Launch your Vision

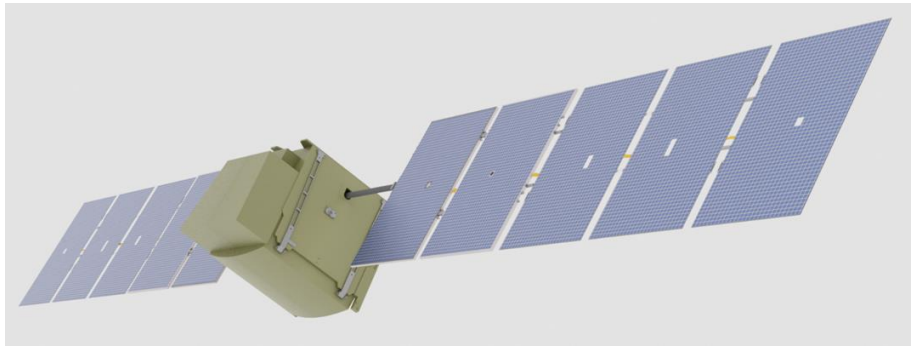
Current Status of SpaceTech Solar Array Design and Validation

Space Power Workshop
Lightning talk 3rd Session

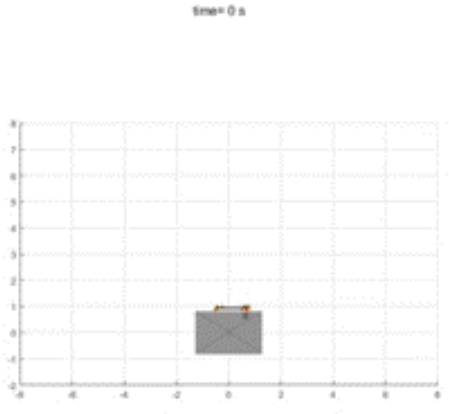
21.04.2021

Mechanical design

- **Rigid and semi-rigid panels with a simple deployment system**
  - Rigid solar array with multiple panel deployment systems
    - Blade springs with torque limiters
    - No need for synchronization
    - Multiple steps deployment for more than 4 hinge lines
- **Extensive multi-body simulation and ZeroG tests**
  - Possibility to model the “uncontrolled” but not caotic deployment dynamics
  - Real time correlation with 0g deployment results

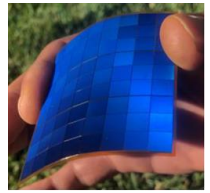


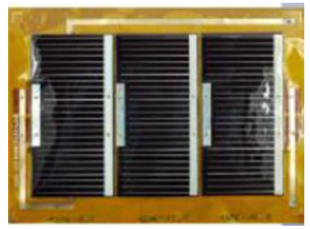
➔ **Comparison of simulation and test**

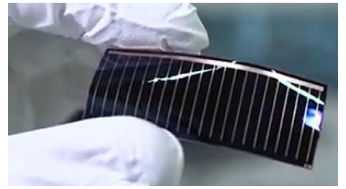


Electrical Design

- **3 or 4 J GaAs cells are the present space standard.**
  - The 4J cell has more voltage than the 3J cell
  - The different voltage level of 3J versus 4J results can resulted in about 3% more power due to slightly better packing factor and marginally better EoL efficiency
- **The STI vision for next generation SAW is based on a combination of solar cell foil technologies offering**
  - Lower price per W & higher packing factor per SAP envelope area
  - Allowing to use semi-rigid SAP which are squeezed between 2 rigid SAP when stowed. This offers min stowed volume and lower mass with the drawback of low deployed eigen frequency (AOCS constraint)
- **Cell foil technologies are standard on ground applications, but none of them is considered proven yet**
  - Crystalline Silicon (c-Si) – realistic "Game Changer Potential" fair TRL
    - High packing factor possible
    - Low production cost, industrial production pushed by mPower
    - Annealing temperature reducible to 60°C resulting in very small degradation due to radiation - no CG needed. Not proven yet,
    - BOL efficiency > 16.3 % (18.3 % at AM0 28°C , CIC level) not proven yet
  - CIGS – best "Game Changer Potential", least TRL
    - Thin film allows very high packing factor
    - Very low production cost, but industrialization unclear; still in research stage but promising candidate
    - Radiation hard technology – very small degradation, no CG needed
    - BOL efficiency > 15 % not proven yet
  - ELO GaAs – realistic "Game Changer Potential", fair TRL
    - BOL SAP efficiency close to 3 /4 Junction standard GaAs – BOL 18.4 % proven.
    - 2J cell get closer to SOA cells with similar drawbacks. High Packing factor partially compensated by reduced cell efficiency
    - Degradation due to radiation similar to SOA cells – CG needed
    - Higher production cost amongst Solar Cell Foil candidates







Validation / Qualification Tests

- **STI performed a significant amount of tests for validating our SA technology**
  - DVT coupon TV cycling and shock test
  - Substrate mechanical qualification
  - Torque margin measurement at extreme temperatures
  - Multi panel deployment test and model correlation
  - PVA integration on different substrates (rigid and semi-rigid)

- **Next to come to enable an efficient use of semi-rigid SA technology**
  - Verification of the mechanical stability of the semi-rigid design under launch loads
  - Coupon cycling of flexible blanket
  - Multi stage deployment sequence
  - In flight proof of concept

SpaceTech GmbH

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