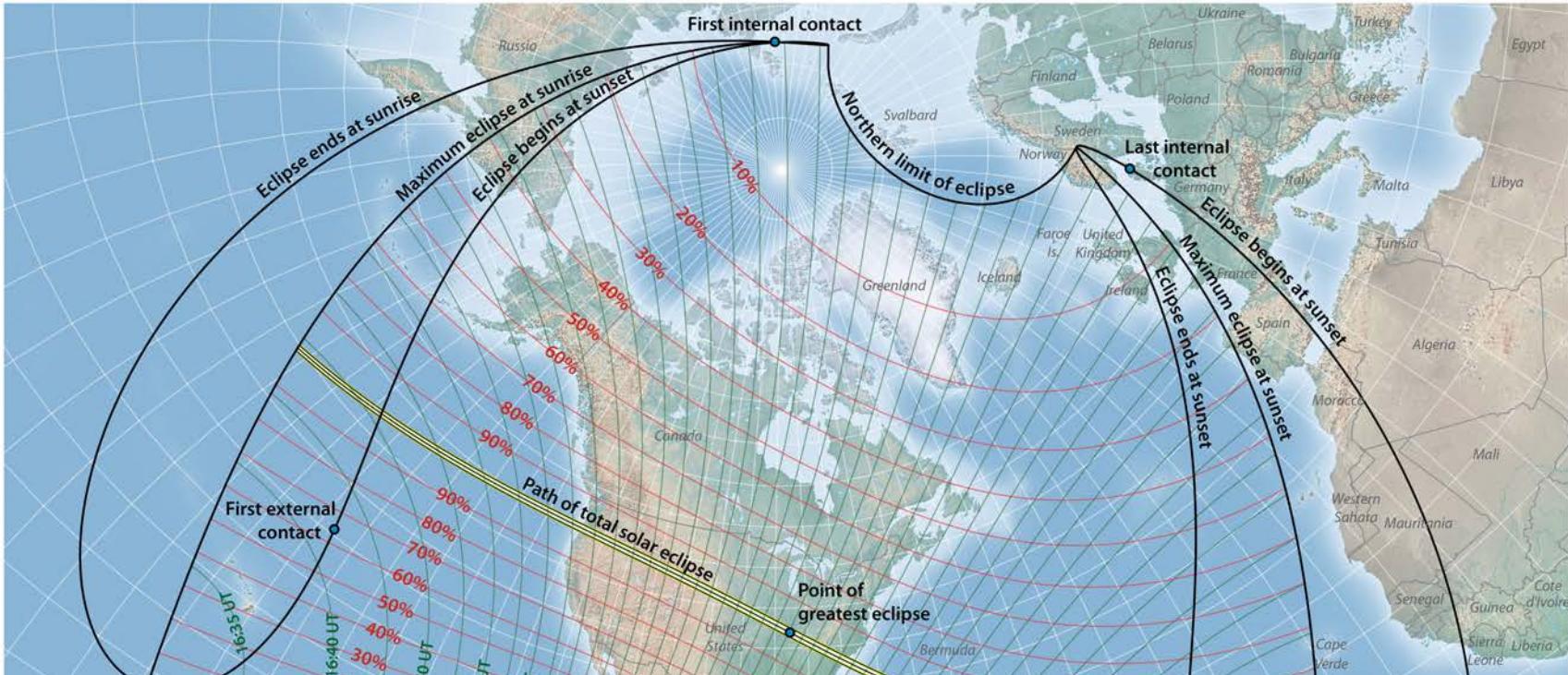


# Total Solar Eclipse: August 21, 2017



Intro (Shunrong Zhang)

- **Doug Drob:** The 2017 Solar Eclipse; Influence on the Thermosphere/Ionosphere
- **Joe Huba:** SAMI3 prediction of the impact of the August 21, 2017 total solar eclipse on the ionosphere-plasmasphere system
- **Robert Marshal:** Studying the D-region ionosphere response to the total solar eclipse through data and modeling
- **Nathaniel Frissel:** HamSCI and the 2017 Total Solar Eclipse
- **Anthea Coster:** Differential Total Electron Content as observed by past solar eclipses
- **Shunrong Zhang:** Incoherent scatter radar observations of solar eclipses

# AUG Fall 2017

## SA007: Solar Eclipse Effects on the Upper

**SA007:**  
**Solar Eclipse Effects on the Upper Atmosphere**

Submit an Abstract to [this Session](#)

**Official Abstract Deadline:**  
**August 2, 2017**

**but please stay stunned!**

**Session ID#:** 26657

**Session Description:**

For the first time in 26 years, a total solar eclipse will occur in the North American on 21 August 2017. During the eclipse-induced sudden interruption in solar illumination, the upper atmosphere will undergo significant changes beyond what a normal sunset and sunrise process would generate. Although eclipse effects have been studied for many decades, recent major advances in modern observational techniques can provide timely new information on eclipse upper atmospheric system response. Global numerical models have become more capable of capturing important coupling processes on various scales. This session will review existing theories and knowledge of eclipse upper atmospheric effects, examine these against modern eclipse observations, in particular during 21 August 2017, and identify unresolved and challenging problems for future research. We welcome contributions addressing scientific questions of the ionospheric, thermospheric and mesospheric variations during a solar eclipse using ground-based and in situ measurements as well as numerical models.

**Primary Convener:**

**Shunrong Zhang**, MIT Haystack Observatory, Westford, MA, United States

**Conveners:**

**Larisa P Goncharenko**, Massachusetts Institute of Technology, Cambridge, MA, United States  
and **Libo Liu**, IGG Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

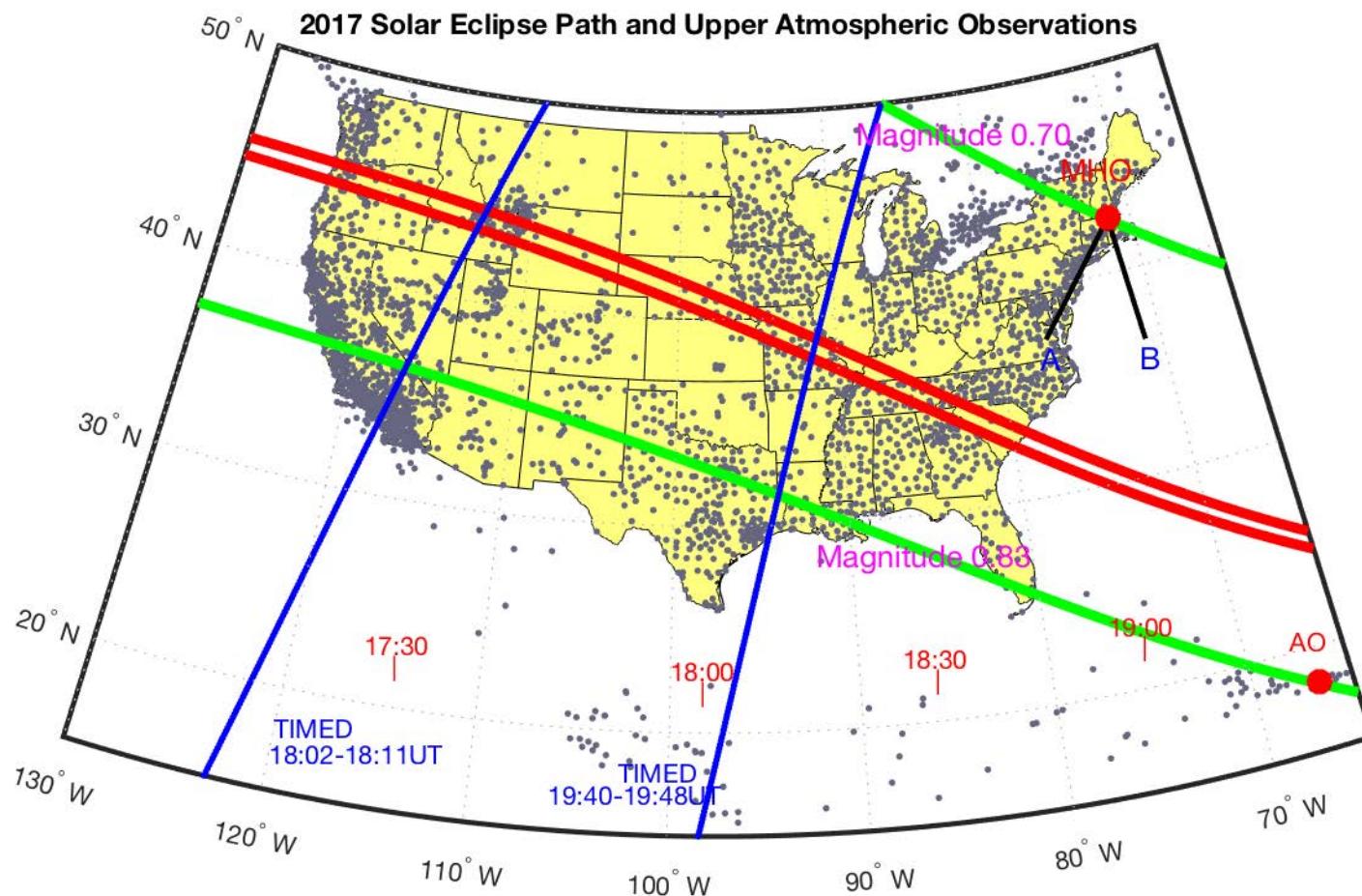
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# Solar eclipse-induced changes in the ionosphere over the continental US

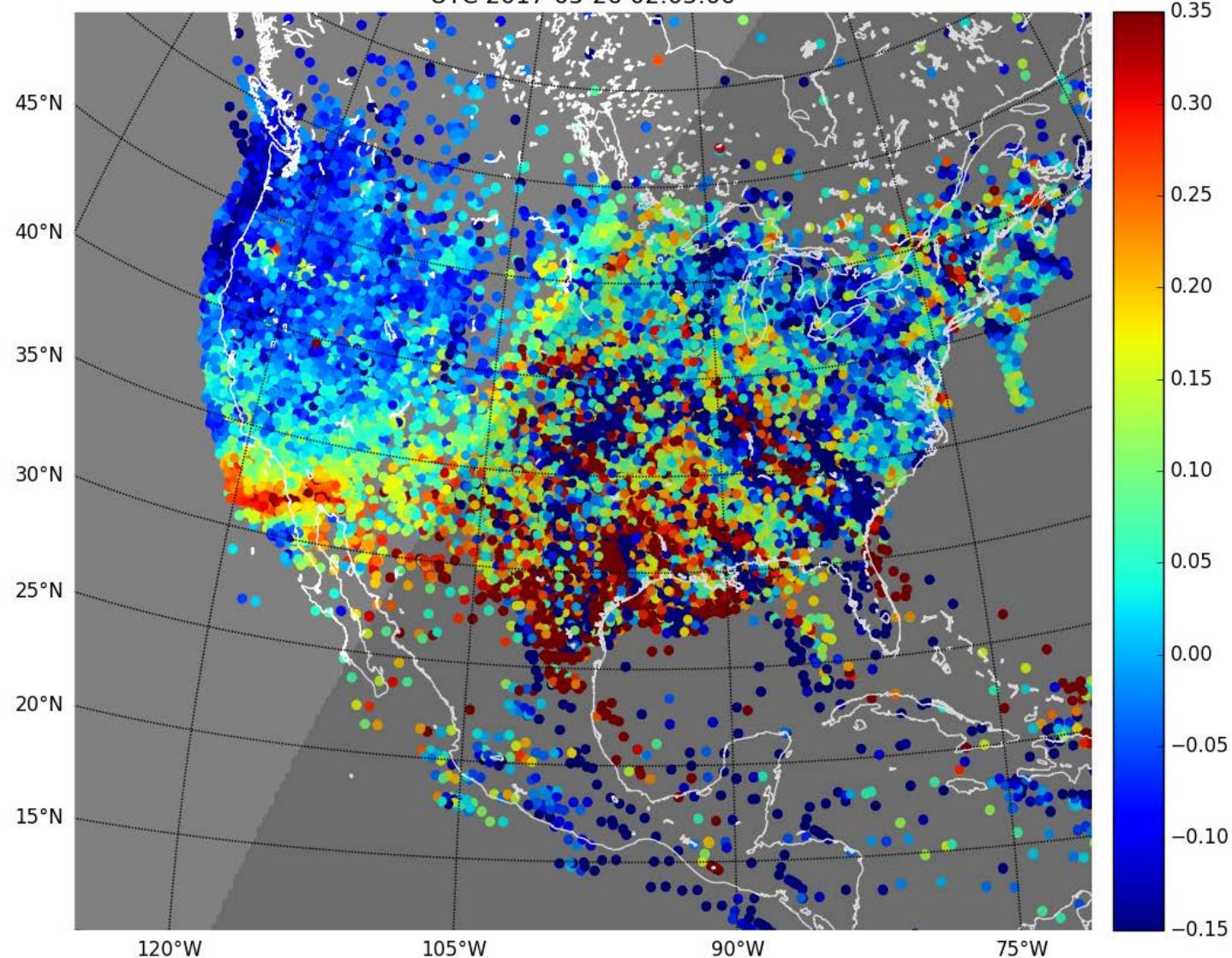
---- **incoherent scatter radar observations**

Shunrong Zhang

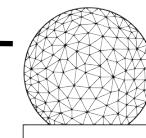
Anthea Coster, Phil Erickson, Larisa Goncharenko



UTC 2017-05-26 02:05:00



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# May 30, 1984 @ Millstone Hill

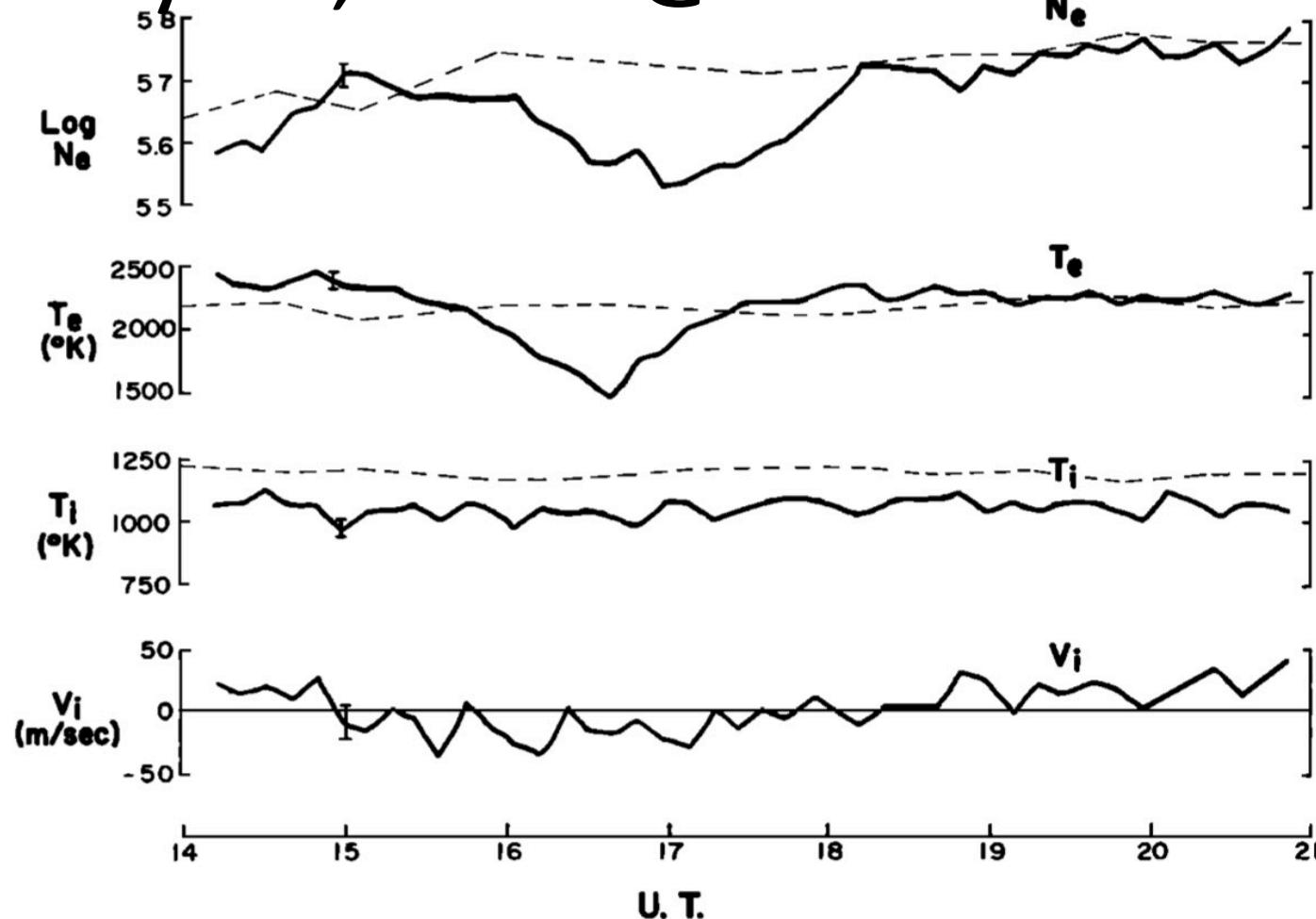


Fig. 3. A slice at an altitude of 300 km showing for May 30, 1984 (solid curves), the temporal variation of the electron density and temperature and the ion temperature and drift velocity for the same conditions as Figure 2. The dashed curves represent reference adjusted measurements (see text) made on May 16, 1984, a normal geomagnetically quiet day.

Salah et al. (1986)

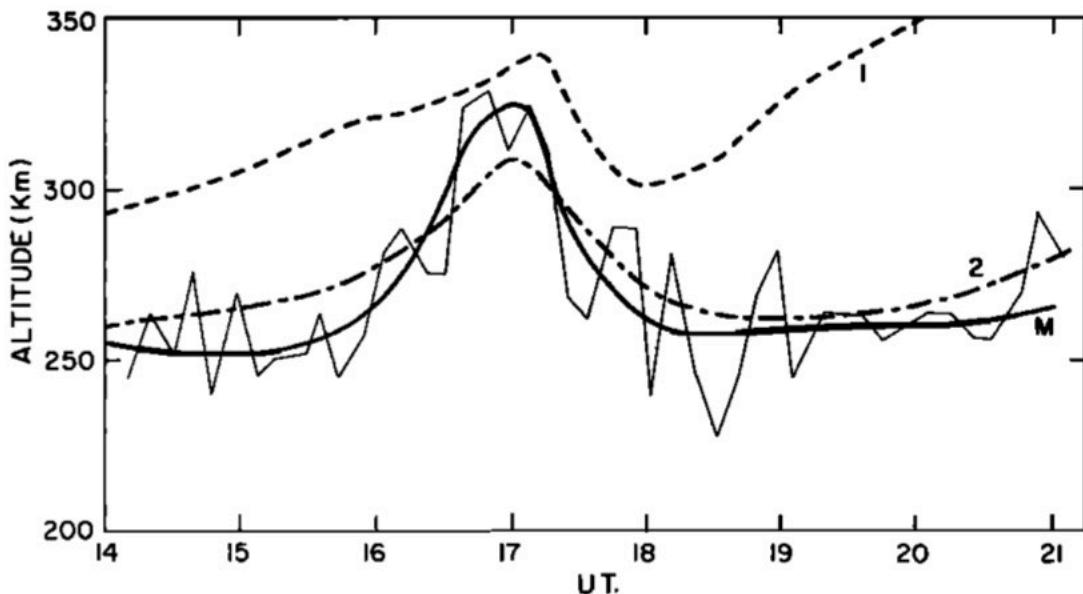


Fig. 12. Comparison of the Millstone Hill electron density  $F$  layer peak altitude with initial predictions model (curve 1) and with appropriate adjusted conditions and neutral atmosphere (curve 2)

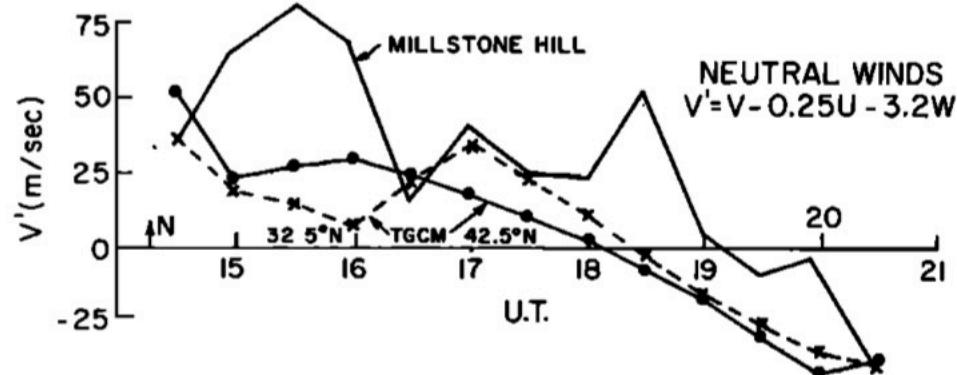
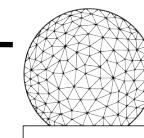


Fig. 14. Comparison of the observed neutral winds at Millstone Hill at 300 km with predictions from the TGCM at two latitudes spanning the eclipse path and the radar observational space.

Salah et al. (1986)



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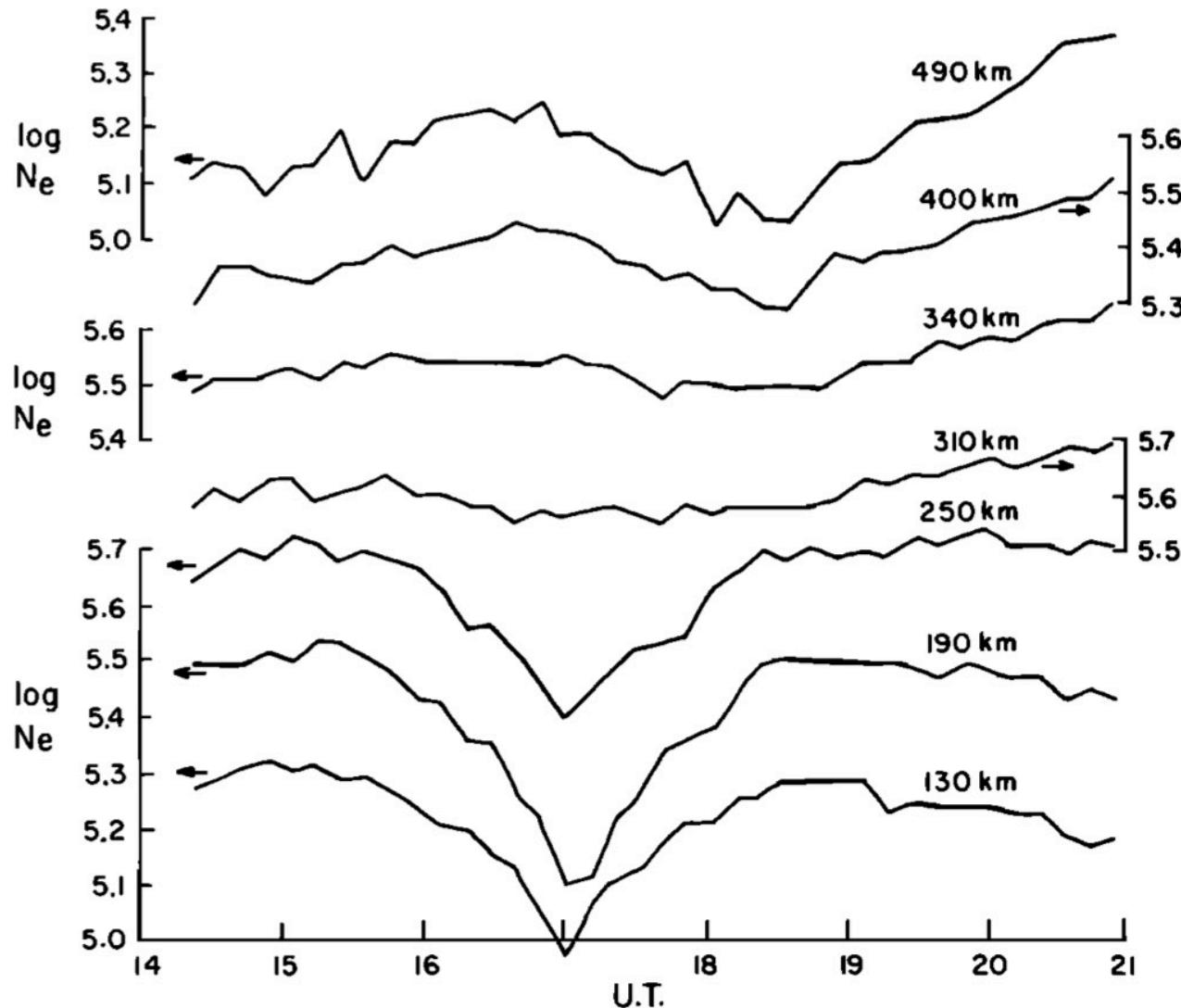
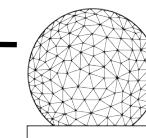


Fig. 4. The variation of electron density at various altitudes above Millstone Hill during the passage of the eclipse.  
The data were averaged over 4-min intervals.

Salah et al. (1986)

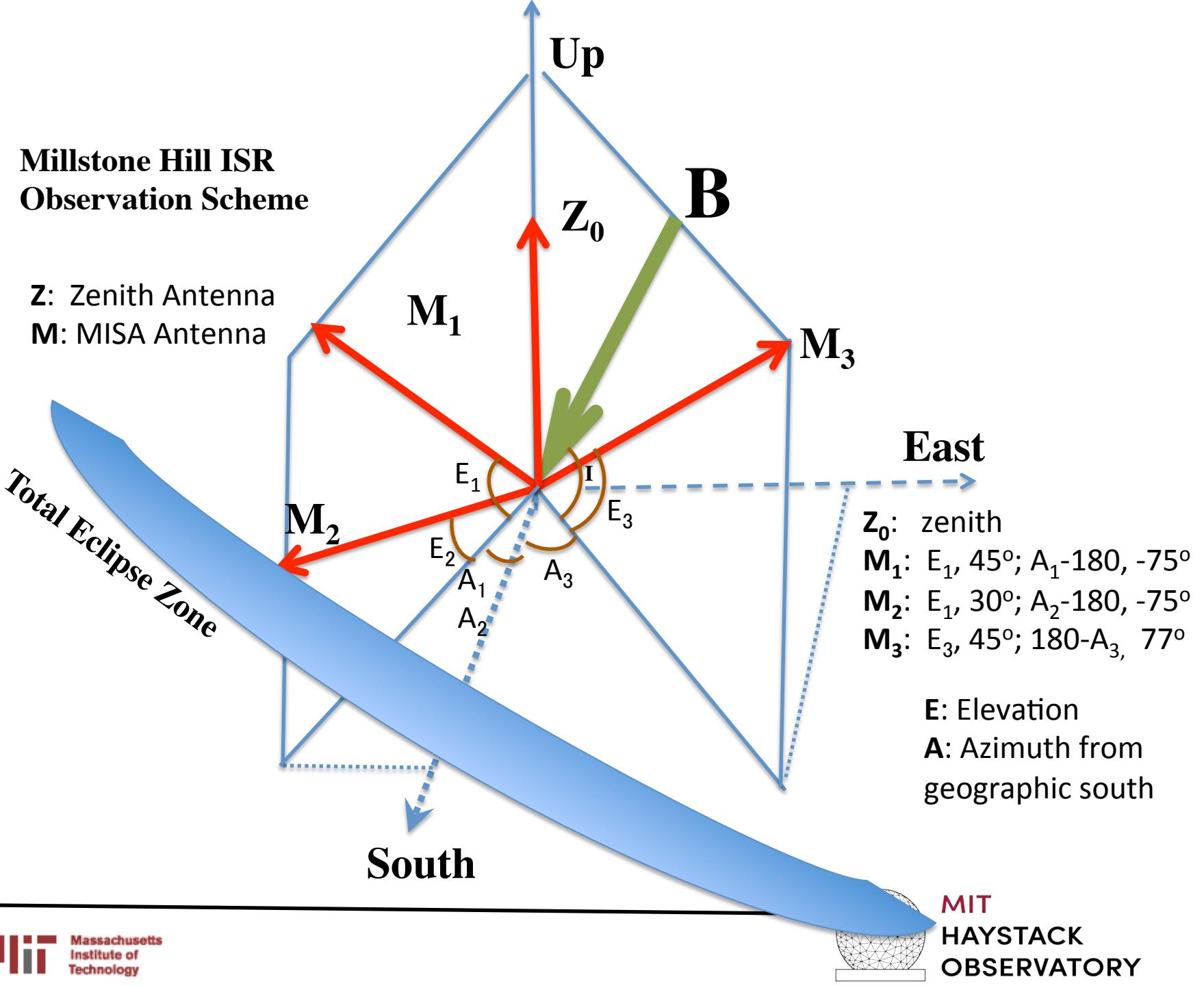


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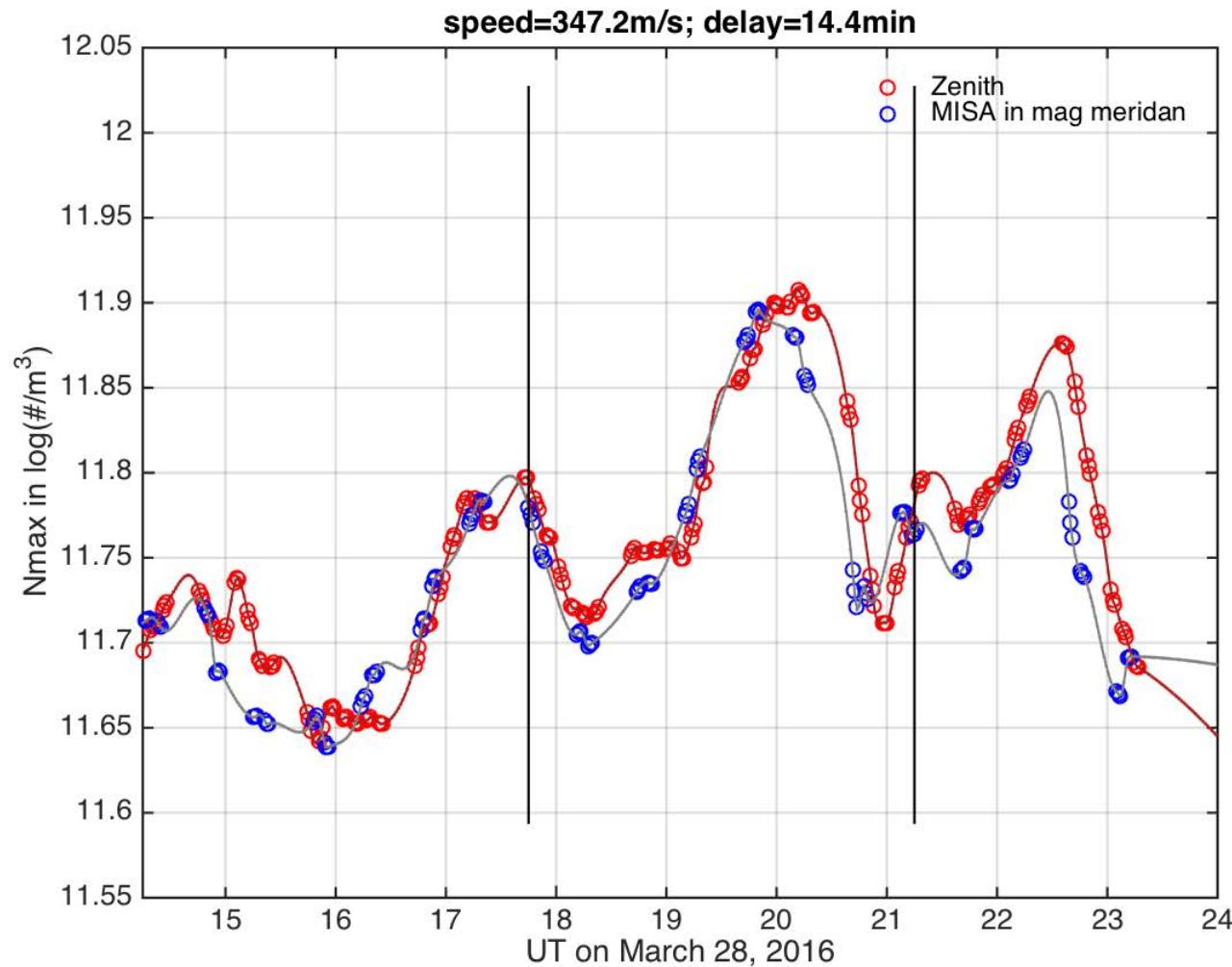


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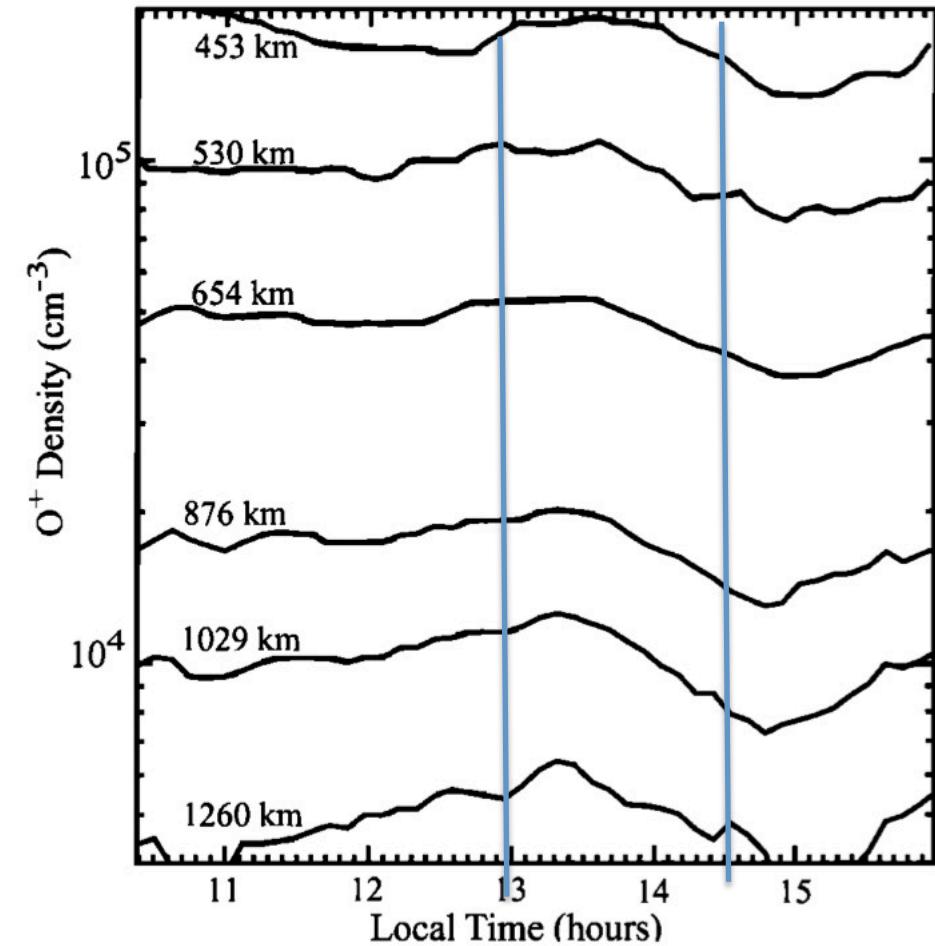
## Millstone Hill ISR Observation Scheme



# Millstone Hill Plasma-line Observations

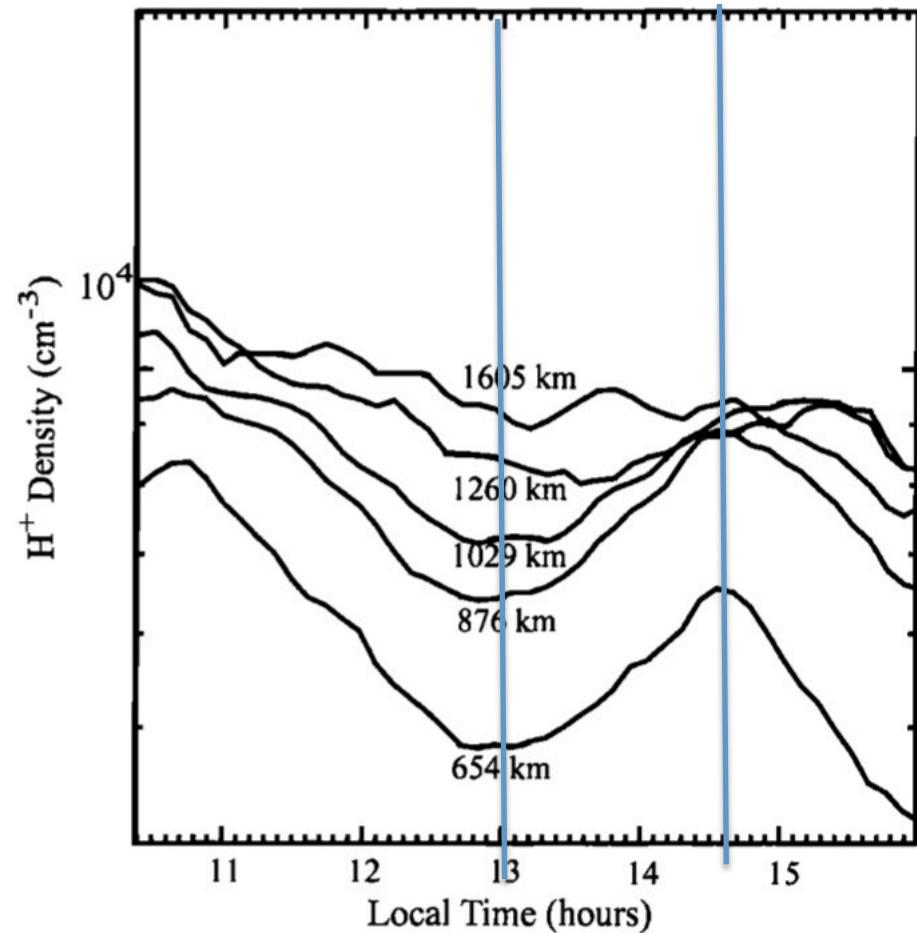


# Feb 26, 1998 @ Arecibo



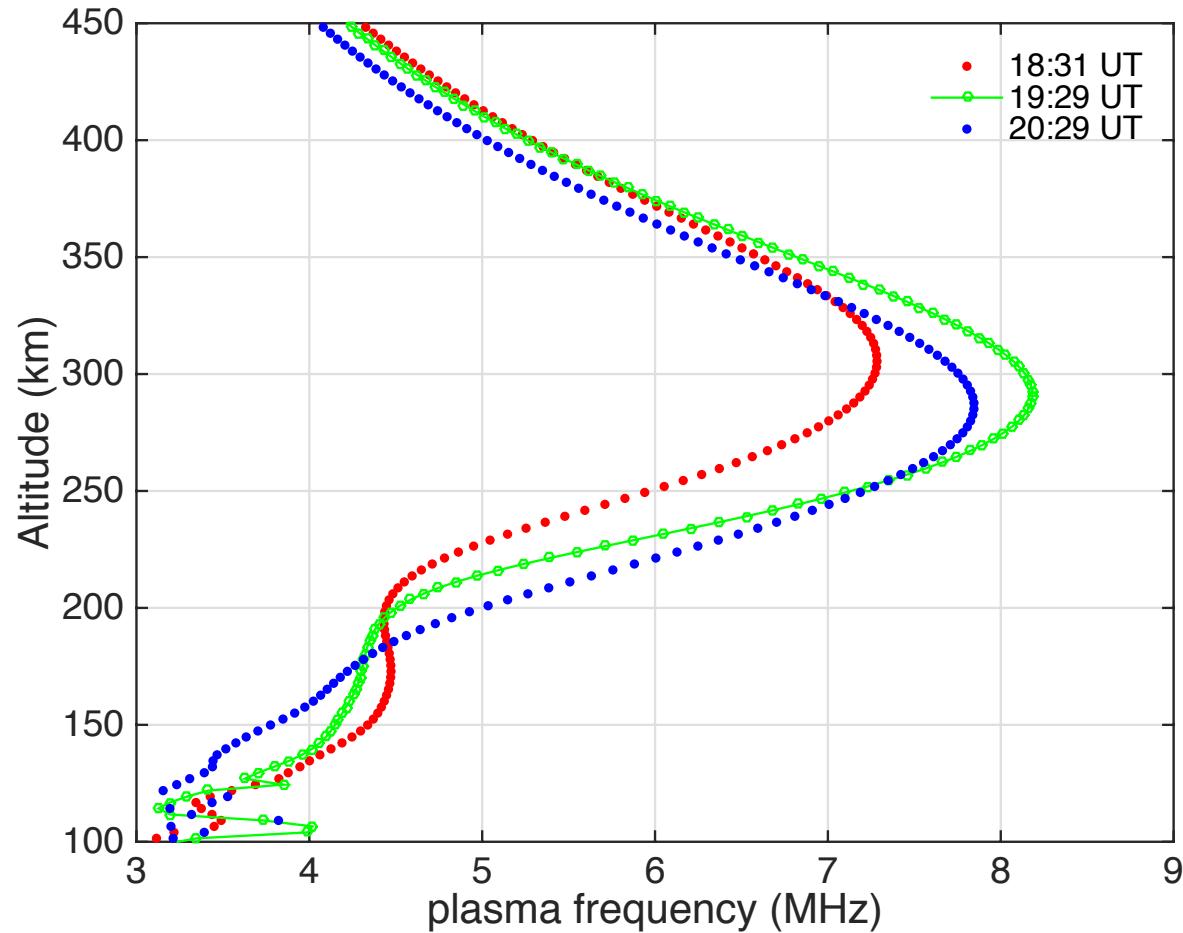
**Figure 9.** The  $O^+$  ion density as a function of local time for various altitudes within the topside ionosphere. All plots are measured quantities.

MacPherson et al. (2000)

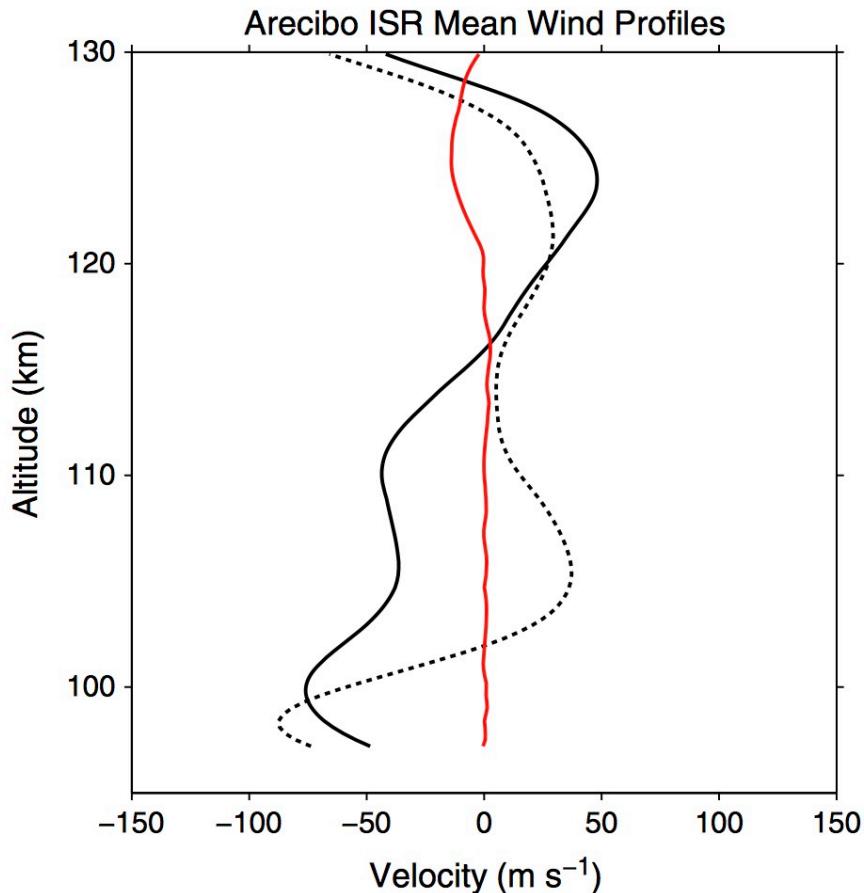


**Figure 10.** Same as Figure 9, but for the  $H^+$  density.

# Arecibo Plasma-line Observation



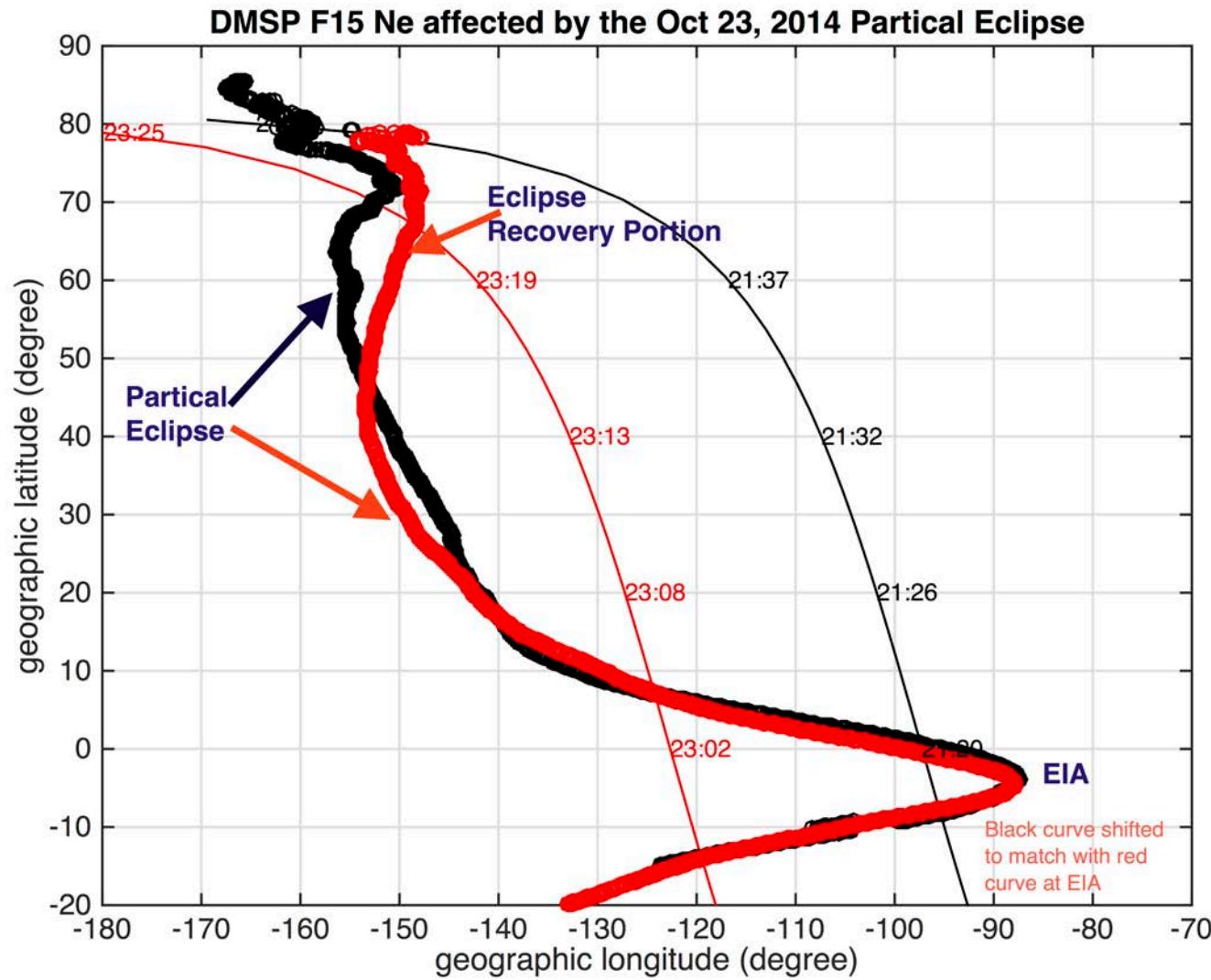
# Arecibo Neutral Wind Observation



**Figure 4.** Mean zonal (solid black line), meridional (dotted black line), and vertical velocity (solid red line) profiles obtained from the analysis of the incoherent scatter radar drift data for the approximately 4 h period.

Hysell et al. (2014)

# DMSP F15



# Summary

- GPS TEC
  - To track ionospheric responses in the totality zone and partial eclipse zones
  - To examine TIDs
  - Conjugate hemisphere?
- ISRs
  - Millstone Hill TID, Ne, Te and Ti (locally and regions close to the totally)
  - Arecibo plasma-line; Arecibo TIDs; PL + photoelectrons?
  - Arecibo winds
  - Satellite data ?