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MULTI-WAVELENGTH OZONE LIDAR FOR STRATOSPHERIC AND TROPOSPHERIC MEASUREMENTS

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A research program on the stratospheric and tropospheric ozone is planned to start in April 1988 at the National Institute for Environmental Studies(NIES). Prior to the start of the program, a large differential absorption lidar system for measuring ozone was constructed at NIES. This paper describes the design and construction of the NIES ozone lidar system.

The ozone lidar system has two transmitter-receiver sub-systems optimized for the measurement in the low and high altitude regions(1.5-15km and 10-50km). Six wavelengths(three for each sub-system) are used to optimize the measurement and to correct the effect of aerosols. A block diagram of the NIES ozone lidar system is shown in Fig. 1, and the system parameters are listed in Table I. The low altitude transmitter consists of a KrF excimer laser and two Raman shifters containing H_2 and D_2 that generate 277, 313 and 292nm. An injection-locked XeCl excimer laser with a D_2 Raman shifter and an injection-locked XeF excimer laser are used in the high altitude transmitter that generates 308, 340 and 351nm with narrow spectral bandwidth.

The low altitude receiver consists of a 0.56-m diameter telescope, optics separating three wavelengths and six photomultiplier tubes. Each wavelength has two detection channels with high and low gain. A 2-m diameter telescope is used in the high altitude receiver. The high altitude receiving optics is similar to the low altitude one except for having narrow band optical filters to reject the background radiation in the daytime.

The data acquisition system has twelve photoncounting channels and six transient recorder channels. Each channel has a high repetition-rate averager with 24-bit accuracy, and can acquire data independently. The transient recorders are used to record strong low altitude signals at the same time with the photoncounter. The acquired data is transferred to a minicomputer and stored on the magnetic tape.

The ozone lidar system was installed inside an observation room with two large apertures in the roof. The lidar will be used in the ozone research program to observe ozone-related phenomena such as the stratosphere-troposhere exchange, the diurnal and seasonal variation, and the long term change in the stratosphere.

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Table I NIES Ozone Lidar Specifications

Low Altitude Transmitter

KrF excimer laser(Lambda Physik EMG201MSC)*

277.1nm	1st Stokes of H2
313.2nm	2nd Stokes of H2
291.9nm	1st Stokes of D2

High Aititude Transmitter

XeCl ecximer laser(EMG160TMSC)**

308.2nm	Primary
339.5nm	1st Stokes of D2

XeF excimer laser(EMG160TMSC)***

351.1nm	Primary

Output power *27W, **36W, ***18W

Spectral bandwidth **0.003nm, ***0.01nm

Low Altitude Receiver

0.56m telescope

Dicroic mirrors, Interference filters,

6 photomultipliers

High Altitude Receiver

2m telescope

Mechanical Chopper, Dicroic mirrors,

Interference filters, narrow-band etalons,

6 photomultipliers

Data Acquisition System

Photoncounter

12 input channels, >100MHz counting rate

1 micro sec gate time, 2048 segments

High speed averager(>250Hz rep. rate) with 24-bit accuracy

Transient Recorder

6 input channels, 30MHz sampling rate

8192 segments, High speed averager with 24-bit accuracy

Minicomputer(Digital Equipment 11/53)

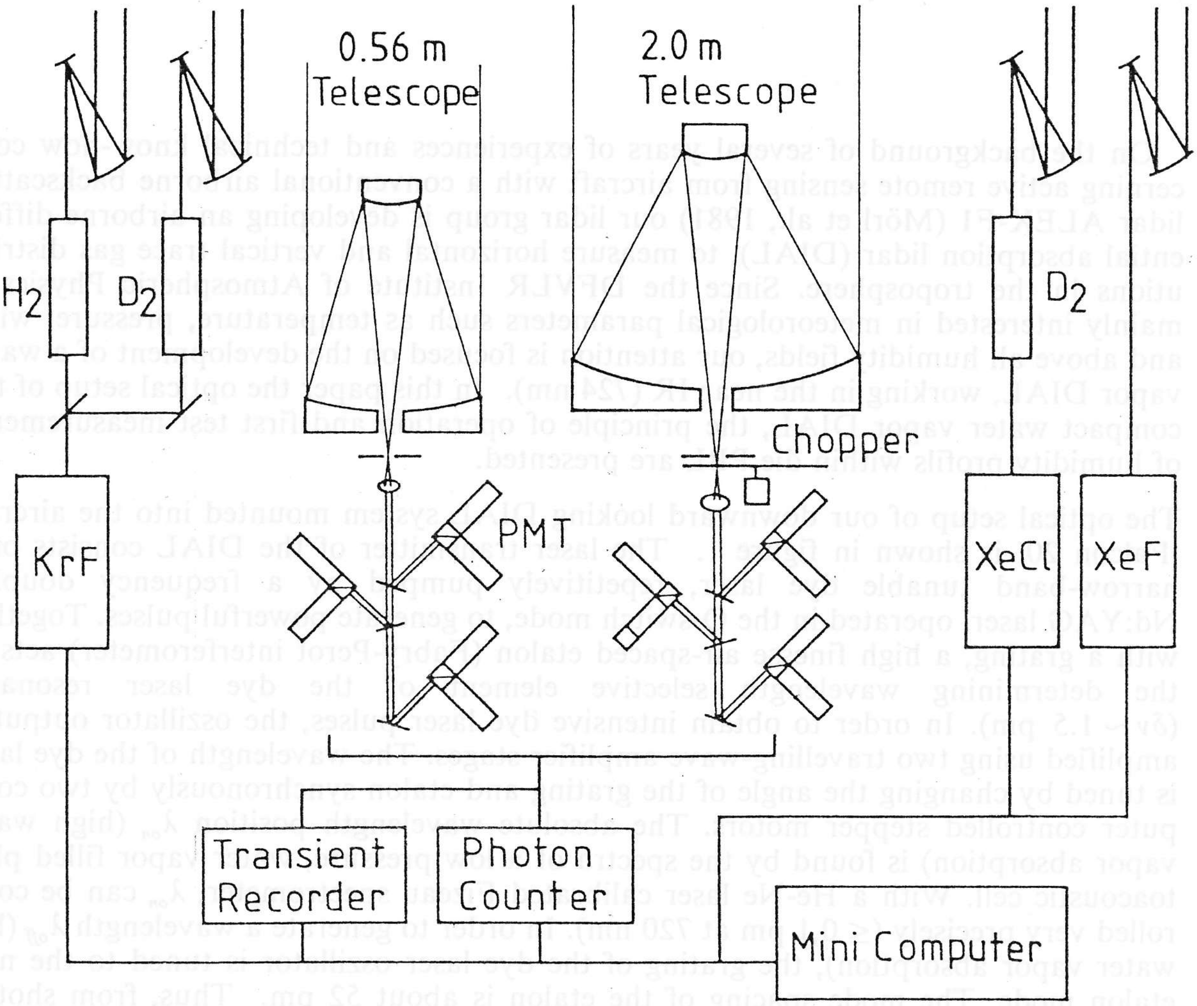

Fig. 1 Block diagram of the NIES ozone lidar system