Sapphire cell development for the daytime Na lidar observations at Tromsø

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An Nd:YAG laser-based sodium temperature/wind lidar was developed for the measurement of the northern polar mesosphere and lower thermosphere at Tromsø (69.6N, 19.2E), Norway. The highly stable laser system is first of its kind to operate virtually maintenance-free during the observation season (from late September to March) since 2010. We plan to upgrade the system to daytime observation. An Na Faraday filter (magneto-optical filter) is one of the best candidate as a ultra-narrowband optical filter to block the Sun light. The problem of the filter is its transmission stability due to a high temperature Na cell, which has been commonly accepted but unsolved problem. A pyrex-glass cell wall is potentially sensitive to the high-temperature (~200 degree Celsius) atomic Na vapor. So the atomic Na density in the cell changes, leading to the unstable transmission. The possible solution of this problem is to use chemically stable material. Mono-crystal sapphire is one of the best candidates. We try to use sapphire both for the cell body and the windows that are attached by optical contact method. In this talk, we present the idea of sapphire cell, the problems to solve, and a new Faraday filter design. We also try to apply the filters to measure [O]/[O_2] ratio measurement.

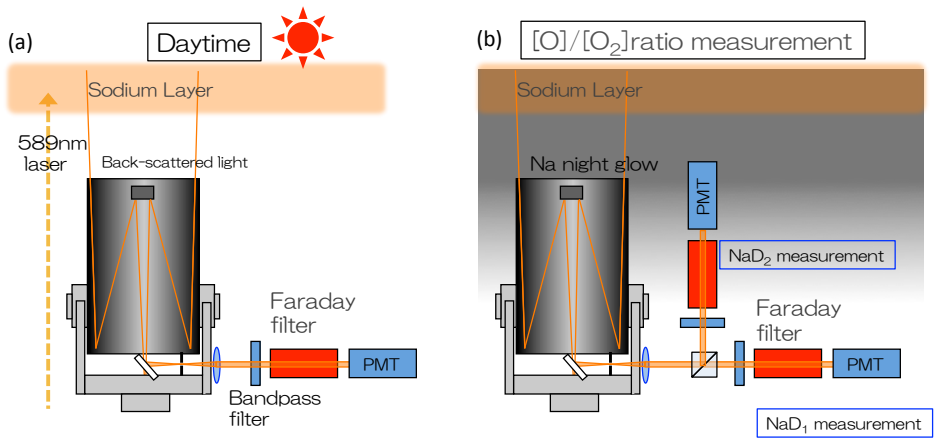

Figure 1. (a) Schimatic layout of daytime observations using a Faraday filter.
(b) Schematic layout of the [O]/[O_2] measurement using two Faraday filters.