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MICRO PULSE LIDAR FOR THE MEASUREMENTS OF AEROSOL AND CLOUDS

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Introduction

Lidar measurements have been proved to be promising tools to enhance our undertaking regarding impact of aerosols and clouds on precipitation, radiative processes and climate study. Lidar systems used for the atmospheric monitoring employ the back scattering of laser radiation to provide information on various atmospheric parameters via a number of scattering and absorption processes. In the recent times many high performance and high resolution Lidars are in operation around the world. Lidars system use lasers in ultra violet visible and infrared range and are capable to make high accuracy of quantitative measurements of many atmospheric parameters[1-2]. In conventional Lidar system high peak Laser pulse power is used has serious eye safety problems. In Micro Pulse Lidar[3,4] technology employs low pulse power transmission and high pulse repetition rate. A polarization micro pulse lidar system has been set up at National Physical Laboratory to perform continuous measurements of aerosols and clouds. The MPL has a capability to monitor range – resolved back-scattered signals from aerosols and clouds at polarizations parallel and perpendicular to the polarization of laser beam. The ratio of two polarizations called depolarization is a useful parameter to study the aerosols and clouds micro physics. In this paper some of the preliminary measurements of clouds and atmospheric boundary layer are described.

Experimental setup

The Schematic system diagram is shown in **Figure 1**. The lidar employs a diode pump Nd: Yag laser which emits secondary harmonics at 532 nm. The lidar pulse duration is about 10 ns at 532 nm and the pulse repetition rate can vary from 1 Kz to 100 KHz. The laser output energy per pulse at 20 KHz repetition rate is also 50µJ. The beam divergence is < 4.5 m radian and the beam diameter is 0.27 mm. The laser beam is expanded and transmitted to the atmosphere. A Schmidt – cassegrain telescope of aperture of 200 mm is used as the transmitter and the receiver in coaxial configuration. The back scattered light receiver by telescope is passed through the orifice to limit the field of view of the receiver. The light is then passed through collimator, interference filter (3nm BW), 532 nm Febery Perot Etalon and polarization beam splitter. Beam splitter, splits the beam in to two channels (co polarization and cross polarization components) .These components are focused on respective detectors. High sensitivity Hamamastsu PMTs with low noise high speed amplifiers are used to detect co and cross polarizatrion component of the signals. Photon counting technique is used to detect signals on both the channels.

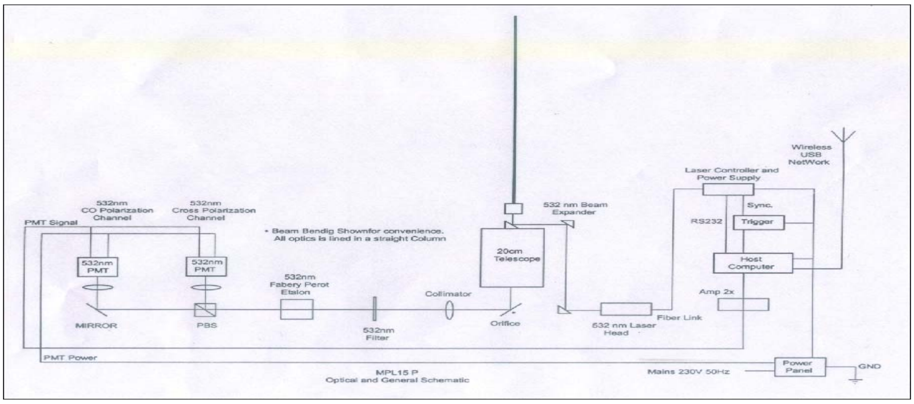
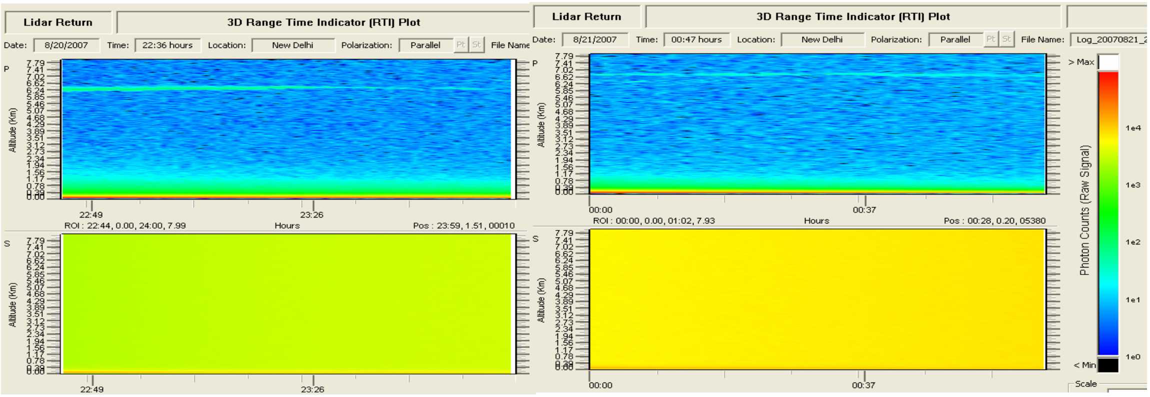


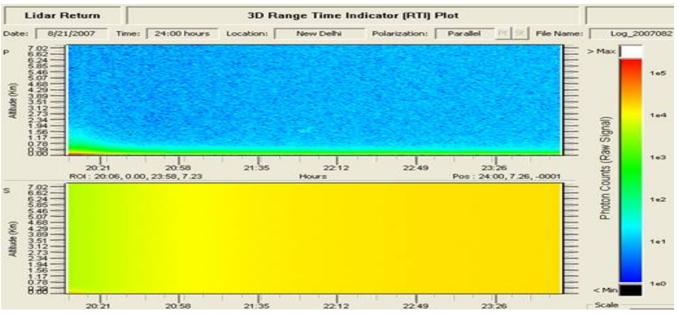
Figure 1: Schematic diagram of Micro Pulse Lidar (MPL-15)

Results and Discussions:

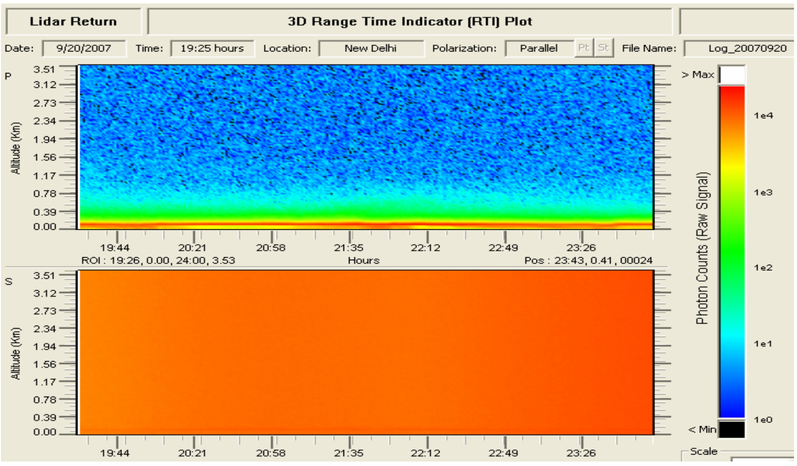
The great contribution of Lidars has been in the visualization of different atmospheric processes. The vertical staring Lidars can provide time histories of the evolution of atmospheric processes through out the depth of atmospheric boundary layer[5]. The time height indication of Lidar data taken during 20-21 August 2007 is shown in **Figure 2**.



This figure shows the typical variation of night time stable boundary layer from 22:45 Hrs to 24:00 Hrs on 20.08.2007. The nighttime stable boundary layer structure has been clearly evolved. The boundary layer height is about 220 meters during the observational period. A layer of clouds is seen at the height of 6.19 Km to 6.141 Km. After 00:00 Hrs i.e., on 21.08.2007, boundary layer height variation is observed from about 200 meters to 140 meters and clouds height have raised to 6.80 Km. Another **Figure 3** shows the time height indication of Lidar data on 21.8.2007 from 20:00 Hrs to 24:00 Hrs.



In this case the stable boundary layer height is 210 meters at 20:03 and has reduced to 140 meters at 20:26 Hrs , when vertical scale is exaggerated a wave like structure is detected at the top of the boundary layer. The waves are generated in a thin particulate layer that has a layer of air directly above it which is moving faster than the layer below. This causes waves in the denser air mass containing the particulates. The **Figure 4** depicts the Lidar data taken on 20.09.07 from 19:27 Hrs to 24: 00 hrs. The boundary layer structure is clearly seen and varies from 170 meters to 120 meters. At the top of the boundary layer the clear wave like structure has been observed. This may be due to the amount of contrast between the particulate rich upwelling parcels of air and the relatively clean down welling parcels of air. This leads to large horizontal variations in the back scatter signal at that region.



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