SPACE SUITE

Beyond the space horizon

A smart solution for space environment effects analysis for small and medium space systems

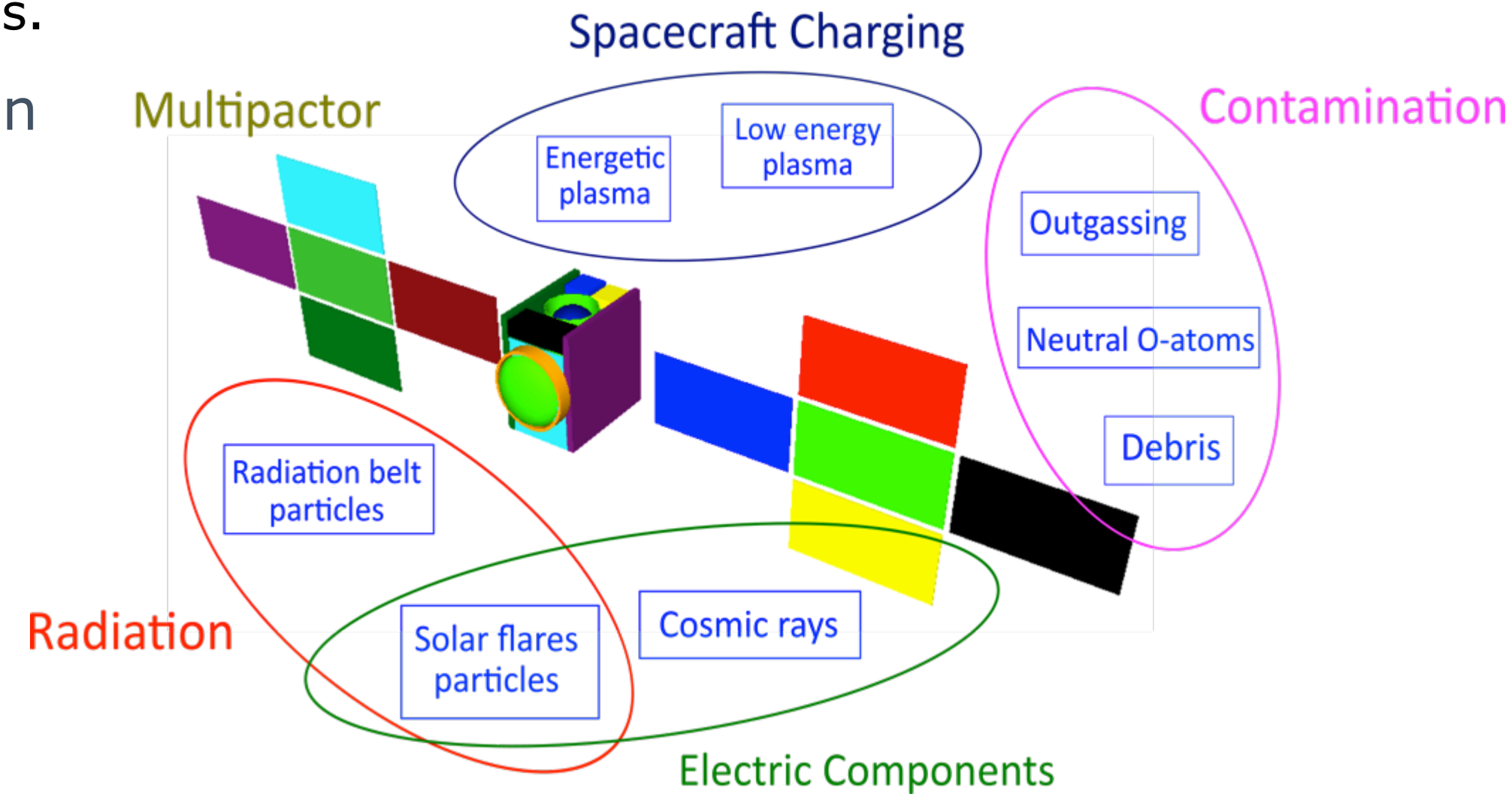
SpaceSuite, an ONERA / Artenum service.

ONERA
THE FRENCH AEROSPACE LAB

ARTENUM, PARIS
Science & Groupware

Scientific context

- Harmful effects of the spacecraft environment
- Consequences on equipment:
  - Losses of sensitive components, payload or even of the entire spacecraft;
  - Malfunctions.
- Optimisation



Industrial context

New constraints

- Use of COTS components
- New spacecraft designs
- New missions (EOR, constellations...)
- Mass optimisation

Proposed solution

- Finer modelling of the impact of space environment

Single physic analysis

Multi-physics analysis

General overview

- An active actor in spacecraft/space environments interactions:
  - To provide a software suite and a pool of expertise for the assessment of the space environment
  - Offers a multi-physical approach to better assess the consequences of the space systems/payload
  - Integration of reference models and tools validated by the community through comparisons with experiments and in-flight data
- Several main domains:
  - Radiation transport
  - Internal charging
  - Spacecraft charging
  - ...
- An Artenum / ONERA partnership

Commercial offer

Services

- Annual online assistance contracts:
  - Support provided by a pool of scientific experts;
  - Annual registration fee.
  - Also available: tickets based assistance
- Advanced studies:
  - On demand studies performed by our experts.
- Trainings:
  - On each software;
  - Small size sessions (10 people max) for an optimised teaching.
- Technical assistance:
  - On-site installation and optimisation of the software.

Simulation tools

- Spacecraft charging, radiations analysis…

A pool of experts

Radiation transport analysis

- Radiations effects analysis performed with 3D Monte-Carlo codes based on GEANT-4:
  - GRAS developed by ESA
  - In-house models
- A pool of experts
- An homogeneous set of pre and post-processing tools:
  - CAD Edition;
  - Mesh scoring;
  - 2D/3D data extraction/visualisation.

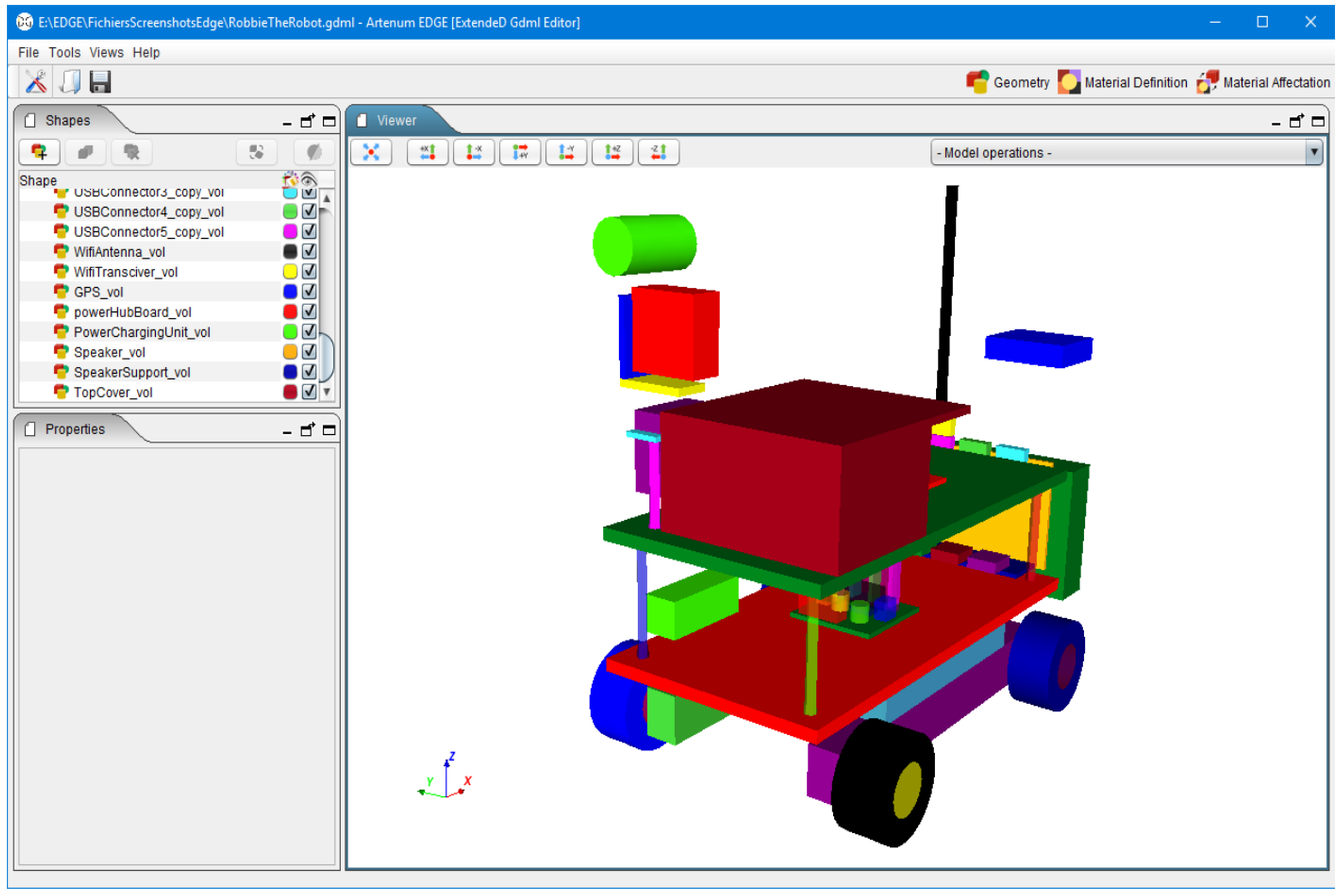
Radiation transport analysis

EDGE
ExtendeD Gdml Editor

- Geometry creation/edition:
  - Load/save to GDML
  - 3D visualization
  - Most basic GDML shapes supported

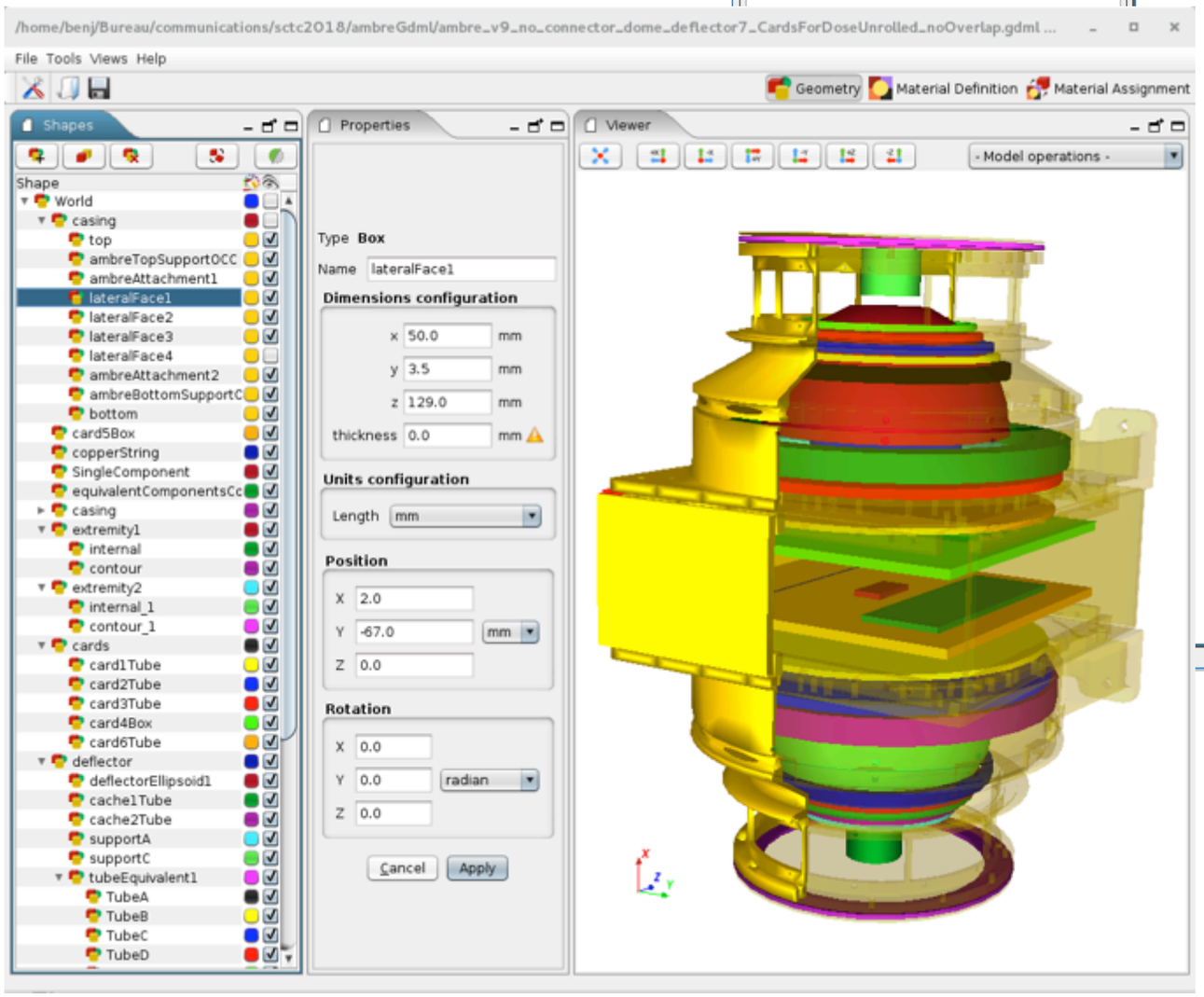
- Materials edition:
  - Edition and attribution
  - Import/export of materials
  - Multi-attribution

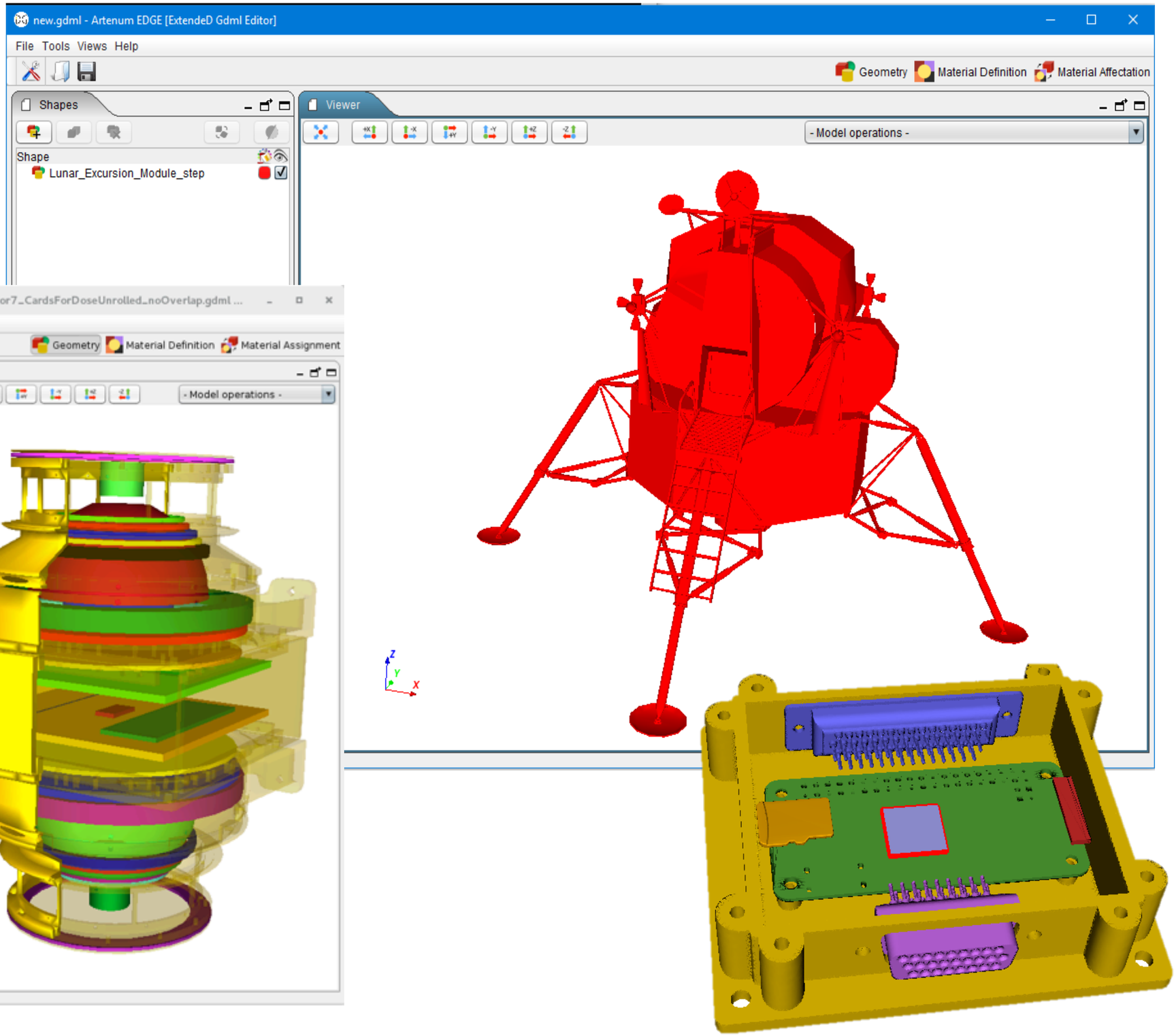
- Import/export capabilities:
  - STEP-AP 203/214
  - GMSH
  - …



Radiation transport analysis

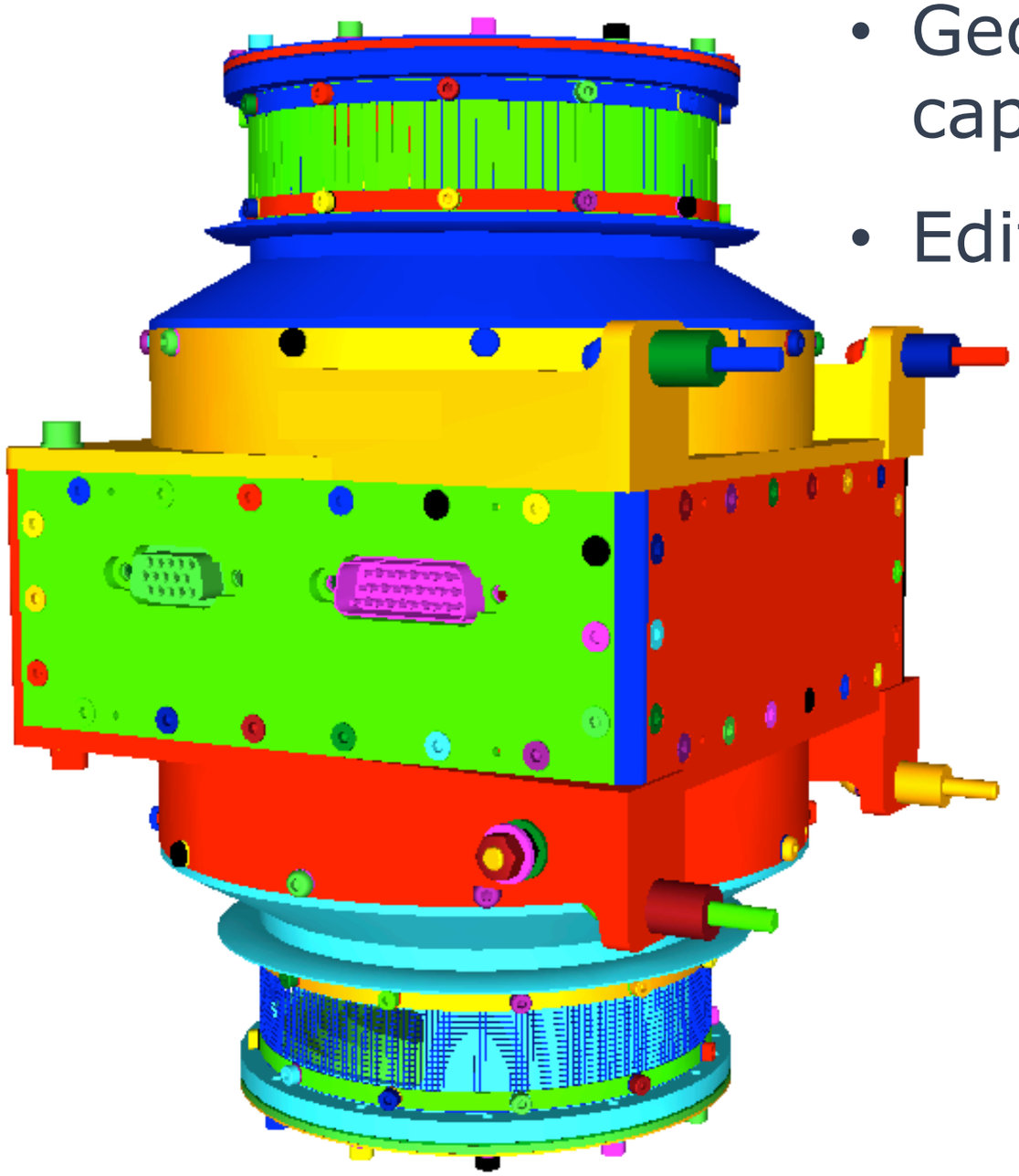
EDGE
ExtendeD Gdml Editor

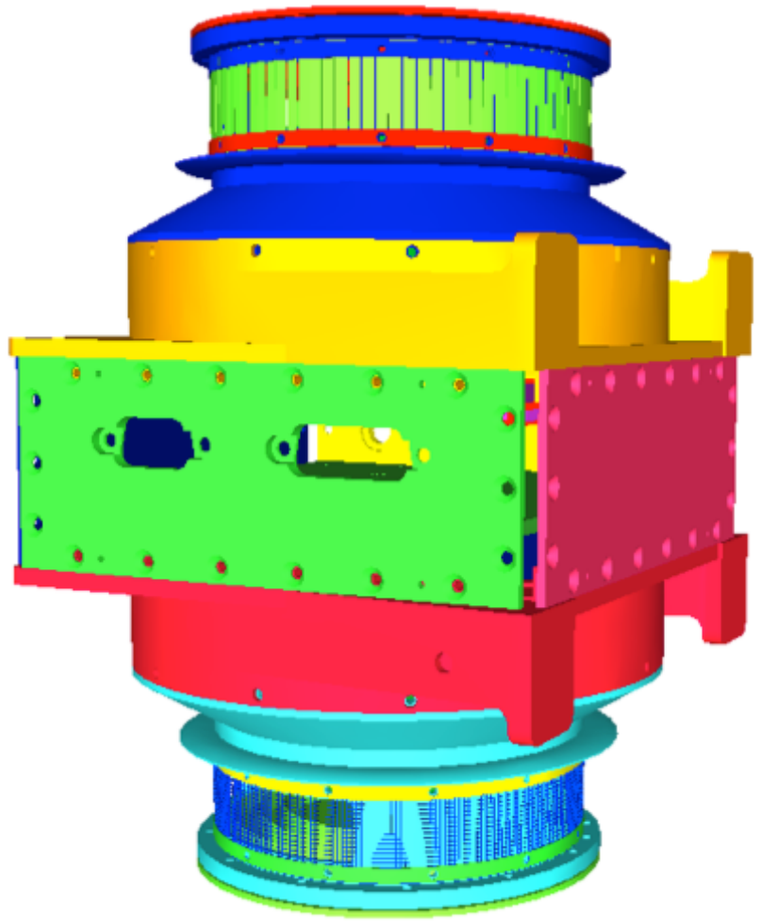




Advanced CAD processing

- Rich STEP-AP importer
- Geometry simplification/cleaning capabilities
- Editing

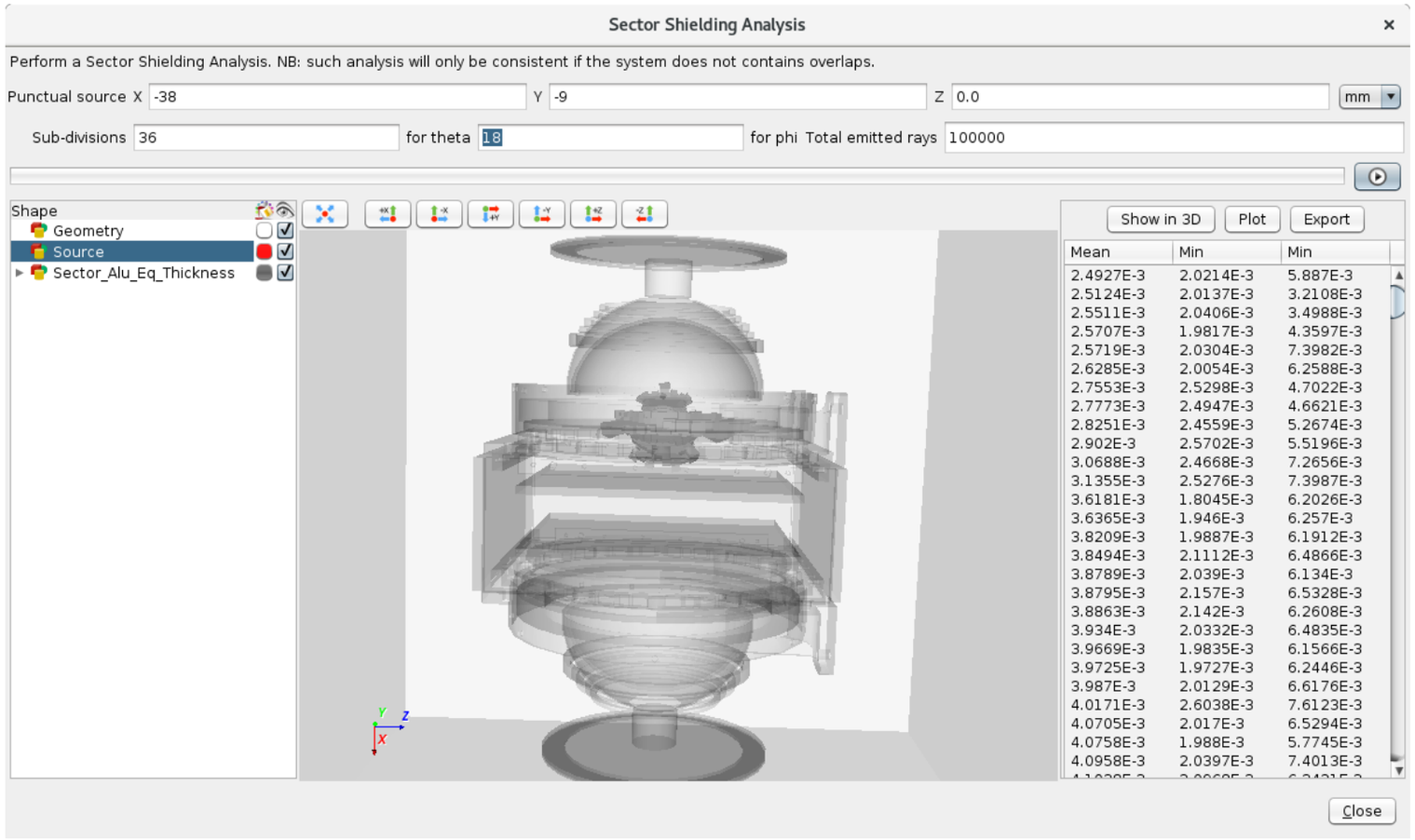




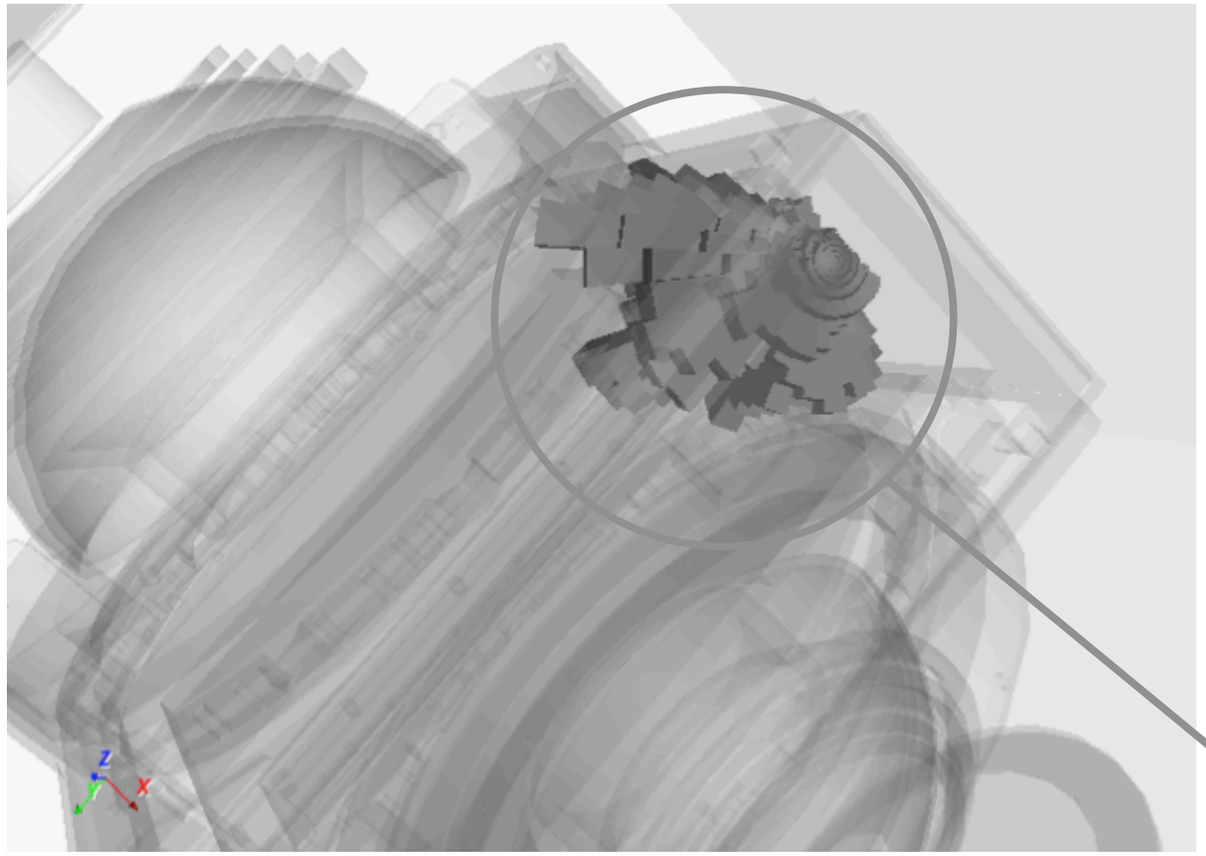
Ambre experiment, with courtesy of CNES

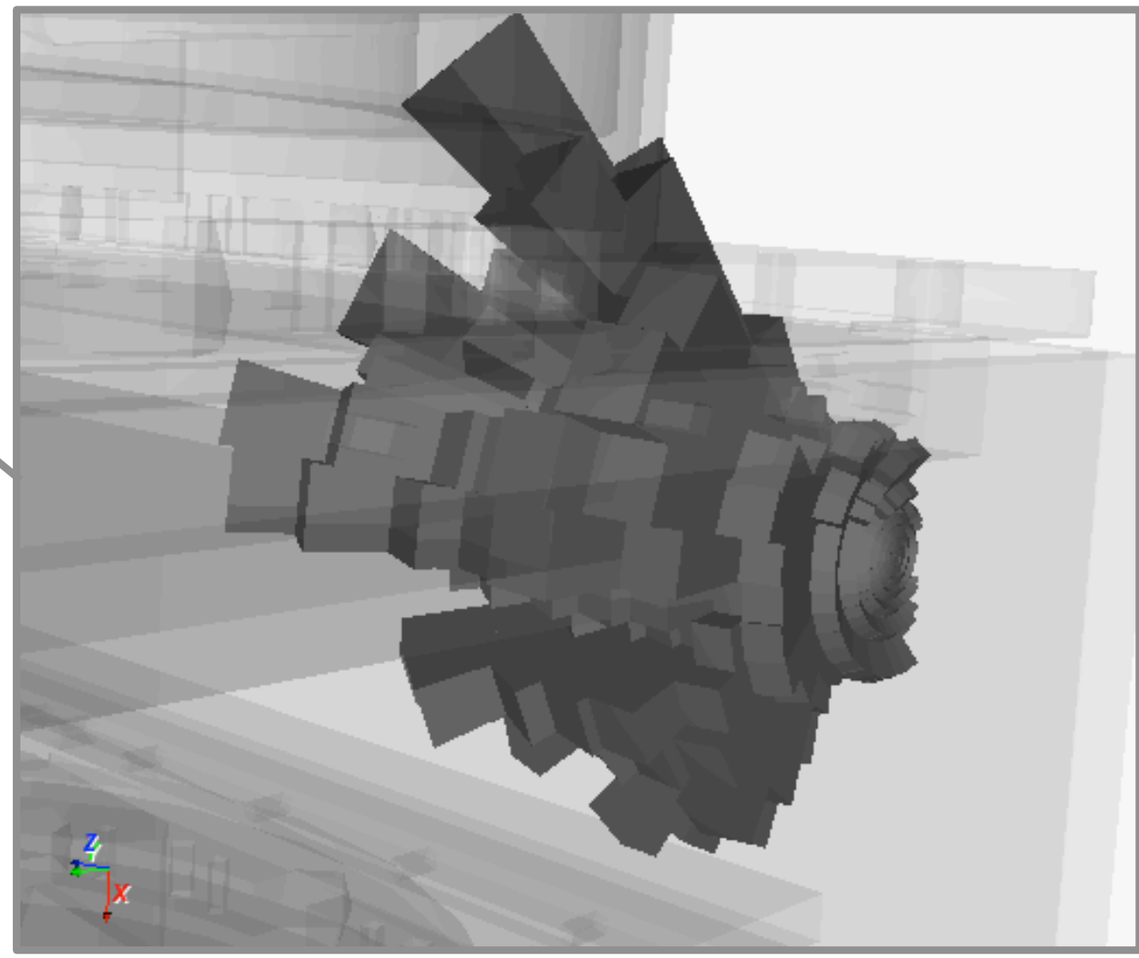
SSAM Sector Shielding Analysis (1/4)

- Radiations pre-analysis EDGE plugin
- Pre-condition tool for Geant4 analysis:
  - Quick calculation
  - Sphere equation model
  - Thickness of each materials from a point
- Aluminium equivalent thickness computation
  - Depending on material densities
  - On all directions
- Deposited dose computation



SSAM Sector Shielding Analysis (2/4)



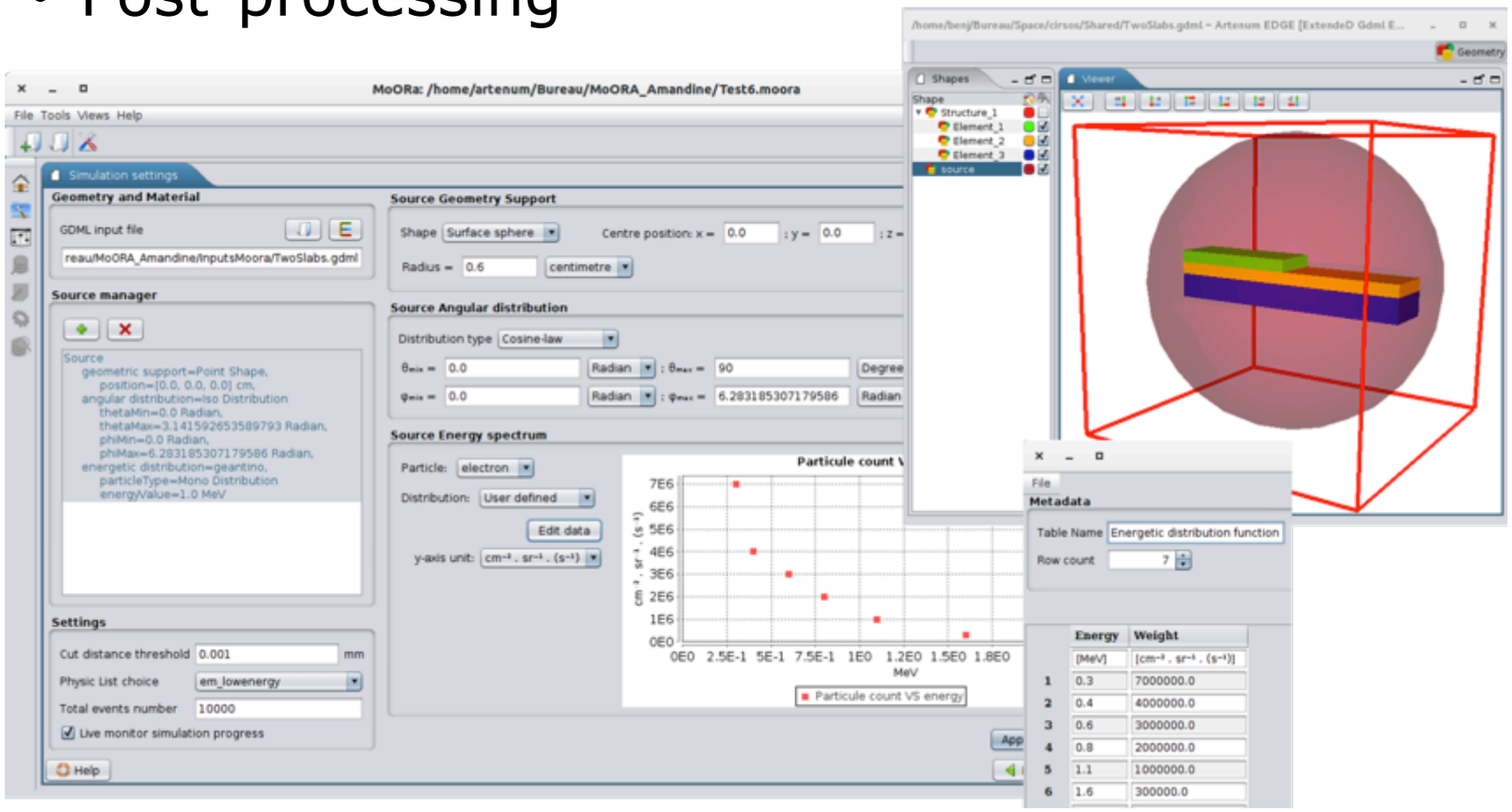


Radiation transport analysis

MoORA — Modelling Of Radiations

- Facilitate the use of GEANT4 models:
  - Rich and user-friendly interface;
  - Easy simulation configuration:
    - Sources definition;
    - Particles spectrum;
    - Events number…
  - Geometry 3D visualization.
  - Post-processing

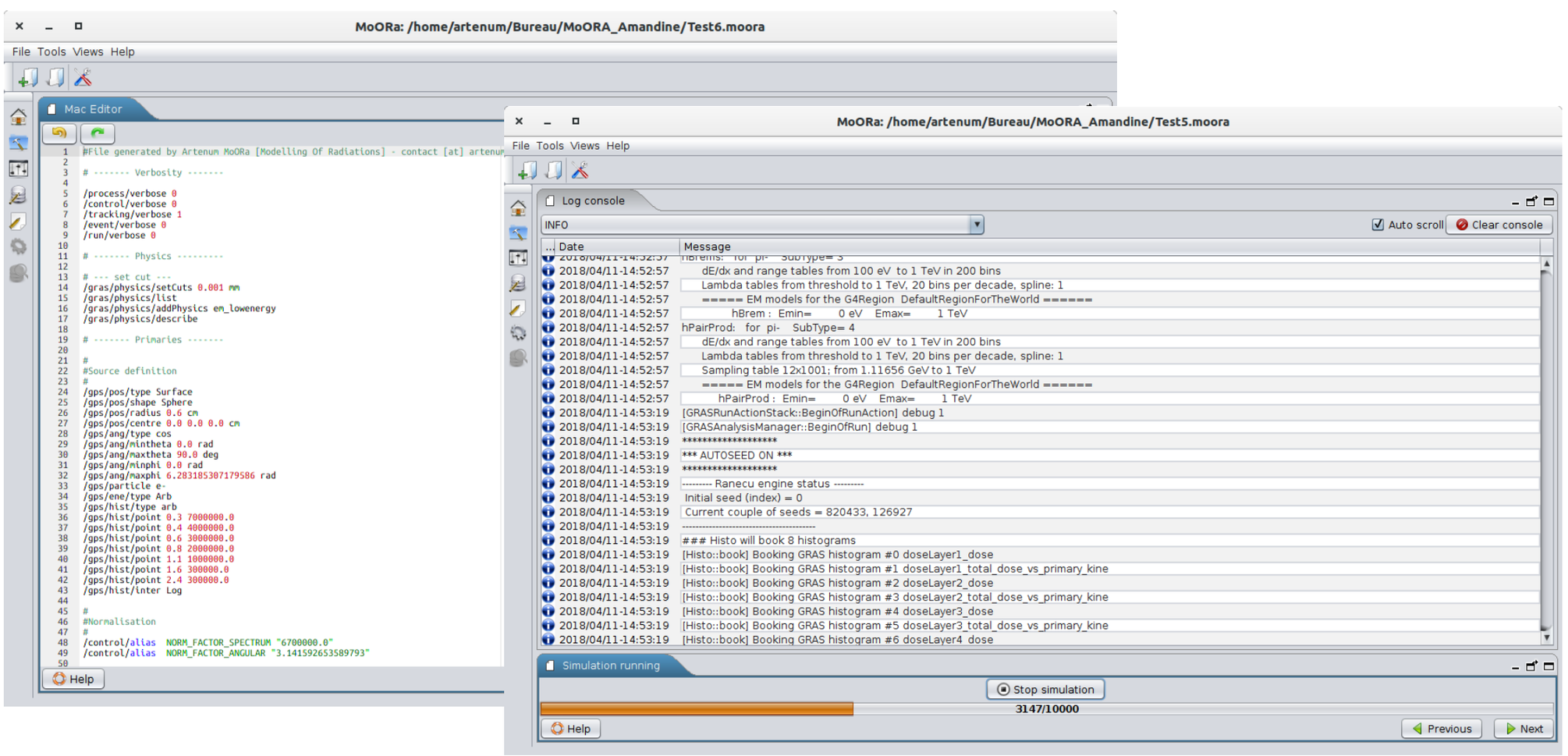
- Deposited dose, energy, charge…
- Fluence energy spectrum
- Scoring for internal charging



Radiation transport analysis

Modelling Of Radiations

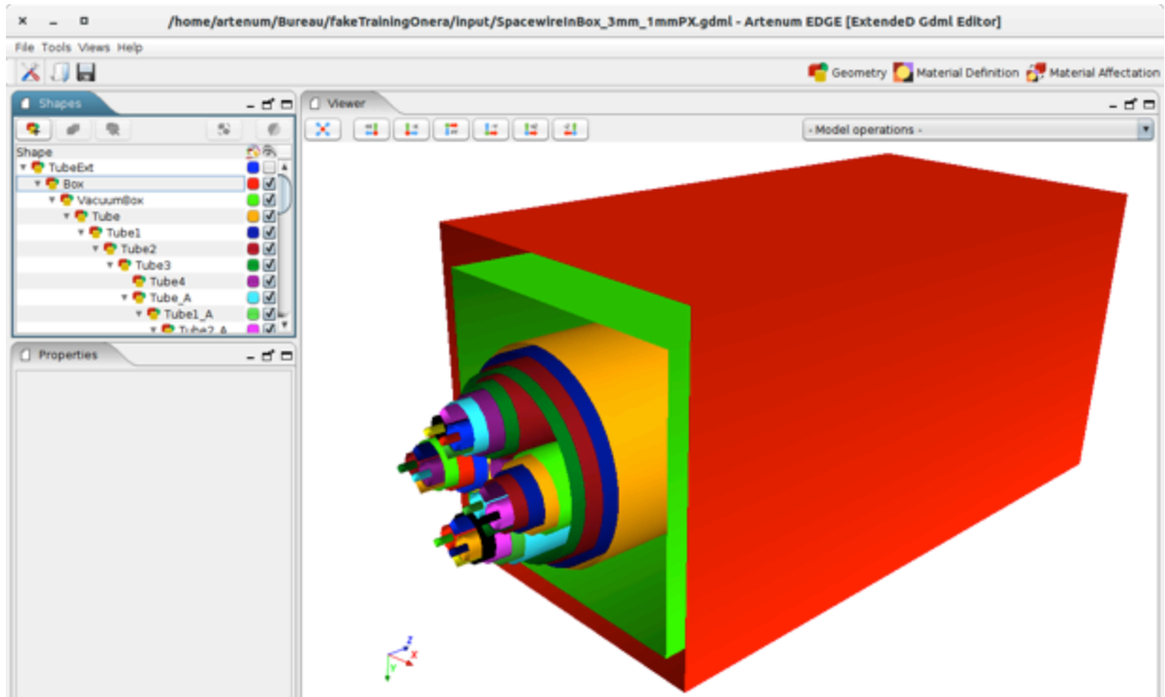
- GEANT-4 macro files generation and edition
- Simulation launch and monitoring
- Full complient with ESA/GRAS
- Extensible / adaptable to other GEANT4 based kernels.

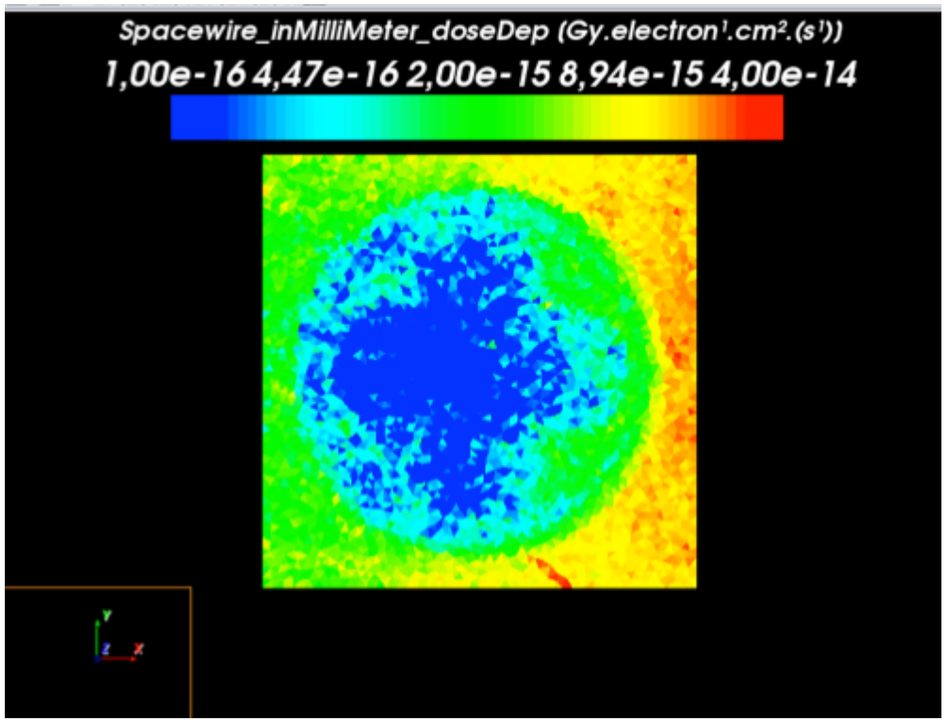


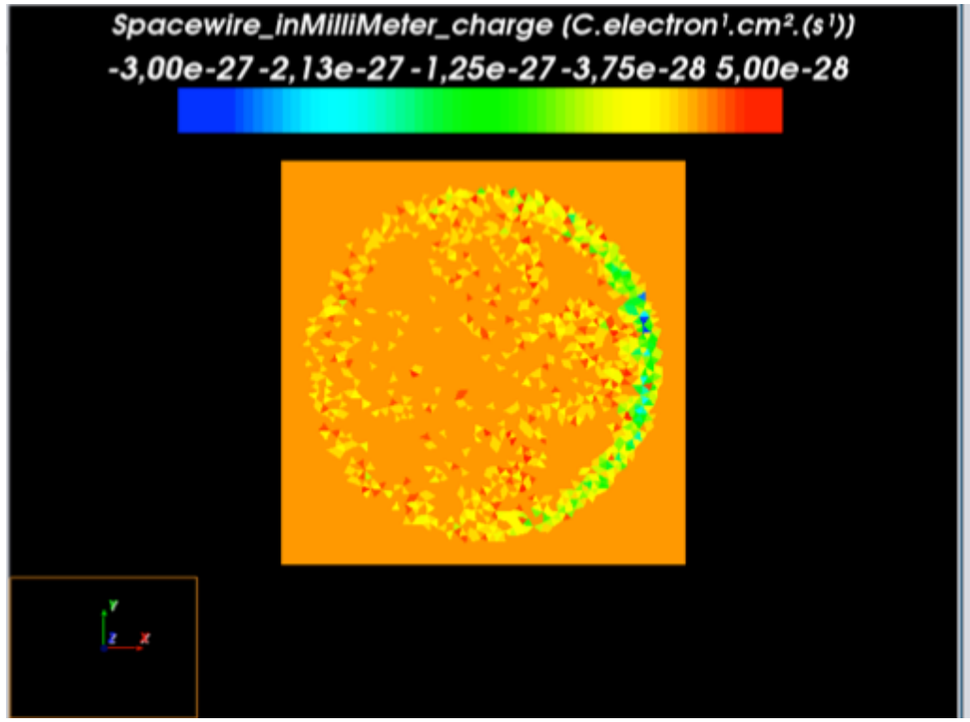
Radiation transport analysis

Modelling Of Radiations

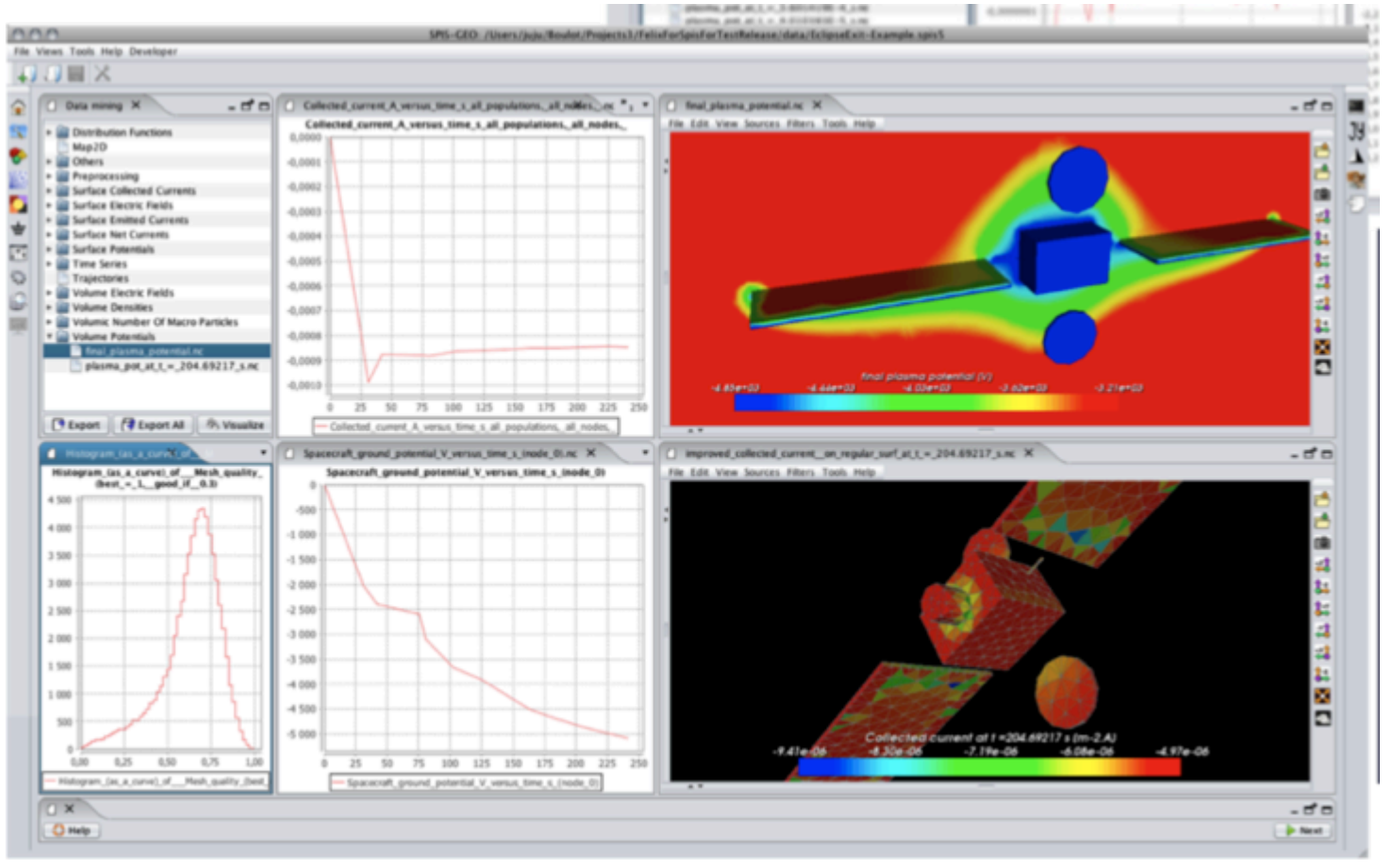
- Example of application case
  - Cable/wire in space







Spacecraft charging and electrical propulsion

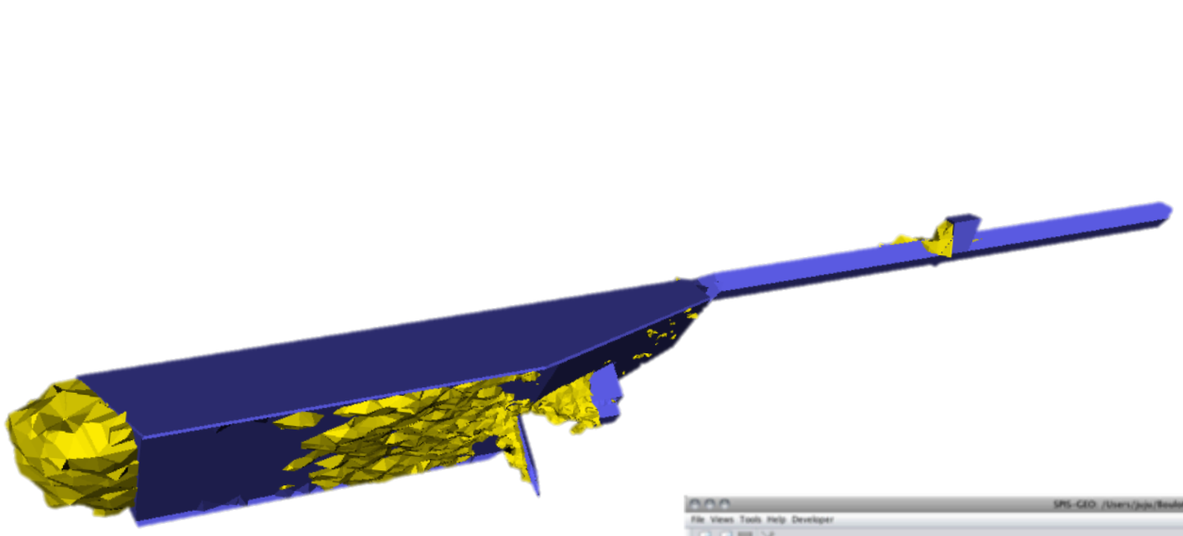


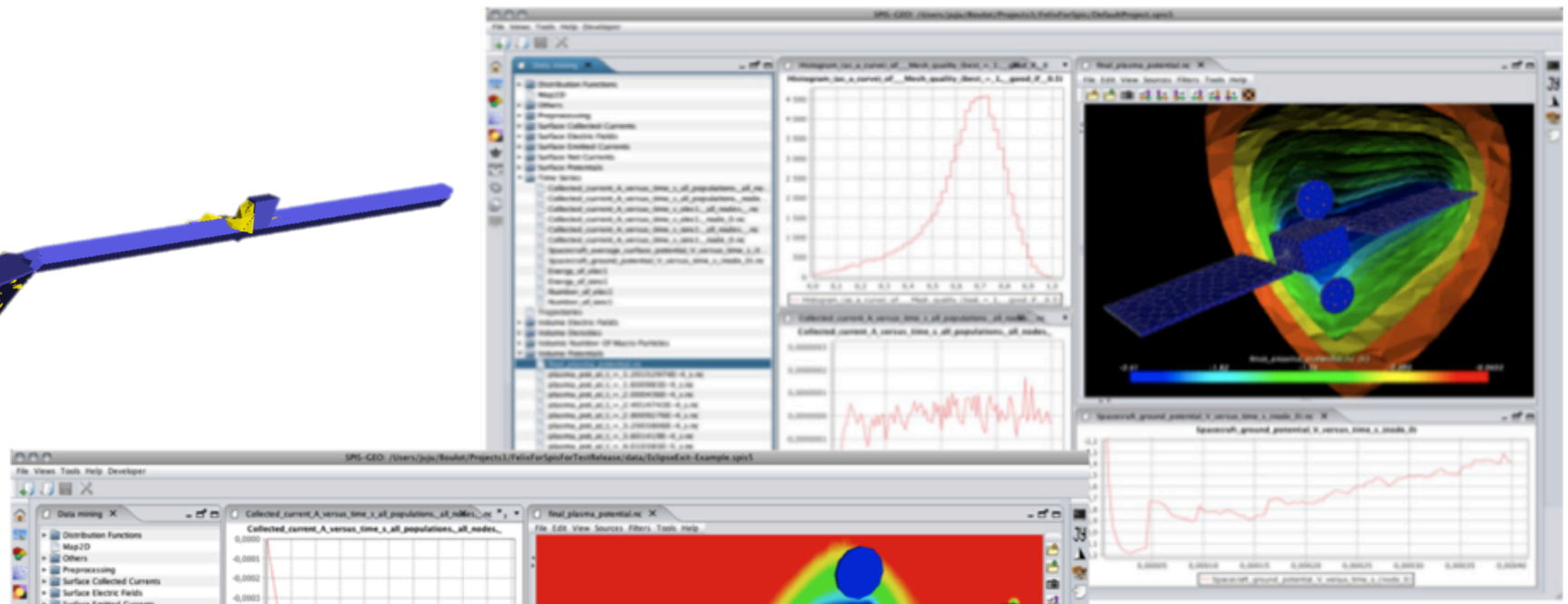
- Spacecraft/plasma interactions and spacecraft charging modelling:
  - Spacecraft charging
  - Sheath and wake structure
  - Electrical thruster plumes
  - ESD and solar array interactions
  - Internal charging
  - Dusty plasma
- Open-source dynamic:
  - SPINE community (www.spis.org)
  - Initiated by ESA and supported by CNES

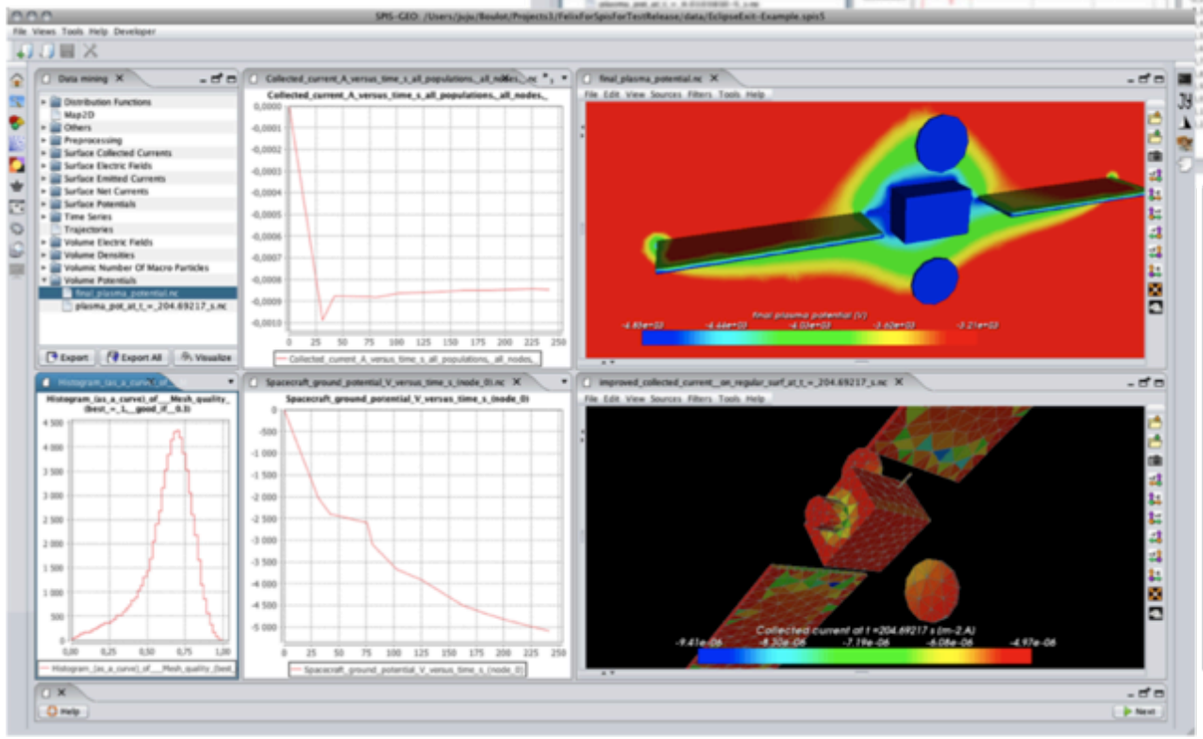
Spacecraft charging and electrical propulsion

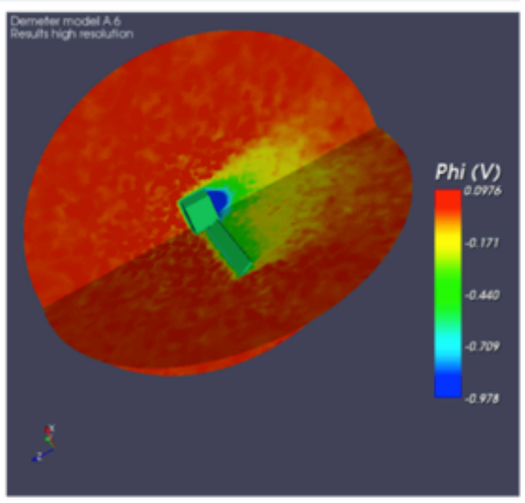
SPIS
Spacecraft Plasma Interactions Software

- Electrostatic sheath analysis
- Plasma wake



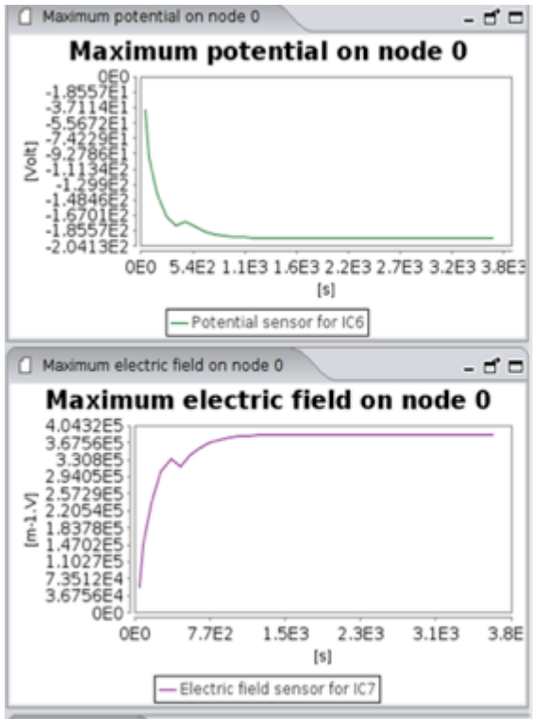


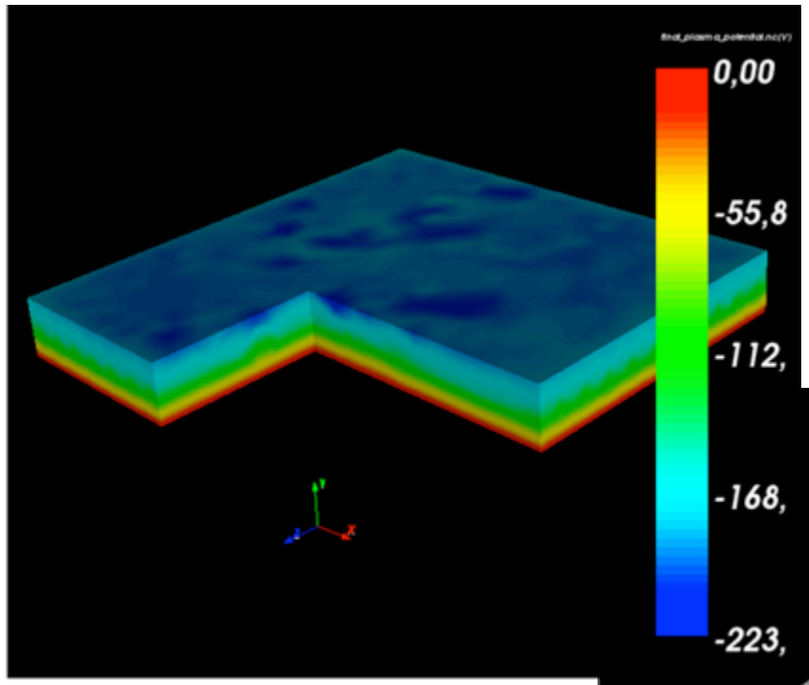


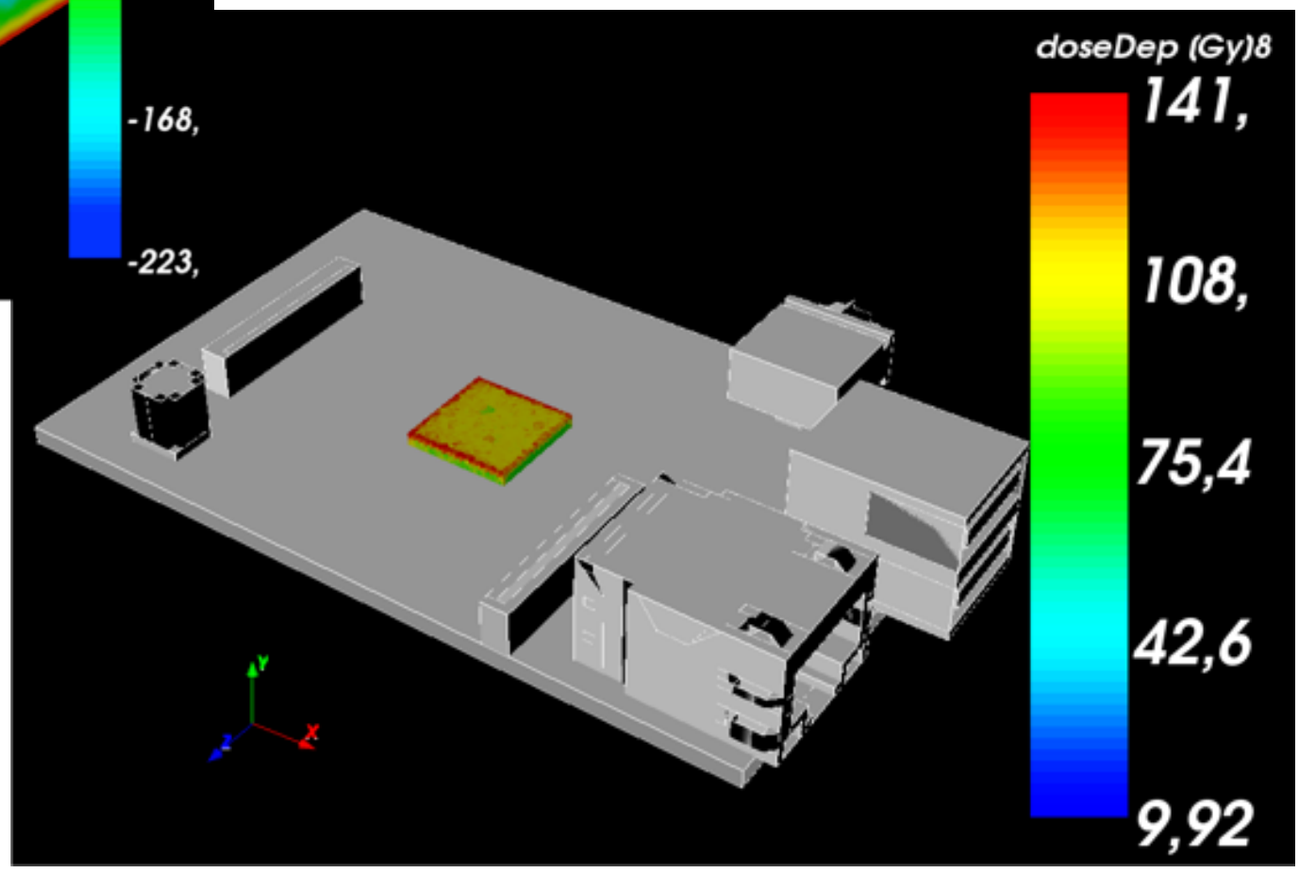


Spacecraft charging and electrical propulsion

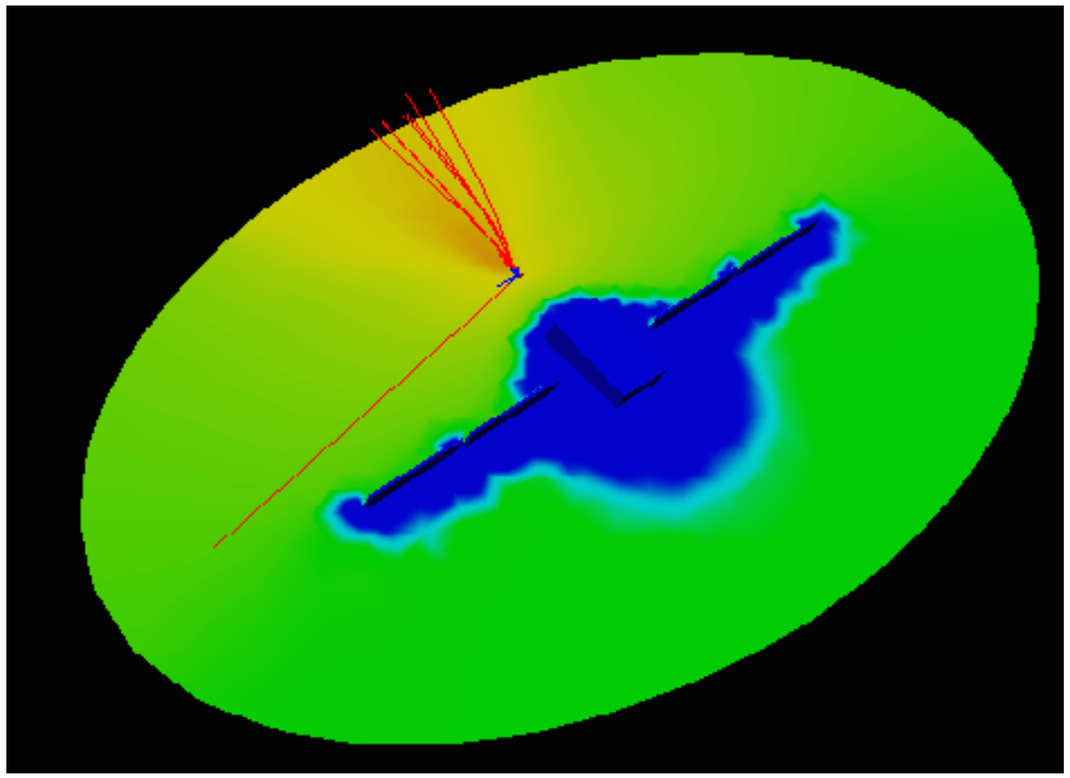
- Internal charging analysis







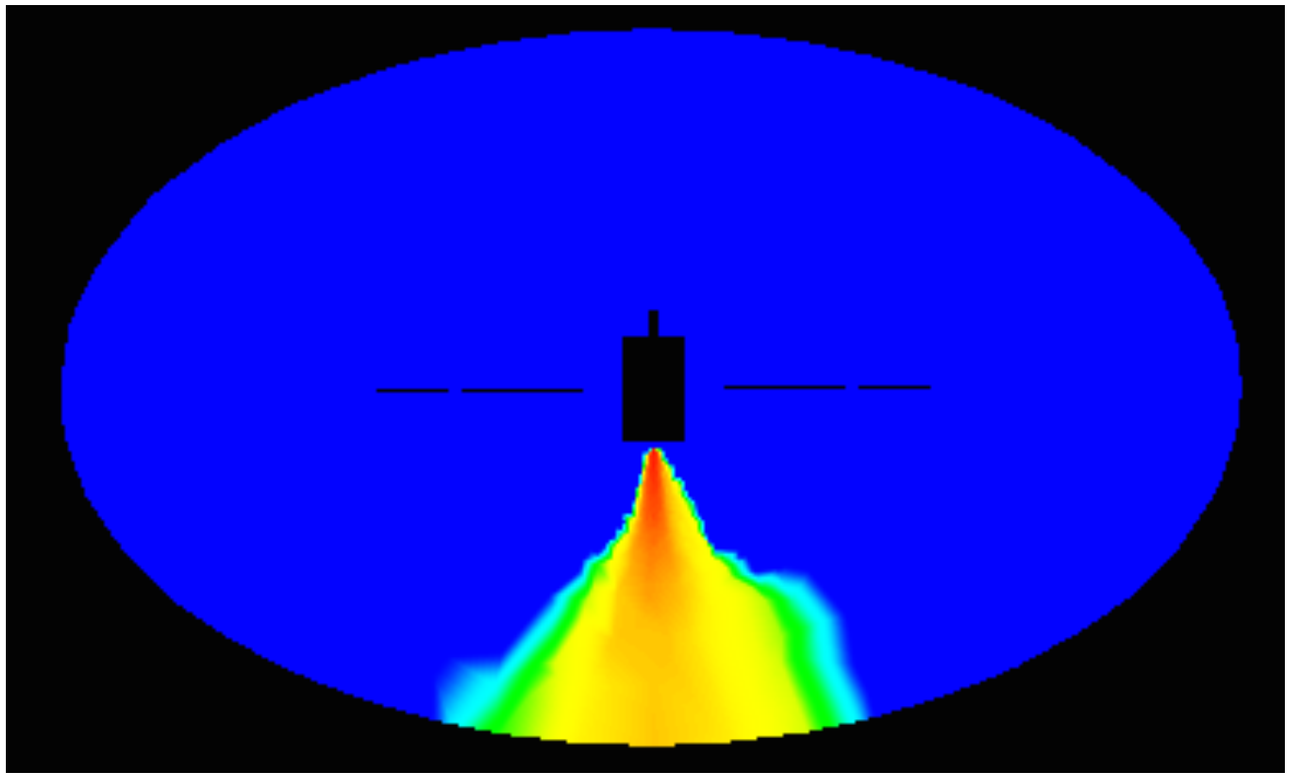
Electrical propulsion plume modelling



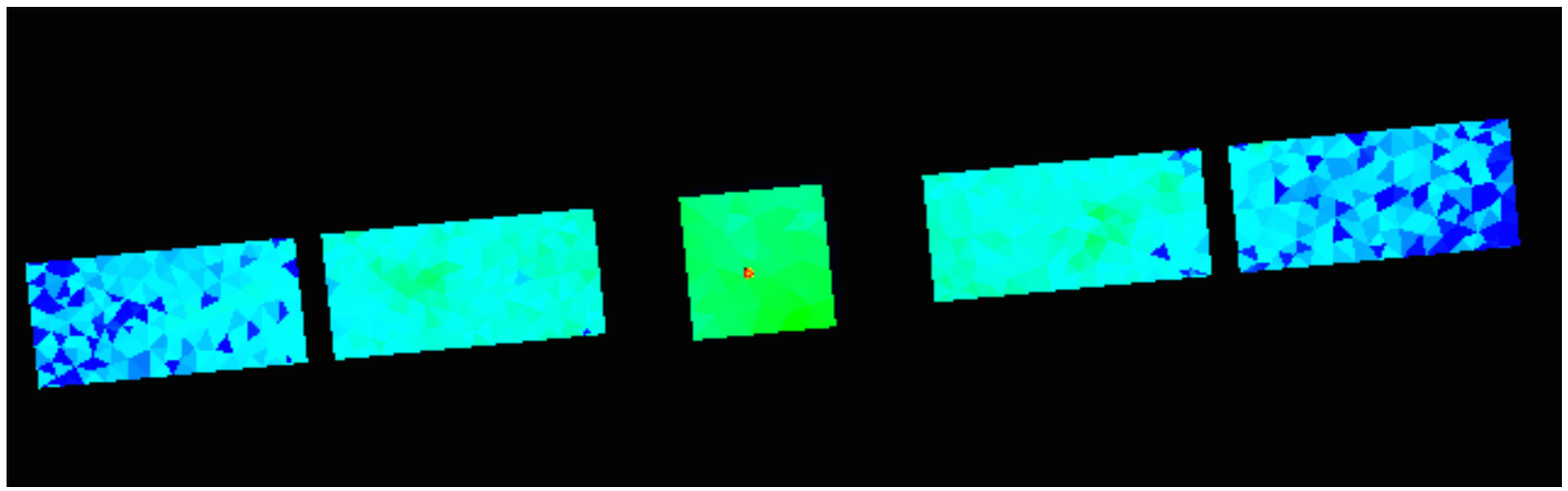
Ions trajectories

Not available yet

Thrust

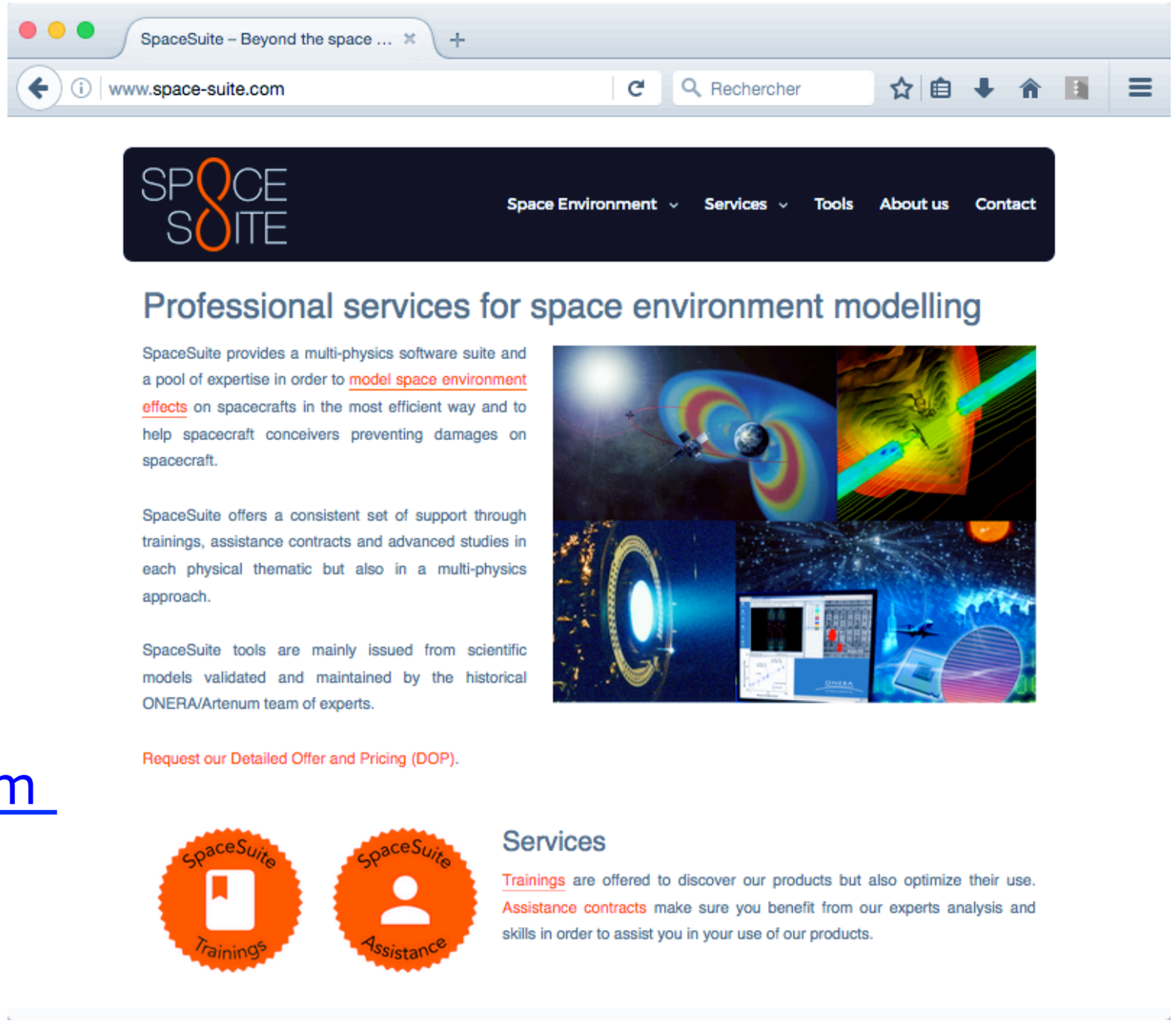


Comtamination



General information

- For more information:
  - contact@space-suite.eu
  - Demand our Detailed Offer and Pricing (DOP);
  - Follow us with our mailing list.
- Please come visit our website:
  - http://www.space-suite.com



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ARTENUM

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