PROPOSAL FOR THE DEVELOPMENT AND APPLICATION OF THE MASS DRIVER

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Abstract

This paper proposes the development of the mass driver to launch atmospheric sounding probes to study the ozone layer of the Earth's atmosphere. At least one of the proposed mass drivers is to be installed on Antarctica to study changes occurring in the ozone layer there.

The mass driver technology is developed to support the mission to planet Earth. This atmospheric sounding mass driver serves as a basis for the further development of a space-capable mass driver.

Introduction

The mass driver technology has been developed to the laboratory and small prototype scale by the Space Studies Institute (SSI) and others. These prototypes are useful inventions for moving payloads.

This paper presents a proposal for the further development of the mass driver technology in the context of a useful service that competing launch systems cannot provide.

Mass Driver Application

We propose that an intermediate scale (mid-range) experimental mass driver be developed to provide access to the ozone layer of the Earth's atmosphere. The mass driver prototype would operate as a rapid-fire "sounding rocket" to sample changes in the ozone layer and to seed the ozone layer with materials. The mass driver is installed at a fixed location and fires probes into the ozone layer at regular intervals. As the mass driver technology is developed and perfected, the payload launches would be increased from weekly to daily and then to hourly launches.

This experimental mass driver could be installed at an Antarctic location and operated in conjunction with the other international scientific research conducted on that continent.

Transition from Laboratory to Application

The mass driver has been developed and demonstrated at laboratory scale. The Space Studies Institute and other organizations have developed a series of laboratory scale mass drivers and similar devices. All of these experiments have contributed to the development of the mass driver state of the art. At this point in time, the mass driver is well developed in the laboratory stage.

We need to move the mass driver beyond the laboratory to the stage where useful payloads are transported. The first major civilian use of the liquid-fuel rocket was for the transportation of atmospheric sounding payloads. We propose a similar application for the mass driver.

A modest increase in the scale of the mass driver prototypes would allow payloads

to be sent vertically to altitudes of several miles. This limited upgrade provides a capability for sending payloads up into thunderstorms and weather fronts.

An additional step upward in capability proves access to the ozone layer at 80,000 to 100,000 feet. This increase in capability would allow the mass driver to provide a major public service of regular access to the ozone layer.

This increase in mass driver capability requires serious research and development efforts. However, it is substantially cheaper and easier than launching payloads to high altitudes or into orbit.

Proposed Initial Activity

We propose that the Space Studies Institute, in cooperation with other organizations, start to organize a research effort directed at free-flight mass driver sounding experiments. Initial planning for these experiments can be started immediately.

The first experiments can be carried out by individuals or by small groups. These people can succeed in building mass divers that can propel payloads on vertical trajectories similar to model rocket flights. However, these individual efforts should be coordinated by realistic safety planning and strict test environments. Even the smallest mass driver can operate as a lethal weapon. Therefore, safe ranges are required for their tests. This need for safety is increased by the current low accuracy of the mass driver.

We also need the participation of larger groups and organizations in the development of the mass driver. We can recruit the participation of these groups by offering the mass driver to perform a useful public service. These organizations will help develop the mass driver and prepare it to deliver useful payloads. The mass driver can help the NASA mission to planet Earth by providing frequent probes of the atmosphere. Atmospheric science would certainly be assisted by hourly "core samples" of the atmosphere from the surface up to 20 miles altitude.

SSI should coordinate the preparation of a proposal to NASA for mid-range mass driver development. This proposal should include the development of a mass driver prototype that can launch payloads to 20 miles (30Km) altitude and the application of this payload to atmospheric sounding.

Proposed Research and Development Tasks

Research and development on the following mass driver aspects is proposed:

1. Increased mass driver capacity (payload velocity, payload weight, payload diameter increases)

2. Improved guidance and aiming of payloads

3. Mass driver reliability, maintainability, and safety

4. Power supply requirements and options for a mid-range mass driver

5. Operation of a mass driver in an arctic or antarctic environment

6. Design of mass driver payloads for sounding and seeding operations.

Increased Mass Driver Capacity

Our goal is to increase the capacity of the mass driver to that of a large artillery piece. This will allow the mass driver to propel its payloads to the required altitudes. Payloads of reasonable size (at least 20 pounds) will be propelled at high velocities.

Military expertise on this subject can be applied to the mass driver as part of the effort to redirect military projects to civilian needs and uses.

Improved Guidance and Aiming

The aiming accuracy of the mass driver needs to be improved to enhance safety of operations and to achieve the goal of accurate delivery of payloads to destination zones in the atmosphere. While this development is progressing, the mass driver prototype can be used to deliver payloads to large size destinations such as the ozone layer.

This research should include the development of dynamic feedback systems that would factor in measurements of wind and atmospheric conditions to adjust payload velocity and pointing.

Reliability, Maintainability, and Safety

Current mass drivers are laboratory experiments for occasional use. We need to develop the mass driver so that it will provide regular and frequent firing of payloads. A desirable goal is one payload launched every 15 minutes for a duration of months. This repeat firing capability is an important feature that cannot be provided by conventional sounding rockets.

The mass driver should be field-repairable and have safe failure modes. Power failures or contact between the payload and the accelerating mechanism should not result in lethal sprays of material over the mass driver's location.

Power Supply Requirements and Options

A mid-range mass driver requires a significant supply of electric current while it is launching a payload. A typical installation uses a power supply to charge a set of capacitors. These capacitors then supply the current to launch the mass driver payload. This use of energy storage results in a required charging period between mass driver launches.

The power supply requirements for a mass driver are a function of the mass and velocity of the payload as well as the firing rate (number of payloads per hour).

We need a power supply that will support frequent firing of 20-pound payloads to a 20 mile altitude. In addition, operation in remote locations such as Antarctica is desired.

Operation in Antarctica

One of the mid-range mass driver prototypes should be operated in Antarctica to probe the ozone layer observing changes over time and experimenting with ozone layer seeding. Additional technical innovations are required to operate a mass driver in this hostile environment. These technical innovations could be a useful intermediate step towards operating the mass driver in space. A rotating structure enclosing the mass driver would be useful. The mass driver can launch its payloads out of the structure through a shuttered port.

Design of Mass Driver Payloads

Development of atmospheric sounding and seeing payloads is needed. These payloads must be able to survive the high g-loads of launch and be capable of taking in atmospheric samples in flight. Other payloads must be capable of releasing chemicals into the atmosphere at selected altitudes. All of the payloads need to have a reliable recovery means. Simple parachutes may not be adequate. Other options such as radio control gliding should be considered.

Participation in the Research and Development

Wide participation in this research and development effort is encouraged. International participation would bring expertise from many points of view to the mass driver project. Contracts for mass driver tasks could be established with Russian and American aerospace organizations that are under-utilized with the fading of the cold war.

Eventually, mass driver sites in several nations can be established for atmospheric sounding. These sites would provide more complete coverage of the Earth's atmosphere.

As the project matures, results of ozone layer seeding experiments can be evaluated internationally to determine if seeding is a useful and desirable response to ozone layer depletion. Any widespread intervention in the ozone layer would have to be approved on an international basis.

International participation will also reduce any fears that the mass driver development is a military project. On the surface, the mass driver looks like a Star Wars weapon. International participation provides an inspection process that reduces the chances that the mass driver would be diverted to military uses. In addition, formal inspections of mass driver sites could be conducted. Mass driver firing rates can be designed so that they are not military in nature. Does one payload each 10 minutes threaten anyone?

Growth Potential of the Mass Driver

Accessing the ozone layer is a very useful product for the mass driver. However, it is not the only or final service of the mass driver. The proposed mid-range mass driver could also be used to ship payloads to points on Earth by suborbital trajectories. With enhanced aiming, the mass driver could deliver materials to emergencies or to ships at sea.

The mid-range mass driver provides a basis for developing a high performance mass driver that can send payloads to high altitudes and to Earth orbit. The high performance mass driver requires the intermediate development step of the mid-range mass driver.

Environmental Impacts of the Mass Driver

The mass driver is a beneficial technology from an environmental standpoint. The payloads fly passively through the atmosphere without emissions of exhaust gases. In studying the ozone layer there would be no destructive interactions of propellants with the ozone layer itself. There would be reduced contamination of atmospheric samples taken as well as a reduction in general atmospheric pollution.

The mass driver should be operated in a remote area, such as Antarctica, to reduce the impact of returning payloads. While situated and operated in these remote locations research could be devoted to the controlled return of payloads to the launch site. This would then allow mass drivers to be conveniently operated from existing rocket launching sites in more populated areas.

The electric power station supplying a mass driver can be a pollution source. However, a mass driver in the Antarctic can be powered by an array of wind power generators. A mass driver in New Mexico or North Africa can be supplied by solar electric power. Development of the mid-range mass driver should include consideration of providing electric power at remote launch sites with minimum environmental impacts.

Citizen Inputs to the Mass Driver

Individual citizens and students should be encouraged to provide inputs to mass driver design solutions. Individuals from many nations can provide useful inventions and

design solutions as they have done in amateur radio. In addition, student teams and individuals can design and construct payloads for launch by the mass driver.

Small firms and minority-owned businesses should be encouraged to participate in the mass driver development and the new markets that it creates.

Conclusion

The mass driver can provide frequent access to the ozone layer of the atmosphere. With the mass driver, the ozone layer in Antarctica can be sampled many times a day for a period of months or years. This service is well suited for the mass driver. Sounding rockets cannot match the frequency, reliability, and continuity of the mass driver operation.

The mass driver can be developed and enhanced during its years of service to the mission to planet Earth. As the mass driver technology matures, it can be applied to launching payloads into space followed later by mass driver installations on the moon and asteroids.