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Initial results from the geodetic VLBI analysis of observations of an artificial radio source on the Moon

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In late 2013 a robotic lander and rover were deployed to the surface of the Moon in order to realize scientific objectives of the Chinese Chang'E-3 (CE-3) lunar exploration mission. This mission included the examination of the geological structure of the Moon and visible/near-infrared observations of celestial bodies. The lander is equipped with instrumentation for X-band data communication as well as instrumentation for Differential One-way Ranging (DOR) at X-band. First observations of CE-3 signals in a geodetic VLBI mode were carried out in 2014 as a single 24-hour session and using two European geodetic VLBI telescopes. During the subsequent OCEL (Observing the Chang'E Lander with VLBI) observing program of the International VLBI Service for Geodesy and Astrometry (IVS), consisting of twelve 24-hour sessions organized between 2014 and 2016, the lander was observed repeatedly with a global network of VLBI telescopes. We present initial results from the geodetic VLBI analysis of observations of CE-3 signals in the OCEL sessions. The project aims at evaluating the current precision of VLBI observations of lunar lander as well as the accuracy of estimated lunar-based parameters, i.e., the lunar lander's position. We also highlight the limiting factors of the presented concept as well as technical difficulties, which need to be resolved before one can access the full potential of such new observation type. Thus, our initial investigations provide valuable insights that motivate the scheduling and observation of lunar artificial radio sources along with standard quasar targets with the aim to extend the field of geodetic VLBI research with new applications.