Estimation of the lifetime of O(^{1}S) state excited oxygen atom

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Pulsating aurora (PsA) is a kind of diffuse aurora which almost always appears in the morning side during the recovery phase of auroral substorm. PsA typically has two characteristic temporal variations. One is so-called main pulsation whose period ranges from a few to a few tens of seconds (main pulsation). The other is a few Hz modulation (internal modulation), which is often seen during the ON time of main pulsation. Recent study revealed the frequency distribution of the main pulsation and demonstrated that the dispersion in the lifetime of O(^{1}S) atoms producing 557.7 nm emission have a potential to smear out higher frequency variation of main pulsation. Such effect has not been taken into account in the analysis of the periodicity of PsA in the previous studies. In addition, the derivation of the lifetime of excited state atoms is useful for estimating the altitude of PsA; thus, the energy of precipitating electrons. Thus, it is significant to understand the lifetime of O(^{1}S) on the morphology of PsA.

We employed the 5-channel photometer in Tromsoe, Norway (69.6N, 19.2E, 66.7MLAT), whose FOV is directed along the magnetic field line. The 5-channel photometer measures the auroral emission at 5 wavelengths (427.8 nm, 557.7 nm, 664.6 nm, 777.4 nm, 844.6 nm) with a temporal resolution of 20 Hz. In the analysis, we extracted the time series of main pulsation at 427.8 nm and 557.7 nm and calculate the lifetime of O(^{1}S) state by performing cross correlation analysis between them. We also derived the histogram of lifetime and the average of the distribution was estimated to be around 0.6 s. In addition, we performed the frequency analysis by using FFT on the time series of 427.8 nm and 557.7 nm, and derived the frequency distribution of main pulsation at both the wavelengths. As a result, it was found that the higher frequency modulation of PsA was not observed at 557.7 nm emission. We will extend the analysis period and derive a statistically significant histogram. In addition, we perform similar frequency analysis on the internal modulation and clarify the effect of lifetime on it.