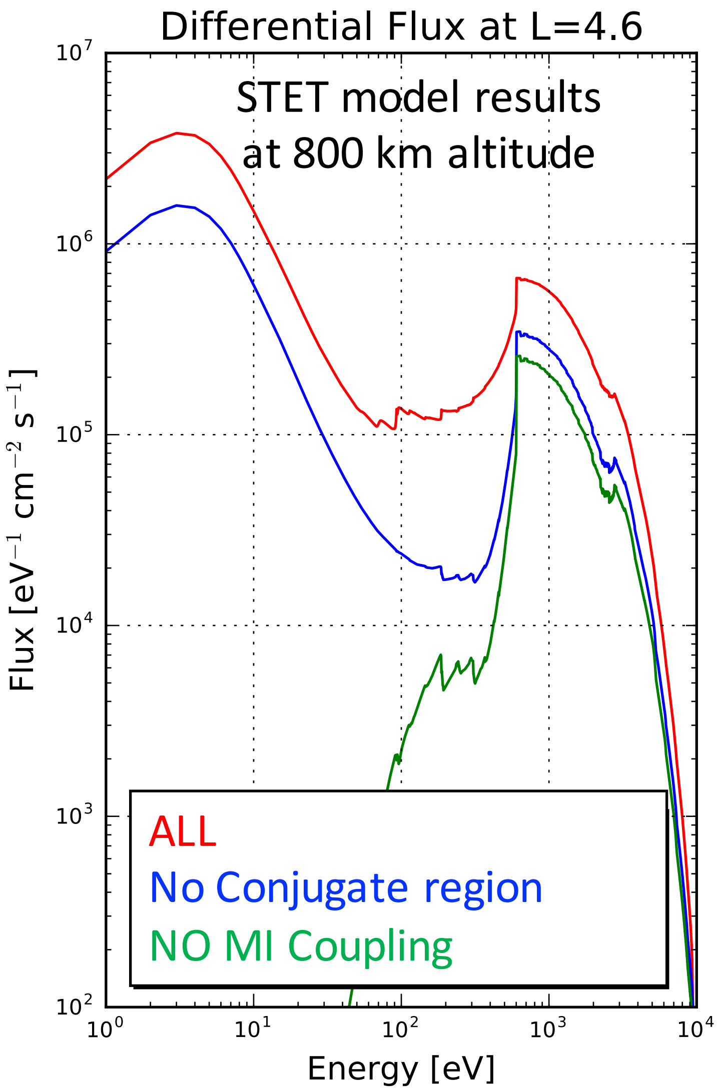
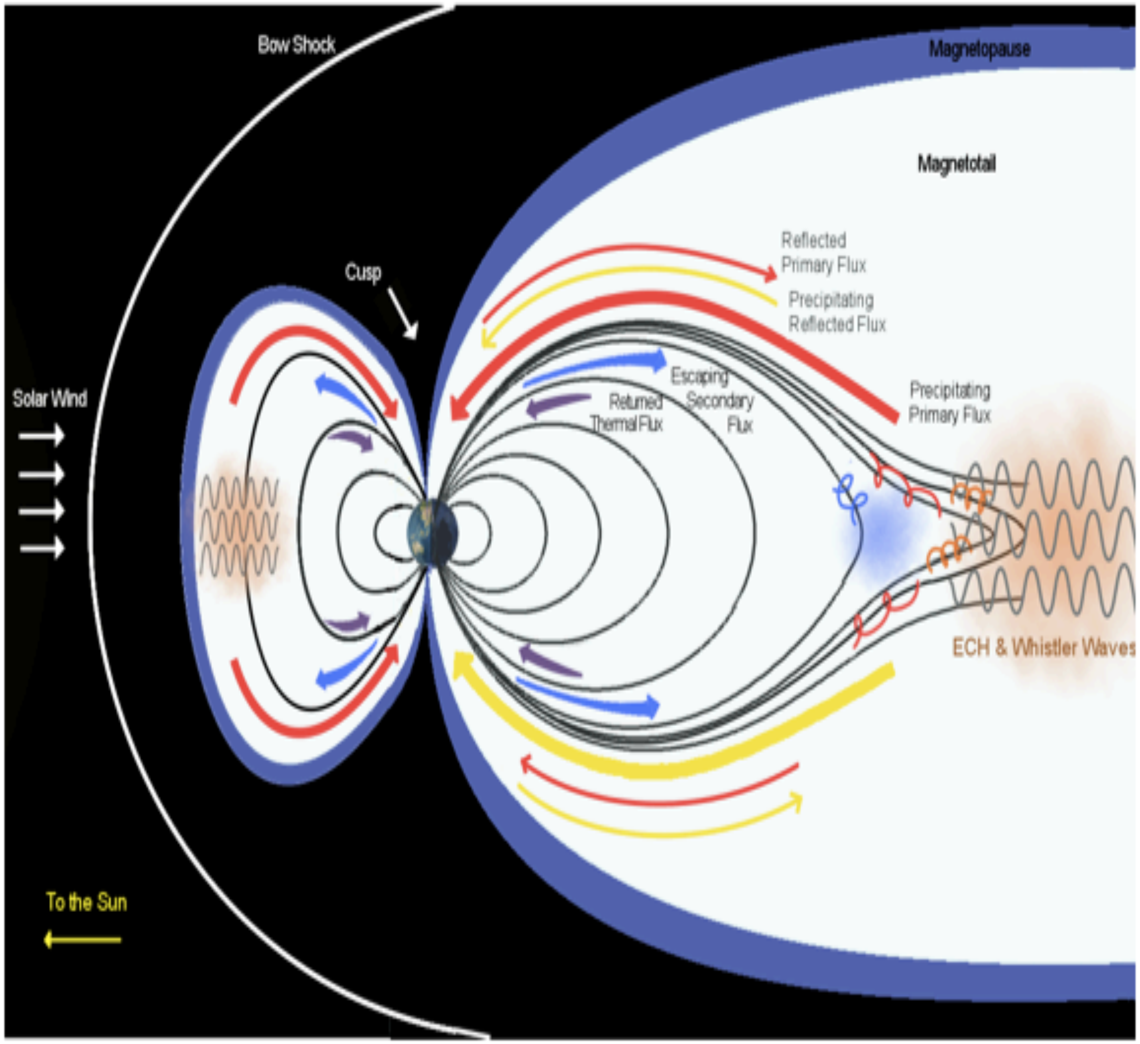
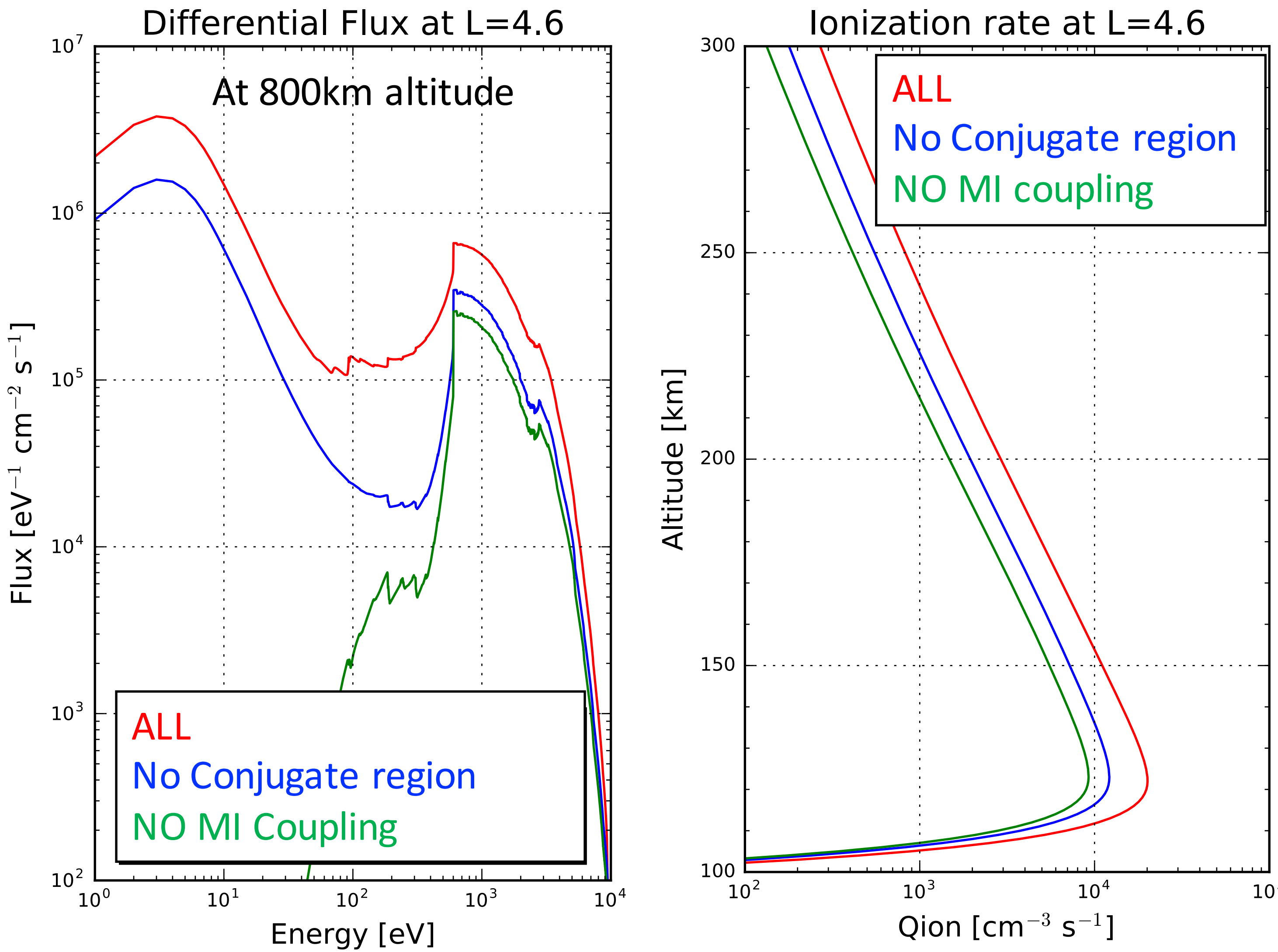
Impact of MI coupling physics on ionospheric conductance

– H. Connor, G. Khazanov, and D. Sibeck –

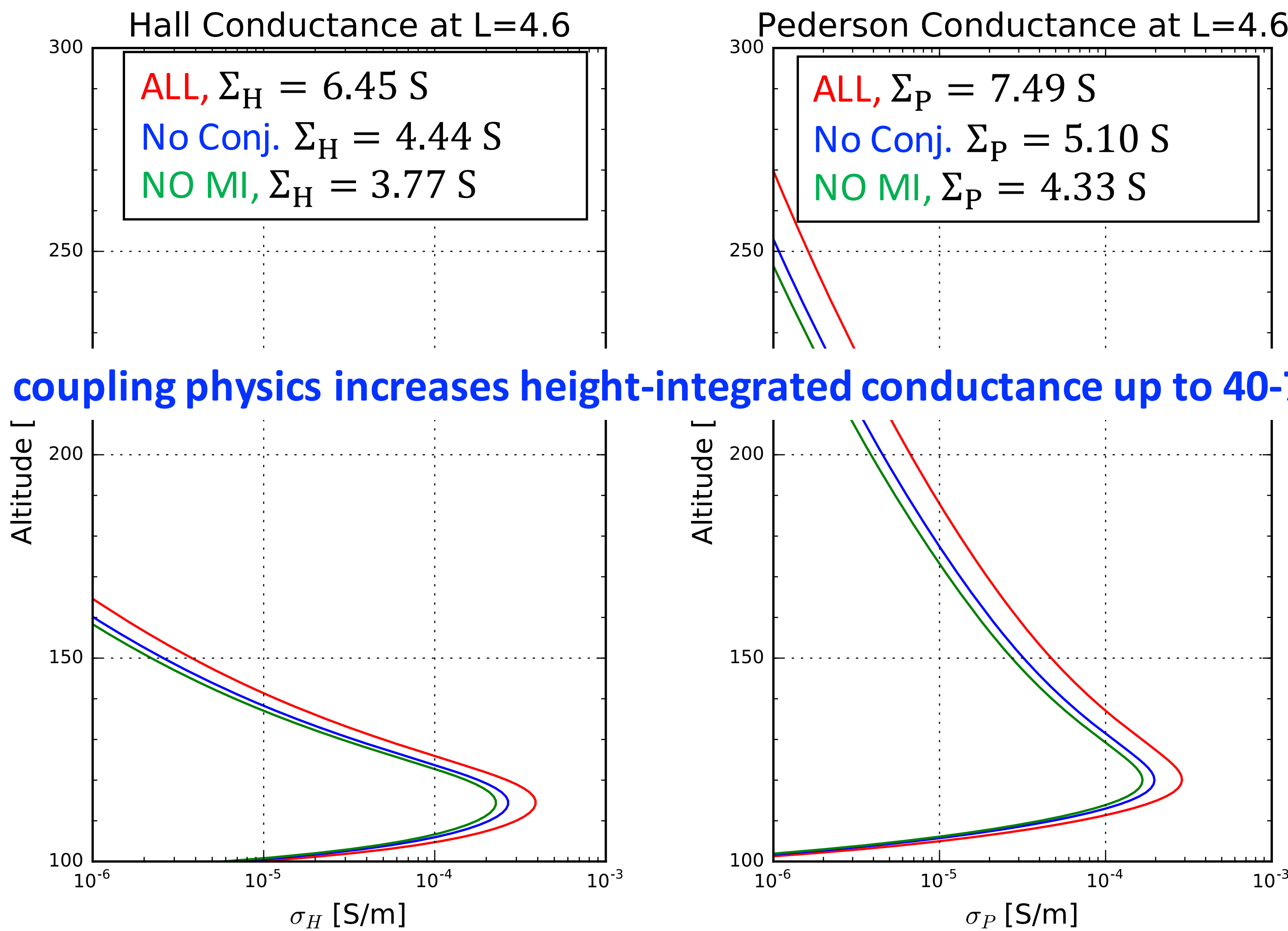




STET model results
Downward Fluxes and Ionization rate



STET model results:
Ionospheric Conductance



MI coupling physics increases height-integrated conductance up to 40-70%.

Summary and Discussion

- We examine ionosphere – magnetosphere energy interchange in the region of diffuse aurora using SuperThermal electron transport code.

- Our study showed that the MI coupling processes produce stronger auroral precipitation and increase height-integrated conductance up to 40 – 70%.

- Note that we introduce moderate strength of aurora precipitation and wave activities. During geomagnetic events, MI coupling impact can be significant.

- By ignoring the MI energy interchange, the current global models can severely underestimate ionospheric conductance, miscalculate ionospheric electric fields and magnetospheric convection, and thus misguide our understanding of MI coupling.

For details, please visit my poster #35 "MI coupling processes and their impact on the ionospheric conductance in the regions of diffuse aurora"

This material is based upon work supported by the National Science Foundation under Award No. 1331368.

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MI coupling processes and their impact on the ionospheric conductance in the regions of diffuse aurora

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Revisit of Robinson et al. [1987]

Robinson formulae [1987]

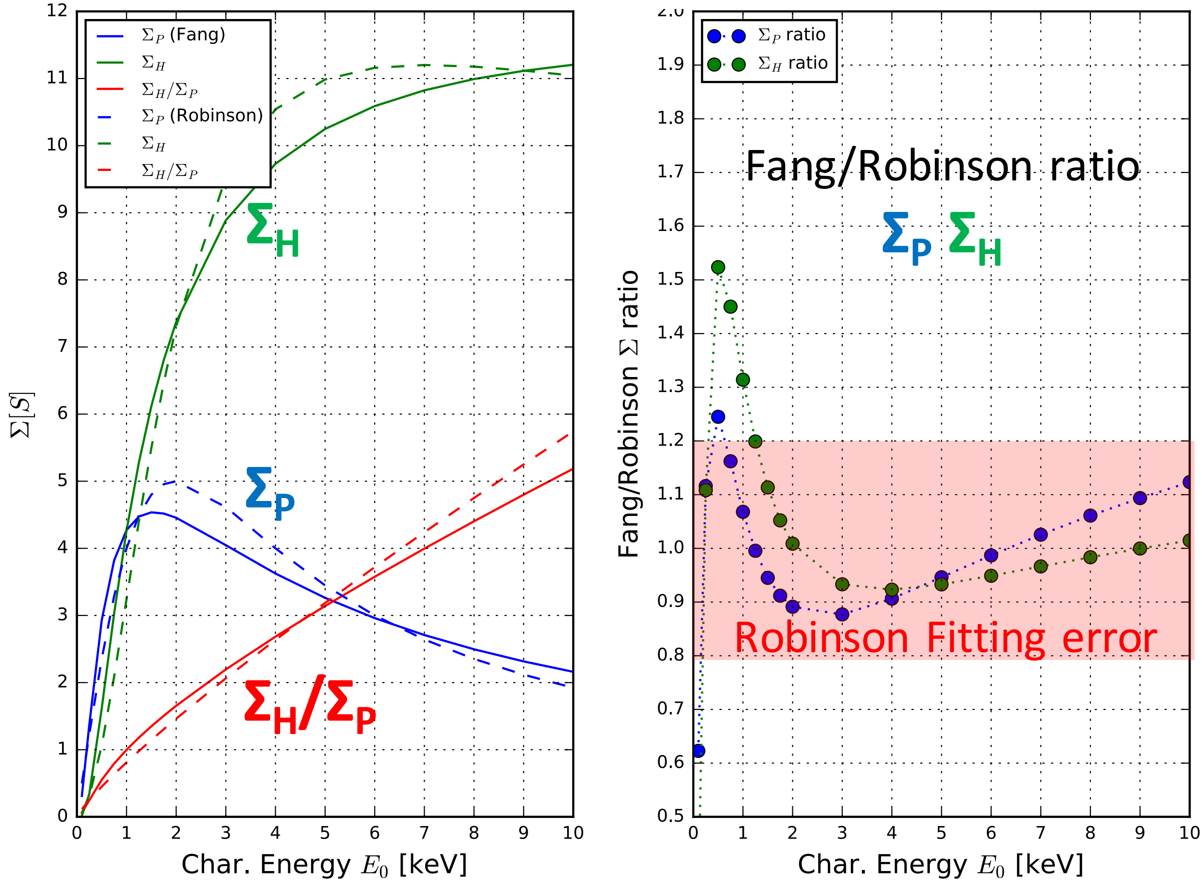
$$\Sigma_P = \frac{40\bar{E}}{16+\bar{E}^2}\Phi_E^{1/2} \qquad \frac{\Sigma_H}{\Sigma_P} = 0.45(\bar{E})^{0.85}$$

Major change in our calculation

Rees energy deposition function [1963] for 5 – 54 keV electrons

➤ Fang function [2010] for 100eV – 1MeV electrons.

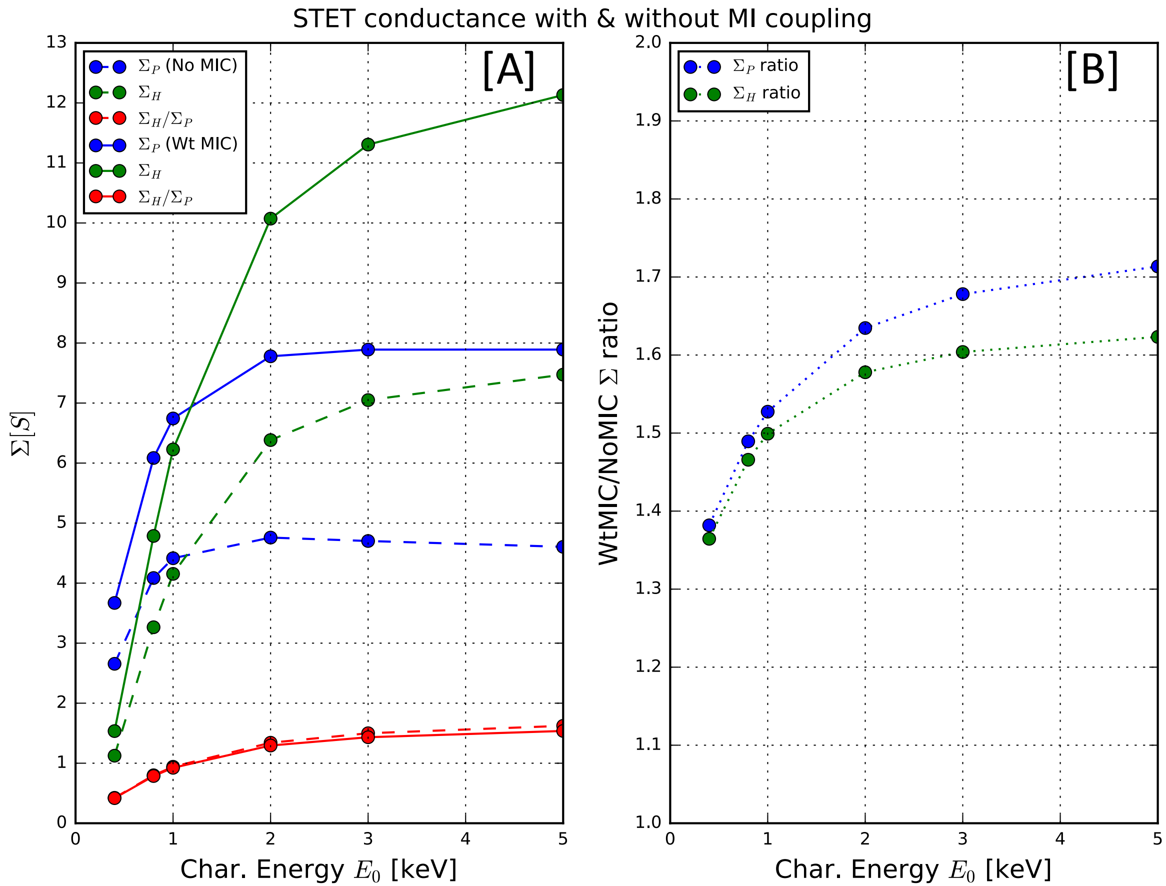
Fang (solid) vs Robinson (dashed) conductance



❖ Considering 20% of embedded error in the Robinson formulae, our calculation matches Robinson formulae very well above 1keV.

❖ Robinson formulae may underestimate the impact of soft electron precipitation whose typical energy is several hundreds eV.

Benchmark study of Robinson et al. [1987] using STET code with/without MI coupling



[A] Pederson conductance (Σ_P), Hall conductance (Σ_H), and Hall to Pederson ratio (Σ_H/Σ_P) calculated with MI coupling (solid lines) and without MI coupling (dashed lines)

[B] With-MIC vs Without-MIC conductance ratio (Pederson and Hall conductance)

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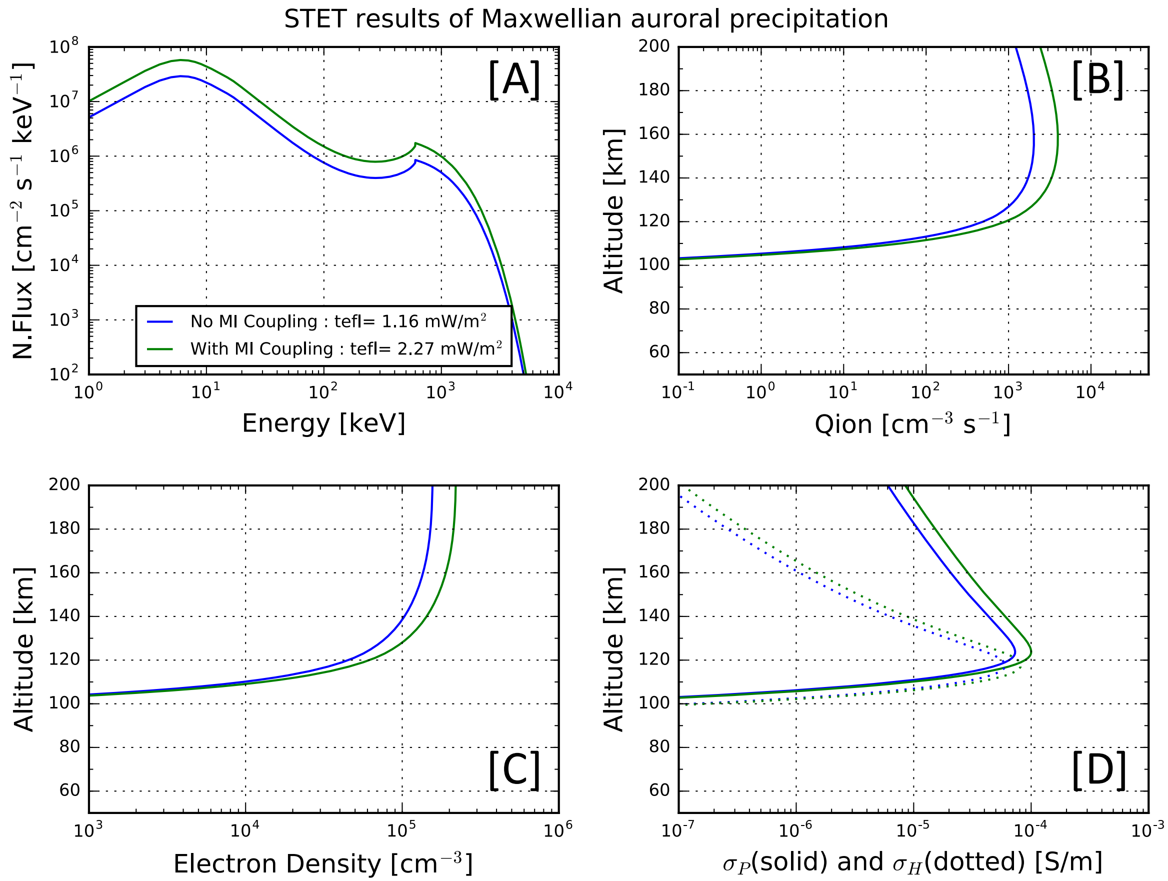
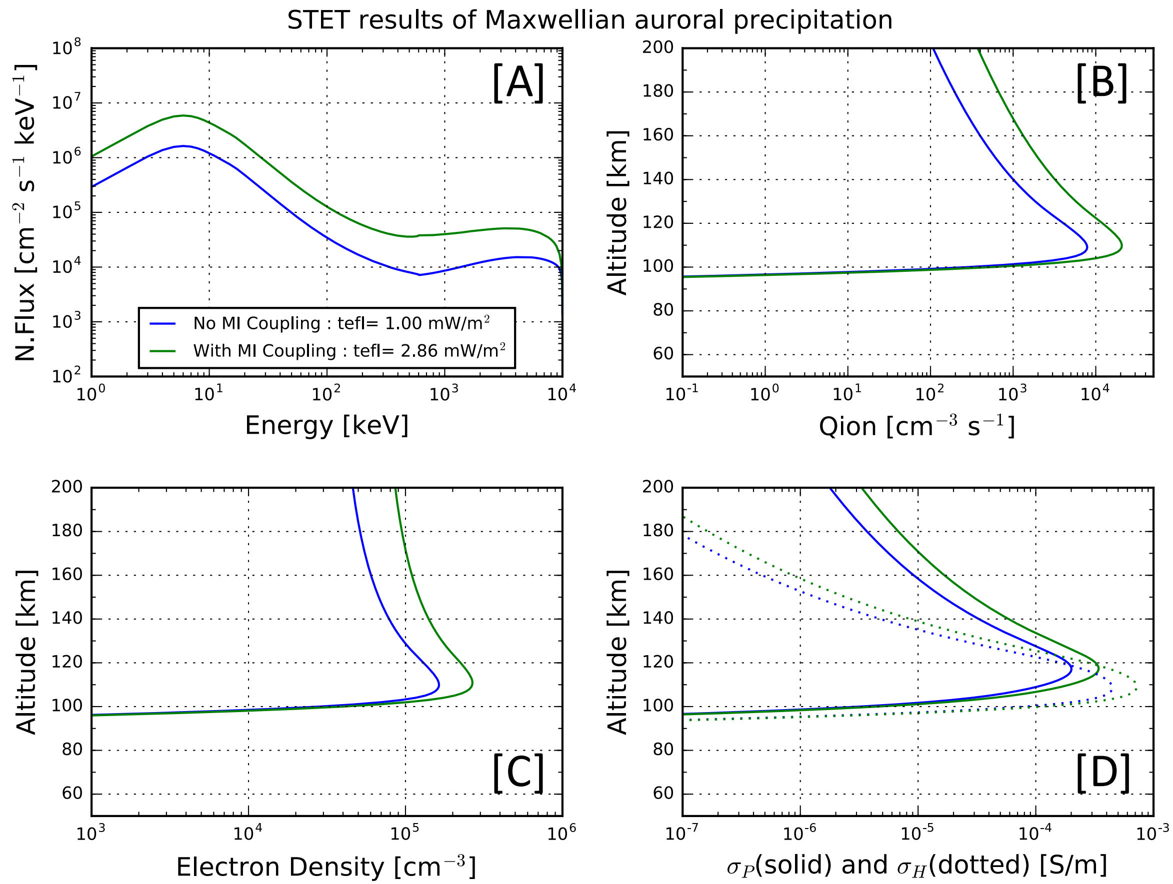
STET code results of Maxwellian auroral precipitation input using E_0 = 400 eV and total auroral energy flux 1mW/m^2



[A] Maxwellian energy distribution of precipitating aurora electrons
[B] Altitudinal profile of ionization rate
[C] Altitudinal profile of Electron density
[D] Altitudinal profile of Pederson and Hall conductivities

STET code results of Maxwellian auroral precipitation input using E_0 = 5 keV and total auroral energy flux 1mW/m²



[A] Maxwellian energy distribution of precipitating aurora electrons

[B] Altitudinal profile of ionization rate

[C] Altitudinal profile of Electron density

[D] Altitudinal profile of Pederson and Hall conductivities