Students at the George Washington University are developing a passive stabilization mechanism for atmospheric rocket flight which extracts work from oncoming air to generate a restoring force.

Airflow channeled through a turbine section spins a shaft, which exerts a torque proportional to its speed and perpendicular to the rocket's trajectory. This additional stability allows for a reduction in the size of fin area and an increase in achieved altitude. This system could be scaled for any sized flight vehicle and calibrated to a required weight balance or stability requirement.

The Passive Ram-air Inertial Stabilization Mechanism, henceforth referred to as PRISM, is an aerodynamically driven gyroscope which aims to counter the natural pitching and yawing moments of a sounding rocket. It is made up of a forward hardpoint to direct the airflow through the nose cone to outlet holes, a turbine fan blade mounted on a steel shaft assembly, and an electronics bay located in a standard six-inch rocket coupler. During flight, airflow is naturally forced through the hollow nose cone, the turbine blade extracts energy from that airflow, and the turbine blade-shaft assembly spins as a result. The spinning shaft provides the torque, or rotational force, to counter the pitch/yaw of a rocket through a phenomenon known as gyroscopic precession. Further research is planned to better optimize the system to minimize spin-up lag and reduce drag. Potential applications for this system include significantly reducing gravity turn for long burn motors and sustained flight, reduction of control surface area, reducing complexity of an active system for simple flight stability, and possibly being implemented as an active system (controlled air intake).

This system is unique because it provides a passive alternative for stability which does not require the flight vehicle to spin and allows for a reduction in the size of the fins necessary for static stability. PRISM can easily be adapted to fit on any flight vehicle due to its internally contained design and was designed with scalability in mind. PRISM is also able to be calibrated by increasing the moment generated by the turbine shaft or adding a fly wheel proportional to the required torque. There is also potential for applications in hypersonic systems by modifying the inlet for supersonic airflow and implementing an aero-spike on the nose.

**Applications:**

- Sounding rocket Stabilization
- Hypersonic missile control surface reduction

**Advantages**

- Scalable for any size rocket or payload
• Allows for reduced control surface area for high speed rockets

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