

A Report on VLBI observation of HAYABUSA in 2005

Mamoru Sekido[1]; Ryuichi Ichikawa[2]; Makoto Yoshikawa[3]; Nanako Mochizuki[3]; Takaji Kato[3]; Yasuhiro Murata[4]; Takafumi Ohnishi[5]

[1] NICT/Kashima; [2] NICT/KSRC; [3] ISAS/JAXA; [4] JAXA/ISAS; [5] Fujitsu Ltd.

<http://www2.nict.go.jp/ka/radioastro/index-J.html>

We are investigating a technique to use VLBI observation for improvement of the accuracy of Spacecraft navigation. Range and range-rate (R&RR) observation, which have been traditionally used for spacecraft navigation in the deep space, has sensitivity of spacecraft coordinate in the line of sight. VLBI observation is complementarily sensitive in the plane perpendicular to the line of sight. Joint use of both technique is expected to improve the accuracy of spacecraft navigation. As well-known, spacecraft HAYABUSA, which was launched by JAXA/ISAS, arrived to asteroid ITOKAWA and performed rendezvous flight and short time landing on it in 2005.

We have been organized several VLBI observations of HAYABUSA by strong support from Japanese VLBI community in 2005. And we have performed evaluation of the precision of group delay observables and phase delay, which is expected to achieve high delay resolution.

Higher than 1 nano second of precision is necessary to get high special resolution with limited Japanese domestic baselines, which are less than 3000km. And precision of group delay observable depends on the bandwidth of the signal from the spacecraft. The results obtained from a series of VLBI observations of HAYABUSA suggests that re-configuration of spacecraft signal might be necessary to get higher angular resolution than JPL/NASA's DDOR method.

Using phase delay observable is another choice to get higher delay resolution. Phase ambiguity is the problem to be solved to use phase delay. Since HAYABUSA stayed nearby ITOKAWA from September to November in 2005 and the orbit of ITOKAWA is precisely known from dynamical ephemeris, the space coordinates of HAYABUSA can be assumed to be known within the minimum fringe interval in the field of view in the sky. Hence phase delay observable obtained in this period can be treated as ambiguity free, and can be used for a good test data to evaluate phase delay observable and geometrical delay model of finite distance VLBI. We performed a series of VLBI sessions for group delay observable in May to August, and 4 VLBI sessions for phase delay in November by the support of Geographical survey Institute, National Astronomical Observatory of Japan, and Yamaguchi University. The results of VLBI observations of HAYABUSA organized in 2005 are reported in this paper.