

# **VRAD (differential VLBI RADio Source) used for gravimetry in SELENE**

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In the Japanese lunar explorer SELENE (SElenological and Engineering Explorer) which will be launched in 2007, VLBI will be applied for lunar gravimetry purposes for the first time in order to improve particularly the accuracy of the low degree gravitational harmonics and the gravity field in the rim region and realize three dimensional observations in cooperation with Doppler measurements. SELENE consists of the Main Orbiter and two sub satellites, a Relay satellite (Rstar) and VRAD Satellite (Vstar), in polar orbits with semi-major axes of 3000 km and 2,200 km, respectively. VRAD (differential VLBI RADio source)-1 and VRAD-2 are on-board Rstar and Vstar, respectively, and are used for differential VLBI observations of trajectories of the satellites with a Japanese network VERA and an international network. We plan to apply a multi-frequency VLBI method to measurements of angular distances between two radio sources in Rstar and Vstar. Three carrier waves in S-band and one in X-band which are emitted from Rstar and Vstar are used for the VLBI measurements in VRAD mission. The multi-frequency VLBI method has been proposed for the purpose of precise positioning using the phase delay and the optimum frequency spacing for three frequencies in S-band, 2212, 2218 and 2287 MHz, and one in X-band, 8456MHz, has been selected. This method uses carrier waves of lower power consumption and is appropriate for the positioning of spacecraft. The domestic VLBI network, VERA, will take part in the VRAD mission for the whole mission period of one year. In addition we will conduct two periods of intensive observations, each one month in duration, which will also include the foreign stations, Shanghai, Urumqi, Hobart, and Wettzell. We have already finished the development of instruments onboard, and are carrying out proto-flight tests under various conditions. Moreover, we have already performed test VLBI observations of orbiters such as GEOTAIL and NOZOMI with the international network.