



# 2021 AFOSR/HVSI/ONR High-Speed Aerodynamics Annual Review

Drs. Sarah Popkin, Eric Marineau; Russ Cummings | July 19-23, 2021 | Arlington, VA

## Agenda Day 1 | Monday, July 19, 2021

Time	Thrust Area	Title	PI/Organization
09:30-10:00	Zoom Login		
10:00-10:10	Welcome and Opening Remarks		Sarah Popkin, AFOSR / Eric Marineau, ONR / Russ Cummings, HVSI
10:10-10:15	DFI	Introduction to Diagnostics, Facilities and Instrumentation (DFI)	Program Officers
10:15-10:35	DFI	Mach Number Independent Hot-wire Anemometry	D. Camello Barros, Universite D'Aix-Marseille
10:35-10:55	DFI	Imaging Non-Equilibrium States in Hypersonic Flow by Slow Light Imaging Spectroscopy (SLIS)	R. Miles, TAMU
10:55-11:15	DFI	ONR - Advancing Transition Experiments in High Enthalpy Flows	J. Austin, Caltech
11:15-11:35	DFI	ONR - Arc-Jet Flow Characterization	L. Maddalena, UTA
11:35-11:55	DFI	ONR- Spectrally-Resolved Laser Diagnostics for High-Enthalpy Flow Sensing	R. Hanson, Stanford U.
11:55-12:25	<b>LUNCH/BREAK</b>		
12:25-12:45	DFI	ONR - Forward Thomson Scattering for the Measurement of Weakly Ionized Plasmas in Hypersonic Flows	R. Miles, TAMU
12:45-13:05	DFI	ONR - Scaling and Structure in Transitional and Turbulent Hypervelocity Flows (YIP)	N. Parziale, Stevens I Tech
13:05-13:25	DFI	Canonical Validation Experiments for Fundamental Hypersonic Aerodynamics	C. Limbach, TAMU
13:25-13:30	SBLI	Introduction to Shock-Boundary Layer Interactions (SBLI)	Program Officers
13:30-13:50	SBLI	Study of SWBLI on the STORT Configuration	A. Guelhan, DLR
13:50-14:10	SBLI	High-fidelity Simulation of Hypersonic Three-dimensional Shock/boundary Layer Interactions	S. Pirozzoli, Sapienza Rome
14:10-14:20	SBLI	Nonlinear Flow Receptivity in Shock-Wave Boundary-Layer Interaction (new start)	G. Rigas, Imperial College
14:20-14:40	SBLI	Hypersonic Boundary-Layer Response to Localized Shock-Induced Vorticity	M. Borg, AFRL/RQ
14:40-15:00	SBLI	Investigation of the Effects of Ablation-induced Distributed Roughness on Shock-wave/boundary-layer (YIP)	C. Combs, UTSA
15:00-15:30	<b>LUNCH/BREAK</b>		
15:30-15:50	SBLI	ONR - Experimental Investigation of Unsteadiness in Swept Hypersonic Shock-Wave / Boundary-Layer	S. Laurence, U of MD

		Interactions	
15:50-16:10	SBLI	Investigation of 3D Shockwave Boundary Layer Interaction and Related Phenomena for the STORT Flight Program	J. Little, U of Arizona
16:10-16:30	SBLI	ONR - A Comprehensive Investigation of Transitional Shock Boundary Layer Interaction Using Experiments, Simulations and Stability Theory	J. Little, U of Arizona
16:30-16:50	SBLI	ONR - Characterization of the Structure and Dynamics of Transitional Shock/Boundary Layer Interactions	J. Schmisser, U of TN
16:50-17:10	SBLI	ONR - Multi-scale Modeling of Unsteady Shock-Boundary Layer Hypersonic Flow Instabilities	D. Levin, UIUC
17:10-17:20	SBLI	ONR - The Origin and Scaling of Low-Frequency Unsteadiness in Shock-Separated Boundary Layers using DNS, LES and Input/Output Analyses (new start)	P. Martin, U of MD
17:20-17:40	DFI	Non-Intrusive, Reliable, and Portable Laser Induced Breakdown Spectroscopy for Instantaneous Gas Composition and Density Measurements in High-Speed Flows	H. Do, Seoul National U
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<b>Agenda Day 2   Tuesday, July 20, 2021</b>			
Time	Thrust Area	Title	PI/Organization
09:30-10:00	<b>Zoom Login</b>		
10:00-10:05	Transition	Introduction to Hypersonic Boundary Layer Transition	Program Officers
10:05-10:25	Transition	Instability Free Three-Dimensional Hypersonic Laminar Boundary Layer Steady-States for Linear and Nonlinear Stability Analyses	L. Alves, U Federal Fluminense
10:25-10:45	Transition	Linear Modal and Non-modal Instability Analyses of High-speed Laminar Separated Flow Over Complex Geometries. Part I: Algorithmic Developments	V. Theofilis, Numerical Modelling
10:45-11:05	Transition	DLR AS-HYP Transition experiments on BOLT-Modell in H2K	T. Thiele, DLR
11:05-11:15	Transition	Growth and Control of Nonlinear Gortler Vortices in Hypersonic Boundary Layers Over Concave Surfaces (new start)	P. Ricco, Sheffield U
11:15-11:35	Transition	ONR - Secondary Instabilities of Hypersonic Crossflow Vortices (YIP)	A. Craig, U of AZ
11:35-11:45	Transition	Experimental Study of the Effect of Nose Bluntness on Hypersonic Boundary-layer Transition (new start)	A. Craig, U of AZ

11:45-12:05	Transition	Competing Instability Mechanisms in Hypersonic Boundary Layers	J. Kuehl, U of Delaware
12:05-12:35	<b>LUNCH/BREAK</b>		
12:35-12:55	Transition	Boundary Layer Transition (BOLT)- Experiments and Simulations (Low Concave Curvature and Leading-Edge Sweep Effects)	H. Reed, TAMU
12:55-13:15	Transition	ONR - Hypersonic Finned Cones	H. Reed, TAMU
13:15-13:35	Transition	Experimental Studies of BL Instability and Transition in the M-6 Quiet Tunnel	S. Schneider, Purdue U
13:35-13:55	Transition	ONR - Towards a Mechanism-based Procedure for Predicting B/L Transition on Slender Models with Highly Swept Fins	S. Schneider, Purdue U
13:55-14:15	Transition	ONR - Numerical Investigations of Particle Interactions with Navy Relevant High-Speed Flows (YIP)	C. Brehm, U of MD
14:15-14:35	Transition	ONR - Predicting Hypersonic Laminar-turbulent Transition with Direct Numerical Simulation	J. Poggie, Purdue U L. Duan, OSU
14:35-15:05	Transition	ONR - Hypersonic Transition: Vortical, Acoustic and Thermal Component Interactions / Receptivity to Breakdown Mechanisms During Transition on Hypersonic Forebodies (new start)	D. Gaitonde, OSU
15:05-15:35	<b>LUNCH/BREAK</b>		
15:35-15:55	Transition	ONR - Transition Prediction and Control for Blunt Hypersonic Configurations with Hemispherical and Ogival Nosetips	P. Paredes Gonzalez, Nat. Inst. Of Aerospace
15:55-16:15	Transition	Novel Concepts for Transition Delay in Hypersonic Boundary Layers and their Optimization	P. Paredes Gonzalez, Nat. Inst. Of Aerospace
16:15-16:25	Transition	ONR - Wave Packets in High-Speed Boundary Layers (new start)	A. Tumin, U of AZ
16:25-16:45	Transition	Numerical Investigation of Non-linear Transition Stages in Hypersonic Boundary Layers for Wind-Tunnel and Free-Flight Conditions	H. Fasel, U of AZ
16:45-17:05	Transition	Development of 3-D Freestream Receptivity DNS Data Base for Hypersonic Flow over Spherical and Elliptical Cones	X. Zhong, UCLA
17:05-17:25	Transition	ONR - Input/Output Analysis of Complex Hypersonic Boundary Layers	J. Nichols, U of MN
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**Agenda Day 3 | Wednesday, July 21, 2021**

Time	Thrust Area	Title	PI/Organization
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09:30-10:00	Zoom Login		
10:00-10:20	Transition	Boundary Layer Transition (BOLT) Post-Flight Research and BOLT II Flight Test Support	B. Wheaton, JHU/APL
10:20-10:40	Transition	Direct Numerical Simulation of Hypersonic Boundary Layer Transition over Distributed Surface Porosity (YIP)	C. Scalo, Purdue U
10:40-11:00	Transition	Radiative and Dispersive Behavior of Instabilities in a Highly Cooled Hypersonic Boundary Layer	N. Parziale, Stevens I Tech
11:00-11:20	Transition	Multi-mode Induced Transition in Hypersonic Boundary Layers	S. Smith, Howard U
11:20-11:50	Transition	ONR - Nonlinear Optimization in High-speed B/L: The most Unstable Nonlinear Disturbances & Robust Flow Design / Measurement-infused Simulations of Hypersonic Transition on Cones with Flares (new start)	T. Zaki, JHU
11:50-12:10	Transition	Enhanced-fidelity Predictions of Hypersonic Transition: Embedded Measurements and Optimal Sensing	T. Zaki, JHU
12:10-12:40	<b>LUNCH/BREAK</b>		
12:40-13:00	Transition	ONR - High Reynolds Number Quiet MACH 6 Swept-Fin Cone Experiments: Flow Instabilities and Transition Control	T. Corke, Notre Dame T. Juliano, Notre Dame
13:00-13:10	Transition	ONR - Detailed Investigation of Hypersonic Instability, Breakdown, and Natural Transition under Quiet Flow with Simulated Ablation-Gas Injection (new start)	J. Jewell, Purdue U
13:10-13:20	Transition	ONR - One-way Navier-Stokes for Transition Prediction in High-speed Boundary Layers (new start)	T. Colonius, CalTech
13:20-13:30	Transition	ONR - Assessment of Hypersonic Transition and Turbulent Heating (new start)	D. Araya, APL
13:30-13:40	Transition	HVSI - Hypersonic Transition Modeling Using an Amplification Factor Transport Equation (new start)	J. Coder, U of Tennessee
13:40-13:50	Transition	HVSI - Development and Testing of RANS Transition Models for Hypersonic Boundary Layers (new start)	H. Fasel, U of Arizona
13:50-14:00	Transition	HVSI - Extensible, Portable Framework for Variable Fidelity Modeling and Shape Optimization Involving Hypersonic Boundary Layer Transition (new start)	M. Choudhari, LaRC
14:00-14:05	TF	Introduction to Turbulent Flows (TF)	Program Officers
14:05-14:15	TF	HVSI - Double Cone Experiment in the X3 Expansion Tube	M. McGilvray, Oxford U
14:21-14:35	TF	ONR / HVSI - Hypersonic Turbulent Heat Transfer Prediction and Validation	R. Bowersox, TAMU
14:35-14:55	TF	HVSI - Development of a RANS-Based Wall-Modeled LES Approach for Hypersonic Flows	C. Brehm, U of MD P. Ireland, Oxford U M. McGilvray, Oxford U
14:55-15:25	<b>LUNCH/BREAK</b>		
15:25-15:45	TF	HVSI - Development of Improved RANS and Hybrid LES/RANS Turbulence Models for Hypersonic Flow	J. Edwards, NCSU D. Stefanski, U of Tennessee

		Applications	
15:45-16:05	TF	HVSI - Evaluation of State-of-the-Art Hypersonic Turbulence Modeling Using M = 6 Benchmark Experiment	M. Semper, USAFA J. Seidel, USAFA
16:05-16:25	TF	HVSI - Turbulence Modeling for Hypersonic Flows	M. Reeder, AFIT K. Gross, AFIT
16:25-16:45	TF	HVSI - Development of Physics-Based Turbulence Models for Hypersonic Flows	G. Candler, U of MN
16:45-17:05	TF	Examining Growth of Turbulence over Heated Walls in Hypersonic Flows	A. Veeraragavan, U of Queensland
17:05-17:25	TF	Advanced Ground Testing and Simulation of the Boundary Layer Transition (BOLT) Flight Experiment	A. Veeraragavan, U of Queensland
17:25-17:35	Transition	HVSI - Measuring the Influence of Wall-temperature Ratio Distribution on Transition using Optical Diagnostics (new start)	S. O'Byrne, UNSW Canberra
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<b>Agenda Day 4   Thursday, July 22, 2021</b>			
Time	Thrust Area	Title	PI/Organization
09:30-10:00	Zoom Login		
10:00-10:20	TF	HVSI - Reynolds-Averaged Navier-Stokes Based Turbulence Modeling for High-Speed Configurations	D. Gaitonde, OSU G. Candler, U of MN
10:20-10:30	TF	ONR - Development of Hybrid Simulation Models for Heat Transport in Hypersonic Turbulent Flow (new start)	P. Durbin, Iowa State U
10:30-10:50	TF	ONR - Simulation and Modeling of Hypersonic Turbulent Boundary Layers Subject to Pressure Gradient and Wall Cooling	L. Duan, OSU
10:50-11:10	TF	ONR- Dynamic Large-Eddy Simulation and Real-Gas Effects in High-Enthalpy Hypersonic Turbulence Boundary Layers (YIP)	C. Scalo, Purdue U J. Larsson, U of MD
11:10-11:30	TF	Collaborative Research: Effects of wall curvature on hypersonic turbulent spatially-developing boundary layers	G. Araya, U of PR K. Jansen, U of Colorado
11:30-11:50	TF	Structure and Modeling of Uncertainty estimation in large eddy simulations of realistic hypersonic flows	J. Larsson, U of MD
11:50-12:20	<b>LUNCH/BREAK</b>		
12:20-12:40	TF	Research in Support of Flight Experiment BoLT 2: Simulations and Characterization of the Turbulent Flow Regime	P. Martin, U of MD

12:40-13:00	TF	DNS and Constrained Nonlinear Analysis of the BOLT-II Flight Experiment	G. Candler, U of MN
13:00-13:20	TF	Absolute Instability of Interacting Planar Mixing Layers and Wakes / Influence of Mach number, Non-adiabatic Walls and Nonlinear Interactions in Resolvent Analysis of Compressible Turbulent Boundary Layers	B. McKeon, CalTech
13:20-13:30	TF	Hypersonic Base Flow Characterization (new start)	R. Gosse, U of FL
13:30-13:35	Propulsion	Introduction to High Speed Propulsion	Program Officers
13:35-13:55	Propulsion	ONR - Combustion in Solid Fuel Ramjets	C. Slabaugh, Purdue U
13:55-14:15	Propulsion	ONR - Transport Physics in Reacting Turbulent Boundary Layers	C. Slabaugh, Purdue U S. Heister, Purdue U
14:15-14:35	Propulsion	ONR - Combustion Behavior Within a Solid-Fuel Ramjet at High Altitudes	D. Kessler, NRL R. Johnson, NRL G. Goodwin, NRL
14:35-14:45	Propulsion	ONR - Experimental and Numerical Investigation on the Combustion Characteristics of Solid Fuels in Supersonic Combustors (new start)	G. Young, Virginia Tech
14:45-15:15	<b>LUNCH/BREAK</b>		
15:15-15:20	GSI	Introduction to Gas-Surface Interaction (GSI)	Program Officers
15:20-15:40	GSI	High-Fidelity Quantitative Measurements of Hypersonic Carbon Ablation (YIP)	F. Panerai, UIUC
15:40-16:00	GSI	Carbon Oxidation in Extreme Environments	A. Martin, U of Kentucky
16:00-16:20	GSI	ONR - Combined Computational and Experimental Study of UHTCs for Thermal Protection of Hypersonic Vehicle	I. Boyd, U of Colorado D. Fletcher, U of VT
16:20-16:25	NEE	Introduction in Non-Equilibrium Effects (NEE)	Program Officers
16:25-16:35	NEE	Energy Exchanges and Transport Phenomena in Aerothermodynamics of High-Speed Platforms (new start)	A. Verhoff, AFRL/RQ M. Brown, AFRL/RQ
16:35-16:55	NEE	Determination of Key Physics for Nonequilibrium Modeling of Hypersonic Air	I. Wysong, AFRL/RQ
16:55-17:15	NEE	Fundamental non-equilibrium experiments for hypersonic flight	M. McGilvray, Oxford U
17:15-17:35	NEE	Study of Non-equilibrium Wakes Model	T. McIntyre, U of Queensland
17:35-17:55	NEE	Wall Temperature and Bluntness Effects in High Enthalpy Hypersonic Separated Flow	S. Gai, UNSW, Australia
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**Agenda Day 5 | Friday, July 23, 2021**

<b>Time</b>	<b>Thrust Area</b>	<b>Title</b>	<b>PI/Organization</b>
<b>09:30-10:00</b>	<b>Zoom Login</b>		
<b>10:00-10:20</b>	<b>NEE</b>	Molecular Energy Transfer Processes in Non-Equilibrium Hypersonic Flows	I. Adamovich, OSU
<b>10:20-10:40</b>	<b>NEE</b>	Sensitivity to Model Parameters in Finite-rate Reacting Hypersonic Flows	P. Schmid, Imperial College
<b>10:40-11:00</b>	<b>NEE</b>	Nonequilibrium Gas-Surface Interactions at High Temperature	T. Magin, VKI
<b>11:00-11:20</b>	<b>NEE</b>	Reactive Collisions and Final State Analysis of C- and O-Involving Reactions	M. Meuwly, Univ. of Basel
<b>11:20-11:40</b>	<b>NEE</b>	Investigation of Thermal Non-equilibrium Effects in Rapid Flow Expansions	O. Chazot, VKI
<b>11:40-12:00</b>	<b>NEE</b>	Evaluation of Aerothermochemistry Models Through Sensitivity Analysis and Low-Uncertainty Experiments	I. Boyd, U of CO
<b>12:00-12:30</b>	<b>LUNCH/BREAK</b>		
<b>12:30-12:40</b>	<b>NEE</b>	Quantification and Mitigation of Thermochemical Non-Equilibrium in High-Enthalpy Hypersonic Wind Tunnels (new start)	D. Baccarella, U of TN
<b>12:40-13:00</b>	<b>NEE</b>	Formulation of a General Collisional-Radiative Model for NO to Study Non-Equilibrium, Hypersonic Flows	D. Levin, UIUC
<b>13:00-13:20</b>	<b>NEE</b>	Modeling of Non-Equilibrium Hypersonic Air Flows by means of Multi-Group Maximum Entropy Method	M. Panesi, UIUC
<b>13:20-13:50</b>	<b>NEE</b>	Spectroscopic Measurements and Nonequilibrium Modeling for High-Enthalpy Air / Spectroscopic Measurements for Recombination Modeling in High-Enthalpy Expanding	J. Austin, Caltech
<b>13:50-14:10</b>	<b>NEE</b>	ONR - Hybrid DSMC/CFD Method Development for High Altitude Hypersonic Flows	G. Candler, U of MN T. Schwartzentruber, U of MN
<b>14:10-14:15</b>	<b>FSI</b>	Introduction to Fluid Structure Interactions (FSI)	Program Officers
<b>14:15-14:35</b>	<b>FSI</b>	Reduced Order Modeling for Hypersonic Aeroelasticity	P. Tiso, ETH, Switzerland
<b>14:35-14:55</b>	<b>FSI</b>	Aeroelastic Characterization of Thin-Panel Structures in High Speed Flow	S. Peltier, AFRL/RQ D. Reasor, AFRL/RW
<b>14:55-15:15</b>	<b>FSI</b>	Fluid Structural Thermal Interactions (FSTI) in Hypersonic Flow	V. Narayanaswamy, NCSU E. Dowell, Duke J. Oefelin, Georgia Tech
<b>15:15-15:45</b>	<b>LUNCH/BREAK</b>		
<b>15:45-16:05</b>	<b>FSI</b>	Dynamics of Interactions Between Turbulent Boundary Layers and Compliant Surfaces	J. McNamara, OSU
<b>16:05-16:25</b>	<b>FSI</b>	An Experimental/Computational Investigation of the Response of a Compliant Panel to Turbulent and Transitional Shock-wave/Boundary-Layer Interactions in Hypersonic Flow	S. Laurence, U of MD

<b>16:25-16:45</b>	<b>FSI</b>	Luminescence-based Pressure and Strain Measurement for Fluid-structure Interactions	P. Hubner, U of Alabama
<b>16:45-16:55</b>	<b>FSI</b>	The Role of Cavitation in Droplet Breakup: Understanding and Predicting Hypersonic Structural Loading through Multiscale Simulations and Shock-tube Experimentation (new start)	S. Grace, Boston U
<b>16:55-17:05</b>	<b>FSI</b>	Aerothermoelastic Experiments and Simulation of High-Speed Vehicle Structures (new start)	S.M. Spottswood, AFRL/RQ
<b>17:05-17:15</b>	<b>FSI</b>	ONR - Fluid-thermal-structure Interaction of a Finned Model at Mach 6 (new start)	D. Bodony, UIUC
<b>17:15-17:25</b>	<b>FSI</b>	ONR - Peridynamic Modeling Development for High Velocity Weather Encounter Damage (new start)	I. Guven, VA Commonwealth U
<b>17:25-17:45</b>	<b>FSI</b>	ONR - Aero-Thermo-Servo-Elastic Analysis and Optimization for High Speed Vehicles	D. Mavriplis, U of WY
<b>17:45-18:05</b>	<b>FSI</b>	Unit Cases to Investigate Hypersonic Fluid-Structure Interaction	A. Neely, UNSW, Australia
<b>MEETING ADJOURN</b>			