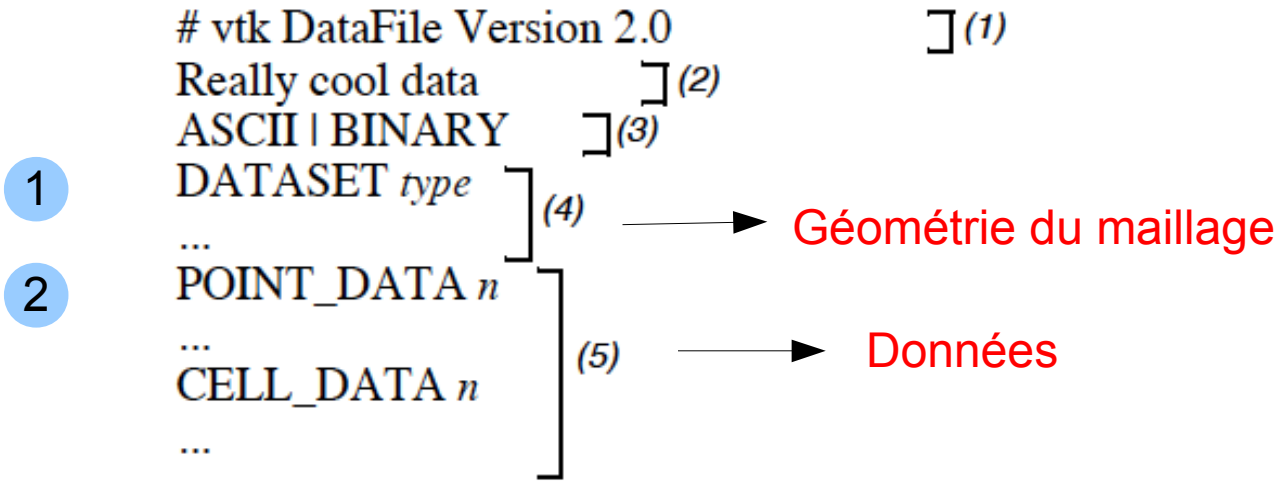
Paraview – for beginners

- 1. Format de fichiers VTK
- 2. Exercice : données sur un carré – 2D
- 3. Programmation d'un fichier de sortie .vtk - Laplace
- 4. Exemples de visualisation « plasma » - 2D

VTK file format



Part 1: Header

Part 2: Title (256 characters maximum, terminated with newline \n character)

Part 3: Data type, either ASCII or BINARY

Part 4: Geometry/topology. *Type* is one of:

```
STRUCTURED_POINTS
STRUCTURED_GRID
UNSTRUCTURED_GRID
POLYDATA
RECTILINEAR_GRID
FIELD
```

Part 5: Dataset attributes. The number of data items *n* of each type must match the number of points or cells in the dataset. (If *type* is `FIELD`, point and cell data should be omitted.

1 DATASET format

1. Structured Points

```
DATASET STRUCTURED_POINTS
DIMENSIONS nx ny nz
ORIGIN x y z
SPACING sx sy sz
```

2. Structured Grid

```
DATASET STRUCTURED_GRID
DIMENSIONS nx ny nz
POINTS n dataType
p0x p0y p0z
p1x p1y p1z
...
p(n-1)x p(n-1)y p(n-1)z
```

POINTS n dataType → Int, float, double, ...

p0x p0y p0z
p1x p1y p1z → Coordonnées des Points du maillage

DATASET format - suite

3. Rectilinear Grid

DATASET RECTILINEAR_GRID

DIMENSIONS n_x n_y n_z

X_COORDINATES n_x *dataType*

x_0 x_1 ... $x_{(nx-1)}$

Y_COORDINATES n_y *dataType*

y_0 y_1 ... $y_{(ny-1)}$

Z_COORDINATES n_z *dataType*

z_0 z_1 ... $z_{(nz-1)}$

DATASET format - suite

4. Polygonal Data

DATASET POLYDATA

POINTS *n dataType*

P0x P0y P0z

P1x P1y P1z

...

P(n-1)x P(n-1)y P(n-1)z

VERTICES *n size*

$numPoints_0, i_0, j_0, k_0, \ldots$

$numPoints_1, i_1, j_1, k_1, \ldots$

...

$numPoints_{n-1}, i_{n-1}, j_{n-1}, k_{n-1}, \ldots$

LINES *n size*

$numPoints_0, i_0, j_0, k_0, \ldots$

$numPoints_1, i_1, j_1, k_1, \ldots$

...

$numPoints_{n-1}, i_{n-1}, j_{n-1}, k_{n-1}, \ldots$

POLYGONS *n size*

$numPoints_0, i_0, j_0, k_0, \ldots$

$numPoints_1, i_1, j_1, k_1, \ldots$

...

$numPoints_{n-1}, i_{n-1}, j_{n-1}, k_{n-1}, \ldots$

TRIANGLE_STRIPS *n size*

$numPoints_0, i_0, j_0, k_0, \ldots$

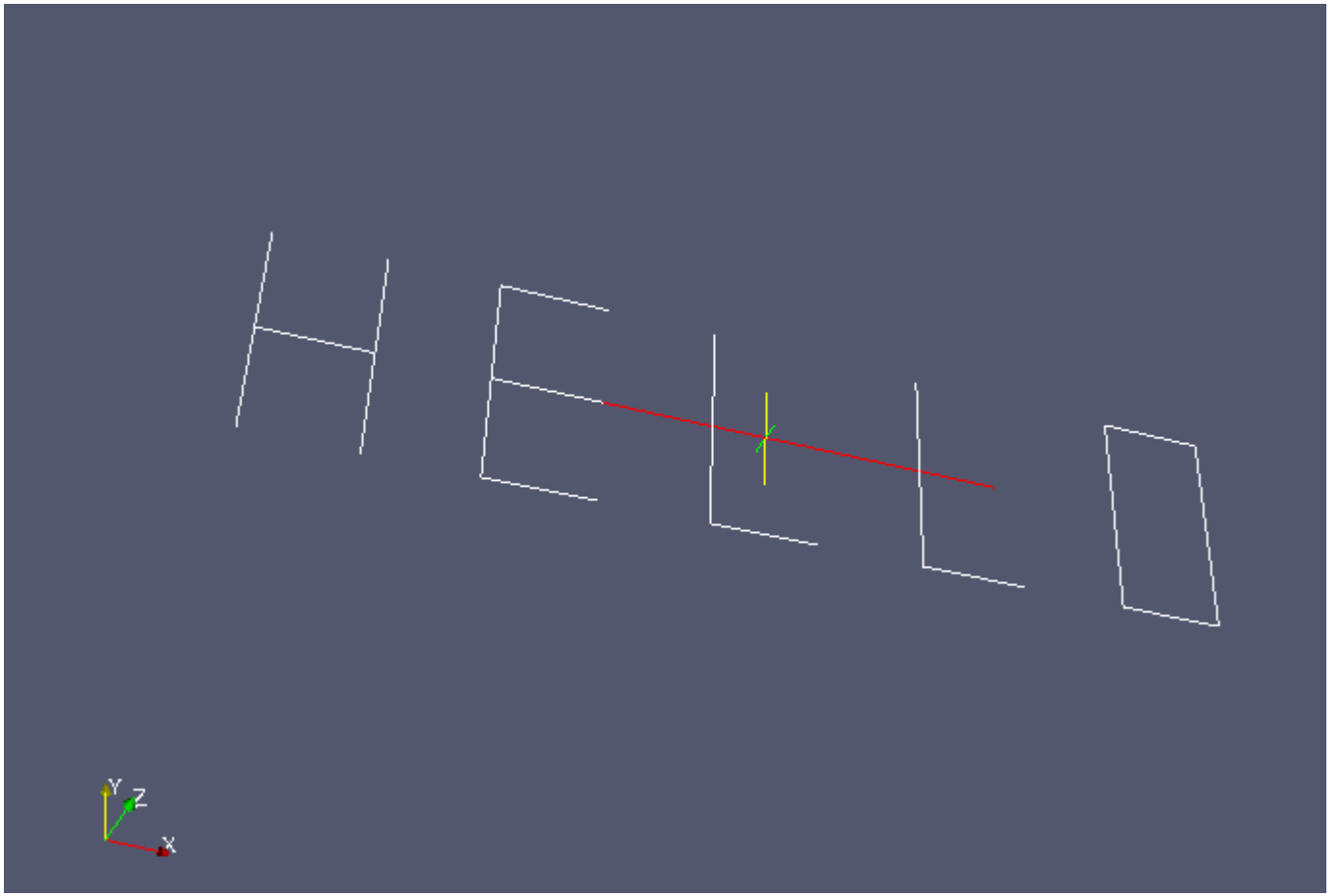
$numPoints_1, i_1, j_1, k_1, \ldots$

...

$numPoints_{n-1}, i_{n-1}, j_{n-1}, k_{n-1}, \ldots$

Exemple : stucture en bâtons

```
# vtk DataFile Version 1.0
Stroked lines spell hello...
ASCII

DATASET POLYDATA
POINTS 22 float
0.0 0.0 0.0
0.0 2.0 0.0
0.0 1.0 0.0
1.0 1.0 0.0
1.0 0.0 0.0
1.0 2.0 0.0
2.0 0.0 0.0
3.0 0.0 0.0
2.0 2.0 0.0
3.0 2.0 0.0
2.0 1.0 0.0
3.0 1.0 0.0
4.0 0.0 0.0
5.0 0.0 0.0
4.0 2.0 0.0
6.0 0.0 0.0
7.0 0.0 0.0
6.0 2.0 0.0
8.0 0.0 0.0
9.0 0.0 0.0
8.0 2.0 0.0
9.0 2.0 0.0

LINES 15 45
2 0 1
2 4 5
2 2 3
2 6 8
2 6 7
2 10 11
2 8 9
2 12 13
2 12 14
2 15 16
2 15 17
2 18 19
2 20 21
2 18 20
2 19 21
```



DATASET format - suite

5. Unstructured Grid

```
DATASET UNSTRUCTURED_GRID
POINTS n dataType
P0x P0y P0z
P1x P1y P1z
...
P(n-1)x P(n-1)y P(n-1)z

CELLS n size
numPoints0, i, j, k, l, ...
numPoints1, i, j, k, l, ...
numPoints2, i, j, k, l, ...
...
numPointsn-1, i, j, k, l, ...

CELL_TYPES n
type0
type1
type2
...
typen-1
```

0

1

n-1

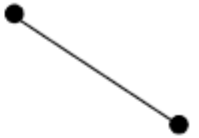
Coordonnées des noeuds du maillage

Liens des mailles

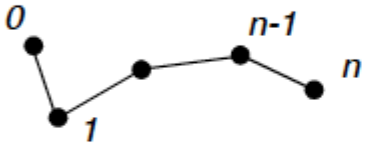
Linear Set Types found in VTK - 2D

VTK_VERTEX (=1)

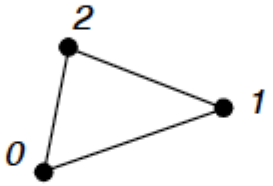
VTK_POLY_VERTEX (=2)



VTK_LINE (=3)

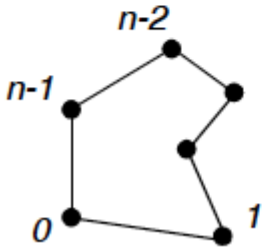


VTK_POLY_LINE (=4)

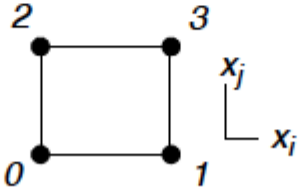


VTK_TRIANGLE(=5)

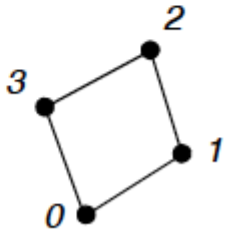
VTK_TRIANGLE_STRIP (=6)



VTK_POLYGON (=7)



VTK_PIXEL (=8)



VTK_QUAD (=9)

5. Unstructured Grid : DATA

SCALARS *dataName dataType numComp*
LOOKUP_TABLE *tableName*
s_0
s_1
...
s_{n-1}

LOOKUP_TABLE *tableName size*
$r_0\ g_0\ b_0\ a_0$
$r_1\ g_1\ b_1\ a_1$
...
$r_{size-1}\ g_{size-1}\ b_{size-1}\ a_{size-1}$

VECTORS *dataName dataType*
$v_{0x}\ v_{0y}\ v_{0z}$
$v_{1x}\ v_{1y}\ v_{1z}$
...
$v_{(n-1)x}\ v_{(n-1)y}\ v_{(n-1)z}$

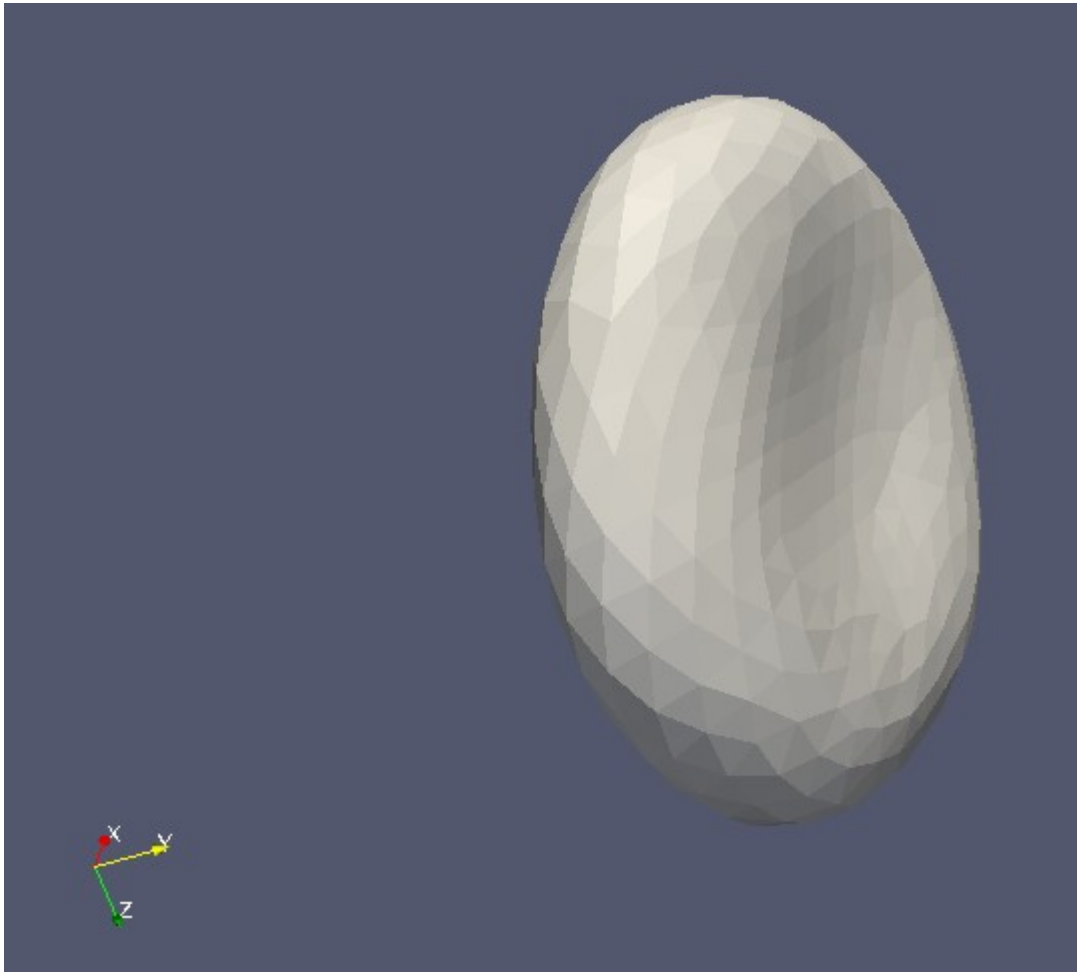
Data Set Attribute formats :

- Scalars
- Lookup Table
- Vectors
- Normals
- Texture coordinates
- Tensors

Exemple : surface 3D en triangles

```
 1 # vtk DataFile Version 1.0
 2 rbc_001.vtk  3D Unstructured Grid of Triangles
 3 ASCII
 4
 5 DATASET UNSTRUCTURED_GRID
 6 POINTS 500 float
 7 -3.424999 -0.855454 2.257396
 8 -1.484919 0.665606 -3.151304
 9 1.636841 -0.848154 -0.458954
10 3.732041 0.187906 -1.319734
11 -1.756719 0.682006 0.807596
12 0.911641 -0.828054 3.040696
13 -0.218059 -0.489374 -3.806524
14 -1.078099 0.891706 -2.420454
15 -3.338019 0.263706 1.386896
16 2.931841 1.447006 1.793796
17 -1.796229 0.715706 1.214996
18 2.421641 1.454706 0.904796
19 -0.204659 0.658506 3.627296
```

```
505 0.530241 1.155206 -1.994664
506 0.333941 1.167606 -2.848074
507
508 CELLS 996 3984
509 3  270  374  303
510 3  104  55  232
511 3  339  225  45
512 3  410  374  315
513 3  104  232  416
514 3  232  55  34
515 3  330  122  403
516 3  410  82  0
517 3  55  0  82
518 3  481  417  420
519 3  339  45  303
520 3  339  303  374
521 3  416  232  361
522 3  122  34  55
523 3  34  122  382
524 3  169  225  104
525 3  104  416  169
```



Cell type : 5 (triangle)

Exemple : surface 2D en triangles

1. Structure

```
1  # vtk DataFile Version 1.0
2  2D Unstructured Grid of Linear Triangles
3  ASCII
4
5  DATASET UNSTRUCTURED_GRID
6  POINTS 8 float
7  0.0  0.0  0.0
8  1.0  0.0  0.0
9  2.0  0.0  0.0
10 0.0  1.0  0.0
11 1.0  1.0  0.0
12 2.0  1.0  0.0
13 0.0  2.0  0.0
14 1.0  2.0  0.0
15
16 CELLS 6 24
17 3  0  1  3
18 3  1  4  3
19 3  1  2  4
20 3  2  5  4
21 3  3  4  6
22 3  4  7  6
23
24 CELL_TYPES 6
25 5
26 5
27 5
28 5
29 5
30 5
31
```

0

7

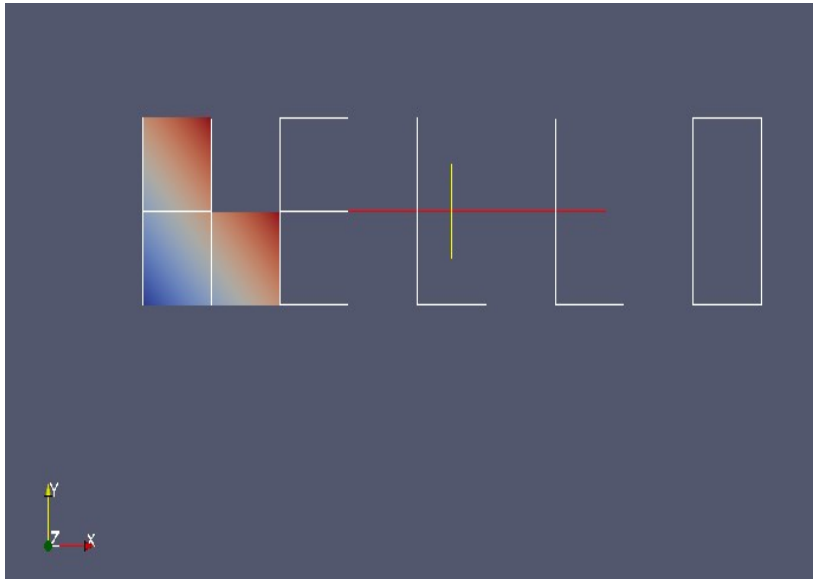
3 : ligne à 3 pts

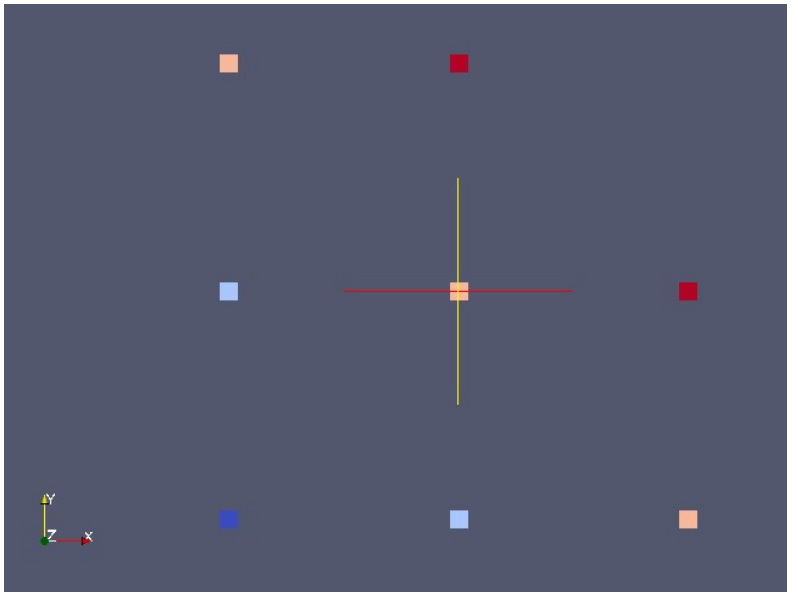
5 : triangles

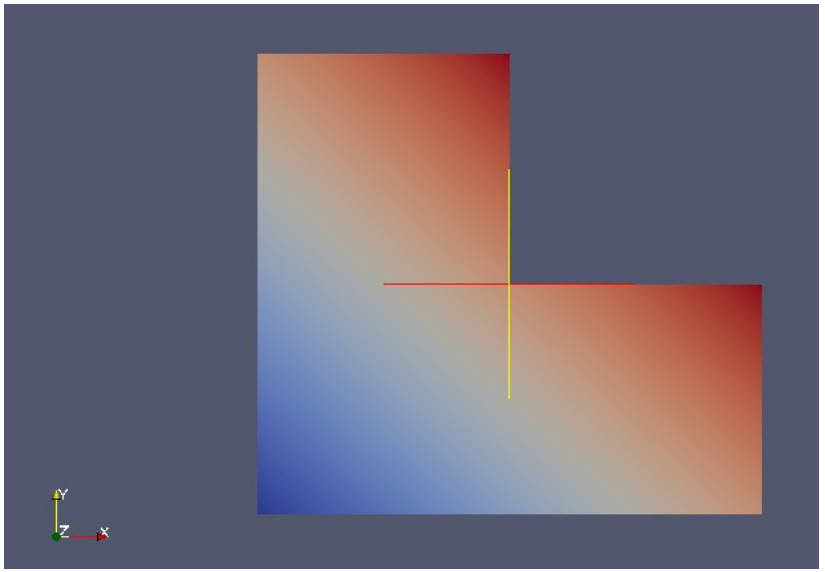
2. Données

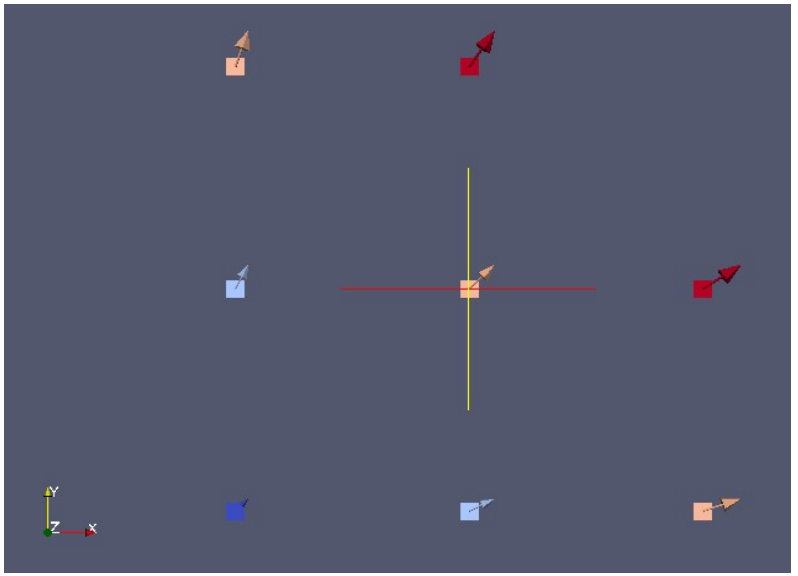
```
32 POINT_DATA 8
33 SCALARS pressure float
34 LOOKUP_TABLE default
35 0.0
36 1.0
37 2.0
38 1.0
39 2.0
40 3.0
41 2.0
42 3.0
43
44 VECTORS velocity float
45 1.0  1.0  0.0
46 2.0  1.0  0.0
47 3.0  1.0  0.0
48 1.0  2.0  0.0
49 2.0  2.0  0.0
50 3.0  2.0  0.0
51 1.0  3.0  0.0
52 2.0  3.0  0.0
53
```

Exemple : surface 2D en triangles - suite

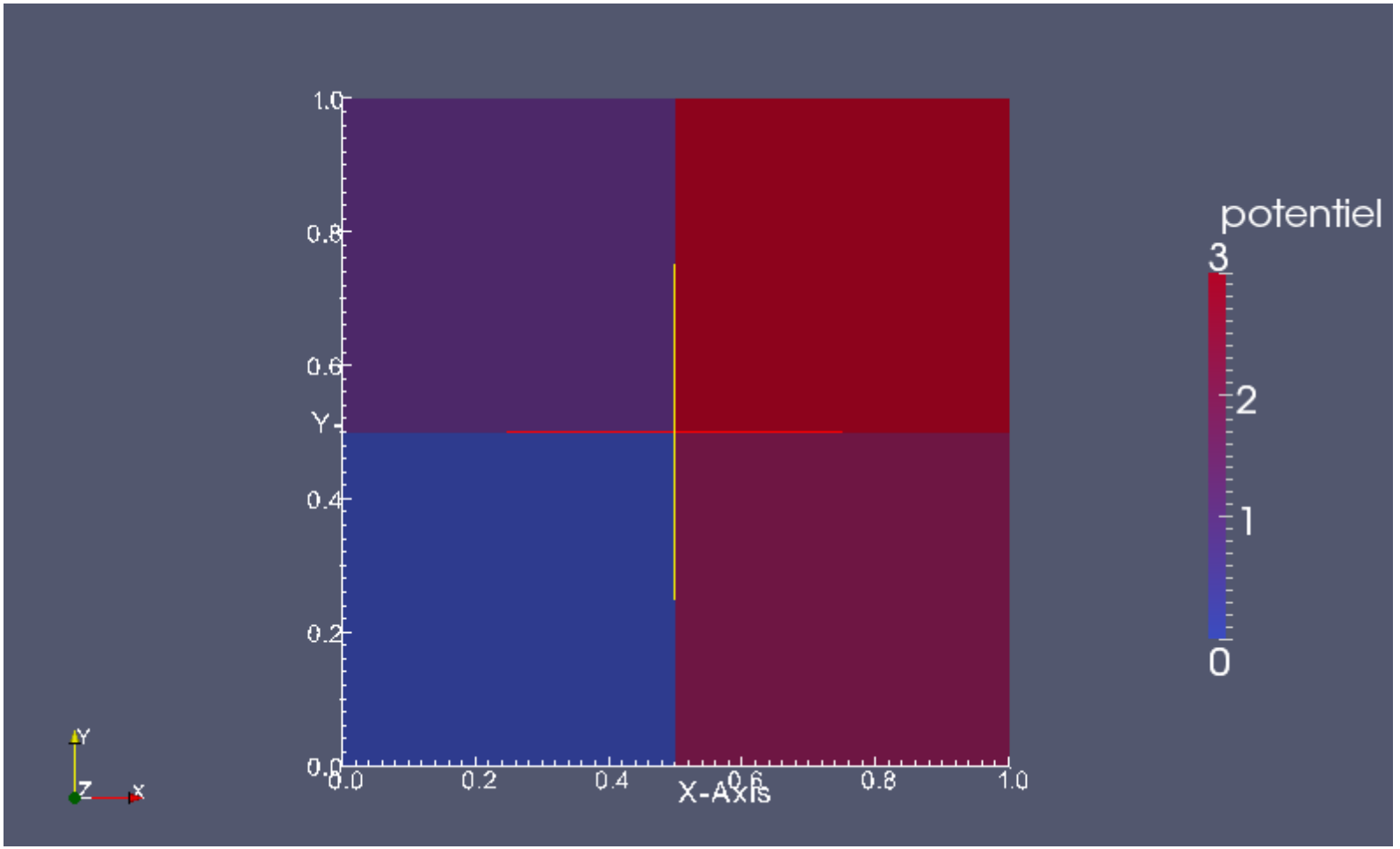








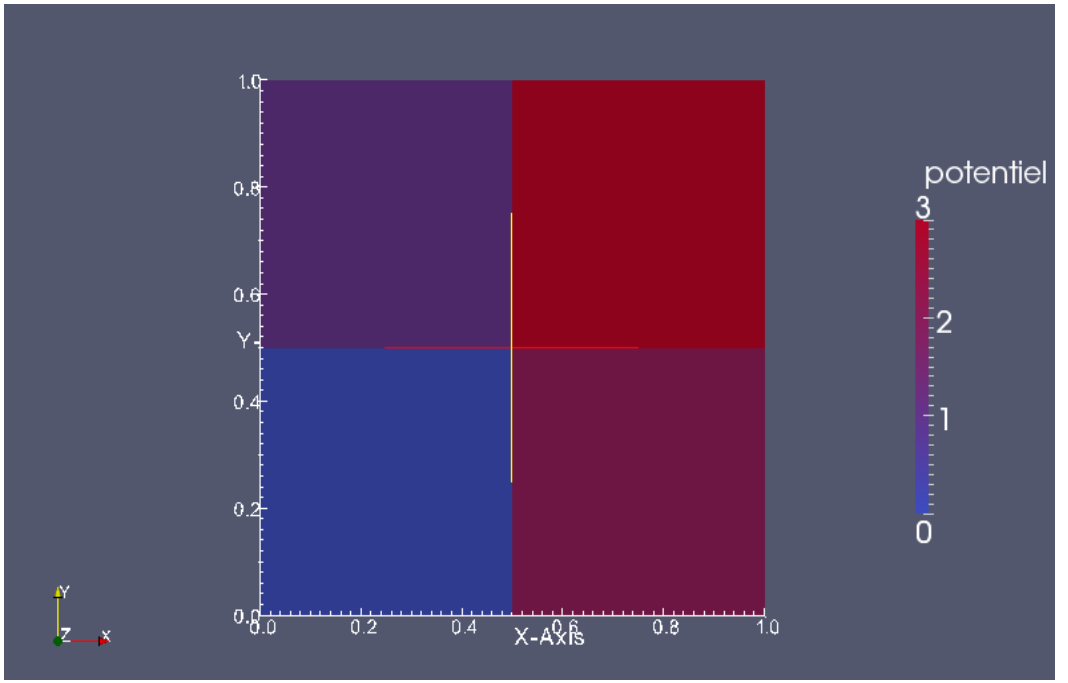
Exercice : écrire un fichier .vtk



Unstructured Grid + Cells

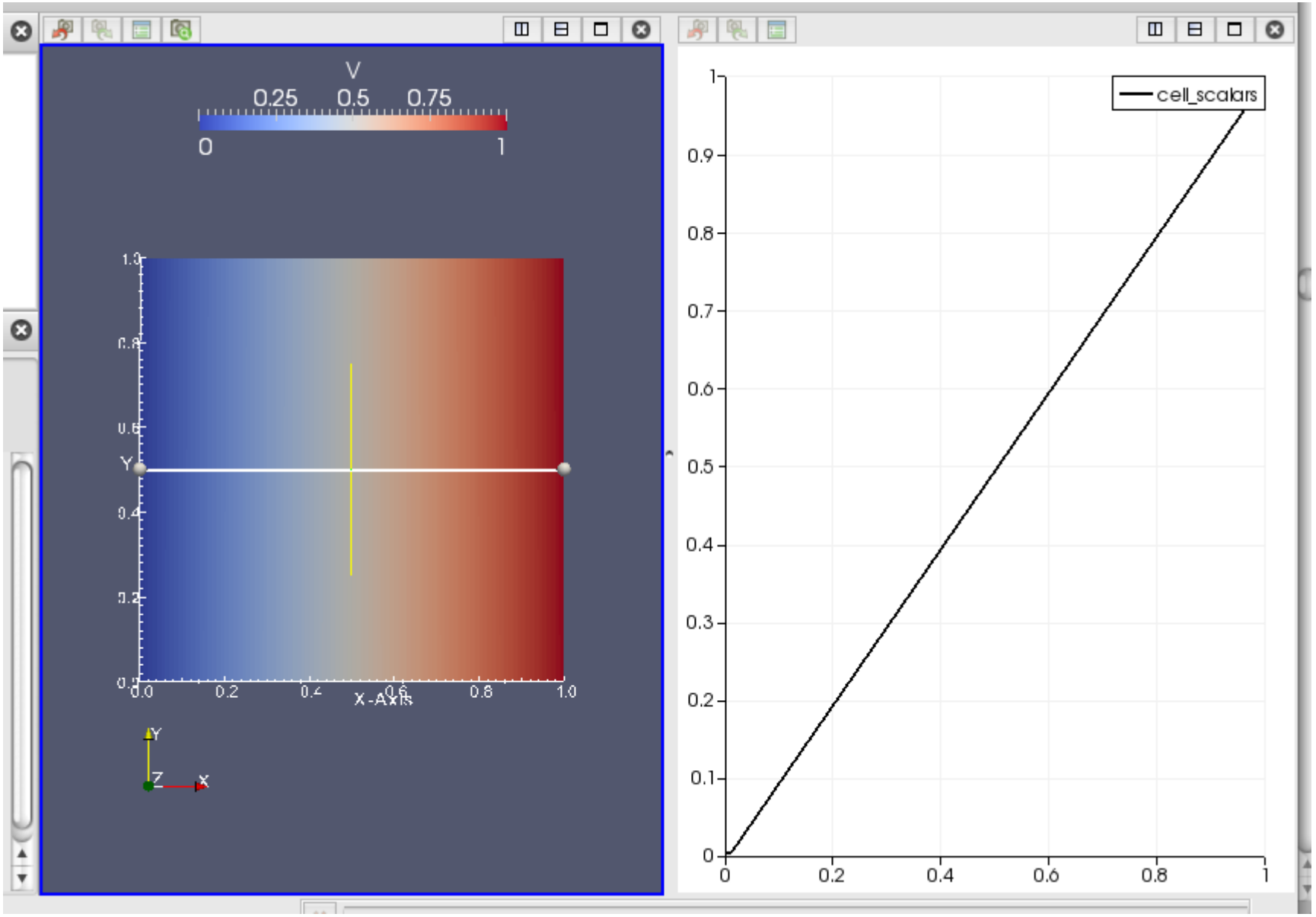
Solution (ex.) : écrire un fichier .vtk

```
# vtk DataFile Version 2.0
carré
ASCII

DATASET UNSTRUCTURED_GRID
POINTS 9 float
0. 0. 0.
0. 0.5 0.
0. 1. 0.
0.5 0. 0.
0.5 0.5 0.
0.5 1. 0.
1. 0. 0.
1. 0.5 0.
1. 1. 0.

CELLS 4 20
4 0 1 4 3
4 1 2 5 4
4 3 4 7 6
4 4 5 8 7

CELL_TYPES 4
9
9
9
9

CELL_DATA 4
SCALARS potentiel float
LOOKUP_TABLE default
0.0
1.0
2.0
3.0
```



Exercice : compléter Laplace_seq.f

nx = 100, ny = 100, iter = 100000, erreur_tol = 1d-8, idielg = 0, idield = 0

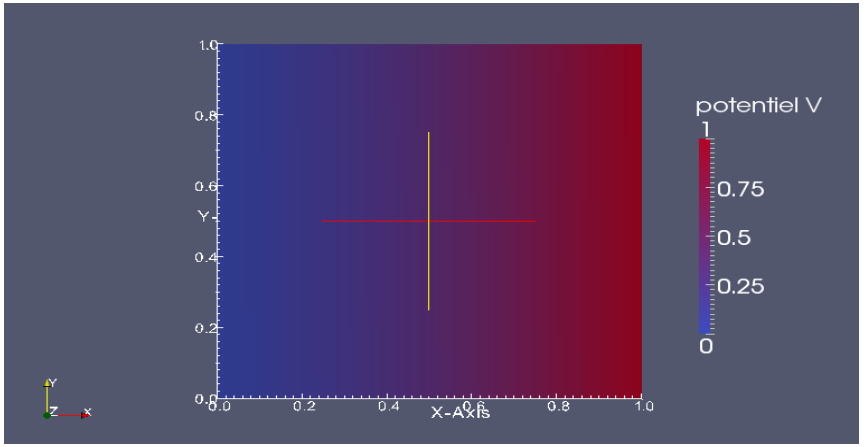


Solution (ex.) : compléter Laplace_seq.f

nx = 100, ny = 100, iter = 1000, erreur_tol = 1d-4

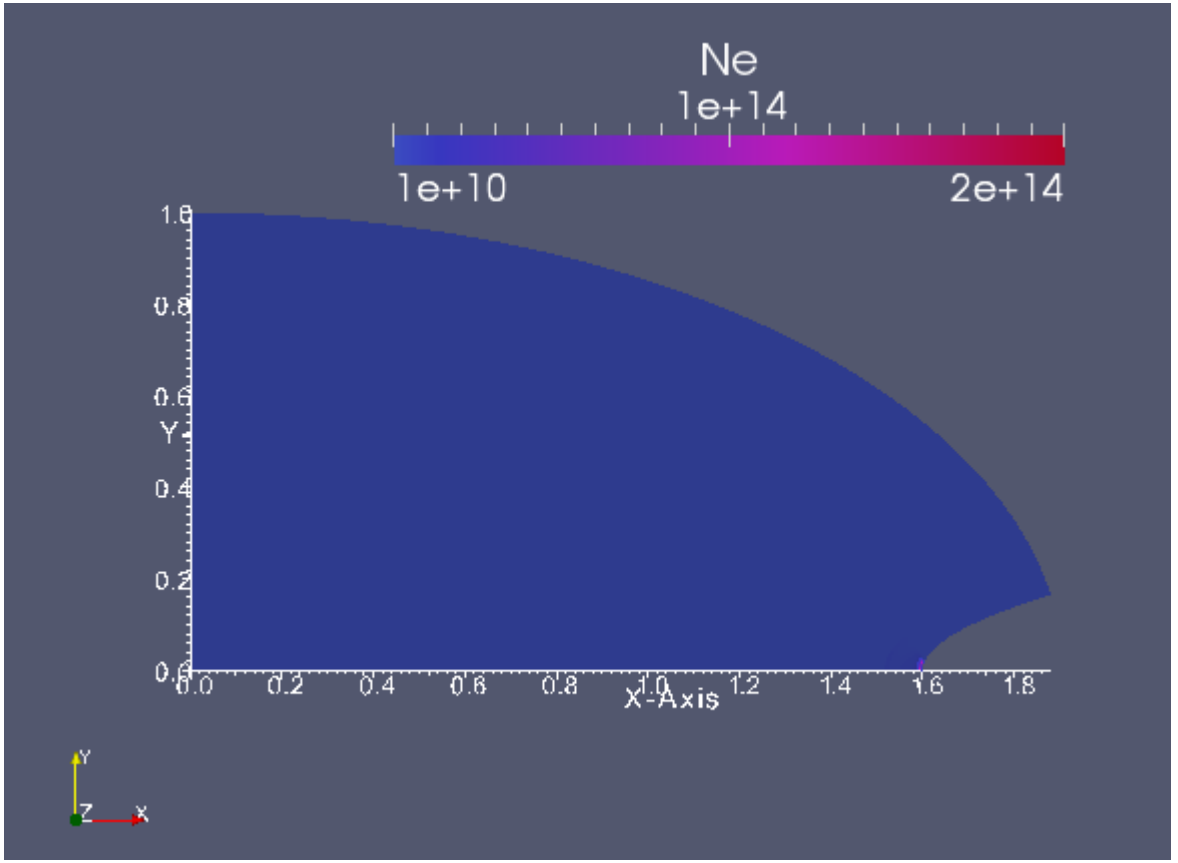
```
261 !-----------------------------------
262 ! sortie des resultats au format VTK
263 !-----------------------------------
264       za=0.e0 ! visualisation en 2D
265       n_cell=nx*ny
266       n_cell_1=(nx+1)*(ny+1)
267       n_poly=5*n_cell
268 
269       open (unit=10,status='unknown',file='potentiel.vtk')
270 
271       write(10,*) '# vtk DataFile Version 2.0'
272       write(10,*) 'Potentiel V'
273       write(10,*) 'ASCII'
274       write(10,*) ' '
275       write(10,*) 'DATASET UNSTRUCTURED_GRID'
276       write(10,*) 'POINTS', n_cell_1, ' float'
277 
278       k=0
279       do i=0,nx
280         do j=0,ny
281           write(10,*) xm(i),ym(j),za
282           n_a(i,j)=k
283           k=k+1
284         enddo
285       enddo
286 
287       write(10,*) ' '
288       write(10,*) 'CELLS', n_cell, n_poly
289       do i=0,nx-1
290         do j=0,ny-1
291           ipoly=4
292           i1=n_a(i,j)
293           i2=n_a(i+1,j)
294           i3=n_a(i+1,j+1)
295           i4=n_a(i,j+1)
296           write(10,*)ipoly,i1,i2,i3,i4
297         enddo
298       enddo
299 
```

```
300       itype=9
301       write(10,*) ' '
302       write(10,*) 'CELL_TYPES', n_cell
303       do ik=1,n_cell
304         write(10,*) itype
305       enddo
306 
307 
308 
309       write(10,*) ' '
310       write(10,*) 'CELL_DATA', n_cell
311       write(10,*) 'SCALARS cell_scalars float 1'
312       write(10,*) 'LOOKUP_TABLE default'
313 
314 
315       do i=1,nx
316         do j=1,ny
317           write(10,*) V(i,j)
318         enddo
319       enddo
320 
321       close(10)
322 
```

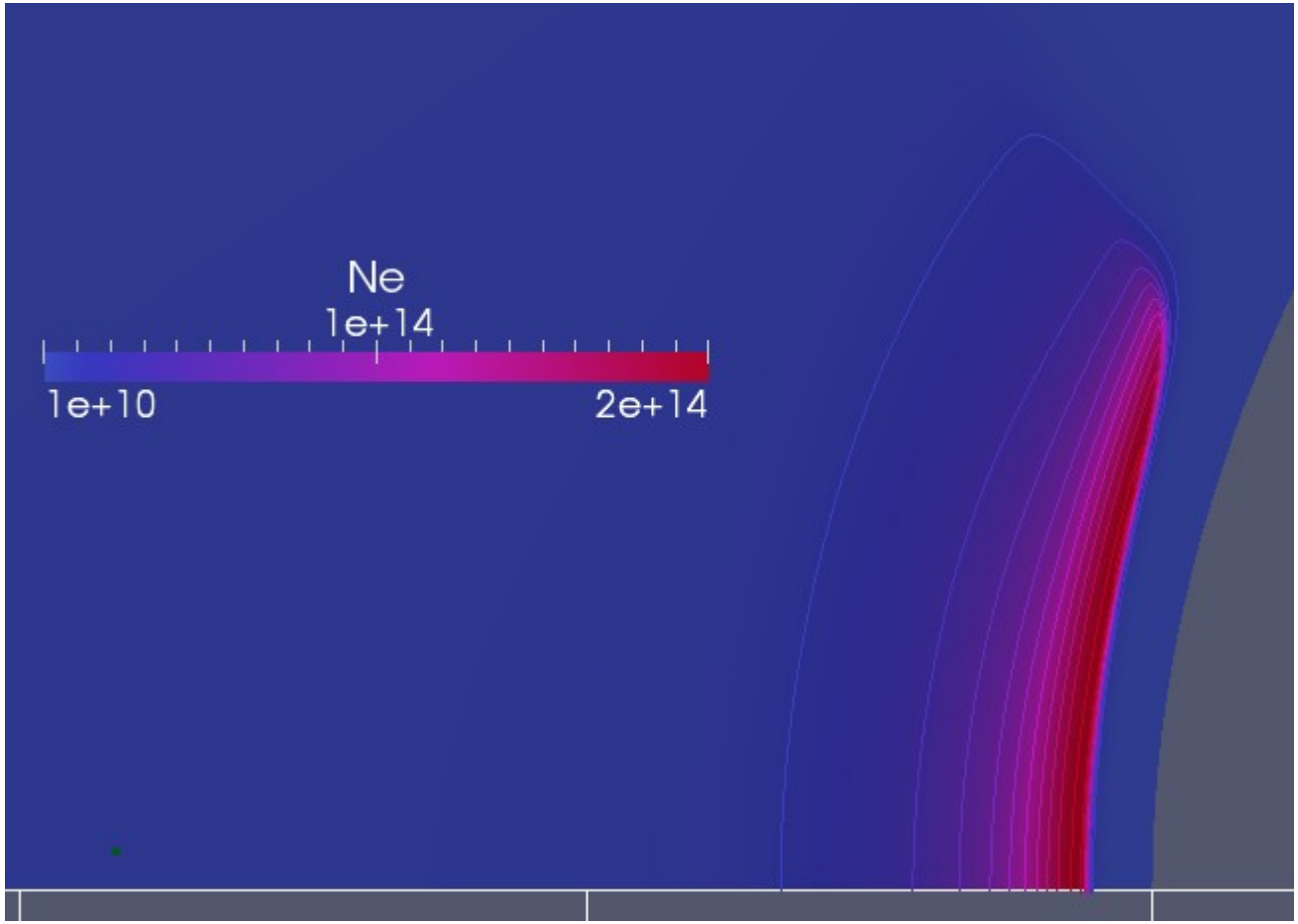


Exemple de visualisation de champ de scalaire

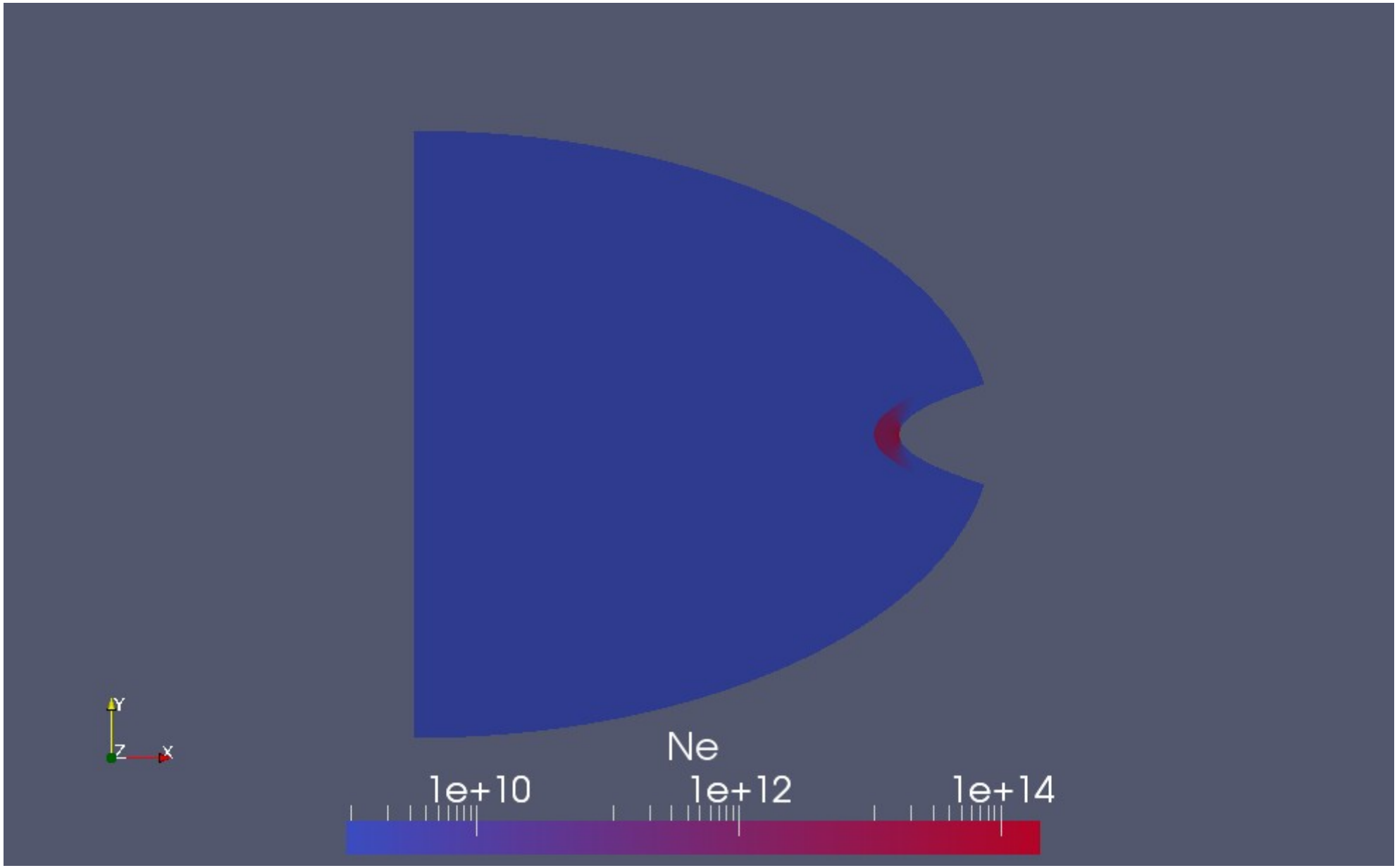
Plasma froid, pression atmosphérique, système d'électrode pointe / plan



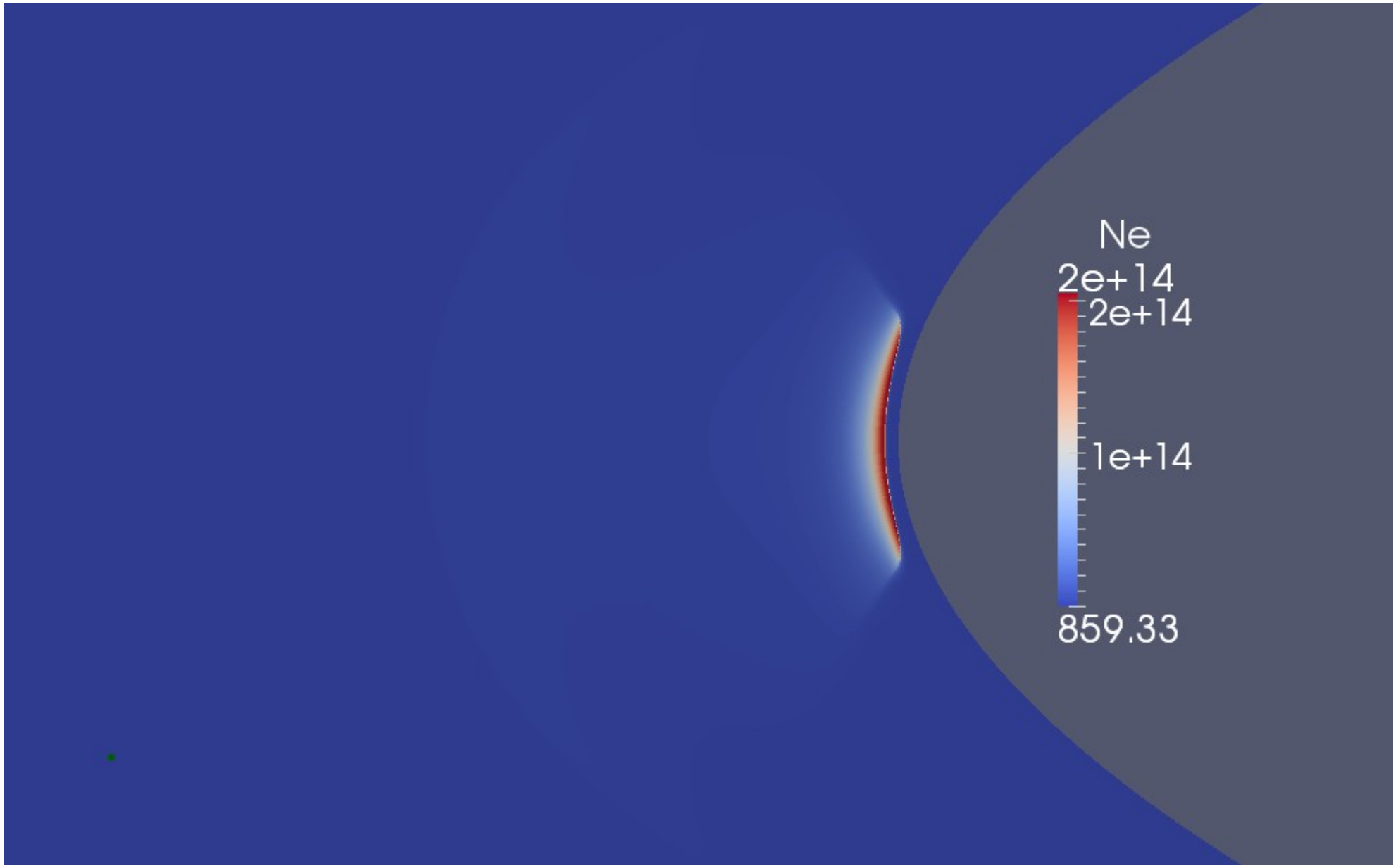
Exemple de visualisation de champ de scalaire



Exemple de visualisation de champ de scalaire



Exemple de visualisation de champ de scalaire



Exemple de visualisation de champ de scalaire