

Nightside Distorted Transpolar Arcs and Their Possible Formation Process Model

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Transpolar Arc (TPA) is an important auroral phenomenon when considering how the energy stored in magnetotail is transported to ionosphere via magnetic reconnection under the northward interplanetary magnetic field. Magnetotail reconnection is considered to play a crucial role in TPA formation. Reconnection X-points are expected to retreat tailward as TPA grows from nightside auroral oval to the dayside. Usually, they straightforwardly retreat tailward, and reconnection-formed TPA morphology is straight-bar shape. However, we wonder how the TPA shape would be expected when traces of the tailward X-point retreats were not straightforward. The Wideband Imaging Camera (WIC), which is a part of Far Ultraviolet (FUV) instrument, onboard the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite detected an interesting type of TPAs, which are identified as “nightside distorted TPAs”. Their main bar-shaped parts were located at the dawn or dusk sides, and the nightside ends of them got distorted toward pre- or post-midnight sectors. Because these TPAs look like the shape of an alphabetical letter of “J” or “L”, we distinguished the nightside distorted TPAs from “J” - and “L” -shaped TPAs. We followed the time sequence of the evolutions of several nightside distorted TPAs with the IMAGE FUV-WIC imager data. In most cases, the “J” and “L” -shaped TPAs started to grow from the nightside main auroral oval, and protruded to the dayside auroral oval via the experience of distortion, suggesting that magnetotail magnetic reconnection was closely related with the formation of the nightside distorted TPAs. In this study, we have proposed a model to explain the nightside distorted TPA formation, in order to discuss that TPAs with their nightside ends distorted toward pre- or post-midnight were formed through how physical process. Furthermore, we have tried to verify whether or not our model proposed is appropriate to adequately explain formation process of nightside distorted TPA based on the global MHD simulation using the BATS-R-US codes.

Keywords: Nightside distorted transpolar arc: “J” - and “L” -shaped TPAs, Nightside magnetic reconnection, Straightforward or wry tailward retreats of X-points, State of dynamic equilibrium, Magnetospheric convection

