Investigation of variation mechanisms of the Jovian radiation belt using ALMA

*Hajime Kita[1], Hideo Sagawa[2], Takahiro Iino[3], Chihiro Tao[4], Takeshi Kuroda[4], Fuminori Tsuchiya[5], Hiroaki Misawa[5], Yasumasa Kasaba[5], Masaki Fujimoto[1]

1. Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency , 2. Faculty of Science, Kyoto Sangyo University, 3. Nature and Science Museum, Tokyo University of Agriculture and Technology, 4. National Institute of Information and Communications Technology, 5. Tohoku University

Jupiter is now considered as an archetype for gas giants widely exist in extrasolar systems. At the outermost layer of this giant planet, there is a 300 km-depth of the nearly isothermal atmospheric layer (stratosphere) above the massive troposphere. Jupiter is also known to be a fast rotator (with a period of 9.9 h) with an enormous magnetic field. High energy particles trapped in the magnetic field form a radiation belt around the planet, much stronger than the terrestrial Van Allen's belt. In the case of the Earth, the primary control factor of the radiation belt is the solar wind, while the solar wind is difficult to impact the Jovian radiation belt because of the intense magnetic field.

It is theoretically expected that the driving mechanism of Jovian radiation belt is due to the interaction between the radiation belt and the upper atmospheric dynamics: neutral wind perturbations and diurnal wind system control the radial diffusion and spatial distribution of the energetic particles, respectively. Therefore, precise measurements of Jovian wind field are essential for not only the dynamics of the stratosphere but also the magnetosphere.

ALMA's unprecedented high spatial-spectral resolution enables us to extract the limb emission of the trace gasses in the Jovian upper stratosphere with a few tens m/s sensitivity. It is well known that HCN and CS have been injected into Jupiter by the Shoemaker-Levy 9 impact and they distribute only in the upper atmosphere (p ~0.4-1mbar). Therefore, the Doppler shift of those molecular emission lines can be used to investigate the dynamics in the upper atmosphere particularly at the limb of the Jovian disk where the line-of-sight direction is equal to the horizontal direction of the atmosphere. Here we present the sensitivity of ALMA observation to measuring Jovian stratospheric winds, and discuss its capability of constraining the magnetosphere-atmosphere coupling. A test analysis is carried out using JVO ALMA archive data.

Keywords: Jupiter, ALMA, stratosphere, radiation belt

