Geocoronal solar wind charge exchange events simultaneously detected by Suzaku and XMM-Newton

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Abstract

Geocoronal Solar Wind Charge eXchange (SWCX) occurs between highly charged solar wind ions and exospheric neutral atoms or molecules. It is now established as time-variable foreground emission for X-ray astronomy satellites orbiting around the Earth. The spatial distribution of geocoronal SWCX is predicted to be high at the dayside magnetosphere including cusp regions (e.g., Sibeck et al. 2018 Space Sci. Rev.). This provides not only a diagnostic tool of minor solar wind constituents but also a remote X-ray imaging technique of the Earth's magnetosphere. The prediction and dependence on several observational conditions such as line of sight directions and/or solar wind parameters are important for proper consideration of currently planned missions aiming at the imaging of the Earth's magnetosphere (e.g., GEO-X; Ezoe et al. 2018 JATIS, SMILE; Branduardi-Raymont & Wang 2017 Space Research Today).

From observational points of view, we systematically analyzed all the archival data obtained from Suzaku which has one of the highest sensitivities to soft X-rays via geocoronal SWCX. We searched for time variability in soft X-ray background and then compared it with simultaneously observed solar wind proton and/or alpha flux (Ezoe et al. 2011 PASJ, Ishikawa et al. 2013, PASJ Ishi et al. 2019 PASJ). Among 3055 data sets covering from 2005 August to 2015 May, we found 90 events affected by geocornal SWCX. To investigate whole structures and responses of geocoronal SWCX, we also analyzed about 100 data obtained from XMM-Newton. These data sets are overlapped with our Suzaku detections. Following another detection procedure (Carter & Sembay 2008 A&A, Carter et al. 2011 A&A), we successfully detected about 20 events. The simultaneously detected events by Suzaku and XMM-Newton occur frequently at the dayside magnetosphere. A correlation of geocoronal SWCX emissivities between Suzaku and XMM-Newton seems to depend on their line of sight directions and/or orbital positions.