



Launch Services Program's Research and Technology Studies

Paul Schallhorn, Ph.D.

Chief, Environments & Launch Approval Chief

Flight Analysis Division

NASA Launch Services Program



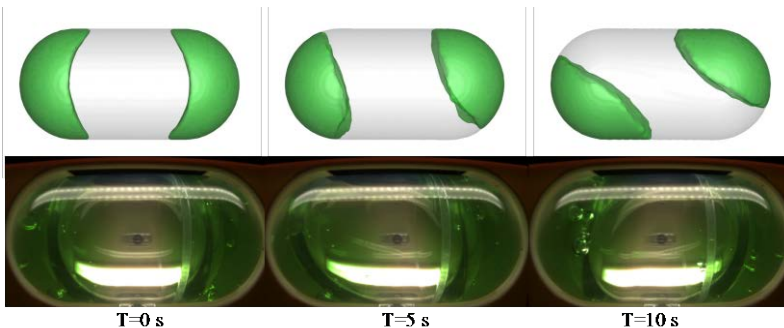
SPHERES Slosh Experiment (ISS)



- LSP has invested significantly in a set of experiments in order to validate analytical modeling methodologies.
- The ISS SPHERES Slosh Experiment is the most widely known example
- The Slosh experiment was performed to validate microgravity slosh Computational Fluid Dynamics (CFD) modeling of launch vehicle cryogenic upper stages during coast phase(s).



"The Boeing Delta IV Launch Vehicle – Pulse-Settling Approach for Second-Stage Hydrogen Propellant Management", Acta Astronautica Volume 61, June-August 2007



T=0 s

T=5 s

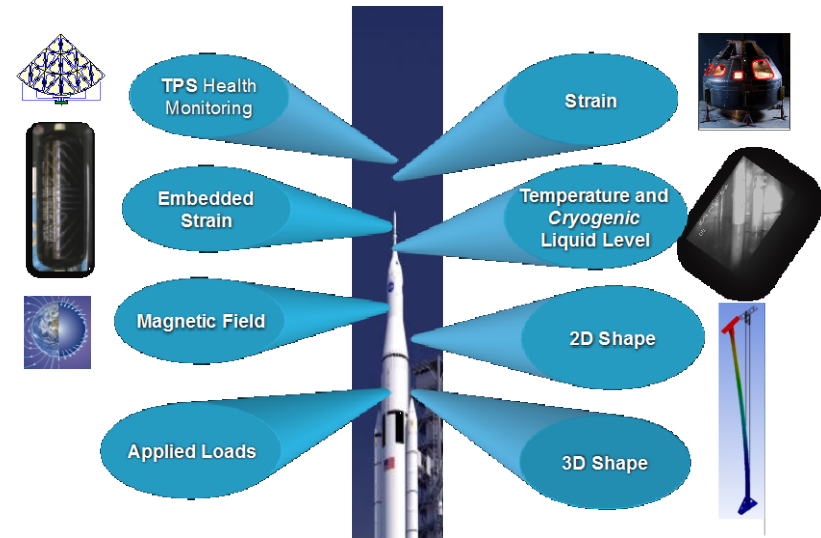
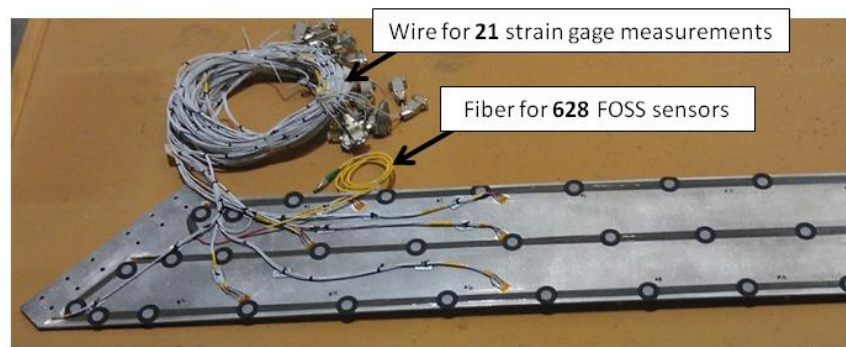
T=10 s



Fiber Optic Sensing System (FOSS)



FOSS has the potential to revolutionize Launch Vehicle Instrumentation



VALUE Proposition - Return on Investment for FOSS

System	Sensors	Cost per Sensor	Acquisition System Cost	Installation Time	Labor Cost (@ \$50/hr)	Total Cost	Normalized Mass	Normalized Information /Data
8 Fiber FOSS System	Up to 16,000	\$1.00	\$100,000	256 hrs	\$12,800	\$128,800	1	1
Crewed Vehicle w/conv. system	1,000	\$5.00	\$100,000	8000 hrs	\$400,000	\$505,000	800+	0.0625
Non-Crewed Veh. w/conv. system	50	\$5.00	\$100,000	400 hrs	\$20,000	\$120.250	40	0.003125