The Response of Photoelectrons in the Martian Atmosphere to Variable Solar Input

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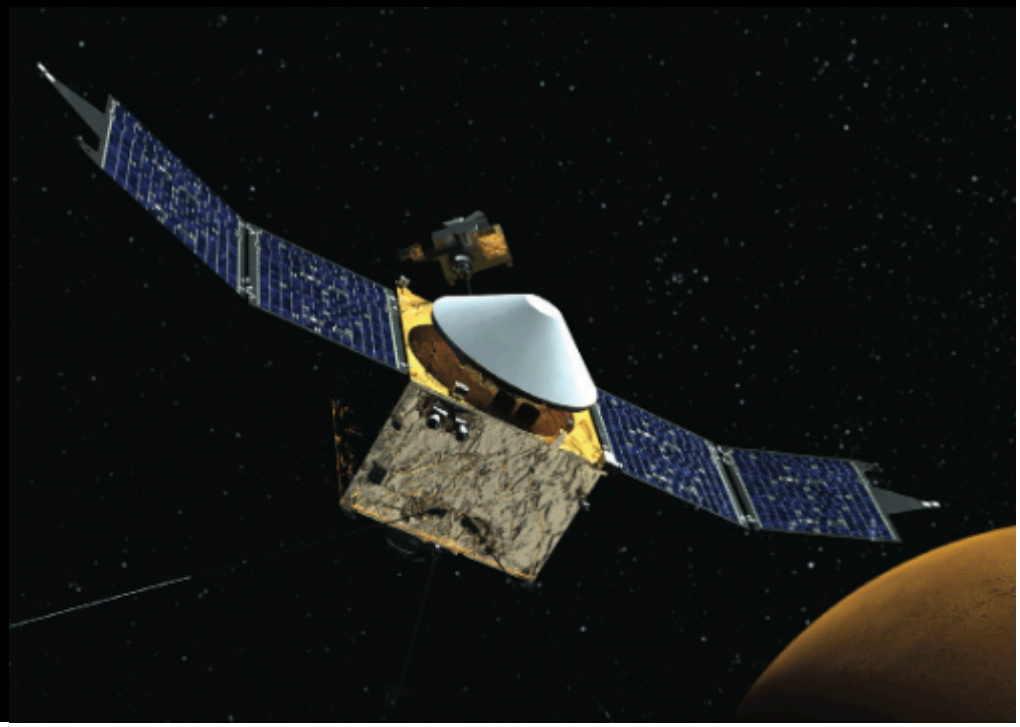
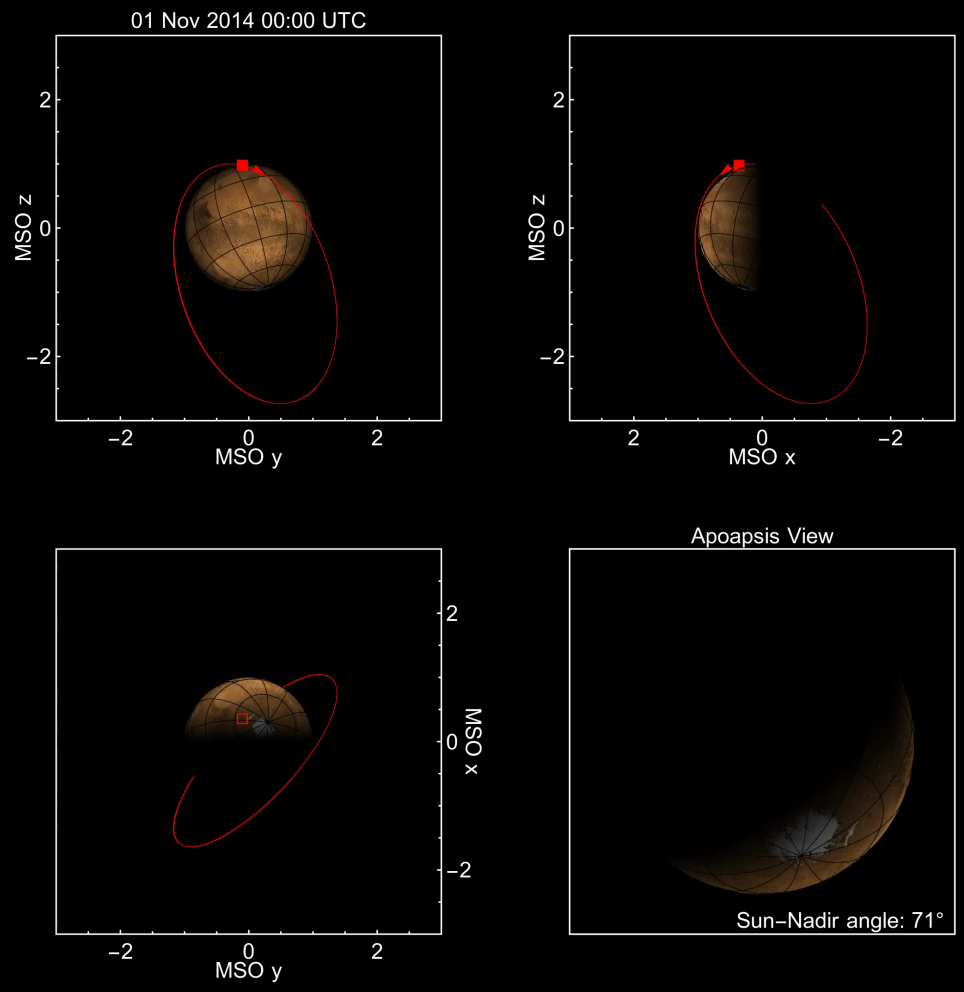




The Mars Atmosphere and Volatile EvolutioN Mission

Launch: November 2013
Obit Insertion: September 2014
Orbit Period: 4.5 Hours

The Ionosphere

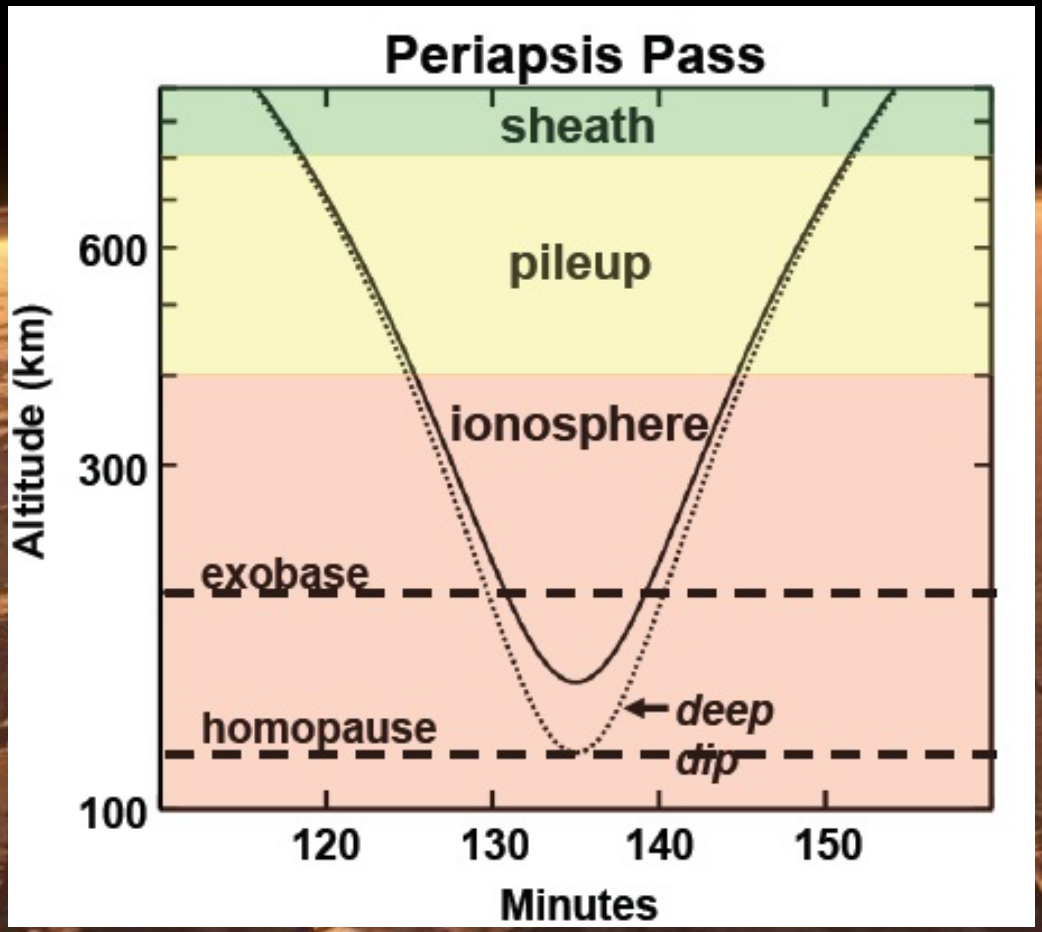
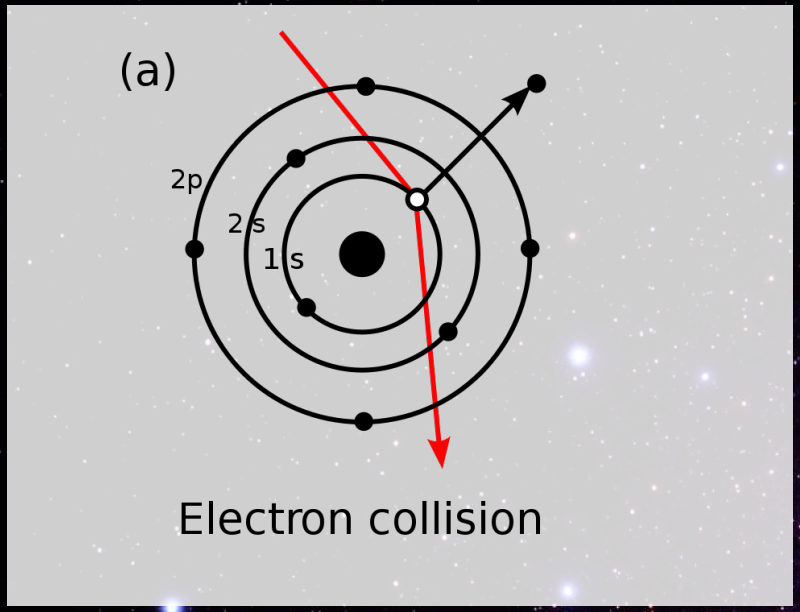


Image Credit: NASA/LASP

The Auger Effect



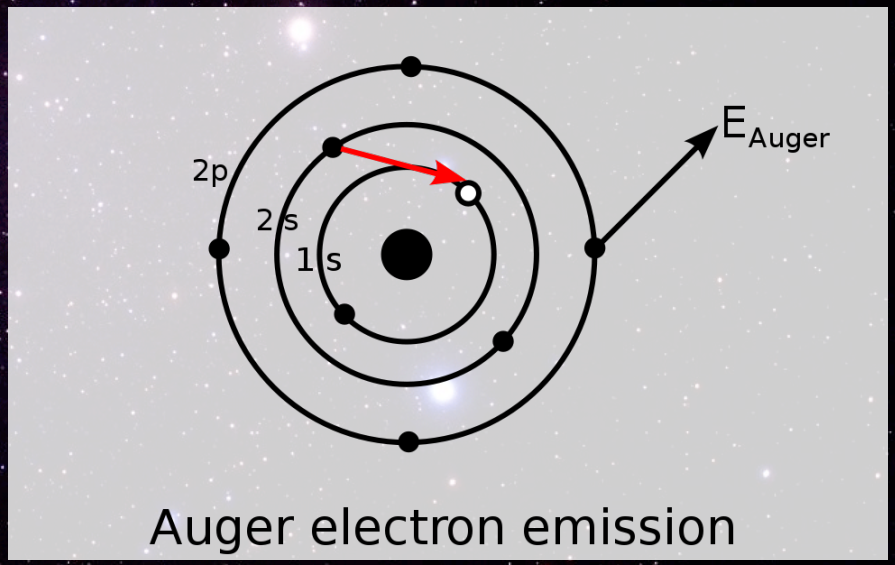
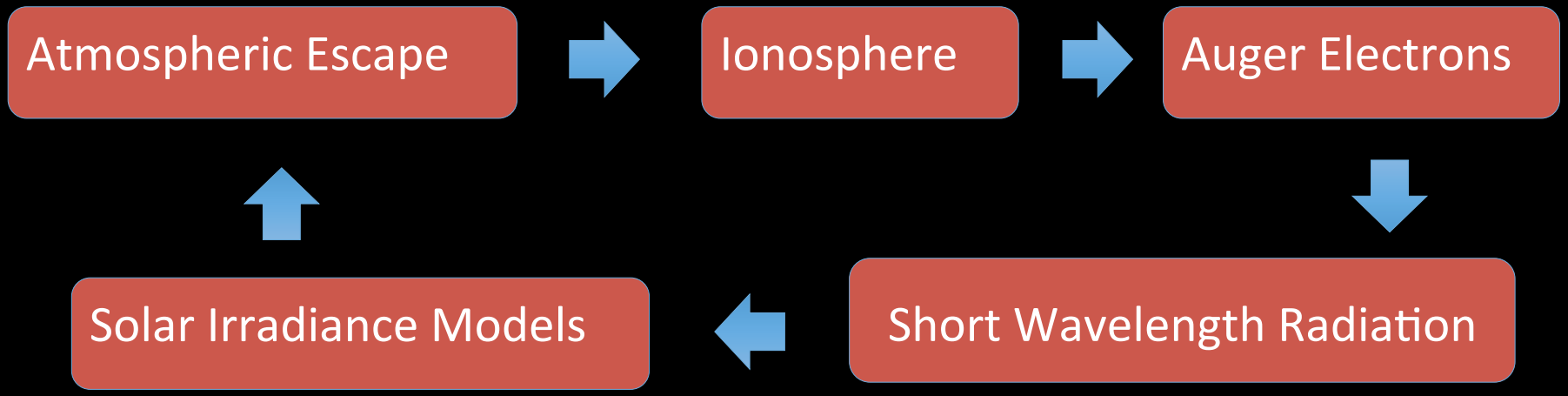


Image Credit: Wikipedia

- Inner Shell Ionization
- Characteristic Energy

What's the Point Again?



EUVM

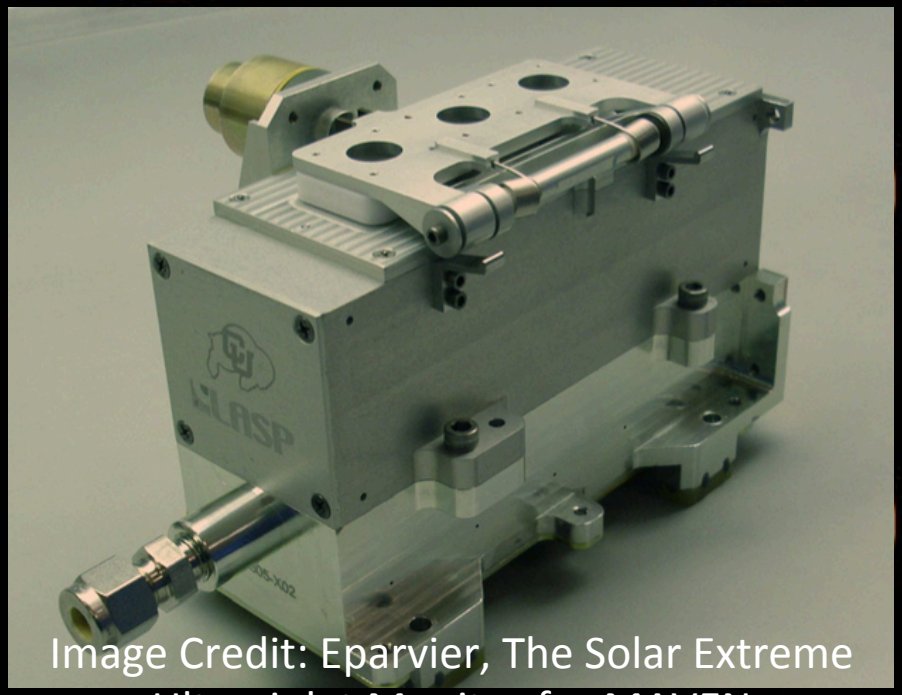


Image Credit: Eparvier, The Solar Extreme Ultraviolet Monitor for MAVEN

SWEA

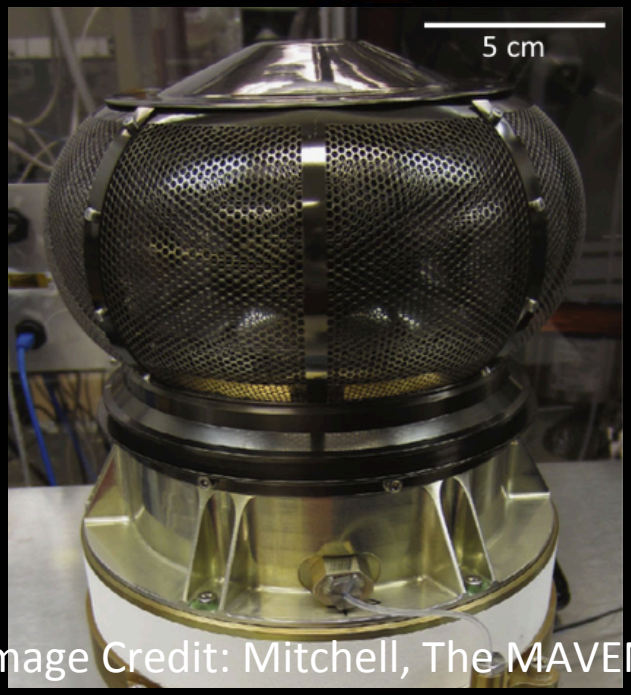
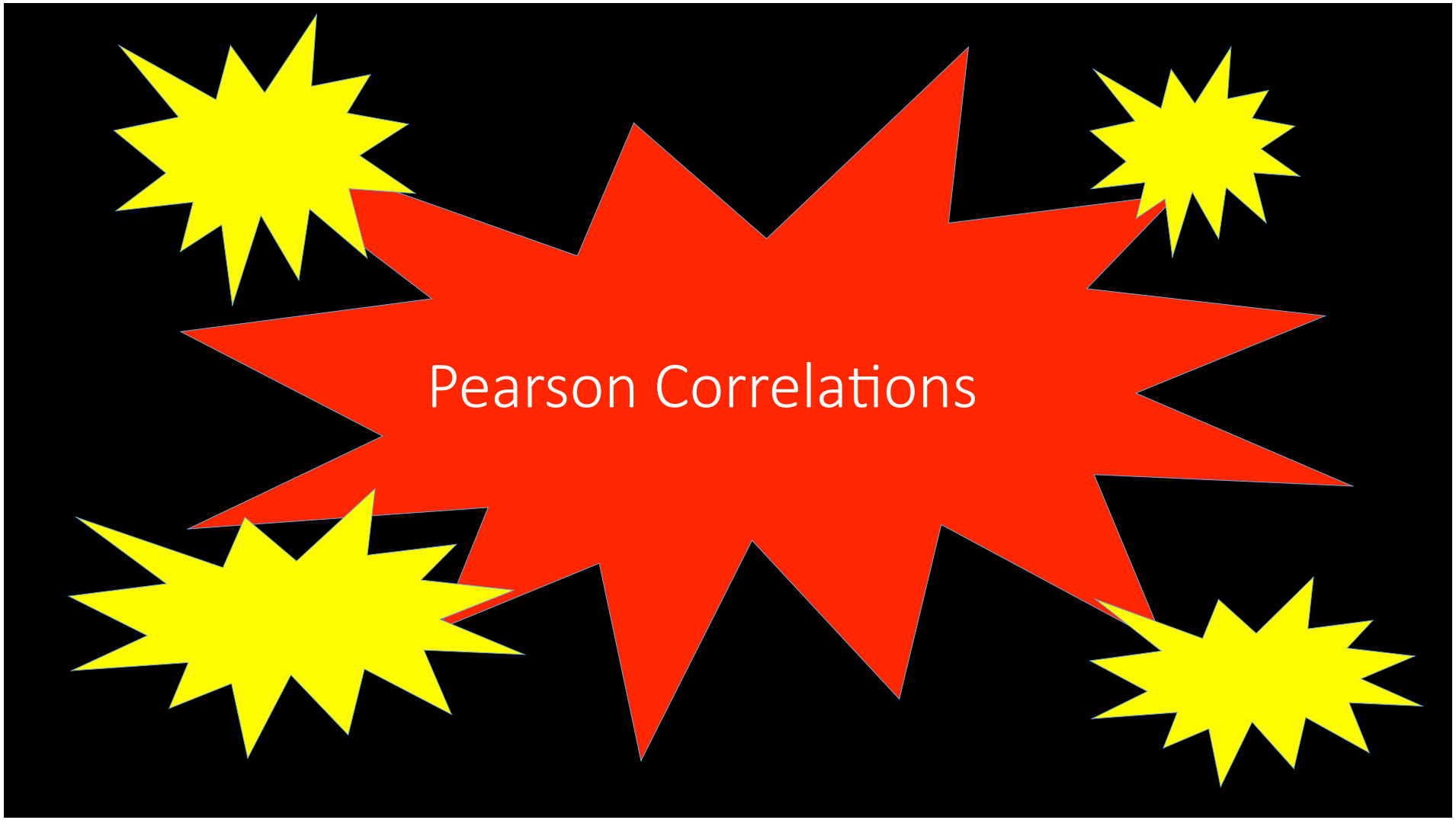


Image Credit: Mitchell, The MAVEN Solar Wind Electron Analyzer

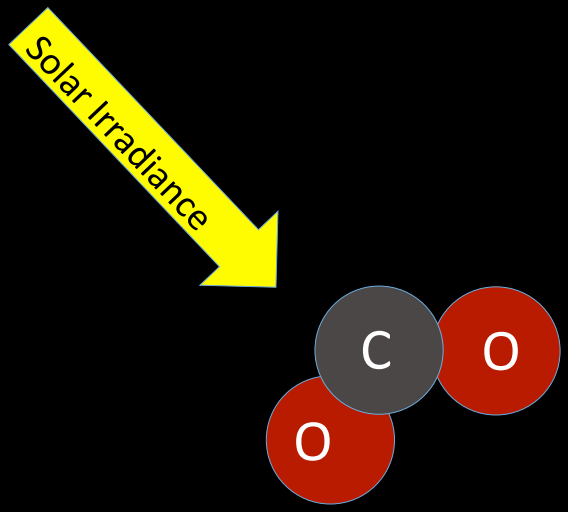
Overall Approach

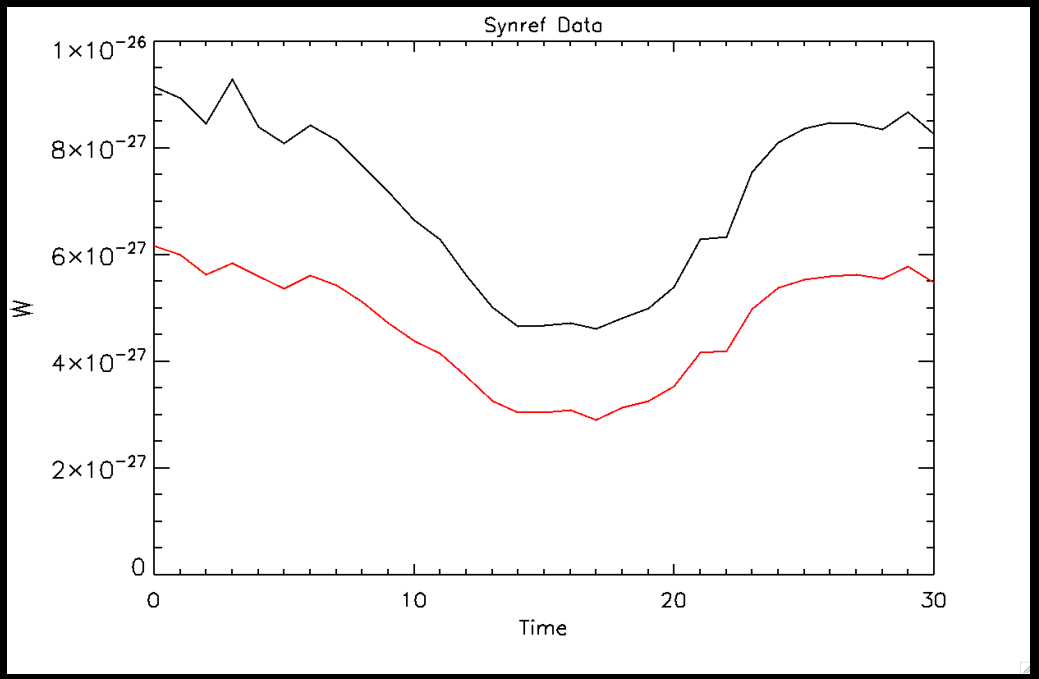
- Compare models to Data
  - 2 Solar Irradiance Models
    - Synthetic Reference (Synref)
    - Flare Irradiance Spectral Model (FISM)
  - 2 sets of measured data
    - EUVM (Irradiance)
    - SWEA (Electron Flux)


Pearson Correlations

Cross Sections

"The effective Target Size"



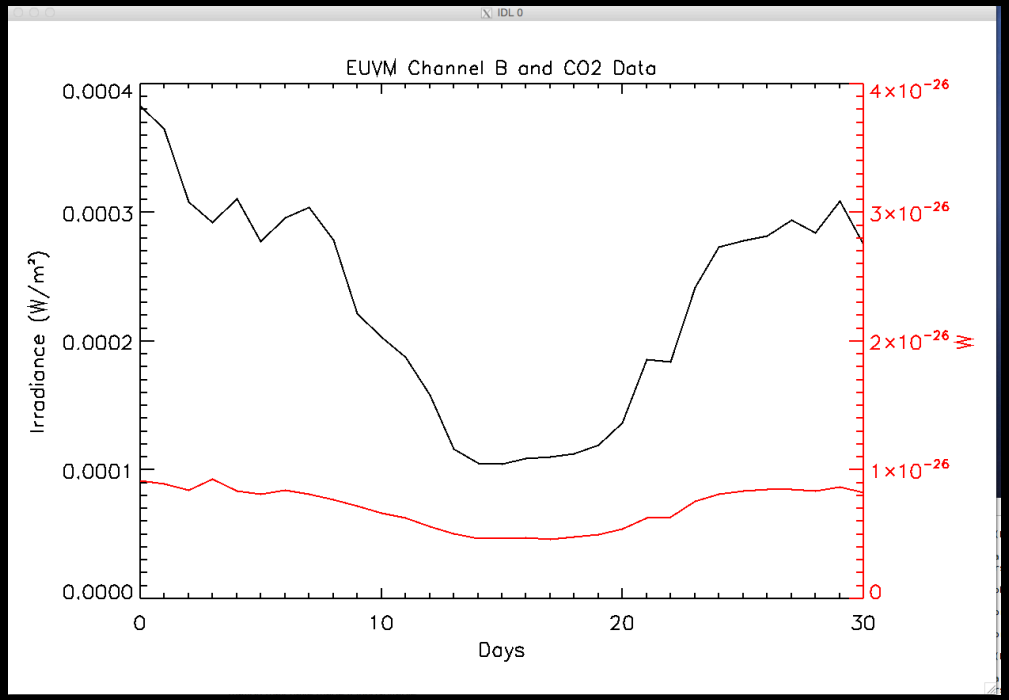


Cross Section/Irradiance convolution

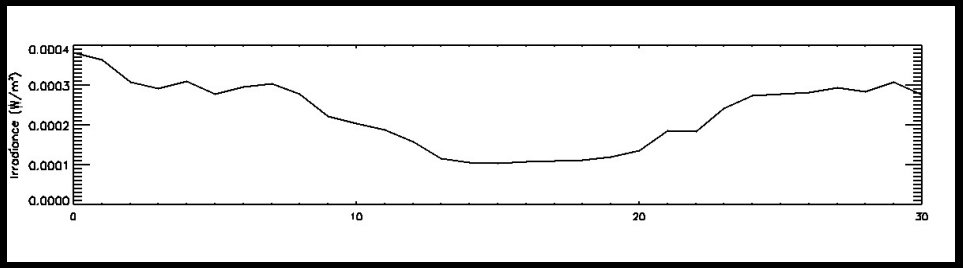
CO2 (black) and O (red)

Correlations with EUVM

Right:
Scaled CO2 convolution and channel B Data
Black: EUVM data
Red: CO2 convolution

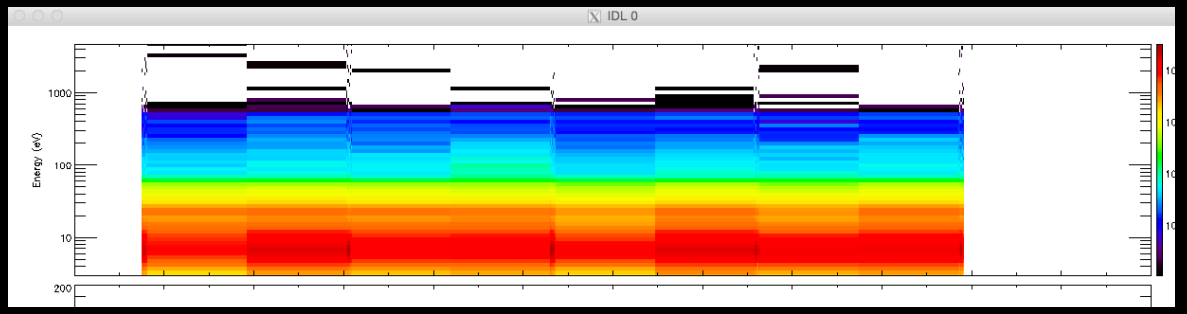


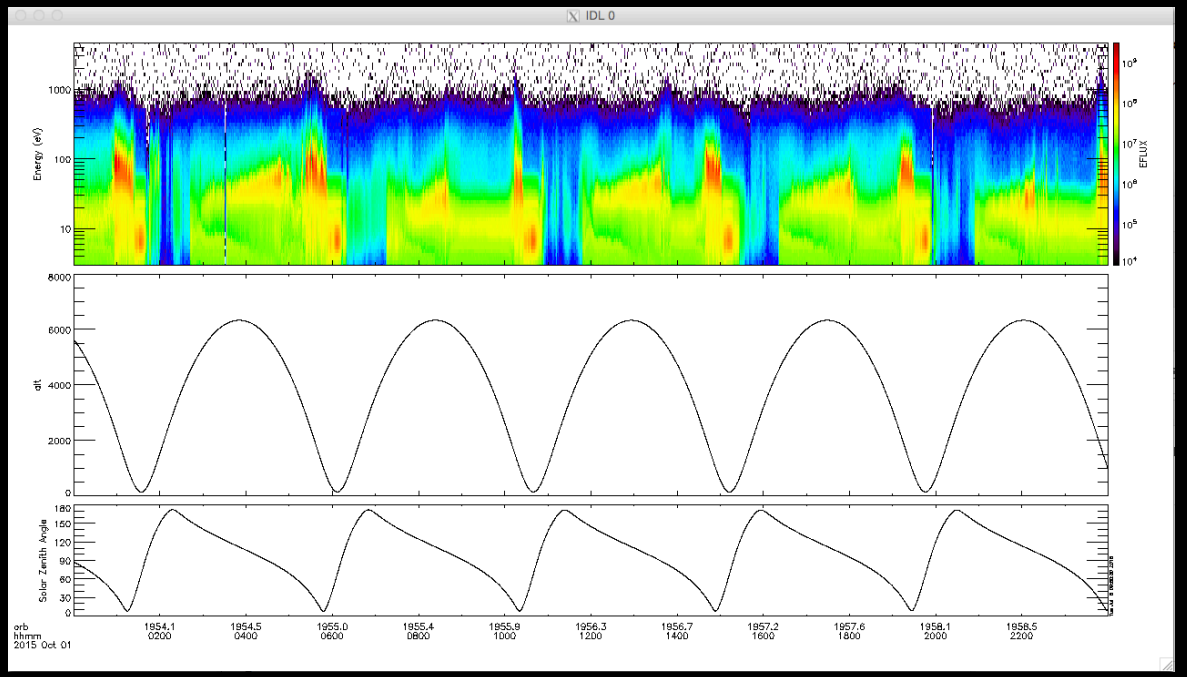
Below: Just EUVM data



Pearson Correlation: 0.978722

Isolating Auger Electrons



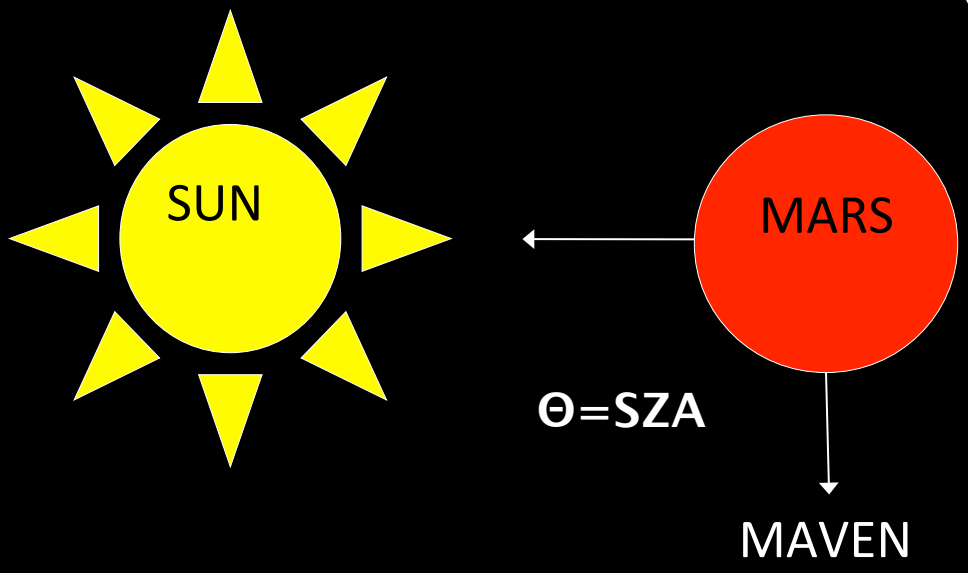


Energy Flux

Altitude

Solar Zenith Angle

Solar Zenith Angle

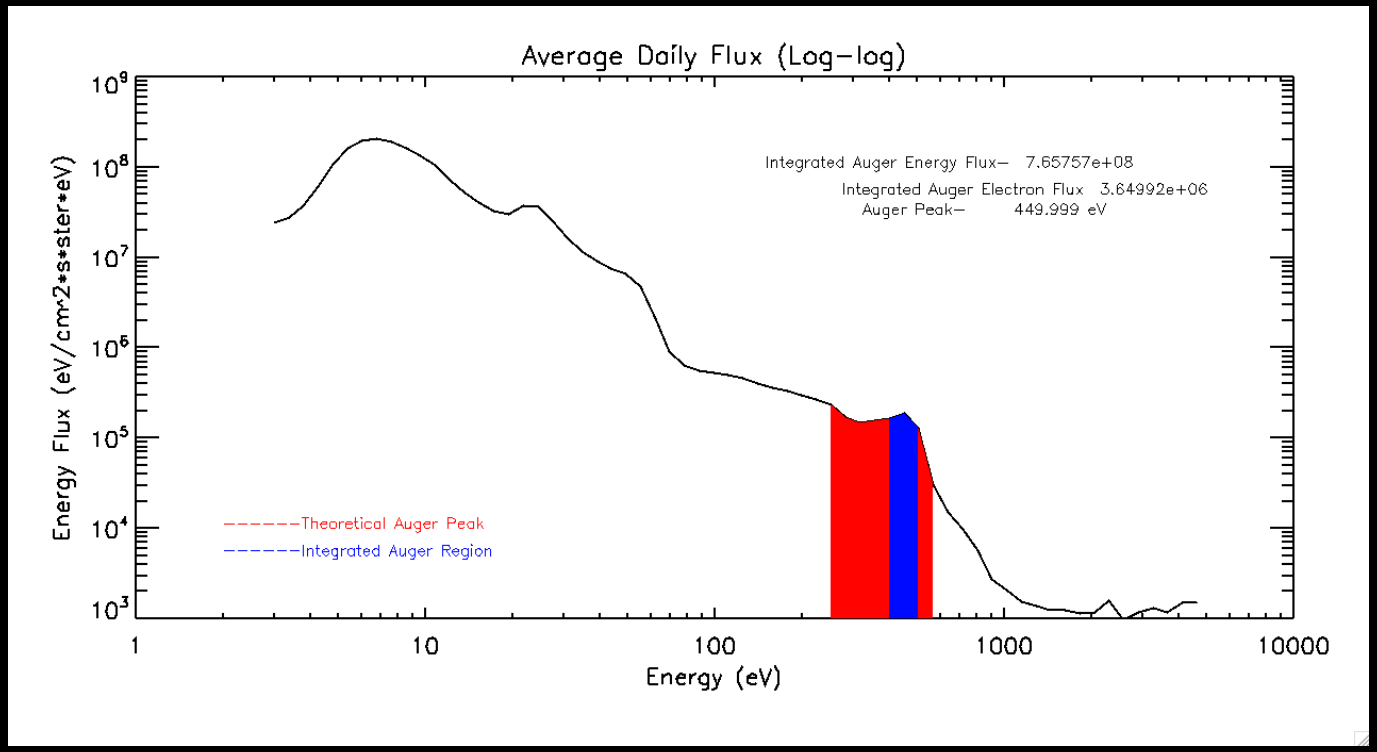


Energy Bins

Auger energies:
CO2- 501 eV
O- 278 eV

SWEA:
64 bins
3-4600 eV

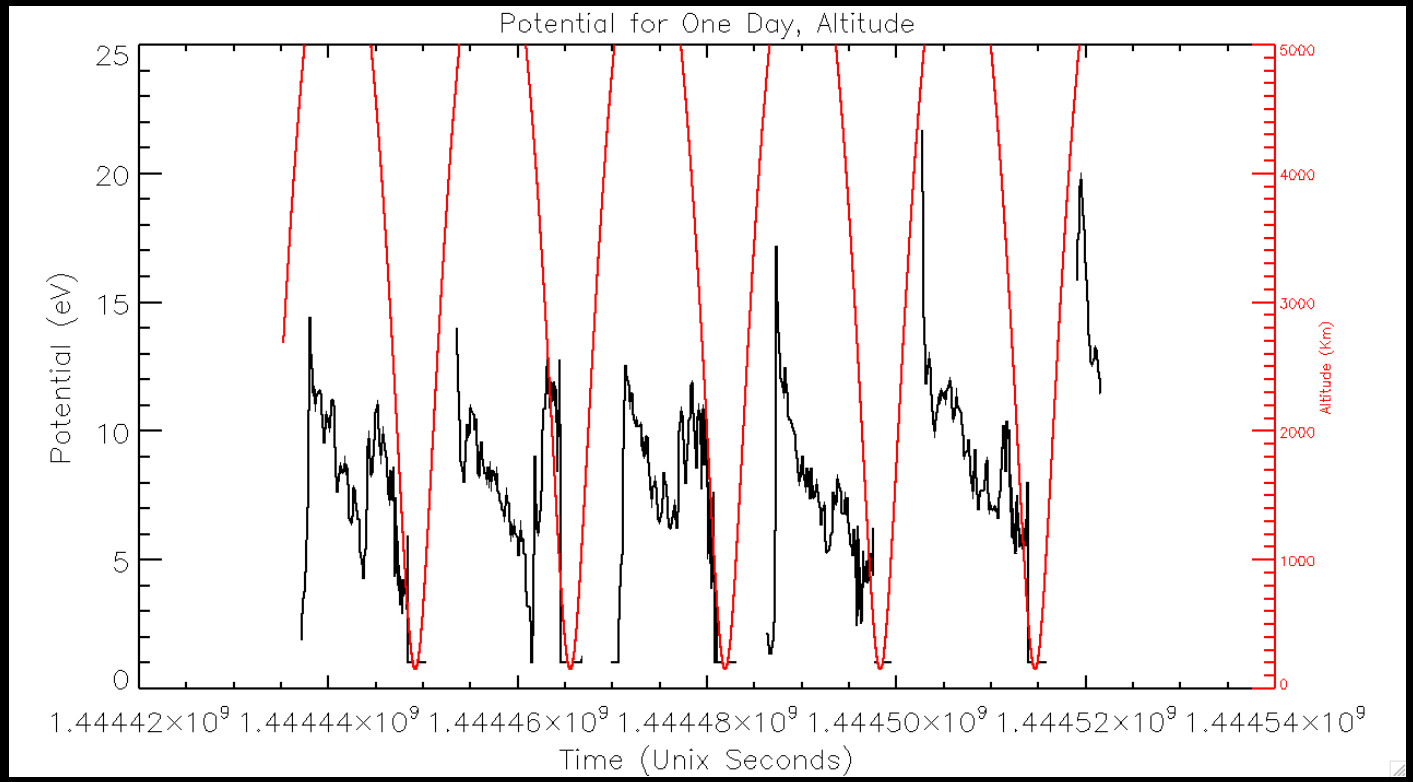
Energy Flux Per Energy Bin



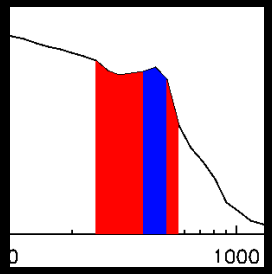
Theoretical Auger Peaks:
CO2: 501 eV
O: 2.. eV
(RED)

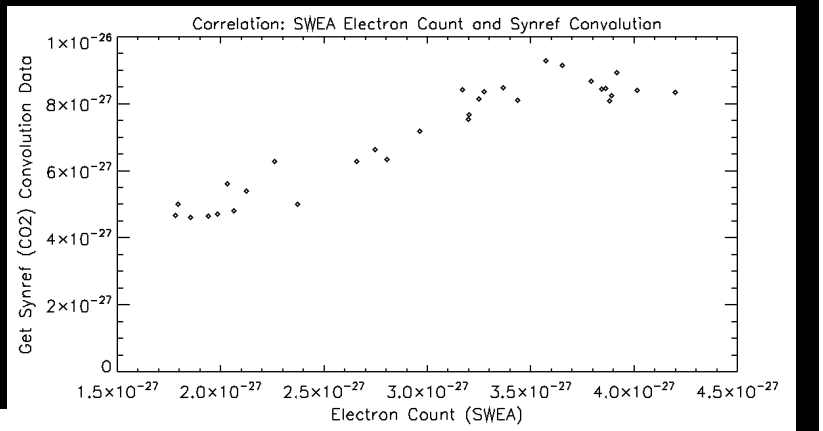
Observed Peak:
449 eV
(BLUE)

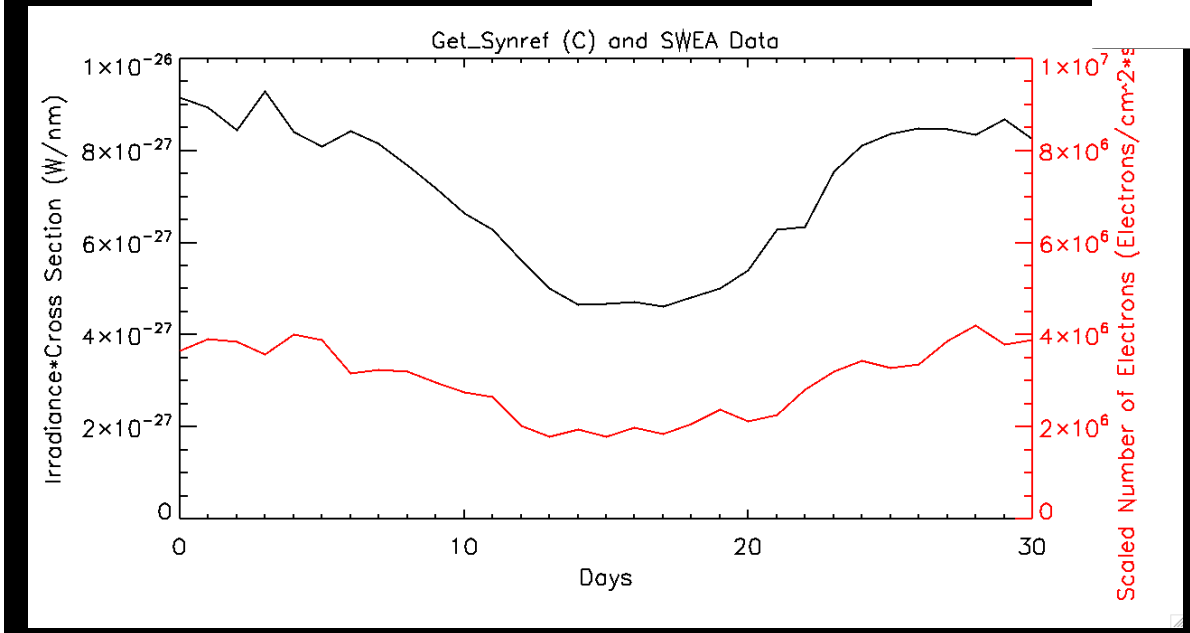
The Potential Problem



Correlations





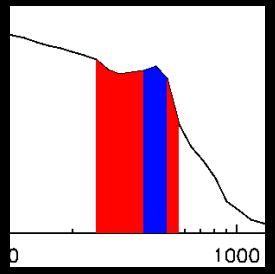


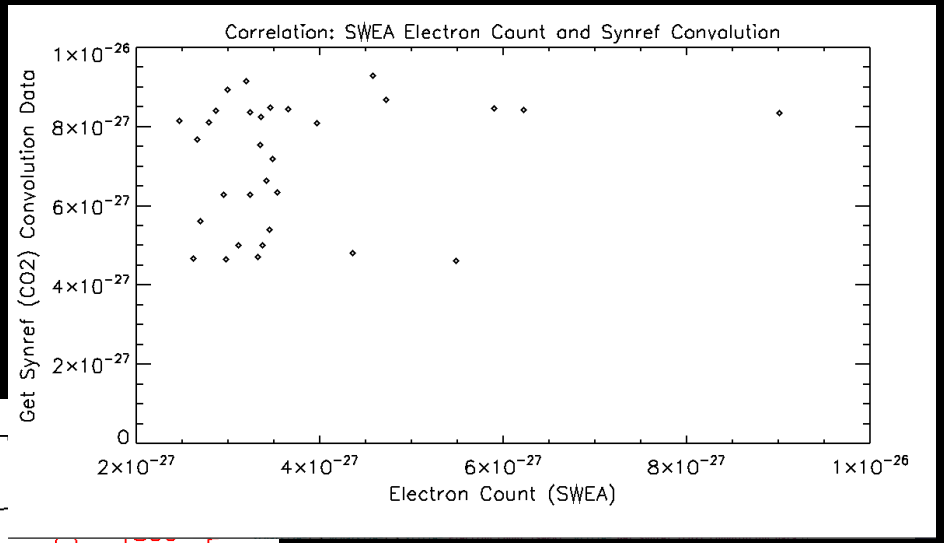
EUVM and SWEA: 0.925578

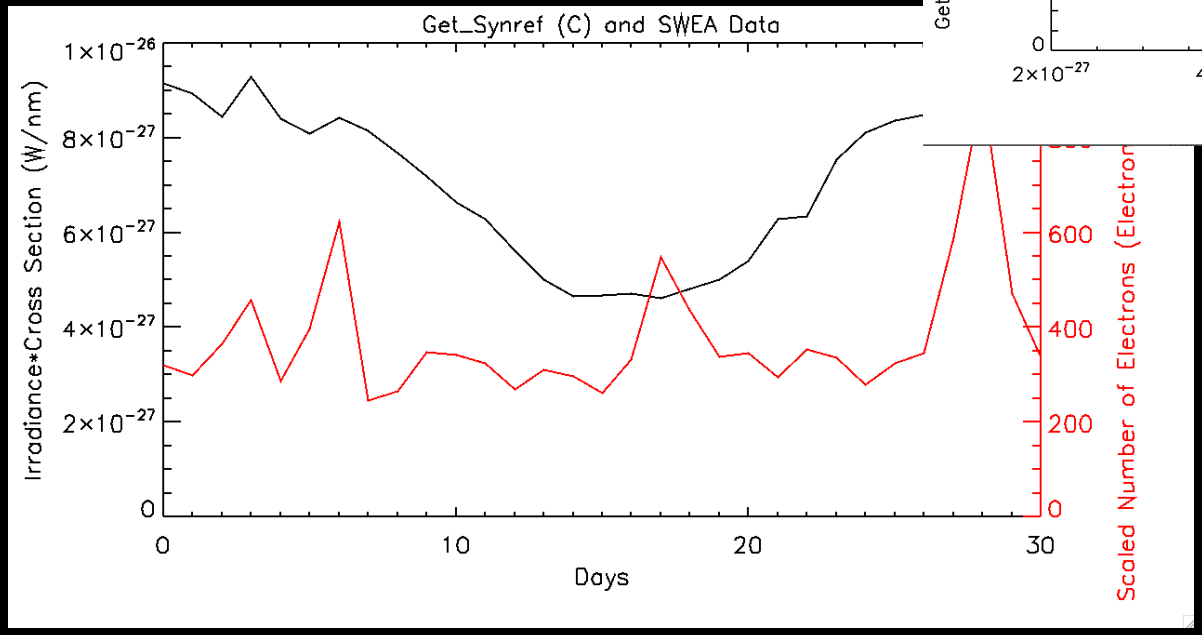
SynRef and SWEA: 0.940046

FISM and SWEA: 0.957628

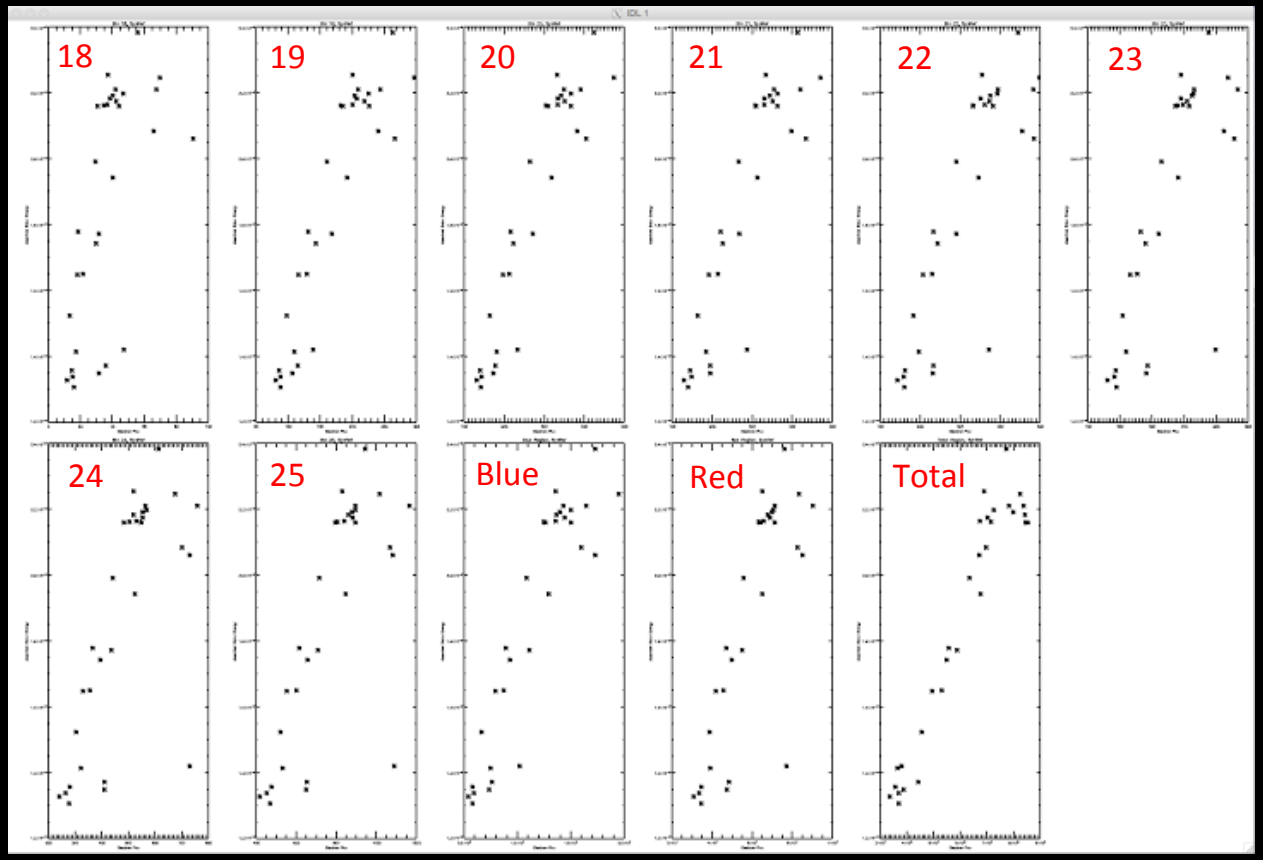
Correlations



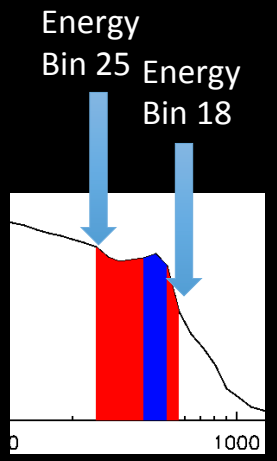




Correlations



64 Energy Bins
Focus: Bins 18-25
18- 568 eV
19- 505 eV
20- 449 eV
21- 400 eV
22- 356 eV
23- 317 eV
24- 282 eV
25- 251 eV

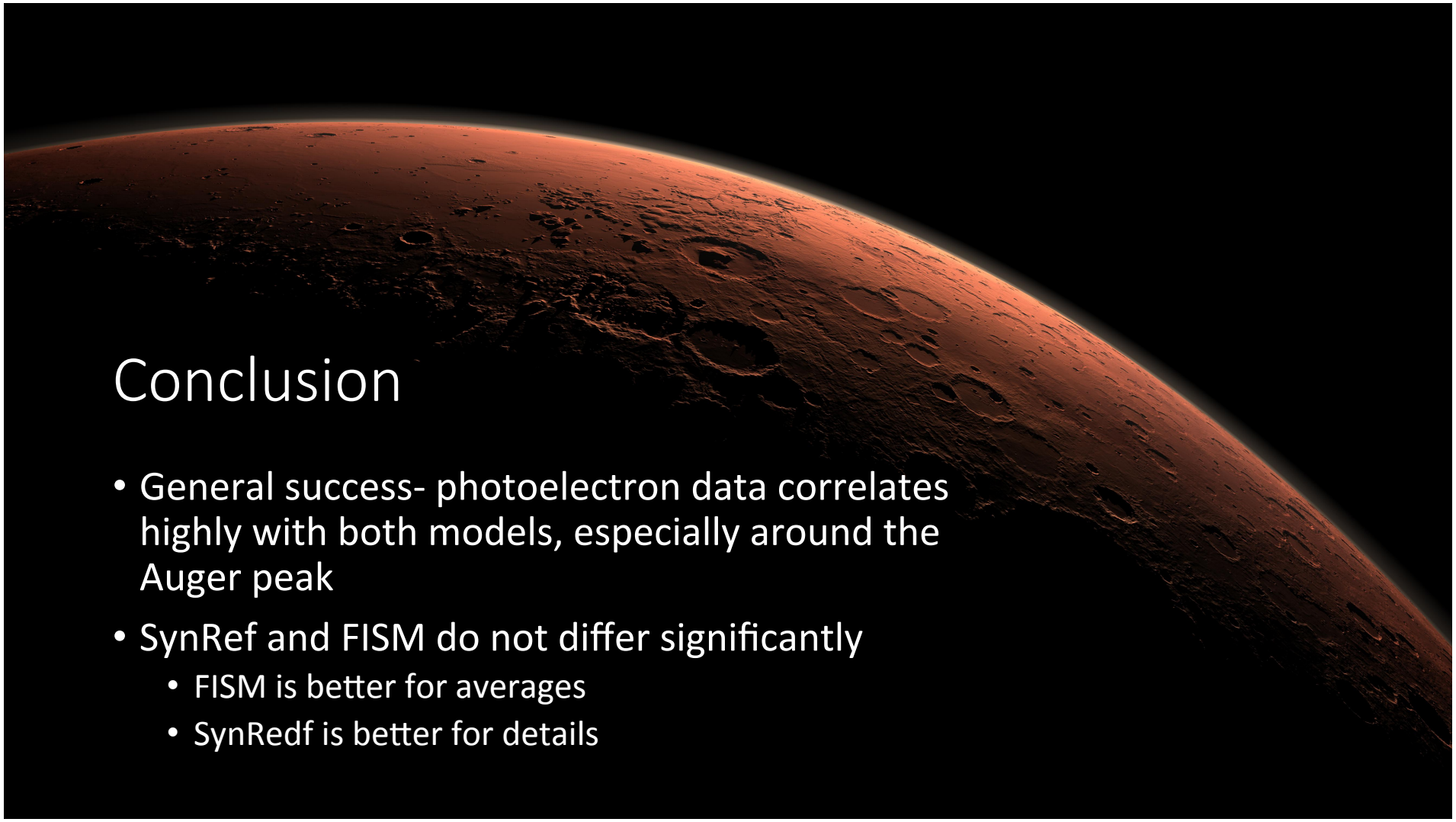


Results

red=max	blue=min	green=peak

SYNREF				
alt (km)	200	250	180	200
sza (degrees)	90	90	90	70
Bin(s)	Correlation with SWEA	Correlation with SWEA	Correlation with SWEA	Correlation with SWEA
18	0.683845	0.683845	0.638655	0.654726
19	0.923751	0.923751	0.908152	0.919146
20	0.936938	0.936938	0.925728	0.935274
21	0.901001	0.901001	0.873045	0.897011
22	0.852452	0.852452	0.805242	0.84368
23	0.779056	0.779056	0.707566	0.768809
24	0.717674	0.717674	0.625654	0.707248
25	0.749037	0.749037	0.665677	0.740579
blue	0.924437	0.924437	0.907729	0.9213
red	0.812154	0.812154	0.749851	0.803652
total	0.941417	0.941417	0.930094	0.939224

FISM				
alt (km)	200	250	180	200
sza (degrees)	90	90	90	70
Bin(s)	Correlation with SWEA	Correlation with SWEA	Correlation with SWEA	Correlation with SWEA
18		0.65978	0.623587	0.640211
19		0.909285	0.89713	0.90799
20		0.927415	0.918509	0.927104
21		0.89359	0.869282	0.891273
22		0.847679	0.805603	0.840915
23		0.776093	0.71189	0.769613
24		0.714127	0.630102	0.707645
25		0.747452	0.672055	0.743148
blue		0.914244	0.900567	0.913077
red		0.811117	0.756011	0.806484
total		0.956686	0.947641	0.958062



Conclusion

- General success- photoelectron data correlates highly with both models, especially around the Auger peak
- SynRef and FISM do not differ significantly
  - FISM is better for averages
  - SynRedf is better for details

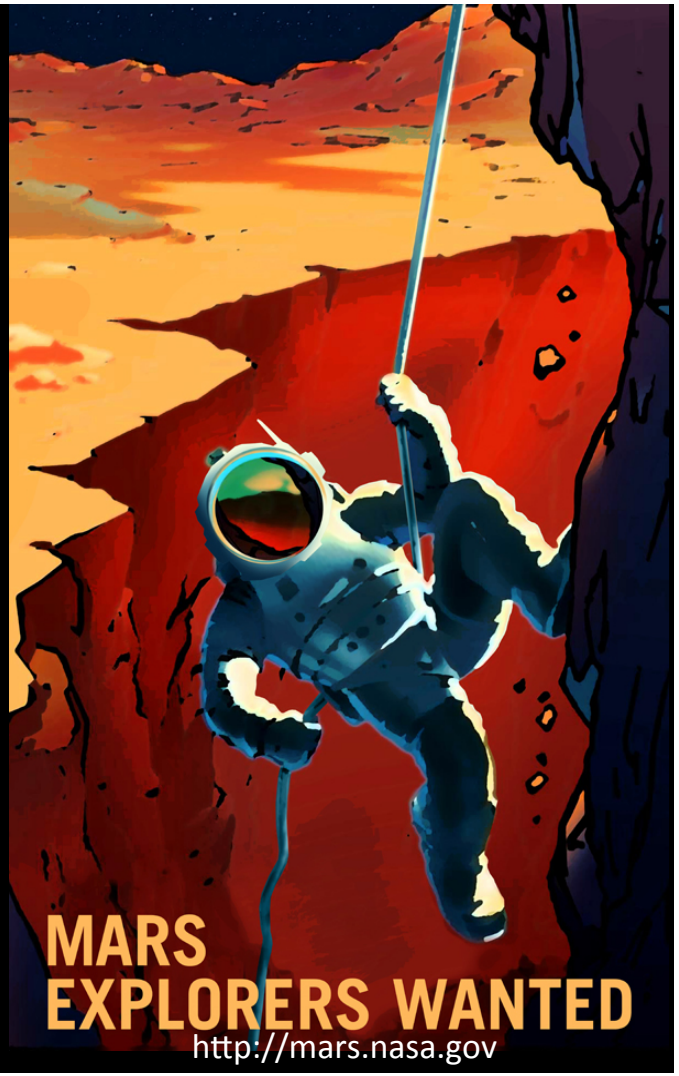
Future Research

Short Term

- Slope of Correlation plots
- Correlate models with SWEA with more combinations of SZA and altitude

Long Term

- Adjust models for higher correlation
  - Temperature assumptions



QUESTIONS?

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References

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- Mitchell, D.L., Mazelle, C., Sauvaud, J.-A., Thocaven, J.-J., Rouzaud, J., Fedorov, A., Rouger, P., Toublanc, D., Taylor, E., Gordon, D., Robinson, M., Heavner, S., Turin, P., Diaz-Aguado, M., Curtis, D.W., Lin, R.P., Jakosky, B.M., 2016. The MAVEN Solar Wind Electron Analyzer. Space Science Reviews Space Sci Rev 200, 495–528. doi:10.1007/s11214-015-0232-1

QUESTIONS