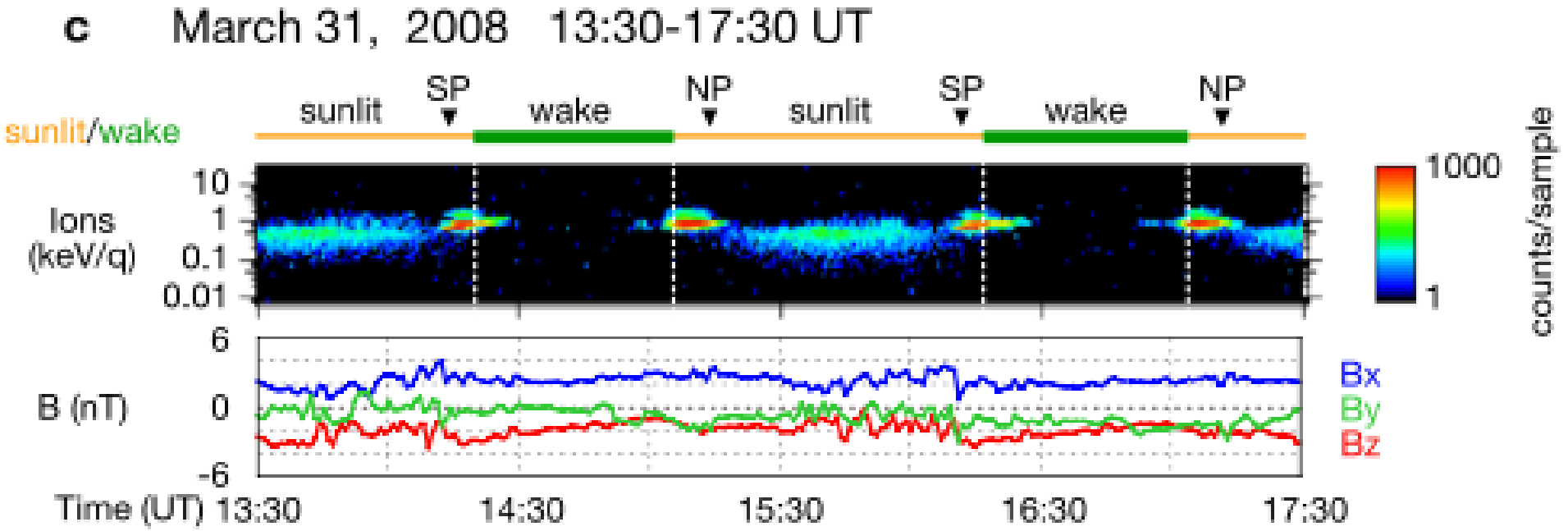


Fig. 4. Number of differential energy spectra whose maximum fluxes are found at the various energies. Data collected from 14h 49m 38s UT December 13 to 14h 00min 34s UT December 15, 1969.

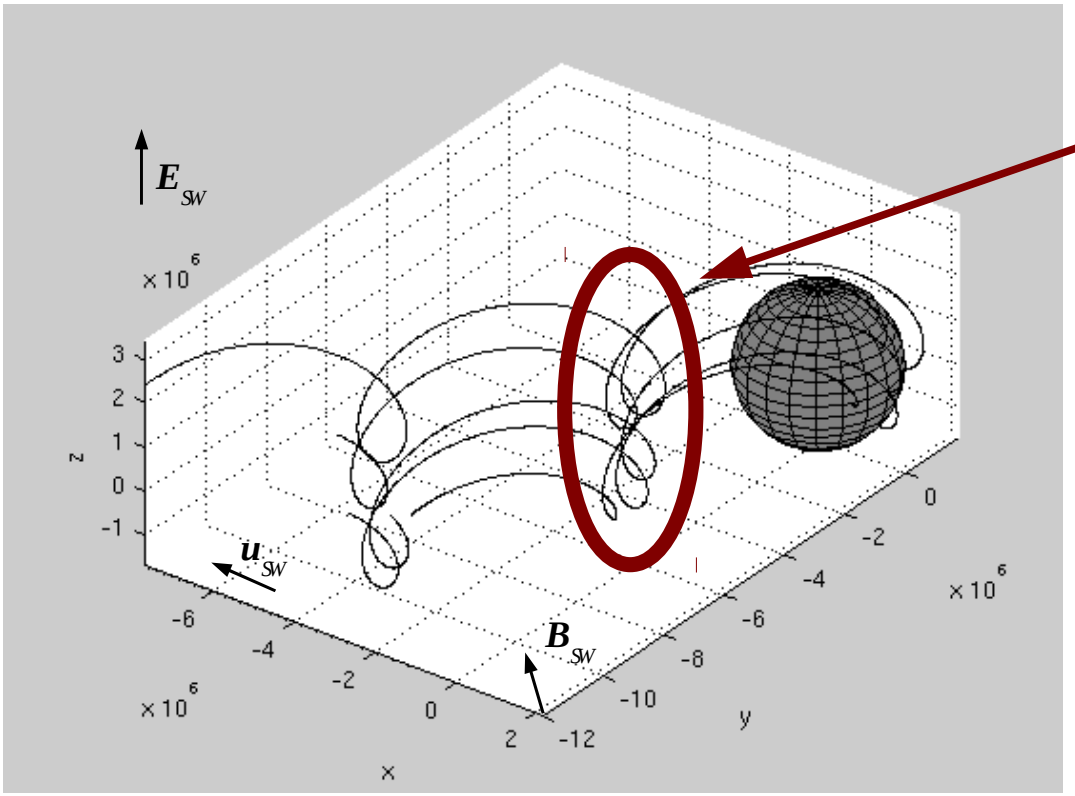
Energetic Ion Bursts on the Nightside of the Moon,
J.W. Freeman, Jr.,
JGR, v. 77, n. 1, 1972

Reflected solar wind protons



Kaguya. Nishino et al., GRL 2009

Proton fluxes in the wake

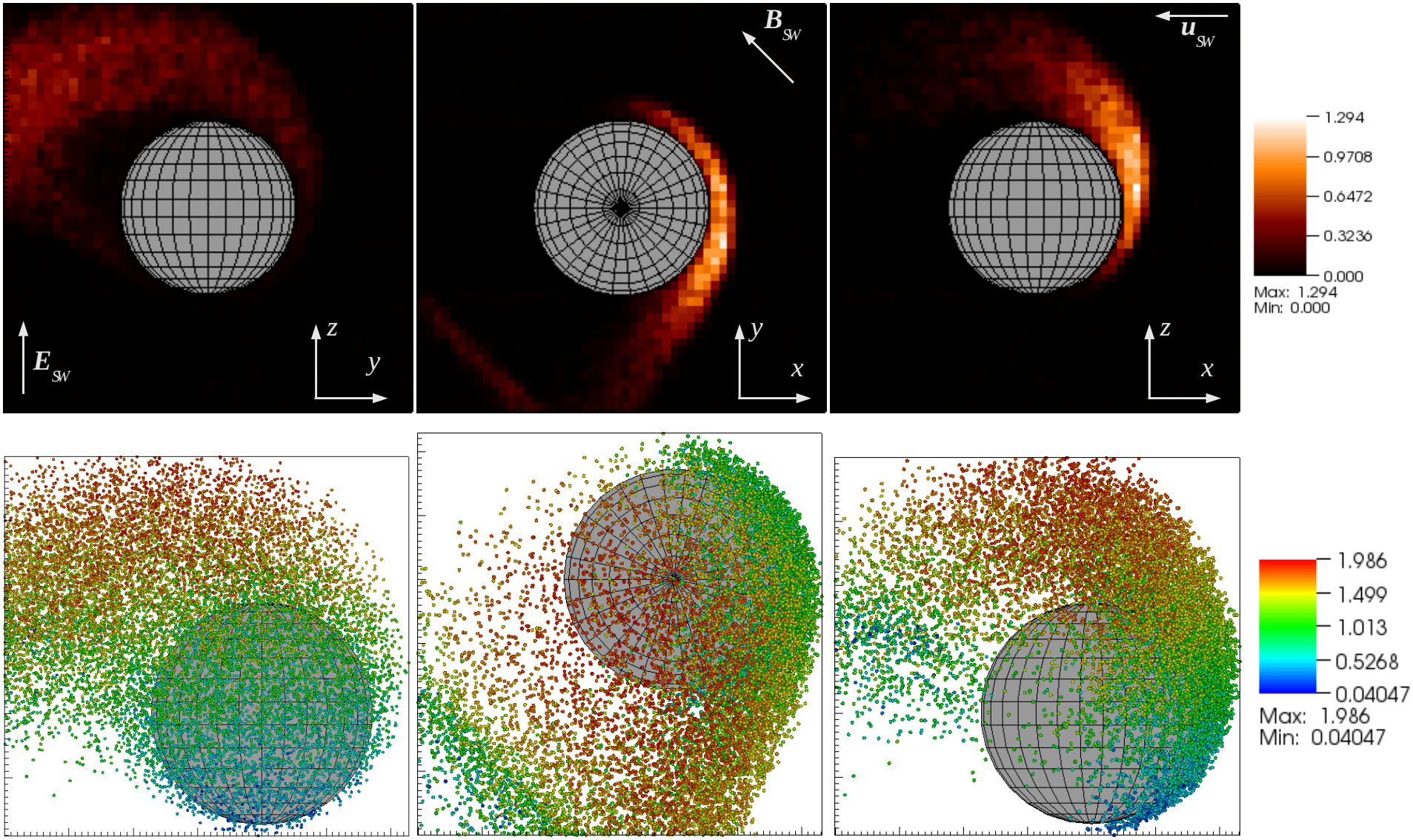


Wake entry possible for reflected protons

Depending on IMF

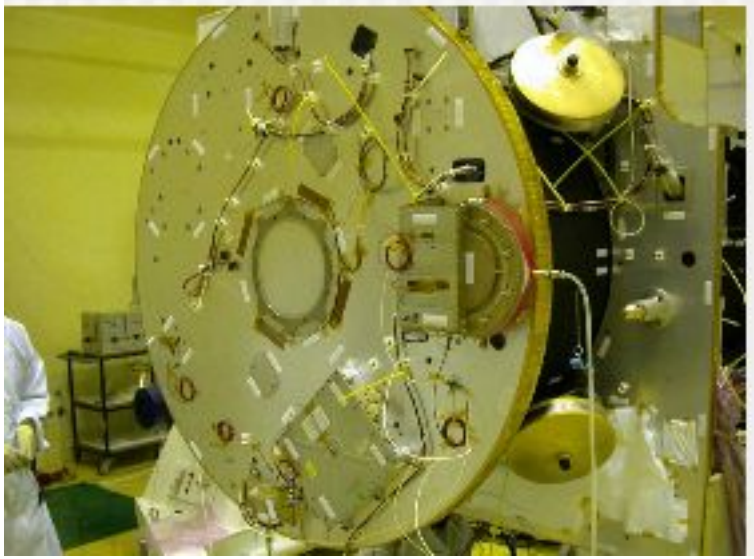
(Nishino et al., GRL 2009, Type-II entry)

Test particle model of reflected protons

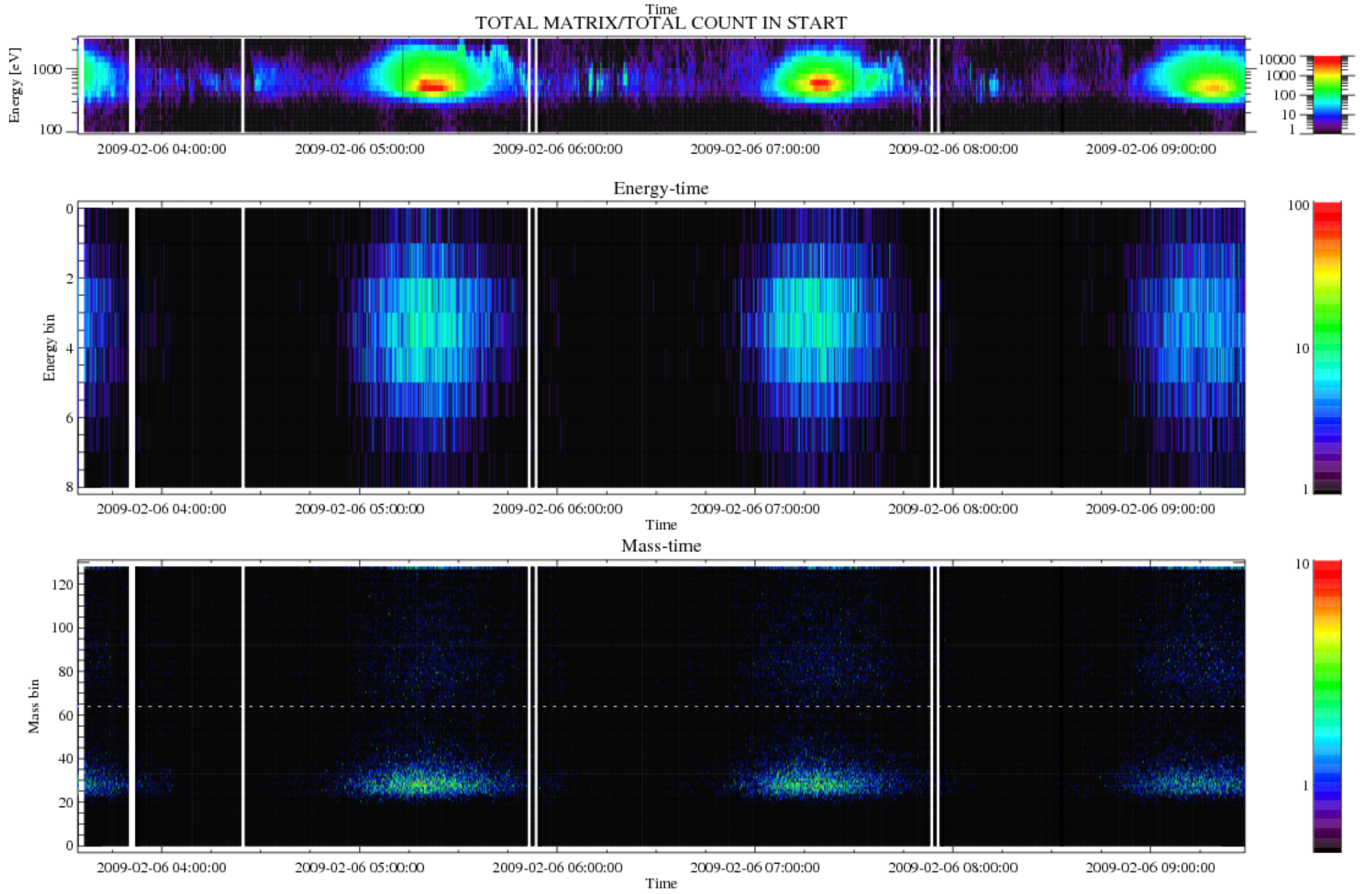


[Holmström, JGR, 2010]

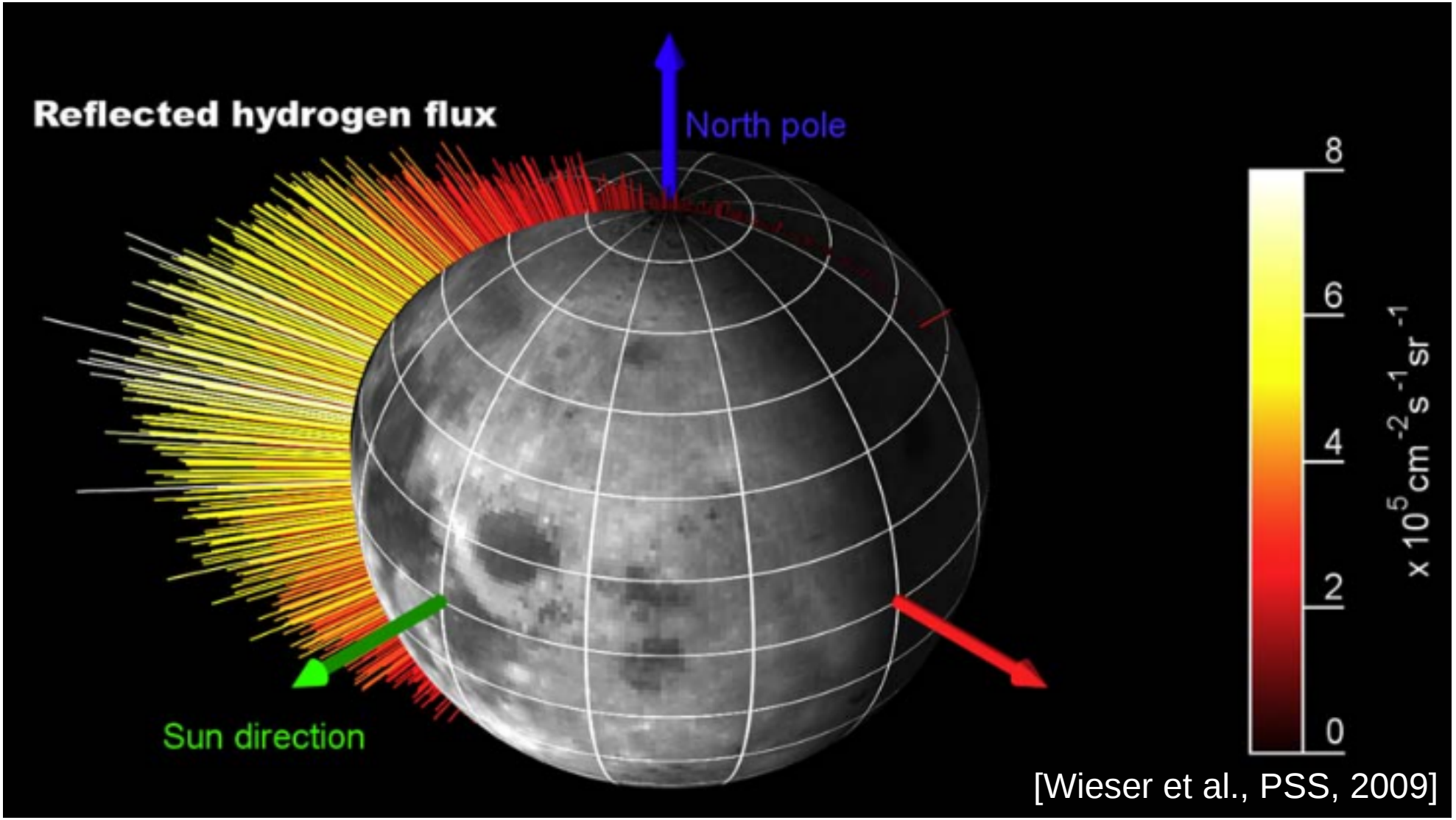
SARA on Chandrayaan-1



- Launch Oct 22, 2008. End Aug 29, 2009. ~3400 orbits
- SARA on for about 40% of the time

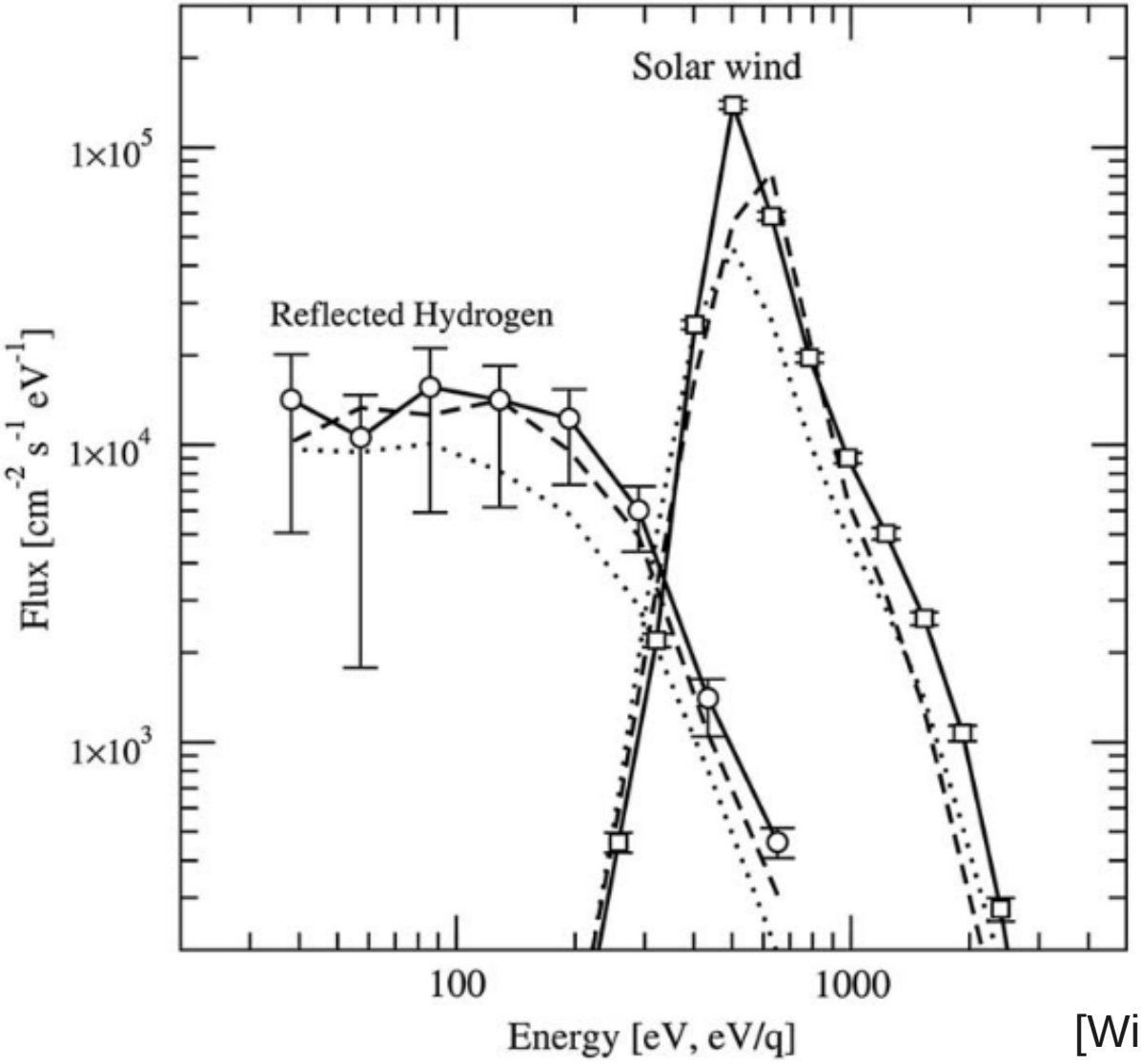

Time
TOTAL MATRIX/TOTAL COUNT IN START
Energy [eV]
1000
100
10000
1000
100
10
1
2009-02-06 04:00:00
2009-02-06 05:00:00
2009-02-06 06:00:00
2009-02-06 07:00:00
2009-02-06 08:00:00
2009-02-06 09:00:00
Energy-time
Energy bin
0
2
4
6
8
100
10
1
2009-02-06 04:00:00
2009-02-06 05:00:00
2009-02-06 06:00:00
2009-02-06 07:00:00
2009-02-06 08:00:00
2009-02-06 09:00:00
Time
Mass-time
Mass bin
120
100
80
60
40
20
0
10
1
2009-02-06 04:00:00
2009-02-06 05:00:00
2009-02-06 06:00:00
2009-02-06 07:00:00
2009-02-06 08:00:00
2009-02-06 09:00:00
Time

The Moon reflects the solar wind



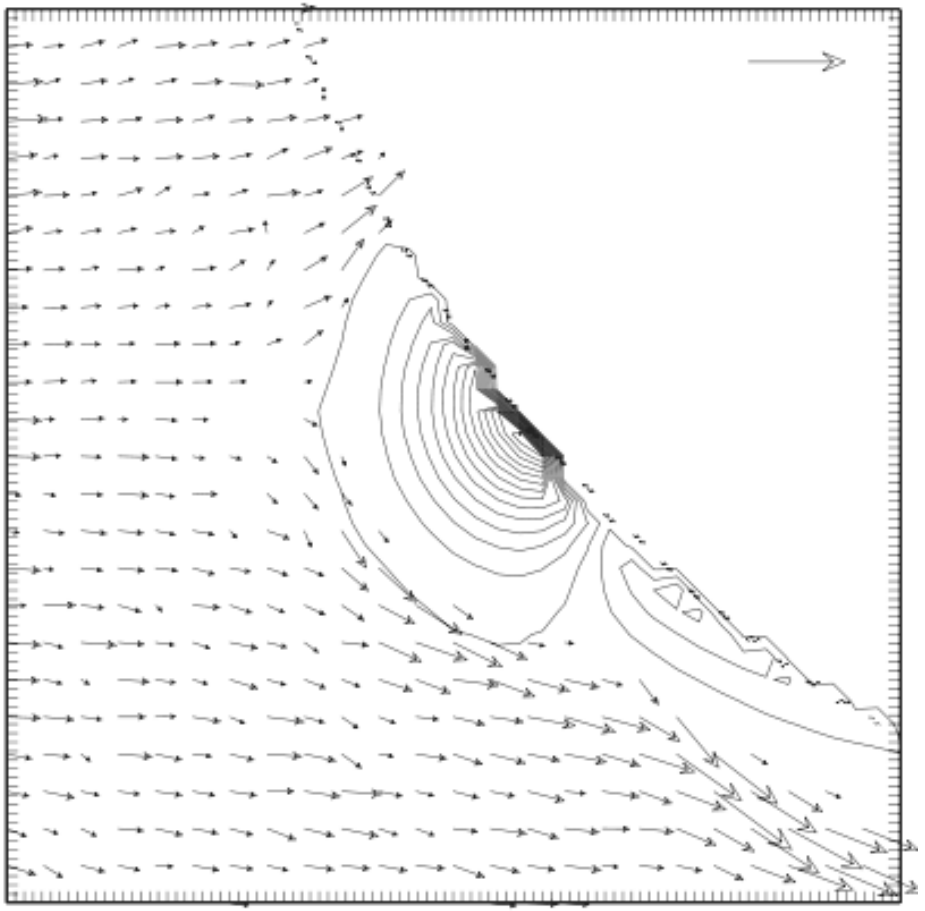
Observation by SARA on Chandrayaan-1: ~20% of the solar wind protons are reflected by the Moon as neutral H.

Reflected spectrum



[Wieser et al., PSS, 2009]

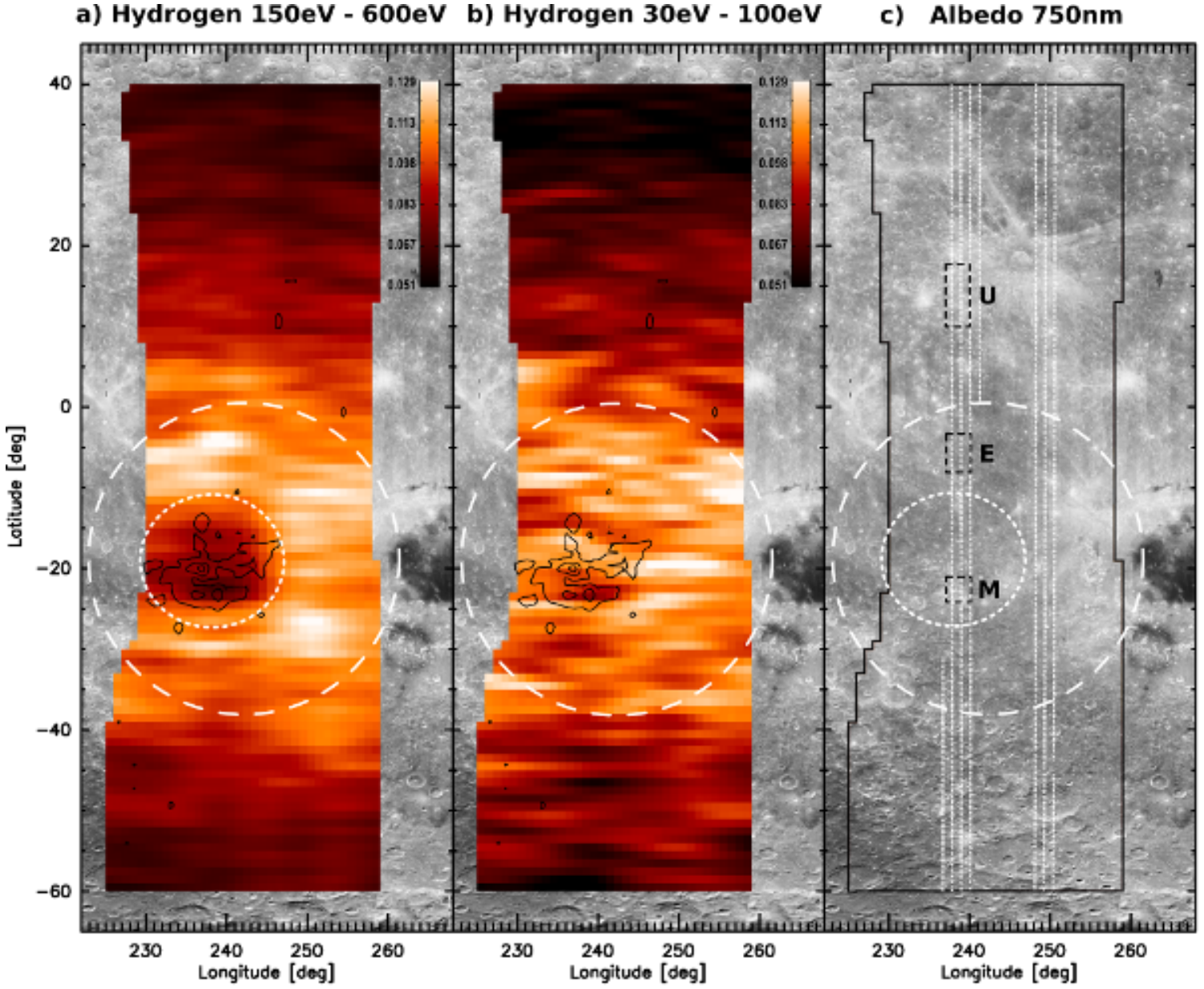
Mini-magnetospheres at the Moon?



(a) Solar Ion Velocity

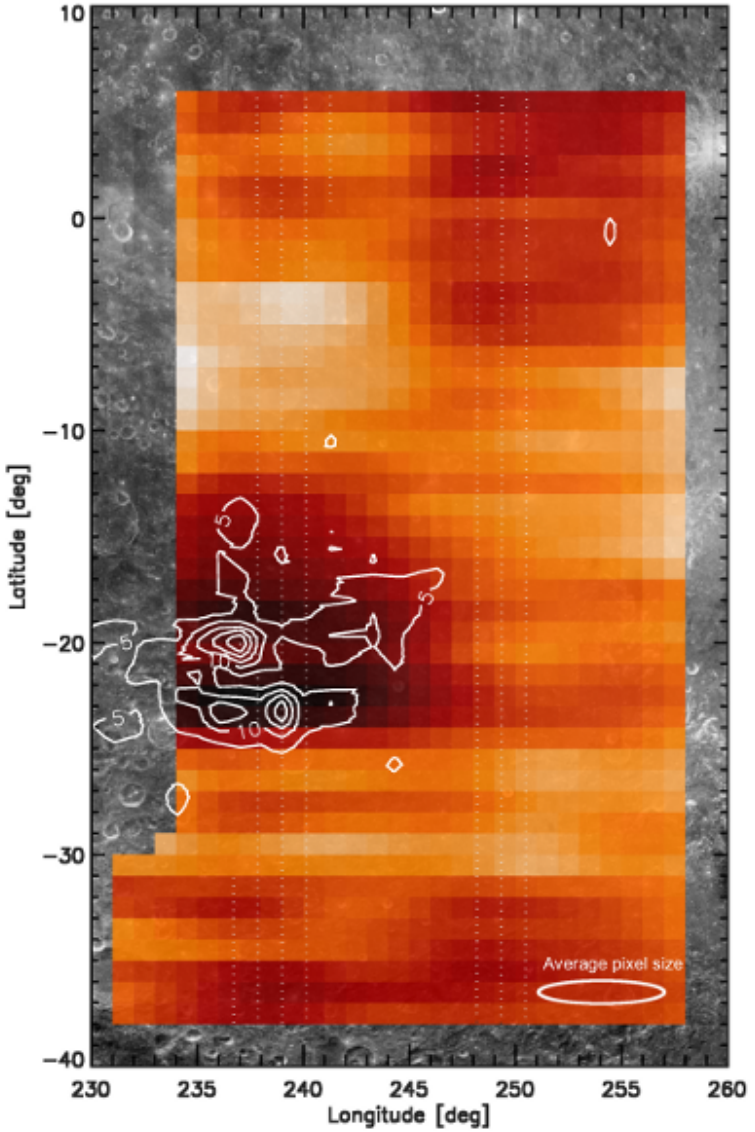
[Harnett et al., JGR, 2002]

A mini-magnetosphere

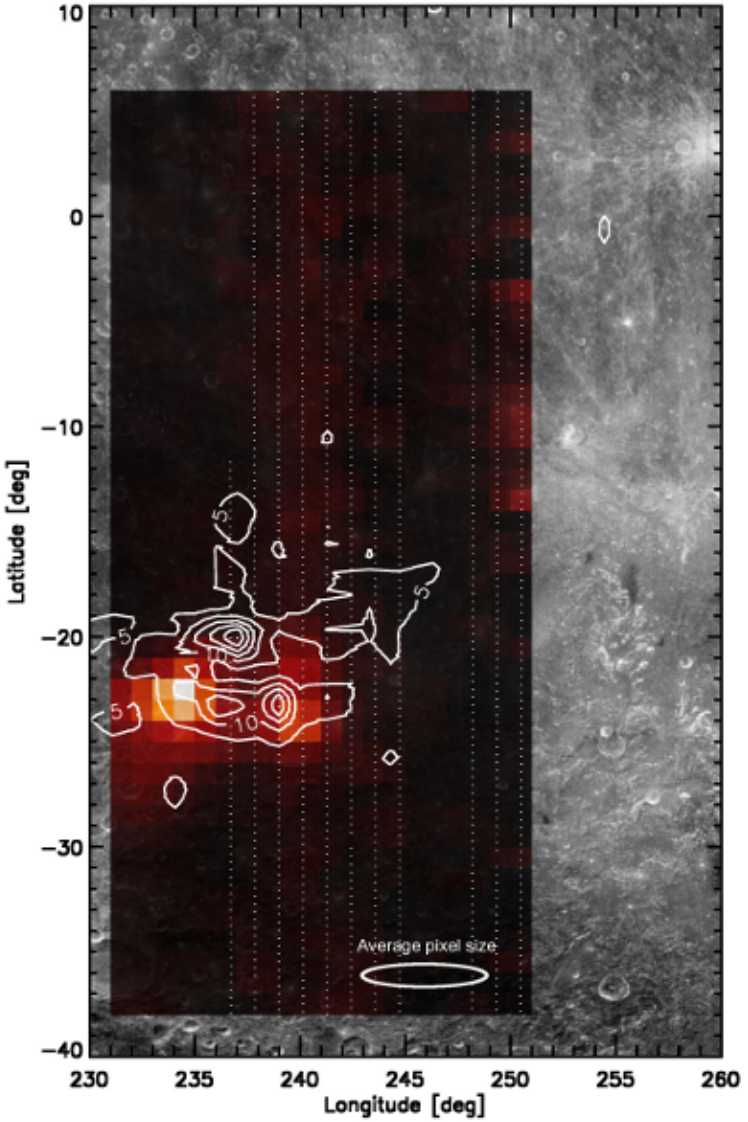


H

[Wieser et al., GRL, 2010]



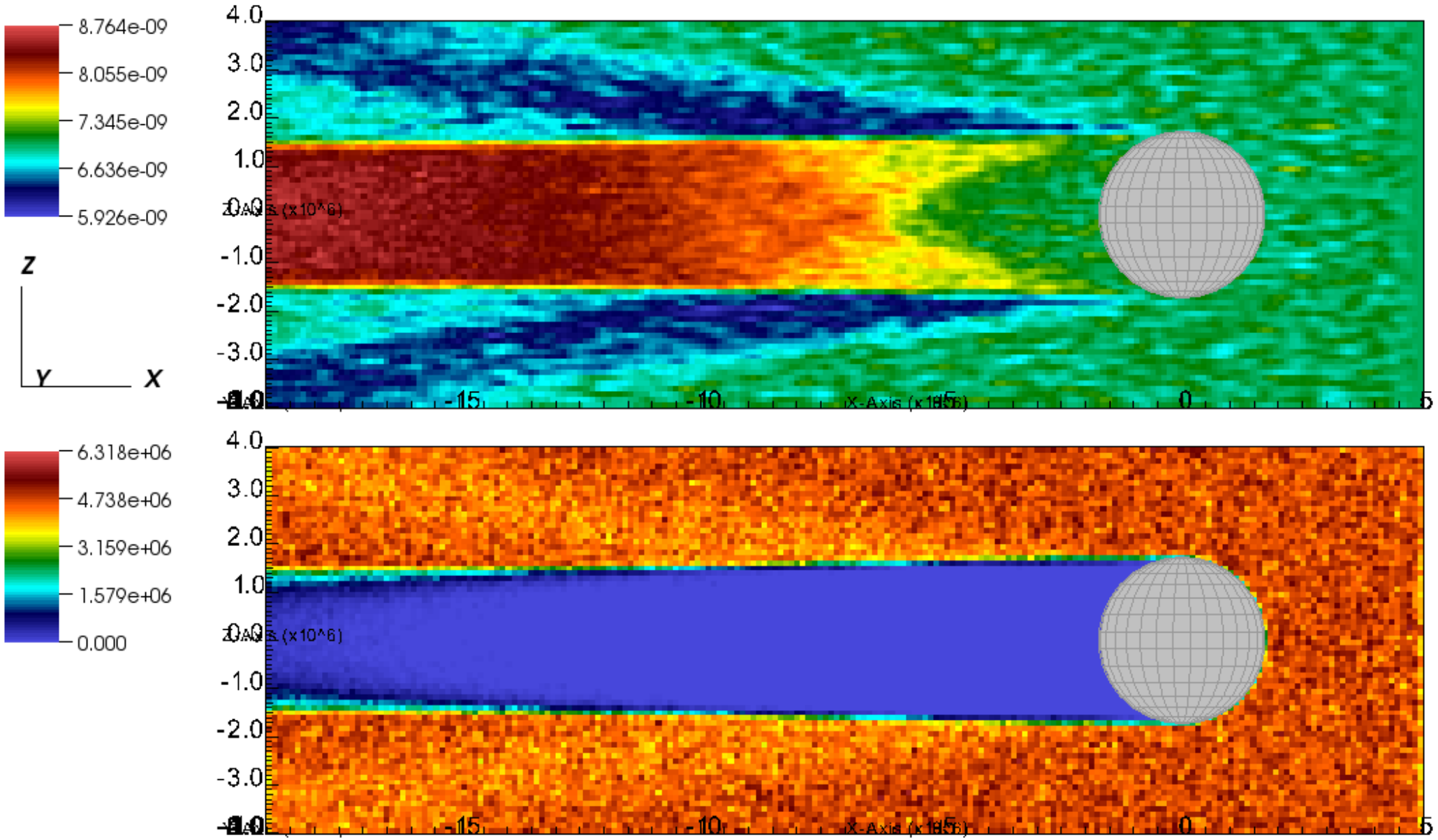
H



H^+

[Wieser et al., GRL, 2010]

Hybrid model of |B| and density



Hybrid model Ion flux