ASEN 6519. Lidar Remote Sensing

HWK Project #1 – Simulation of Lidar Return Signals

This project is the beginning of a series of lidar simulation projects through our class.

This project contains three aspects –

(1) Start to write a MatLab code for lidar simulations through the class. You may want to set up the platforms so that you can add on things later.

(2) Estimate the return signals (photon counts per pulse) of potassium resonance fluorescence from the entire K layers in the mesosphere and lower thermosphere (75-115 km) using the Arecibo K Doppler lidar parameters and atmosphere conditions.

(3) Estimate the return signals (photon counts per pulse) of Rayleigh scattering from a 150-m bin at 30 km using the Arecibo K Doppler lidar parameters and atmosphere conditions.

Related Arecibo K Doppler lidar parameters are

Laser pulse energy: 100 mJ
Laser repetition rate: 30.55 Hz
Laser wavelength: 770.1088 nm (in vacuum)
Transmitter mirror reflectivity: 99.8% for each mirror and total of 3 mirrors
Telescope primary mirror diameter: 80 cm
Primary mirror reflectivity: 91%
Fiber throughput: 75%
Transmission of receiver optics: 74%
Interference filter peak transmission: 80%
PMT quantum efficiency: 15%
Geometric factor for above 20 km: 1

Related atmosphere parameters are

Lower atmosphere transmission at 770 nm: 80%
Atmosphere number density at 30 km: 3.83×10^{23} m^{-3}
Atmosphere pressure at 30 km: 11.97 mbar
Atmosphere temperature at 30 km: 226.5 K
Mean potassium column abundance is 6×10^{7} cm^{-2}

Related atomic parameters are

Potassium effective cross section: 10×10^{-16} m^{2}
Molecular weight of ^{39}K: 38.9637069
Molecular weight of ^{41}K: 40.96182597
Molecular weight of standard K: 39.0983

You are required to show your MatLab or equivalent code with your simulation results.