Integration of MAVEN neutral and plasma observations

(or, Testing basic ionospheric predictions and seeing where they fail)

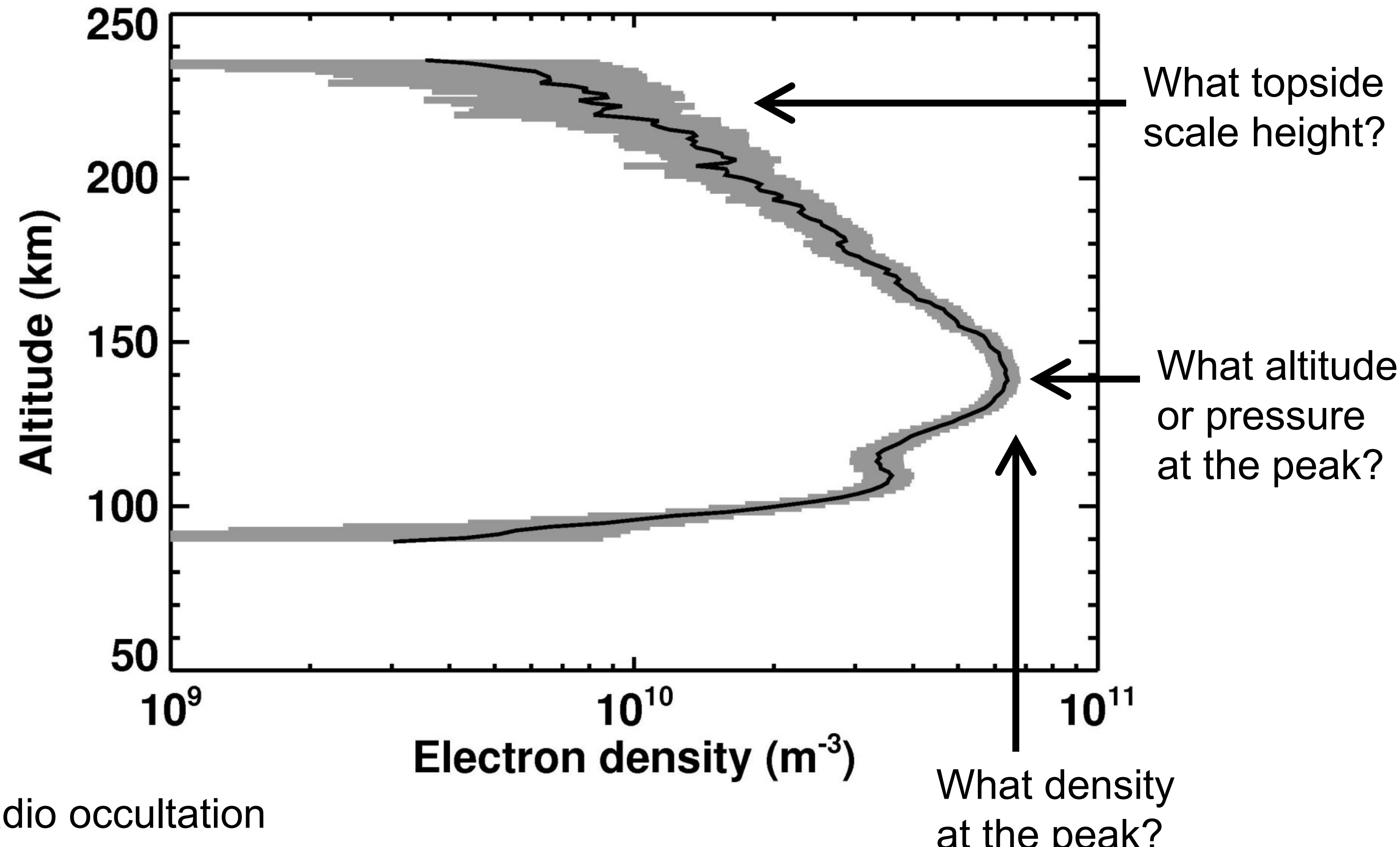
Paul Withers (withers@bu.edu)

MAVEN Participating Scientist

Tag team seminar, BU

2014.02.20

Several predictions can be properly tested for the first time



MGS radio occultation electron density profile

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- Find peak plasma density with LPW
  – Langmuir probe instrument, Ne and Te
- Find pressure with NGIMS
  – Neutral/ion mass spectrometer
  – Hydrostatic equilibrium

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- $\partial N / \partial t = P - L$
- (neglecting transport)

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- $\partial N/\partial t = P \; - L$
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- Check dimensions
- $cm^{-2}\ s^{-1}\ .\ cm^{-3}\ .\ cm^{2}$
- $cm^{-3}\ s^{-1}$ OK

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- Subsolar and at τ=1…
- F = F_0 /e and nσH = 1

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- $\partial N/\partial t = P - L$
- P = F n σ
- At peak, P = F_0/eH

- CO_2 + hv -> CO_2^+ + e

- CO_2^+ + O -> O_2^+ + CO
  - fast
  - CO_2^+ is <u>not</u> main ion

- O_2^+ + e -> O + O
  - slow
  - produces hot O, which escapes

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- $F_0/eH = \alpha(Te)\, N^2$

- Find F_0 with UV instruments
- Find H with NGIMS neutral mass spectrometer
- Find Te and Ne with LPW Langmuir probe

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- $\Uparrow \quad \Uparrow \quad\quad \Uparrow$ constant

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- N proportional to $\exp(-z/2H)$
- $Hp = 2Hn = 2kT/mg$

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- Predict Hp = 20 km
- Hp from LPW Langmuir probe electron densities
- Hn from NGIMS mass spectrometer neutral densities

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- $0 = m_e\underline{g} - {}^{1}/_{N}\,\underline{\nabla}(NkT_e) - e\underline{E} - m_e\upsilon_{en}\underline{v_e}$

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- One eigenfunction has v->0, other has v->infinity (guess which one I will pick)

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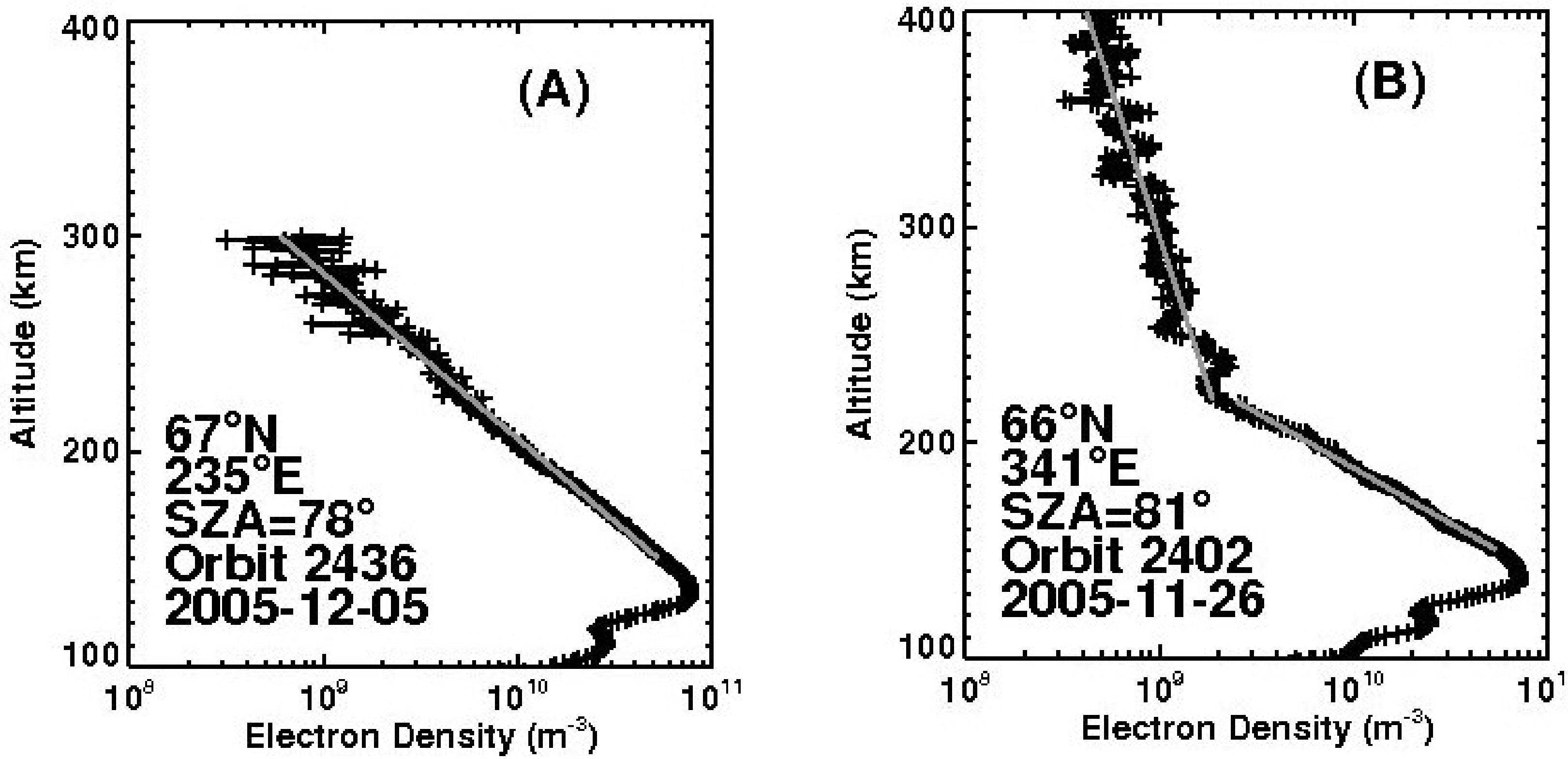
- m_i g = - k (Ti + Te) d (ln N)/dz
- N proportional to exp(-z/Hp) where
- Hp = k (Ti + Te) / m_i g
- Hp = 200 km (not 20 km)



- Such diverse topside structures do exist!
- Hp ~ 20 km -> Consistent with no transport
  - Strong horizontal magnetic field
- Hp ~ 200 km -> Consistent with diffusive equilibrium
  - Strong vertical magnetic field or no field

A+ B – MEX radio occultation profiles

Summary

- MAVEN will measure:
  - Background neutral atmosphere,
  - Driving solar conditions, and
  - Ionospheric response
  - Simultaneously
- Great opportunity to determine how the ionosphere functions
- Failures of canonical predictions will show where interesting physics can be found