12 レーザーレーダーによる超高層観測

Observation of upper Atmosphere by Laser Radar

山中千代衛 中井貞雄 北村新三 柏原俊昭 土師統一

C.Yamanaka, S.Nakai, S.Kitamura, T.Kashihara, S.Haji,
近田彰夫

A.Konda

大阪大学工学部

Department of Electrical Engineering,
Faculty of Engineering, Osaka Univ.

Observation of Aerosol in Upper Atmosphere by Laser Radar boarded on Rocket

S. Nakai

T. Imagawa

T. Kashihara

Y. Izawa*

C. Yamanaka

Department of Electrical Engineering,

Faculty of Engineering,

Osaka University, Osaka, JAPAN

*Present address

Industrial Research Institute, Osaka Prefecture

Abstract

The laser radar system which can be boarded on rocket has been developed and applied for the measurements of aerosol in upper atmosphere. The system consisted of the GaAs semiconductor laser apparatus, the scattered light detector and the data processing device. The rocket observation experiment was performed successfully at 21.00, 3rd Sep. 1971 from Kagoshima Rocket Center in JAPAN.

Several scattering layers were observed at the altitude of 90 ~ 110 km (layer A) 255 ~ 275 km (B) and 320 ~ 340 km (C). Using the scattering coefficient of atmospheric air as the calibration of the apparatus, it was estimated that a particle density of $N \sim 1\ cm^{-3}$ for aerosols of radius 0.65 μ and refractive index 1.5 for layer A.

1. Introduction

The laser radar system which can be boarded on rocket has been developed and applied for the measurements of aerosol in upper atmosphere.

The scattered laser light from the surroundings was detected by the photon counting system loaded on rocket. The system consisted of the GaAs semiconductor laser apparatus, the scattered light detector and the data processing device. The first observation was performed at 20:30 on 19th, September 1970 by using L-3H-5 sounding rocket, which aimed mainly to test the actual performance of the laser radar system. The second trial was done at 21.00 on 3rd, September 1971 by using L-3H-7 rocket and the interesting results were obtained.

The aerosol in upper atmosphere is closely related to the noctilucent clouds.[1] The nature and origin of these clouds are not well understood although they have been studied for more than eighty years. New techniques for observation of aerosol in upper atmosphere can be expected to get the clearer data. These methods are

(1) collection of aerosol particles by rocket,[2][3][4]

(2) detection of particles by microphone, thin film or other newly developed instruments loaded on rocket,[5][6]

(3) measurements of diffused sky light by rocket borne

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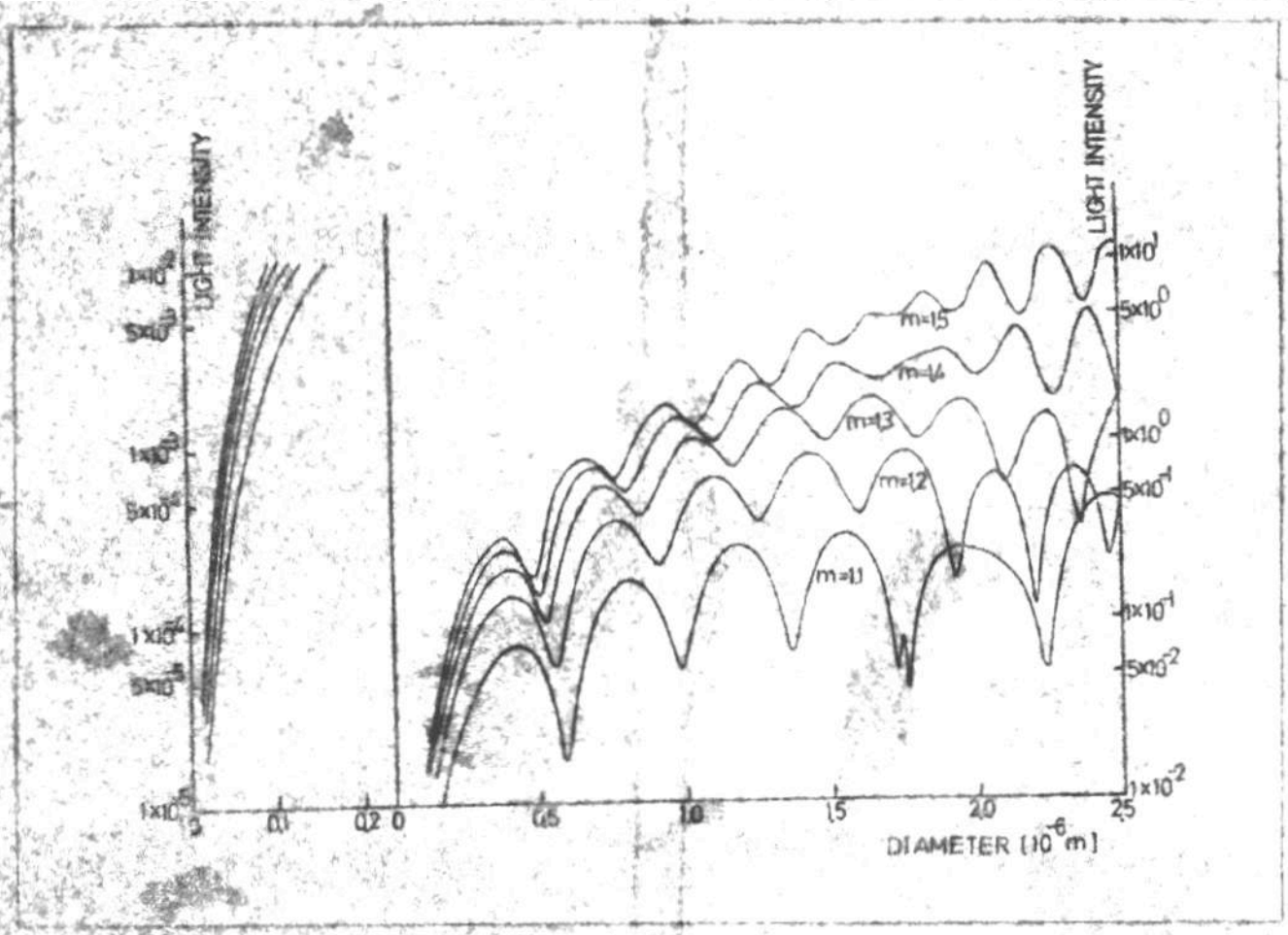

Fig. 1 Back scattering function $|S(\pi)|$ as a function of particle size with the parameters of the refractive indexes.

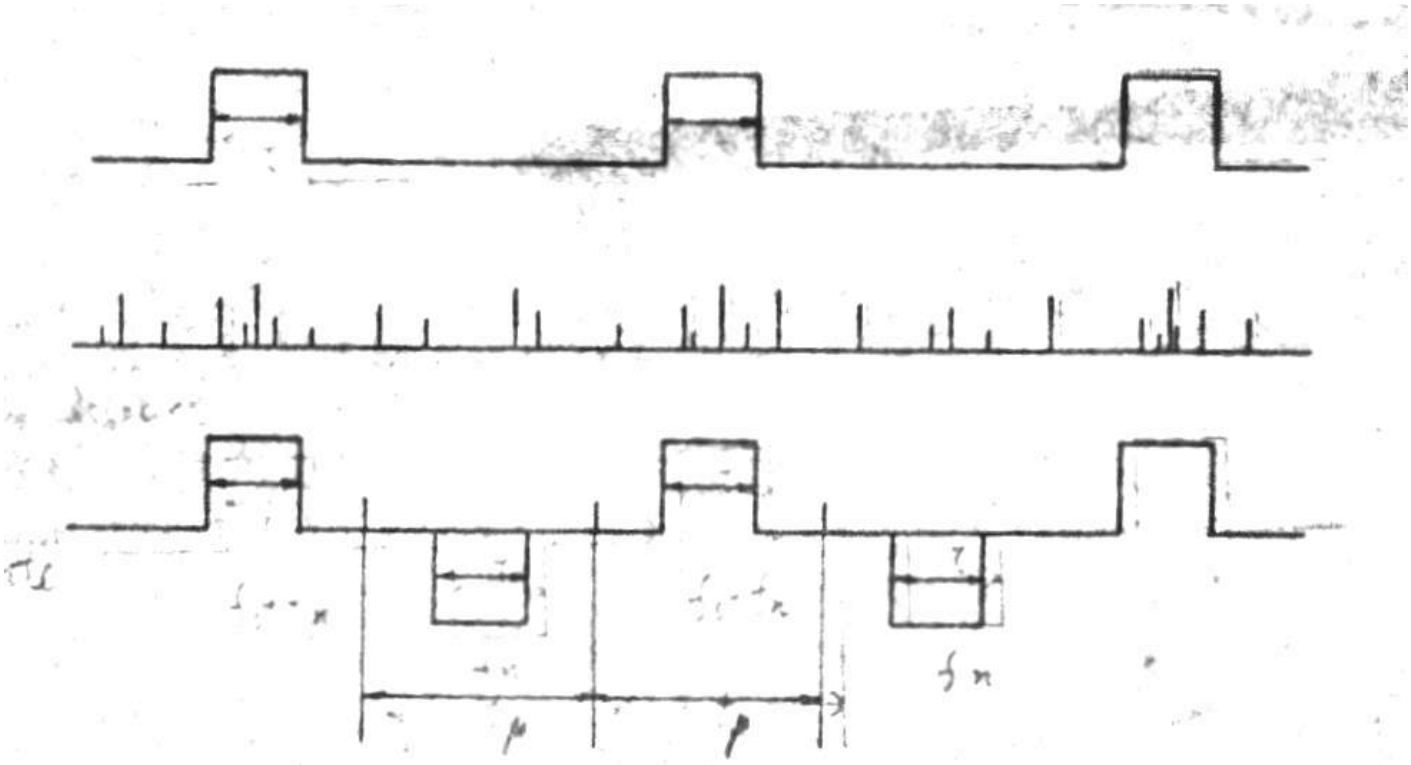

Fig. 2 Principle of phase sensitive photon-counting

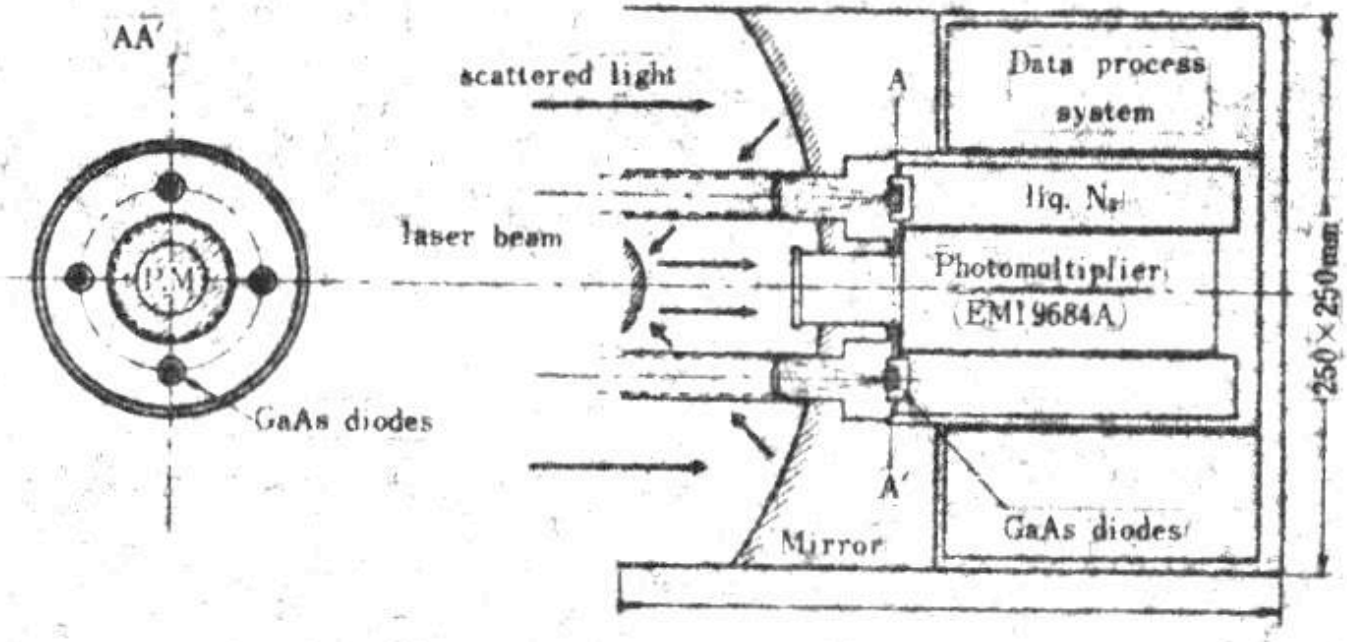

Fig. 3 Schematic diagram of apparatus

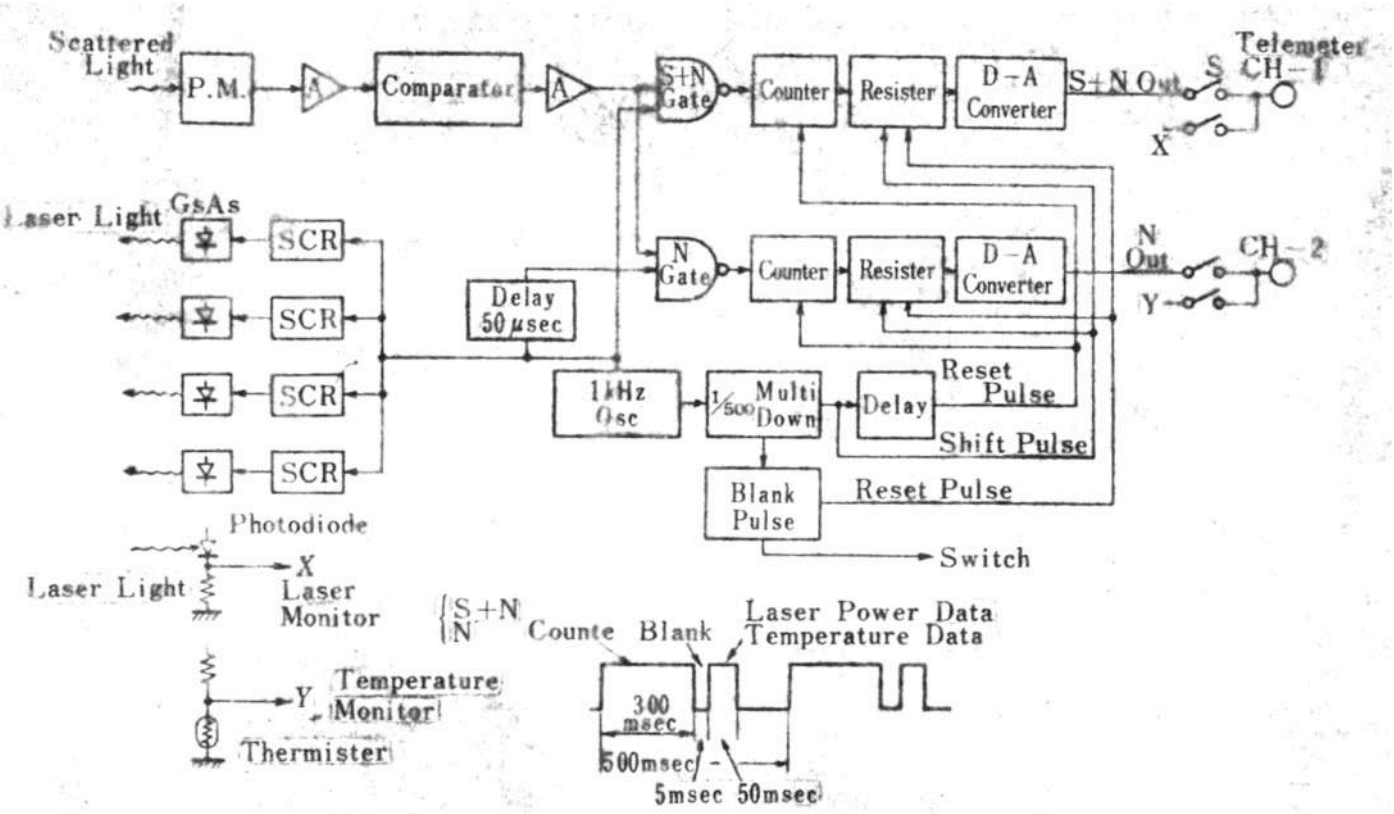

Fig. 4 Block diagram of laser radar

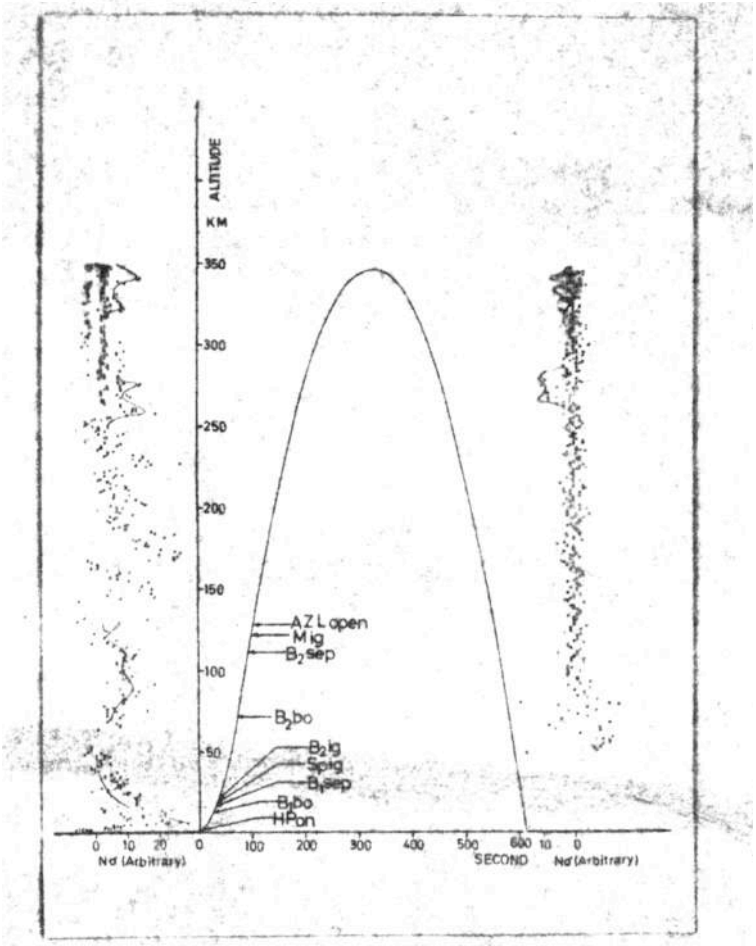

Fig. 5 Distribution of scattering coefficient as a function of height, left hand side : ascent, right hand side : descent. Center is the trajectory of instrument.

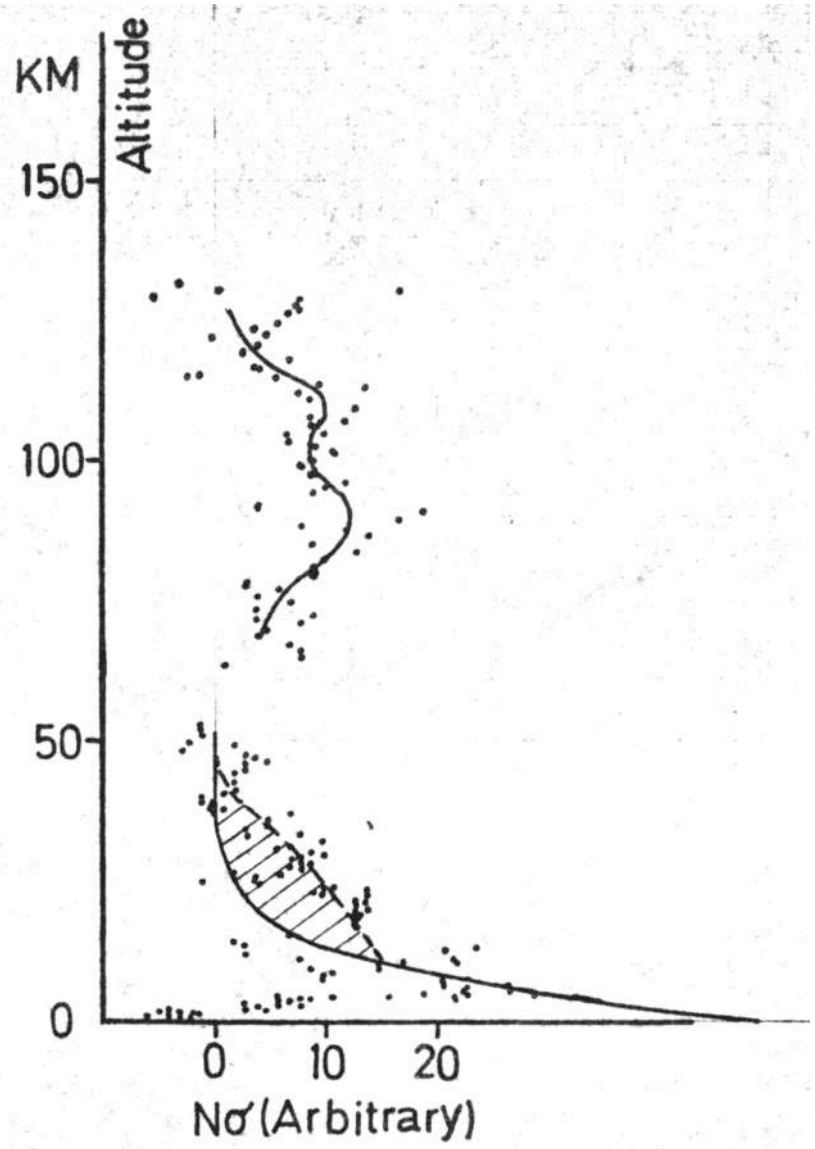

Fig. 6 Distribution of scattering coefficient below 130 km.

Table 1

height	$\Sigma N\sigma$ $cm^{-1}str^{-1}$
0 km	2.25×10^{-9}
10	7.59×10^{-10}
20	1.63×10^{-10}
30	3.38×10^{-11}