

Revisiting Solar Array String Failures on the International Space Station

A photograph of the International Space Station (ISS) in orbit above Earth. The station's complex structure, including multiple modules and large solar array wings, is clearly visible against the blue and white background of the planet. The solar arrays are arranged in a symmetrical pattern around the central hub.

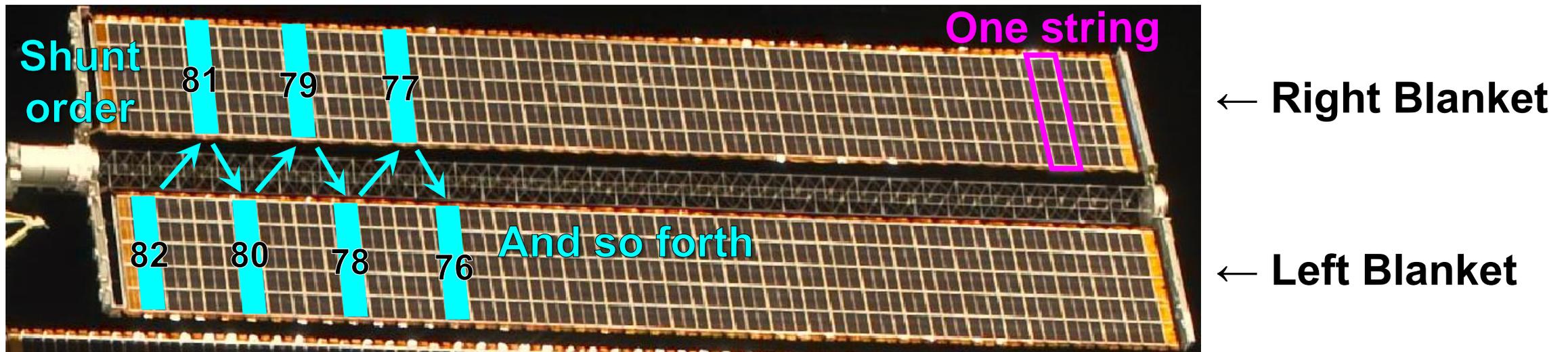
Steven Korn
NASA Glenn Research Center
Space Power Workshop 2025



Background: ISS SAW Operation



- Each of the power channels on the ISS consists of 82 solar array strings across two blankets to generate electrical power.
- When less power is needed, strings are shunted in a set order.
- A shunted string contributes no electrical power to the EPS and thus heats up due to the solar flux (conservation of energy).



All string numbering in this presentation will follow the shunt order.



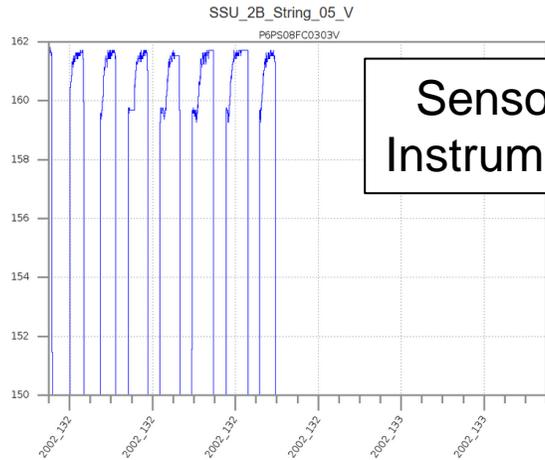
Why Identify Failed Strings?



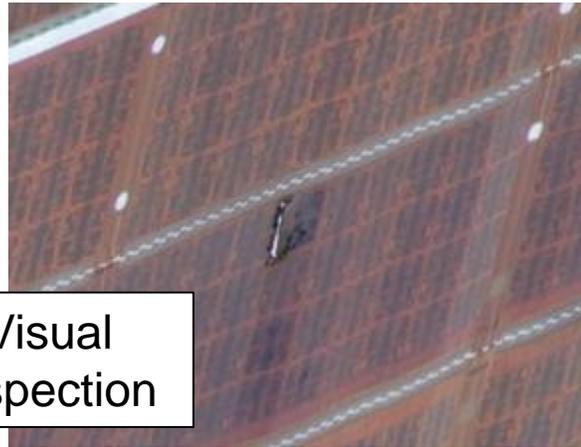
- **A failed solar array string on the ISS can cause a drop of usable electrical power by a few hundred Watts.**
- **Knowledge of string failures is needed to make accurate predictions of power capability for upcoming missions.**
 - **Power margins are getting tighter due to higher ISS utilization and older solar arrays.**
- **There are multiple methods to identify a failed solar array string. Each method has different strengths and limitations.**



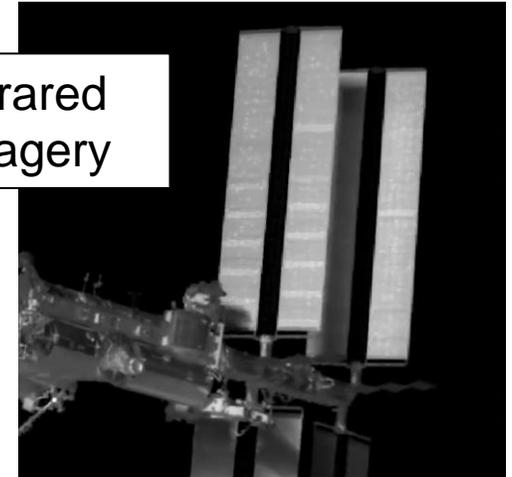
Methods to Identify Failed Strings



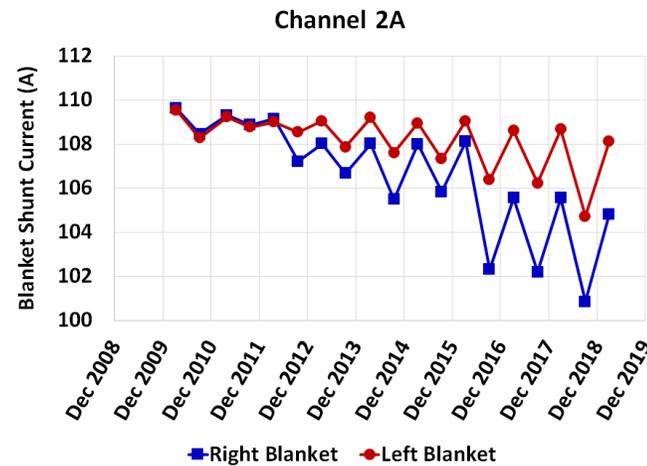
Sensors and Instrumentation



Visual Inspection



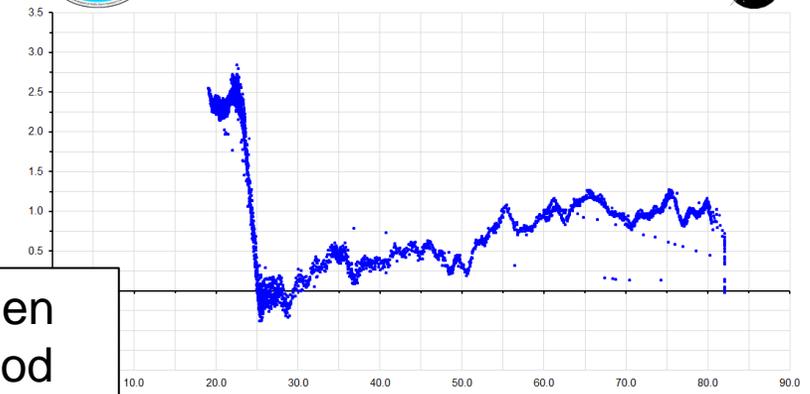
Infrared Imagery



Total and Delta Shunt Current



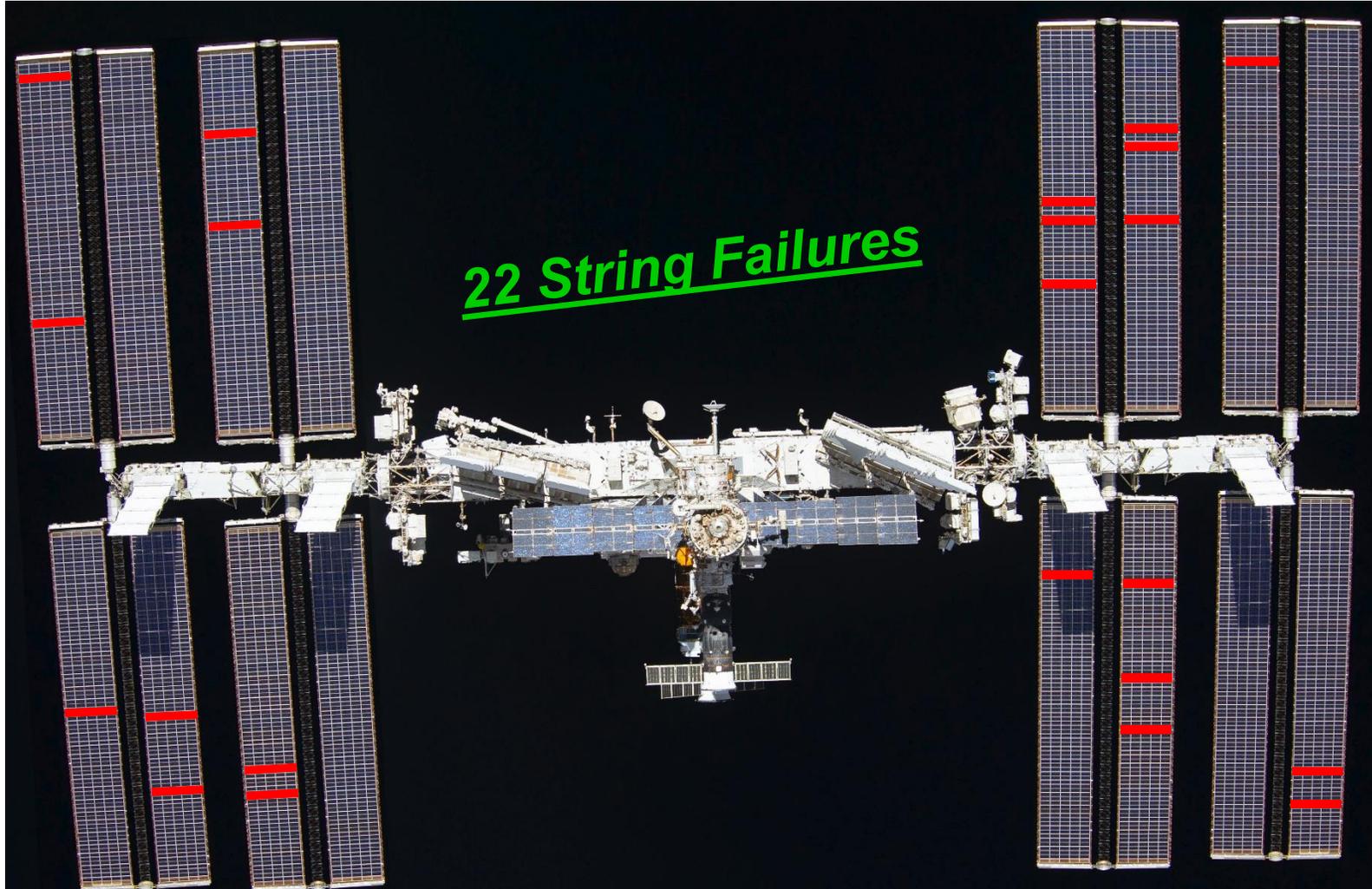
SSU 2A Shunt Current Differential
Timespan: 2018_335:00:00:00 to 2018_336:00:00:01



Whalen Method

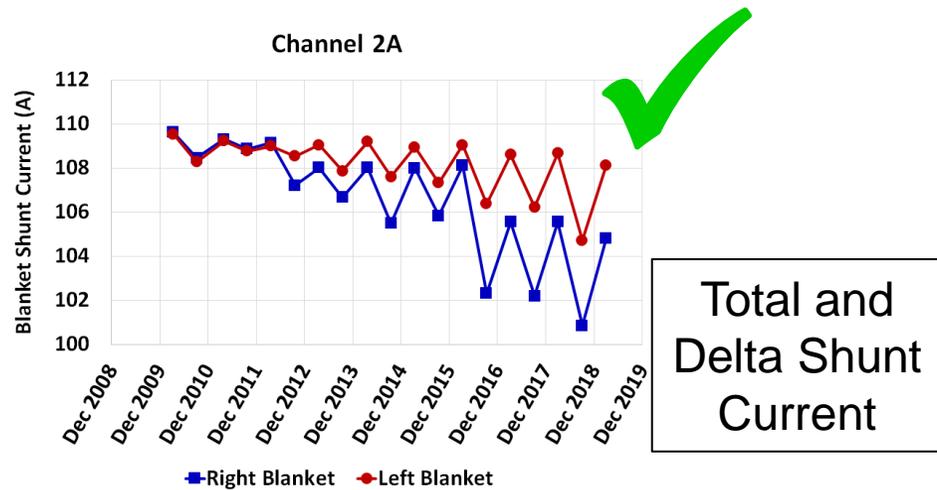
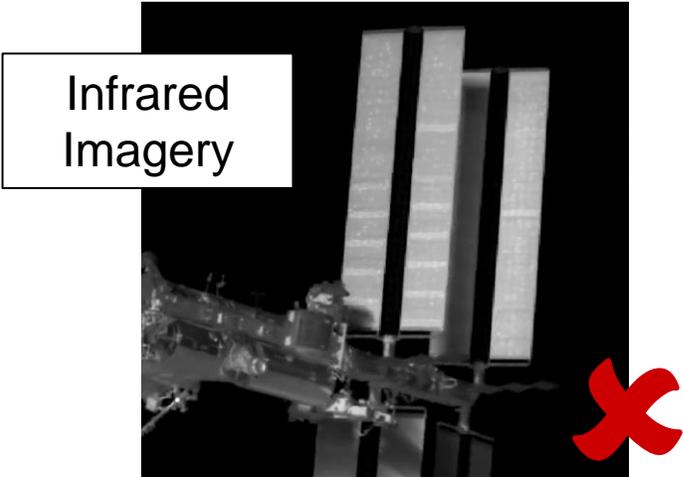
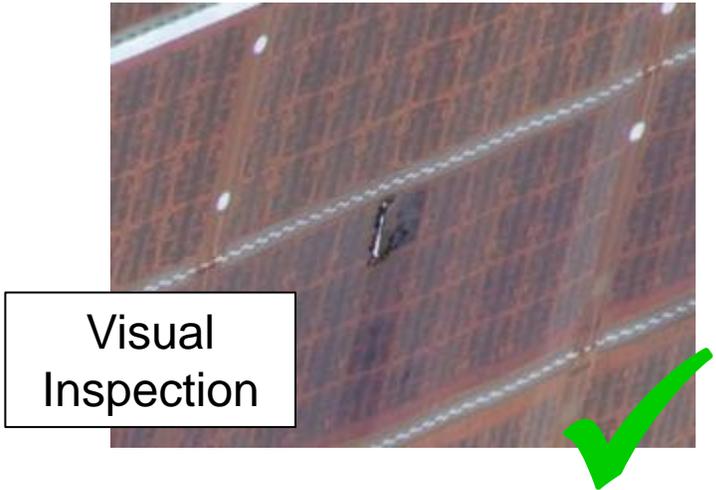
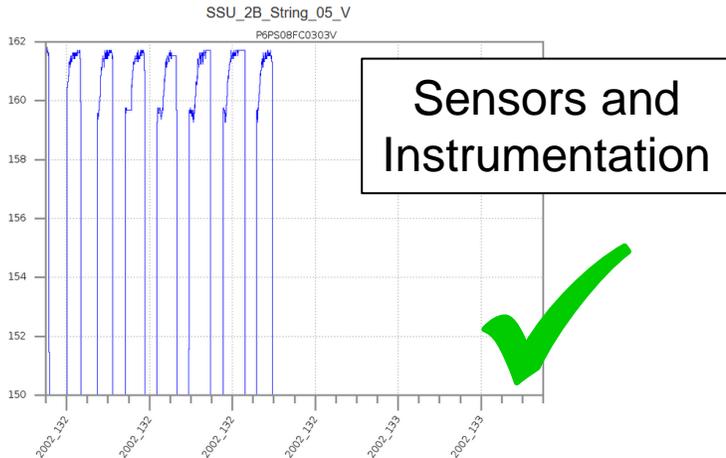


Recap of Failures through 2018





Finding Failures - Now vs. Then



But the Whalen method, however...

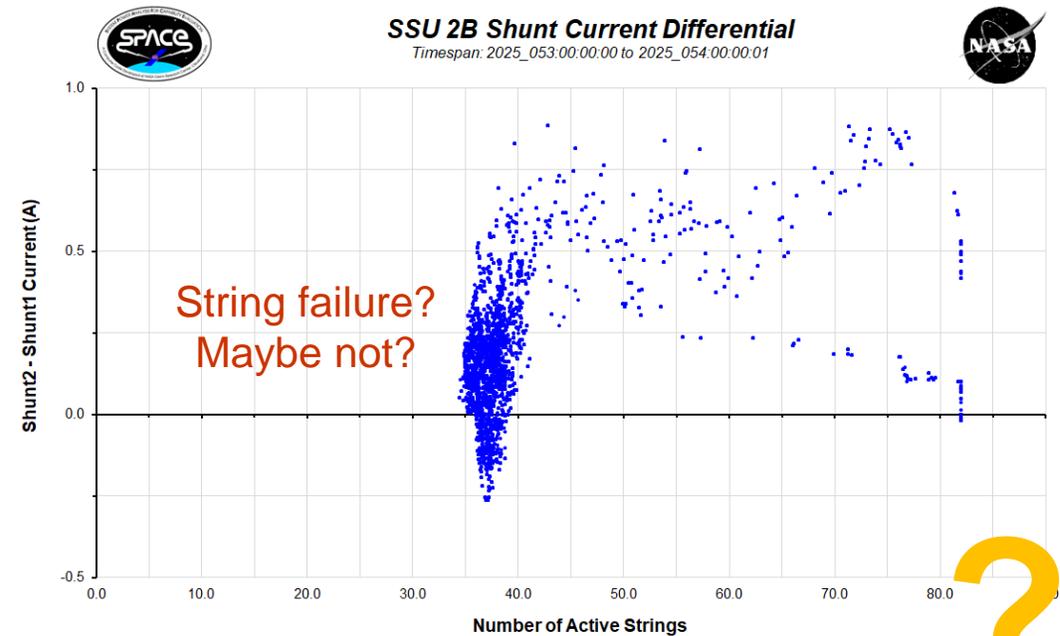
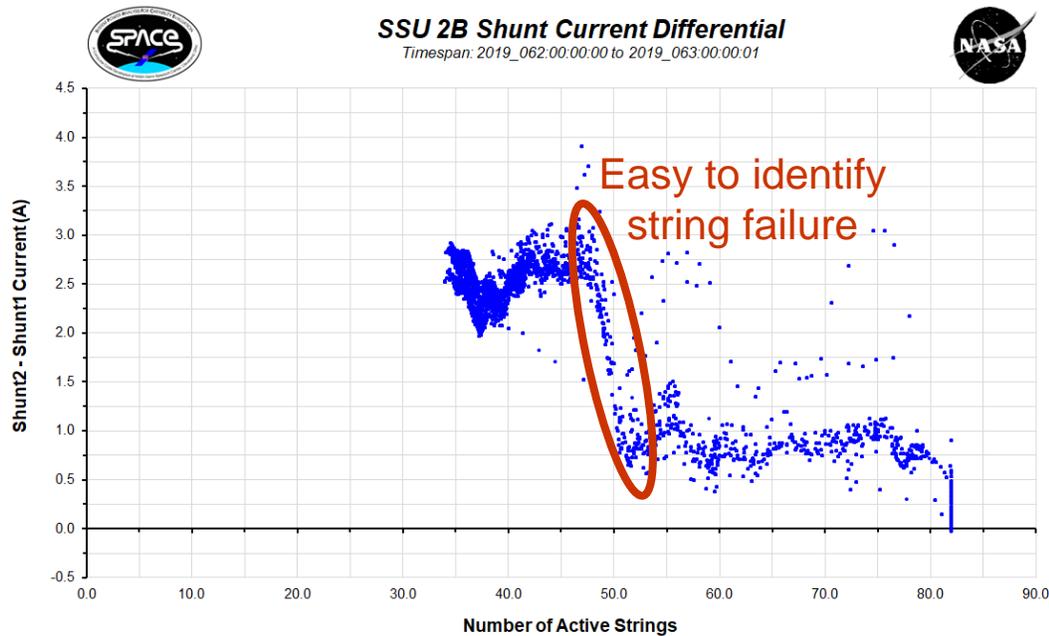


Finding Failures - Now vs. Then



2019 - March 3

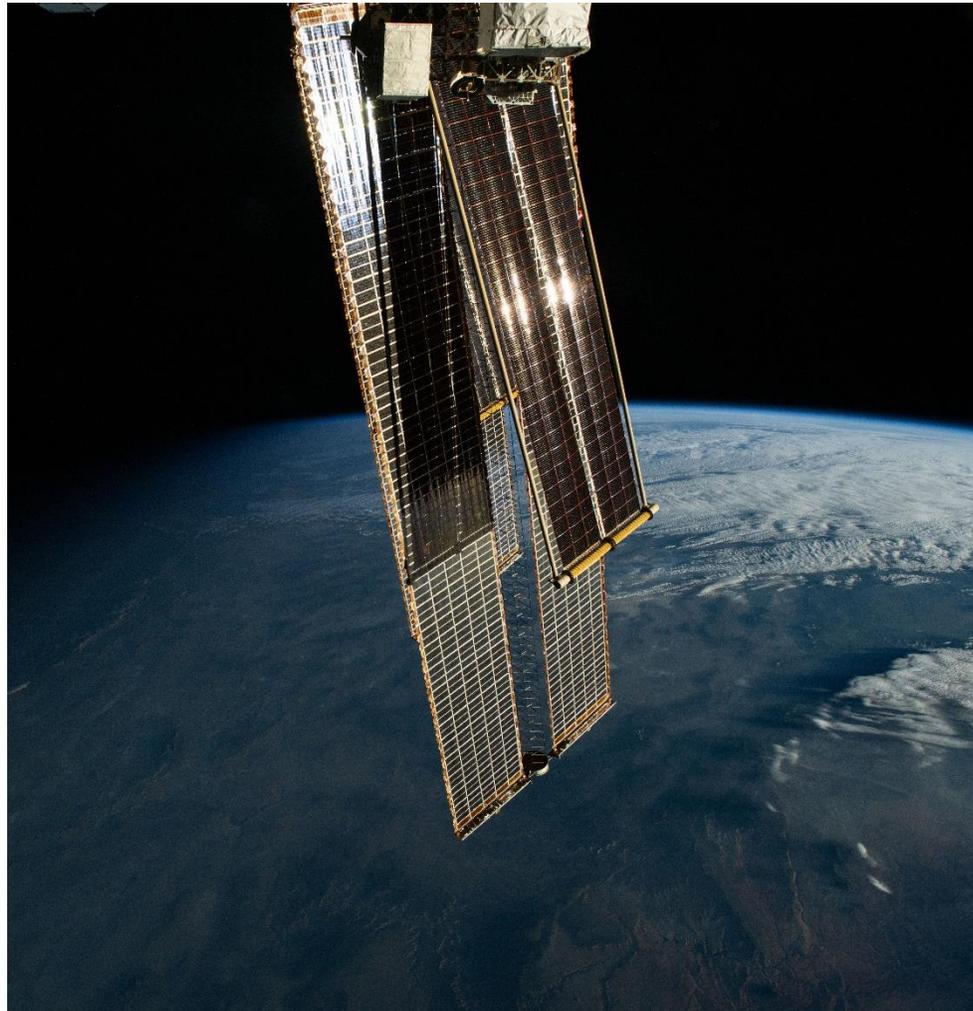
2025 - February 22



Whalen Plots are less clear than in years prior. A large reason for that is...



IROSA Installations



- **New solar arrays were installed on the ISS**
 - **Placed in front of existing solar arrays**
 - **Newer cell technology**

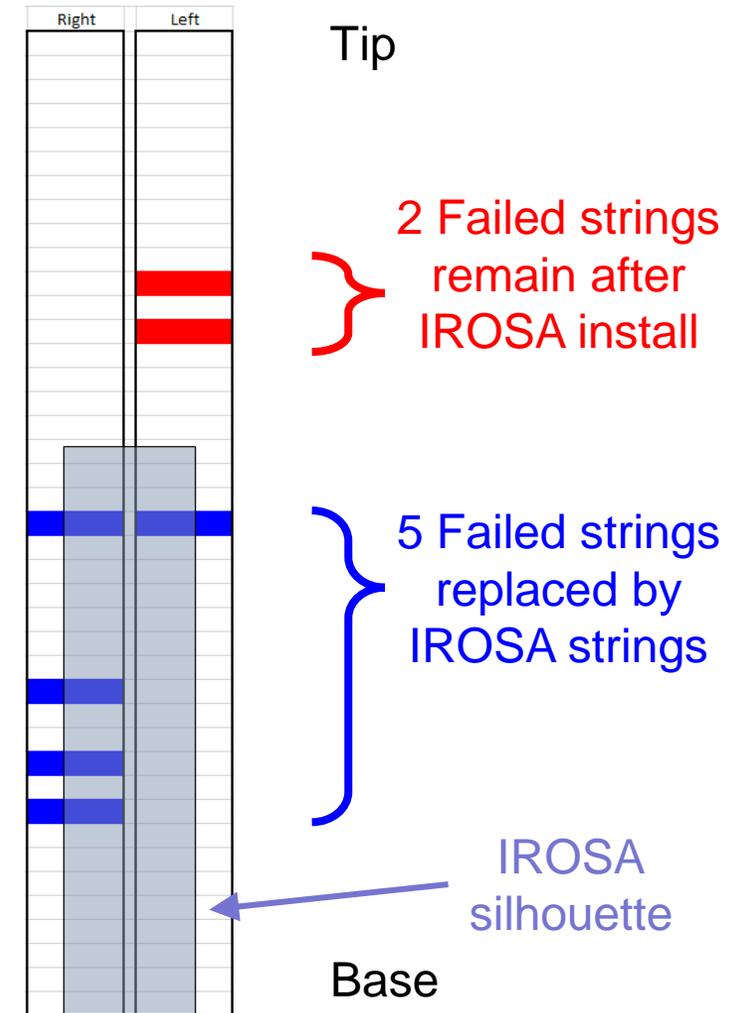
- **IROSA installations**
 - **Two in mid 2021**
 - **Two in late 2022**
 - **Two in mid 2023**
 - **Final two not yet installed**



IROSA Installations



- IROSA wings are wired into some of the existing solar array circuitry
- Some original string failures get unplugged during installation and replaced by new IROSA strings
- From the perspective of the EPS, it seems as if the string has revived



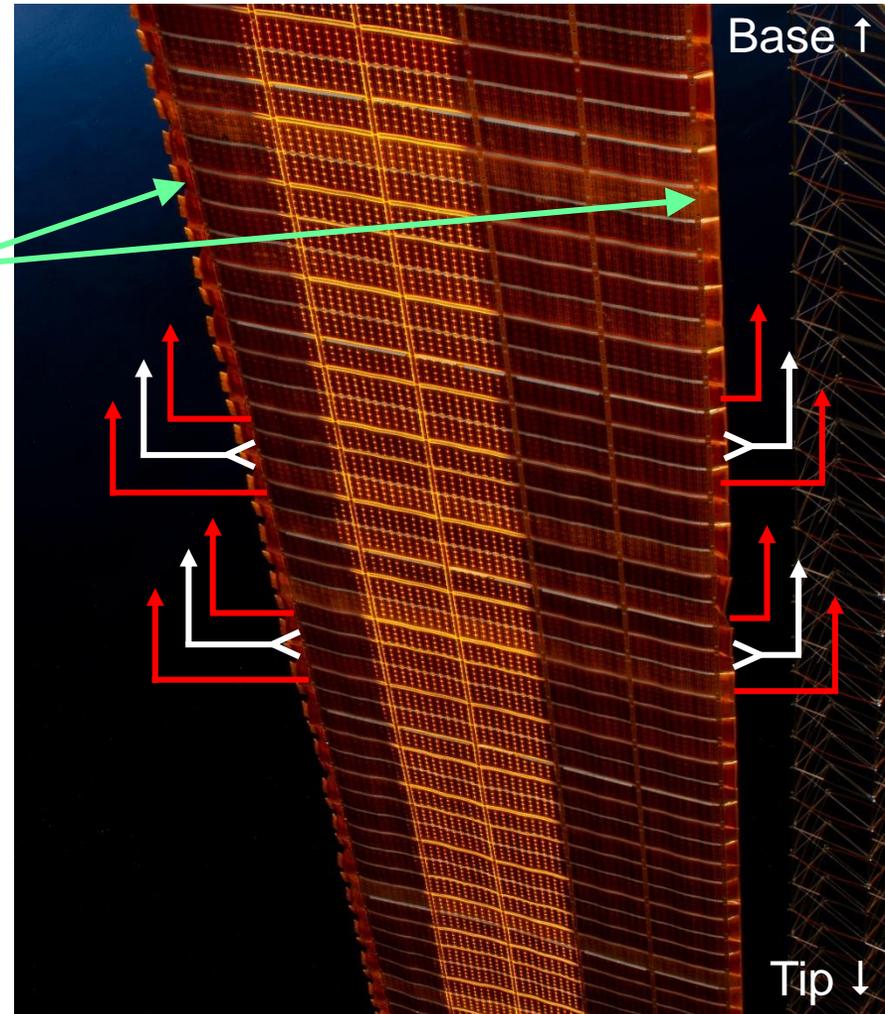


Original Solar Array Wiring



Hot and return through the ribbon cable on the sides

Each string has dedicated hot trace (red)

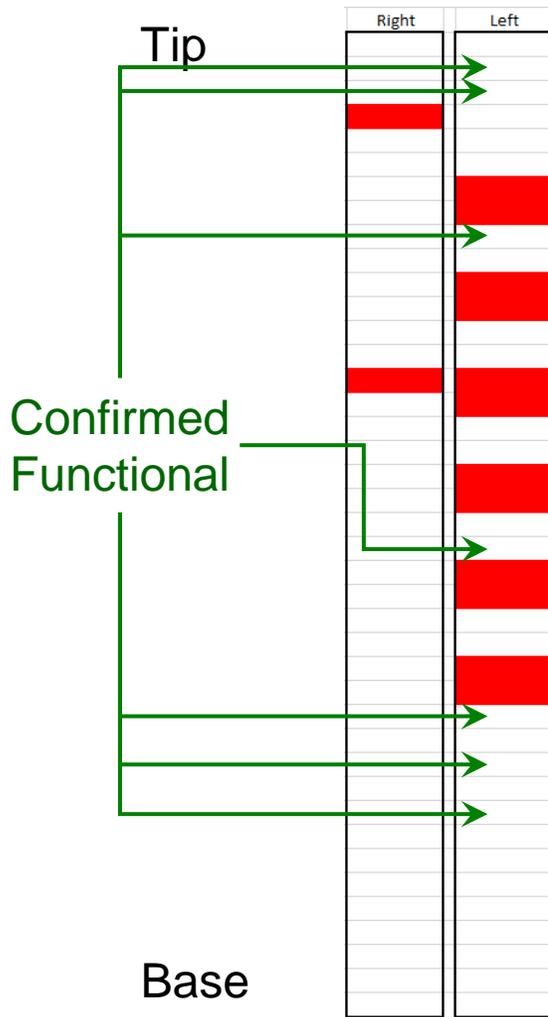


(at the base of the array)
A round cable connects to downstream EPS hardware

Two strings share a return trace (white)



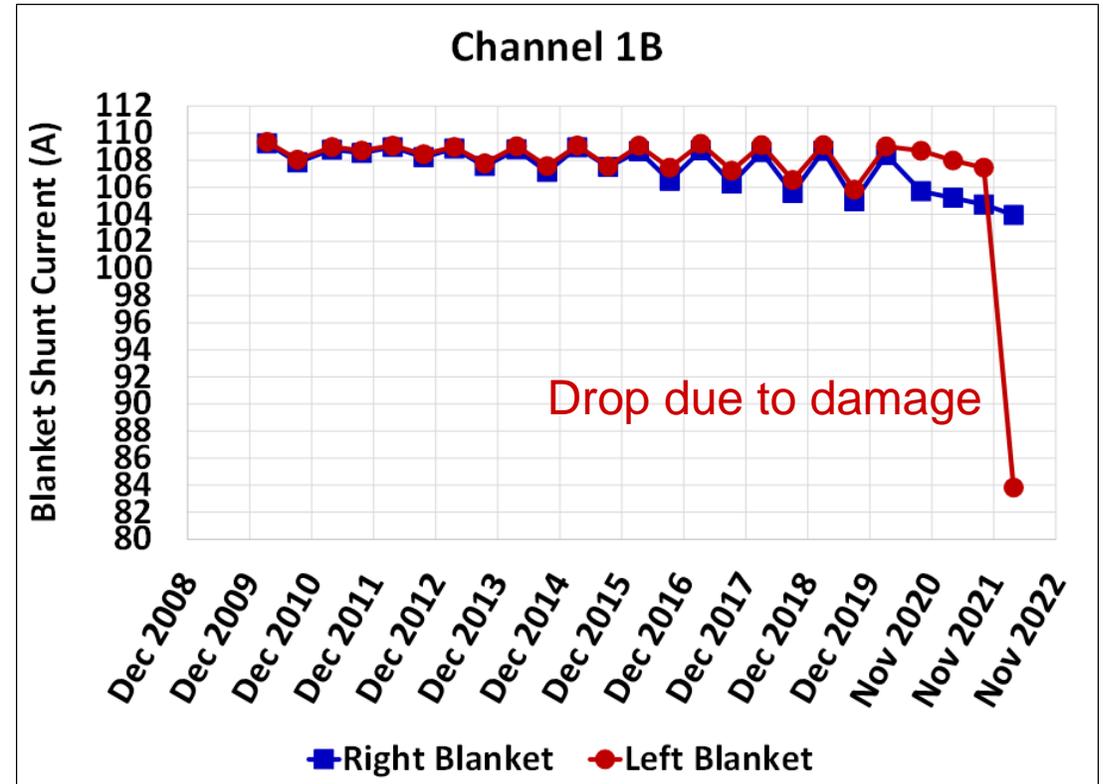
2022 String Failures, Damage



Arcing damage visible on inboard ribbon cable

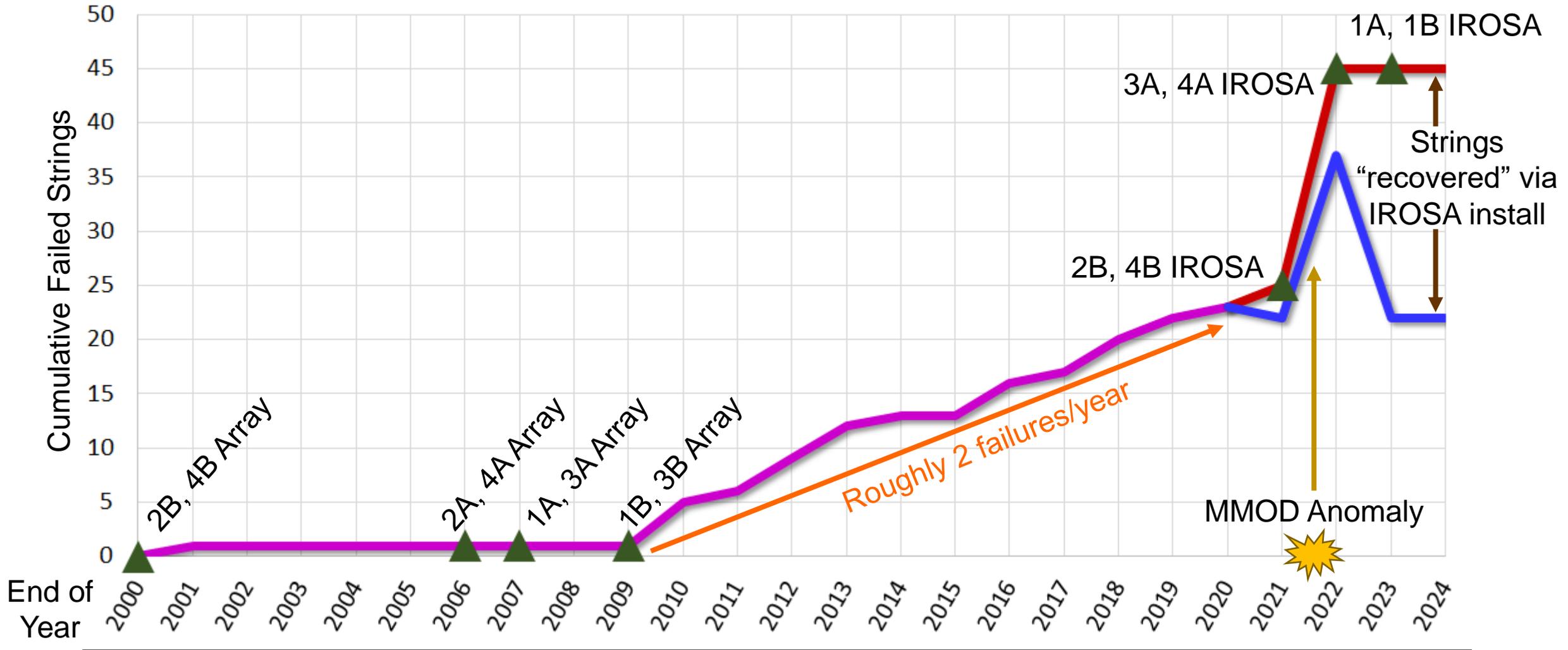
Thought to be caused by MMOD

Twelve strings now unable to contribute power



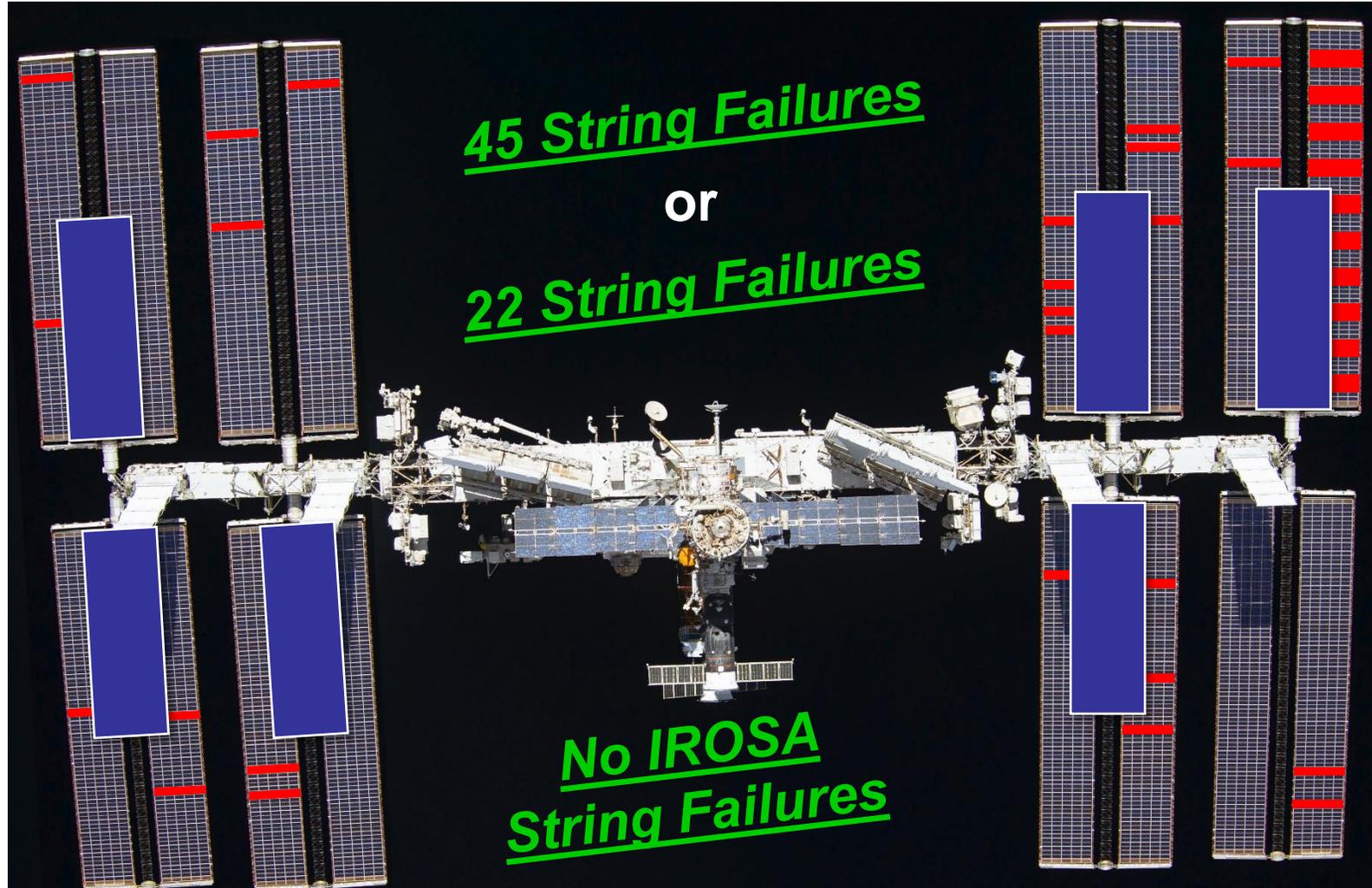


Reviewing String Failure Trends





String Failures Through 2024





Thank You



- **Sarah Tipler / NASA GRC**
- **Cindy Chapa / Boeing**
- **Israel Garza / Boeing**
- **Ann Delleur / NASA GRC (ret.)**
- **Jeff Hojnicky / NASA GRC (ret.)**
- **David Mckissock / NASA GRC (ret.)**
- **Tom Kerslake / NASA GRC (ret.)**
- **Ken Whalen / Boeing (ret.)**
- **Conference Organizers**