

2004 Electron Outflow at Mars

R. A. Frahm
J. R. Sharber
J. D. Winningham
S. J. Jeffers
C. A. Gonzalez
J. R. Scherrer
J. Mukherjee
M. Muller

Southwest Research Institute
PO Drawer 28510, 6220 Culebra Road
San Antonio, TX 78228-0510



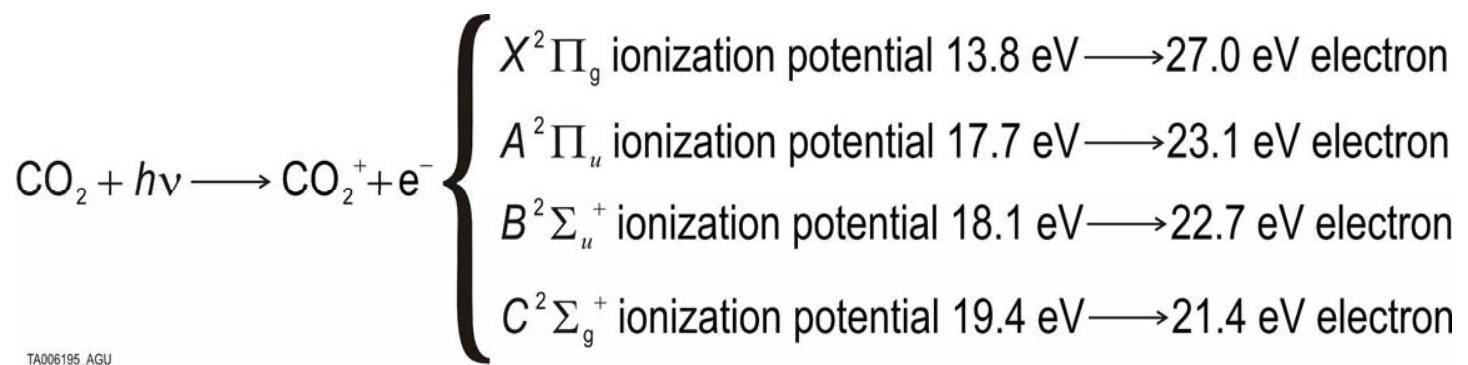
Introduction

Object – Determine the number of electrons created by ionization of solar 30.4 nm HeII which escape Mars.

Ion Escape

- Total Phobos-2 at Solar Max: $3 \times 10^{25} \text{ s}^{-1}$ [Lundin et al., 1989, 1990]
- Total MEX at Solar Min: $6-60 \times 10^{23} \text{ s}^{-1}$ [Dubinin et al., 2006]
- CO_2^+ scaled from Phobos-2: $4 \times 10^{24} \text{ s}^{-1}$ [Carlsson et al., 2006]
- O^+ from MEX: $1.6 \times 10^{23} \text{ s}^{-1}$
 O_2^+ from MEX: $1.5 \times 10^{23} \text{ s}^{-1}$
 CO_2^+ from MEX: $8 \times 10^{22} \text{ s}^{-1}$ [Barabash et al., 2007]

30.4 nm Photoionization of Carbon Dioxide

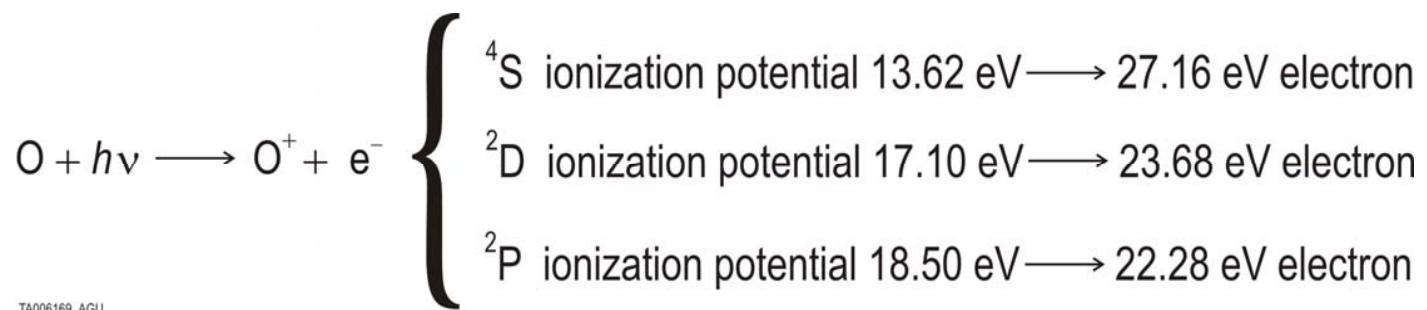


TA006195_AGU

[Padial et al., 1981]



30.4 nm Photoionization of Atomic Oxygen



TA006169_AGU

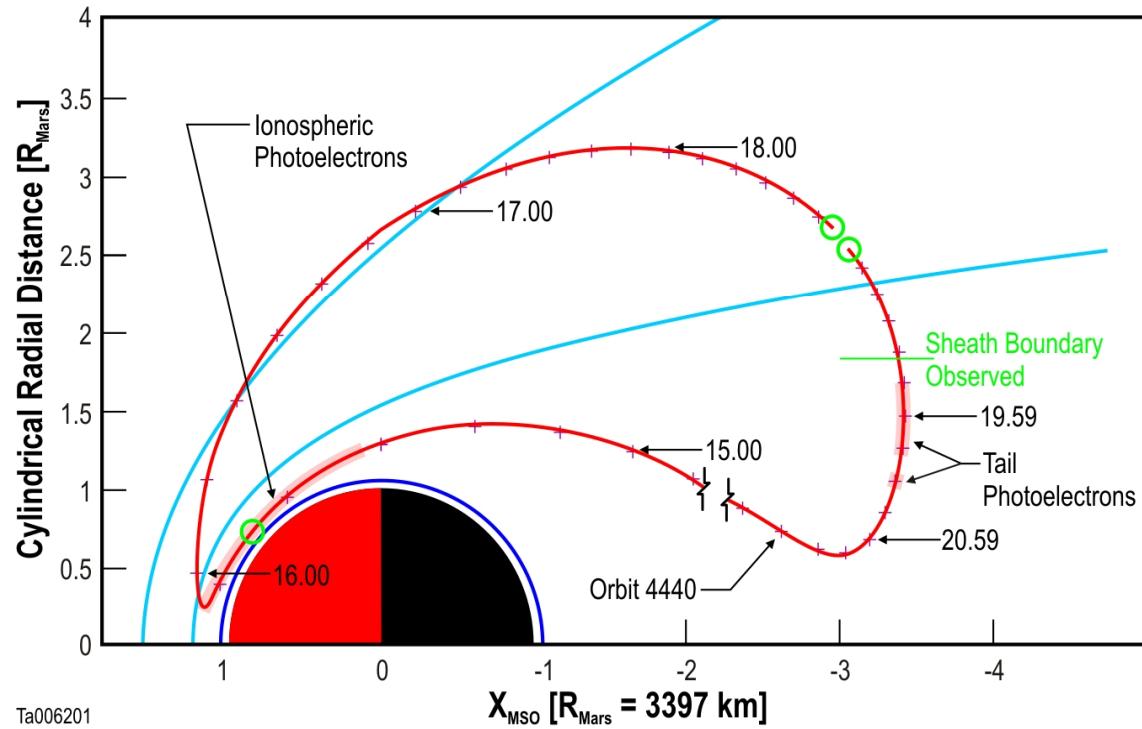
[Mantas and Hanson, 1979]

Mars Express Sample Orbit

MEX position every 10 min. Cylindric coordinates. Orbit 4439

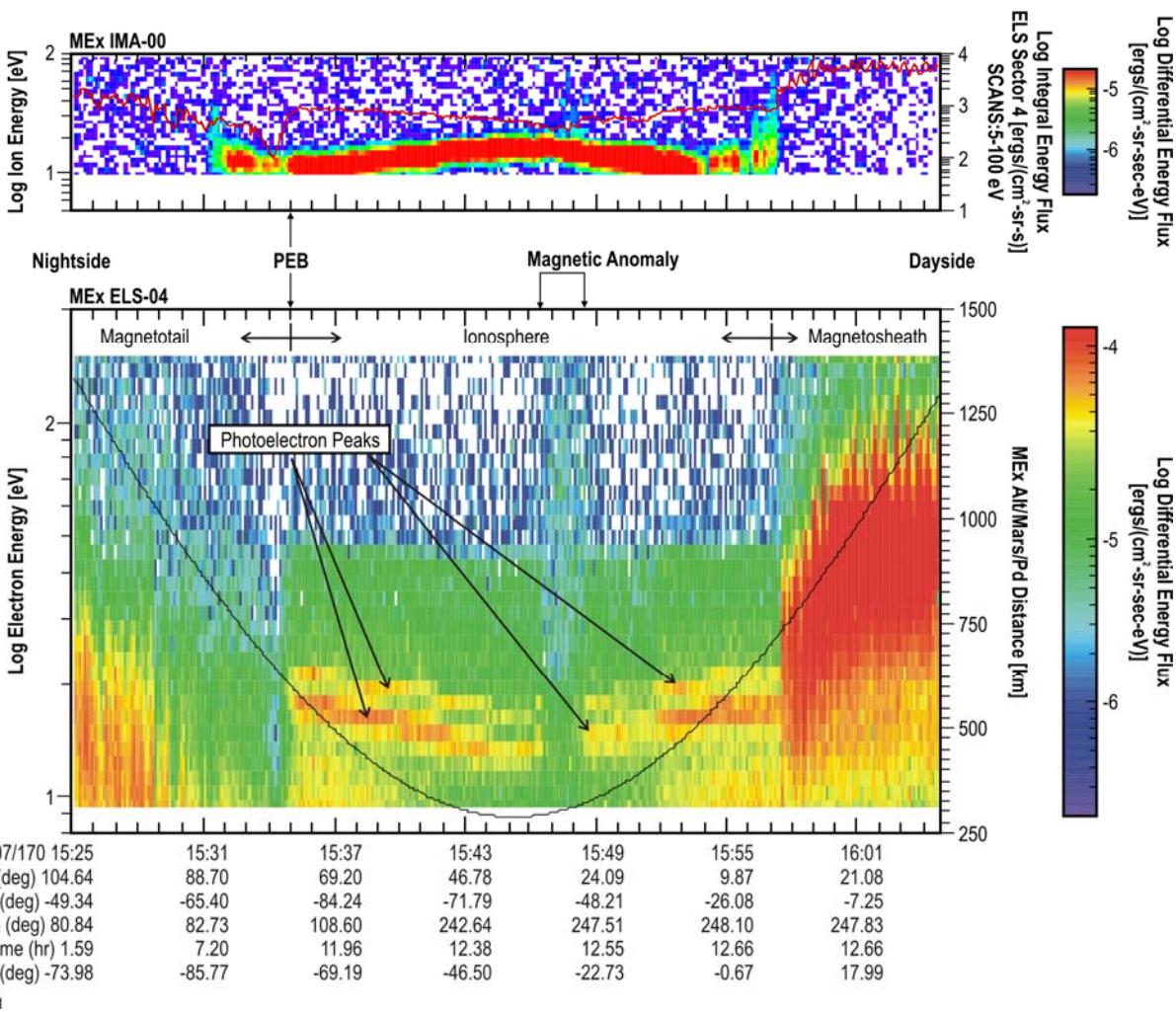
Pericenter at 2007-06-19 15:45:04

Start at 2007-06-19 12:23:30 End at 2007-06-19 19:06:42

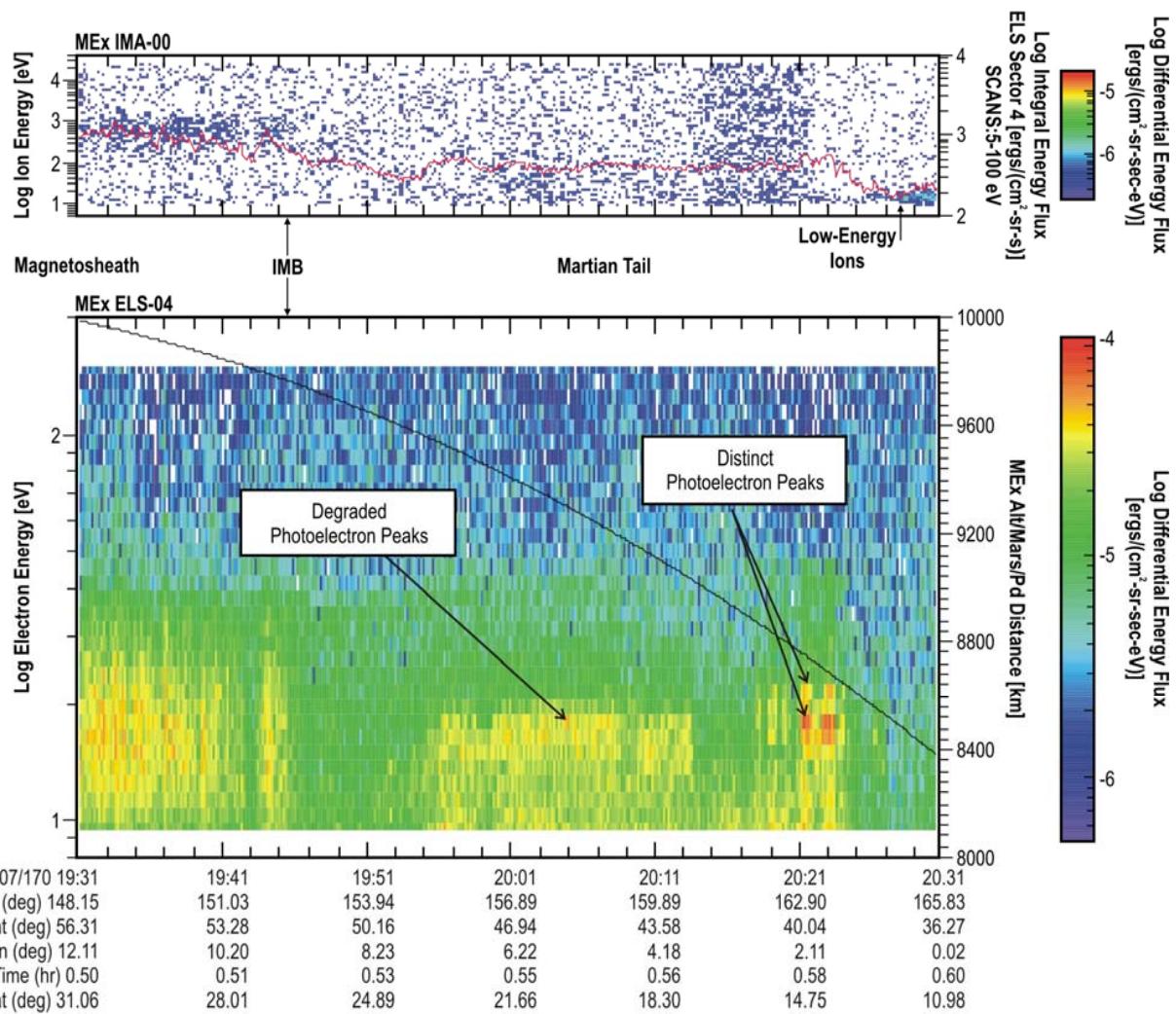


Ta006201

19 June 2007 Ionosphere Plasma

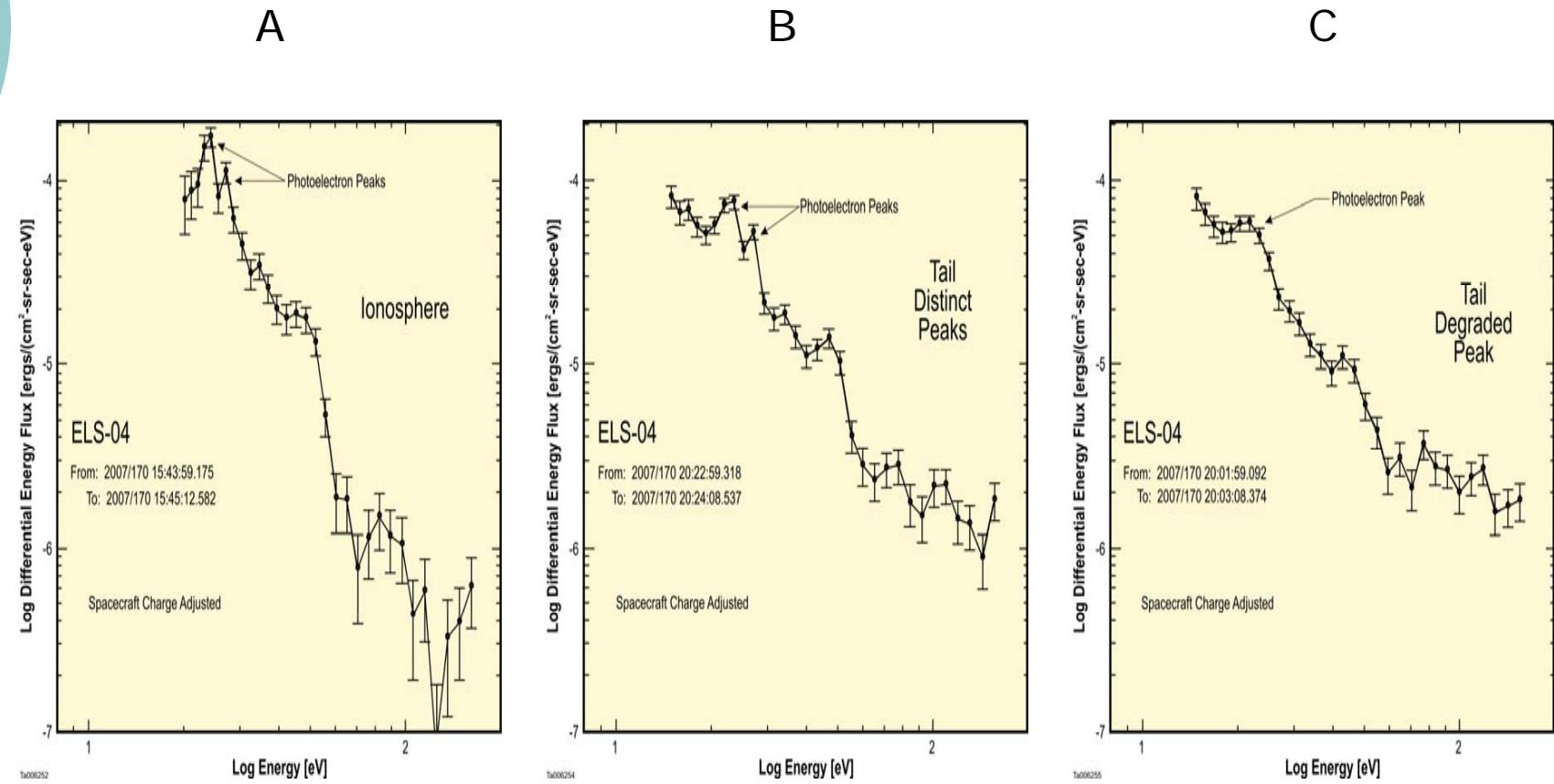


19 June 2007 Tail Plasma



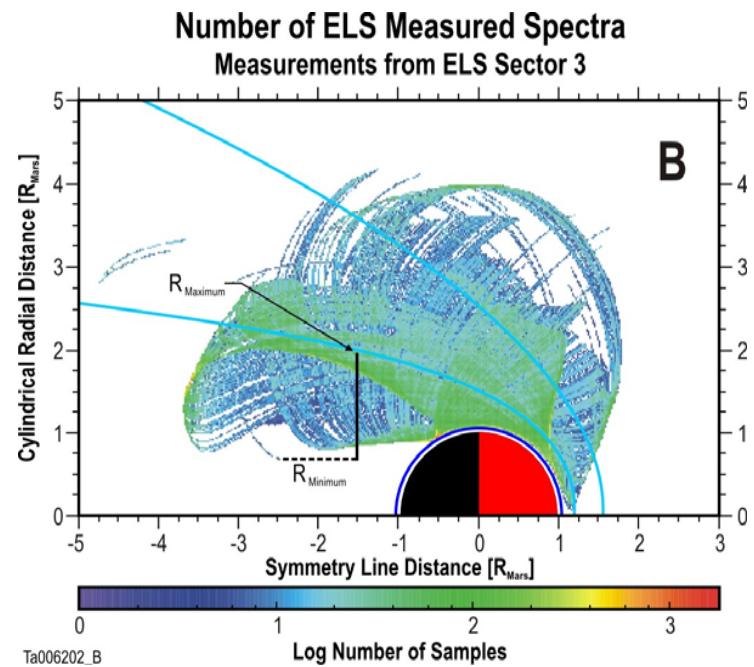
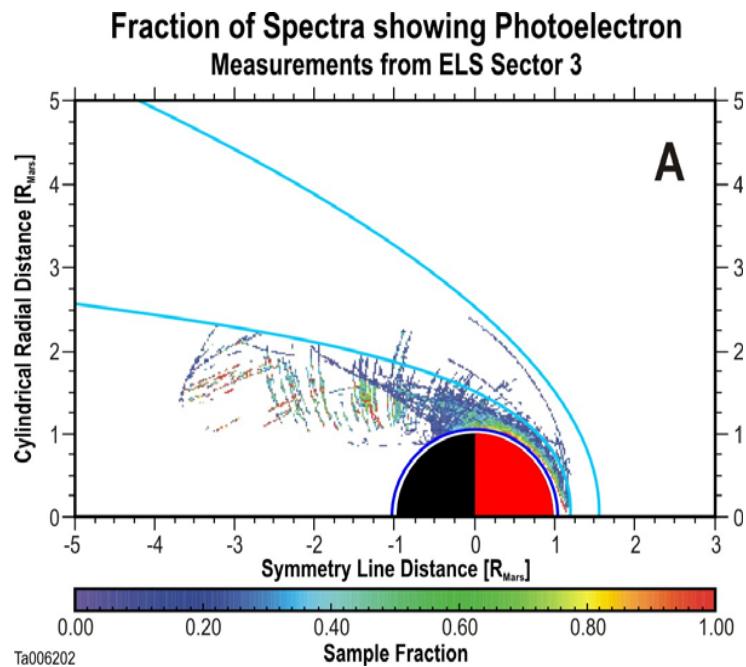
Ta006204

Ionosphere and Tail Electron Spectra



2004 Distinct Photoelectron Statistics

Jan 05, 2004 – Jan 25, 2005



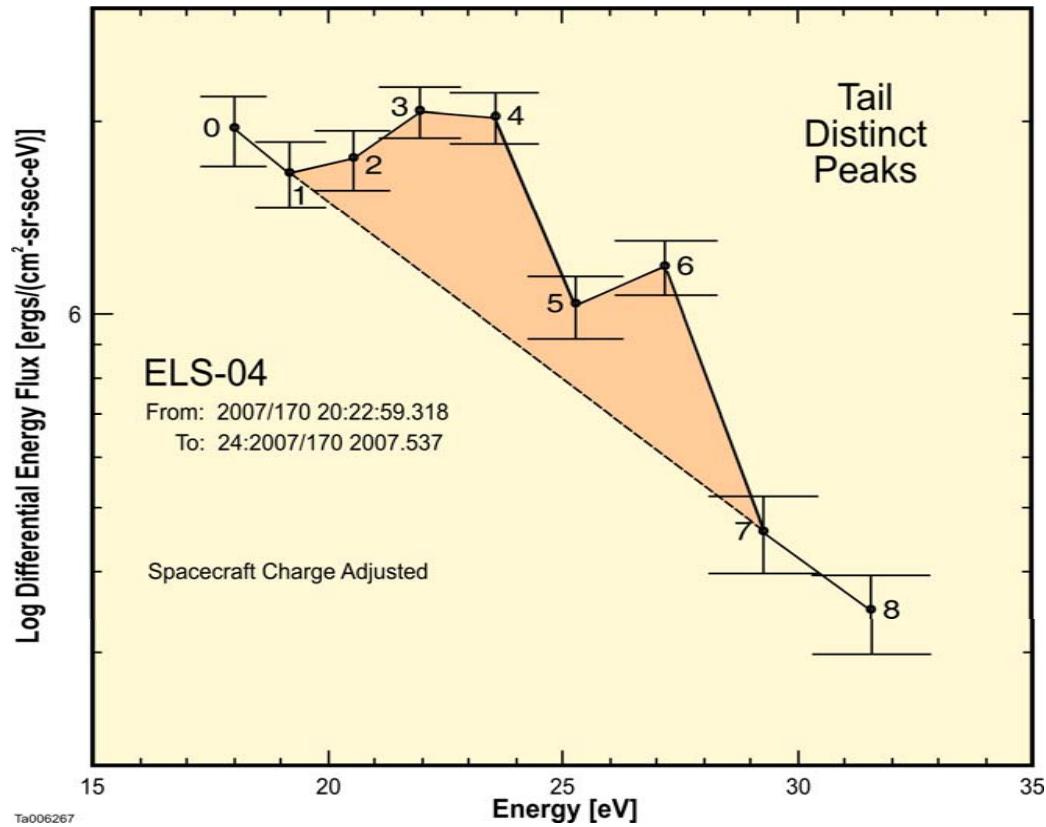
- 81,575 measured spectra less than $1.5 R_{\text{Mars}}$ and below average MPB position
- 7,331 Photoelectron spectra less than $1.5 R_{\text{Mars}}$ and below average MPB position
- ELS measured distinct photoelectron spectra 9% of the time



Tail Area at $1.5 R_{\text{Mars}}$

- $R_{\text{max}} = 6700 \text{ km}$ (average MPB position)
- $R_{\text{min}} = 2850 \text{ km}$ (min measured position)
- Annular Area = $1.16 \times 10^{18} \text{ cm}^2$

Electron Flux Integration Details



Escaping Electron: 5.74×10^6 electrons/(cm² s sr)

Uncertainty: 1.26×10^{26} electrons/(cm² s sr)



Angular Measurement Range

Measurements typically between 1 and 3 ELS sectors.

Average angular area (2 ELS sectors):
 $0.478 \pm 0.235 \text{ sr}$



Conclusion

Electron Outflow

$$= \text{Electron Flux} * \text{Angular Flow} * \text{Escape Area} * \text{Yearly Measured Fraction}$$

$$= 5.74 \times 10^6 * 0.478 * 1.16 \times 10^{18} * 0.09$$

$$= 2.85 \pm 1.53 \times 10^{23} \text{ electrons/s}$$

2004 Electron loss = 15 ± 8 Mmole

Acknowledgement: NASA Contract NASW-00003