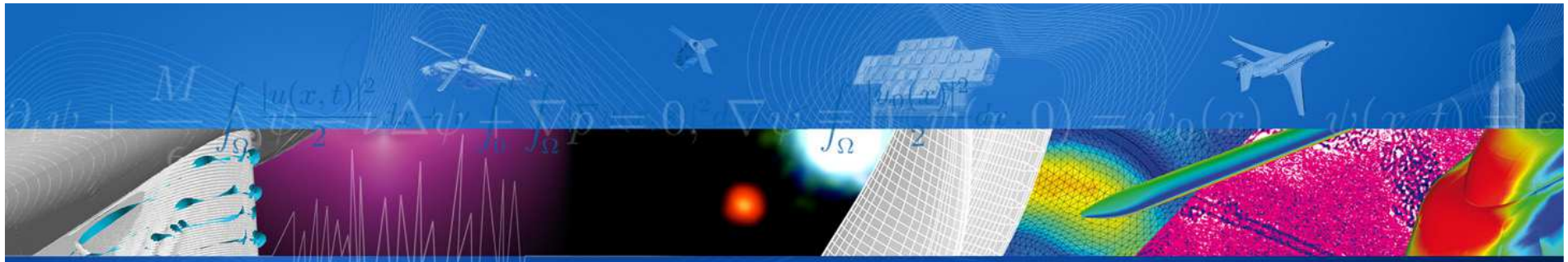


Improved Modelling of Electrical Thruster Induced Plasma plume Interaction

SPIS-EP Release

S. Hess, P. Sarrailh, J.C Matéo-Vélez, A. Hilgers, F. Cipriani, K. Dannemayer, C. Théroude, L. Popelier, B. Thiébault, T. Lagrée, M; Lepilliez, J. Forest, A. Trouche, B. Jeanty-Ruard, V. Perrin-Bailly, A. Sita, S. Brosse, D. N'Guyen Van Song

ONERA

THE FRENCH AEROSPACE LAB

retour sur innovation

SPIS – EP main goals

Simulate the emission of particles from thrusters and cathodes

Simulate the coupling between the thruster plume and the environment

Simulate the coupling between the thruster plume and the spacecraft (including small interconnects on solar panels)

Simulate with the maximum accuracy all the phenomena leading to surface erosion and contamination

Better, Harder, Faster, Stronger ♫

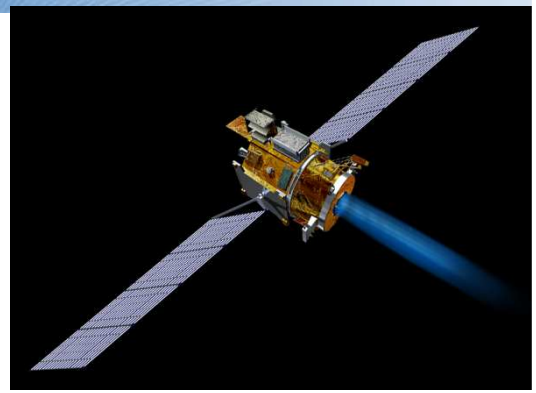
The team

Project started mid-January 2016.

ESA TOs: Alain Hilgers and Fabrice Cipriani

Budget: 300k€

Duration: 2,7 years + 1 year maintenance



Consortium

ONERA (lead.):

- Management
- Requirement definition
- Physical model developments
- Numerical core refactoring & development

ARTENUM, PARIS Science & Groupware

- Software requirements
- User interface updates & developments
- Host and maintenance of the development server
- Packaging

AIRBUS DEFENCE & SPACE

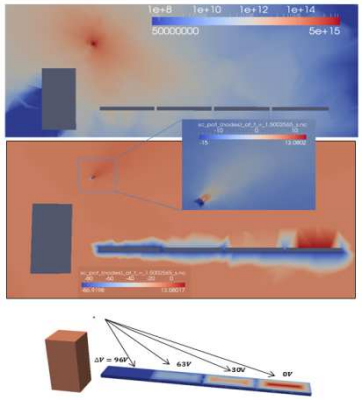
- User requirements
- Validation

ThalesAlenia Space

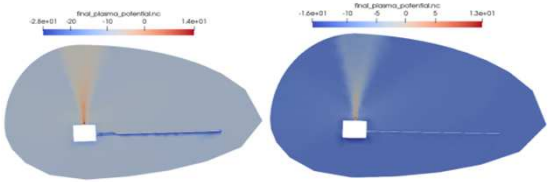
- User requirements
- Testing and feedbacks

First, some results

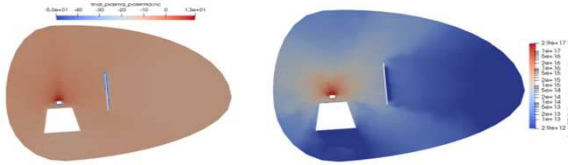
Neosat



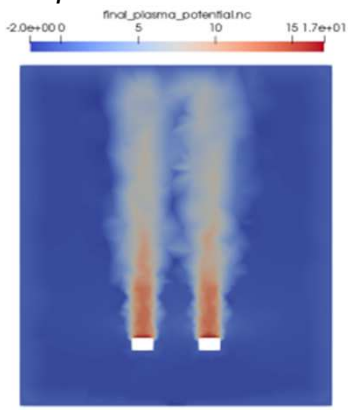
Smart1



OneWeb

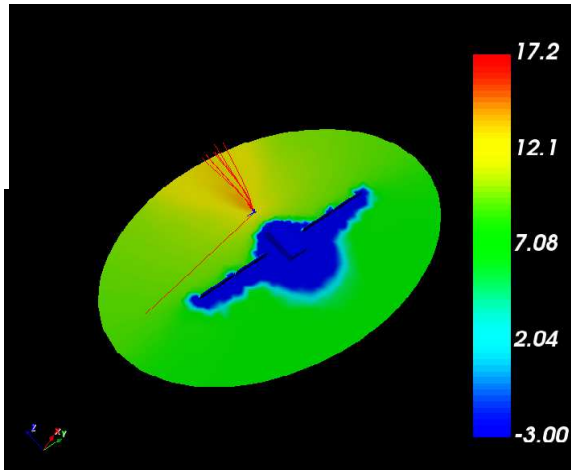


BepiColombo thrusters

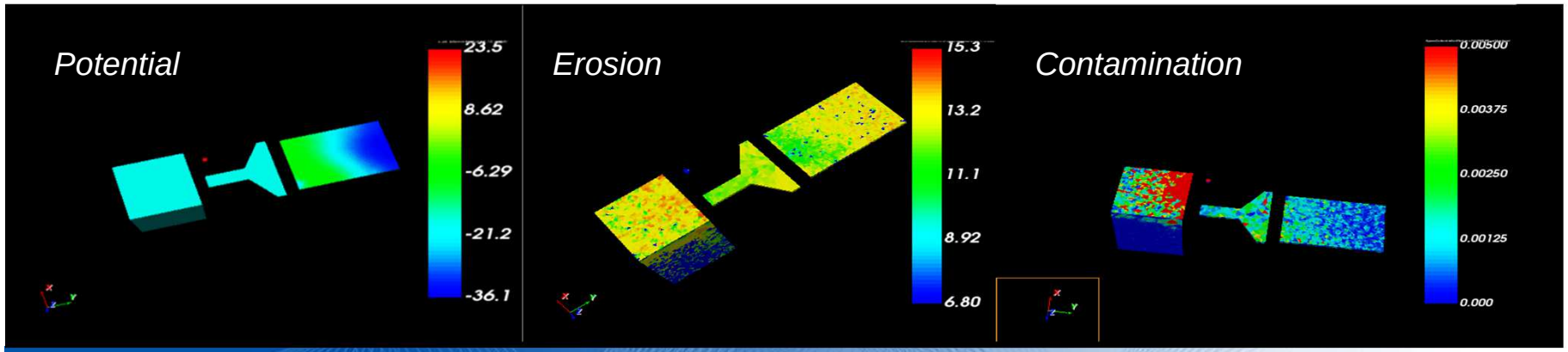


Pictures of Airbus DS validation cases

Cathode electron trajectories and densities in the plume



Pictures of Thales Alenia Space test cases



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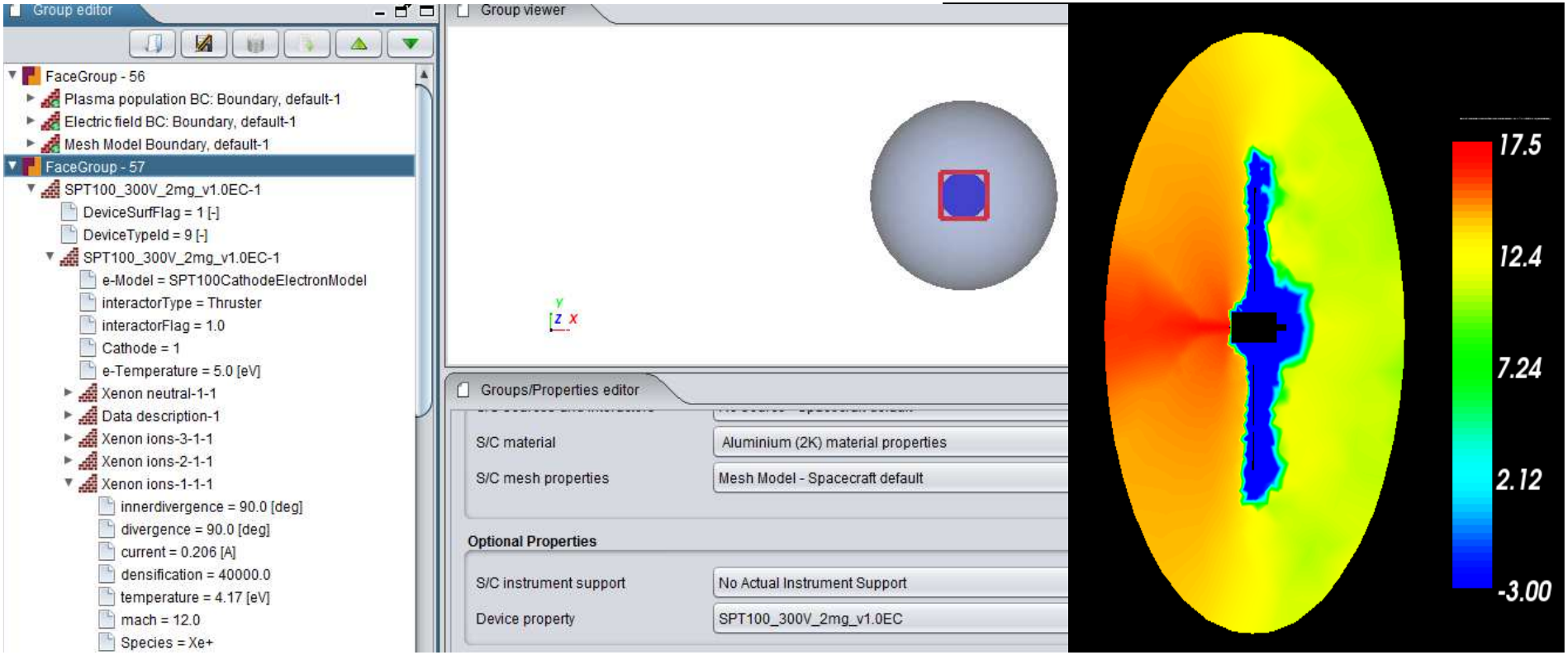
New functionnalities

Simpler setup for thrusters and cathodes



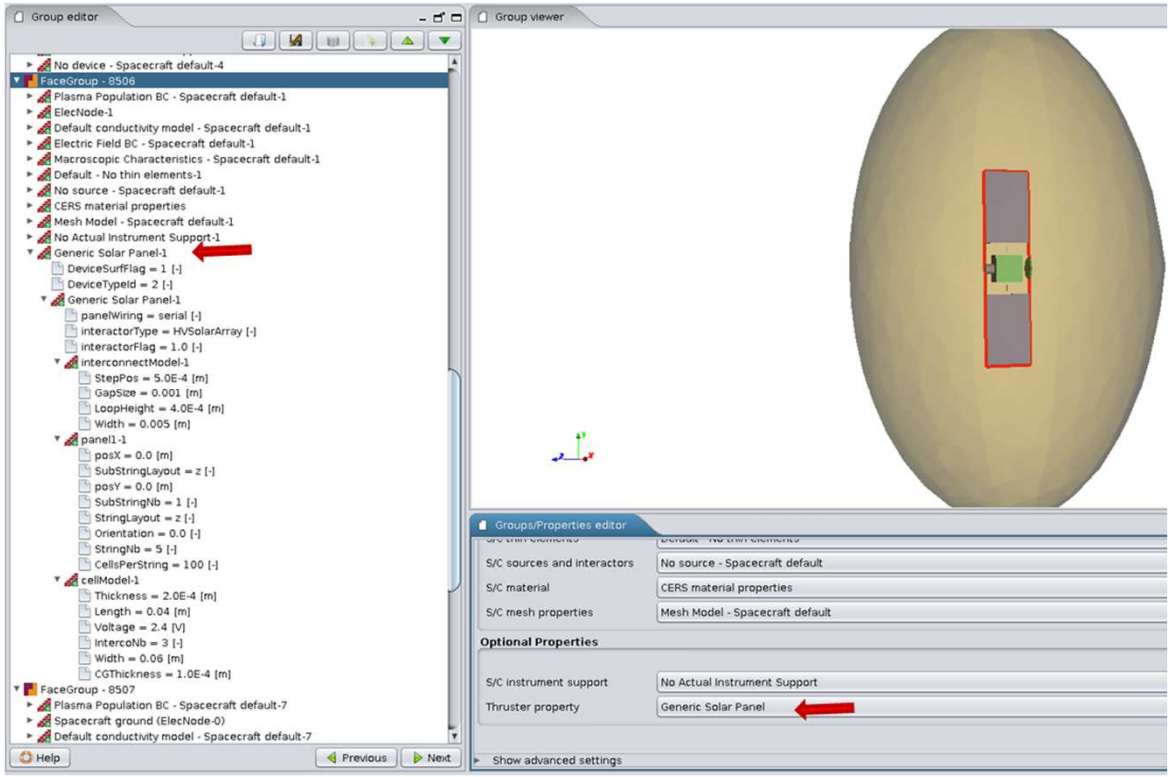
Improved cathode electron models (allows coupling with environement)

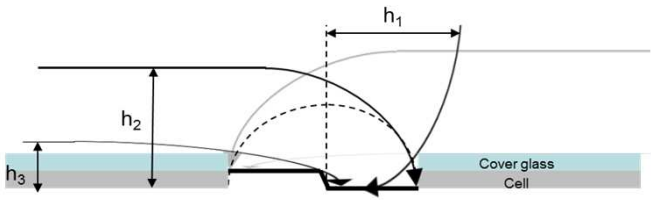
UC3M models of electron cooling (from « Modex » ESA-Airbus DS activity)

Model for multi-cathodes, multi-thruster current balance

New functionnalities

Simpler setup for solar panel



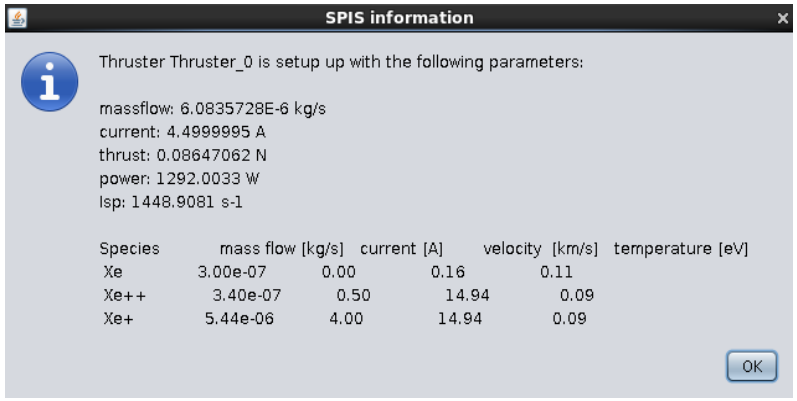


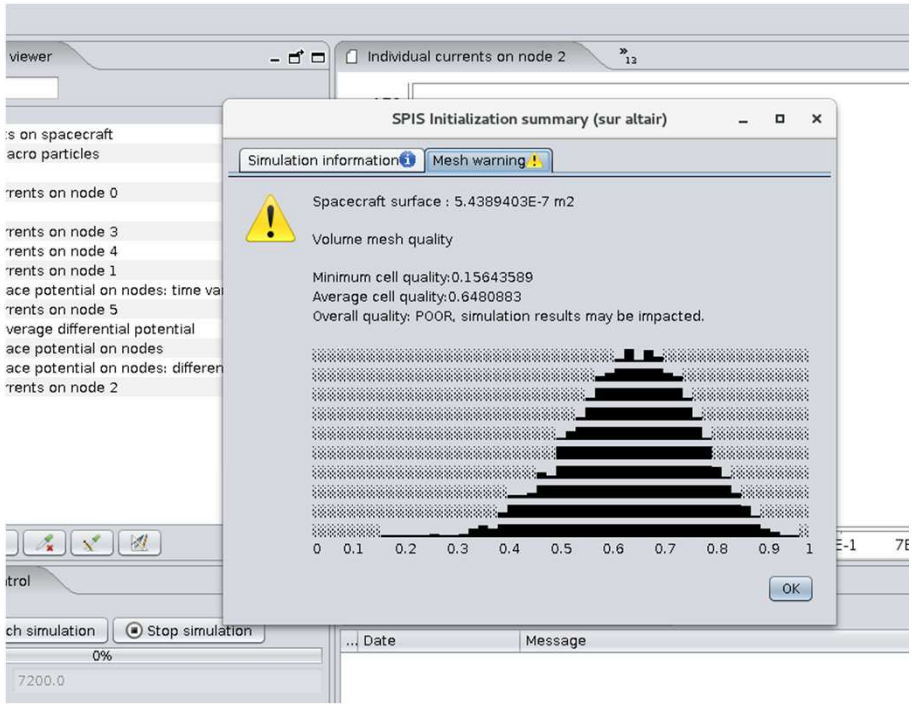
Possibility to define the solar panel layout, the cell and interconnect geometry.

Taken into account in an analytic current collection model.

New functionnalities

SPIS now provides an initialization summary where main parameters can be double checked





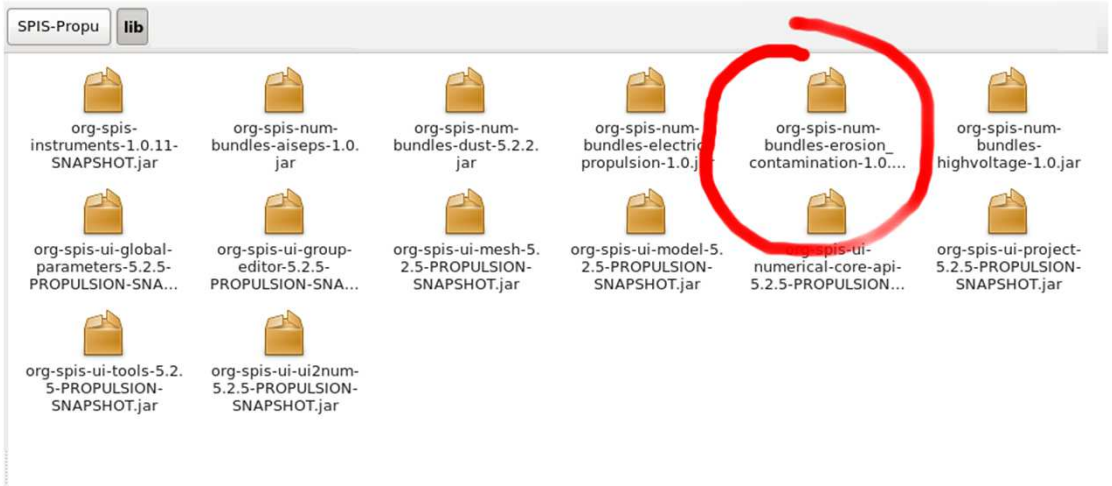
Mesh quality inspector made more easy to find and read….

… there are some reasons to it!

Architecture modifications

SPIS now accept third party plugins:

- allows more flexibility (chose the physics you want)
- eases the maintenance
- eases the new development (create a new plugin instead of modifying the core)
- easy to deploy (just copy the plugin file in SPIS lib directory)



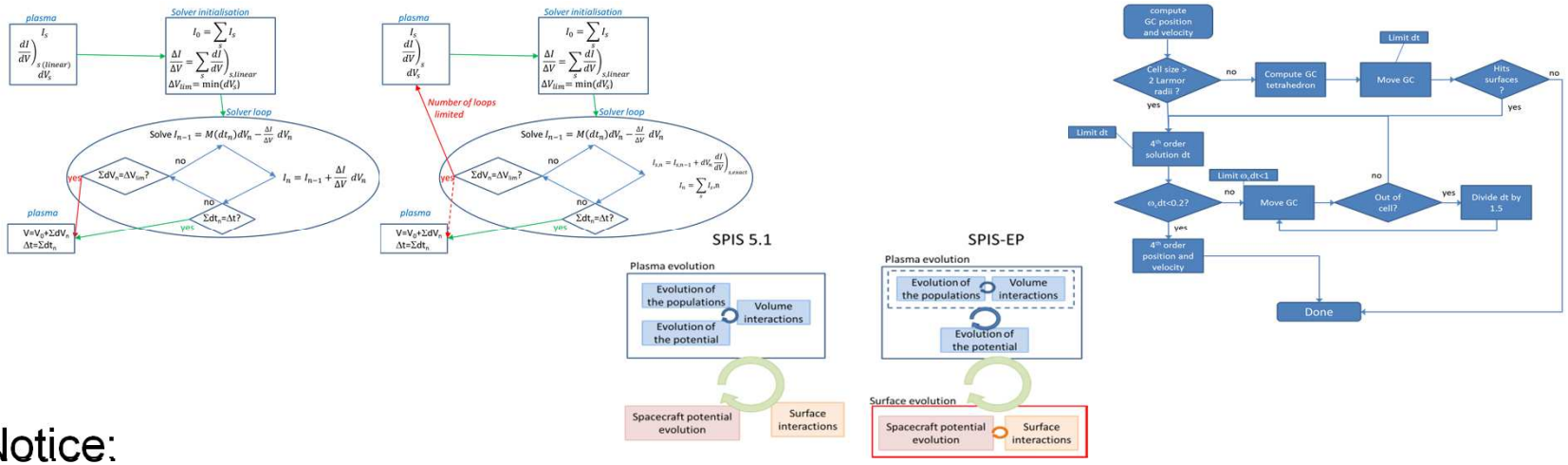
Legal Notice, SPIS is licenced under GPL v3:

- any modification of SPIS UI, SPIS-instrument or SPIS-NUM-CORE must be reversed if it is distributed.
- any software that uses SPIS as a library must have a GPL-compatible licence.
- following GPLv3, this requirement is explicitely excluded for NUM plugins following the NUM API.

Architecture modifications

The circuit, Poisson and (magnetic) field pusher algorithms were improved

Needed to handle simulations with density and current variations by 12 order magnitude over 10cm



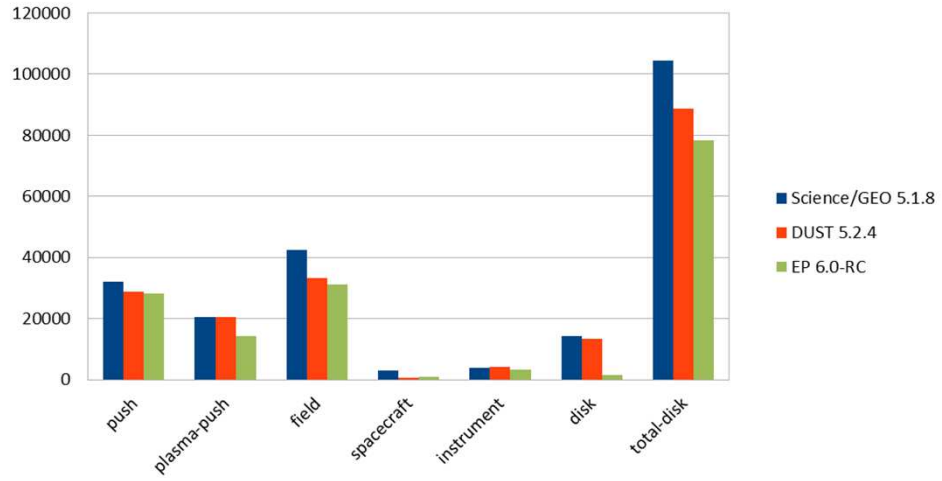
Notice:

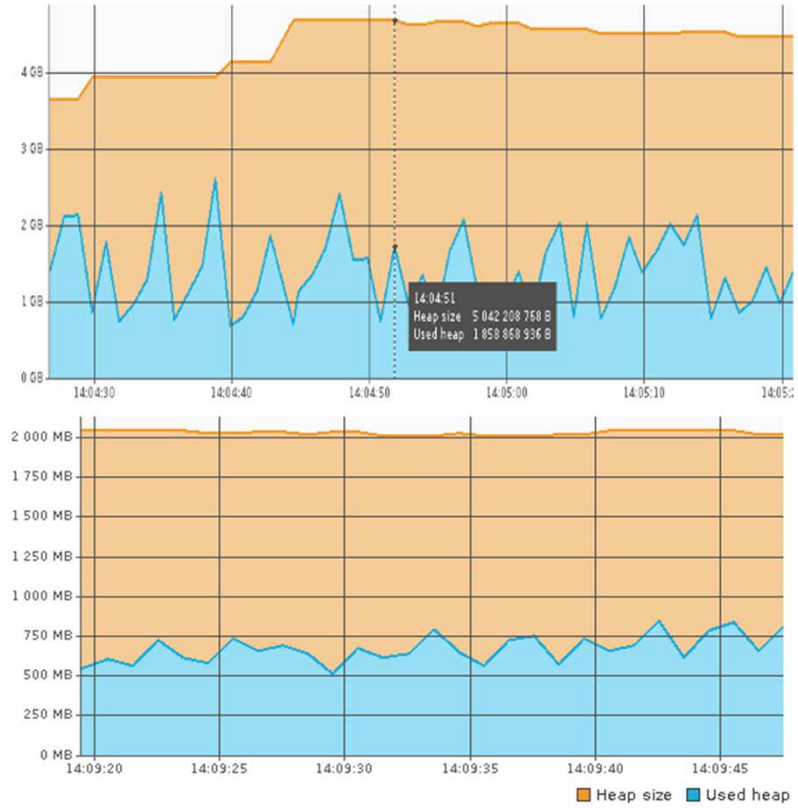
because of these small variations in orders of magnitude, perfoming EP simulations may require a careful setup…

Regression and performances

SPIS-EP passed the non regression chain, plus some tests made by consortium members. Still if you find one, please tell us.

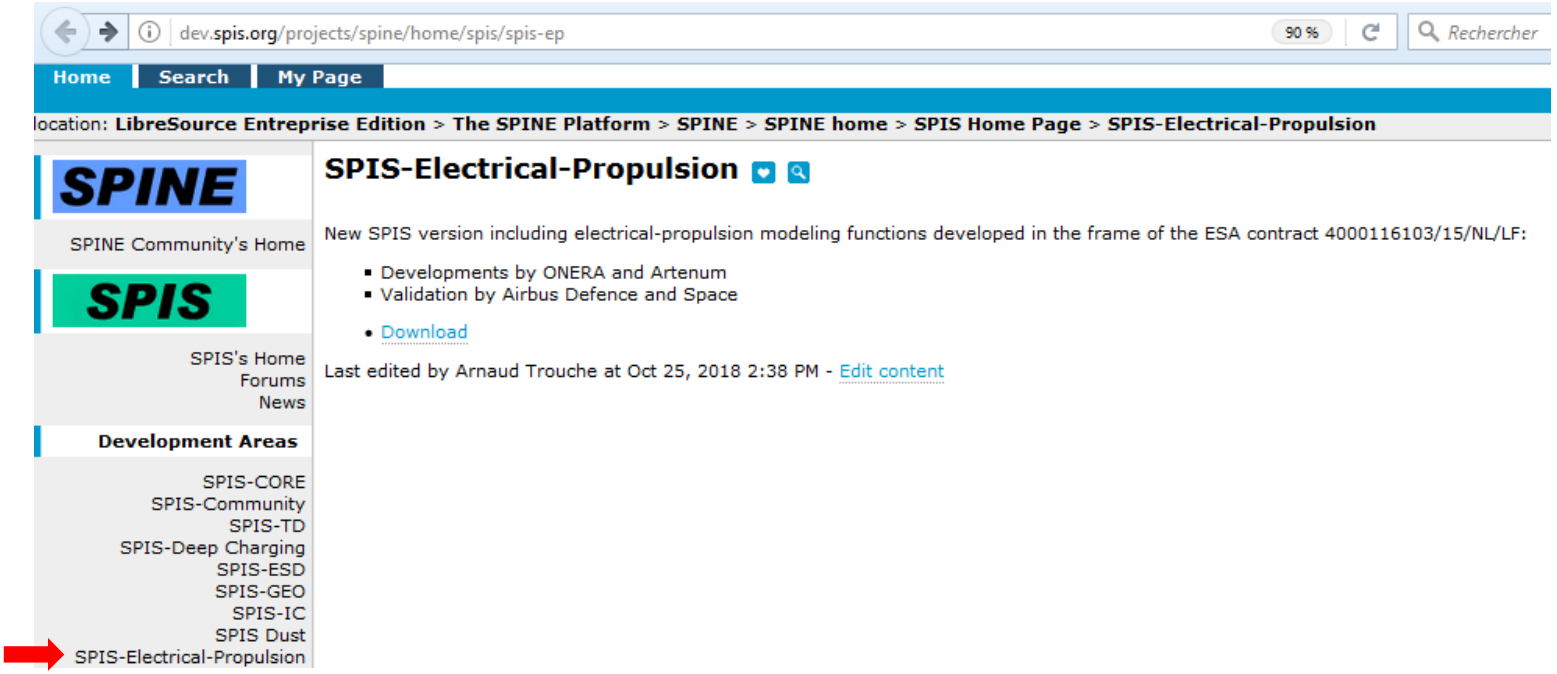
Performance improvement over the NRC





It is available!

Not an official community version yet. But available in the project area of the SPINE website, under GPLv3 licence.



Maintenance period still running for ~1year, feedback welcome