Mini-groupwork 3, 2016

Space Physics, EF2240

a) A simple model describes the dayside ionospheric electron density at a certain altitude by the following equation:

$$\frac{\partial n_e}{\partial t} = q - \alpha n_e^2$$

where q is the ionization rate due to solar EUV radiation, and the second term in the right-hand side is the recombination rate. Assuming that the ionosphere is in equilibrium, use data from the figure below to estimate the recombination coefficient α at 120 km altitude. (Give α in SI units.) Use the following values for the intensity of EUV radiation above the ionosphere, I_0, absorption coefficient a_a, ionization coefficient a_i, temperature T, and neutral number density at the surface of Earth, n_0:

$I_0 = 3.6\times10^{13}$ m^{-2}s^{-1}
$a_a = 1.5\times10^{-23}$ m^2
$a_i = 0.9\times10^{-23}$ m^2
$T = 273$ K
$n_0 = 2.5\times10^{25}$ m^{-3}

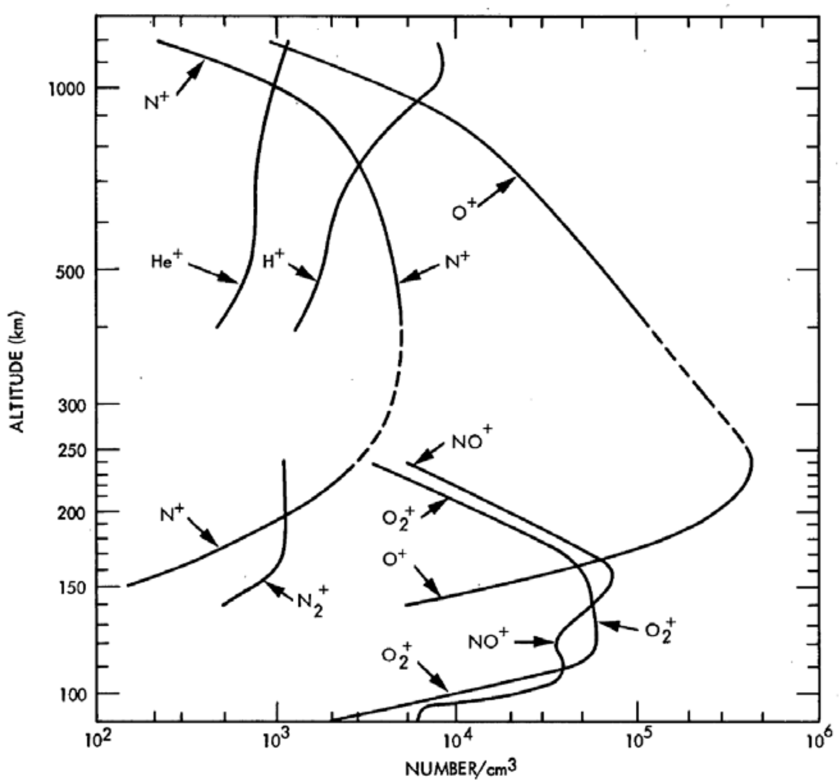

Figure 8 - Ionic composition of solar minimum daytime winter ionosphere (ref. 42).

Please, turn!

b) A radio wave pulse with a frequency of 5 MHz is emitted straight upwards from Earth. A receiver registers an echo of this signal at a slightly later time. Estimate the expected time difference between the emission and detection of the pulse, if this experiment would be carried out during daytime, this year.