Launch your Vision

2023 Space Power Workshop

Energy Generation III session

„Multi-panel deployable wings, from standardization to series production“

Manhattan Beach

April 27th



Agenda

Presentation outline

Short overview of STI SA product

- The origin and present
  - Mechanical design
  - Electrical design
  - SA Drives
- Main challenges
  - Mechanical margins
  - Simplification of the electrical network

Beginning of Series Production

- OneWeb experience
  - Lessons learnt
- One step forward
  - Running constellations

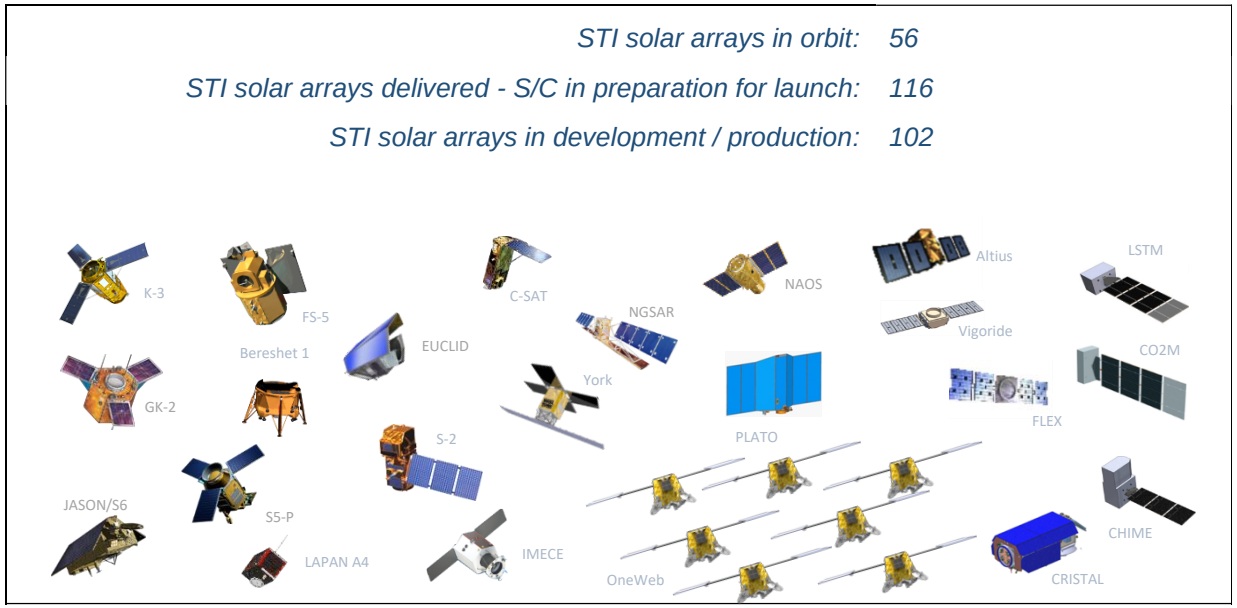
STI SA standard

- Overview of the SA design
- Standard product and limits

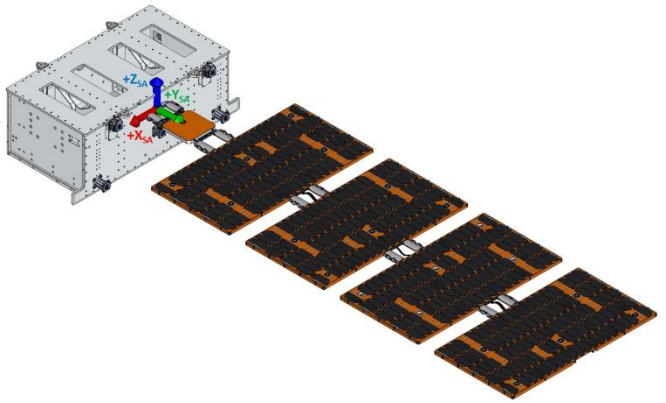
Future development

- Semirigid panels
- Combination of different solar cell technologies

Acknowledgments



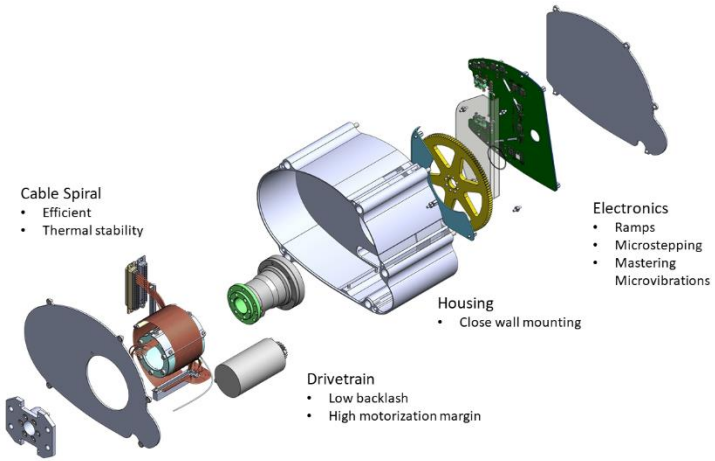
STI Solar Array Product (1 of 3)

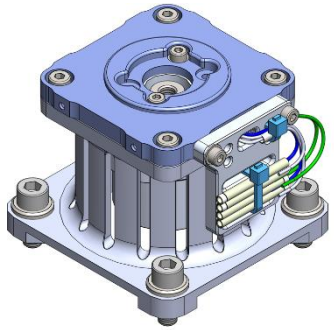


The origin and present

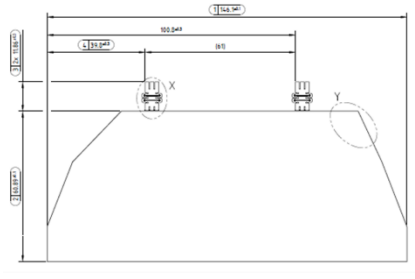
Technical overview

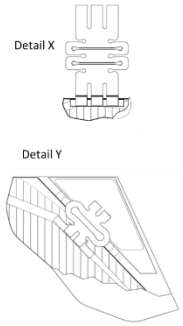
- Mechanical design
  - Simple multi hinge, rigid array
  - Tape spring hinges with torque limiters
  - Demonstrated up to 6 axes
- Electrical design
  - Large area multi-junction cells
  - Suitable for alternative low cost cell technologies
  - Minimal rear side harness thanks to the planar front side blocking diode technology
- SA Drives
  - Twist capsule drive assembly
  - 42 AWG22 lines available

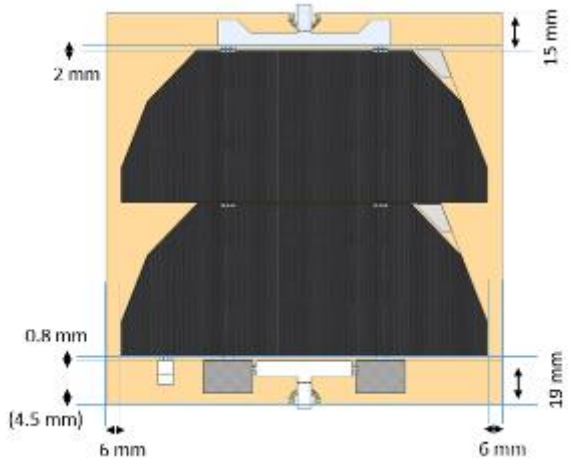








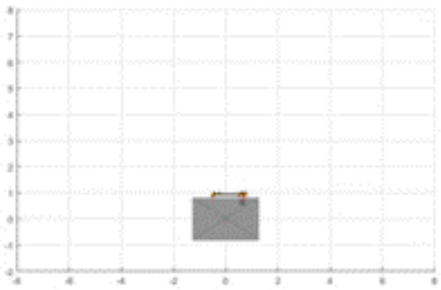


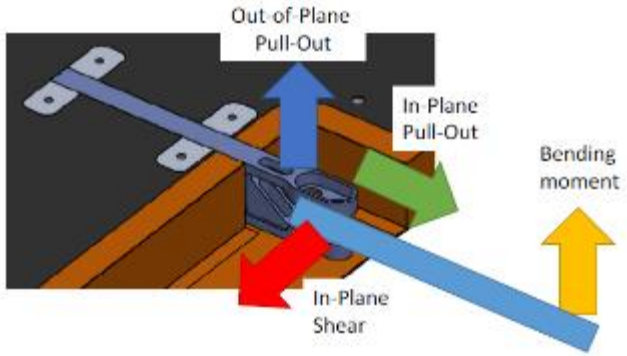


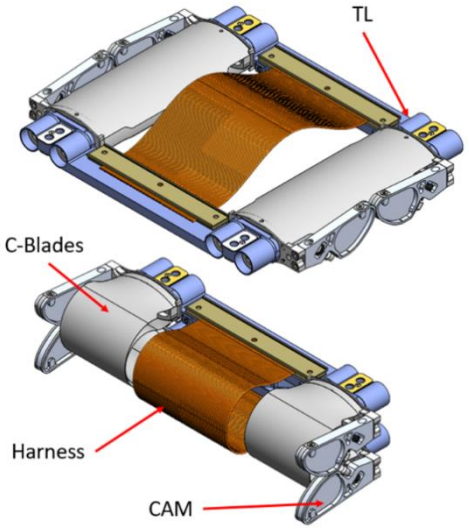
STI Solar Array Product (2 of 3)

Main challenges

- **Mechanical design**
  - Unsynchronized but controlled
  - Deployment torque margins
  - First eigenfrequency in stowed and deployed
  - Reduction of mechanical stress on hinges during launch
  - Minimize panel gapping with a safe dynamic clearance





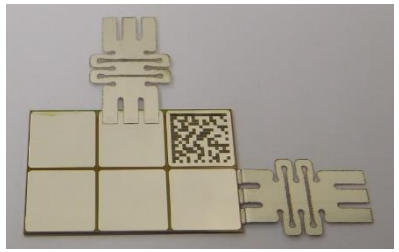


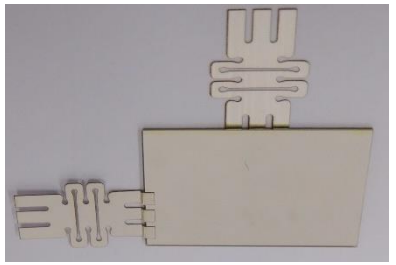


STI Solar Array Product (3 of 3)

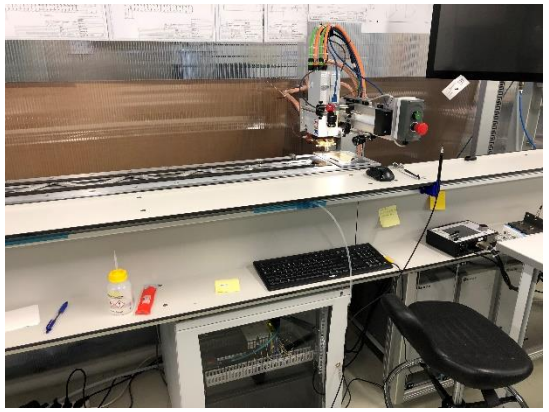
Main challenges

- **Simplification of the electrical network**
  - Compatibility with a full automated laydown process
  - Avoid string meandering
  - Simplify binning
  - Simplify the rear side cabling and harness
  - Standardize the components







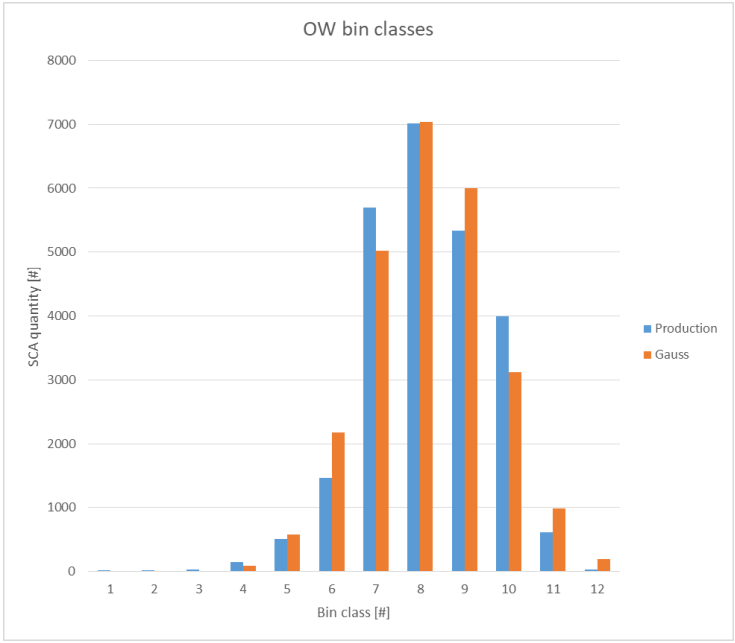


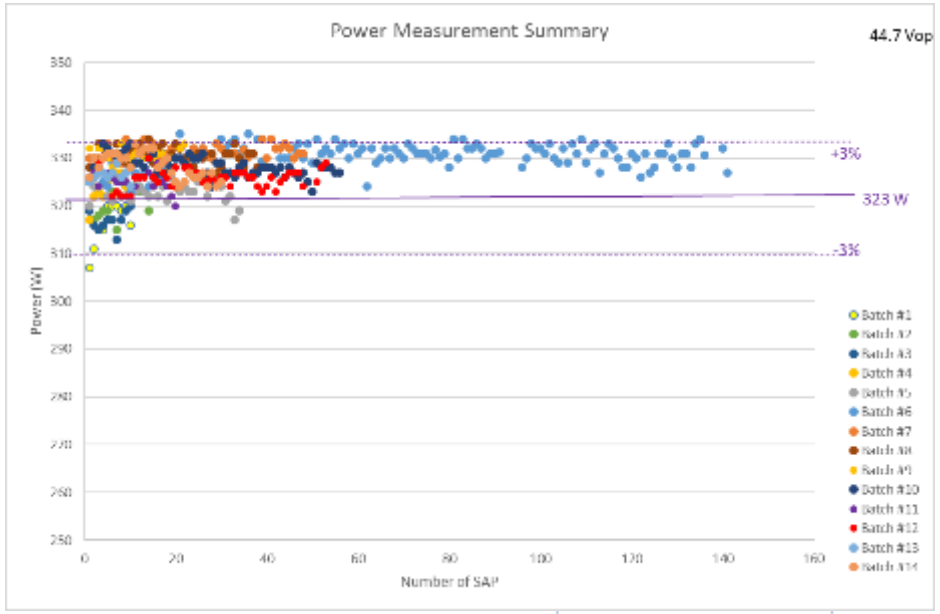


Beginning of Series Production (1 of 3)

Beginning of Series Production

- OneWeb experience
  - SCA binning
    - Simplified approch
    - Two current classes
  - Best engineering vs minimum average performance
    - Minimum average requirement
    - Average performance

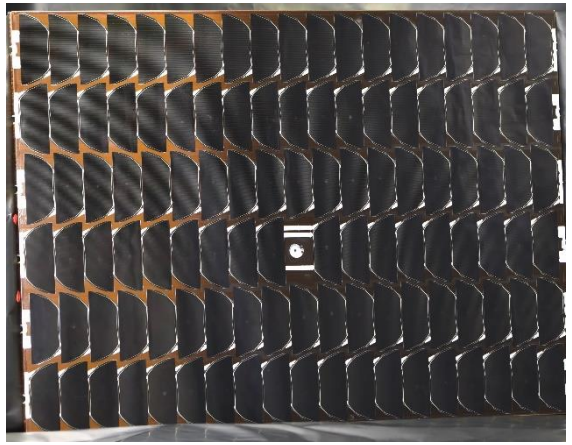


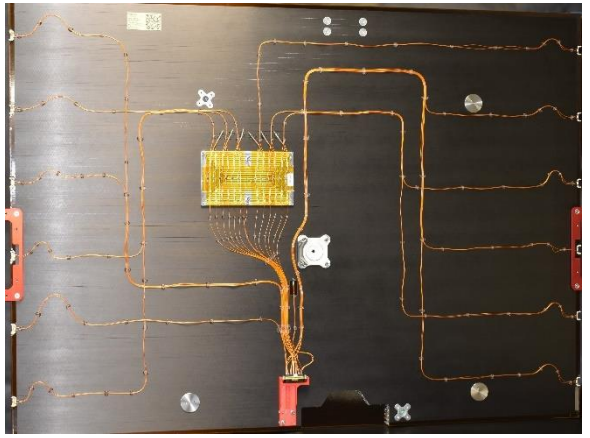


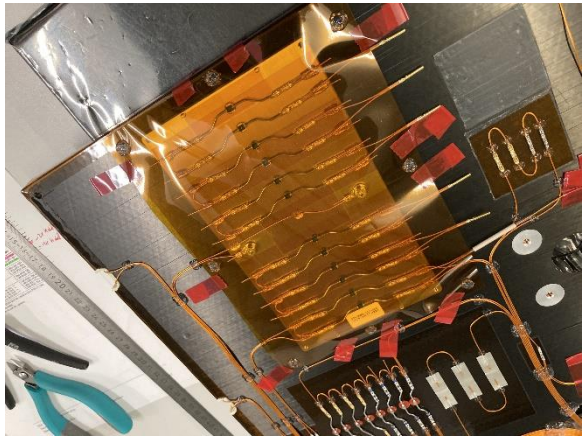
Beginning of Series Production (2 of 3)

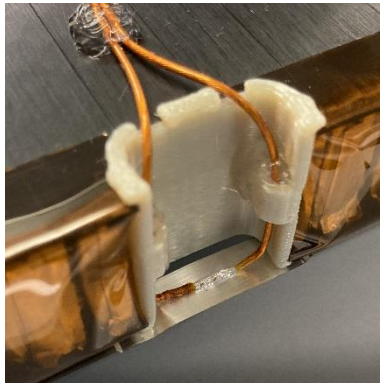
Beginning of Series Production

- OneWeb experience
  - String layout and joining technique
    - Antiparallel string placement
    - Heritage PGRW process
  - Automated laydown
    - Automatic identification of string position and geometry
    - Placement and accelerated curing
  - Harnessing and testing
    - Pre-assembly of the rear side harness
    - Diode board
    - String terminal welding







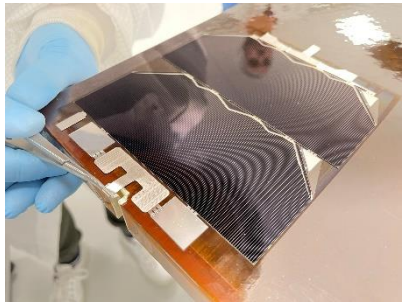


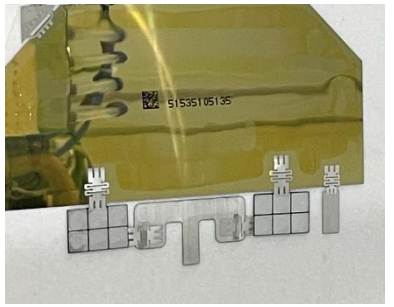
Beginning of Series Production (3 of 3)

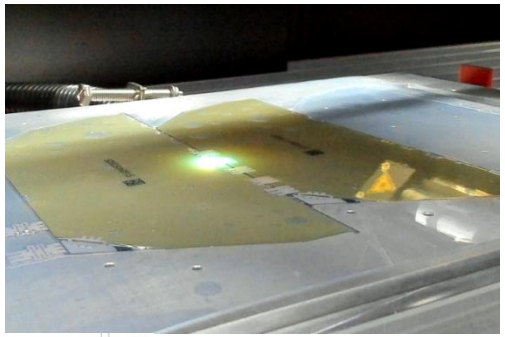
A further step into the constellation business

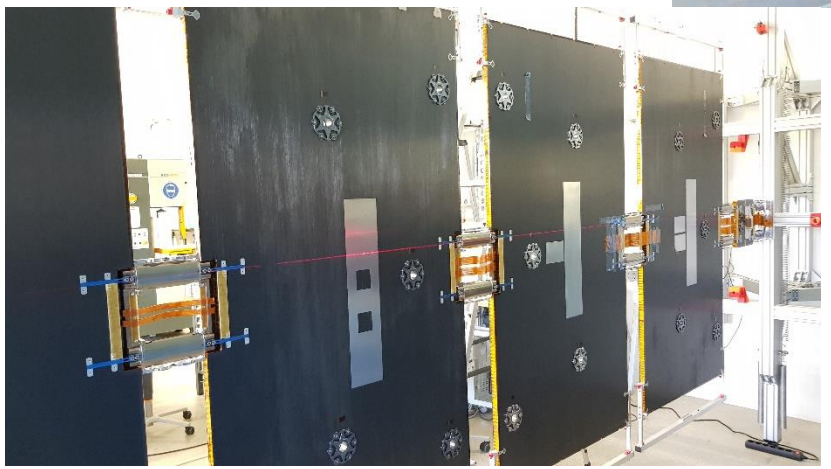
Beginning of Series Production

- One step forward – running constellation programs
  - Front side planar blocking diode solution
    - Blocking diode heat dissipation issue
    - Simplification of harnessing
  - Laser welding
    - Laser welding process
    - Adaptation to a large integration portal
  - Wing mechanical integration and testing
    - Mechanism integration
    - Alignment
    - Deployment test
    - Lot acceptance test



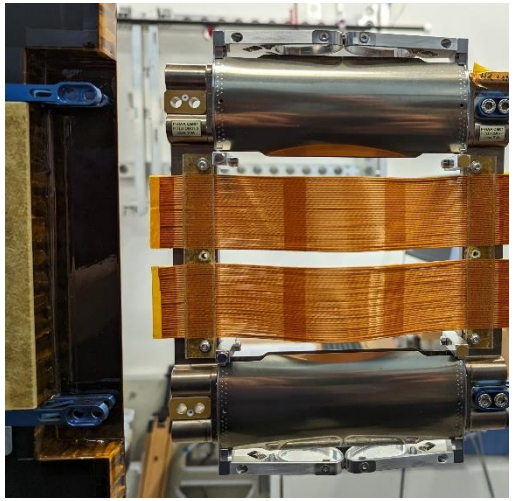




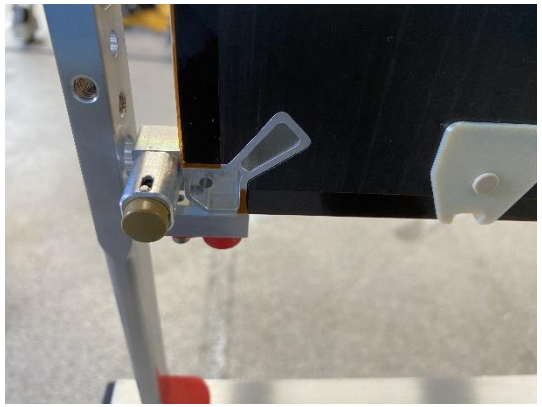


STI SA standard (1 of 2)

- **Overview of the SA design**
  - Substrate panel
  - Hinge assembly
  - Hold down points
  - Snubber points
  - Release actuators
  - Solar array drive mechanism



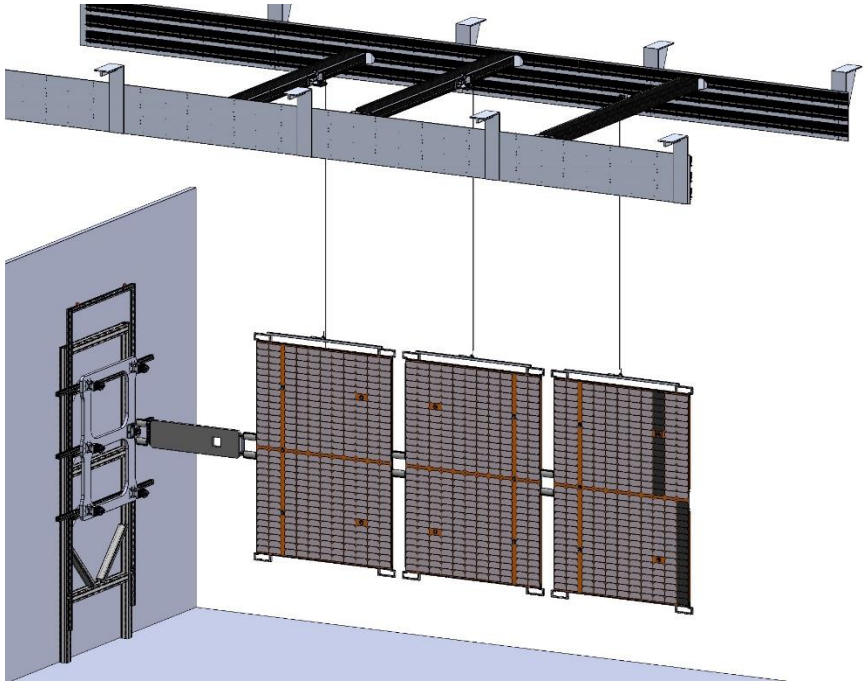


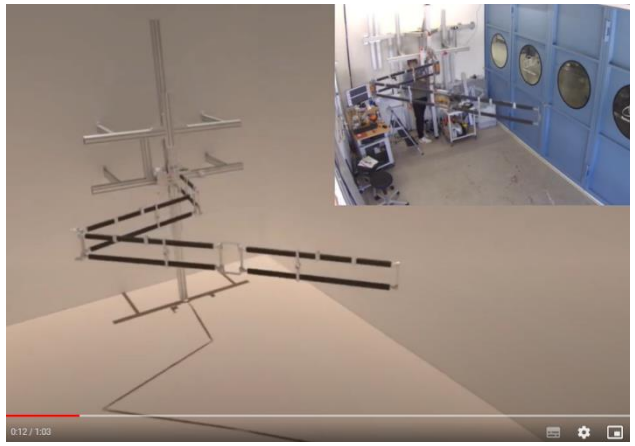




STI SA standard (2 of 2)

- **Standard product and design constraints**
  - Maximum number of deployment axis
  - Deployment corridor and margins
  - First deployed EF

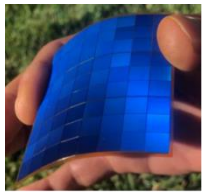


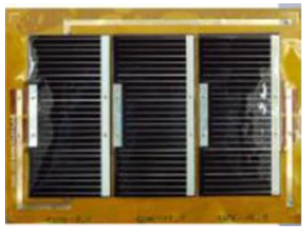


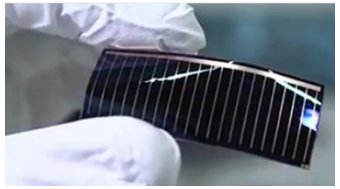


Future Development (1 of 2)

- **Trade off between the additional cost of a more sophisticated mechanical part vs PVA**
- **Use of cells alternative to GaAs state of the art**
  - Low-cost GaAs (dual or triple junction)
  - New generation Si cells
  - Perovskite cells
  - Thin film cells (CIGS)





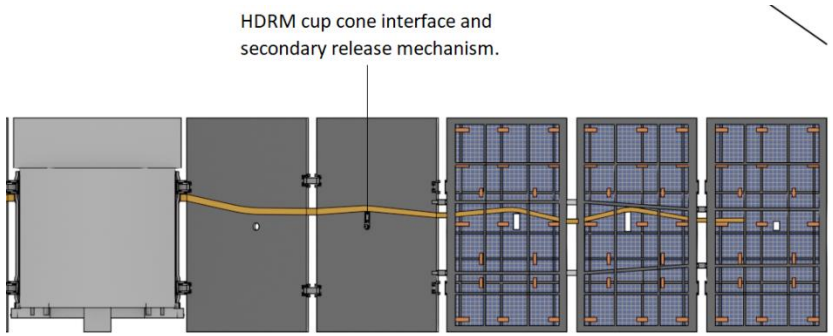


Technology	η BOL @ 80°C	η EOL @ 80°C	PVA Mass [kg / sqm]	Packing factor	Actual TRL
Reference (III-V MJ)	22%	16%	1.3	79%	9
C-Si today	16%	13%	0.8	92%	5
C-Si potential	19%	16%	0.8	92%	2
CIGS today	17%	14%	0.7	95%	3
CIGS potential	19%	16%	0.7	95%	1
ELO GaAs today	18%	13%	1.0	86%	5
ELO GaAs potential	21%	15%	1.0	92%	2

Future Development (2 of 2)

- **Trade off between the additional cost of a more sophisticated mechanical part vs PVA**
- **Combination of rigid and semi-rigid panels**
  - Same launch volume, more panels stacked on to of each other
  - Rigid panels are necessary to protect the thin ones during launch
- **Combination of different solar cell technologies**
  - State of the art cells installed on rigid panels
  - Alternative cells on semi-rigid panels





Acknowledgments

STI Team

System engineering

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Electrical

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