ASTRA Science Traceability Matrix

Goals	Objectives	Investigations	RAMS	SASA	HWA	Measurements / Process
Advance the TRL of the RAMS, SASA, and HWA to improve instrument selectability	Demonstrate the enabling technologies in a scientific context	Demonstrate the Ion Optical Bench (Ion CCD) rapid response	•			Rapidly acquire multiple valid spectra
		Demonstrate ultrasonic transducer operation		•		Measure transit time of closely-spaced ultrasonic pluses
		Demonstrate hybrid MUX for thermocouple measurements			•	Observe wind vector direction in 2-D
	Demonstrate the instrument's range, accuracy, precision, resolution, and sensitivity at Mars-like conditions	Analyze a known calibrant gas mixture in a Mars-like ambient environment	•			Accurately observe species composing the calibrant gas mixture
			•			Distinguish the following isotopic pairs: ^{12}C-^{13}C, ^{14}N-^{15}N, ^{16}O-^{18}O, doubly ionized ^{36}Ar-^{40}Ar, singly and doubly ionized Xe
		Acquire atmospheric data of comparable quality	•			Acquire spectra spanning 14-80 amu
		Examine winds in a Mars-like environment		•		Detect wind speeds from 0-10 m/s, with a sensitivity of 5 cm/s
				•		Measure wind speed with a precision of ± 5 cm/s
					•	Detect wind speeds from 0-10 m/s, with a sensitivity of 0.1 m/s
					•	Measure wind speed with a precision of ± 0.1 m/s
					•	Measure wind direction to an precision of ± 15°
		Compare anemometer function		•	•	Measure winds simultaneously with SASA and HWA
		Correlate mean vertical winds to gondola ascent/descent rates		•	•	Measure gondola ascent/descent rate to an accuracy of ± 25 cm/s
	Use the instrument to acquire scientifically useful data	Investigate variations in isotpoic abundances with altitude	•			Measure atmospheric composition with isotopic resolution during ascent, float, and descent
		Variations in water abundance across tropopause	•			Measure atmospheric composition with isotopic resolution during ascent, float, and descent
		Characterize vertical wind motion in the stratosphere		•	•	Examine small-scale turbulent winds while at float
		Characterize turbulence across the tropopause		•	•	Measure winds during ascent and descent. Possible Kelvin-Helmholtz instability
	Improve instrument selectability	Assess instrument performance	•	•	•	Record engineering data during environmental testing and flight
		Assess the 'tall-poles' for flight implementation	•	•	•	Robustness, lessons learned
		Assess quality of instrument vs state-of-the-art	•	•	•	Systems Engineering and Project metrics of capability and success
Advance balloon platform for in situ instrument maturation	Verify Mars analog environment	Characterize the dynamics of the stratospheric environment	ASTRA Flight System			Measure P, T, wind power spectrum, isotopic-scale composition
	Determine potential of balloon platform maturation	Understand benefits / limitations of stratospheric balloon flight versus thermal vacuum tests	ASTRA Project Team			Systems Engineering and Project metrics of capability and success
						Identify non-recurring engineering elements
						Identify recurring engineering elements
		Assess the difference between TVAC and "Thermal Mars"				Remote, autonomous operation, instrument electronics in relevant environment, elucidate process and steps for further advancement