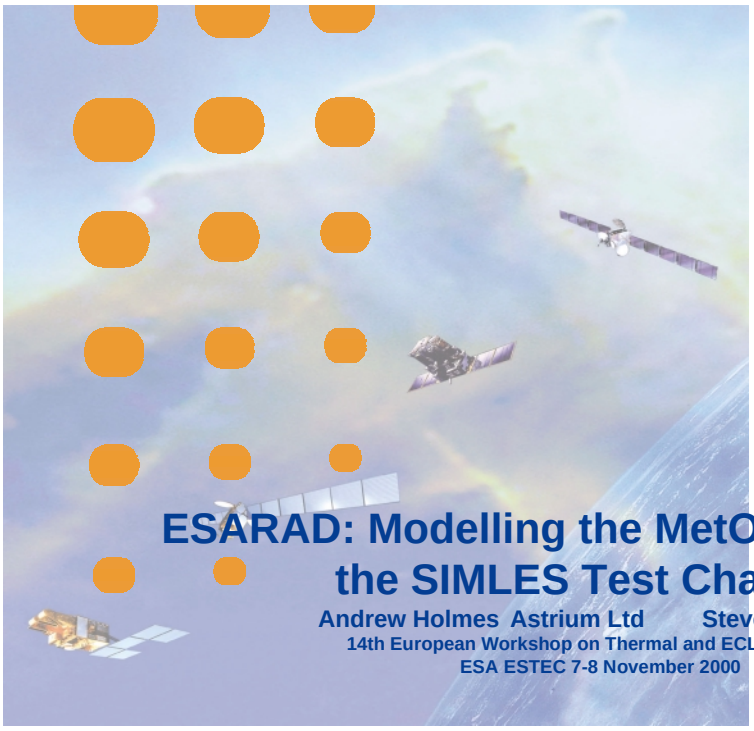

ESARAD: Modelling the MetOp-SVM within the SIMLES Test Chamber

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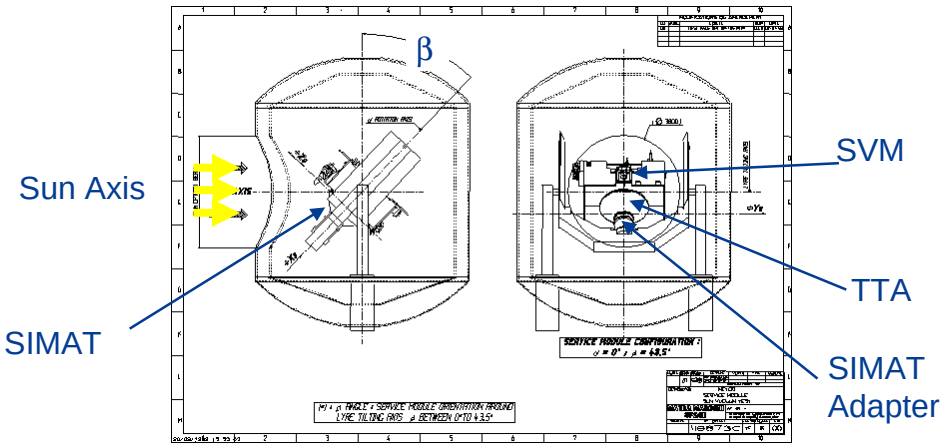
Summary

Purpose of Test Model

- **Validation of the Thermal Control Design**
- **Correlation of the Detailed and RCS Pipe Thermal Models**
- **Verification of External Appendages Models: STDs, SAS, etc**
- **Verification of the PLM/SVM Interface Thermal Control**
- **Verification of Thermal Interfaces (Appendages → SVM)**

SIMLES Facility Description (1)

- **INTESPACE Toulouse:**



SIMLES Facility Description (2)

• SIMAT: Attitude and Spin Simulator

- Mounts the Test Specimen in the Solar Beam using a TTA (Thermal Test Adapter)
- Rotation Angle (α): Around the Xs-axis
  α = 0° +Zs face Sun pointed
  α > 0 for clockwise rotation
- Tilt Angle (β): Around the Ys-Axis
  β = 0° for +Xs-axis vertical
  β > 0 for clockwise rotation (Towards the Sun)

• Sun Simulator:

- Solar Flux: 400 W/m^2 to 1600 w/m^2

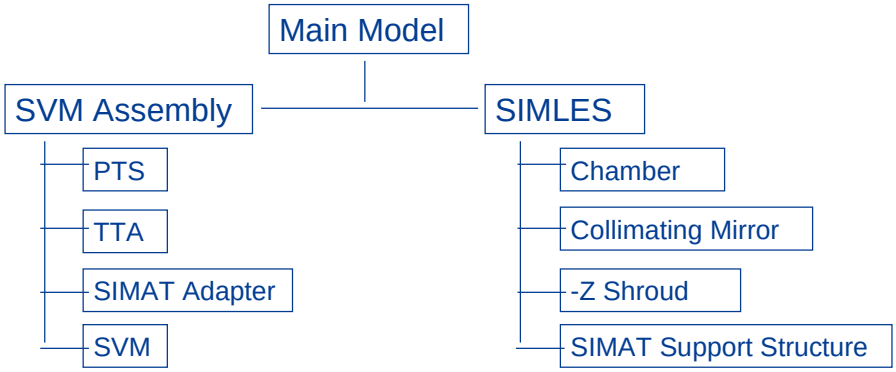
Modelling Requirements

- **Create a full ESARAD geometry model of the internal Chamber surfaces including the SVM and support structure**
- **Generate the necessary REFs and Solar fluxes required**
- **Model the following cases:**

Case	Phase Number	Phase Name	Tilt Angle β (°)	Solar Flux (W/m^2)	Geometry
Hot Routine	1.1	Hot Steady State	-31.0	319.96	Fixed
	1.2	Hot Orbital transient	-31.0	1420	Moving
Cold Routine	3.1	Cold Steady State	-43.5	286.61	Fixed
	3.2	Cold Orbital Transient	-43.5	1320	Moving
Cold Safe Mode	5	Safe Orbital Transient	0.0	1320	Fixed

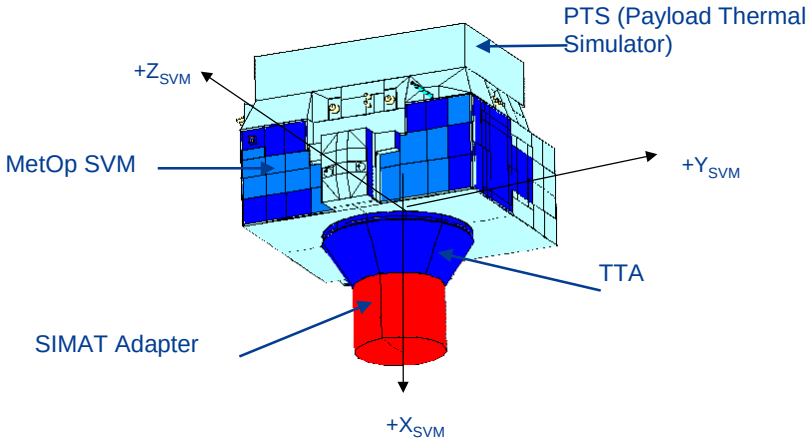
ESARAD Model Description (1)

- **Based on ORION (Telecoms S/C) Thermica Model**
- **Geometry Hierarchy Description:**



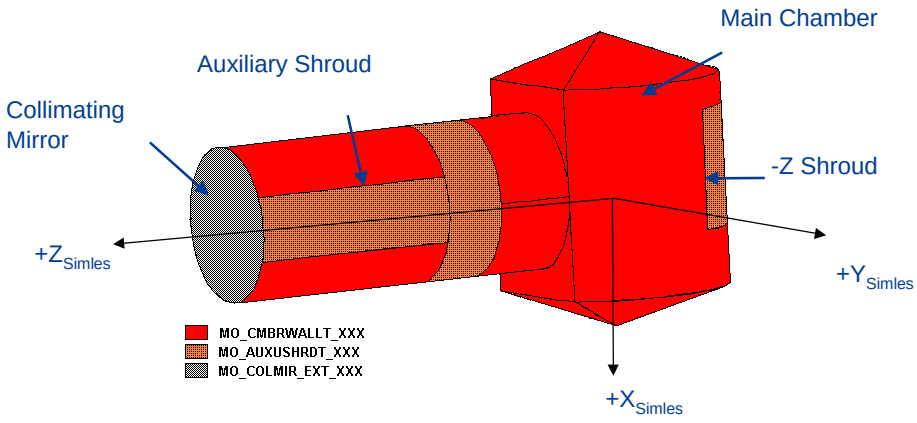
ESARAD Model Description (2)

- **SVM Assembly Diagram**



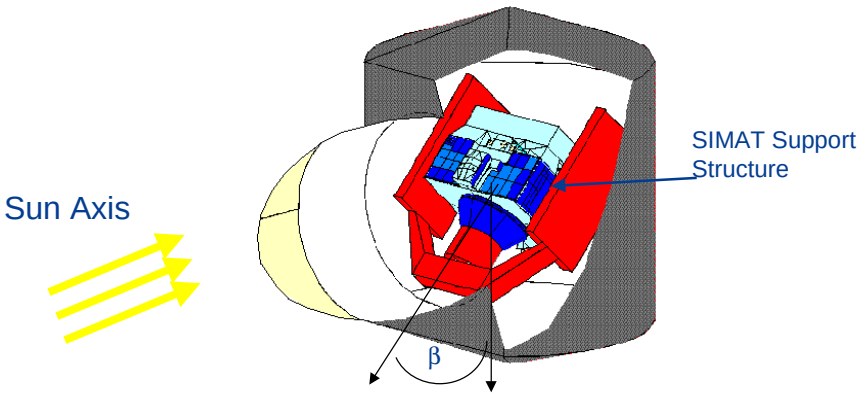
ESARAD Model Description (3)

- **SIMLES Chamber External Diagram**



ESARAD Model Description (4)

- **Internal SIMLES Cut - Away View**



ESARAD Model Description (5)

- **Description Of Analysis:**

Fixed Analysis: **Phases 1.1, 3.1, 5**

- Perform Analysis at 1 position only
- SVM non-rotating

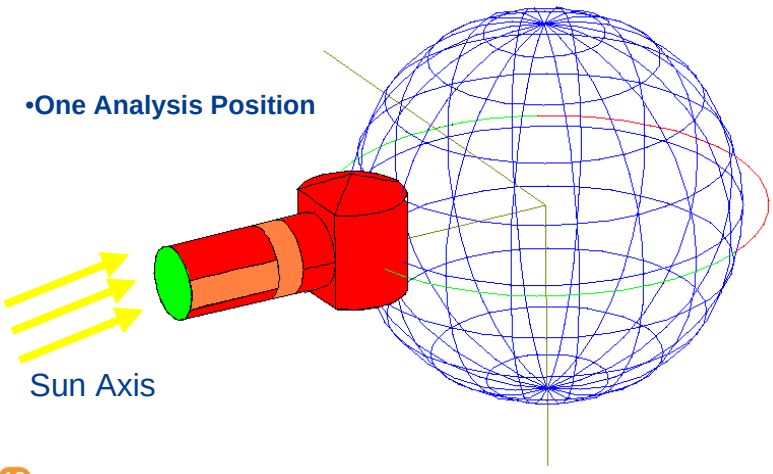
Rotating Analysis: **Phases 1.2, 3.2**

- Perform Analysis at several Positions
- SVM rotating different orientation at each analysis position

ESARAD Model Description (6)

- **Chamber Orbit - Fixed Analysis**

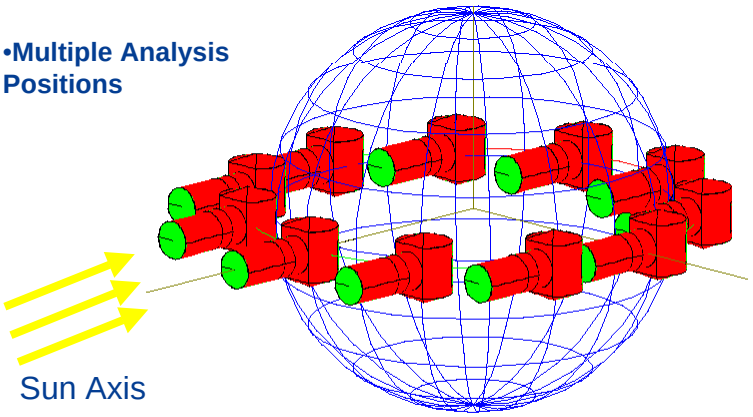
•One Analysis Position



ESARAD Model Description (7)

- **Chamber Orbit - Rotating Analysis**

•Multiple Analysis Positions

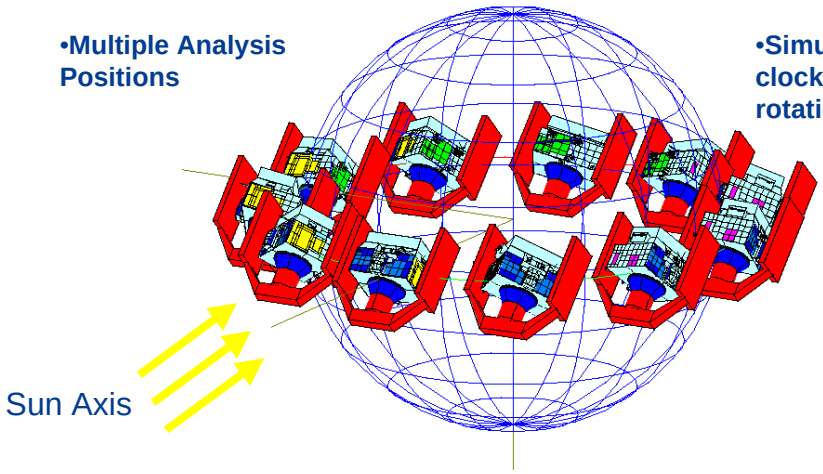


ESARAD Model Description (8)

- **Internal Chamber Orbit - Rotating Analysis**

•Multiple Analysis Positions

•Simulation of clockwise SVM rotation



ESARAD Model Description (9)

- **Summary Of Kernel File:**

  - **SIMLES Chamber:** Reference Component, $+Z_{SIMLES}$ Sun Pointing

  - **SVM Assembly:** Moving Component, $-Z_{SVM}$ Planet Pointing

  - **Chamber in Dummy Circular Orbit:**
    Inclination = 0°
    Solar Declination = 0°
    Phi, Psi, Omega Rotation Rates = 0°/s
    SUN_PLANET_DIST = INFINTE

Problem Description (1)

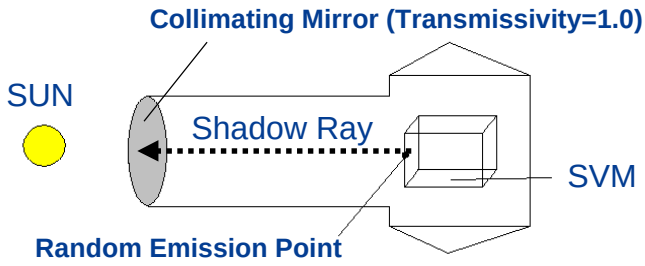
1/ Consecutive runs did not produce consistent results

2/ +Z facing surfaces did not have sensible flux values incident.

- Adjoining nodes did not have similar values
- Validated by simple hand calculations

Problem Description (2)

- **Direct Solar Flux Algorithm**

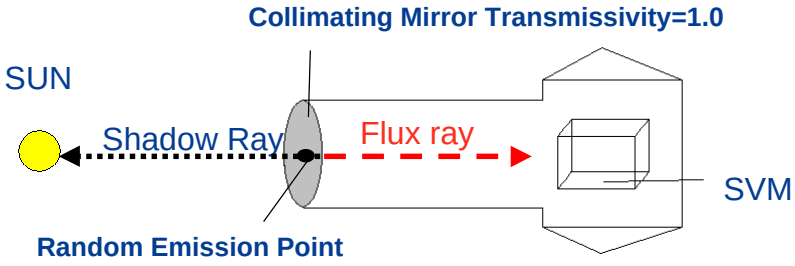


- **Shadow Ray Intercepted by Mirror**

  No Direct Solar Flux in Chamber

Problem Description (3)

- **Absorbed Solar Flux Algorithm**



- **Shadow Ray does not hit another surface Direct Solar Flux on Mirror**
- **Flux rays from the collimating mirror only**
- **Flux ray propagates into SVM Model**

Problem Summary

Total Number of Rays Fired:

- 10,000 per surface

Collimating Mirror:

- Transmissivity = 1.0

Direct Solar Flux:

- Only incident on Collimating Mirror (10,000 rays on mirror)
- No direct solar flux within Chamber

Absorbed Solar Flux:

- Only 10,000 flux rays in total fired from mirror into Chamber
- Analysis requires 10,000 flux rays per surface

Solution Option 1

1/ Increase the number of rays to ~1E6

Pros:

Only one model to run

Cons:

Huge processing times!
Greater Possibility of Crashing

Solution Option 2

2/ Split the External ESARAD into 2 models:

- Model 1: Chamber with Collimating Mirror
  - Calculates internal REF's
- Model 2: Chamber without the Collimating Mirror
  - Calculates Internal Chamber absorbed solar fluxes

Pros:

Each model only(!) requires ~ 16hrs to process

Cons:

Greater degree of model maintenance required

Need to extract 2 sets of results into ESATAN

Recommendations

Future versions of ESARAD should permit accurate geometrical representation of transmissive surfaces and the ability to transfer the correct specified number of rays through the surface.