SPIS-UI

Integrated Modelling Environment (EMI) for Space Modelling

Final presentation

CAD modelling and pre-processing

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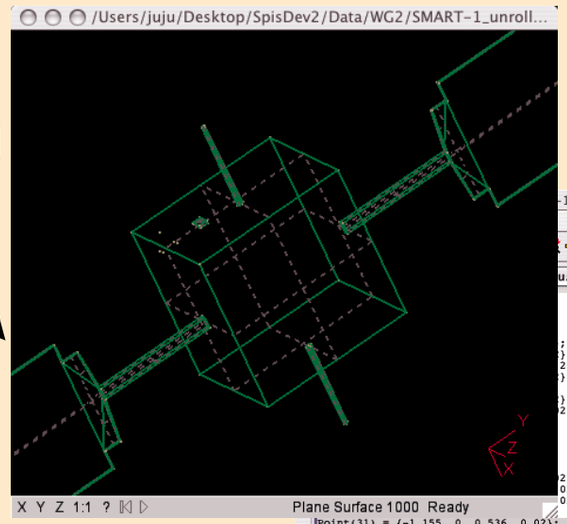
System building

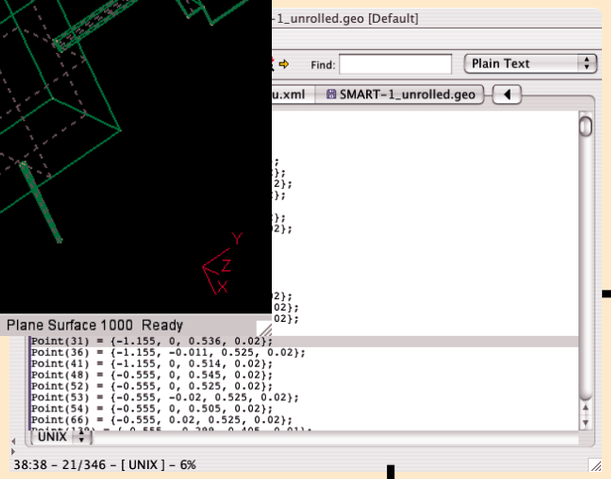
- Define the system (S/C + environment) to be modelled
  - Define the S/C geometry (CAD modelling)
  - Define the boundary and the initial conditions
    - Attribution of material properties
    - Attribution of “plasma model”, i.e numerical properties
    - Attribution of electrical properties
- Deploy fields on the mesh(es) taking into account priority rules
- Convert for the “generic” structure to the solver one

Modelling process: pre-processing

import



CAD edition
(gmsh+Jedit)



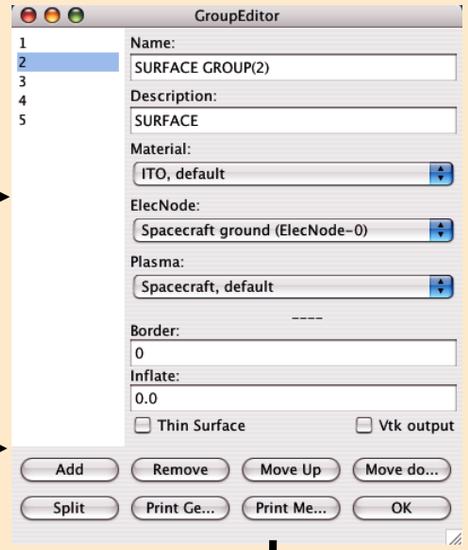
Properties

Meshing

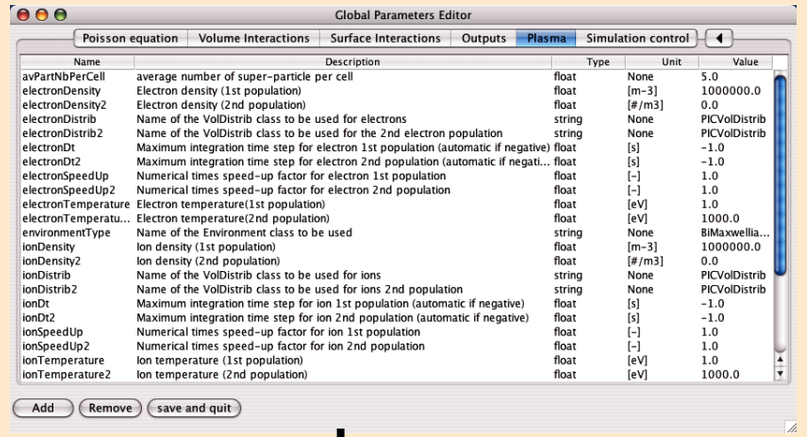
- Gmsh
- Netgen
- Other...

SPIS-UI pre-processing modules

local parameters
and BC



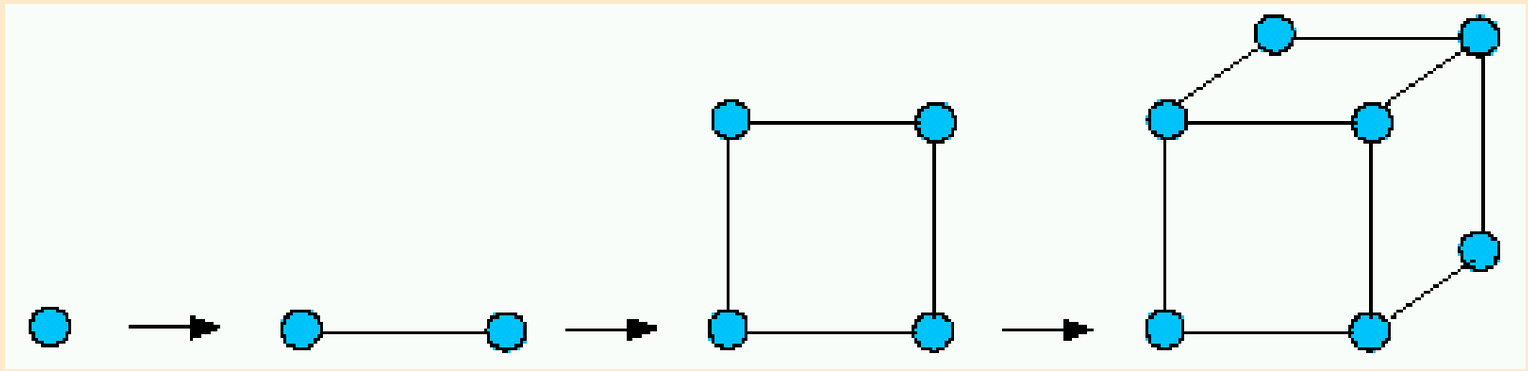
Global parameters



Modelled
system

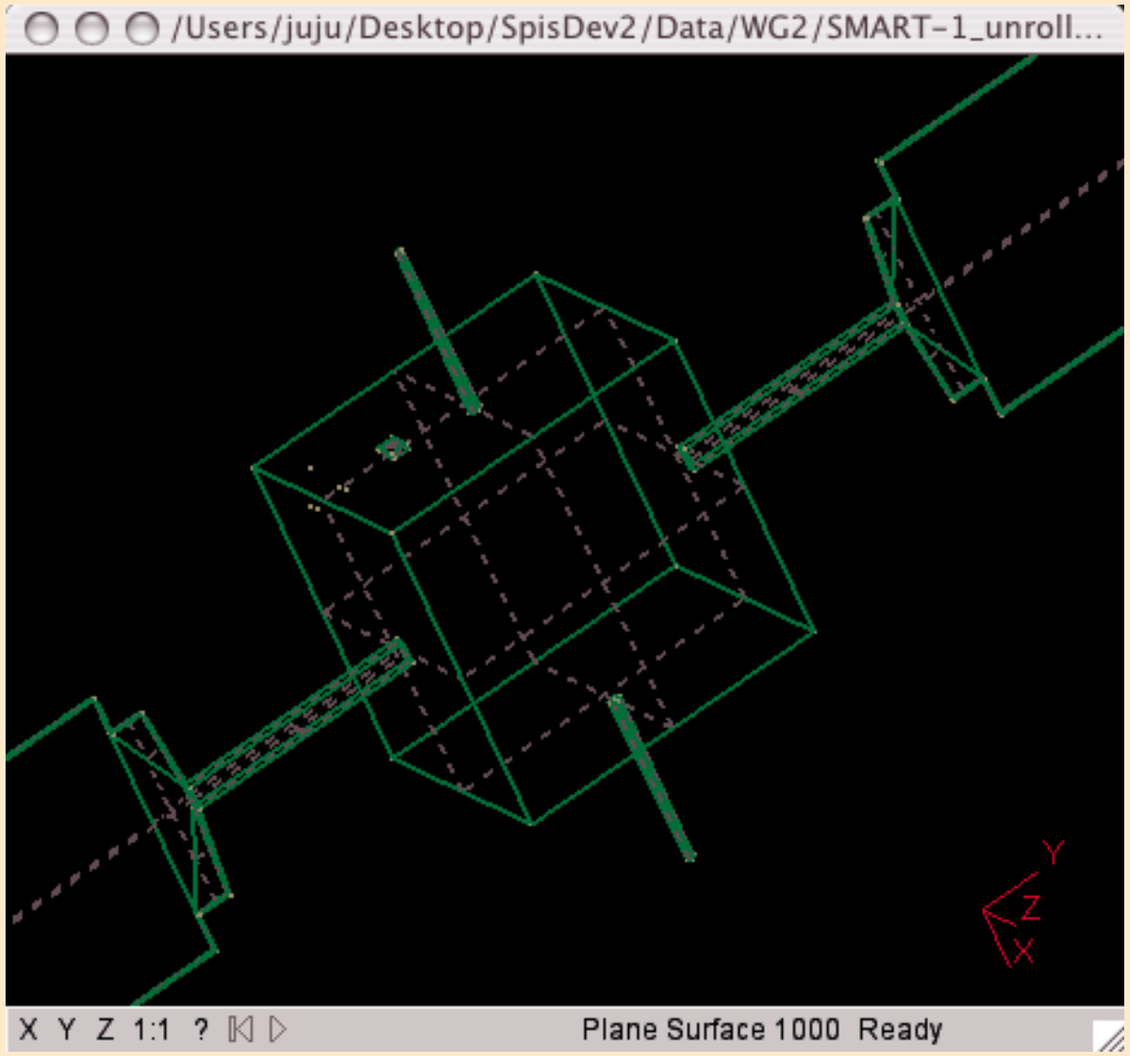
CAD modelling (1)

- Based on a BERPS approach (boundary)
  - Definition of the base nodes
  - building of the edges
  - Close loop of edges to define surfaces
  - Close loop of faces to define volume



CAD modelling (2)

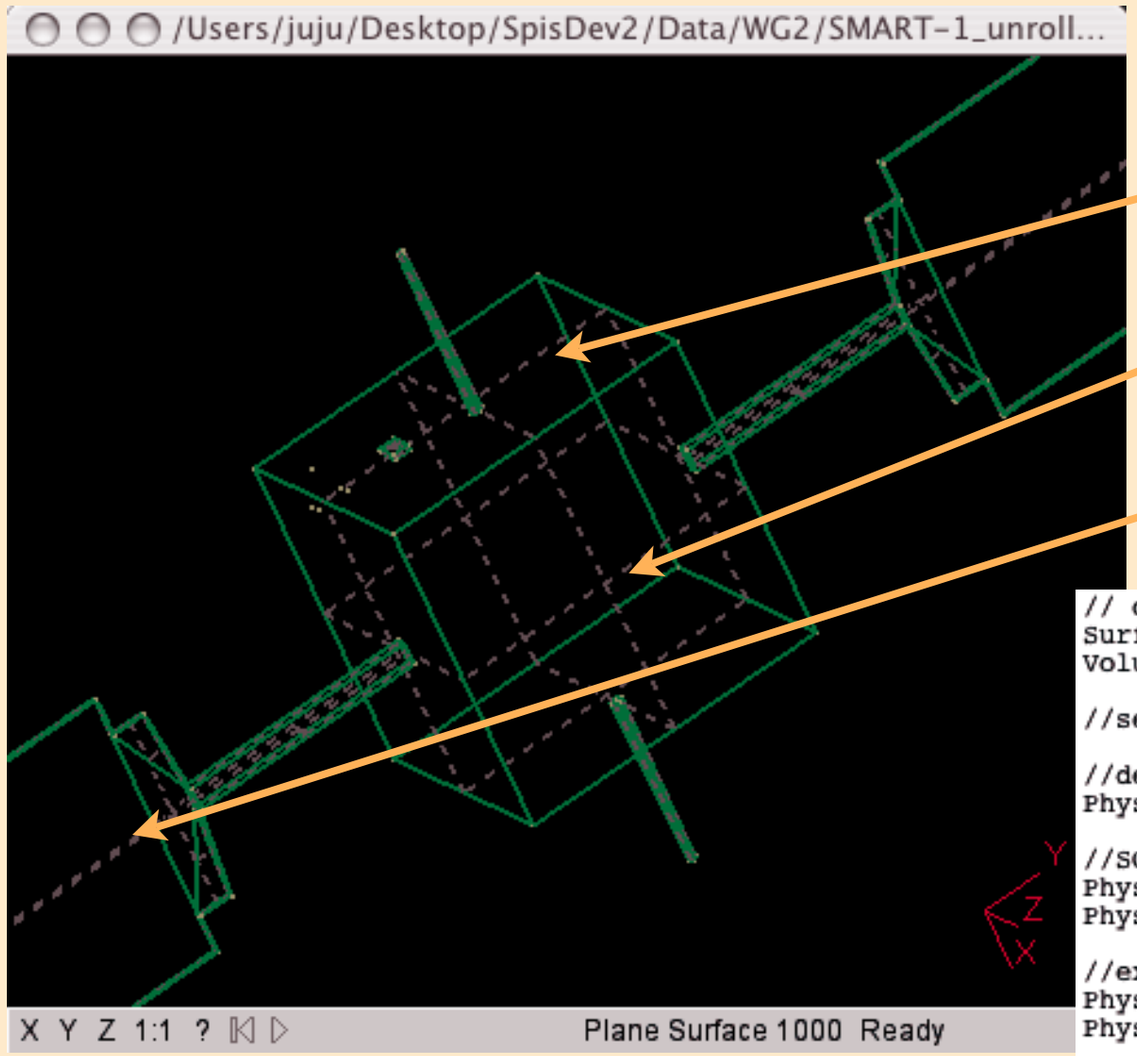
Gmsh based approach




```
// SC definition
Point(1) = {0, 0, 0, 2.9};
Point(2) = {10, 0, 0, 2.9};
Point(3) = {0, 10, 0, 2.9};
Point(4) = {0, 0, 10, 2.9};
Point(5) = {10, 0, 10, 2.9};
Point(6) = {0, 10, 10, 2.9};
Point(7) = {10, 10, 0, 2.9};
Point(8) = {10, 10, 10, 2.9};

Line (1) = {7, 2};
Line (2) = {2, 5};
Line (3) = {5, 8};
Line (4) = {8, 7};
Line (5) = {8, 6};
Line (6) = {6, 3};
Line (7) = {3, 7};
Line (8) = {6, 4};
Line (9) = {4, 5};
Line (10) = {1, 4};
Line (11) = {1, 2};
Line (12) = {1, 3};

Line Loop (1) = {7, 1, -11, 12};
Plane Surface (1) = {1};
Line Loop (2) = {4, -7, -6, -5};
Plane Surface (2) = {2};
Line Loop (3) = {6, -12, 10, -8};
Plane Surface (3) = {3};
Line Loop (4) = {3, 4, 1, 2};
Plane Surface (4) = {4};
Line Loop (5) = {5, 8, 9, 3};
Plane Surface (5) = {5};
Line Loop (6) = {9, -2, -11, 10};
Plane Surface (6) = {6};

//external boundary definition
Point(9) = {5, 5, 5, 0.5};
Point(10) = {6, 5, 5, 0.5};
Point(11) = {5, 6, 5, 0.5};
Point(12) = {5, 5, 6, 0.5};
Point(13) = {6, 5, 6, 0.5};
Point(14) = {5, 6, 6, 0.5};
```

Attributes local properties (1)

- Definition of sub-systems to applied local data



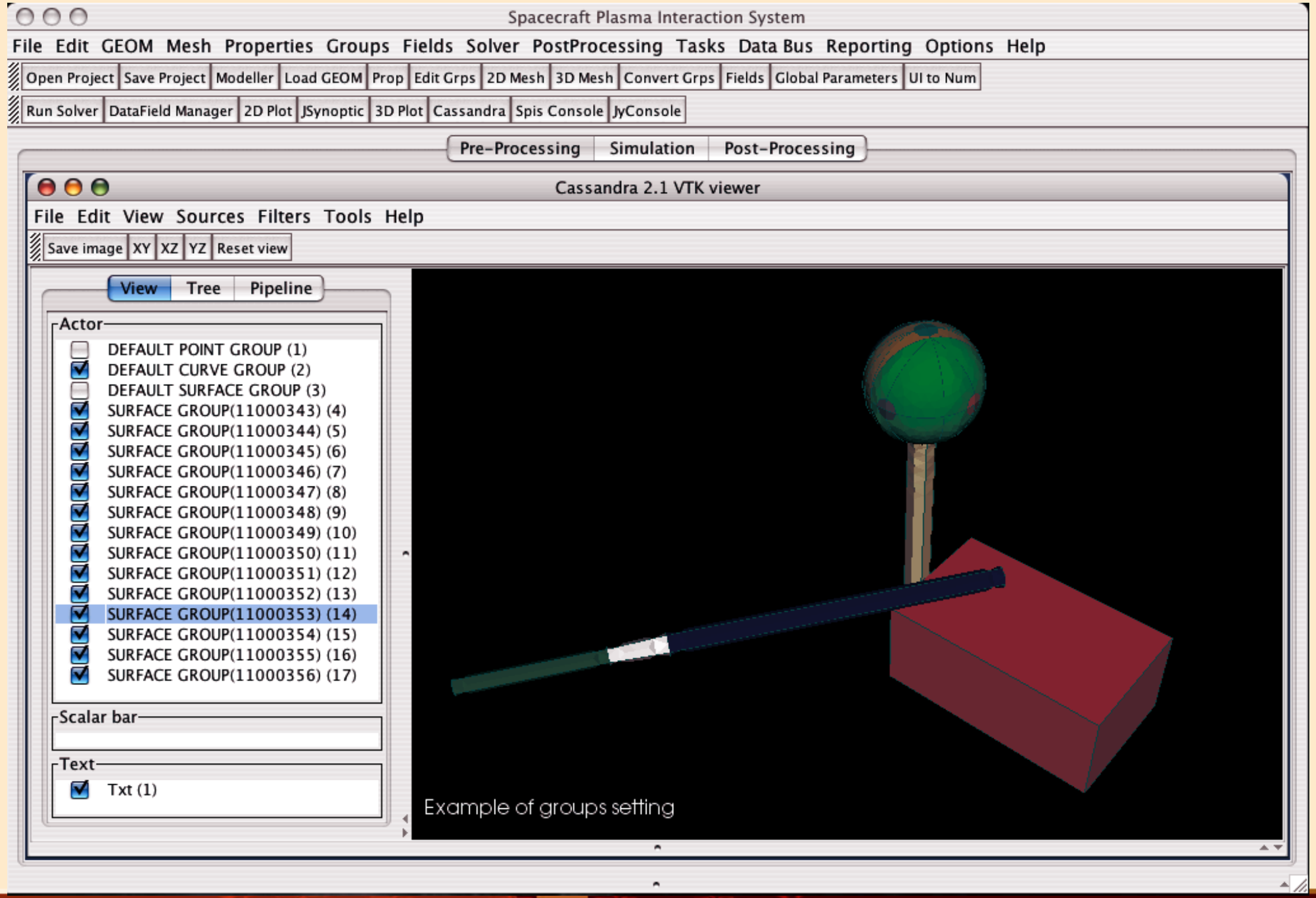
Group or Physical 1

Group or Physical 2

Group or Physical XX...

```
// conputationnal volume
Surface Loop (1) = {2, 4, 5, 3, 6, 1, 8, 10, 11, 9, 12, 7};
Volume (1) = {1};

//setting and attribution of physical (for groups setting)

//default group for nodes
Physical Point (6) = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16};

//SC
Physical Surface (1) = {7, 8, 10};
Physical Surface (2) = {11, 9, 12};

//external boundary
Physical Surface (3) = {1, 2, 4};
Physical Surface (4) = {5, 3, 6};

//comutationnal domaine
Physical Volume (5) = {1};
```

Groups/Physical visualisation



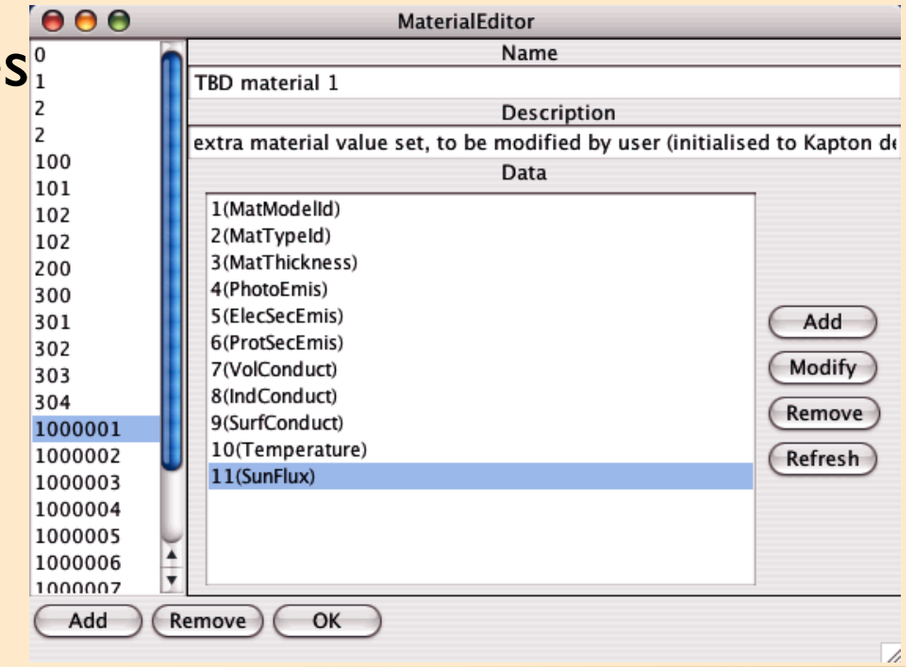
Groups Manager: link CAD *physical* and properties

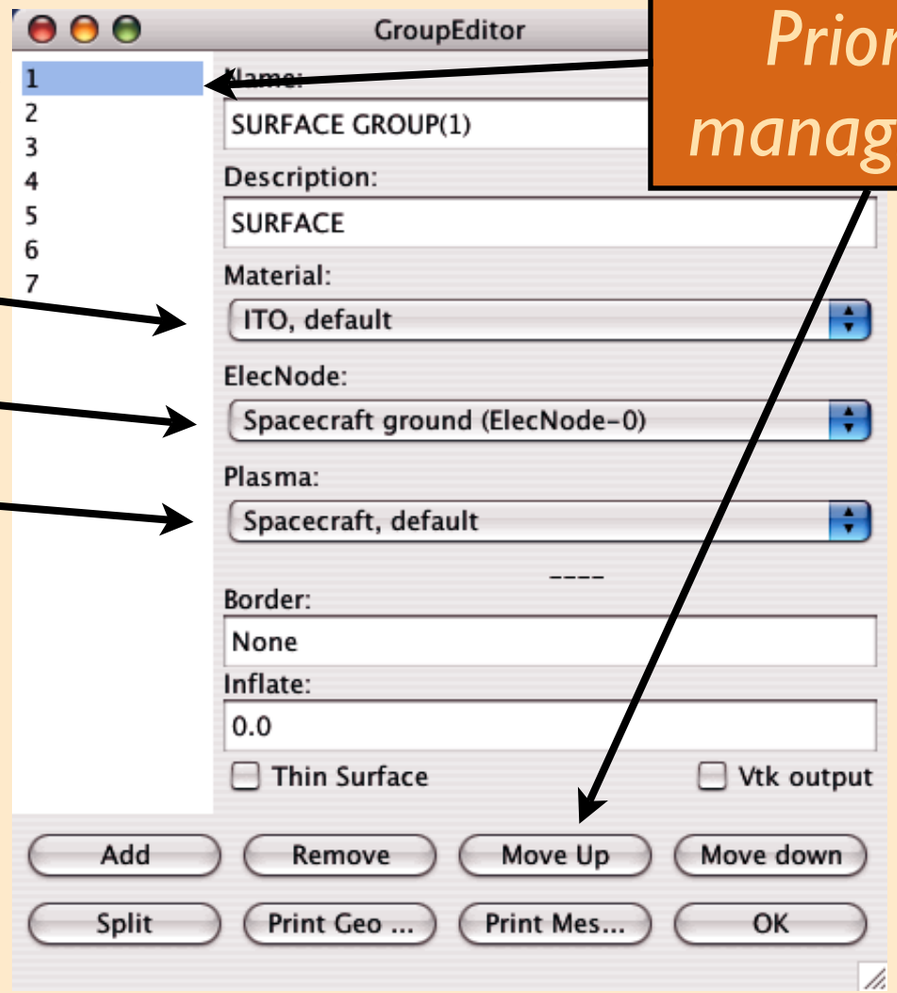
CAD *physicals* (topology)

Catalogues of properties

- Materials
- Electrical nodes
- Plasmas

Properties editor



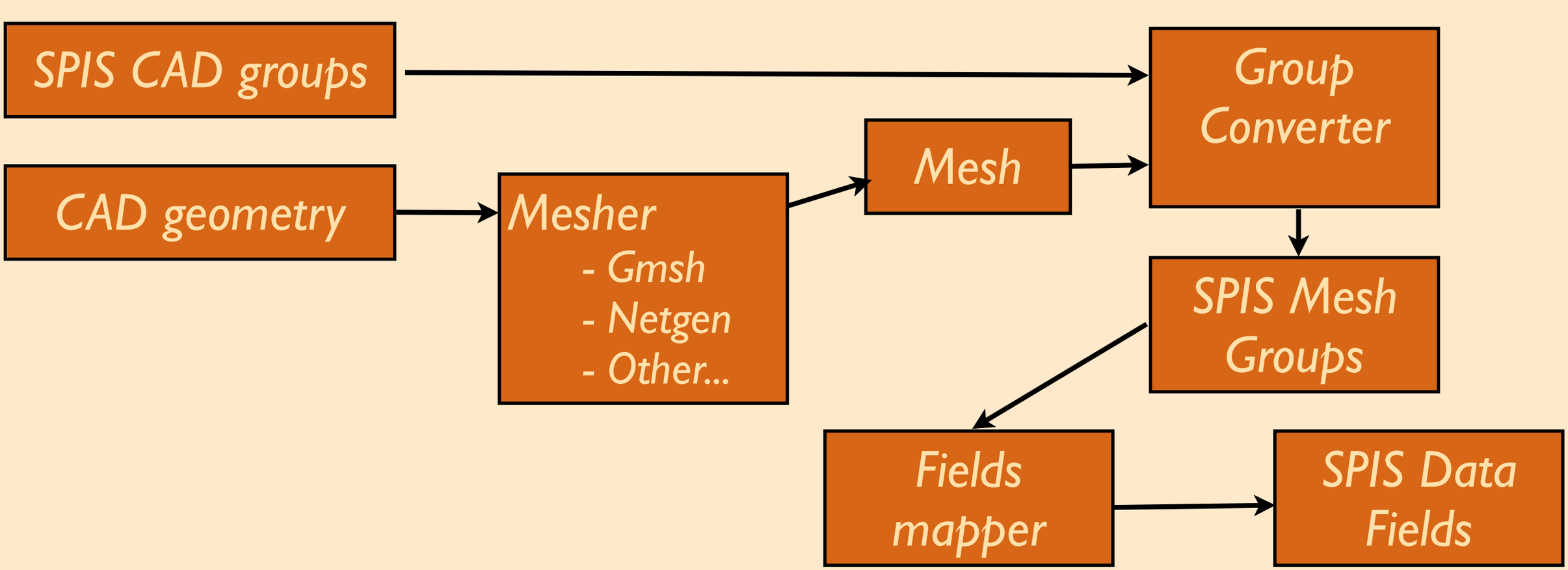


Priority managment

SPIS CAD groups

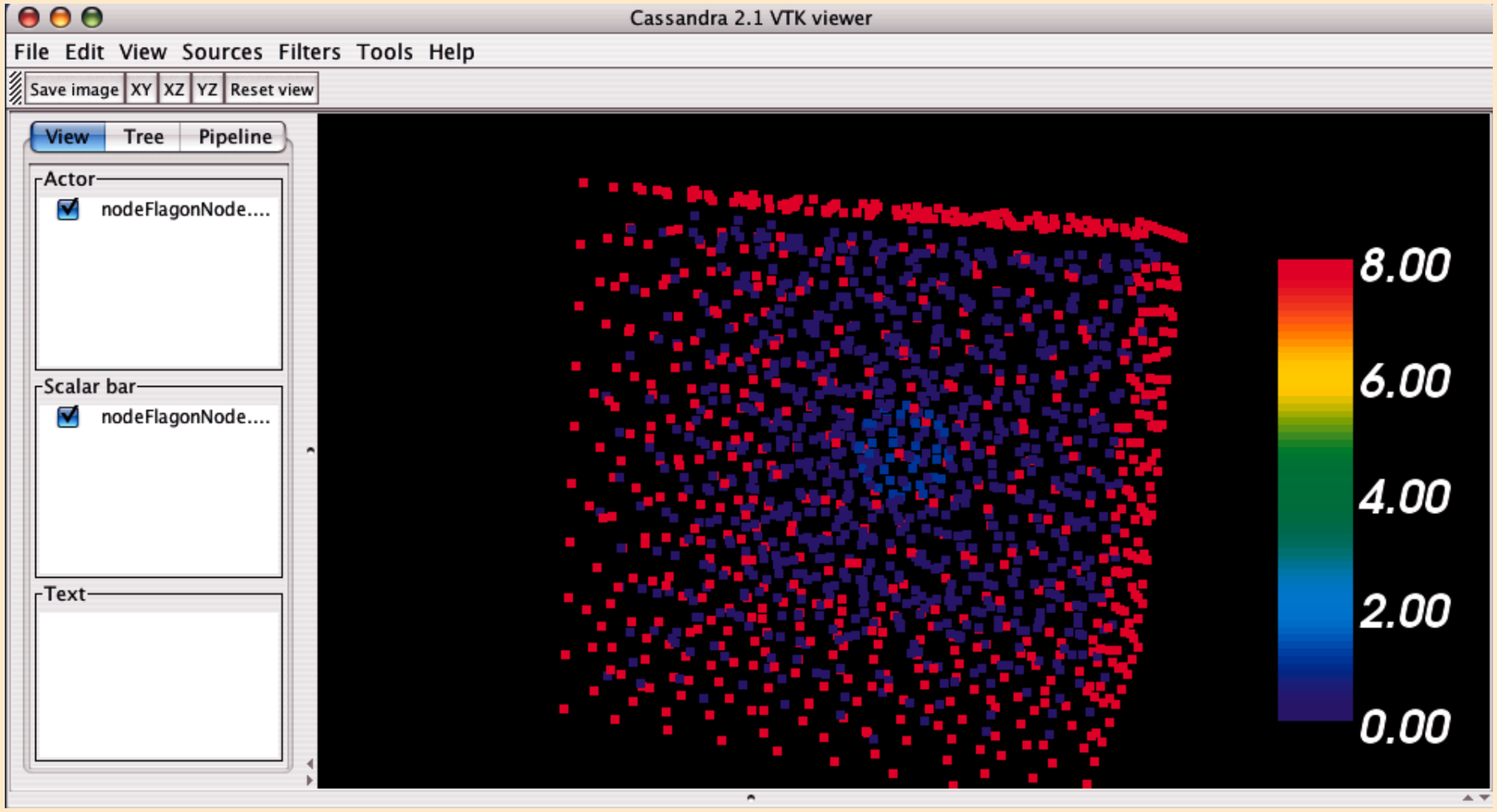
Meshing and fields deployement

- Solvers understand fields deployed on mesh only
  - need to mesh
  - need to convert CAD groups to groups of mesh
  - need to "map" or "deploy" fields on the mesh



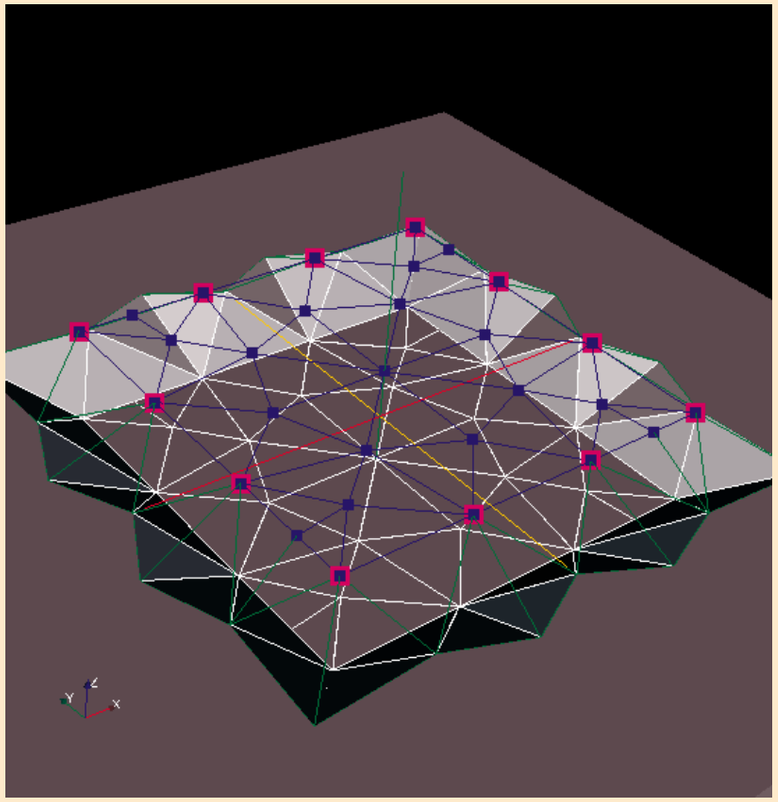
Deployed fields

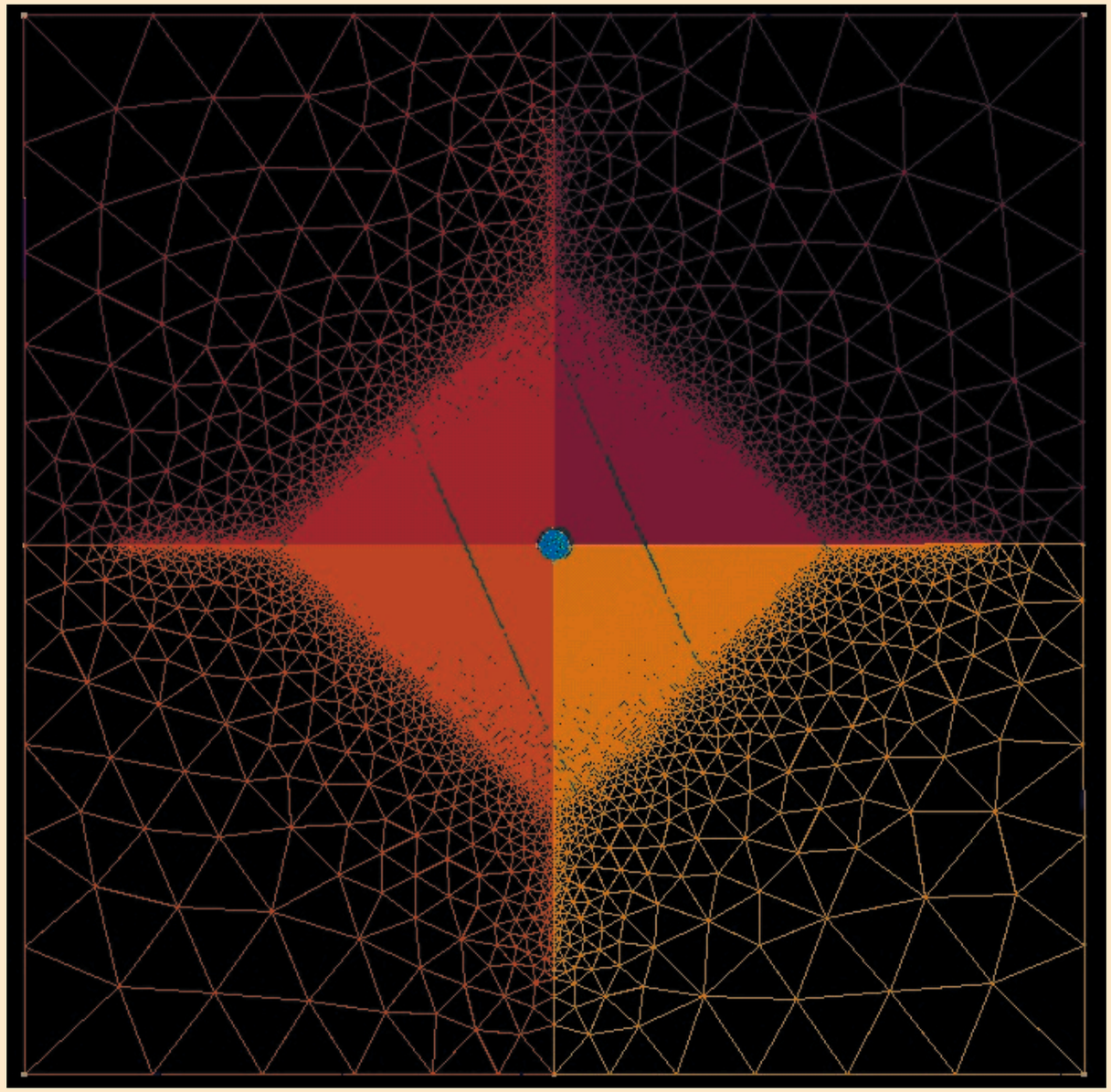
- Same tools for pre and post-processing



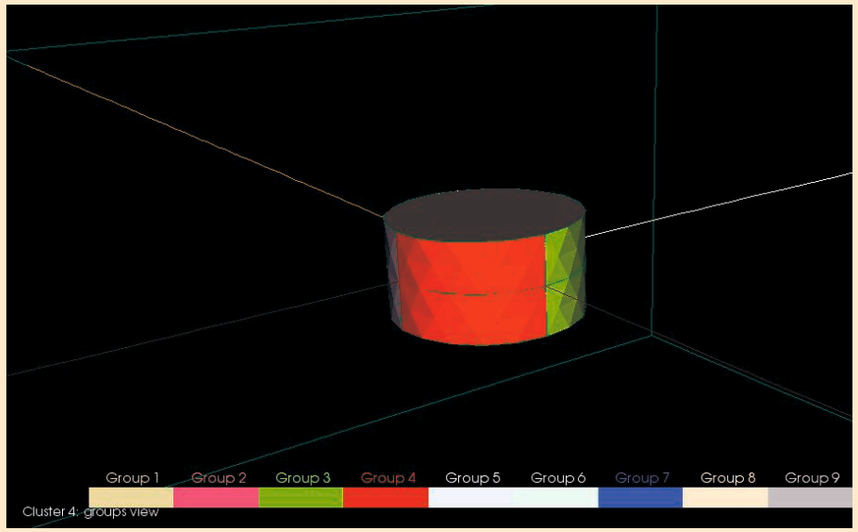
Meshing and refinement

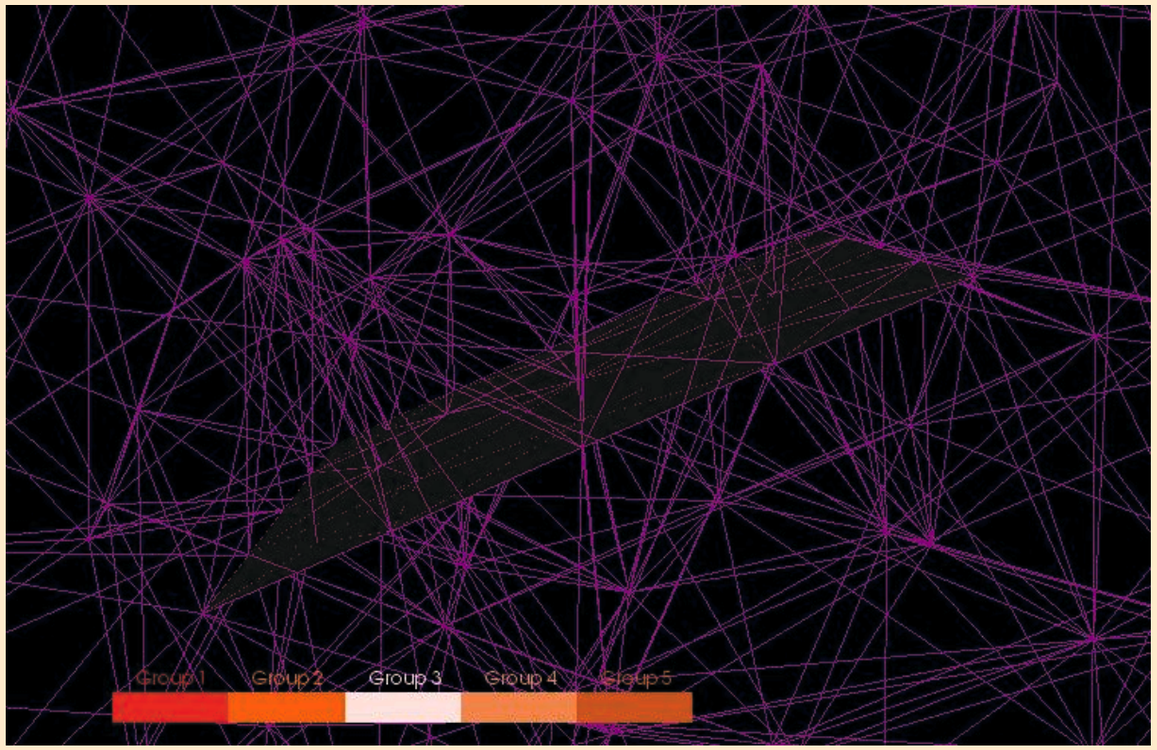
- Possibility of mesh refinement
- Mesh pre-processing for singularities (i.e 2D thin surfaces)

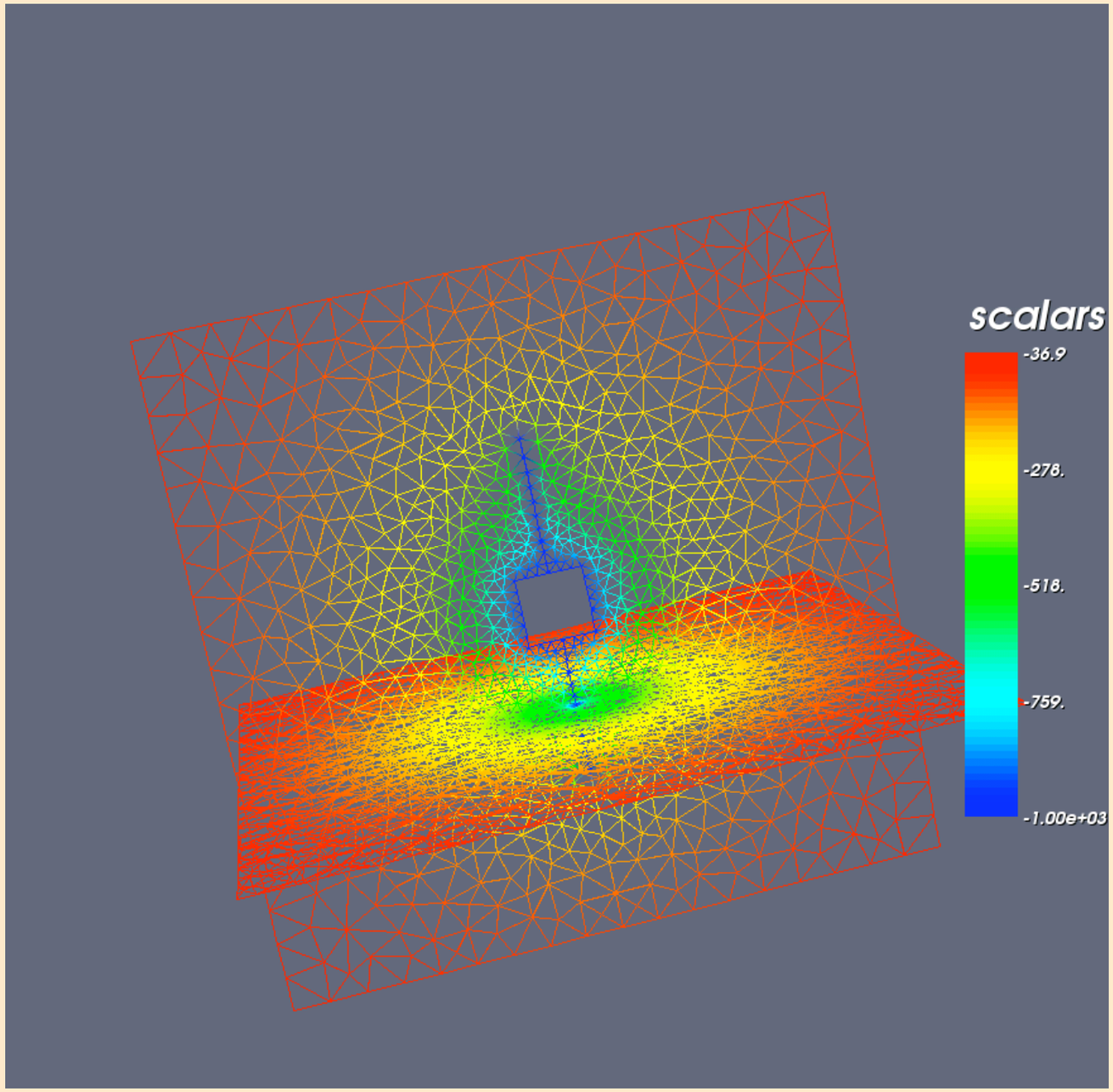




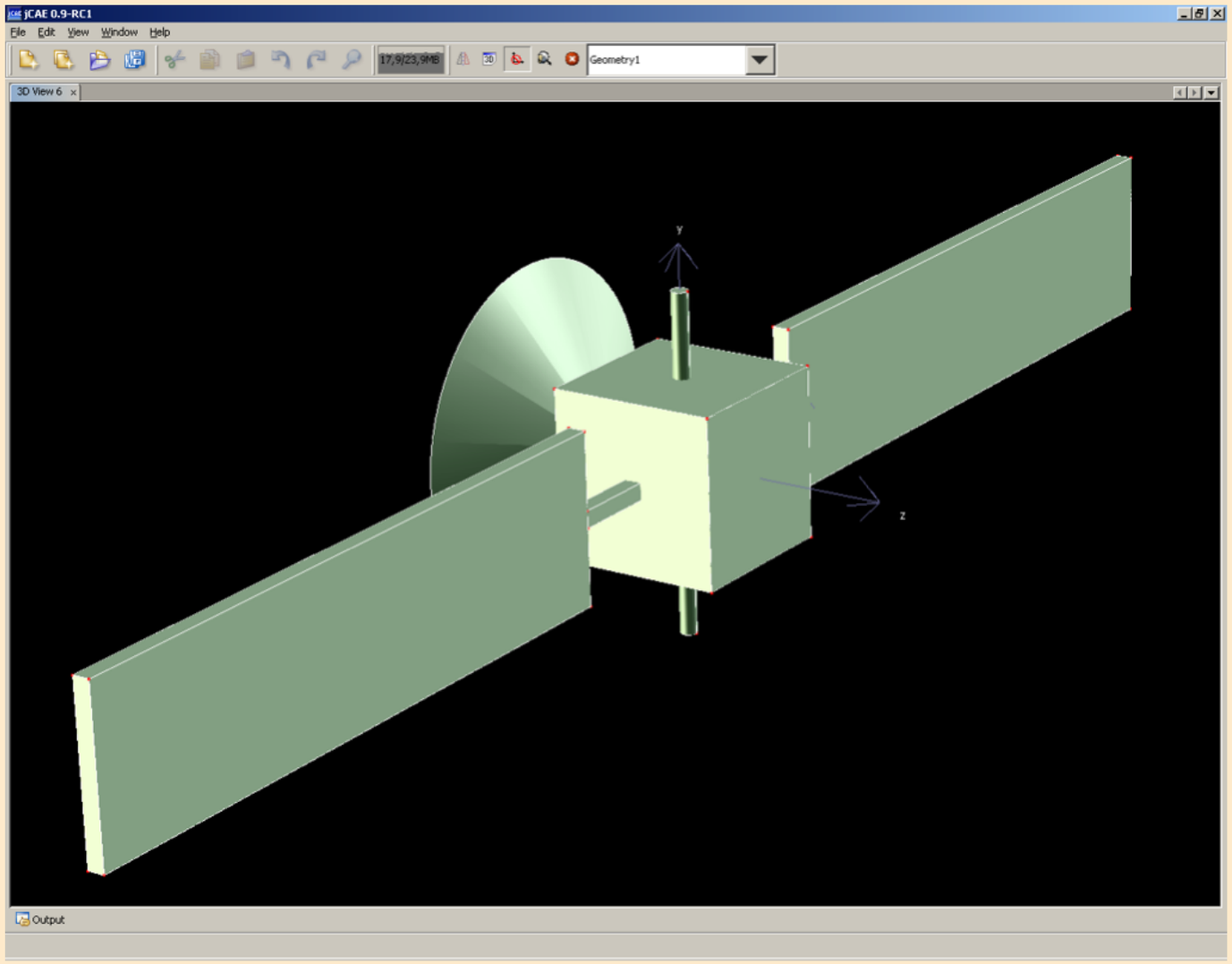
1D and 2D thin elements







CAD modelling tomorrow



The Artenum R&d effort:

- Study of integration of an OpenCascade based CAD module with JCAE projecrt
  - Possibility of CSG and BREP approaches
  - Possibility of import of industrial formats (IGES, STEP...)

Conclusion on CAD modelling

- Possibility to model complex and realistic 3D models
- Possibility of detailed properties attribution
- Possibility of 2D/3D meshing with refinement capabilities
- Still CAD modelling rough and long due to the strict BREPS approach
- Still limitations in the import of industrial formats (IGES, STEP, MED...)
- Improvements expected in a near future with the possible of the integration of JCAE, OpenCasade based CAD modeller