NASA Glenn Speakers Bureau

The Space Shuttle
Thirty Years of Flight
with Lessons Learned From the Columbia Accident

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On February 1, 2003, the Space Shuttle Columbia broke apart during reentry, resulting in loss of the vehicle and its seven crewmembers. For the next several months, an extensive investigation of the accident ensued involving a nationwide team of experts from NASA, industry, and academia, spanning dozens of technical disciplines. The Columbia Accident Investigation Board (CAIB), a group of experts assembled to conduct an investigation independent of NASA, concluded in August, 2003 that the most likely cause of the loss of Columbia and its crew was a breach in the left wing leading edge Reinforced Carbon-Carbon (RCC) thermal protection system initiated by the impact of thermal insulating foam that had separated from the orbiters external fuel tank 81 seconds into the mission's launch. During reentry, this breach allowed superheated air to penetrate behind the leading edge and erode the aluminum structure of left wing, which ultimately led to the breakup of the orbiter. The findings of the CAIB were supported by ballistic impact tests, which simulated the physics of External Tank Foam impact on the RCC wing leading edge material. These tests ranged from fundamental material characterization tests to full-scale Orbiter Wing Leading Edge tests.

Following the accident investigation, NASA spent the next 18 months focused on returning the Shuttle safely to flight. In order to fully evaluate all potential impact threats from the many debris sources on the Space Shuttle during ascent, a significant impact testing program was instituted at the NASA Glenn Ballistic Impact Laboratory. The results from these tests led to the validation of high-fidelity computer models, capable of predicting actual or potential Shuttle impact events, which were used in the certification of STS-114, NASA’s Return to Flight Mission, as safe to fly.

Matt Melis provides a detailed look into the inner workings of the Space Shuttle and a behind the scenes perspective on the impact analysis and testing done for the Columbia Accident Investigation and NASA's Return to Flight programs. His presentation is full of rich, still and motion picture imagery, and, although technical, is easily understood by all audiences. In addition, highlights from recent Shuttle missions are presented demonstrating how NASA conducted it’s operations differently and more safely, post Columbia, through better imagery, better analysis, and enhanced best practices.

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Matt received both a BS in Civil Engineering and an MS in Engineering Mechanics from Michigan State University and has worked at the NASA Glenn Research Center for thirty three years. His primary area of focus is in advanced finite element modeling and analysis methods including nonlinear and dynamic impact loading. Trained in engineering mechanics, he has been recognized for expertise in actively cooled structures, stress analysis, ballistic impact research, and multiphysics analysis during his tenure at the Research Center. He has worked on numerous aeronautics and space programs for the agency including the International Space Station, the Space Shuttle and NASA's Exploration Program. In the four and one half years that followed the Columbia accident, Matt was assigned full time to working the Columbia Accident Investigation and the Shuttle Return to Flight Program as technical lead of the NASA Glenn Ballistic Impact team. Matt currently leads an aeronautics research element of NASA's Advanced Composites Program to advance our understanding of composite material response to high energy impact events.

In addition to his technical commitments, Matt also devotes significant effort to public outreach and teaching for NASA at all levels of education as well as professional groups. Since 2003, he has delivered dozens of invited lectures and keynote presentations at conferences pertaining to Ballistic Impact Research, The Columbia Accident Investigation, NASA's Return to Flight and the Space Shuttle Program. Notable organizations he has spoken to include: The National Transportation and Safety Board, The Nuclear Regulatory Commission, Dartmouth College, The Canadian Royal Astronomical Society, Ontario Science Center, Ivey Business School in Canada, The University of Reykjavik, Iceland, The American Institute for Aeronautics and Astronautics, the American Society for Mechanical Engineers, and the American Society for Metals, Skywalker Sound, Industrial Light and Magic, and the London Science Festival.