The study of Jupiter’s zonal wind formation mechanism based on cumulonimbus observation

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From Galileo spacecraft observation, it is suggested that the zonal jet is created by the small-scale convection and coupling the small-scale eddies made by the vertical convection that involved cumulonimbus [Gierasch et al., 2000]. From the numerical simulation, the intermittency of cumulonimbus is from a few days to one hundred days. However, the observation period of the previous study by spacecraft is from a few days to one month. It is not enough observation period to reveal the relationship between the cumulonimbus and zonal wind. In our study, we observe the cumulonimbus’s time variation by using methane absorption band filters installed 1.6 m Pirka telescope and compare it with the zonal wind velocity variation to reveal this relationship.

In this presentation, we introduce the observational result by ground-based telescope from Jan to June in 2017. And we show the result that compares with the wind velocity time variation. We observed the 727 nm, 756 nm, and 889 nm filters installed at Multi-Spectral Imager (MSI) (pixel scale = 0.39 arcsec/pix) of the 1.6 m Pirka telescope. In our observation, we estimate the existence of cumulonimbus by using the relationship that high cloud top appears as a bright point because the sunlight reflected at cloud top before it is completely absorbed by Jupiter’s atmosphere. We operated the Gaussian High-Pass-Filtering to identify the position of cloud whose cloud top altitude is high like a cumulonimbus. For our observation data, the high cloud top altitude point is extracted in the resolution of one pixel. From the simulation, the intermittency of cumulonimbus would be about 5-100days [Sugiyama et al.,2014]. So, we tried to operate the observation once in a few days. We achieved to operate the observation total 61 times. The interval of observation ranged from successive days to over one week. The average seeing is about 3.0 arcsec. From these observation result,we find the high cloud top altitude point as a possible candidate of cumulonimbus at about latitude -12° and system III longitude 120° on April 20th, 2017. These observation conditions were 2.16 arcsec, equal to about 5000km spatial resolution on Jupiter, and observation covered region was from system III 90° to 180°. Compared with the amateur images that obtained the same day, it is confirmed that the white and bright pattern appeared at that same coordinate position. We observed Jupiter once in every three days from April 20th to the next couple of weeks. However, we couldn’t detect the bright point from data when observed April 23rd, 2017. Compared with the amateur images, we couldn’t confirm the bright and white point around that position. And on April 16th, 2017, from the amateur images, we couldn’t find the bright and white point at the same position. From these results, the lifetime of cumulonimbus at about latitude -12° and system III longitude 120° is about 6 days. We use amateur images to estimate the wind velocity. We compare the wind velocity variation about previous and late date of April 20. From this result, when cumulonimbus is generated, the wind velocity accelerates following the hypothesis. In the other hand, when cumulonimbus is disappeared, the wind velocity decelerates. In the other case, we couldn’t find this relationship. However, the number of data that can compare the wind and cumulonimbus time variation is few. And the accuracy of wind velocity estimated is not enough. So it is not enough to verify the hypothesis suggested by Gierasch and Ingersoll.

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