R009-P16
ポスター 4 ：11/26　AM1/AM2 （9:00-12:00）

系外惑星のオーロラ検出に向けた磁気圏-電離圏結合過程の汎用モデル開発

#アサ サティアグラハ [1], 木村 智樹 [1], 藤井 友香 [2], 森野 隆盛 [1]
[1] 東京理科大学, [2] 国立天文台

Development of Analytical Model Generalized for Exoplanetary Auroral Radio Emission

#Satyagraha Asa[1], Tomoki Kimura[1], Yuka Fujii[2], Ryusei Morino[1]
[1]Tokyo University of Science, [2]National Astronomical Observatory of Japan

Planetary aurora is believed to be a key for the direct detection of planetary magnetic fields and atmosphere. The circular polarization of the auroral radio emissions (Wu & Lee, 1979) enables them to be easily differentiated from other radio sources, and their emission frequency is theoretically proportional to the magnetic flux density in the radio source region. Therefore, auroral radio observations can directly constrain the magnetic field without relying on complex model assumptions. The auroral radio emission, however, has not been observationally detected from any exoplanet yet. Modeling of auroral radio emission is needed to predict which exoplanets are appropriate for auroral detection. Past modeling of exoplanetary aurora has been conducted, focusing on the Magnetosphere-Ionosphere coupling (Nichols, 2011, 2012) and Star-Planet Interaction mechanism (Saur et al., 2013), but have not been able to generally explain emissions from a variety of exoplanets. Here, we developed a new generalized analytical model of the Magnetosphere-Ionosphere(M-I) coupling that predicts the exoplanetary auroral radio power, based on the pioneering exoplanetary M-I coupling model by Nichols (2011, 2012). Our model assumes the flow speed distribution of the magnetosphere to estimate the auroral current density. This model is applicable to both Earth-like and Jupiter-like planets which have been addresed independently in previous models (Jupiter-like: Nichols et al., 2011, 2012; Earth-like: Nichols & Milan, 2016). Validation of our model with Jupiter and Saturn suggests that our model successfully describes the total auroral energy dissipated as Joule heating in the planet's magnetosphere (Jupiter: ˜450 TW; Saturn: ˜5 TW) within one order of magnitude of observations, and consistent with past modeling. We believe that our results on the total power dissipated as Joule heating will allow us to understand the polar atmospheric escape associated with the aurora of exoplanets when we apply our model to exoplanets in the future (Cowley et al., 2004; Gronoff et al., 2020). Furthermore, analysis of past models shows a 0.1% conversion efficiency of energy dissipated as Joule heating to radio emission (Cowley et al., 2002, 2004). Application of the convertion efficiency to our results suggests that the predicted radio emission power from Jupiter and Saturn agrees with obsrvational results within one order of magnitude (Jupiter: ˜450 GW; Saturn: ˜5 GW). We are currently validating and modifying our model based on comparative study with the auroral radio emission observations for other solar system bodies, ultracool (e.g., Kao et al., 2023) and brown dwarfs (e.g., Berger et al., 2001; Kao et al., 2016, 2018) before application to exoplanets. Here, we present the current status of our modeling and validation.