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Structure of High Energy, Heavy Ions in Venus' Upper Ionosphere

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The solar wind interacts with the atmosphere of Venus, and can reach directly down to the ionosphere. The interaction has previously been studied using the Pioneer Venus mission (PVO) and is now known to cause variations in the density in the ionosphere [Taylor et al., 1980], a transport of ions towards the night side [Knudsen et al., 1980], and an outflow of ions from the atmosphere [Barabash et al., 2007]. Measurements made by PVO showed that the main constituents of Venus ionosphere in the altitude range 150-400 km is the O+ and O_2+ ions, where the former dominates from 180 km and higher, and the latter dominates from 180 km down to 150 km [Taylor et al., 1980].

New measurements, made by the Ion Mass Analyzer (IMA) onboard the Venus Express spacecraft, reveal the high-energy (10 eV to 15 keV) plasma characteristics in the ionosphere of Venus. Using the data collected during the low altitude (down to 130 km) pericentre passages during the aerobraking time period, we are able to extract the height profile of the total heavy ion content (O+ and O_2+ ions) of Venus ionosphere. The results show two scale heights separated at $\sim$200 km; $\sim$10 km for <200 km and $\sim$100 km for >200 km. We interpret the results as two heavy ion components, namely, the O+ ions are dominant for >200 km, while the O_2+ is dominant for <200 km. This is consistent with previous results from PVO.

Furthermore, we attempt several methods of mass separation, to extract the two ion components of the scale height profiles, (O+ and O_2+). First method is to use the moderate mass separation capabilities of the IMA instrument. The individual mass spectra are fitted by two Gaussian curves, representing O+ and O_2+, derived from ground calibration information. The second method uses the energy spectrum, which sometimes has two discrete peaks. By assuming the same velocity for different components in the spacecraft reference frame (resulting in different energy for different masses), we can separate the composition. We will discuss the results of the obtained mass separated height profiles.