

A photograph of the International Space Station (ISS) in orbit above Earth. The station's complex structure, including multiple modules and large solar panel arrays, is clearly visible against the blue and white background of the planet. The text is overlaid on the left side of the image.

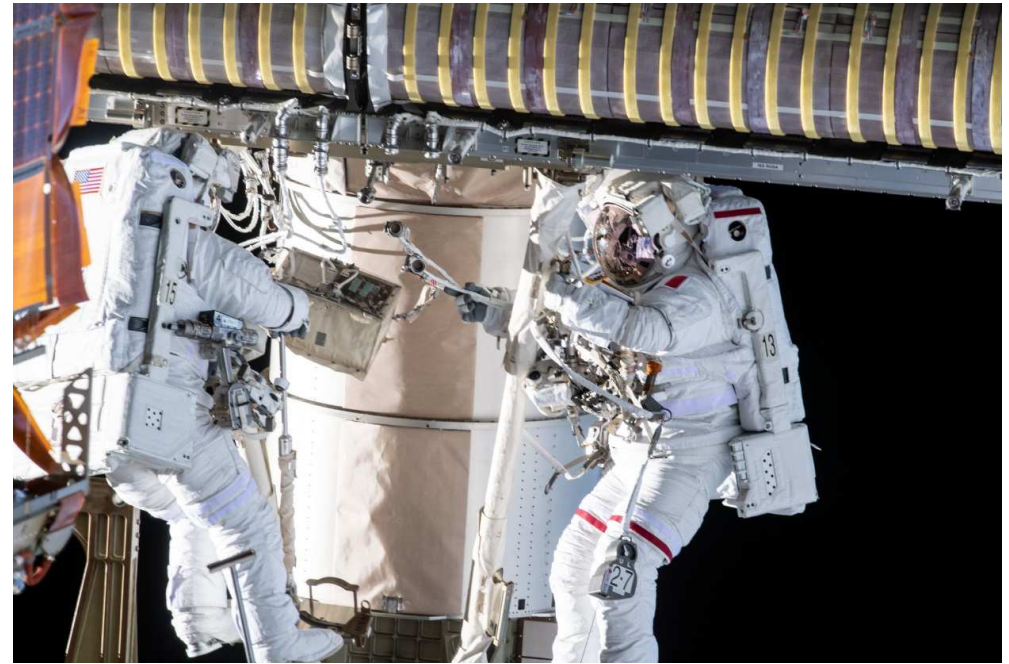
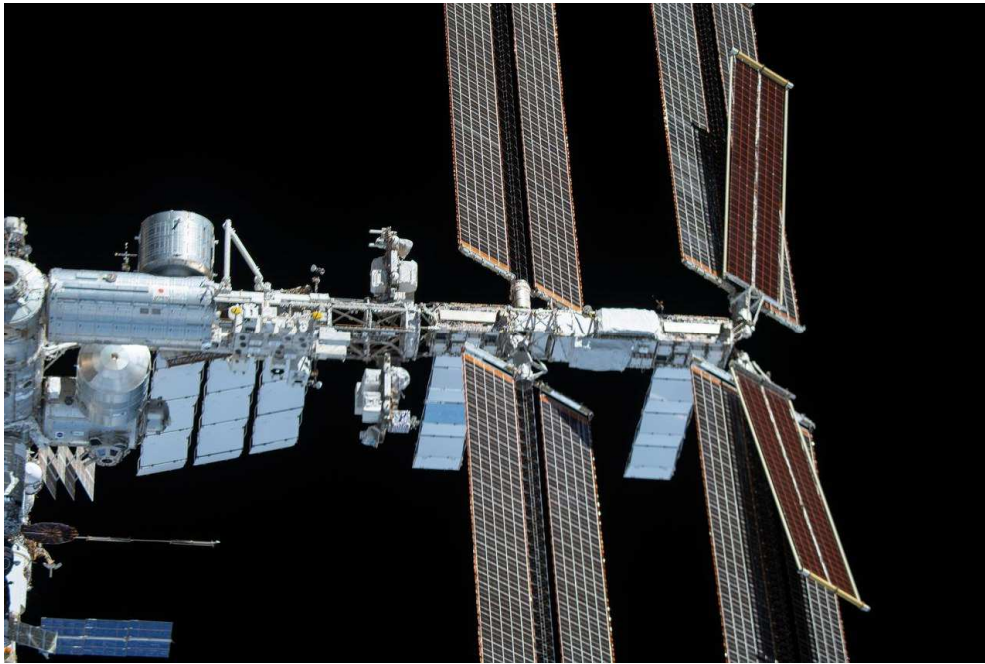
# **iROSA Computational Model Development and Integration for the International Space Station**

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NASA Glenn Research Center  
Space Power Workshop 2024**

Approved for Public Release



# iROSA Installation





# Task for SPACE-ISS Team

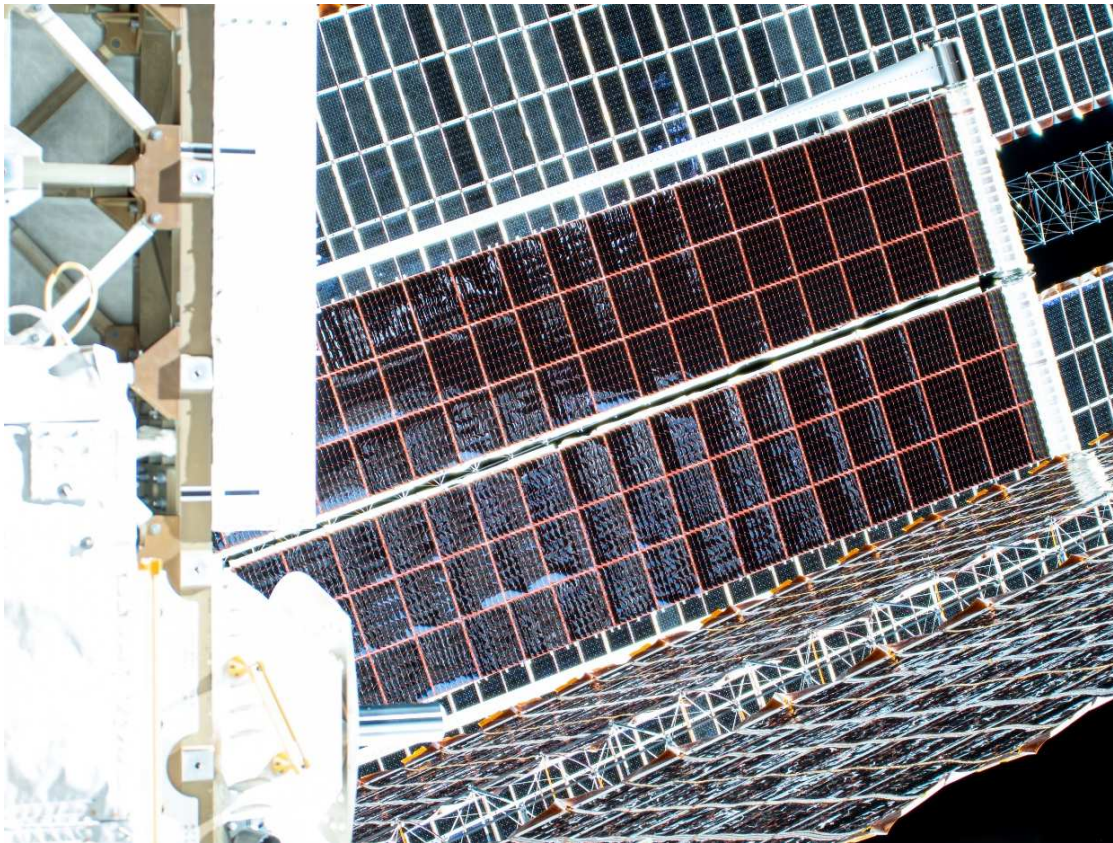


- 
- **Our team models the EPS of the ISS using SPACE.**
  - **Therefore, we needed to develop and integrate the iROSA into our model.**
    - **Building up iROSA power calculations**
    - **Developing new shadowing methodologies**
    - **Integrating the changes into our model**
    - **Evaluate the completed model ahead of flight**





# New Cells and Layout



Different Solar Cell  
IV Curve

Different Solar  
Cell Size

Different  
Degradation Rates

Different Temperature  
Coefficients

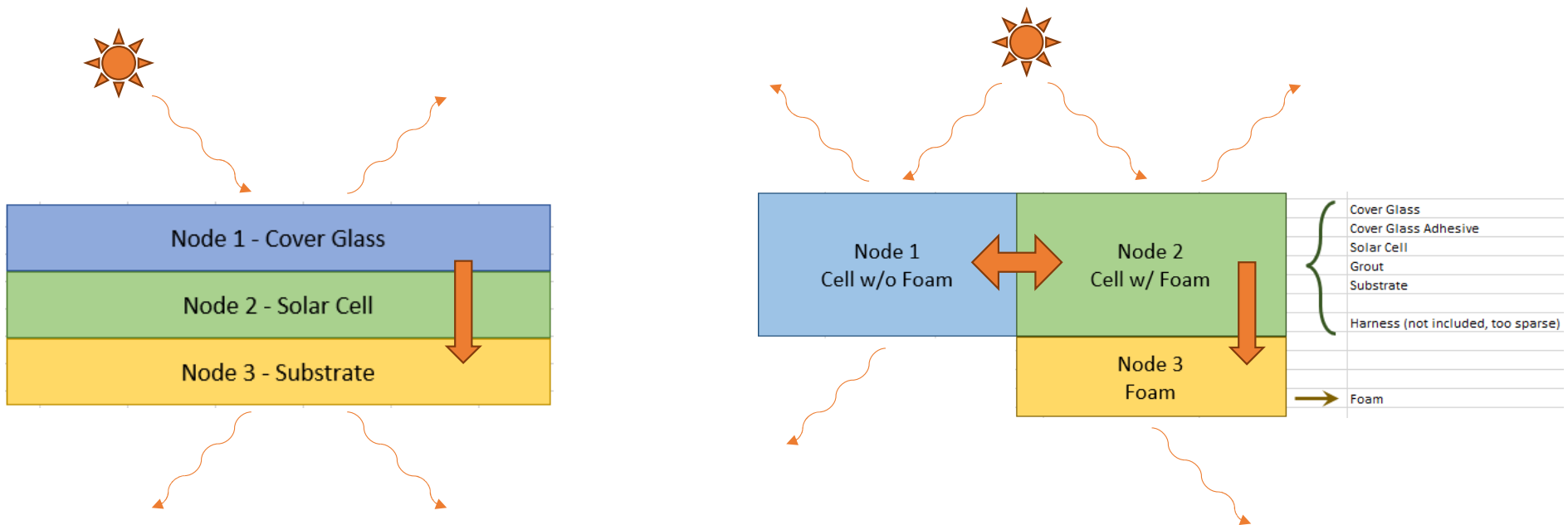
Different Harnessing  
Resistances

Different Solar Absorptance  
and Emittance

Different Number  
of Cells per String



# Different Thermal Model

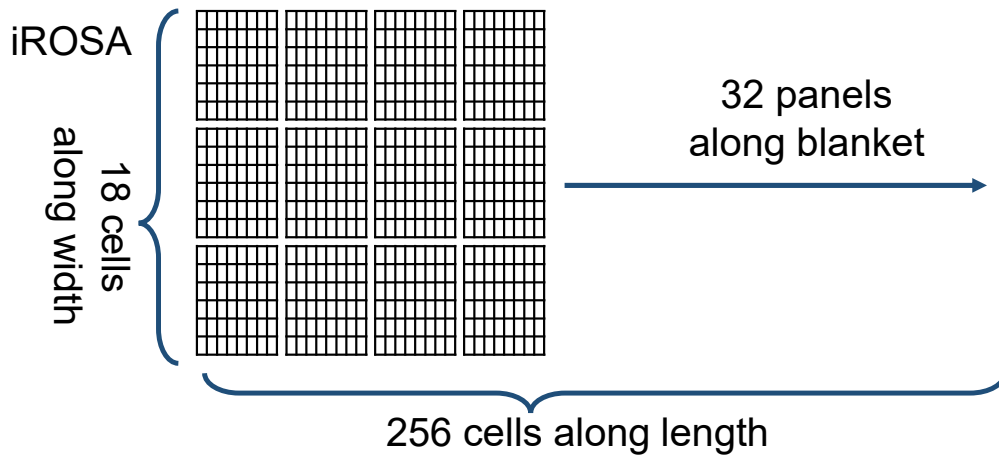
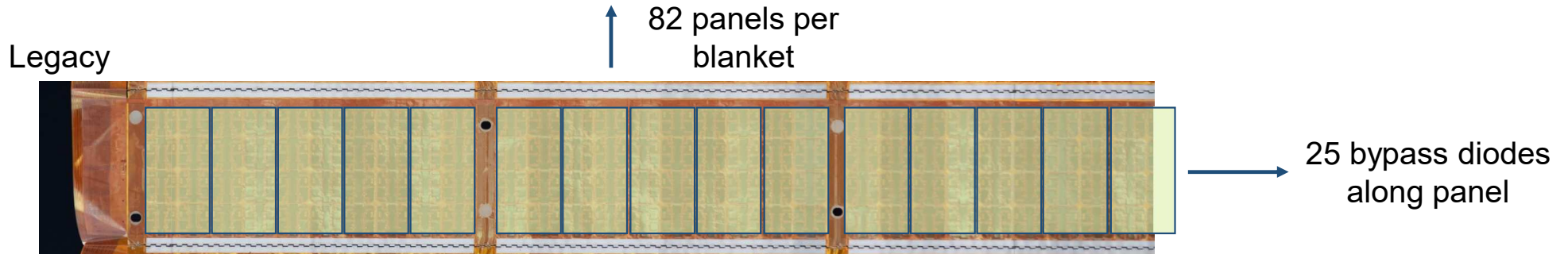


Traditional Node Design

iROSA Node Design



# New Shadowing Algorithms



Legacy Blanket:  
25 bypass diodes per panel  
82 panels per blanket

iROSA Blanket:  
18 x 256 bypass diodes per blanket



# String Mapping



Number	Right	Left	Number
41			82
40			81
39			80
38			79
37			78
36			77
35			76
34			75
33			74
32			73
31			72
30			71
29			70
28			69
27			68
26			67
25			66
24			65
23			64
22			63
21			62
20			61
19			60
18			59
17			58
16			57
15			56
14			55
13			54
12			53
11			52
10			51
9			50
8			49
7			48
6			47
5			46
4			45
3			44
2			43
1			42

iROSA strings replace Legacy strings nearest the base of the array

32	64	96	128	160	192
31	63	95	127	159	191
30	62	94	126	158	190
29	61	93	125	157	189
28	60	92	124	156	188
27	59	91	123	155	187
26	58	90	122	154	186
25	57	89	121	153	185
24	56	88	120	152	184
23	55	87	119	151	183
22	54	86	118	150	182
21	53	85	117	149	181
20	52	84	116	148	180
19	51	83	115	147	179
18	50	82	114	146	178
17	49	81	113	145	177
16	48	80	112	144	176
15	47	79	111	143	175
14	46	78	110	142	174
13	45	77	109	141	173
12	44	76	108	140	172
11	43	75	107	139	171
10	42	74	106	138	170
9	41	73	105	137	169
8	40	72	104	136	168
7	39	71	103	135	167
6	38	70	102	134	166
5	37	69	101	133	165
4	36	68	100	132	164
3	35	67	99	131	163
2	34	66	98	130	162
1	33	65	97	129	161

Need to map via the shunt order

### 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).

Shunt order

One string

And so forth

← Right Blanket

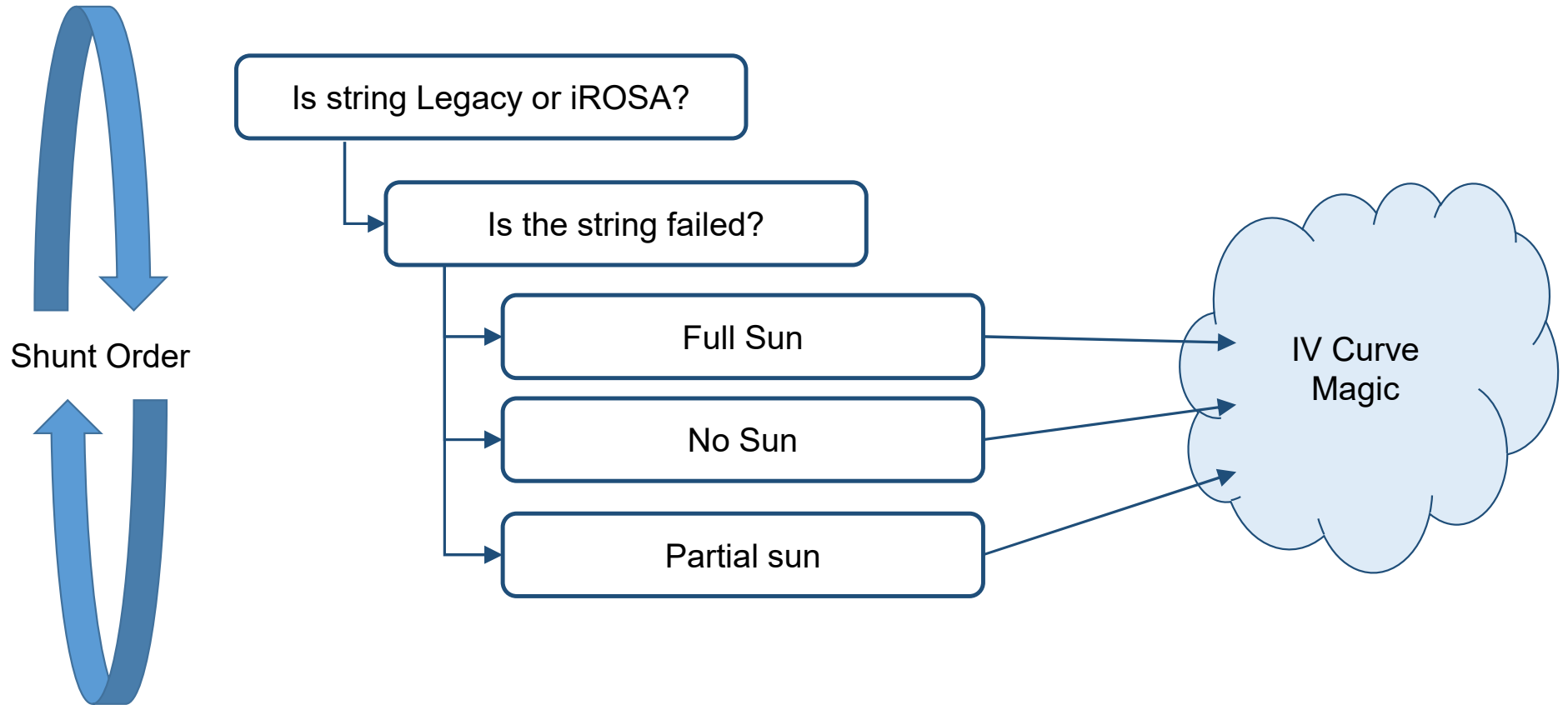
← Left Blanket

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

See 2019 SPW presentation



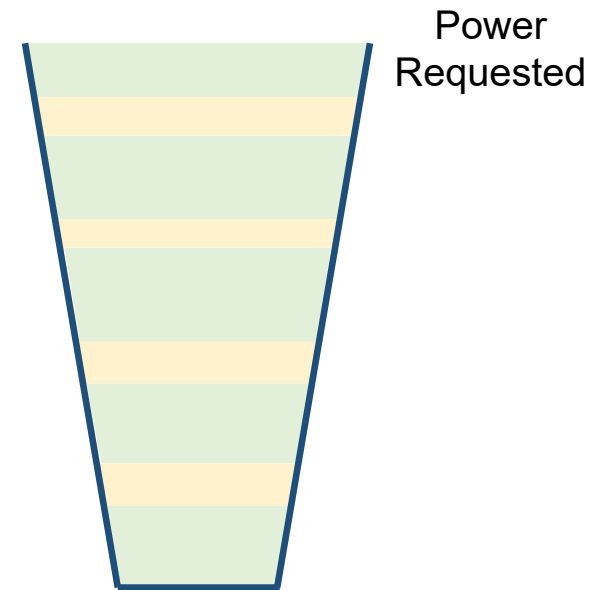
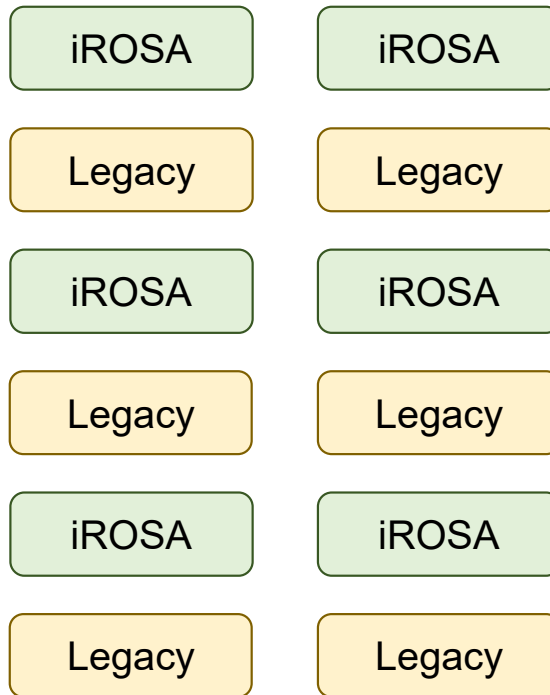
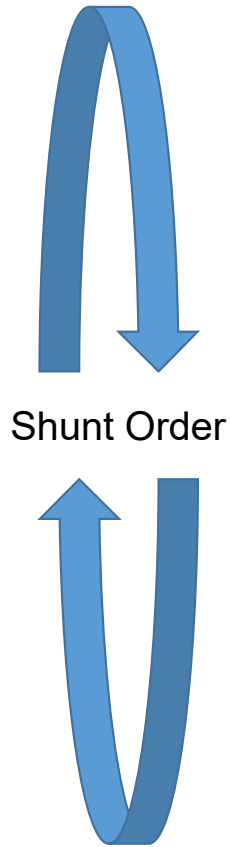
# Calculating Power Correctly







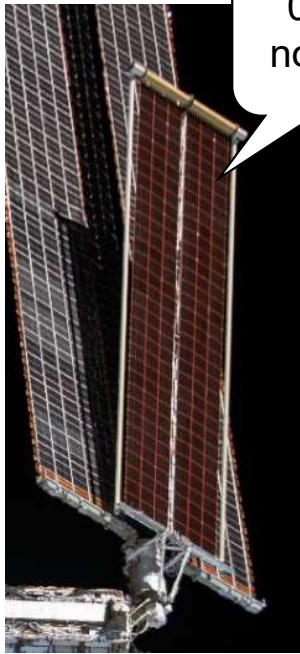
# Calculating Power Correctly



*Everything left is shunted*

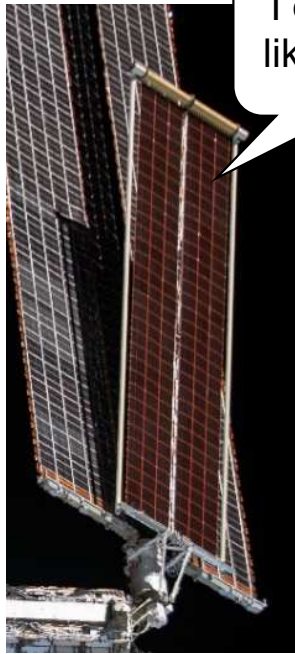


# Model Checkout - Fun Bugs



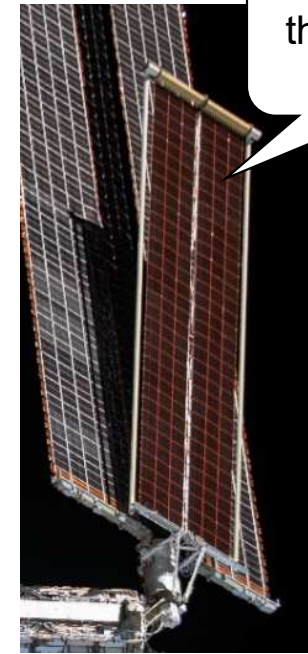
OK is not OK

iROSA Temperatures below Absolute Zero



I don't feel like it today

Negative power while in the Sun



Stick it where the Sun don't shine?

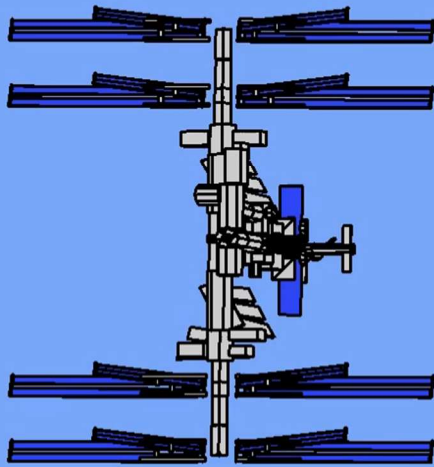
Cant in the wrong direction (some of them)



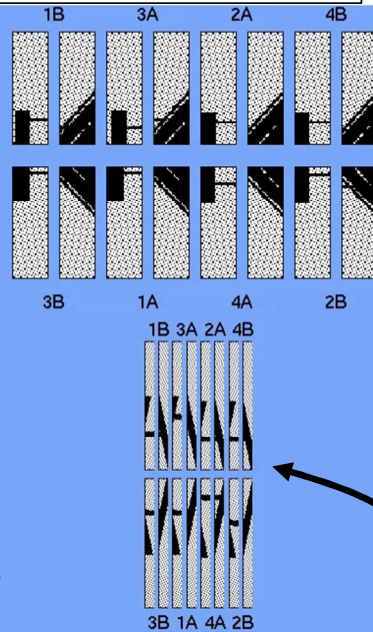
# Model Checkout - Most Fun Bug



View of ISS as if you were looking from the Sun



Shadow patterns on Legacy Solar Arrays



Frame Counter: 1

Orbit Counter: 1

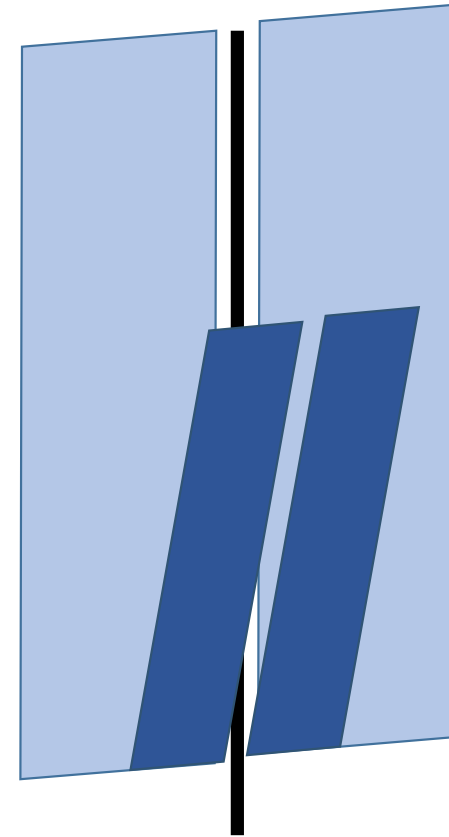
DAWN

NOON

DUSK

Timeline through insolation

iROSA shadow patterns  
Watch here

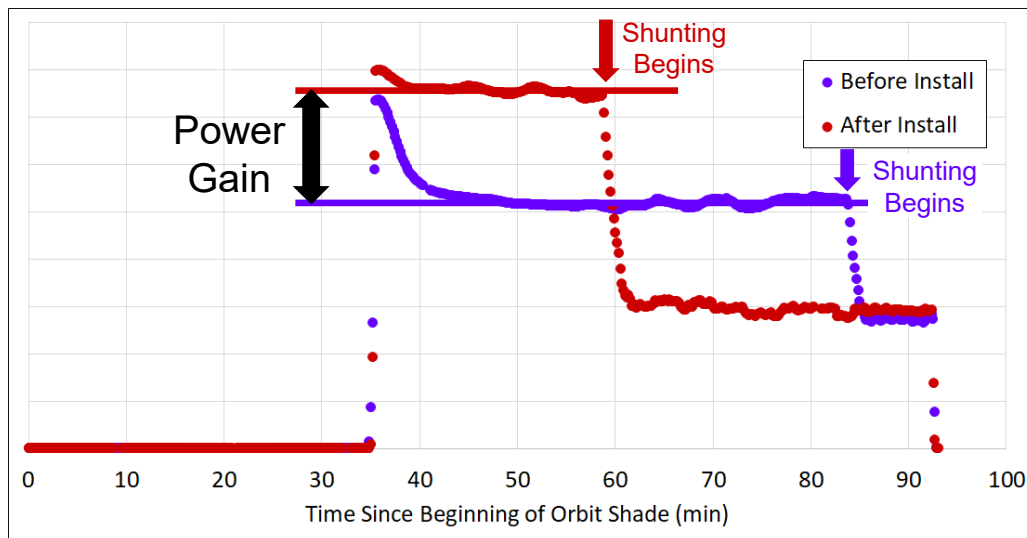




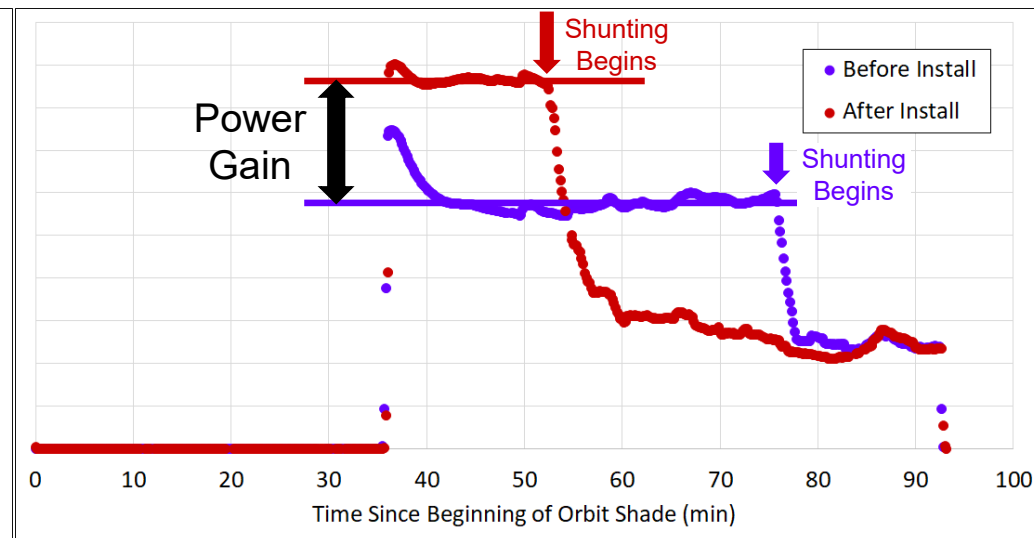
# Gains in Power Generation



First iROSA (Jun 2021)



Second iROSA (Jun 2021)



*Power Gain from Initial iROSA:*

*Nominally 5-7 kW*

*Best case 7-9 kW*

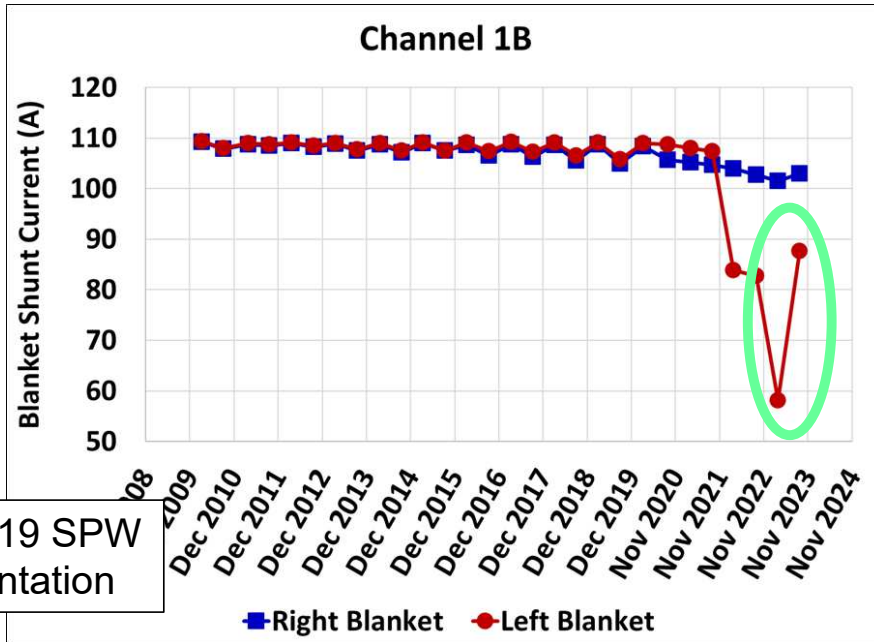




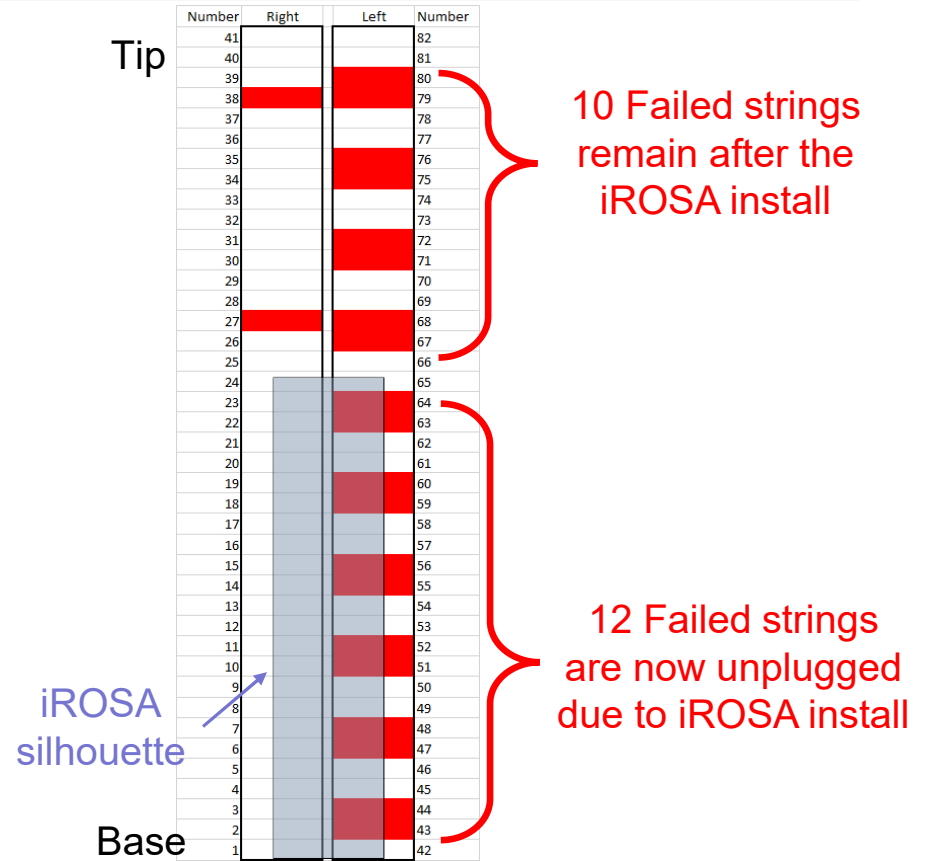
# Restoring Lost Circuitry (kinda)



- Some of the legacy string failures went away

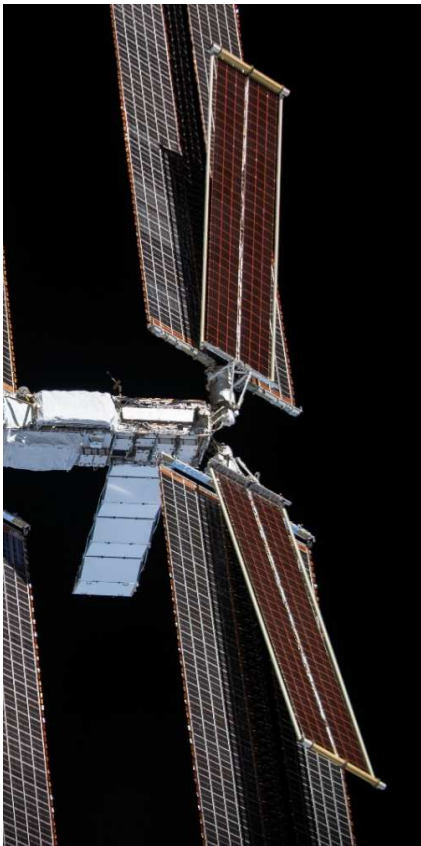


See 2019 SPW presentation

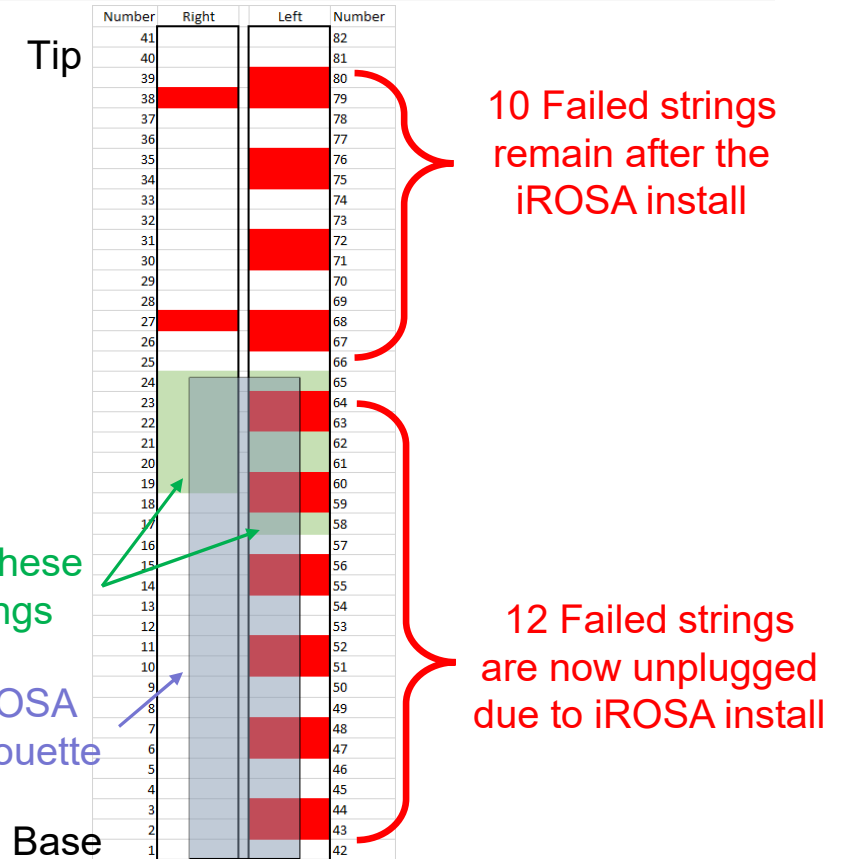




# Opportunity for Even More Power



- An off-pointed array lets some light around the side of iROSA onto legacy strings.
- Could we unplug the 10 failed strings near the tip and wire in different legacy strings to get some additional power?
- Yes. It requires more rewiring on EVA, but could give a bit more power.





# Thank You



- 
- **Ann Delleur / NASA GRC**
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  - **Stuart Wodzro / NASA GRC (former)**
  - **Caroline Austin / NASA GRC (former)**
  - **David Mckissock / NASA GRC (ret.)**
  - **David Hoffman / NASA GRC (ret.)**
  - **Tom Kerslake / NASA GRC (ret.)**
  - **Conference Organizers**
-