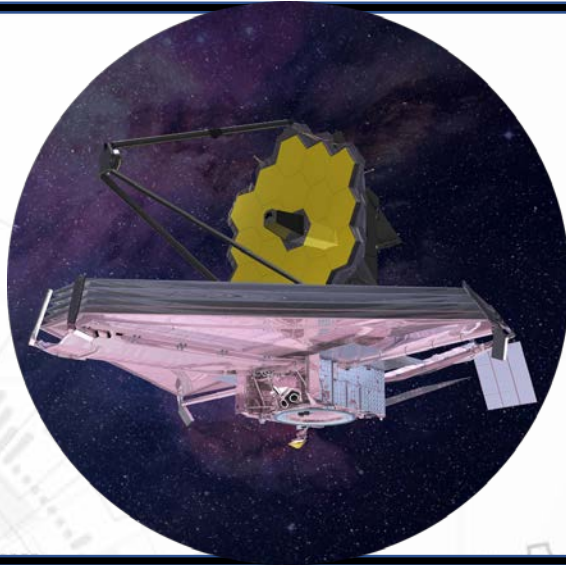
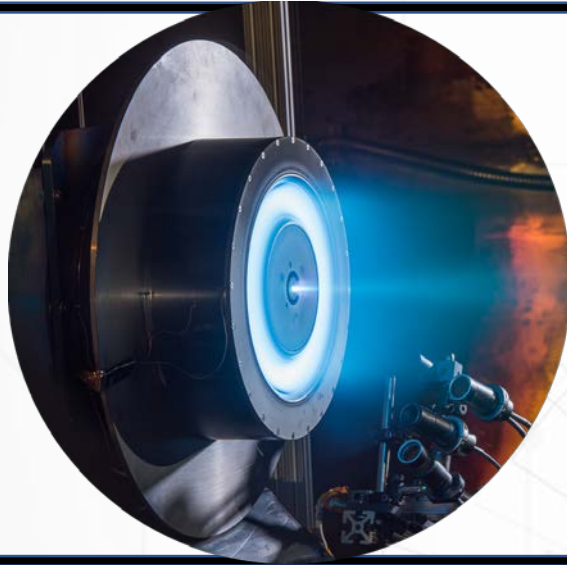


Anomalous Uses of Mass Spectrometers at NASA

National Aeronautics and
Space Administration



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My Background

Education:

- Bachelor's and Ph.D. in Chemistry (Environmental and Materials Track), University of Central Florida
- Master's of Science Industrial Chemistry, University of Central Florida

Career:

Before NASA

- Environmental Analytical Chemist/Supervisor (private labs, Walt Disney World)

NASA

- Research Scientist, Principal Investigator, Subject Matter Expert
- Deputy Chief Technologist

Outside of work:

- Family, Outdoor activities, and adventures,



Objective

- Discuss alternative Mass Spec Applications at NASA
- Challenge Innovative Solutions

Background: We (HEMS) Focus on Bringing the Instrument to the Sample Because it's not Practical to Bring the Sample to the Lab

National Aeronautics and
Space Administration



NASA Focus Areas

- Global Studies
 - Atmospheric studies
- Planetary Science
 - Atmospheric studies
 - Organic volatiles and nonvolatile
 - Elemental and mineral identification
- Grounds Systems
 - Leak detection of fuels, toxic vapors, and purge gases

A Few NASA Applications Where We Bring the Samples to the Instrument

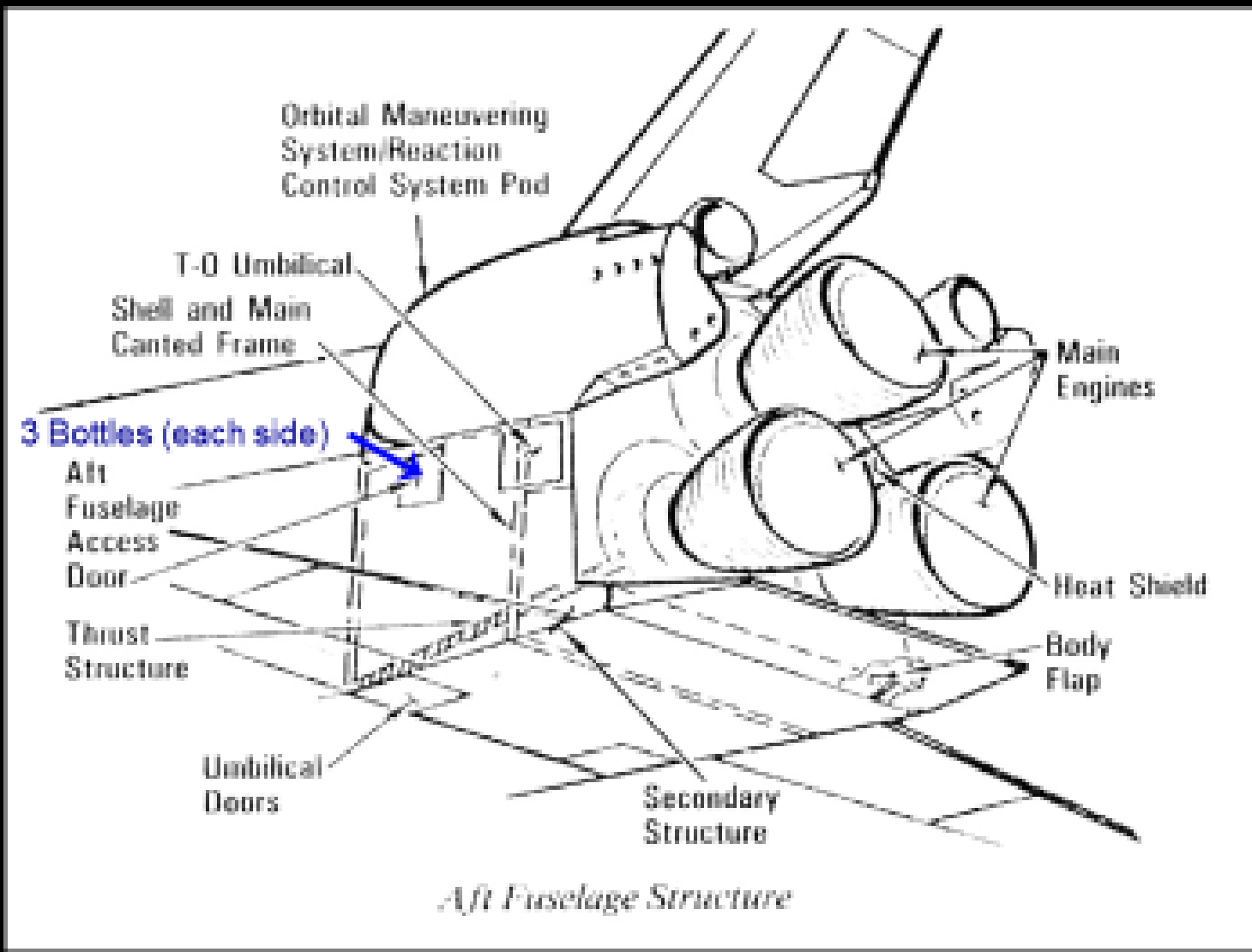


1. Space Shuttle Aft Gas Analysis* –evacuated autonomous sampling containers required
2. Anomaly investigations*- requires sample wipes, tape lifts, etc
 - Contamination Identification
 - Particles, films, liquids
 - Often trace forensic “unknown” unknowns
 - Requires a suite of instruments spectroscopy and spectrometry
 - Organic volatiles and nonvolatile
3. Preflight Applications*
 - Cleanliness verifications
 - Commodity and fuel purity

**Ripe for Innovative Solutions*



Atlantis
Discovery
Endeavour





Aft Gas Requirements

- Six Evacuated Bottles in Aft of Orbiter During Ascent
- Opened at Specific Times During Ascent
- Bottles Removed After Mission
- All Pressures Sub Ambient
 - 2 – 175 torr
- Analyzed for Commodities of Interest for Main Engine
 - H₂, He, O₂, Ar, CH₄, CO, CO₂
 - Detection Limits of 0.01 %
- Used to Help Evaluate Main Engine Performance



Analytical Technique

Utilizes GC/MS along with Custom Sample Inlet

Detect Parts-Per-Million of Commodities

Monitor any Gas with Molecular Weight below 50 Daltons

Can Be Sub Ambient

Small Sample Volumes

Performs Shuttle Aft Gas Analysis



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Why Do We Use Permanent Instruments?

Nothing available currently that addresses these issues:
(Closest reflective IR)

- Samples are in awkward locations geometrically
- Contaminants of interest are not necessarily volatile
- Sample may be coated on a hardware that can't be removed
- Hardware must be treated with delicacy
- Need accuracy and selectivity



What if could bring the instruments to the samples?

Advantages

- Less potential sampling artifacts
- Real time data
- Environmentally friendly

Other Markets

1. Commercial Aerospace
2. Forensics- crime scene
3. Medical- real time diagnostics

For Inorganic Compounds there are COTS instruments available, XRF. Maybe make a combo instrument?



What would it look like?

- Let's discuss



Innovation

- Converting ideas into value