Measurement of Atmospheric CO2 Column Density with a Fabry-Perot Etalon

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Concentration of carbon dioxide in the air increases year by year as a result of expanding fossil fuel consumption in human activity. The precise measurement of atmospheric CO_2 is of great interest because of global warming caused by heat sinks of CO_2. The projects of GOSAT in Japan and OCO in USA have been in progress to observe column densities of greenhouse gases from a satellite. The concentration of atmospheric CO_2 has been monitored by an instrument, typically a Fourier Transform Infrared Spectrometer (FT-IR), and the data have been open though a global network connecting continents. The FT-IR is expensive and requires a great deal of skill to get meaningful results. The observation network is thus not always functional because of unsatisfactory infrastructure in developing countries and lands with severe conditions in climate.

We developed a new, simple and small instrument to observe the column density of atmospheric CO_2 by use of a narrow bandpass filter and a Fabry-Perot etalon: The photoabsorption bands of CO2 in the region of 1572+-1 nm was separated by the bandpass filter. Free spectral range (FSR) of the Fabry-Perot etalon, being a comb-like shape, was adjusted as much as possible with the spacing of photoabsorption bands of CO_2. The transmitted wavelength through an etalon shifts by changing the temperature of the etalon. Thus, we are able to deduce the CO_2 column density in the Air by controlling the temperature of the etalon.

Performance of the new instrument to monitor the CO_2 column density will be presented. The CO_2 column density observed in Adelaide, Australia for the first campaign of the GOSAT project will be discussed. Preliminary results by employing a fiber Bragg gratings and an optical fiber etalon will be also presented. The fiber optics elements, which have been developed for communication, are small, light, cheap, strong and easy to handle.