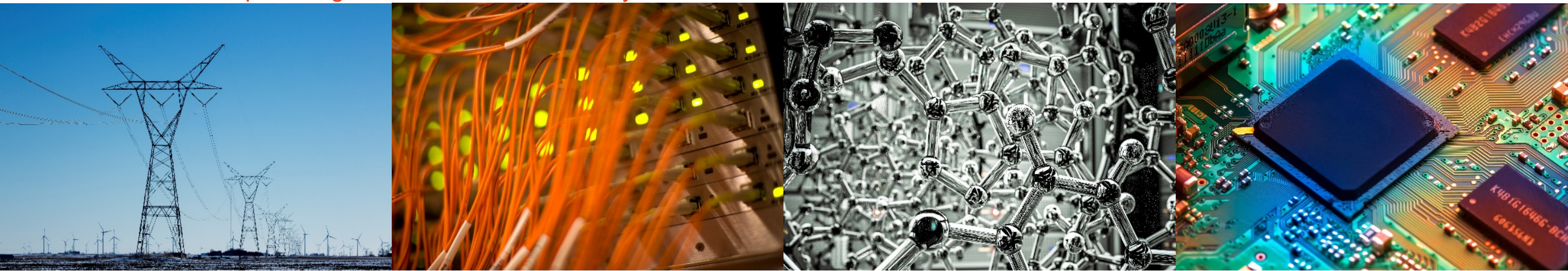


Revealing the role of “hidden heavy ions” component in the terrestrial polar wind outflow

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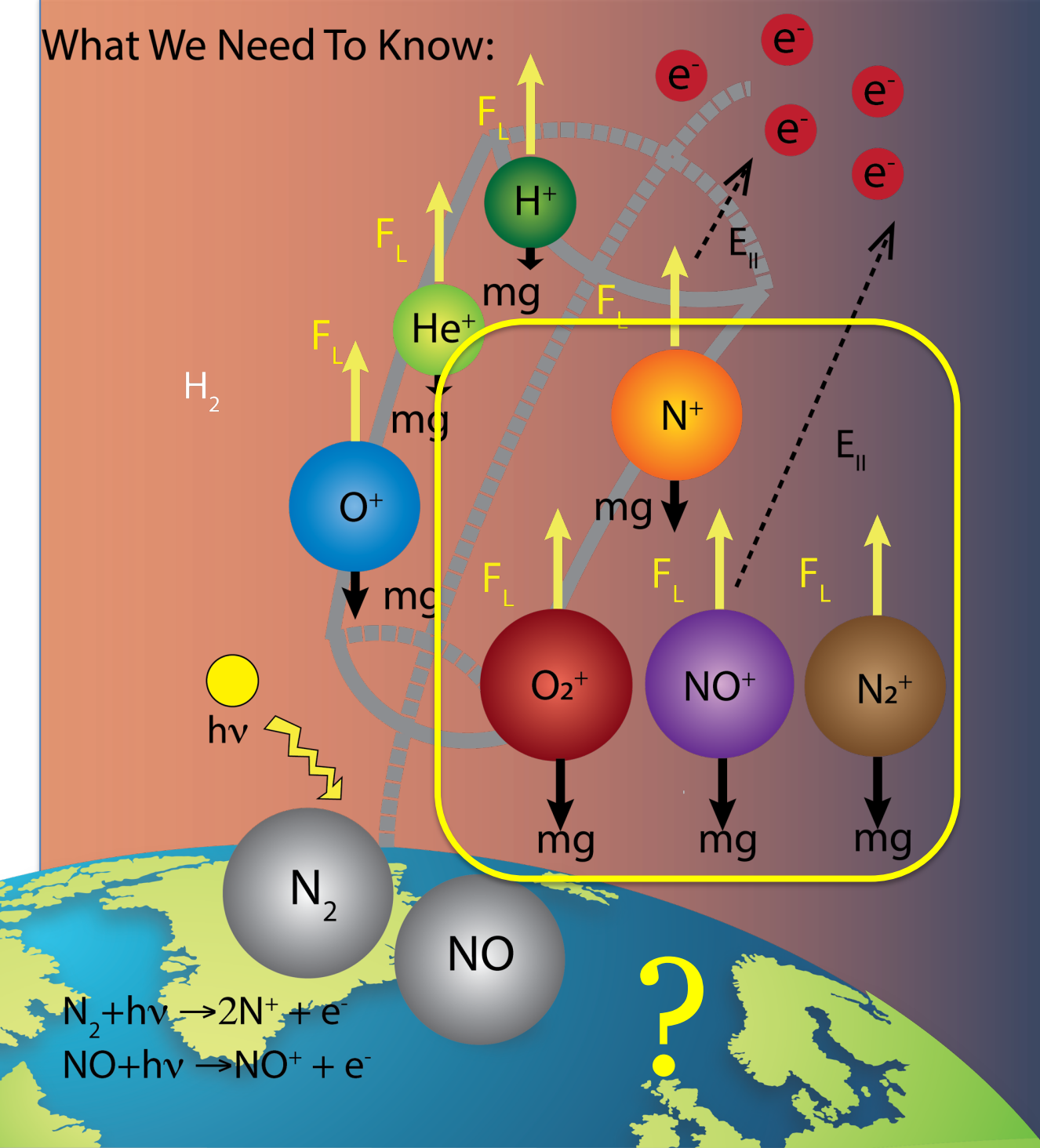
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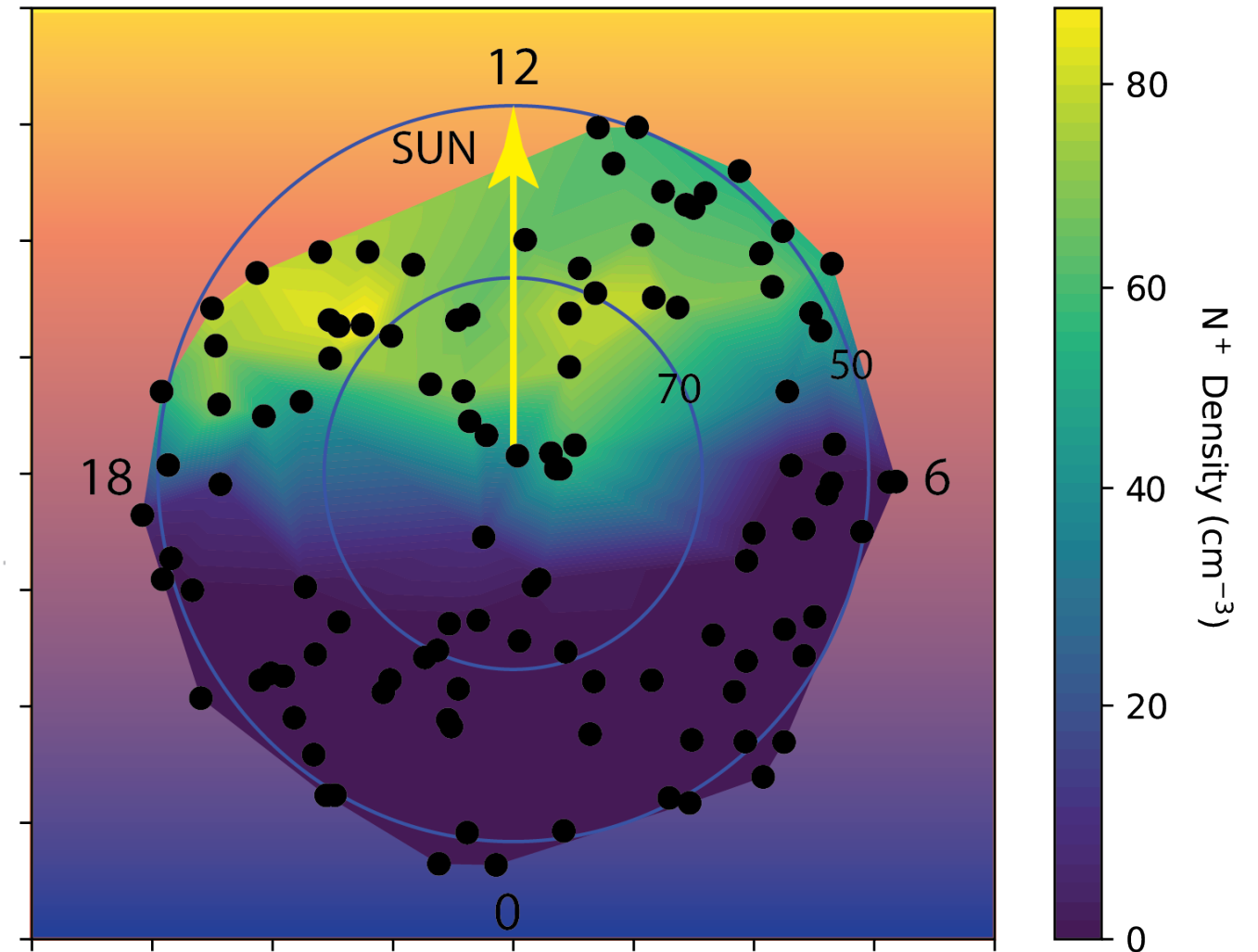
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What We Need To Know:

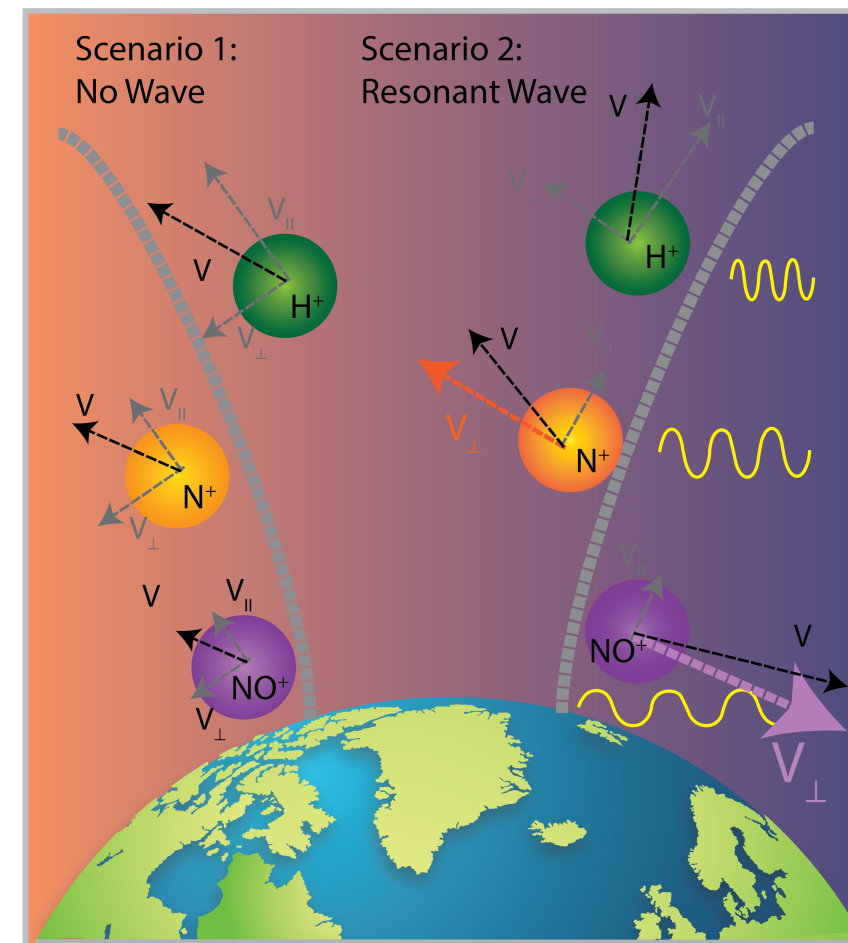
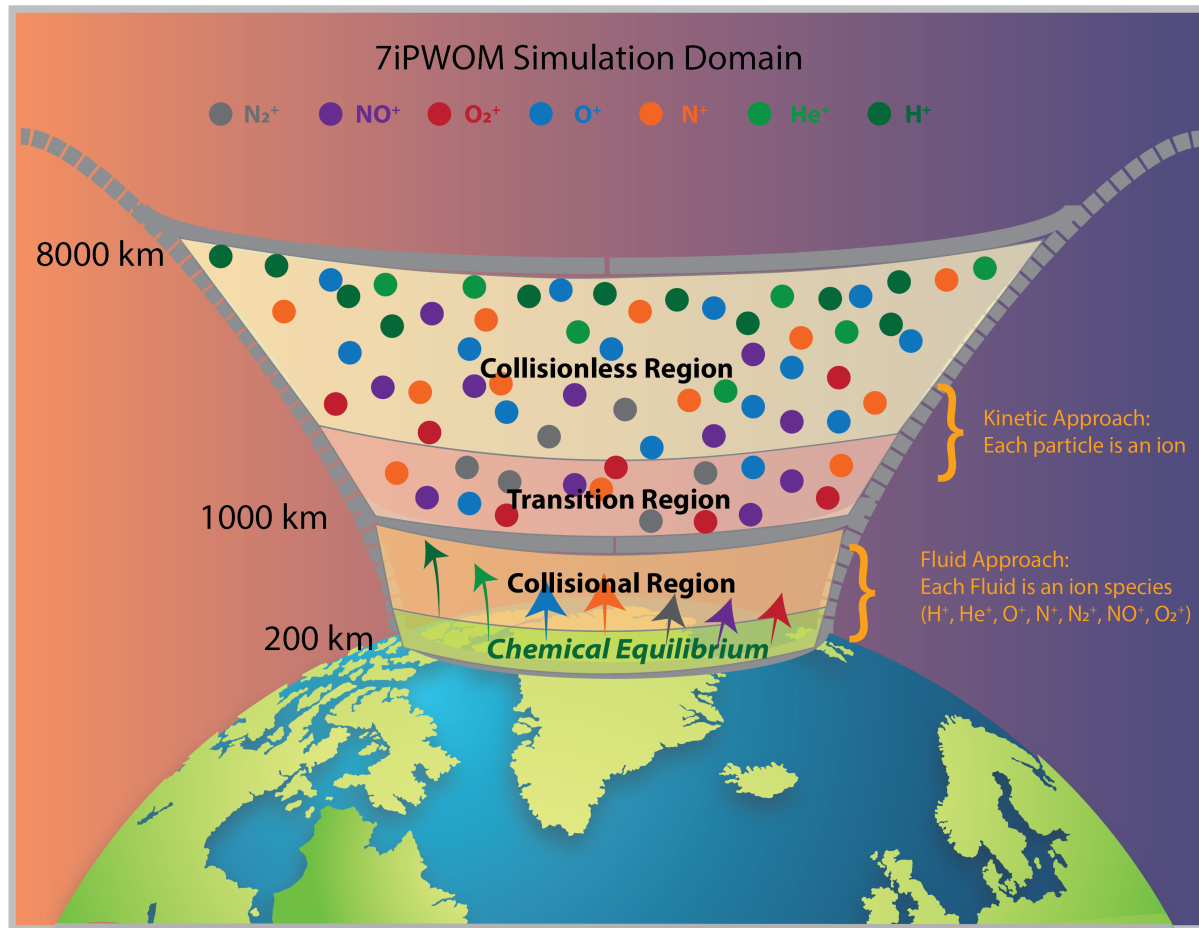


~ 2500 lbs of N^+ lost a day

Multiple Field Line Fluid Solution for N^+ (@ 1200 km altitude)



Seven Ion Polar Wind Outflow Model (7iPWOM)



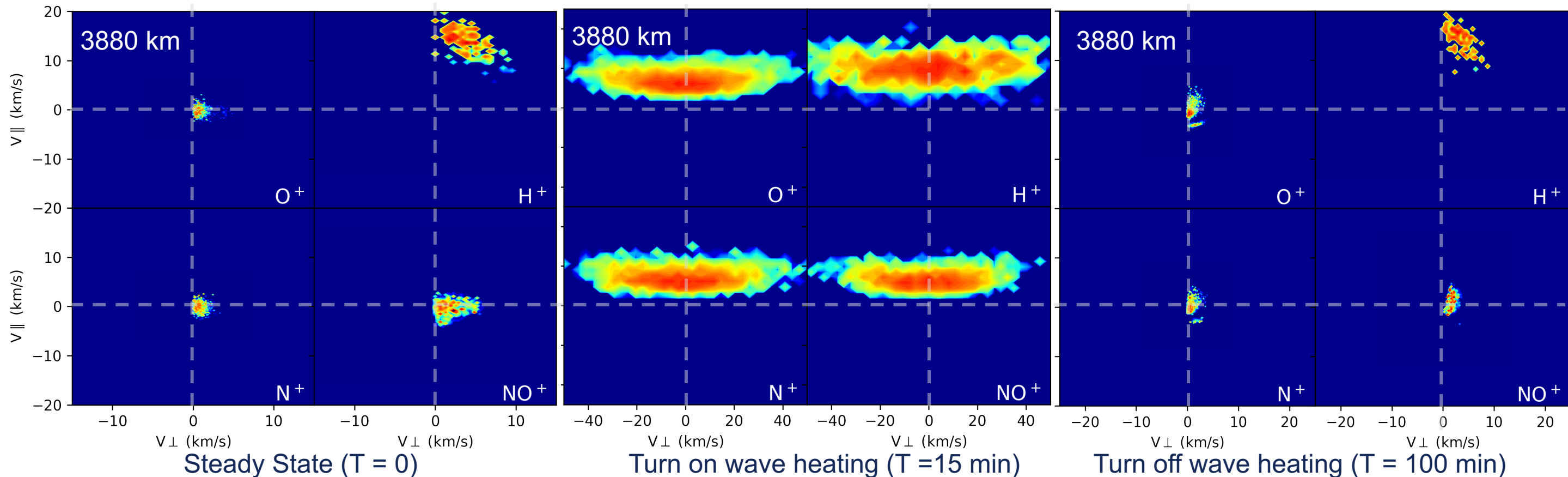
WPI increase V_{\perp}
 \downarrow
 Ions move up (V_{\parallel})
 along B
 \downarrow
 Form ion conic in
 velocity space

- Developed from PWOM (Glocer et al., 2018), 7iPWOM solves H^+ , He^+ , N^+ , O^+ , N_2^+ , NO^+ , O_2^+ with fluid approach below 1000 km altitude and kinetic approach beyond.

- Heavy ions, especially molecular ions, are expected to be preferentially heated.

Effect of Wave Heating

- **N⁺ ions are a key species** in the ionospheric outflow.
- Preliminary simulations show that **molecular ions can acquire sufficient energy via WPI** to escape from the high latitude ionosphere.



- Few NO⁺ ($n < 10^{-5} \text{ cm}^{-3}$) existed during the steady state. However, after turning on wave, $n(\text{NO}^+)$ increase to 10^{-1} cm^{-3} and the average V_{\parallel} is $\sim 10 \text{ km/s}$ ($>$ escape velocity).
- The presence of molecular ions upflows provides an important framework to understand wave heating mechanisms in the polar wind.