THE ATSA SUBORBITAL OBSERVATORY: WHAT ASTRONOMICAL TARGETS CAN BE OBSERVED?

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Summary
Earth-based observations of Solar System objects close to the Sun represent the most difficult astronomical targets *for any telescope to acquire* since they require observations at small angular separations from the Sun. Ground-based observations of these objects are often constrained to twilight observations with the resulting interference of stray sunlight and effects of a high, rapidly-changing air mass. In addition, they fail to eliminate the attenuation of light at different wavelengths caused by the Earth's atmosphere. A major advantage of space flight is to expand above the Earth's atmosphere for astronomical observations. The Atsa Suborbital Observatory aims to capitalize on this advantage. We will discuss the feasible observations that the Atsa telescope can achieve, and how these drive instrumentation needs.

Introduction
Space-based observations have the advantage of being able to study astronomical targets with no interference from the loss of transmissivity caused by ultraviolet (UV) absorption due to the ozone layers at 50-km altitude above the Earth. Absorptions due to the telluric water content beginning in the near infrared (NIR) at 0.73 µm, and extending non-uniformly through the mid-IR with increasing absorptivity, are also eliminated above 100 km. Major advances in astronomy have been made with space-borne telescopes in Earth orbit such as the Hubble Space Telescope and Spitzer Space Telescope. Most celestial objects can be safely observed using these telescopes at some time during each year. Existing space-borne robotic telescopes cannot, however, observe near the Sun (the solid angle excluded around the Sun for HST is 50^{o} [1]; for SST, it is 82.5^{o} [2]).

A unique need exists to observe Solar System objects remotely from Earth orbit, using telescopes that can point within that solid angle excluded for most of the robotic telescopic spacecraft. From Earth's heliocentric distance, observations of the Aten and inner-Earth asteroids, Vulcanoid searches, Sun-grazing comets, comets approaching the Sun through perihelion, and the planets Mercury and Venus, all must be made in the Sun's vicinity. Observations of these objects provide clues to the existence, composition and physical structure of Solar System materials, which in turn teach us about Solar System and, by extension, planetary system evolution, and the attributes of populations of objects that threaten the Earth through impact.

In the past, suborbital robotic rockets and balloons have carried instrumentation to high altitudes to study some of these astronomical targets in spectral regions not accessible from the ground. These experiments can certainly be productive, but are likely to be single or limited flights. Human-tended observations on suborbital flights can observe spectral regions inaccessible from the Earth's surface, while limiting the developmental expense and maximizing the flexibility of the flight hardware by simply inserting "human-in-the-loop".

How well can suborbital spacecraft observe?
These observations are not, however, without well-considered concerns. Target acquisition and tracking for faint, moving point sources represents the greatest observational challenge. A single experiment likely will constitute the business of an entire flight. Pointing and spacecraft stability requirements probably limit the number of experiments requiring pointing during one flight. These flights are likely not suitable for flying tourists. Night launch could be required for some temporally-driven experiments. What observations are possible using a suborbital telescope system? How faint is too faint to observe effectively? How close is too close to the Sun? What telescope stability can be achieved? What instrumentation works?

We will present the results of our studies incorporating these concerns with the targets we plan to pursue, considering what we can achieve observationally with what instrumentation, and whether this is sufficient to meet scientific needs.

References
[1] __ (2007) HST Primer for Cycle 17, 2.3 Pointing Constraints. [2] Gehrz, R., et al. (2007) Rev. Sci. Instrum. 78, 011302.