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# Measuring High Speed Deformation for Space Applications

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# What WSTF Does

- Propulsion Testing Office
- Materials and Components
- Technical Services Office
- Health Safety and Environment



# Applications For PDV

- Pyrotechnic Devices
- Hypervelocity Impact Testing
  - Projectile Studies
  - Equation of State Studies



# Frangible Joints

- What is the underlying physical phenomena that causes reliable function of frangible joints?

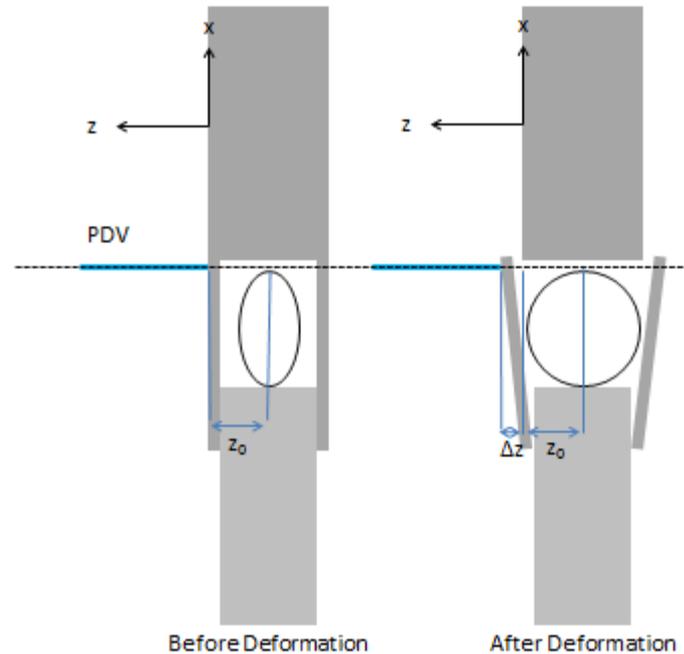
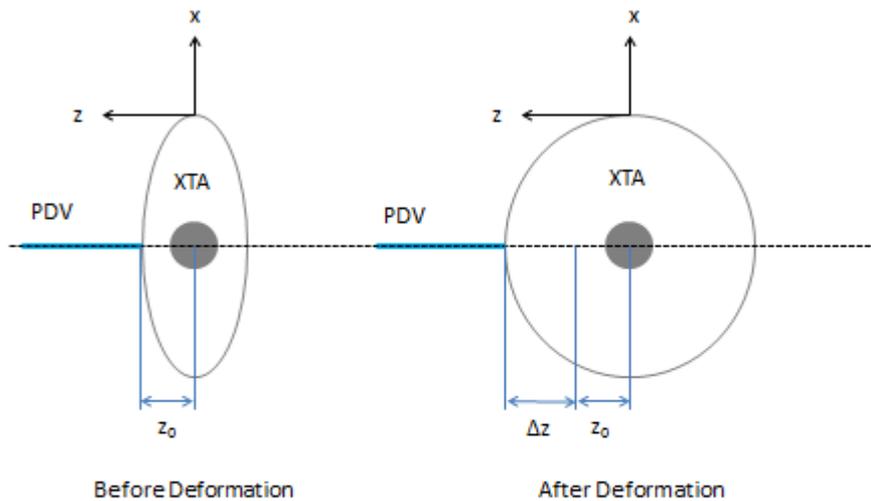


# Why Understand Deformation Processes

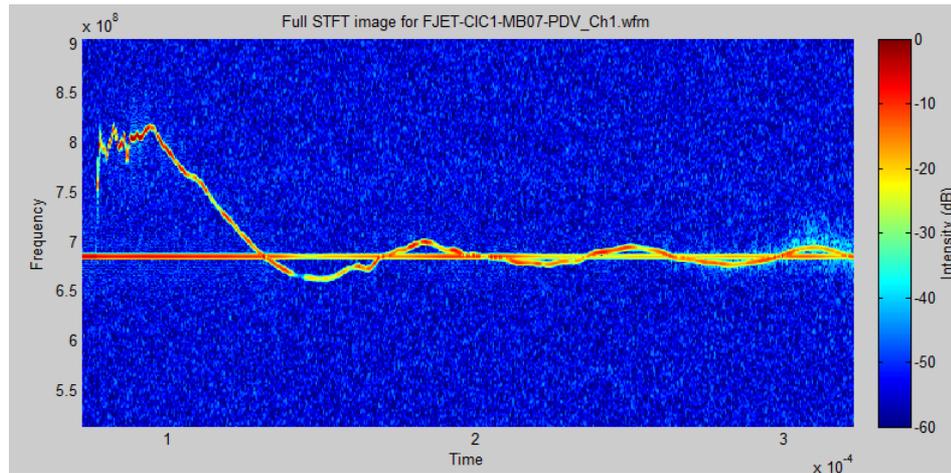
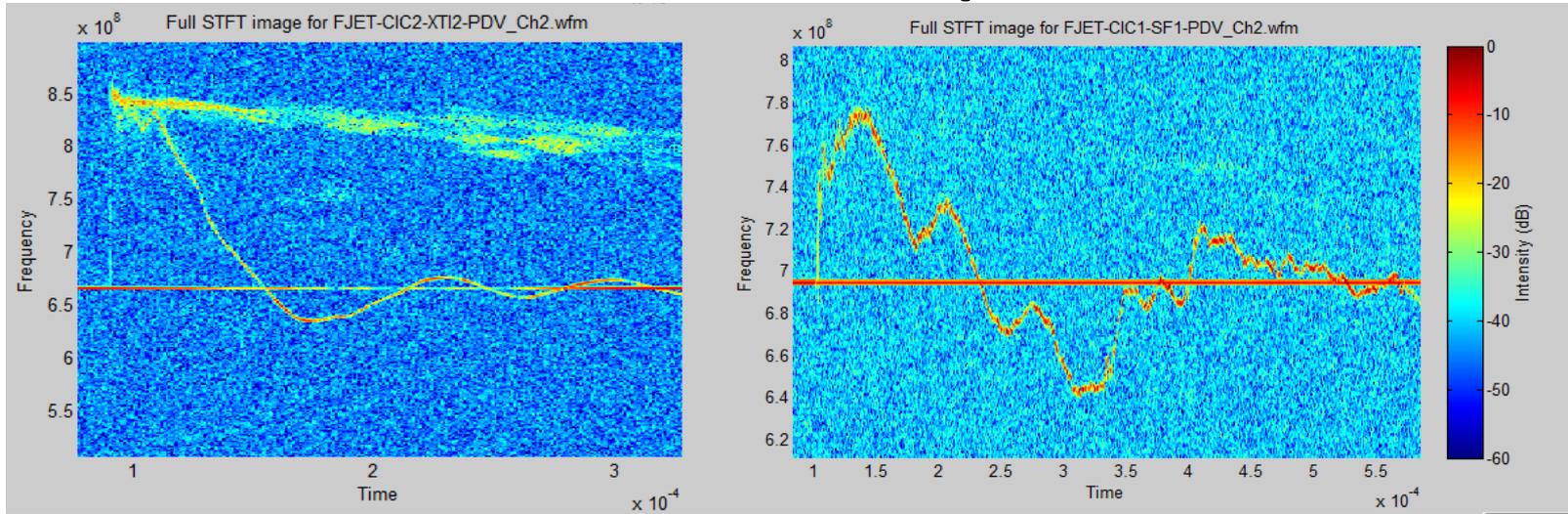
- February 24, 2009
  - The Orbiting Carbon Observatory satellite mission
- March 4, 2011
  - The Glory spacecraft satellite mission
- As a result of these failures the reliability and functionality of frangible joints has been called in to question and an investigate by the NASA Engineering and Safety Center (NESC) has been initiated.



# Deformation Process



# Data Examples



# Hypervelocity

- How do materials respond to impact from space debris?
- How do you validate gun codes?



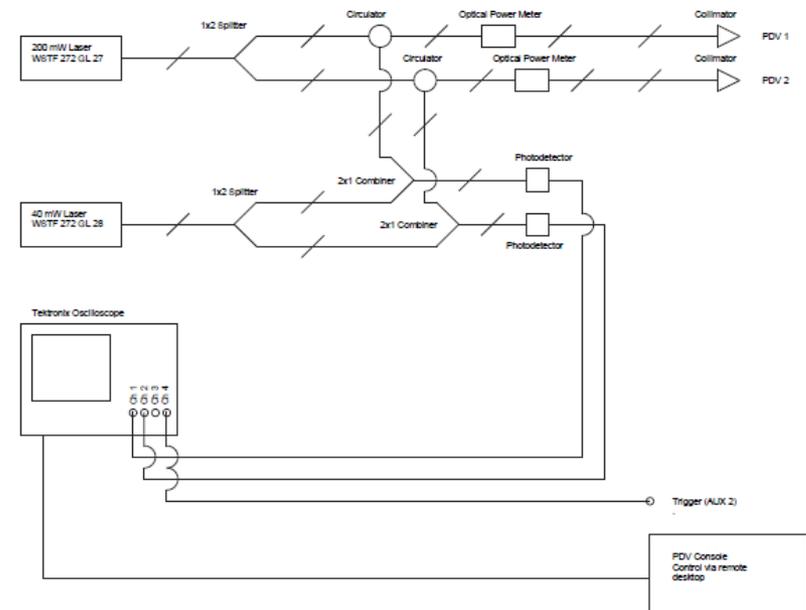
# Current and Planned Systems

- 2-channel system in operation and use
  - Capable of up to 10 km/s
- 8-channel system being built
  - Lower speed (300 m/s), more data



# 2-Channel Heterodyne System

- NKT Photonics Koheras Adjustik Lasers
- EigenLight OPMs
- Thorlabs Fiber Components
- Discovery Semiconductor Lab Buddy photo-detectors
- Tektronix Oscilloscope



# Conclusions

- PDV has proven to be a reliable and versatile technique to observe rapid deformation of frangible joints
- It will be a valuable technique in order to understand the physics of two-stage light gas guns and the material response to hypervelocity impact

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