

Comment on angeo-2022-23

Shin-ichiro Oyama (Referee)

Referee comment on "The altitude of green OI 557.7 nm and blue N₂⁺ 427.8 nm aurora" by Daniel K. Whiter et al., Ann. Geophys. Discuss.,
<https://doi.org/10.5194/angeo-2022-23-RC1>, 2022

This study performed a statistical analysis of the peak emission height at optical wavelengths of 557.7 and 427.8 nm using a large data sets from several cameras in Scandinavia. The result shows higher peak emission height at 427.8 nm than at 557.7 nm. That is a variable result that defies our long-held notions. The authors discussed energy transfer among particles, comparing with the model calculations, in a careful manner. Basically my recommendation to the editor is "publish this study", but I have a couple of questions. The text may be better to be revised, according to the authors' reply to be made, for further understanding of the physics. Please note that this doesn't mean the text should be drastically changed. The text is well designed, focusing on the energy transfer. But in my mind, dynamics may also play a role, as mentioned in comment (1).

(1) Effects of dynamics

O is a neutral particle and N₂⁺ is a charged particle. In the lower thermosphere/ionosphere, they likely move together because of very frequent collisions. However, going to higher altitudes, ions can move more separately in the direction of the magnetic field due to less collisions. While the less-collision shift with altitudes can be gradual, altitude of approximately 120 km may be an important boarder. The ion-neutral collision frequency is equal to the ion gyrofrequency at this altitude. Then looking at Figure 4, which shows the height difference (green – blue) with the mean height, negative magnitude of the difference height gradually increases with the mean height. This suggests that the blue peak tends to appear at higher altitude than the green one above 120 km. The energy transfer process in discussion of this study may play a significant role to cause the height difference, but I can't ignore the height difference turns to be clearer with altitude above 120 km. A recent publication presents upward extension of the blue emissions, which may be a feature in dawn (Shiokawa+ 2018GL079103). Then I would like to ask the authors to discuss effects of dynamics and local time dependence of the peak height difference.

(2) Shape of the modeled spectrum

In calculating Figures 7 and 8, two types of the spectral shape, Gaussian and Maxwellian, were selected. Could you tell me the reason why the two functions were selected in this study?

