Ultra Long-Lived Autonomous Air Quality Sensing

HAT: 4.5.a-E, 4.7a-E, 6.3a-E, 6.4a-E

TA: 4.5.1 System Health management; 7.5.3 – Integrated Flight Operations Systems; 6.3.1 - Medical Diagnosis and Prognosis; 6.4.1 - Sensors: Air, Water, Microbial, and Acoustic

TRL: start 3/ current 4

OVERVIEW

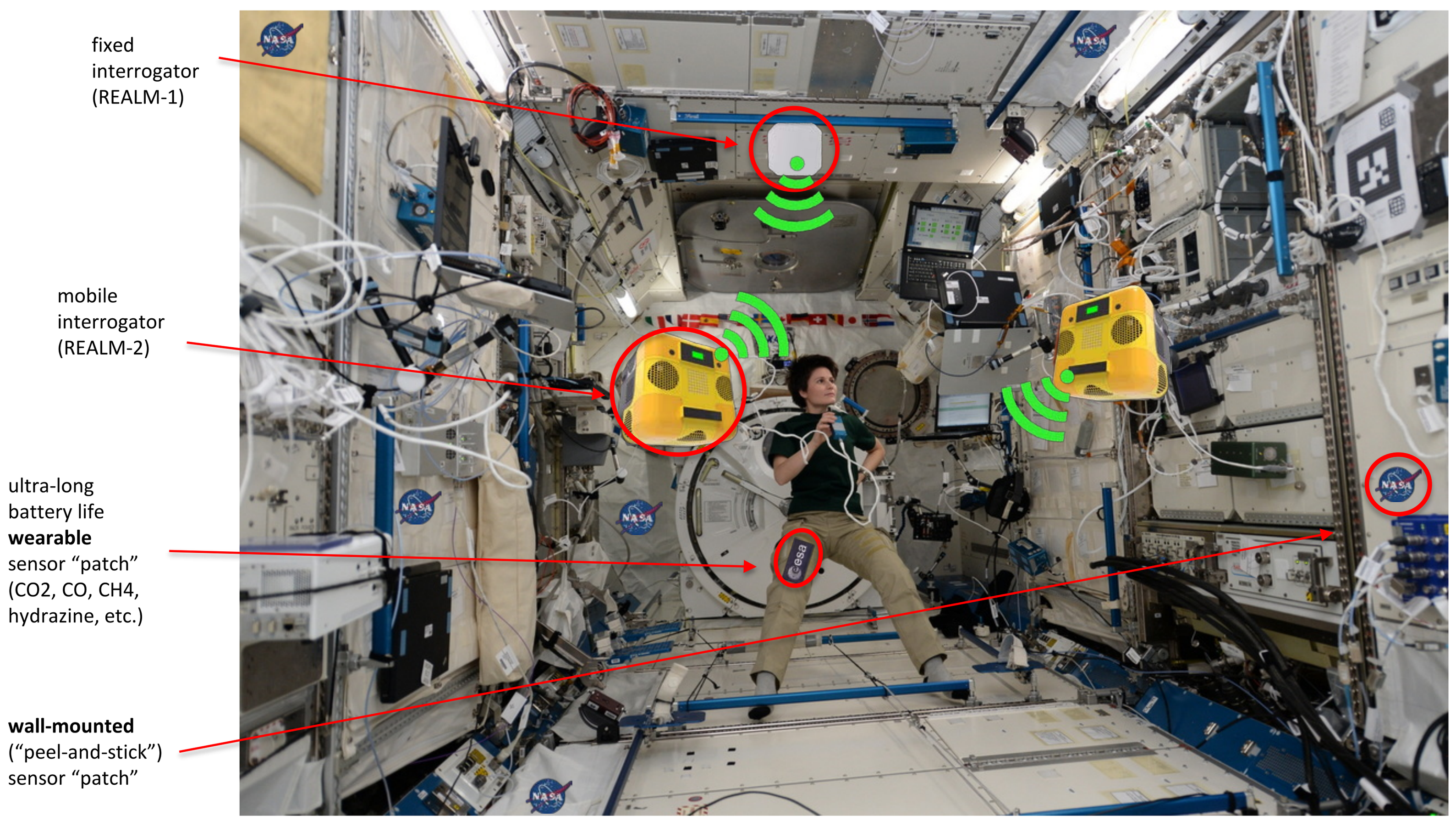
Environmental sensing will be key to autonomous vehicle operation and crew health monitoring in tended/untended long-duration habitats for Human Space Exploration in deep space. Small wireless sensors, based on Radio Frequency Identification (RFID) technology, can provide unprecedented capacity to monitor crew/habitat health. We propose a next-generation, wireless air quality sensor capable of operating for years on a small coin-cell battery without crewmember intervention.

INNOVATION

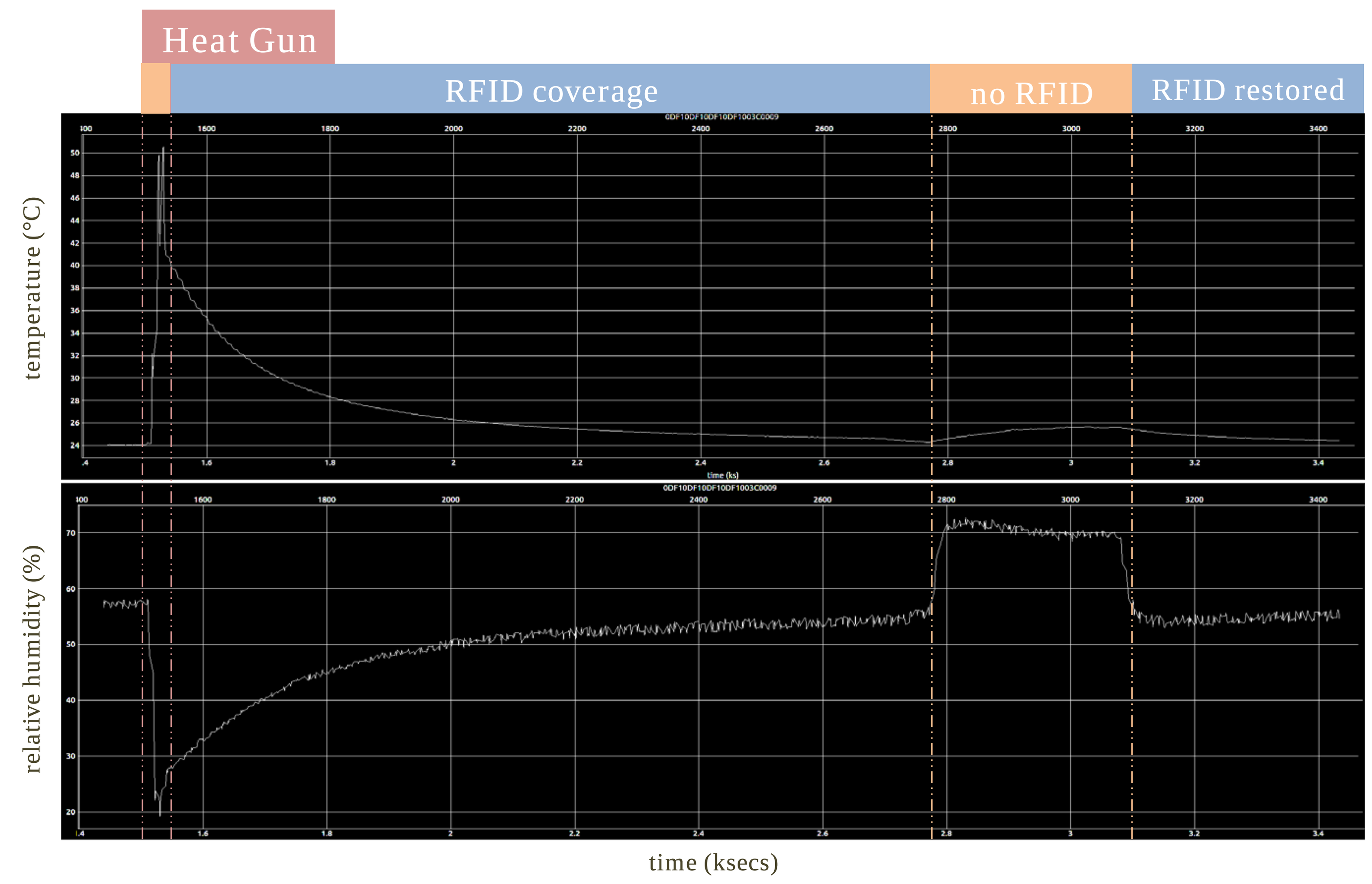
This technology integrates ultra-low power CO2 sensors under development at NASA-Ames with ultra-low power, RFID-enabled wireless sensing developed at NASA-JSC and a delay-tolerant networking (DTN)-inspired overlay.

OUTCOME

- Wireless temperature/humidity sensors have been demonstrated to achieve an 9-year lifetime on a CR2032 coin cell at a 10 min./sample duty cycle.
- Integration of the RFID-sensing platform with the ARC CO2 sensor has been substantially advanced



Wearable/"peel-and-stick" sensors in multi-interrogator ISS environment.



DTN-inspired transfer as sensor moves in/out of interrogator coverage.

INFUSION SPACE / EARTH

- This technology is broadly applicable to years-long wearable and "peel-and-stick" wireless sensors in a crewed vehicle environment (provided sufficiently low-power sensors can be integrated to the platform). It will readily integrated with the RFID Enhanced Autonomous Logistics Management (REALM) system on ISS.
- Terrestrially, the platform also shows promise for deployable sensing in industrial settings and patient monitoring using long-lived medical wearable sensors.

PARTNERSHIPS / COLLABORATIONS

This work has been developed in collaboration with Dr. Jing Li (NASA-ARC), who is advancing ultra-low power CO2 nano-materials sensors, and Dr. Peter Chai and Dr. Edward Bower (Harvard University, Brigham & Women's Hospital) who are providing medical wearable feedback.

FUTURE WORK

This work will continue as a year-2 Center Innovation Fund. CO2 sensor integration will be completed, the antenna design will be finalized, and integration of the software into the REALM infrastructure will be undertaken. Upon completion, the system will be ready for flight certification, and an ISS demonstration in conjunction with REALM will be proposed.