Developing Exploration Technologies on the International Space Station (ISS)

Advanced Solar Arrays on the ISS

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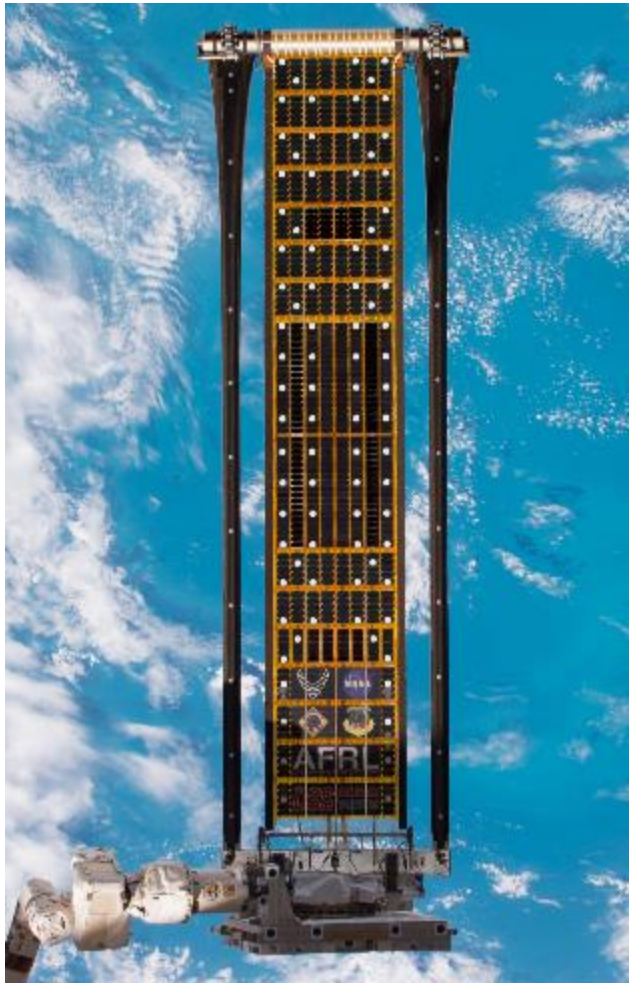
Roll-Out Solar Array (ROSA)

- The technology for the new ISS solar arrays will be a larger version of the Roll-Out Solar Array (ROSA) that was tested on the space station in June 2017. The successful prototype demonstrated the mechanical capabilities of solar array deployment successfully.

- ROSA is an innovative new solar array design that uses high strain one-piece carbon fiber composite slit-tube booms. The stored strain energy of the booms provides the deployment actuation. Once deployed the booms provide the array's structural stiffness and strength.

- The flight experiment characterized the performance of an array in a relevant space environment to compare to scalable model predictions and on-ground test data. The data were used to fully develop the structural models for future spacecraft applications and higher power levels.

- ROSA significantly improves the power density, stowage efficiency, and scalability over current rigid panel array technology.



How many new arrays?

- Upgrading all 8 power channels would provide the most operational flexibility for the program
- Performed a thorough power analysis considering loads supportability
  - Core loads including crew and cargo vehicles
  - Payloads at all beta ranges
  - Russian segment transfer at agreed to levels
  - Commercial Module

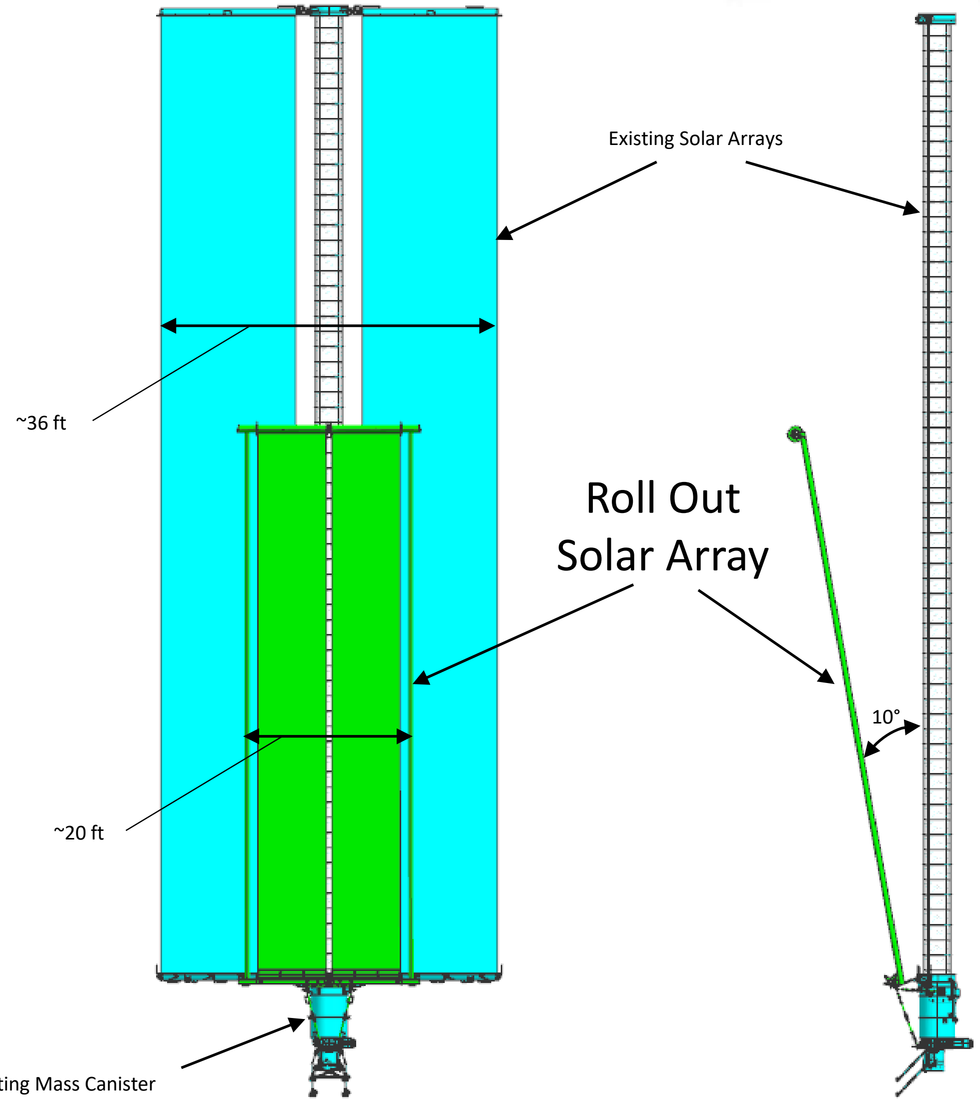
- Upgrading 6 channels is the minimum amount required to avoid negatively impacting ISS operations

- Supplied by
  - The Boeing Company
    - Deployable Space Systems (DSS) - array
    - Spectrolab – solar cells

The new arrays will contribute to commercializing low earth orbit and provide the ISS with enough power to continue doing scientific research and spaceflight operations at the full capability of the orbiting laboratory

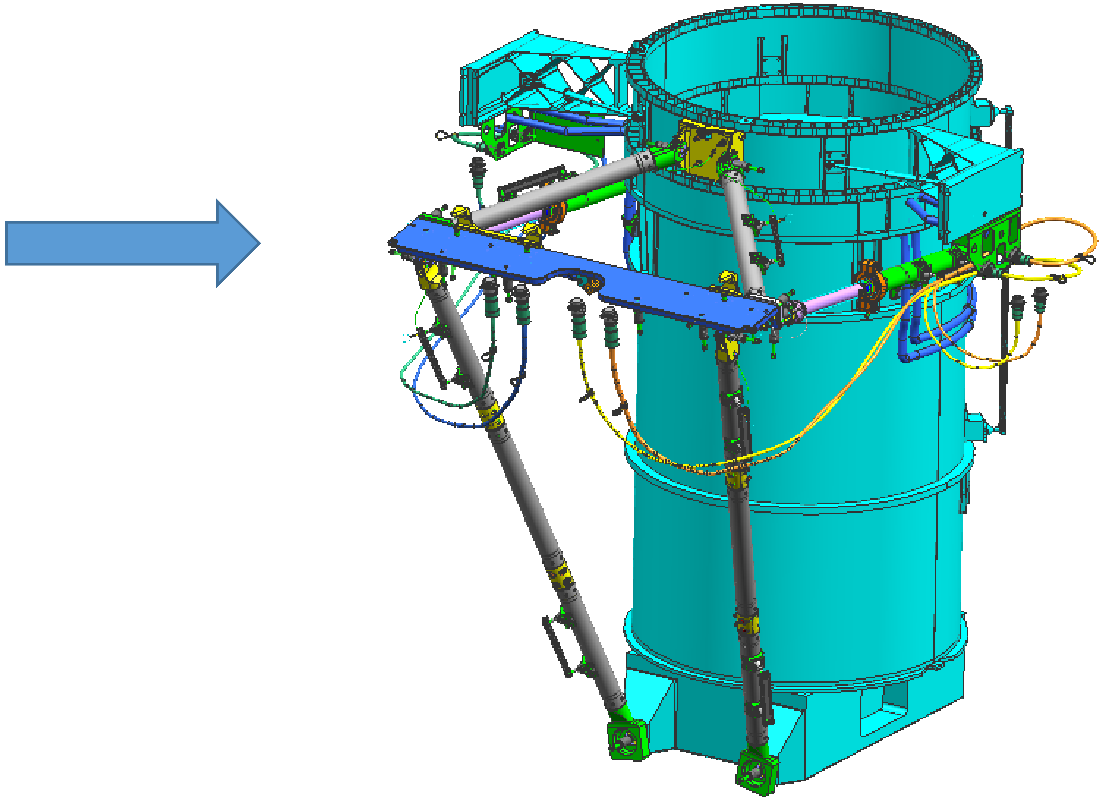
ISS Roll Out Solar Array(iROSA) overview

- iROSA will be positioned in front of the legacy solar arrays
  - Attaching to the existing Beta Gimbal Assembly (BGA) allows use of existing sun tracking, power distribution, and channelization
  - Shadowing approximately two-thirds of the legacy arrays and connected to the same power system to augment the existing supply
    - Un-shadowed portion of legacy array remains active
  - The two arrays are electrically combined and both provide power to the ISS resulting in an increase in power performance compared to the legacy ISS solar array
  - Each iROSA will produce more than 20 kilowatts of power, totaling 120 kilowatts of augmented power.



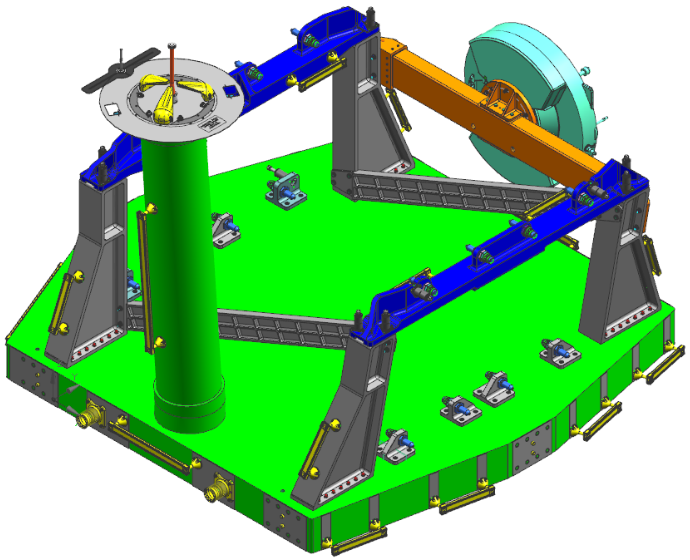
Preparing the Worksite

- Modification Kit
  - Launched in pressurized cargo volume
  - Extra Vehicular Activity (EVA) installed, attaches to mast canister lifting pad interfaces
  - Provides mounting location for iROSA

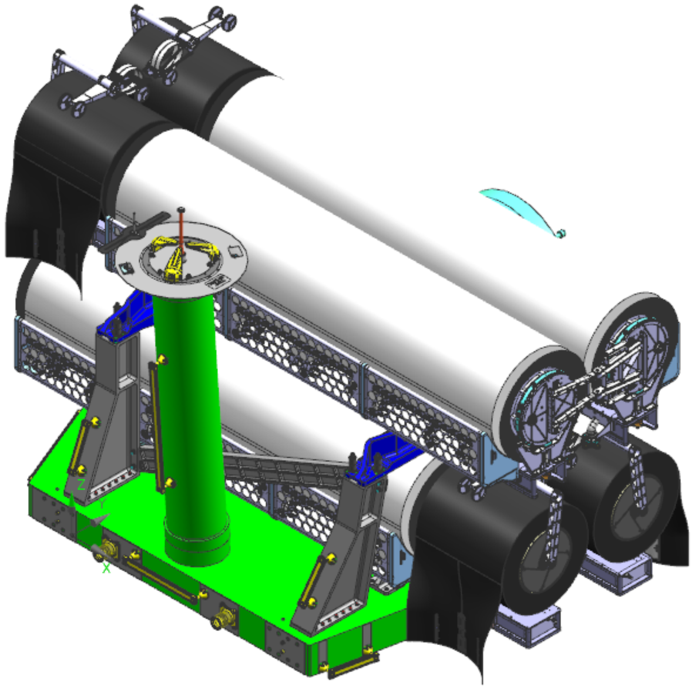


iROSA Launch Configuration

- In pairs, the solar arrays will be delivered in the trunk of 3 SpaceX cargo vehicles starting as early as 2021
- Once on orbit, the ISS robotic arm removes carrier from the Dragon trunk and temporarily stows it



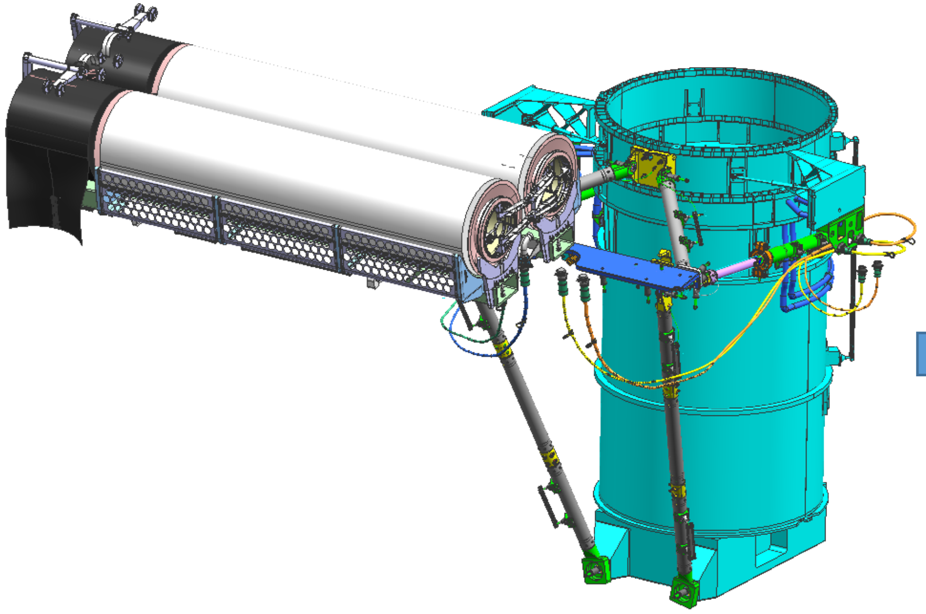
Deployable Carrier



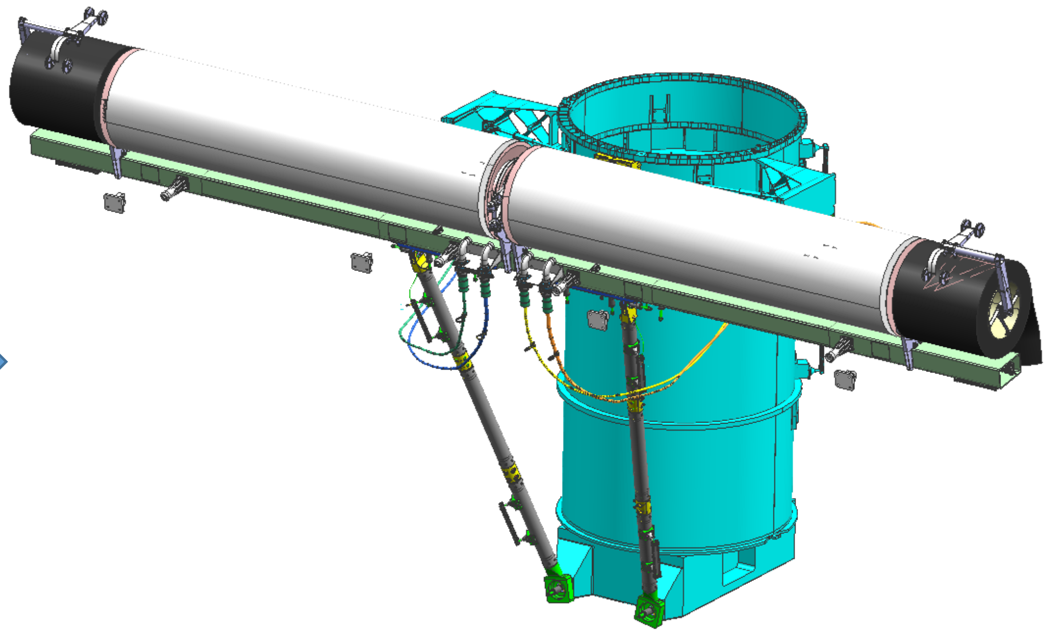
2 arrays per carrier

iROSA Mechanical Design Overview

- 6.5” diameter carbon fiber booms, aluminum root structure
- Hinge in middle to accommodate launch configuration

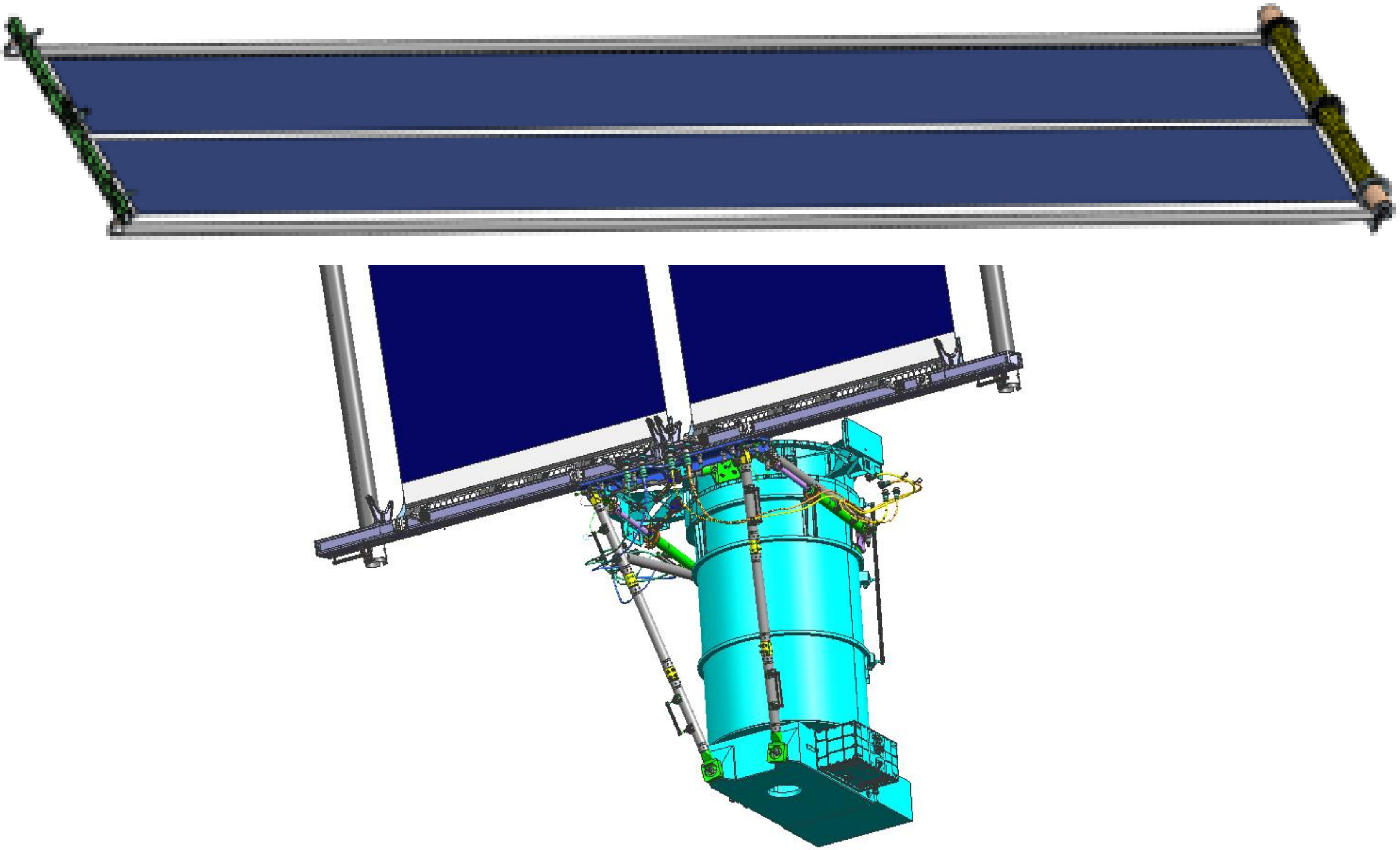


iROSA in the staged configuration mounted to the Modification Kit



iROSA ready to deploy from this configuration

iROSA Mechanical Design Overview (continued)

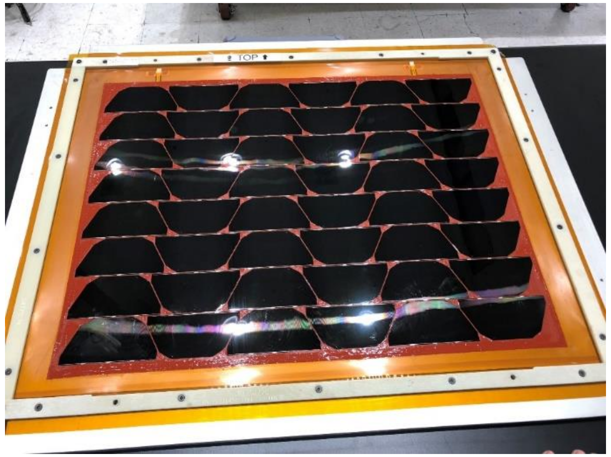


- iROSA in the deployed configuration once the wing has completely deployed and tensioned

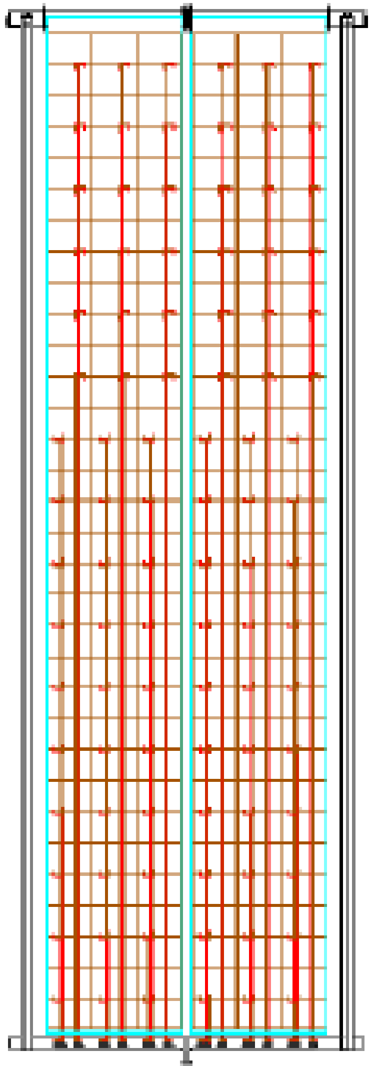
iROSA Electrical Design Overview

- iROSA generation >20kW on-orbit after 10-years
- Spectrolab Next Triple Junction XTJ Prime solar cells
- BOL Efficiency 30.7% efficiency (legacy ISS cells 14.2%)
  - 73.81-cm2 active area, 140 µm w/ 100 µm coverglass
- 48 series-interconnected-cells per SPM (2 SPMs per string)
  - Vmp >160V EOL circuitry 96-cells per string
- Heritage blocking diode boards with all welded construction
- 6-columns X 8-rows orthogonal pattern
- Discrete flex harness for SPM's, all-welded construction
- All strings routed to diode boards located on root structure where circuits are grouped to electrical connectors

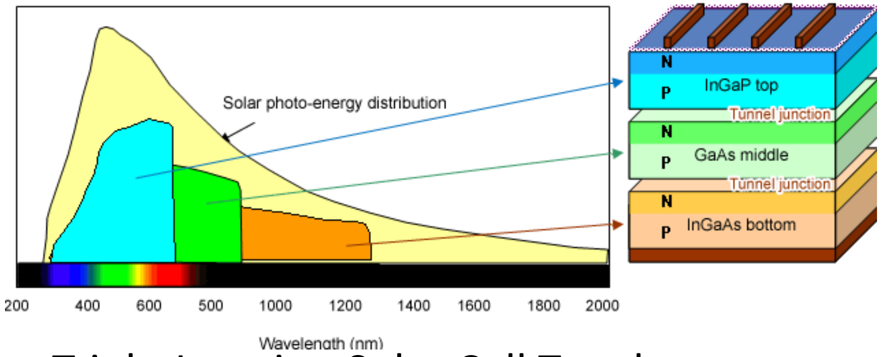
XTJ Prime Solar Cell



Solar Power Module (SPM)



Flex Harness Layout



Triple Junction Solar Cell Topology