The Hayabusa2 Sample Return Mission and its Small Carry-on Impactor Experiment

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On December 3, 2014 the Hayabusa2 spacecraft was launched by JAXA to investigate and return samples from carbonaceous Asteroid (162173) Ryugu. The spacecraft's payload contains several remote sensing instruments that are designed to characterize the asteroid's surface and to help identify scientifically interesting locations from which samples can be obtained safely. The data collected by these instruments will also help place any obtained samples in context with respect to the global characteristics of Ryugu. In addition to the suite of remote sensing instruments and the sampling device, Hayabusa2 also includes a small carry-on impactor (SCI) payload experiment, which is designed to impact the surface of the asteroid and excavate fresh material for subsequent collection. The SCI consists of a 30 cm diameter 2 kg copper disk that is accelerated by an explosive charge into the surface of Ryugu at approximately 2 km/s. The resultant crater formed during this experiment is estimated to be approximately between 2 – 10 meters in diameter with an ejecta blanket extending to 10 – 100 meters on the asteroid. Hayabusa2 will not be able to observe the impact experiment directly due to considerations of spacecraft safety since there is some risk of collisions with debris from the explosion and ejecta from the crater. However, prior to moving safely away, the spacecraft will deploy a small imaging system called Deployable Camera 3 (DCAM3). DCAM3 will detach from Hayabusa2 just before the detonation of the SCI and will image the moment of impact, crater formation, and ejecta propagation. These data will be transmitted to Hayabusa2 and will help constrain the near-surface properties of Ryugu and also impact scaling laws for small bodies in low gravity environments. These data could also be useful for gaining insights into determining asteroid physical properties from higher velocity impact events (e.g., DART and HERA data of Didymos).