Stratospheric Aerosol and Gas Experiment III nstalled on the International Space Station (SAGE III/ISS): Update

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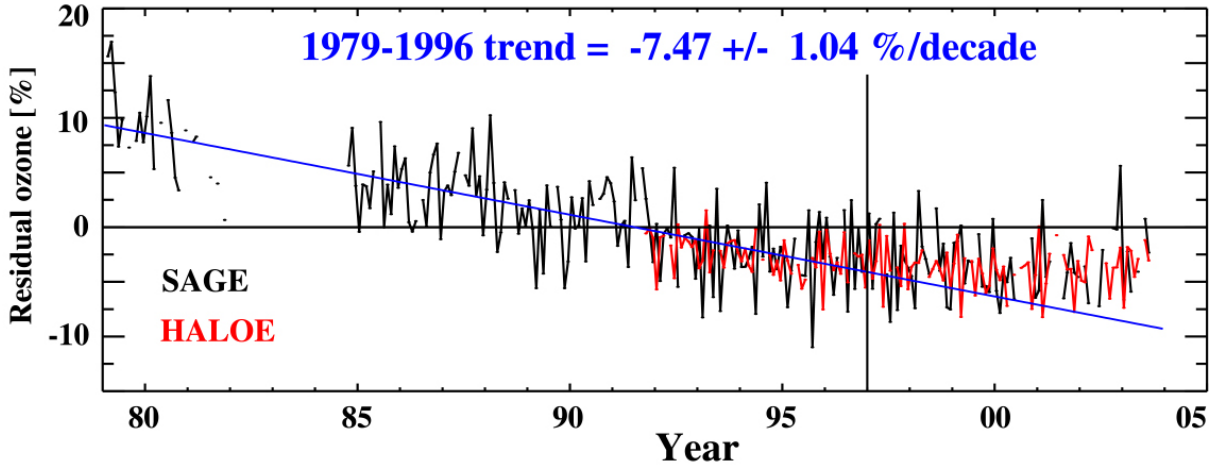
Objective of SAGE

- **Monitor the vertical distribution of aerosol, ozone and other trace gases in the Earth's stratosphere and upper troposphere**
- **SAGE III/ISS will provide data necessary to:**
  - Assess the state of the recovery in the distribution of ozone
  - Extend the stratospheric aerosol measurement record needed by both Climate models and Ozone models
  - Gain further insight into key processes contributing to ozone and aerosol variability

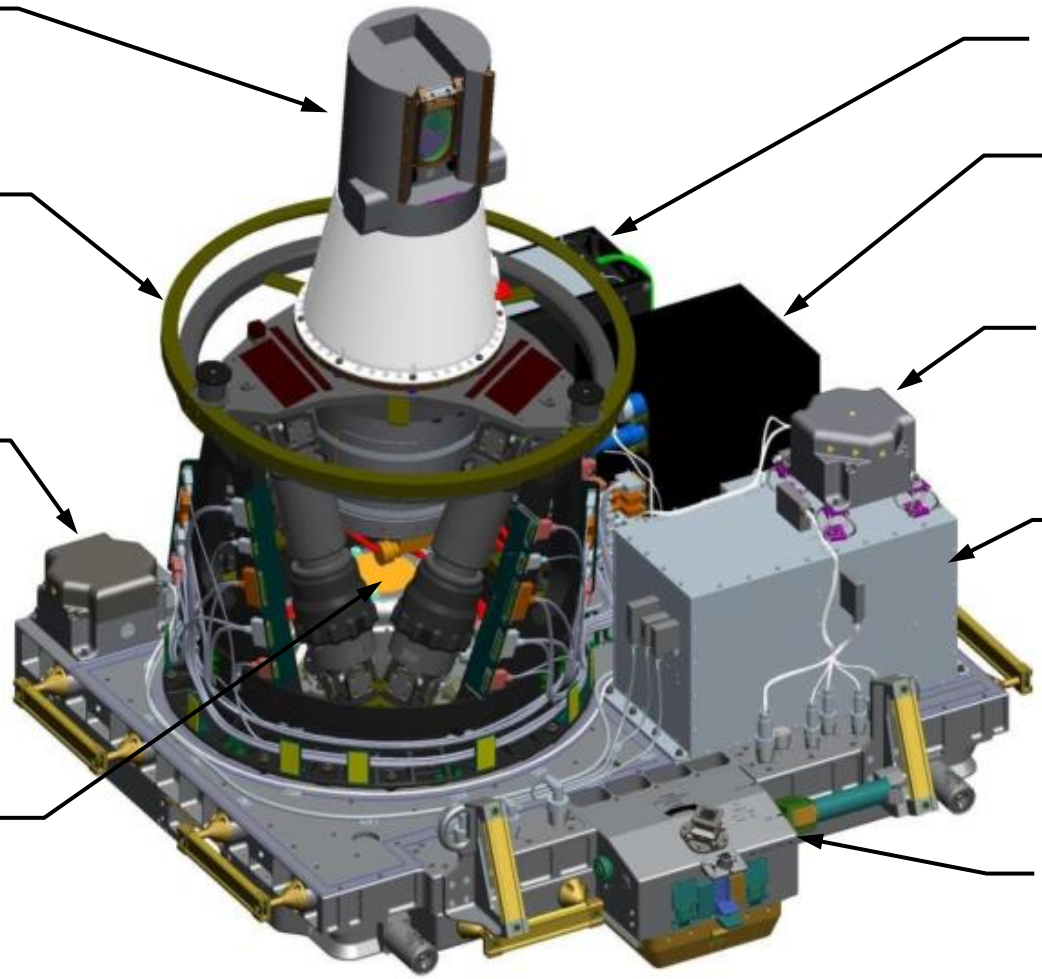


SAGE III/ISS Overview

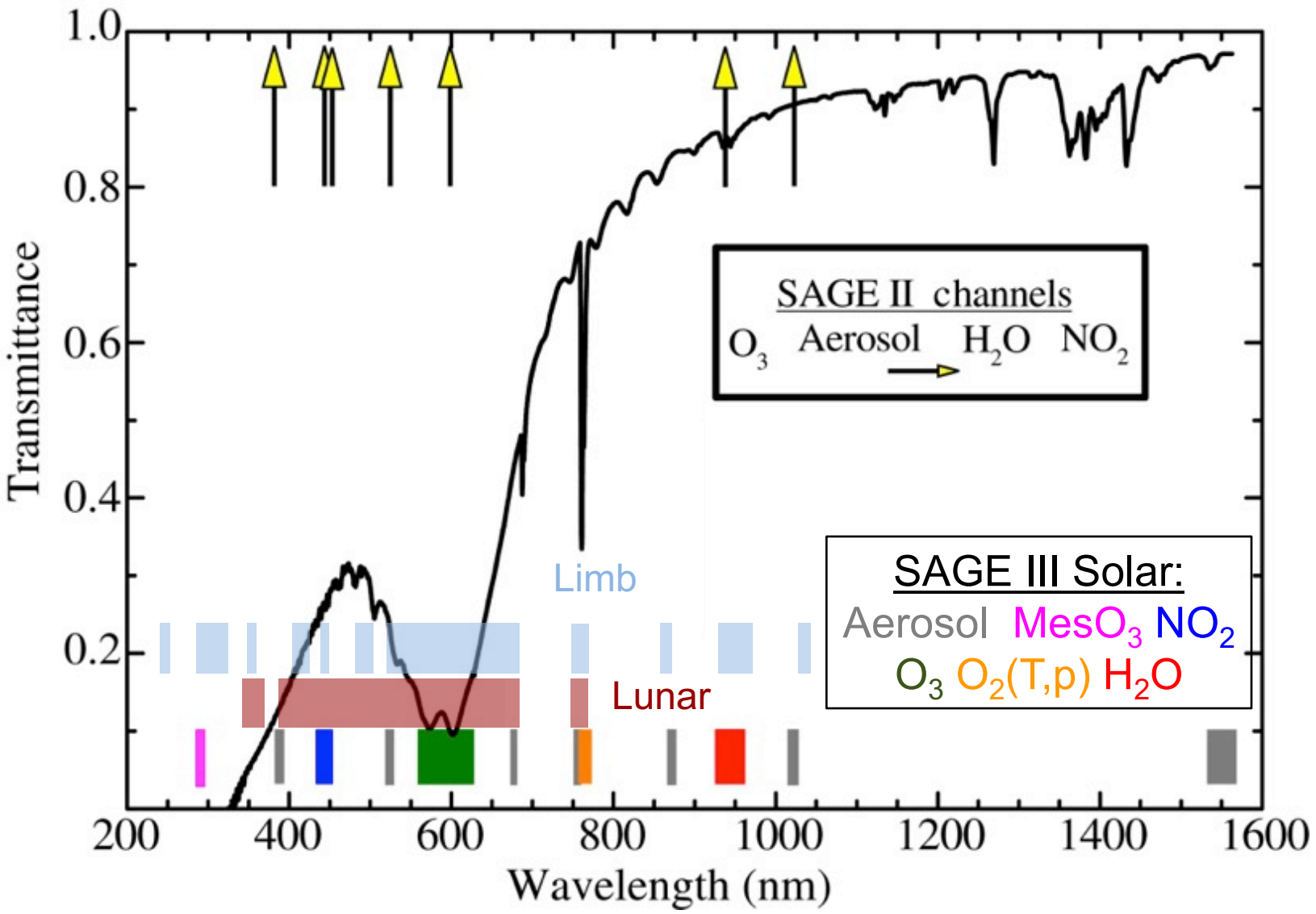
- **Utilizes occultation and limb scatter methods to remotely sense stratospheric aerosol, ozone and other trace gases**
- **Instrument summary (solar occultation mode):**
  - 0.5 arc-min (0.5 km) IFOV scans the vertical extent of solar disk
  - Spectrometer: 290 nm to 1020 nm with 1.4 to 2.0 nm resolution
  - Focal plane also includes 1540 nm diode channel
- **Timeline:**
  - Launched in February 2017; Installed onboard the ISS in March 2017
  - Routine observations began June 2017
  - Data Beta version (V5.0) released: Solar Oct. 2017, Lunar Dec. 2017
  - Data Provisional version release ~ Sept. 2018
- **Baseline mission July 2017 – June 2020**
  - Extended mission reviewed in 2-yr cycles
  - ISS flight manifest until at least 2024

SAGE III/ISS Mission

- **Collaborative effort: NASA (SMD, HEOMD-ISS) & ESA**



Spectral Sampling

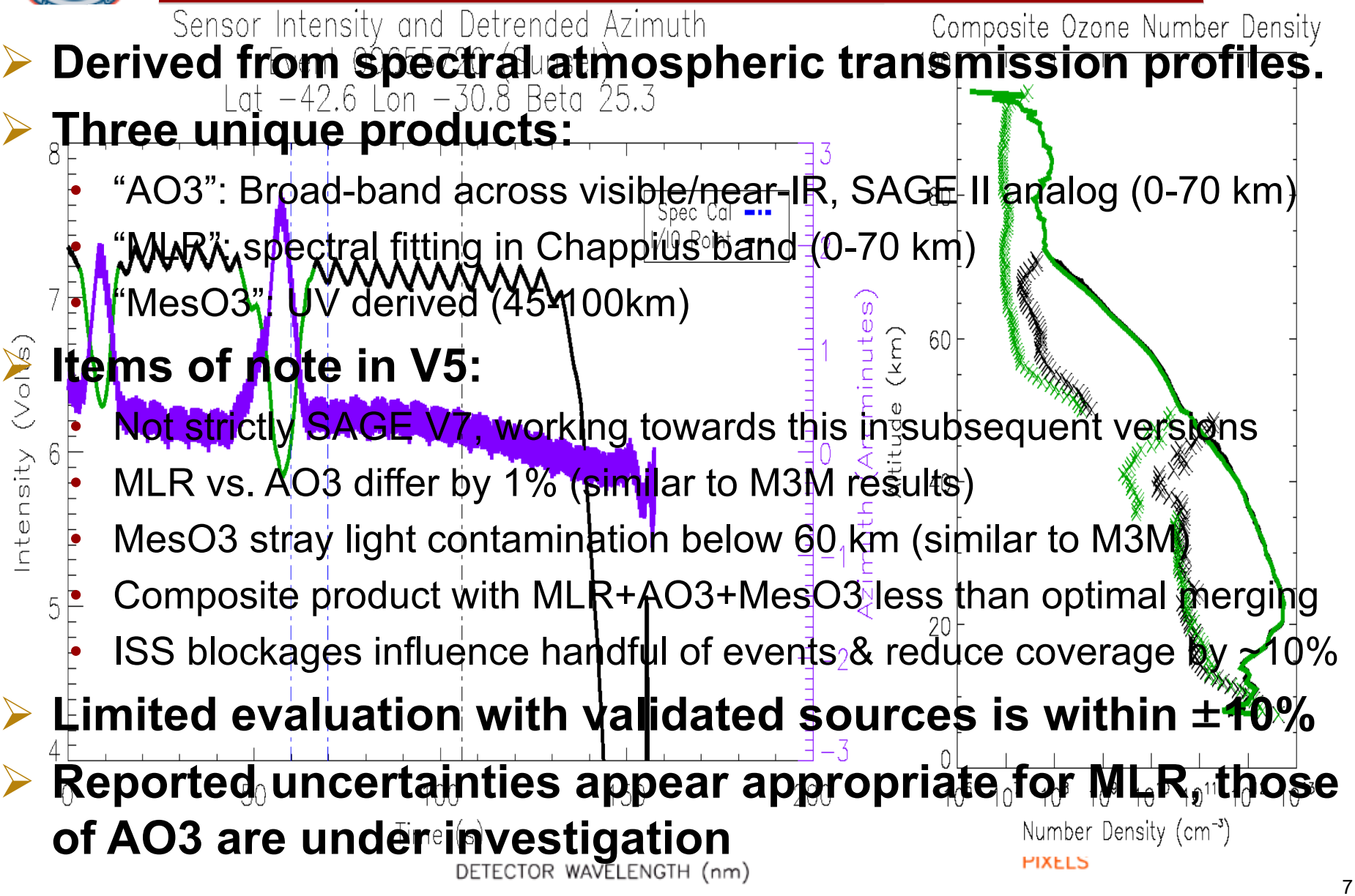


SAGE III/ISS Data Products

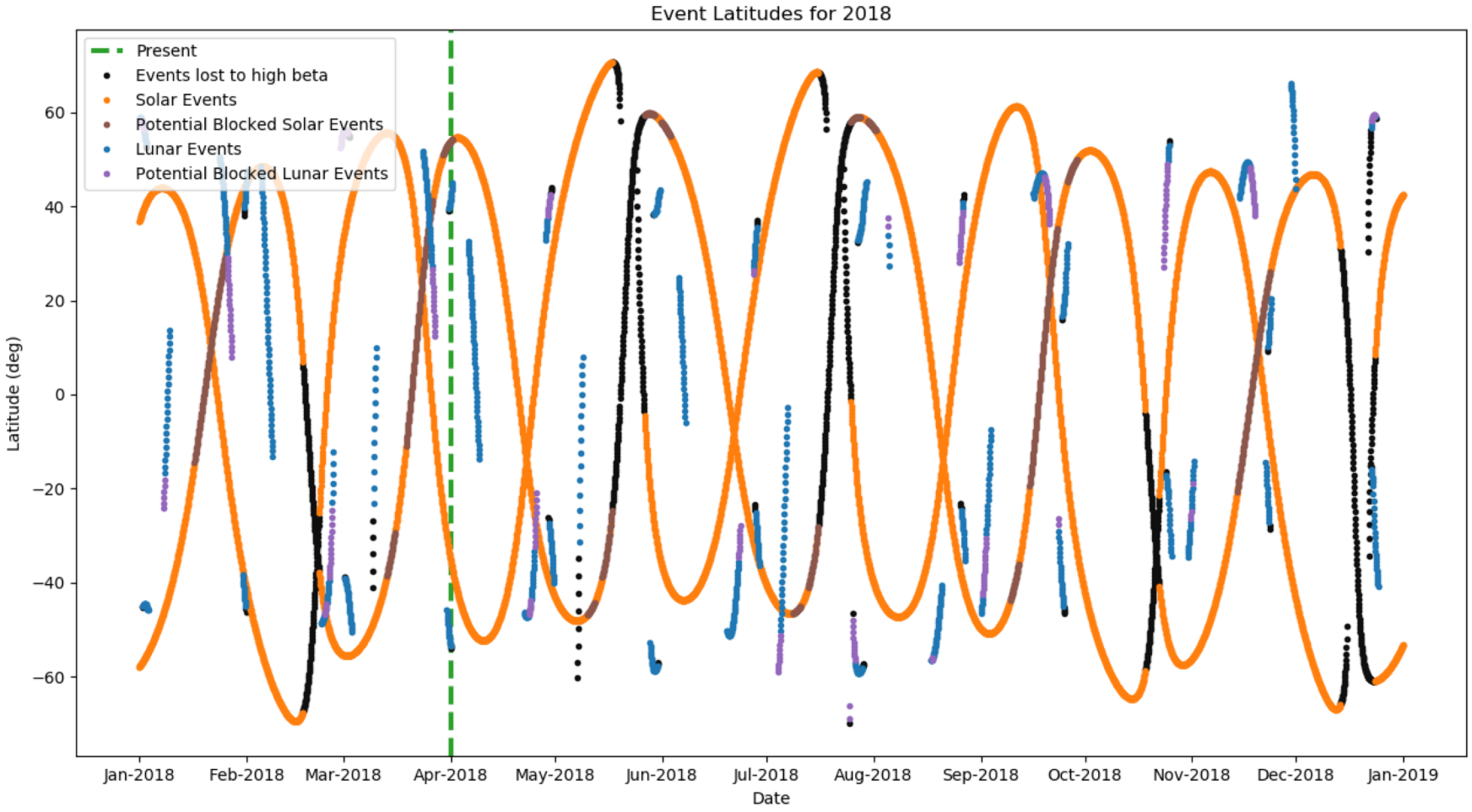
- **SAGE III/ISS is processed in monthly batches when the ancillary inputs are available, i.e. MERRA-2 pressure/temperature**
- **Standard data products are publicly available, per NASA standard practice**
  - eosweb.larc.nasa.gov/project/sageiii-iss/sageiii-iss_table
- **Current released version, V5.0, is categorized as Beta**
  - Solar Water Vapor and Lunar Nitrogen Dioxide not yet included
- **Provisional version to be released ~ September 2018**
  - Will include Solar Water Vapor and Lunar Nitrogen Dioxide
- **Validation/evaluation is on going**

SAGE III/ISS Ozone Products

- **Derived from spectral atmospheric transmission profiles.**
- **Three unique products:**
  - "AO3": Broad-band across visible/near-IR, SAGE II analog (0-70 km)
  - "MLR": spectral fitting in Chappius band (0-70 km)
  - "MesO3": UV derived (45-100km)
- **Items of note in V5:**
  - Not strictly SAGE V7, working towards this in subsequent versions
  - MLR vs. AO3 differ by 1% (similar to M3M results)
  - MesO3 stray light contamination below 60 km (similar to M3M)
  - Composite product with MLR+AO3+MesO3 less than optimal merging
  - ISS blockages influence handful of events & reduce coverage by ~10%
- **Limited evaluation with validated sources is within ±10%**
- **Reported uncertainties appear appropriate for MLR, those of AO3 are under investigation**



Structural Blockage



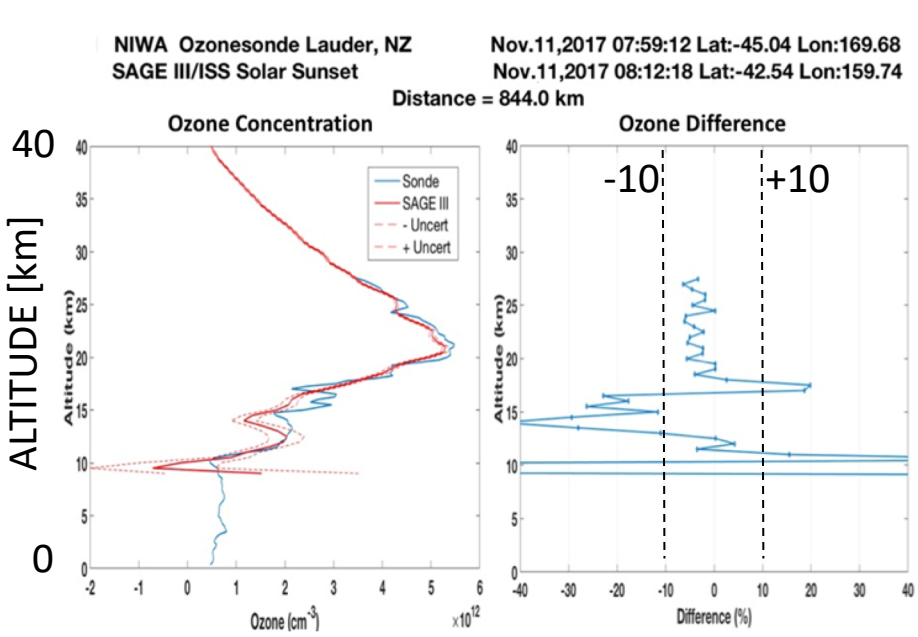
No significant sampling issues arise from ISS blockages

Validation

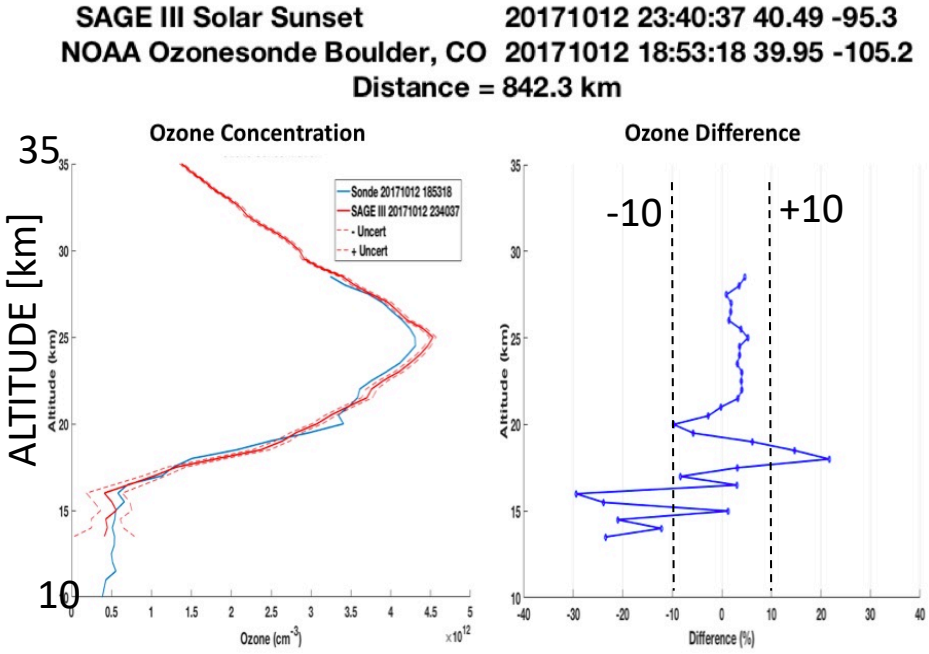
- **Focus on Ozone, Aerosol, and Water Vapor**
- **Multi-pronged approach**
- **Internal consistency assessment**
  - Use internal metrics such as our different ozone retrievals and spectral consistency of the aerosol extinction
  - Analysis of residuals
- **Comparison with funded sonde launches**
  - Boulder, Co & Lauder, NZ
- **Rely on well established ground-based lidar and balloon measurements**
  - Measurement predictor to facilitate closer temporal/spatial matches
  - sage.nasa.gov/validation

Validation: Ozone-sonde Flights

- Ozone-sonde launches planned to coincide with SAGE III/ISS measurements
- Differences are less than 10% in middle stratosphere.
- Altitude registration better than 1 km



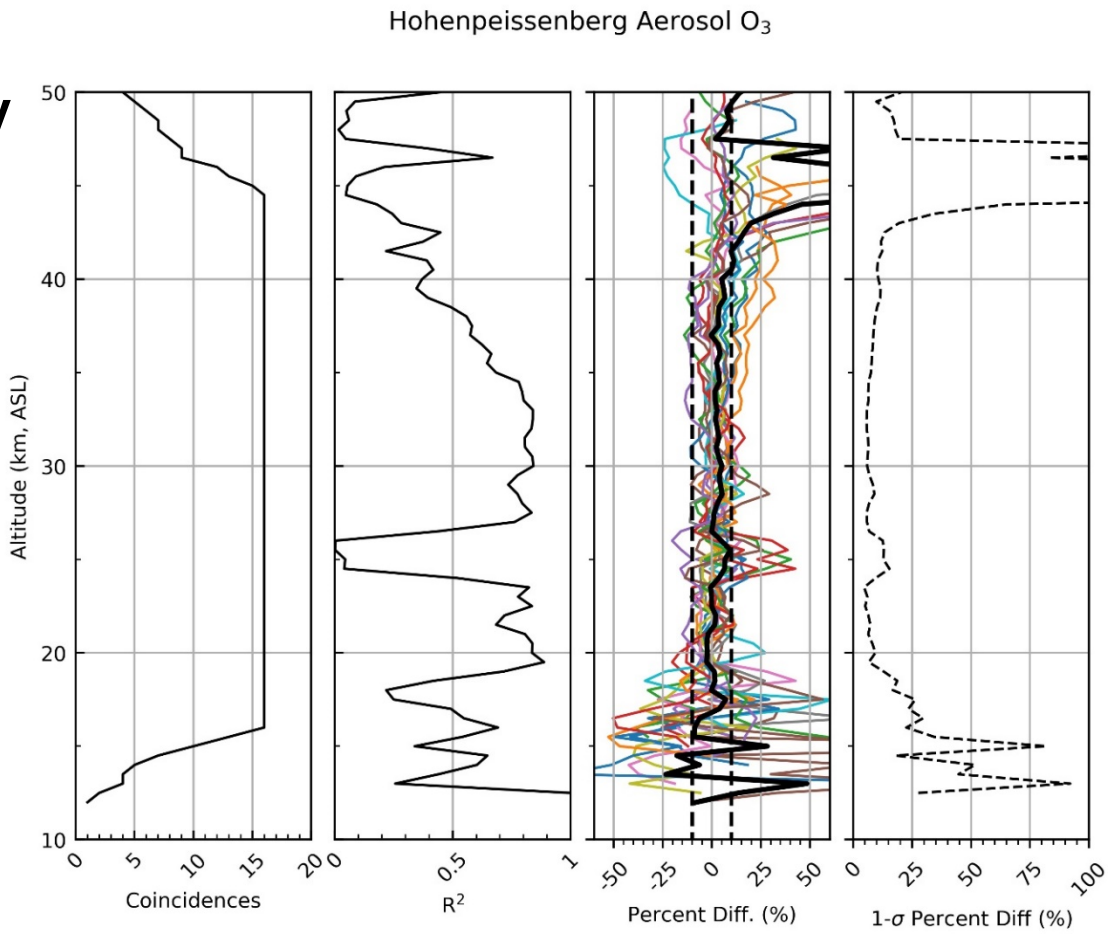
(SAGE-sonde)/sonde*100 %



(SAGE-sonde)/sonde*100 %

Validation: Lidar Profiles

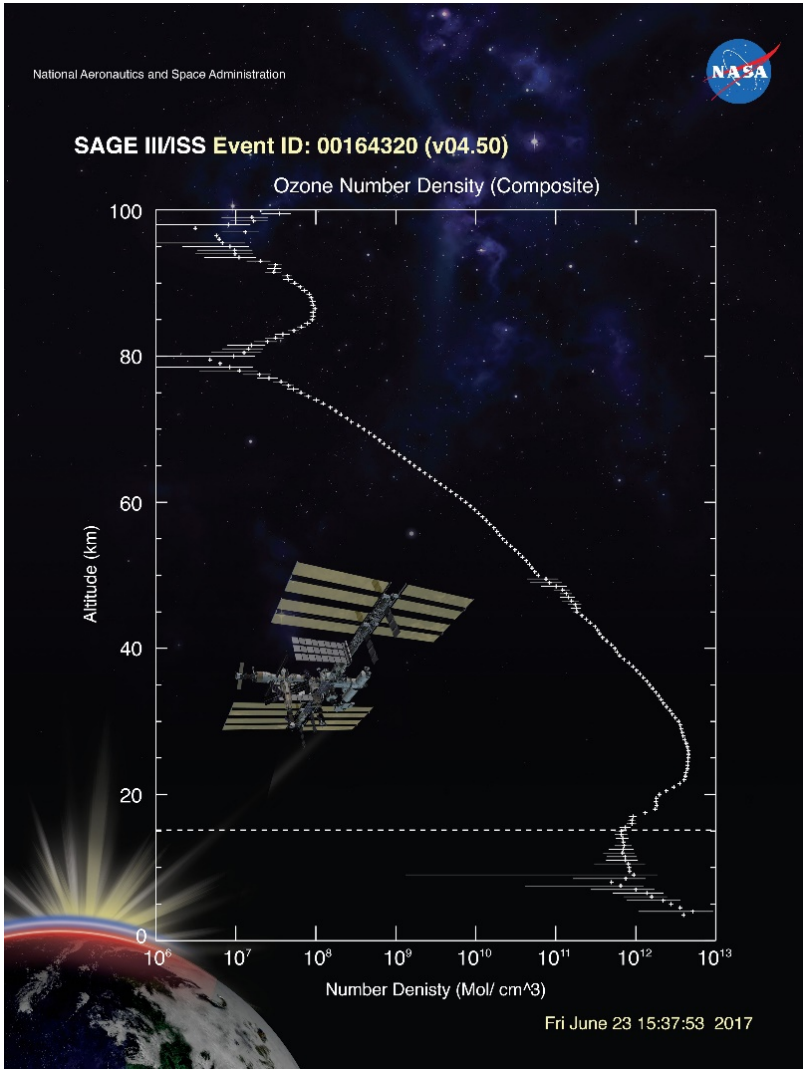
- **Past experience proved NDACC lidar comparisons to be very accurate and stable**
- **Initial comparisons:**
  - Features similar to historic SAGE
  - Bias < 3% in mid-stratosphere
  - Standard deviation <10%
  - Very slight altitude variation
  - Lidar structure ~25km lacking in SAGE



Coincidence Criteria: ±5° Lat., ±15° Lon., ±24 hr.

Summary

- **SAGE III/ISS is a climate continuity mission addressing critical international science needs: sage.nasa.gov**
- **SAGE III/ISS is operating nominally with additional data released at monthly intervals**
  - General information: eosweb.larc.nasa.gov/project/sageiii-iss/sageiii-iss_table
  - Solar species: search.earthdata.nasa.gov/search/project?p=!C1432788952-LARC&tl=1507560928!4!!
- **Data Beta version publicly available; Provisional version ~ Sept. 2018**
- **Preliminary comparisons show mid-stratosphere ozone within ±10% of validated sources**
- **Baseline mission is July 2017 – June 2020; continuation expected in 2-yr cycles**



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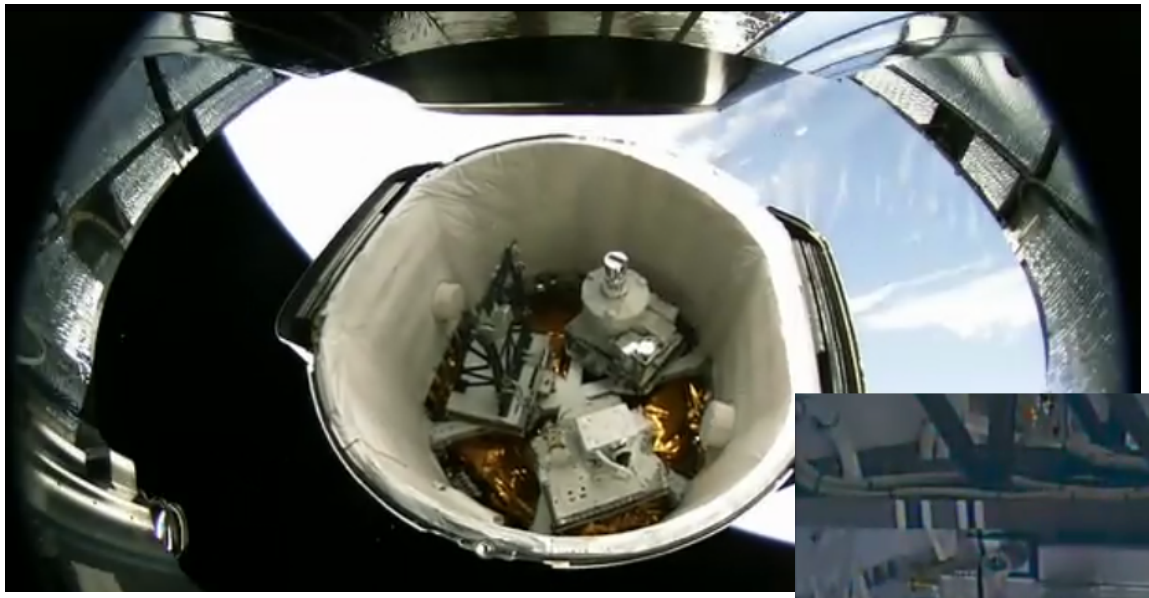
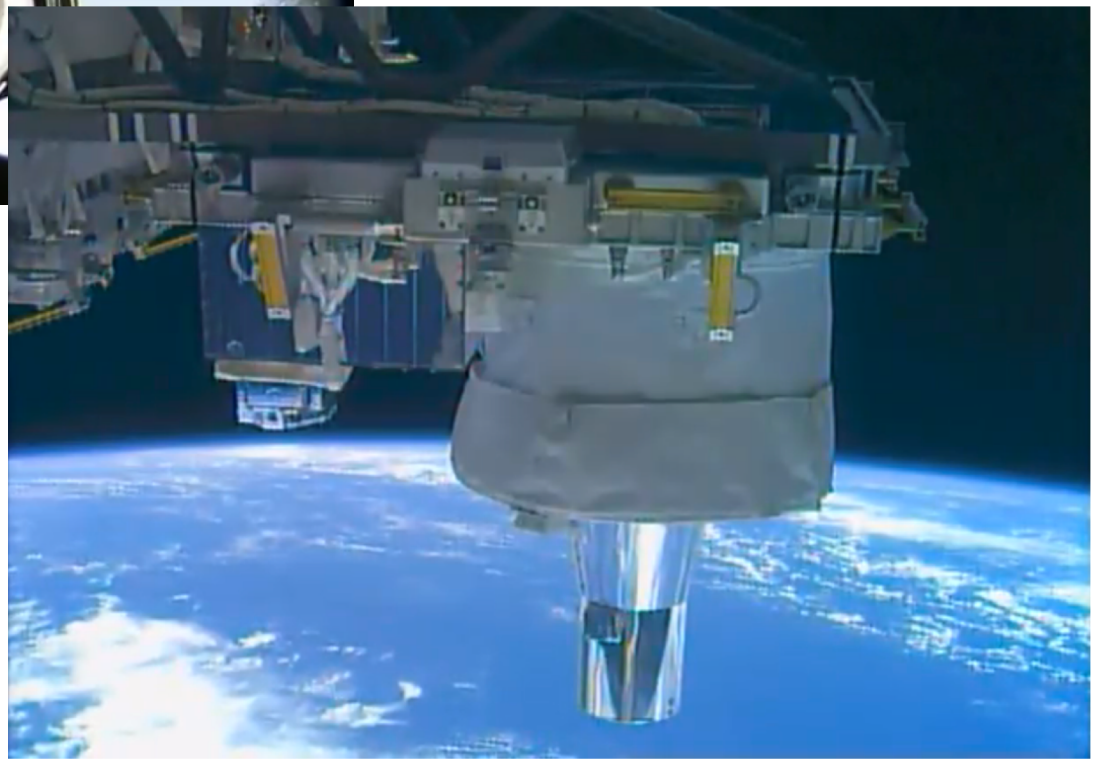
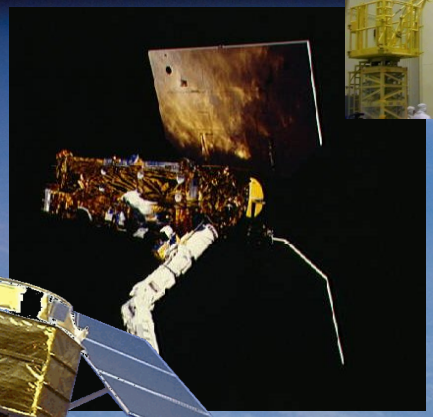


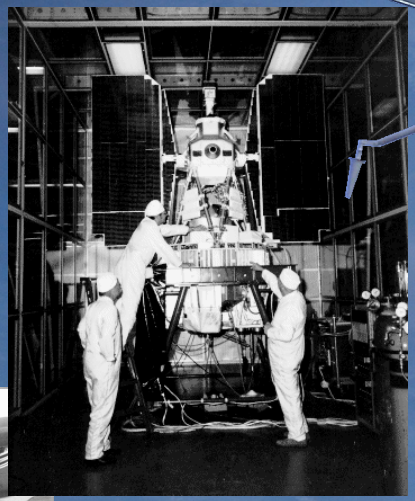
2nd Stage Separation of SpaceX Dragon CRS-10



SAGE installed on ISS

THE END





July 22, 1975