

Spectrum

ISS Fluorescence Imaging

ISS R&D 2019

Spectrum Payload Development Team

Kennedy Space Center

Science & Engineering Goals

Building on ABRS Heritage



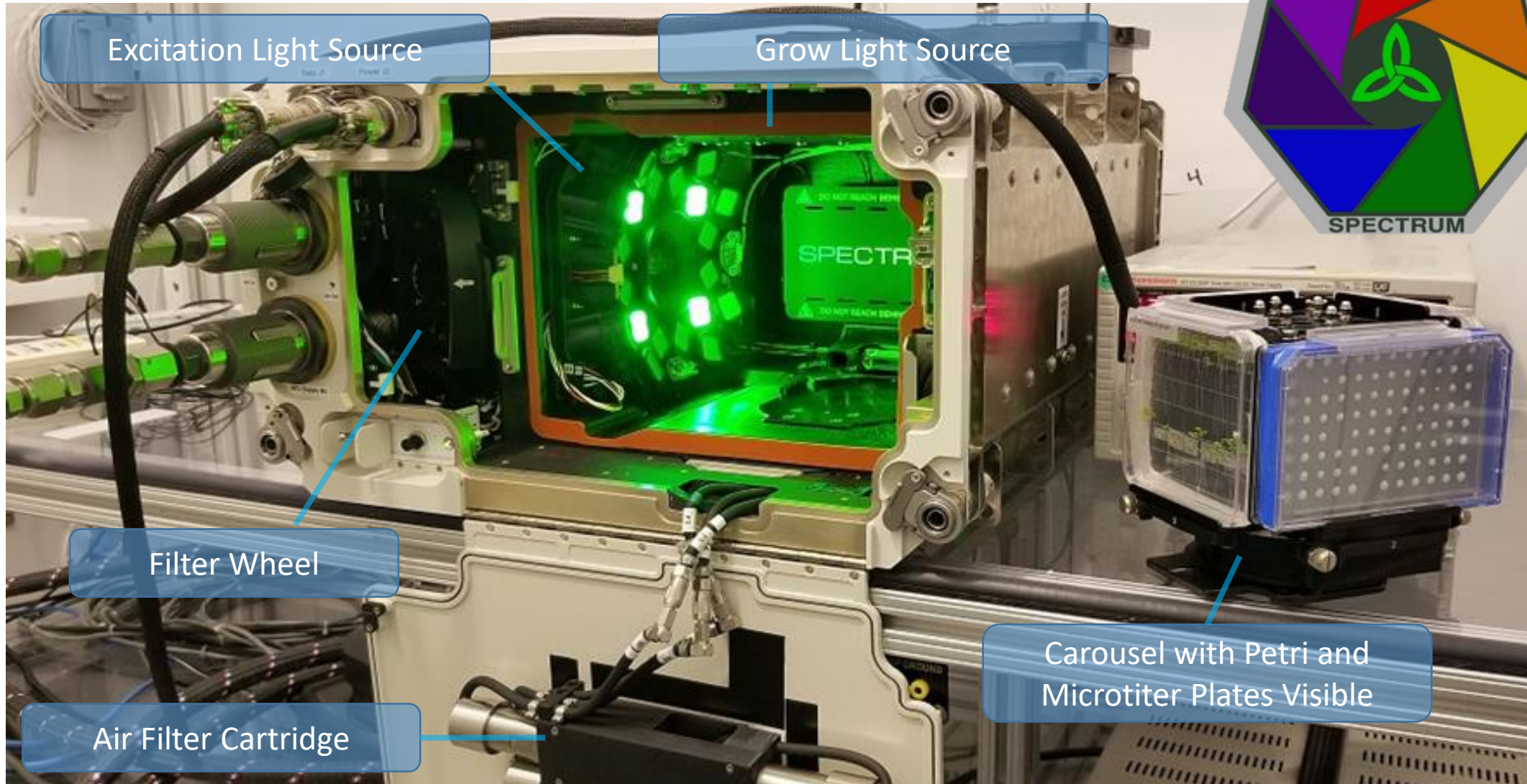
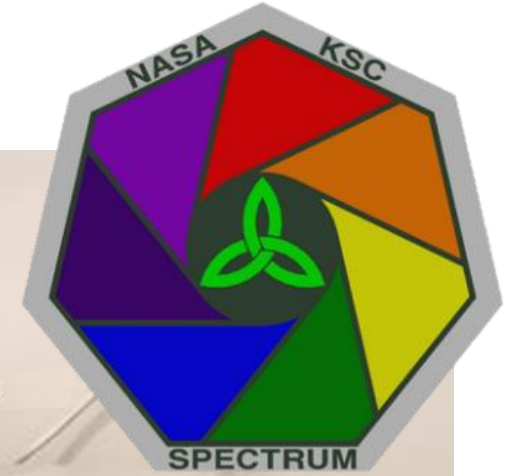
ISS022E011304

ISS022-E-011304 (15 Dec. 2009) - NASA astronaut Jeffrey Williams, Expedition 22 commander, conducts a daily status check of the Advanced Plant Experiments on Orbit (APEX) experiment in the Kibo laboratory of the International Space Station. During each check, Williams looks for health and color of the plants, since the Cambium plants are removed from the Advanced Biological Research System (ABRS).

Evolution of ABRS into Spectrum

	<i>ABRS</i>	<i>Spectrum</i>
<i>Fluorescence</i>	GFP	CFP, GFP, YFP, OFF, RFP, Chlor
<i>Imaging</i>	Video	RGB Color Imaging
<i>Subjects</i>	One Petri	Four Petri/Microtiter
<i>Camera</i>	Bionetics	Illunis 71 Mpix (13 μ m)

Spectrum Flight Unit Science Verification Test (SVT)



Excitation Light Source

Grow Light Source

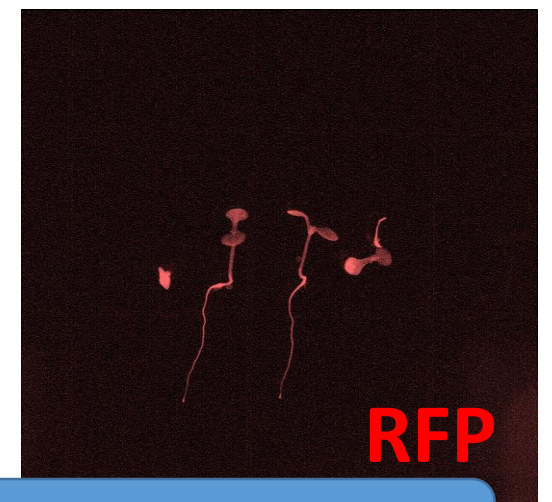
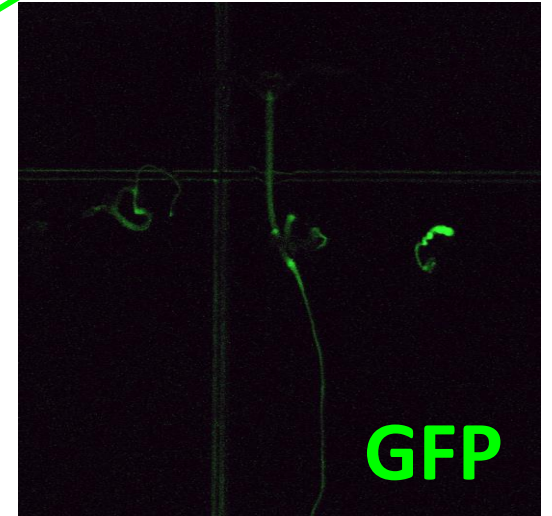
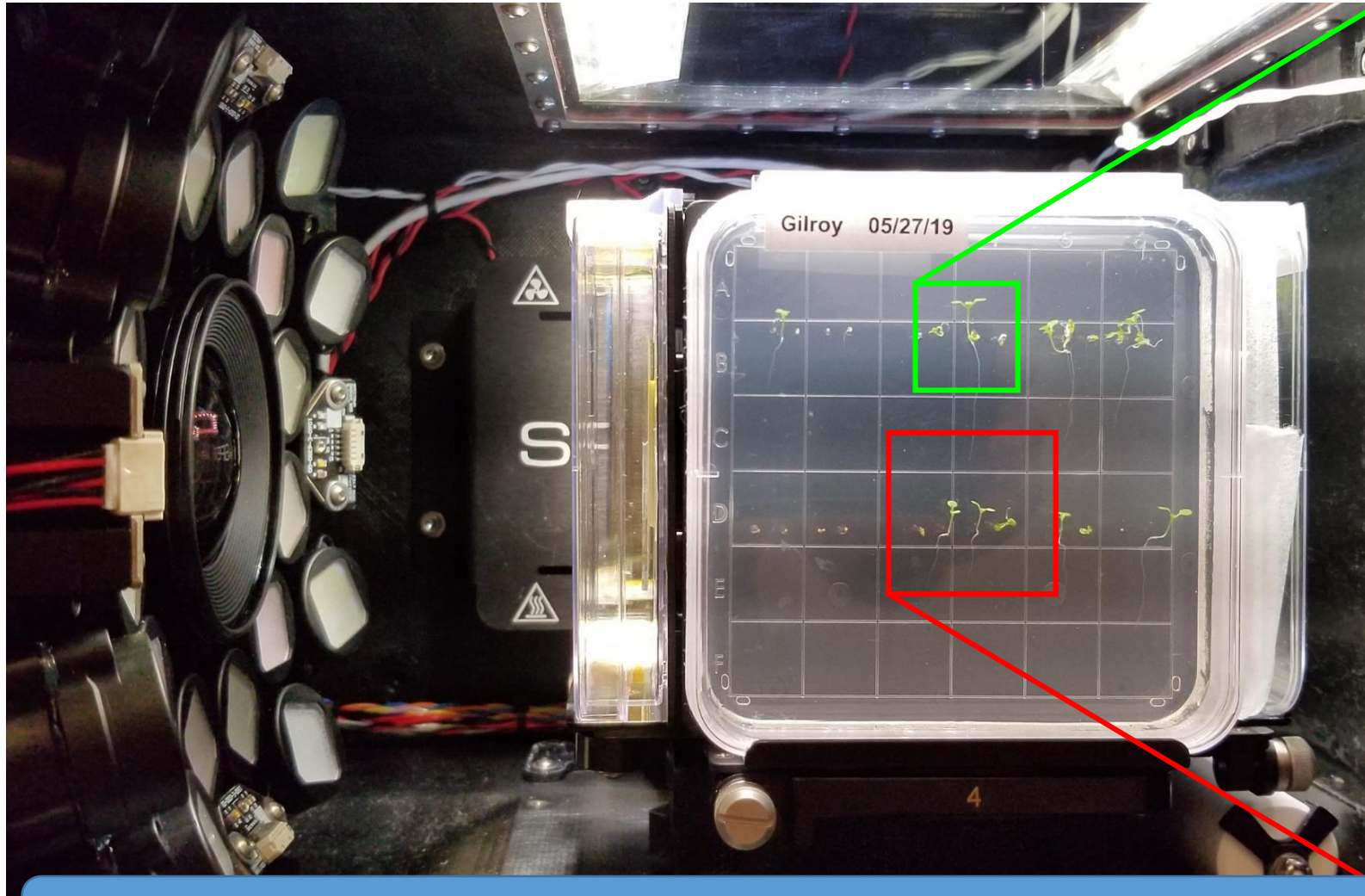
Filter Wheel

Air Filter Cartridge

Carousel with Petri and
Microtiter Plates Visible

Fluorescence Imaging

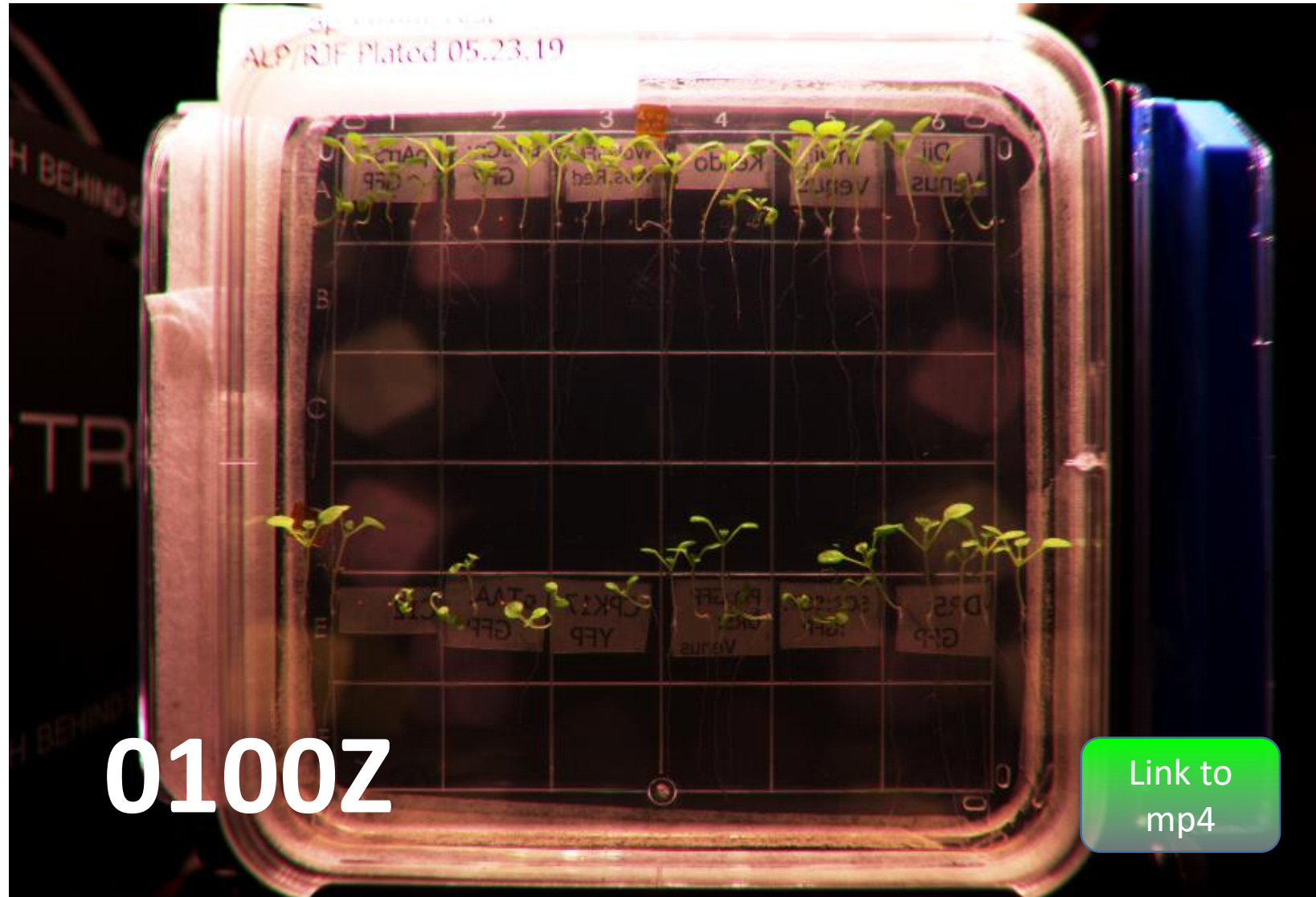
10-day ISSSES Chamber SVT



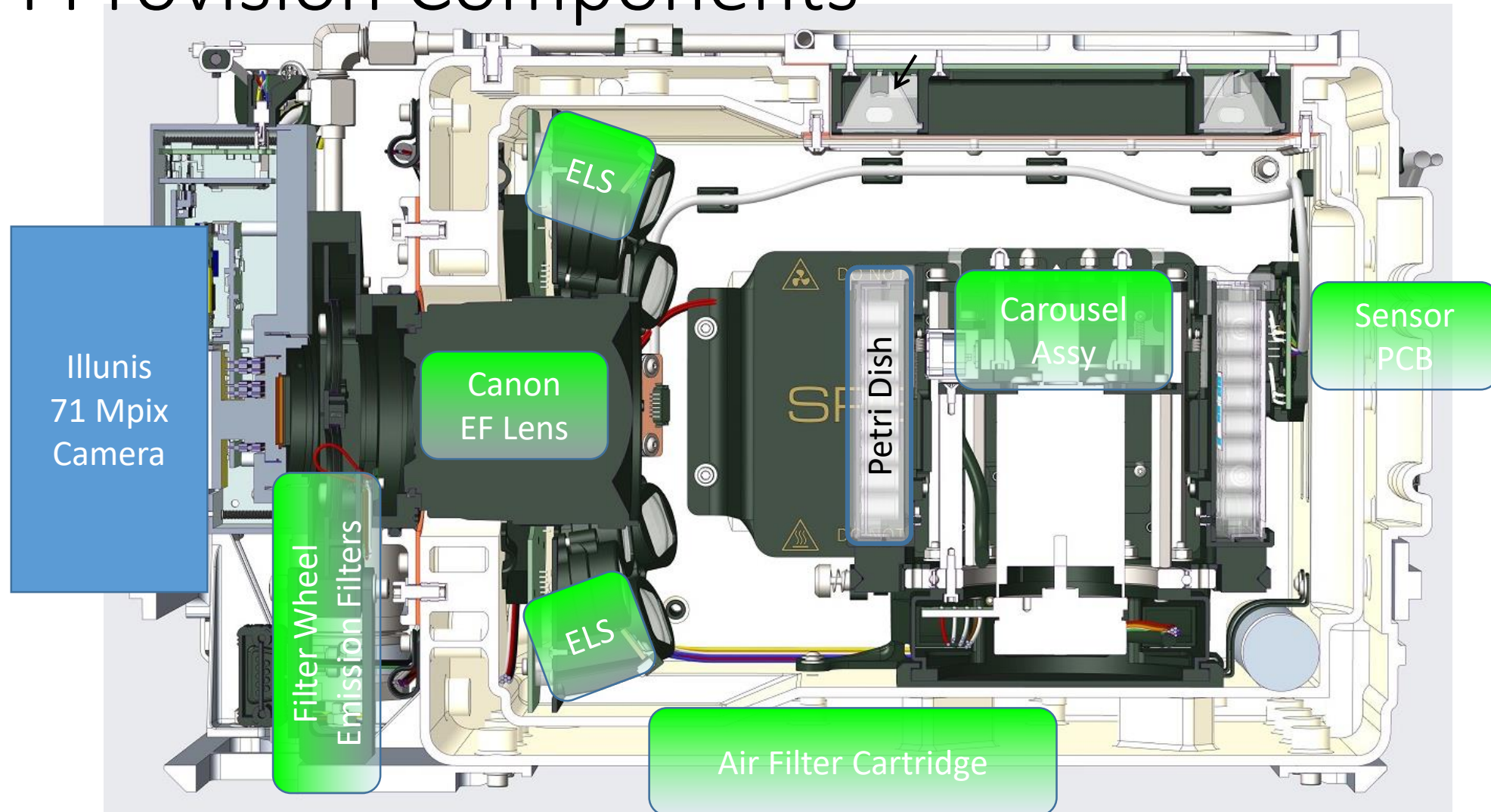
Arapadopsis exhibiting GFP and RFP Fluorescence on SVT Day 10

Color Animation

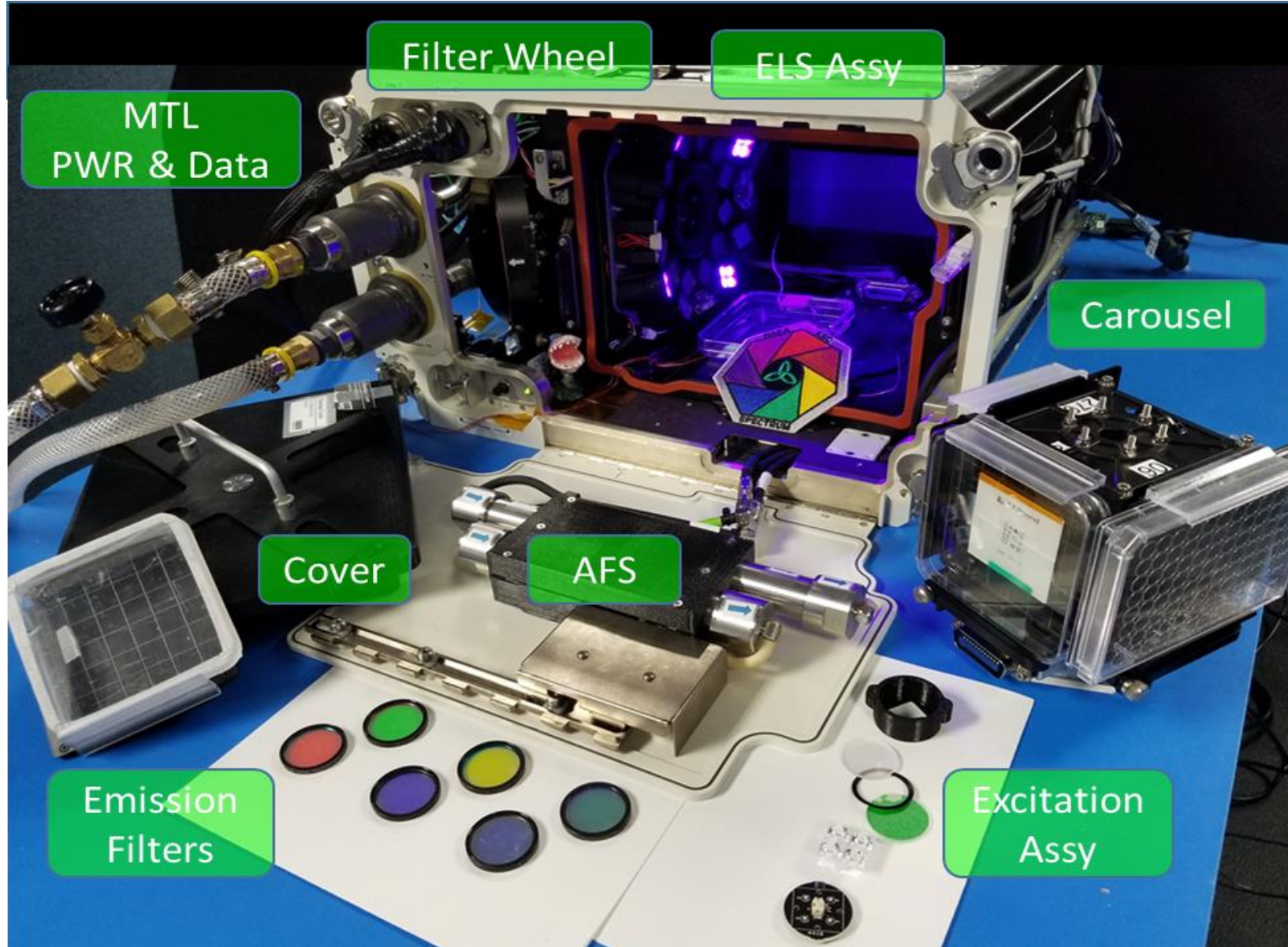
Scheduled Hourly Imaging



Orbital Replaceable Units (ORU) PI Provision Components



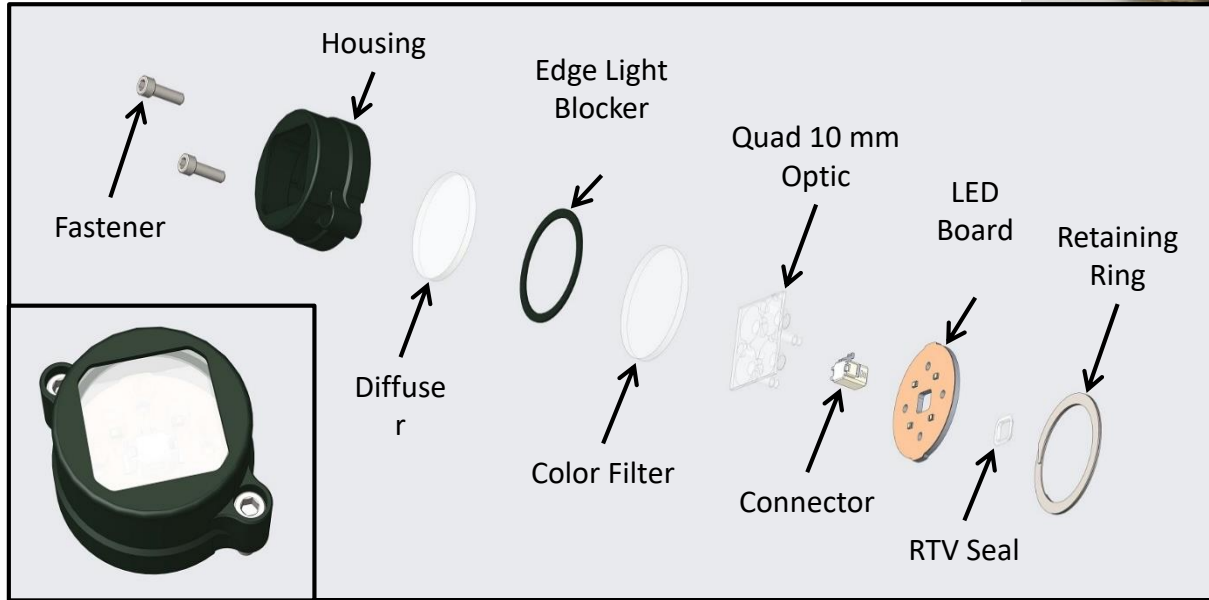
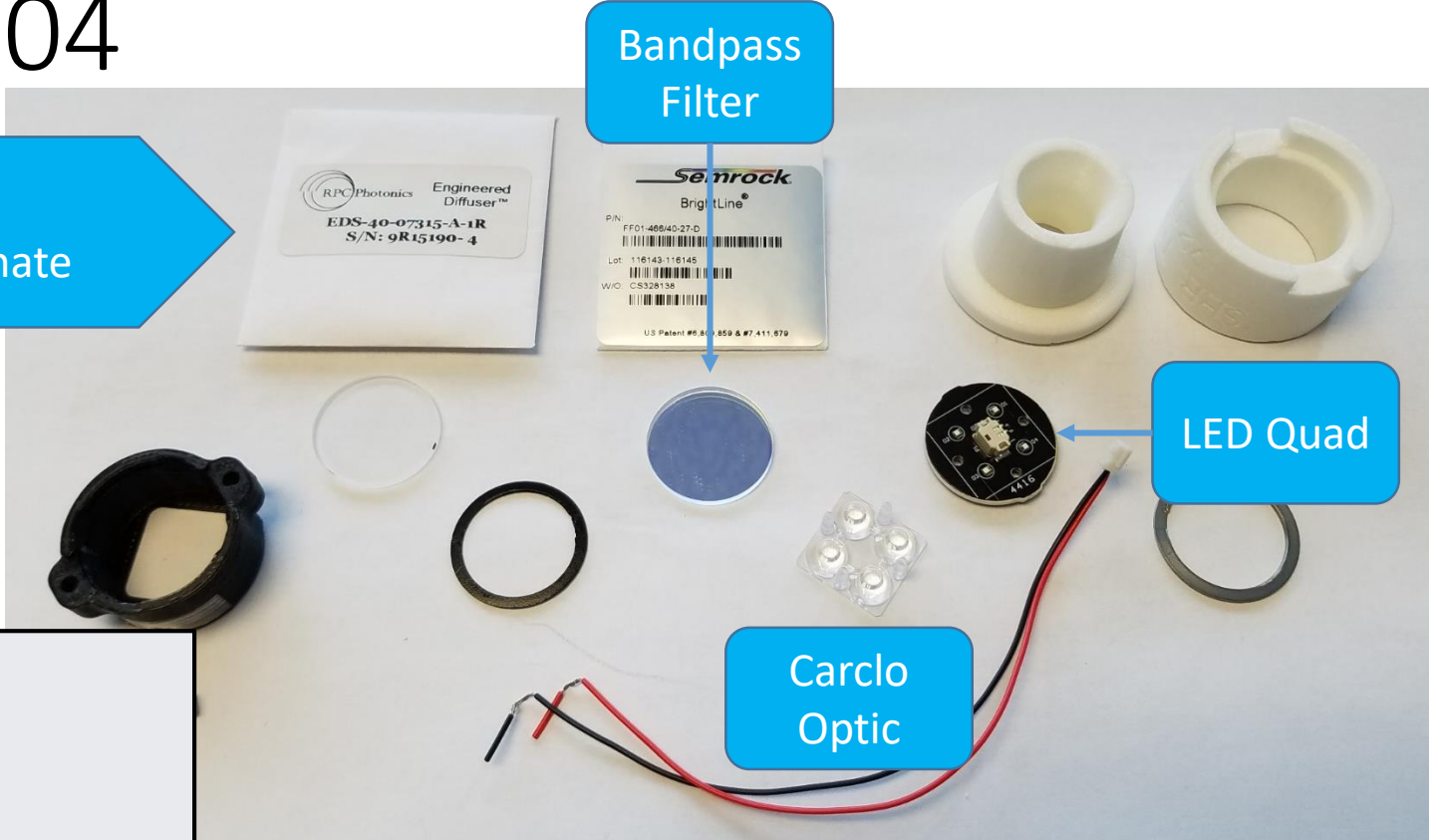
Spectrum Flight Unit ORU



Excitation Light Source ORU

NASA NTR KSC-14104

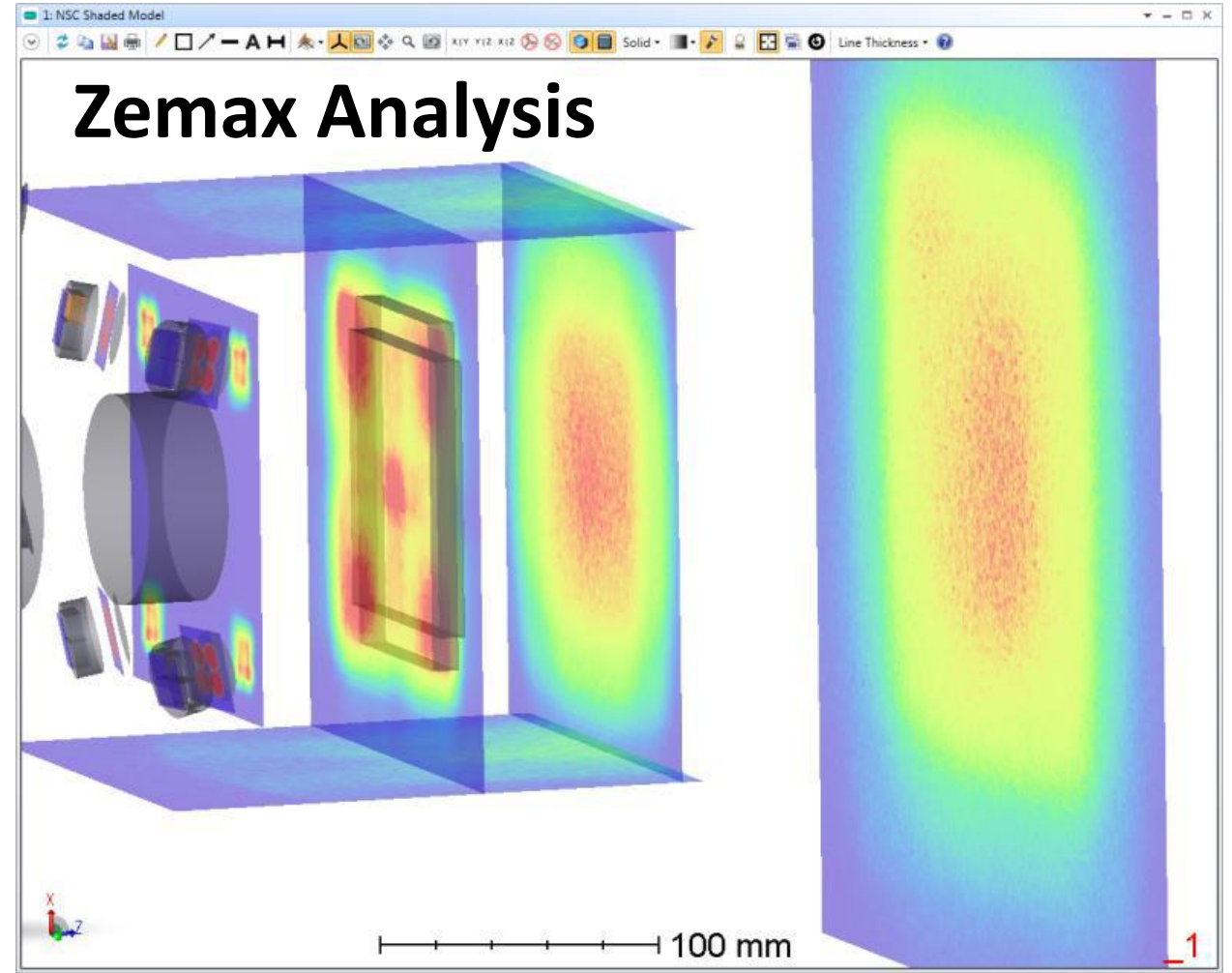
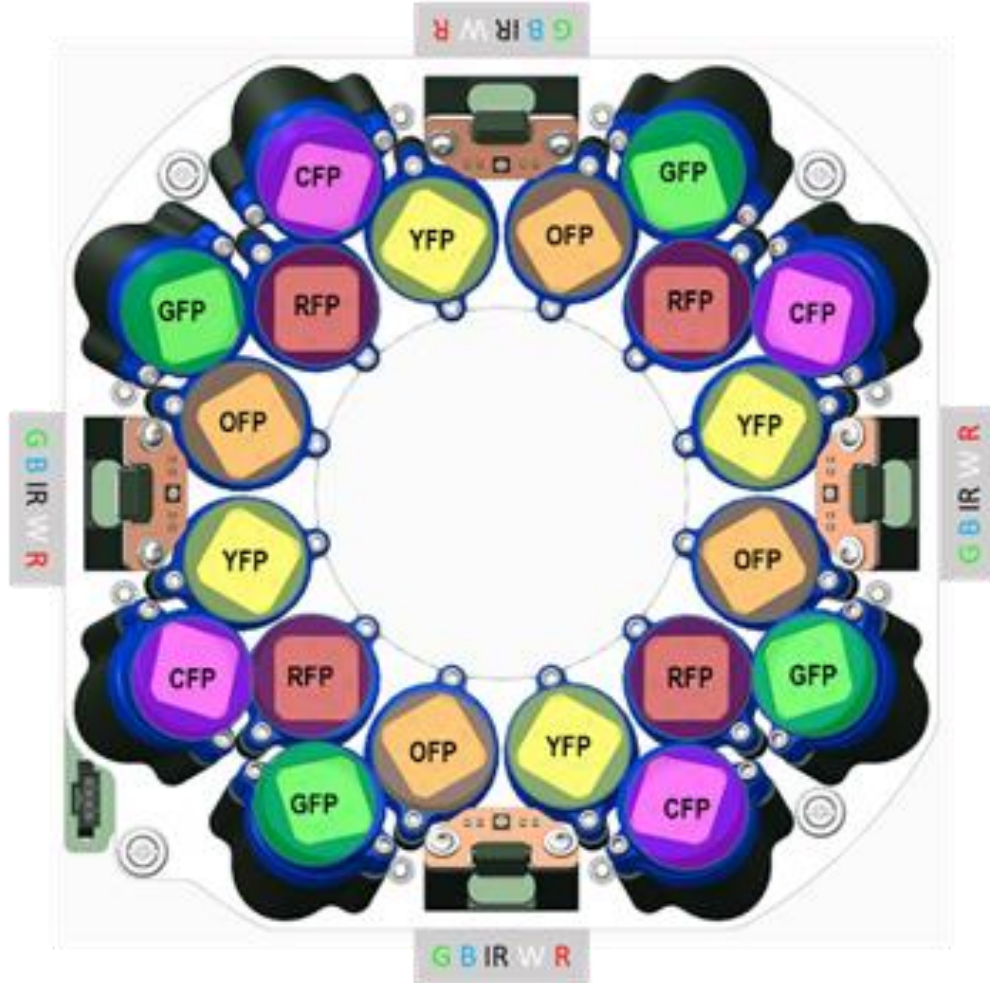
RPC Photonics 40 degree Engineered Diffuser on Polycarbonate



Collimation is required to achieve spectral bandpass when LED light is passing through "Color Filter"

Excitation Light Source ORU

ELS Uniformity



Excitation & Emission Filters

COTS Filter Selections

Protein Categories	Excitation (nm)	Excitation Filter Center Wavelength/Band Pass (nm)	Dichromatic Mirror Cut-On (nm)	Emission (nm)	Barrier Filter Center Wavelength/Band Pass (nm)
Cyan ECFP-type	~439	435 / 40	460 LP	~476	495 / 50
Green EGFP-type	~484	470 / 40	495 Long Pass (LP)	~507	515 / 30
Yellow EYFP-type	~514	490 / 40	515 LP	~527	540 / 30
Blue EBFP-Type	~383	375 / 50	405 LP	~445	445 / 50
Orange	~548	525 / 40	550 LP	~562	585 / 50
Red	~584	560 / 55	590 LP	~607	630 / 60
Chlorophyll	~484	470 / 40	495 LP	~680	680 / 50

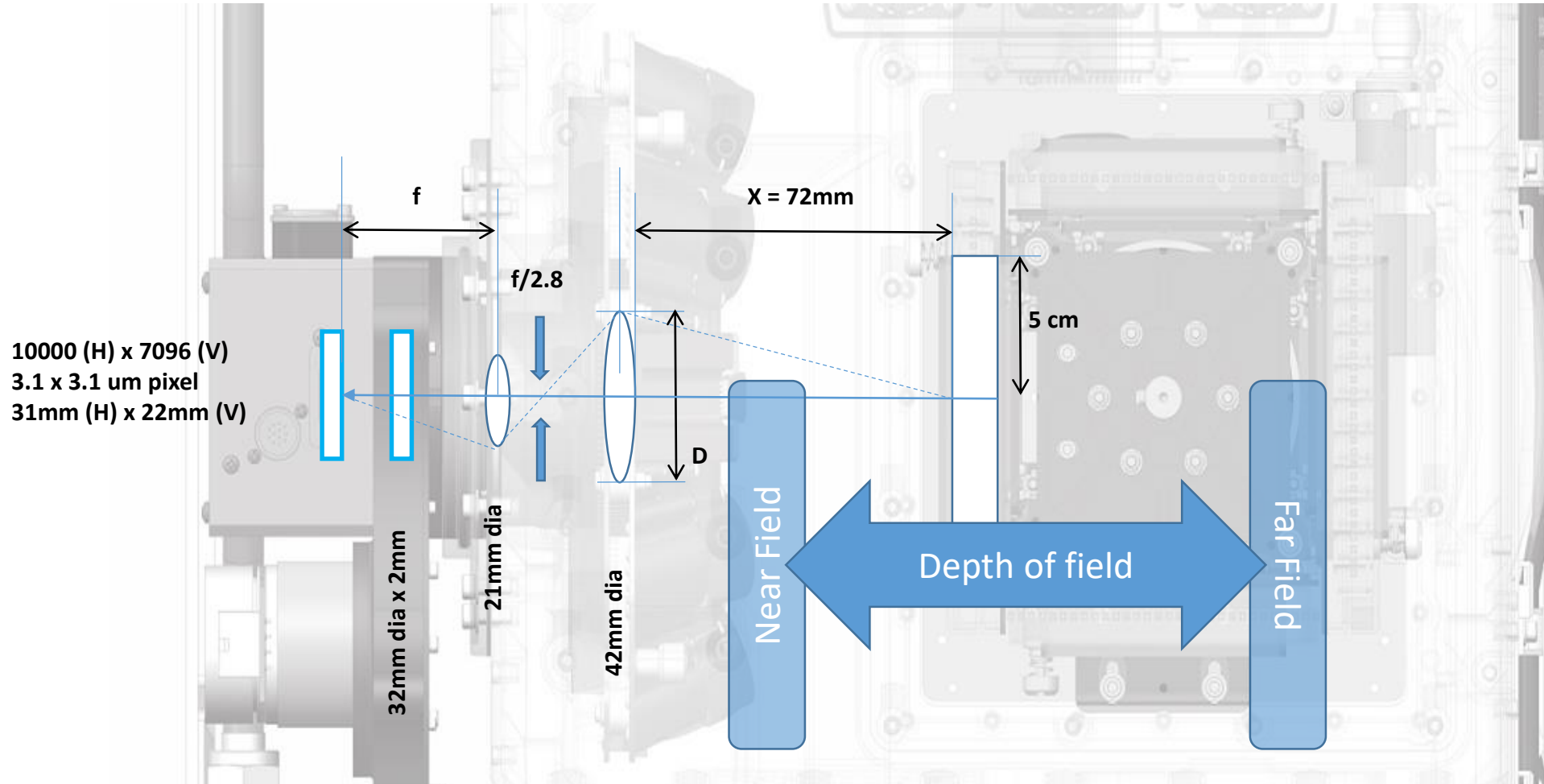


Filter Wheel	Description	Excitation Filter [nm]	Emission Filter [nm]	Mnemonic Color
1	Bayer Blue		458/64	Blue
2	Bayer Green		535/50	Green
3	Bayer Red		650/100	Red
4	Transparent		409/LP	White
5	CFP	435/40	482/25	Cyan
6	GFP	466/40	512/25	Green
7	YFP	504/12	539/30	Yellow
8	OFP	534/20	585/40	Orange
9	RFP	572/28	629/56	Red
10	CHLOR	CFP & GFP	680/42	Dark Red

SRD 3.1.2 Spectrum shall provide fluorescence imaging of (1) emission wavelength at a time. Common proteins and their excitation and emission wavelengths are listed in the table. Note: **The proteins and their associated wavelengths are examples and are not requirements**; actual proteins and wavelengths to be imaged shall be determined during pre-mission testing by the appropriate Principal Investigator (PI).

Spectrum Optical Geometry

PI Technical Reference



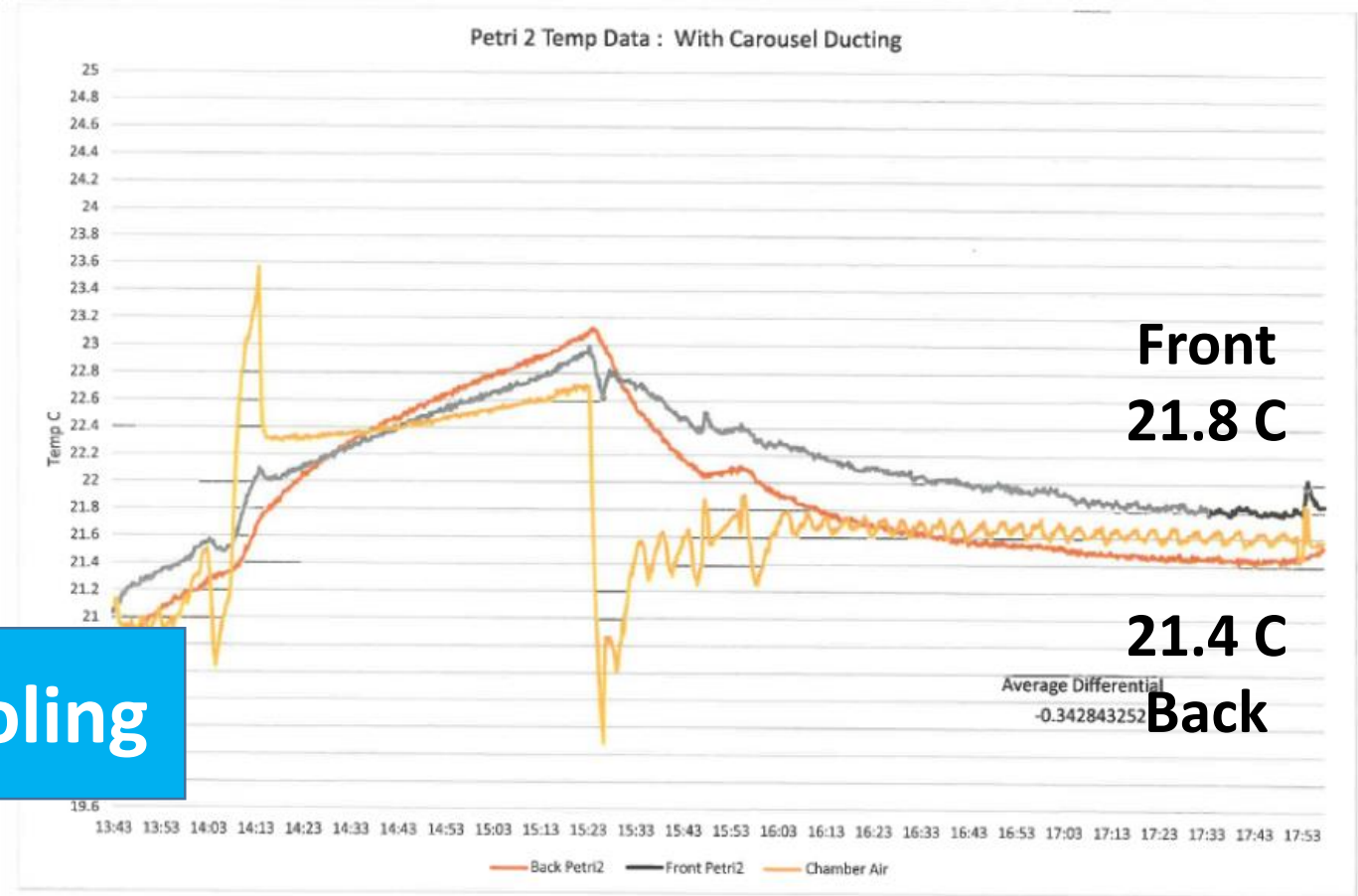
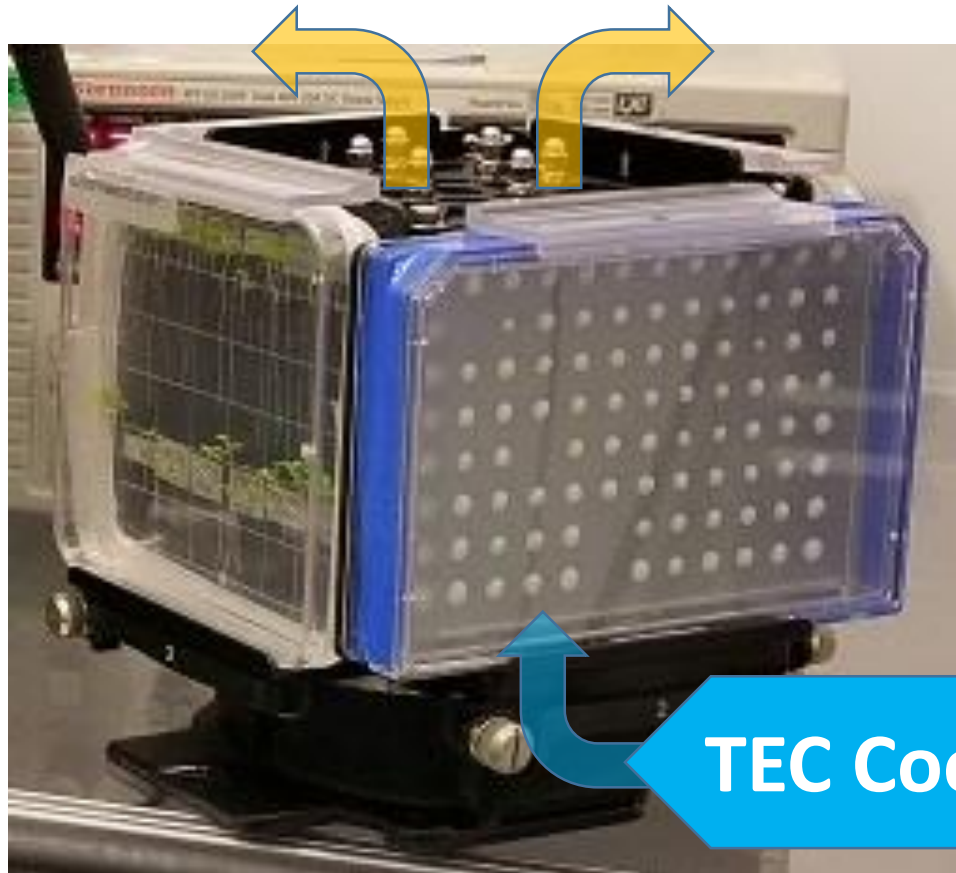
Carousel ORU

Challenge to Suppress Fogging



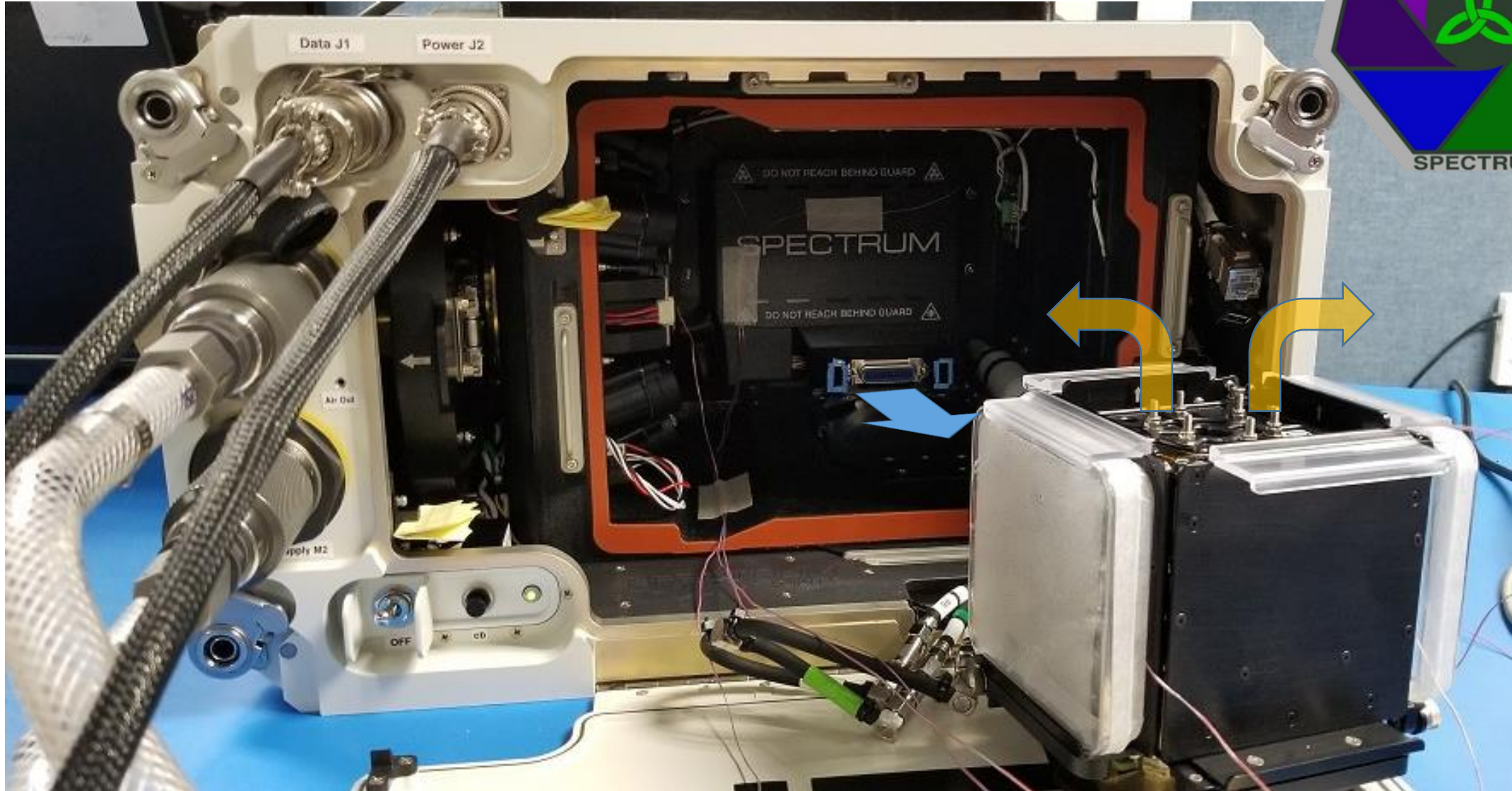
Carousel ORU

Method to Suppress Condensation



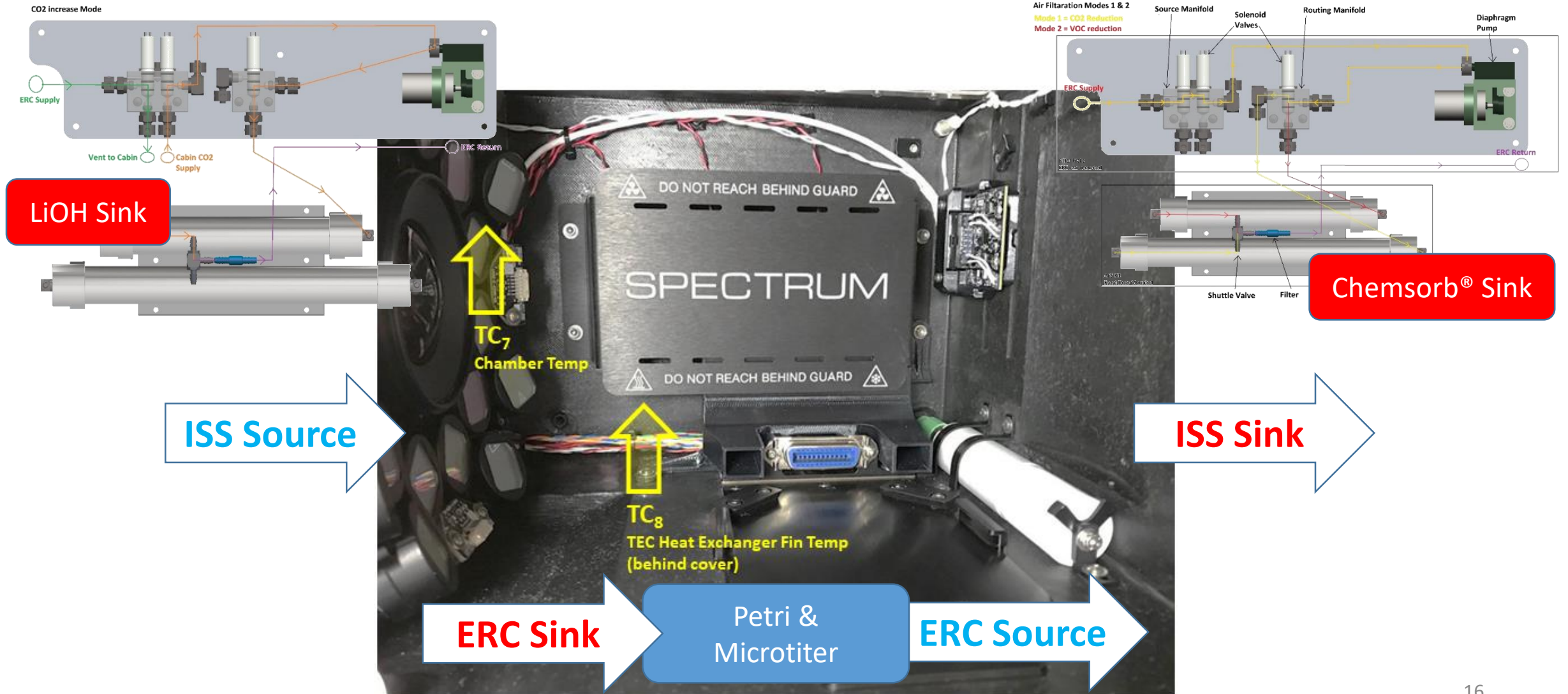
Carousel ORU

Condensation Suppression Test



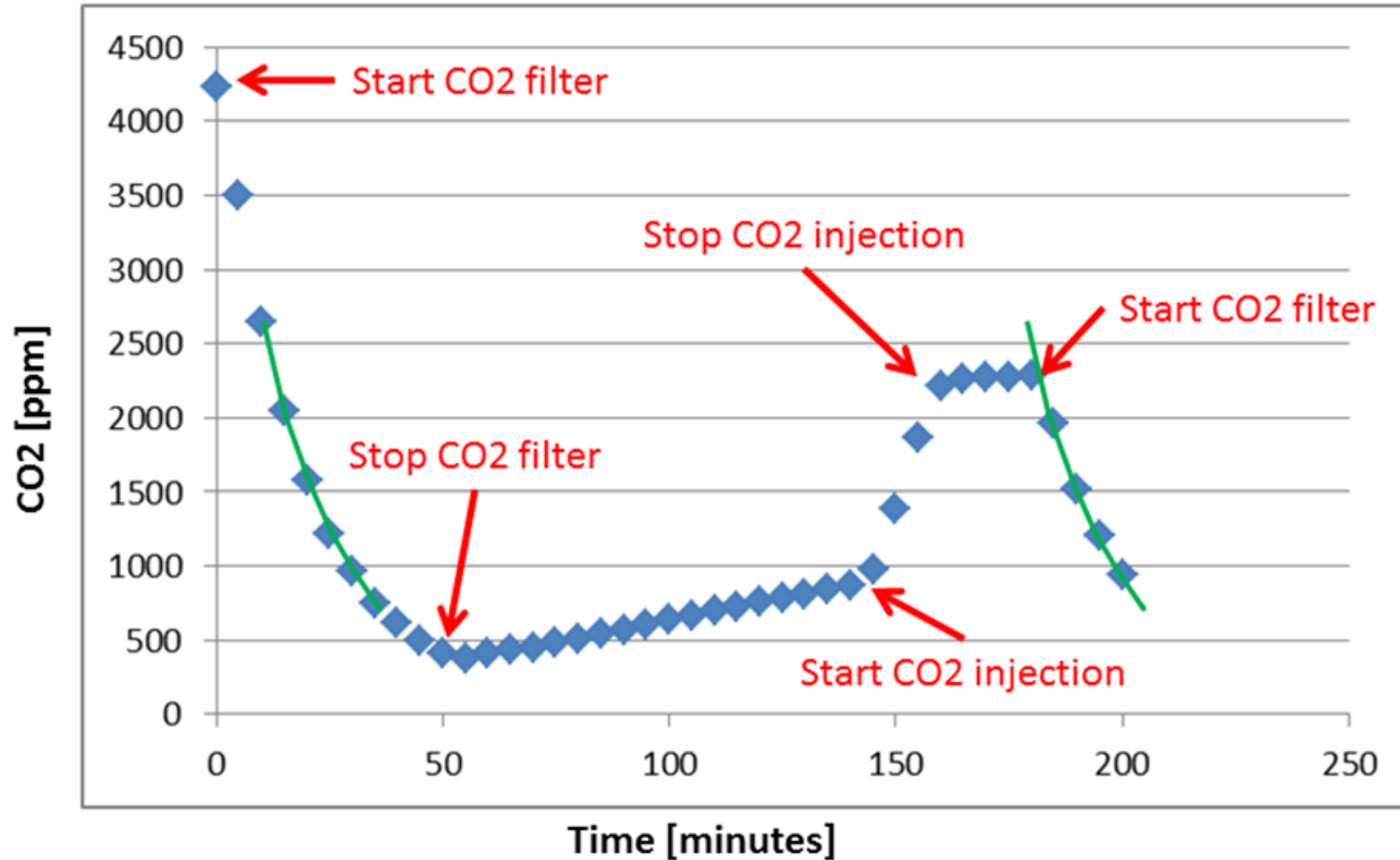
Environmental Controls

CO₂, H₂O vapor, Temperature, VOC



Carbon Dioxide Management ISSES Chamber at 4000 ppm

SPECTRUM Chamber CO2



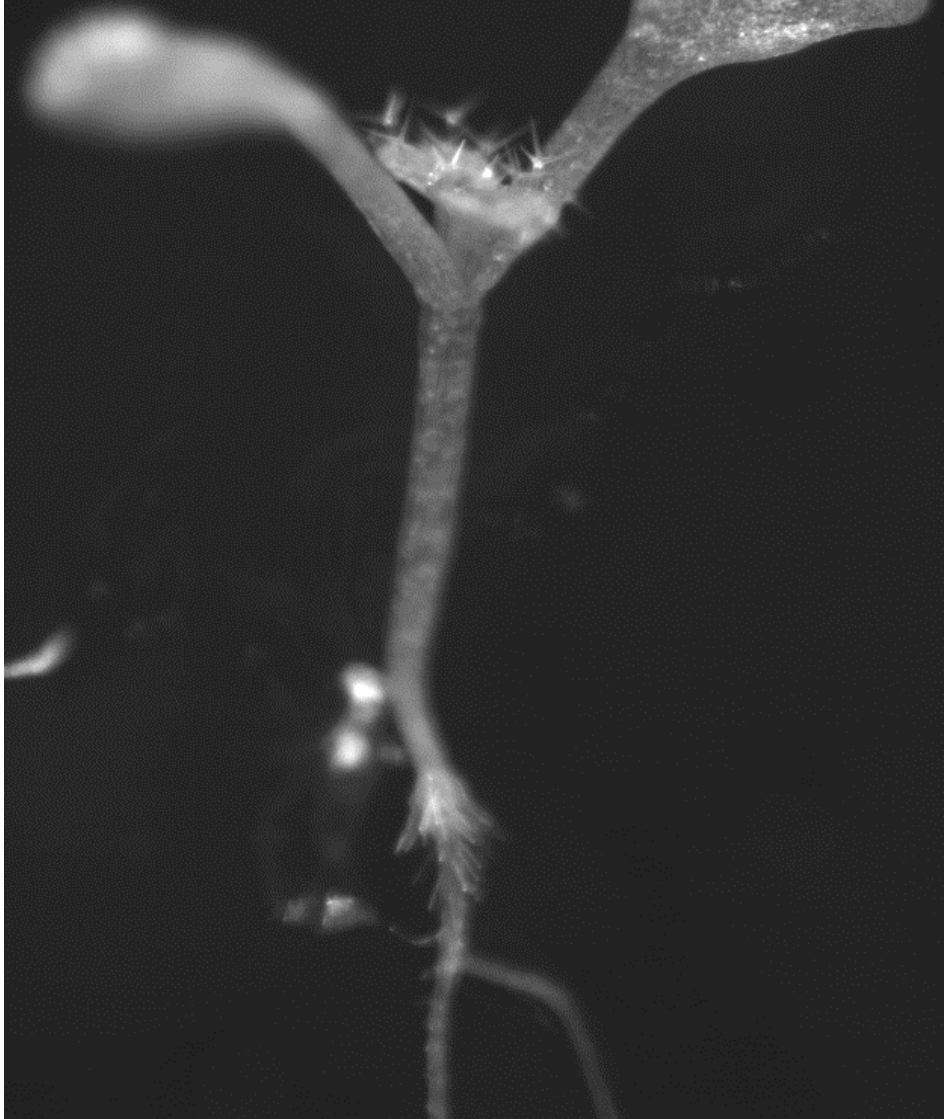
Unique Carousel ORU “The Tomko”



PI Provision Carousel for 100 mm Macro Imaging

Canon EF Lens ORU

100 mm USM



Questions?

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