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NEW OPTICS OF THE OZONE DIAL LIDAR SYSTEM AT OHP (44°N, 6°E)

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We describe here the new optical system of the recently modified stratospheric ozone lidar system implemented at the Observatoire de Haute-Provence (44°N, 6°E), one of the NDSC (Network for the Detection of Stratospheric Changes) primary stations. The implementation of the lidar system is represented on figure 1 : the lasers, the transmitter-receiver system and the signal analysis device are located in 3 different rooms. For the optics, we have used an optical concept derived from the transportable LIDAR ELSA implemented for the EASOE campaign [1] : the optical receiving system consists of four similar F3 mirrors of 53 cm diameter, which correspond to an equivalent receiving surface of 1.06 meter diameter. The laser beams are emitted in the center of the collecting area so that each mirror acts as the receiver of an elementary lidar but the whole system is quasi-coaxial. The light is collected by four optical fibers of 1 mm diameter mounted in the focal plane of each mirror. The fiber mounts can be moved manually in the vertical direction for focalization adjustement. They are motorized in the X-Y directions to position the fibers exactly on the image of the scattered light. For the alignment of the whole system, one of the 2 laser beams (in our case the 308 nm) acts as the vertical reference. The position of each fiber is then adjusted by maximising the signal of the corresponding mirror. Once the optical axis of each mirror is aligned with the vertical reference, the alignment of the other wavelength is made by adjusting its emitting mirror. After detection, the optical fibers transmit the backscattered light to the optical analysing device which icludes imaging optics, a mechanical chopper and a mutichannel monochromator designed for the wavelength separation. The chopper consists of a 40 Watts cooled motor which drives a blade of 140 mm diameter and 20 mm width, rotating at 2400 rpm in primary vacuum. The 1 mm fibers are assembled together on a line in a specially designed mount which enables a sharp desobturation of the laser signal in 5.7 μs. The detected wavelengths are 308 nm, 355 nm and the corresponding 1st Stokes wavelengths in the Nitrogen vibrational raman spectrum. The backscattered signals related to theses wavelengths are used in order to reduce the volcanic aerosol inference on the measured ozone number density [2]. The spectrometer (figure 2) is a Czeny - Turner system. Its dispersion is given by a 3600 gr/mm grating and a collimating mirror of 600 mm focal length. 2 focusing mirrors of 600 mm focal length are used : one for the 308 nm, 331 nm and 355nm wavelengths and the other for the 387 nm wavelength. The spectral separation is 0.3 nm/mm which gives a resolution of about 1 nm. Besides, in order to account for the large dynamic of the lidar signals in the measurement altitude range (15 to 50 km), we use a low altitude and a high altitude channel for the elastic backscattered signals of the two emitted wavelengths, so that in total, the lidar set up includes 6 optical channels.

CHARACTERISTICS OF THE TRANSMITTOR RECEIVER SYSTEM

Transmittor :

Emitted Wavelengths :
- the 3rd harmonic of Nd:Yag laser (355nm).

emitted nergy : 150 mJ/pulse at 50 Hz
XeCl exciplex laser (308nm)
250 mJ/pulse at 50 Hz

beam expander magnification :
X 2.5
final divergence : 0.20 mrd

X 3
final divergence : 0.15 mrd

collecting system :

telescope :

4 mirrors
diameter : 530 mm
focal length : 1.5 m

whole system field of view : 0.67 mrd

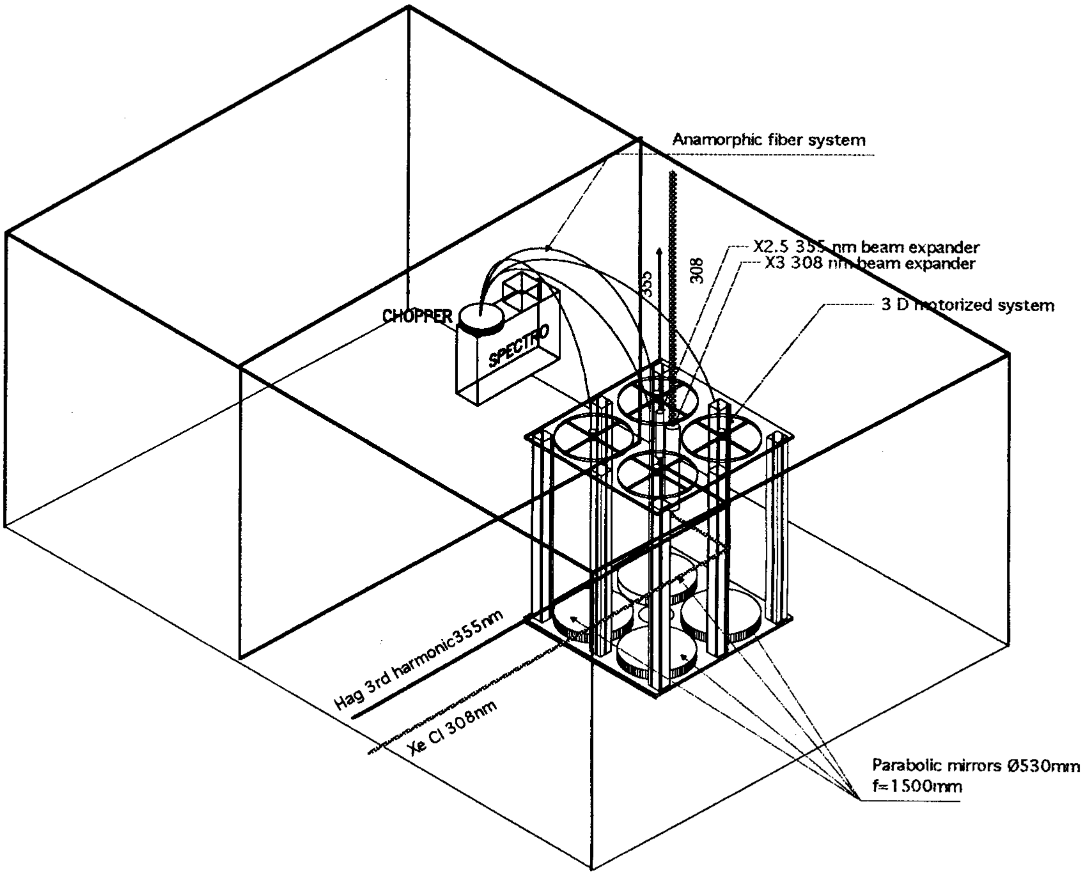
Spectrometer :

detected wavelengths :
308, 331, 355 and 387 nm
3600 gr/mm grating
spectral resolution : 1nm

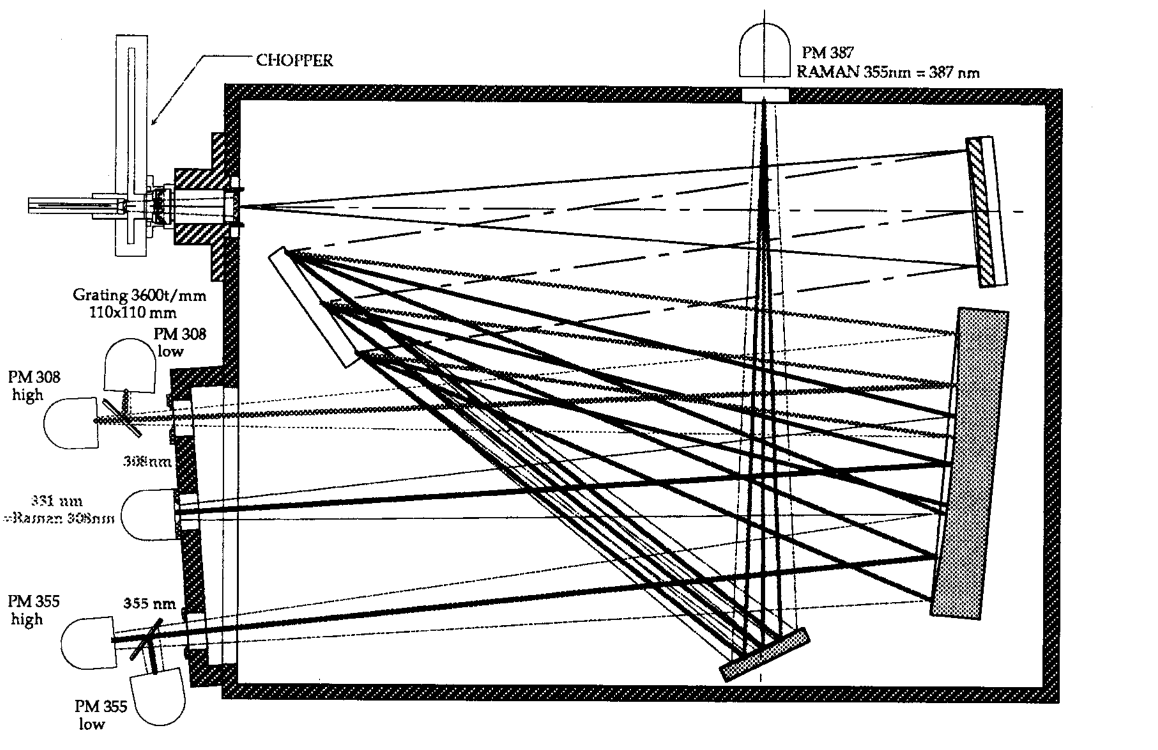
REFERENCES

1. J. Porteneuve, S. Godin, Optics of the ozone lidar ELSA 16th ILRC., Boston, 1992

2. U.N. Singh, T. McGee, M. Gross, W. Heaps and R. Ferrare, A new Raman DIAL technique for measuring stratospheric ozone in the presence of volcanic aerosols, 16th ILRC, Boston, 1992



RECEIVER / TRANSMITTER



GRATING MULTICHANNEL MONOCHROMATOR FOR OZONE LIDAR OHP