FLASH - FIRST LUNAR APPULSION SPACECRAFT AT HYPERVELOCITY. D. P. Manian[1], R. B. Barney[2], R. S. Legge[2], A. H. Lind[2], and G. J. Sisco[2], [1]Brown University Mechanical Engineering Student (Box 0495, Brown University, Providence, RI 02912-0495, Daniel_Manian@brown.edu), [2]Brown University Mechanical Engineering Student.

Introduction:

Mission statement. Impact a selected target area on the moon with three consecutive impacts at a hypervelocity of 10 km/sec using a small, low cost spacecraft by leveraging available, low cost, excess launch capacity.

Why impact the moon? Impacting the moon enables scientists to calibrate observed impact flashes. In particular, this mission will measurably improve the interpretation of data from the recorded impact flashes of three different meteor showers (Leonids, Taurids, Perseids). A lunar impact will also allow scientists to observe spectral evolution and will create an impact crater of known age. This mission will enable scientists to further calibrate the physics of ~10 km/sec appulsions (comparison with *Deep Impact*), and will also allow scientists to assess evolution/dispersal of ejecta, and to observe spectral evolution of ejecta. It will provide a low-cost extraterrestrial spacecraft technology demonstration. In addition, the mission can help scientists understand the survivability of organisms at ~10 km/sec. Finally, the mission will engage citizens, scientists, and researchers in watching the event from Earth and possibly from the space station.

Development and Guidance: The spacecraft's (Figure 1) hardware, software, and mission plan is currently being developed by the FLASH Team. The FLASH Team was assembled and began work in February 2005 under the guidance of Dr. Rick Fleeter, Professor of Engineering at Brown University and CEO and President of AeroAstro Inc. The project is currently in its third semester of work. The Team continues to be inspired by Dr. Peter Schultz, Professor of Geological Sciences at Brown University. Project design has also benefited from the review and comments from Tye Brady of Draper Laboratory. Areas of development include orbit definition and propulsion system, guidance and control, navigation and communication, and mechanical design and analysis.

Mission Plan: Figure 2 shows the current FLASH mission plan. Injection into Geosynchronous Transfer Orbit (GTO) is required to achieve the hypervelocity impact speed of 10 km/s. At a prescribed instant near perigee, a solid rocket motor will burn, 'slingshoting' the spin-stabilized spacecraft out of GTO and on a hyperbolic trajectory toward the moon. Any post burn error in trajectory or position will be sensed via star sensors and ranging navigation equipment. Attitude determination and control thrusters will correct the trajectory for the desired lunar impact. Separation of the empty solid rocket and a five kilogram copper mass from the spacecraft will provide the prescribed three lunar impacts. The impacts will be separated by 500 meters on the lunar surface and by at least one second in time.

Additional Information: The FLASH mission uses a low cost, reproducible design which can be replicated and adapted for additional lunar, asteroid and planetary impact research.

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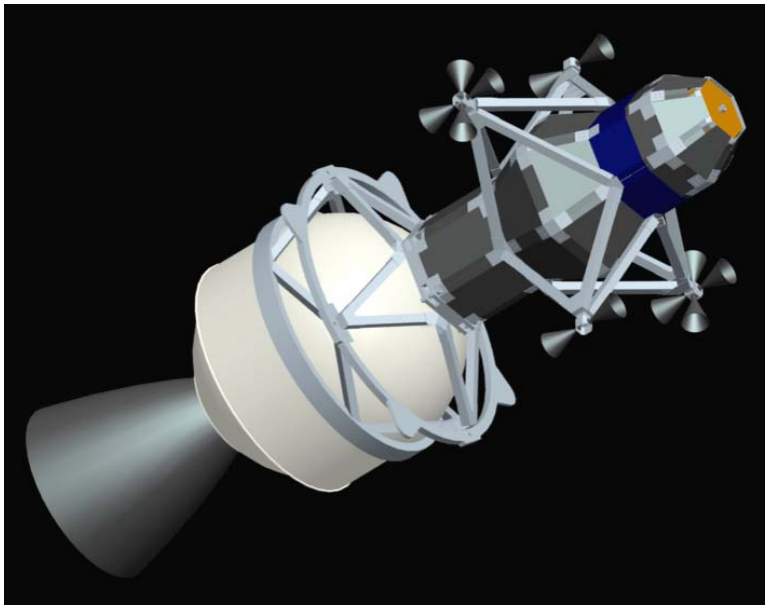

Figure 1: Brown University Lunar Impactor

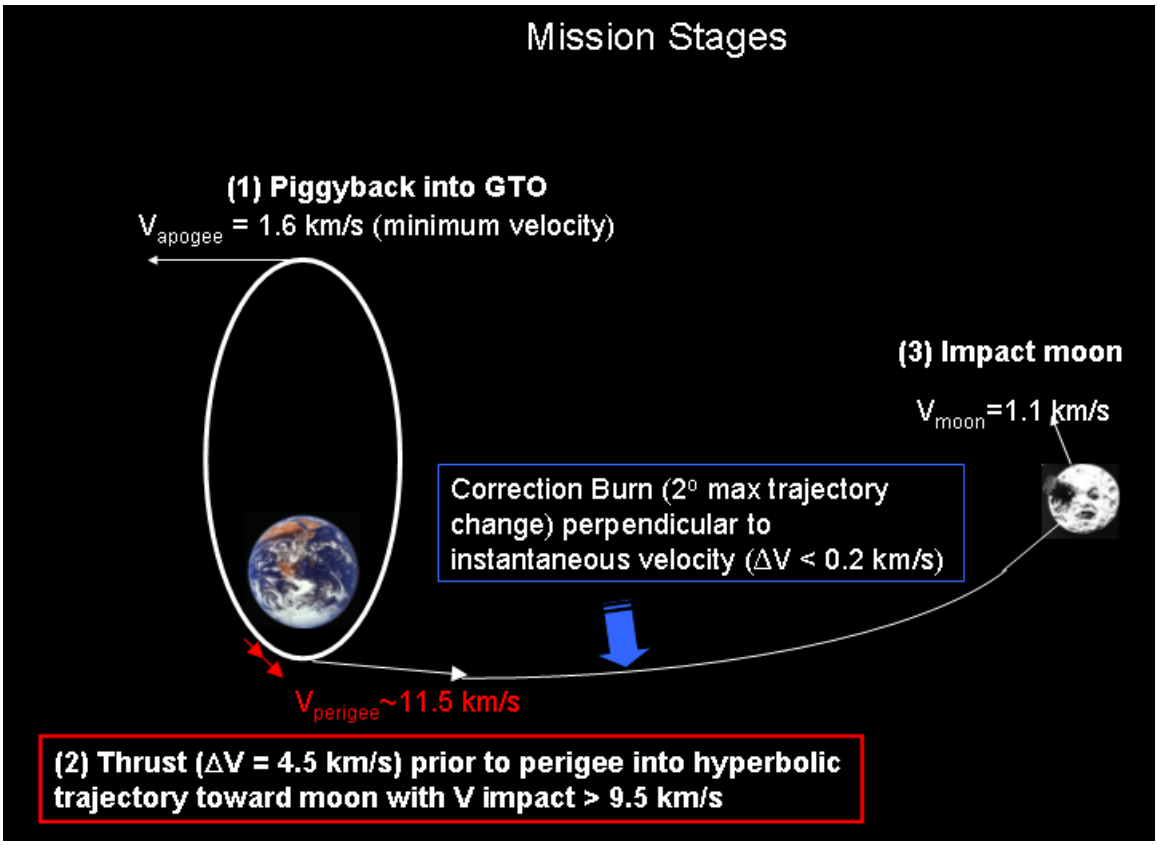

Figure 2: FLASH Mission Stages