INVESTIGATING UPPER ATMOSPHERIC DYNAMICS FROM NEXT GENERATION SUBORBITAL PLATFORMS: NOVEL OBSERVATION OPPORTUNITIES AND ACCELERATED DEVELOPMENT OF INNOVATIVE INSTRUMENTATION. C. R. Englert[1], J. M. Harlander[2], D. E. Siskind[1] and D. D. Babcock[3], [1]Naval Research Laboratory, Space Science Division, 4555 Overlook Ave SW, Washington DC, 20375, USA , [2]St. Cloud State University Department of Physics Astronomy and Engineering, St. Cloud, MN, 56301, USA, [3]Artep Inc., 2922 Excelsior Springs Ct, Ellicott City, Maryland 21042, USA.

Introduction: Next generation suborbital vehicles provide an unprecedented, radically different experiment platform, that will influence many scientific fields. They provide previously unavailable access to the thermosphere, relatively long dwell times at the peak altitude, the opportunity to have a human operator on board, and frequent and affordable flights at several locations. The investigation of upper atmospheric dynamics, especially winds, can potentially benefit significantly from these new platforms in two ways: First, the vehicles could be used as platforms for in-situ and/or remote sensing wind instruments to measure winds from the stratosphere, mesosphere, and thermosphere, all of which are by no means well understood at the present time. Secondly, next generation suborbital vehicles can be used to rapidly increase the technical readiness level (TRL) of novel instrumentation, especially, when adequate test measurements cannot be performed from the ground, sounding rockets, or balloons. An accelerated TRL increase will shorten the necessary time to bring a new sensor idea from the conceptual stage to, for example, an operational satellite instrument. Doppler Asymmetric Spatial Heterodyne Spectroscopy (DASH) is a novel optical technique for remotely measuring winds that could take advantage of both of these benefits.

The DASH Concept: A DASH interferometer [1] is a modified Spatial Heterodyne Spectroscopy (SHS) [2,3], optimized to measure the Doppler shift of atmospheric emission lines, which carries the information of the line of sight wind speed. DASH can be regarded as a combination of SHS and the stepped Michelson technique, which was used, for example, for the highly successful WINDII instrument on the NASA UARS satellite [4]. The DASH concept has high interferometric throughput, and does neither require moving parts nor the isolation of a single atmospheric emission line, which eliminates the need for an ultra-narrow pre-filter. In addition, DASH allows the simultaneous calibration of each measurement with an on-board frequency standard.

The DASH concept was first published in 2006 [5] and subsequent laboratory studies have increased its TRL [1]. Recently, the first monolithic DASH interferometer was successfully integrated and laboratory testing of this compact, rugged device is currently ongoing. A photograph of the interferometer is shown in Figure 1.

Desired Vehicle Resources: Using optical remote sensing devices for scientific and instrument development purposes is likely not going to put any unusual power, mass, or size demands onto the vehicle. However, it may require special window materials, and somewhat stringent requirements on viewing geometry, pointing control, and pointing knowledge. Examples applicable to the remote measurement of upper atmospheric winds will be presented.

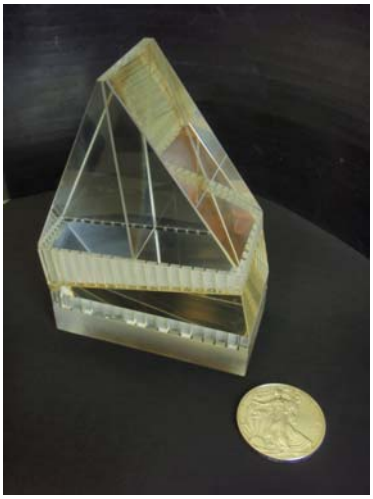

Figure 1: Photograph of the first monolithic DASH interferometer. This interferometer is designed for the thermospheric "red line". A silver dollar is provided for size comparison.

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