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STUDY OF SIZE SCALE EFFECT IN THE ASTEROID DEFLECTION DUE TO HYPERVELOCITY IMPACT

Abstract

Recently, there are many asteroids in space, and an asteroid may collide with the Earth. This study focuses on asteroid deflection by Kinetic Impact at hypervelocity. When an impactor strikes a target at hypervelocity the momentum transferred to it is greater than the initial impactor momentum due to the crater ejecta thrown in the direction opposite that of the incoming impactor. Momentum enhancement is quantified by β, which is the ratio of the momentum of the initial impactor to the momentum of the target after impact. In the case of the aluminum targets, it has been confirmed that there is size scaling, and it is thought that the momentum enhancement of rock targets also scales to the impactor size. This was confirmed by conducting experiments in which a two-stage light gas gun was used to accelerate an impactor with a diameter of 13.6 mm to 2.0 km/s and strike with a firebrick. However, because the diameter of the impactor is fixed due to limitations of the experimental equipment, the length of the impactor was varied and quantified using the aspect ratio L/D, where L is the length and D is the diameter of the projectile. Since the current experimental equipment can only be used in experiments with a cylindrical geometry, numerical analysis was also performed to investigate whether there is a size scale even with a spherical impactor. As a result of impact experiments and numerical calculations, in the case of a cylindrical impactor, the momentum enhancement reaches a maximum of 2.14 when the projectile aspect ratio is 0.52 at a maximum of 2.0, that is, the length is up to twice the diameter of the reference value. Spherical impactors are still under investigation by numerical simulations. In addition, the possibility of saturation of the size scale effect is also being investigated using numerical calculations.