A new auroral phenomenon: The anti-black aurora

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Black auroras are small-scale features that show a significant reduction in optical brightness, i.e. reduced flux of particle precipitation, compared to the surrounding diffuse aurora. It typically occurs post-substorm after magnetic midnight. This phenomenon also exhibits lower mean energy than the surrounding brighter aurora it is embedded in. The underlying mechanisms that cause black auroras are not yet fully understood, although several theories have been proposed: a coupled ionospheric-magnetospheric generation mechanism, and a magnetospheric generation mechanism. This shift in particle precipitation energy to a lower mean value is confirmed by using synchronised dual-wavelength optical and EISCAT incoherent scatter radar observations that ran in parallel, and agrees with the magnetospheric generation mechanism theory. Now reported for the first time is an even more elusive small-scale optical structure has been observed occurring paired with ~10% of black aurora patches. A patch or arc segment of enhanced luminosity, distinctly brighter than the diffuse background, which we name the anti-black aurora, may appear adjacent to the black aurora. The anti-black aurora always moves in parallel to the black aurora. The paired phenomenon always drifts with the same average speed in an easterly direction. From the first dual-wavelength observations of anti-black and black aurora pairs, we show that the anti-black and black auroras have a higher and lower mean energy, respectively, of the precipitating electrons compared to the diffuse background.