

Abstract Submitted
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Elastic Collisions and Gravity STEVEN BALL, LeTourneau University

— Elastic collisions are fascinating demonstrations of conservation principles. The mediating force must be conservative in an elastic collision. Truly elastic collisions take place only when the objects in collision do not touch, e.g. magnetic bumpers on low friction carts. This requires that we define a collision as a momentum transfer. Elastic collisions in 1-D can be solved in general and the implications are quite remarkable. For example, a heavy object moving initially towards a light object followed by an elastic collision results in a final velocity of the light object greater than either initial velocity. This is easily demonstrated with low friction carts. Gravitational elastic collisions involving a light spacecraft and an extremely massive body like a moon or planet can be approximated as 1-D collisions, such as the “free return” trajectory of Apollo 13 around the moon. The most fascinating gravitational collisions involve the gravitational slingshot effect used to boost spacecraft velocities. The maximum gravitational slingshot effect occurs when approaching a nearly 1-D collision, revealing that the spacecraft can be boosted to greater than twice the planet velocity, enabling the spacecraft to travel much further away from the Sun.

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