ELISE (Experimental Lidar In Space Equipment) : First Japanese Spaceborne Lidar Project

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1. INTRODUCTION

Lidar technologies have tremendously capabilities for measurements of various important parameters in atmospheric sciences, e.g. cloud and aerosol observation by using the Mie backscattering lidar, water vapor measurement by DIAL, atmospheric wind sounding by Doppler lidar. Any instrument does not remotely measure these. So, the spaceborne lidars should be only sensors to observe three-dimensionally them from space.

National Space Development Agency of Japan (NASDA) has been developing the first spaceborne lidar aiming to launch it in 2001. The name of spaceborne lidar program was called the Experimental Lidar In Space Equipment (ELISE), which is a two-wavelength Mie backscattering lidar. Many atmospheric scientists, engineers have been dedicating to its development with NASDA towards realization of the first spaceborne lidar in this decade. Unfortunately, however, this program was cancelled after the launch failure of H-II rocket in last fall.

In this paper, we would like to present summaries of ELISE program, s present status and a future plan after ELISE program.

2. ELISE program

In advance of ELISE program, a feasibility study has been made for the first Japanese spaceborne lidar from scientific view by the committee, which was supported by the National Institute for Environmental Studies (NIES). Many people from fields of both lidar and atmospheric science in Japan were involved in this study to discuss on the science objectives. Among discussions, the importance of global three-dimensional measurements of cloud and aerosol were pointed out for understanding the global climate system and its change relating to them. At the same time, NASDA is been developing a small launch vehicle and a single mission satellite, which was called the Mission Demonstration Test Satellite (MDS). The primary aim of this MDS is to demonstrate an advanced sensor like the lidar, critical components and key technologies in space environment, quickly and inexpensively. The program of MDS-2 lidar was planned to launch in 2001 after the recommendation of the NIES's committee.

Component	
Laser	High average power (100mJ. 100Hz), SHG crystal
Heat dissipation	200watts
Receiving telescope in Beryllium	Diameter of 100cm, thermal expansion Light weight

Table.1 Primary critical components

Table.1 lists up critical components for ELISE program. The most critical component is the 100mJ laser transmitter at

a repetition of 100Hz with a space qualification. In pre-phase (1991-1993), Tsukuba Space Flight Center (TKSC) has directed their efforts to developing laser diode pumped Q-switched Nd: YAG / and Nd: YLF laser with a high wall-plug efficiency and a high average power. The average power of 5 watts with a repletion rate of 50 Hz/ 100Hz were achieved with the optical-electrical conversion efficiency of more than 8 %, respectively. The ELISE program was directed to acquiring various technological data and to demonstrating the capabilities of lidar in space.

Table.2 shows an original schedule of ELISE program. As shown in the Table, the system design was started in 1997 and the Basic Test Model (BTM) was also begun in the middle of 1998. According to the original schedule, the Demonstration Mode (DM), which is similar to the Flight Model (FM), was intended to be developed after the Design Review (DR) in the end of 1999. Unfortunately, however, this program was cancelled in the review of Japanese space programs after the launch failure of H-II rocket in last fall.

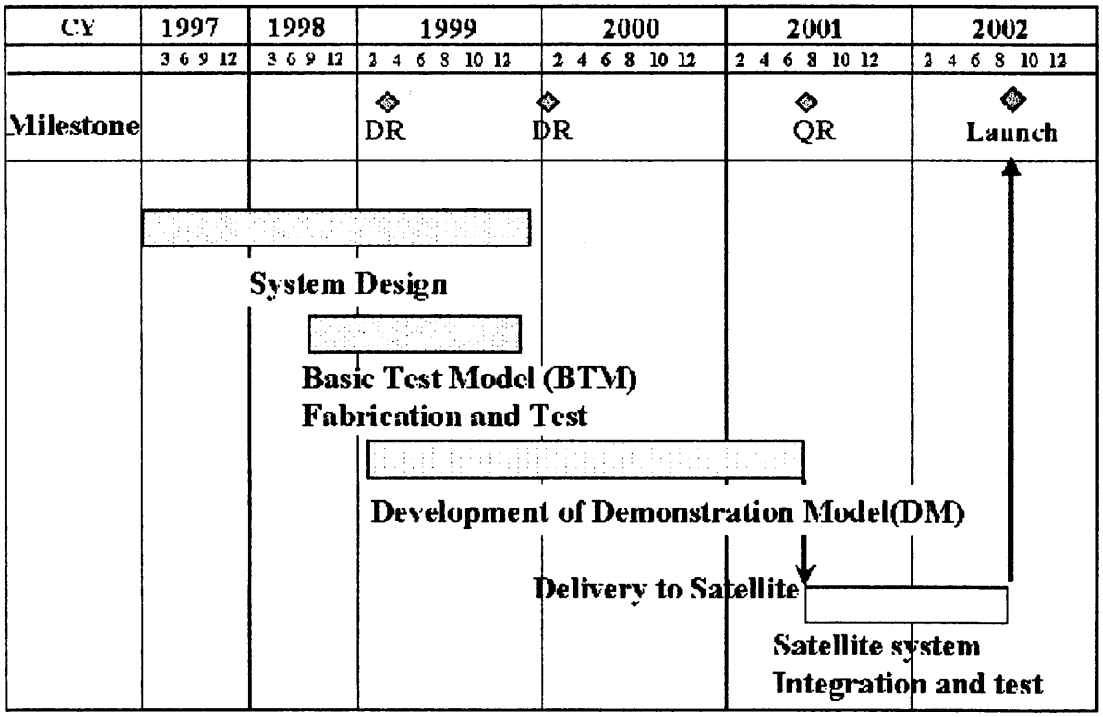

Table 1 Original schedule of ELISE program

3. Future plan after cancellation of ELISE

As the above mentioned, ELISE was cancelled to fly in space. The knowledge obtained in the ELISE program intended to use for a design of the operational lidar on the future earth observation satellites, i.e. like ATOMS-B1. An objective of ATMOS-B1 mission is to clarify the mechanism of earth-atmosphere climate system. In the point of such a view, the effect of cloud and aerosols to the climate system through radiation budget and water cycle should be targeted at first. To dedicate to these science objectives, employing the lidar, a cloud profiling radar, an imager and Fourier Transform IR spectrometer (FTIR) on one satellite was preferable in the ATMOS-B1. Though ELISE never flies, however, the development and ground-based test are being continued to achieve the space lidar technology.

NASDA and ESA recently started to investigate the possibility of the joint collaborative mission, tentatively named ATMOS-B1/ERM program, dedicated to the radiation budget study. ATMOS-B1/ERM is planned to launch into 380 km sun-synchronous polar orbit in 2008 if this mission was selected. We believe that the lidar technology obtained in the ground test of ELISE will surely be useful in the design of ATMOS-B1/ERM lidar.