1. **Research Title:** Leveraging Both Experimental and Computational Data to Study Hypersonic Flight
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Aerospace Engineering, Mechanical Engineering, Engineering Physics (MS or PhD level)
4. **Objectives:** To study hypersonic aerodynamic phenomena such as aero-heating, boundary-layer transition, and shock/boundary-layer interactions and to develop the diagnostic techniques and tools required to enhance our understanding of these flows
5. **Description:** A vehicle flying at hypersonic Mach numbers encounters some of the same aerodynamic phenomena as at lower speeds. However, the effects can be significantly compounded. For example, both boundary-layer transition and shock/boundary-layer interactions can substantially increase heat flux, reduce the effectiveness of control surfaces, and alter the aerodynamic characteristics of the vehicle. A unique challenge in the study of hypersonic aerodynamics is the inability of either wind-tunnel facilities or computational studies to simultaneously match/model all relevant flight conditions: Mach number, Reynolds number, enthalpy, and disturbance levels. Because no experiment or computation fully models hypersonic flight, each dataset offers only a limited view of the full in-flight physical processes. This topic aims to utilize combined experiments and computations to increase our understanding of and ability to predict aerodynamic effects at hypersonic Mach numbers. Data-collection may be primarily focused on either experiments or computations, however, the prospective student(s) must work with, understand, and interpret both experimentally-generated and computationally-generated data and leverage the perspectives given by each.

    a. Some possible topics of interest include:
    -Investigation of the effects of surface roughness, mixed instability modes, entropy layers, or sharp geometrical changes (e.g. fins, flaps, excrescences, cavities) on boundary-layer transition.
    -The control of boundary-layer transition by active and/or passive means.
    -The study of laminar, transitional, and turbulent shock/boundary-layer interactions.
    -Development of new diagnostic tools and techniques-particularly non-intrusive methods.
    -Development of computational techniques to better model experimental diagnostic tools and/or experimental flow conditions.

6. **Research Classification/Restrictions:** U.S. Citizens only. Most aspects of this research fall under the 6.1 basic research classification. However, there is potential for some aspects to be subject to ITAR restrictions.
7. **Eligible Research Institutions:** DAGSI, AFIT