OpenMC Visualization & Data Extraction

OpenMC Application to Tokamak Neutronics Analysis Meeting
May 28, 2025

Argonne NATIONAL LABORATORY

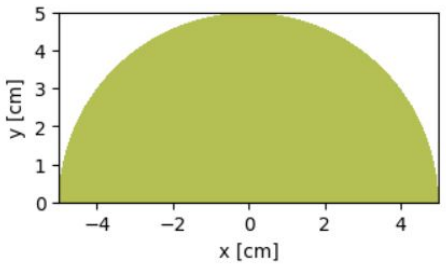
Visualization & Plotting

Inline Plotting

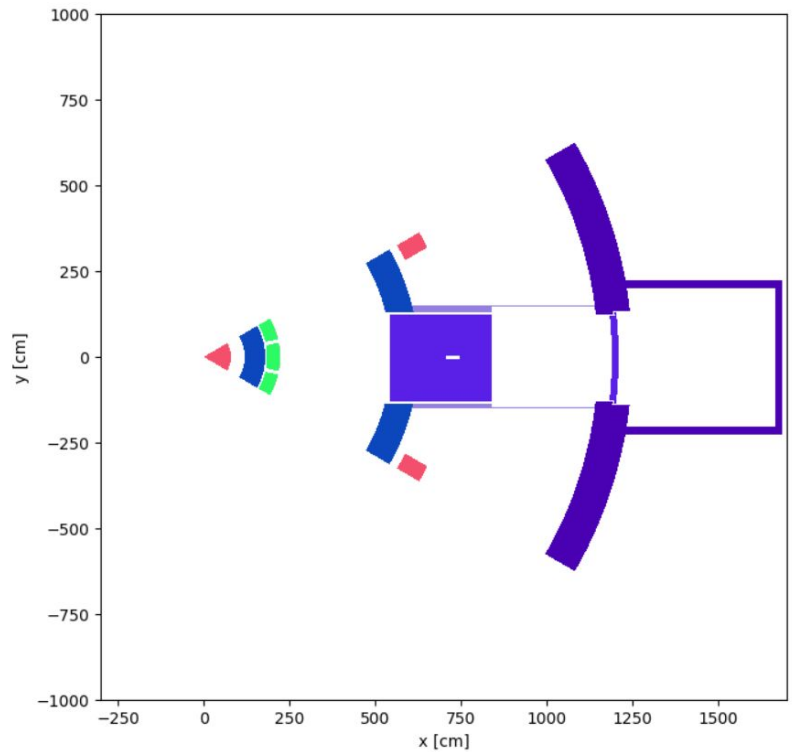
Plots can be generated using many objects:

Region, Cell, Universe, Model

```
[1]: import openmc

[2]: sphere = openmc.Sphere(r=5)
     y_plane = openmc.YPlane(y0=0)
     region = -sphere & +y_plane
     region.plot()

[2]: <Axes: xlabel='x [cm]', ylabel='y [cm]'>
```

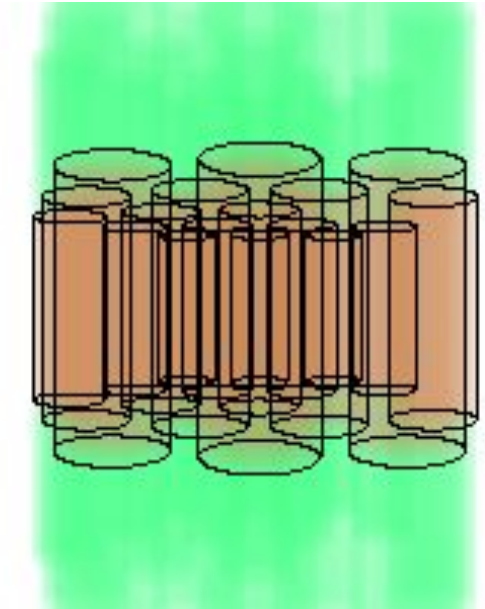



```
[14]: model.plot(color_by='material', width=(2000, 2000), origin=(700, 0, 0), pixels=(600, 600))

[14]: <Axes: xlabel='x [cm]', ylabel='y [cm]'>
```

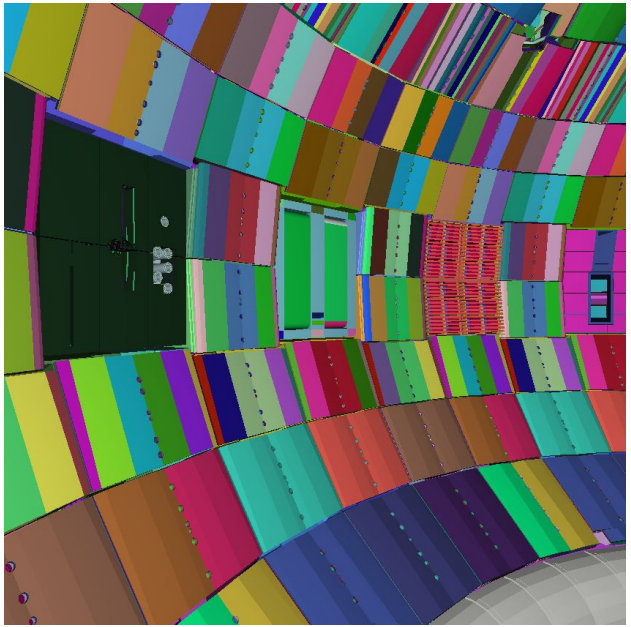


RayTrace Plotting

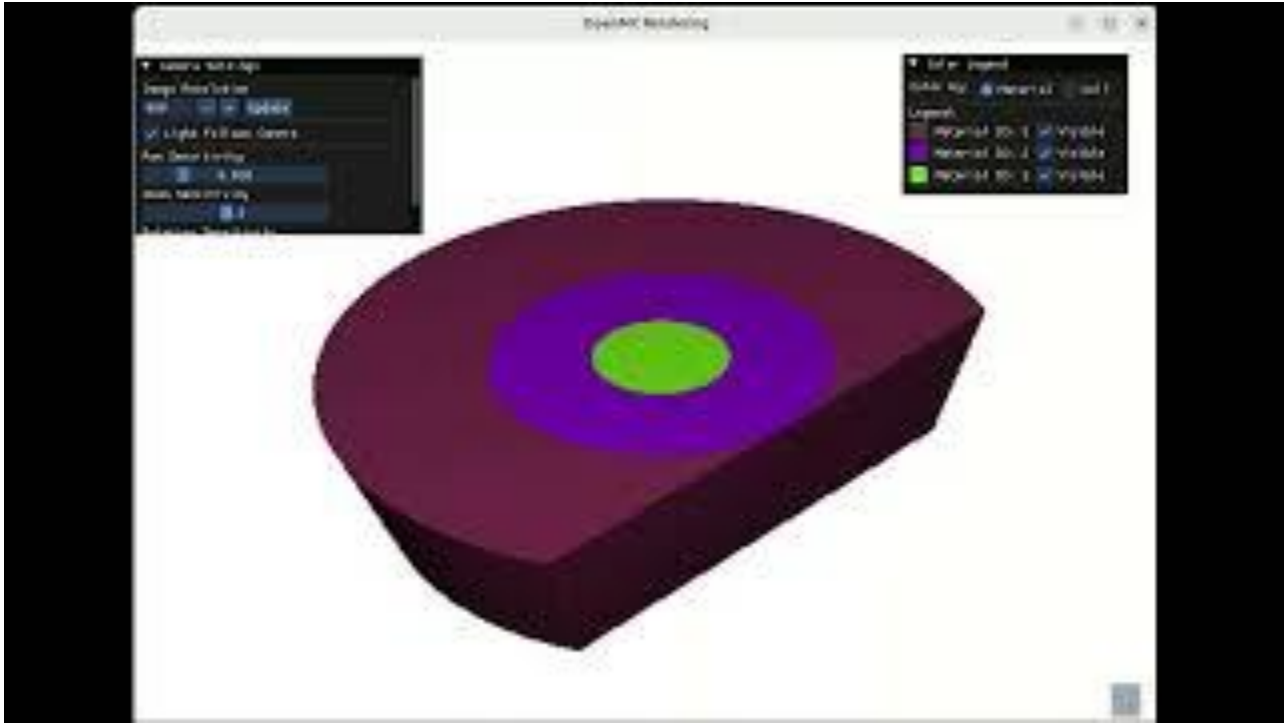
Wireframe Plots



Solid Plots



Native Renderer?



Plotting Utility

OpenMC Plotter

```
$ pip install openmc-plotter
```

Data Extraction

Streamlining Tally Extraction

Input object:

`openmc.Tally`

Output object:

`openmc.Tally`

```
[14]: tally = openmc.Tally()
      tally.scores = ['flux']
      mesh = openmc.RegularMesh()
      mesh.lower_left = (0, -700, -1200)
      mesh.upper_right = (1800, 700, 1200)
      mesh.dimension = (200, 200, 200)

      mesh_filter = openmc.MeshFilter(mesh)
      material_filter = openmc.MaterialFilter(model.materials)

      tally.filters = [mesh_filter, material_filter]

      model.tallies = [tally]

[15]: sp_file = model.run(output=False)

[16]: with openmc.StatePoint(sp_file) as sp:
          new_tally = sp.tallies[tally.id]

[17]: print(new_tally.mean.max())

      0.045387690493174634
```

Streamlining Tally Extraction (v 0.15.2)

Single object for input and output

[18]:
```
tally = openmc.Tally()
tally.scores = ['flux']
mesh = openmc.RegularMesh()
mesh.lower_left = (0, -700, -1200)
mesh.upper_right = (1800, 700, 1200)
mesh.dimension = (200, 200, 200)

mesh_filter = openmc.MeshFilter(mesh)
material_filter = openmc.MaterialFilter(model.materials)

tally.filters = [mesh_filter, material_filter]

model.tallies = [tally]
```

[19]:
```
sp_file = model.run(output=False, apply_tally_results=True)
```

[20]:
```
print(tally.mean.max())
```

```
0.045387690493174634
```

Working with Mesh Data

Shape `openmc.MeshFilter` data into structured indices (when appropriate)

[5]:
```
tally = openmc.Tally()
tally.scores = ['flux']
mesh = openmc.RegularMesh()
mesh.lower_left = (0, -700, -1200)
mesh.upper_right = (1800, 700, 1200)
mesh.dimension = (200, 200, 200)

mesh_filter = openmc.MeshFilter(mesh)
material_filter = openmc.MaterialFilter(model.materials)

tally.filters = [mesh_filter, material_filter]

model.tallies = [tally]
```

[6]:
```
sp_file = model.run(output=False, apply_tally_results=True)
```

[9]:
```
reshaped_data = tally.get_reshaped_data()
reshaped_data.shape
```

[9]:
```
(8000000, 8, 1, 1)
```

[10]:
```
expanded_data = tally.get_reshaped_data(expand_dims=True)
expanded_data.shape
```

[10]:
```
(200, 200, 200, 8, 1, 1)
```

Mesh Visualization

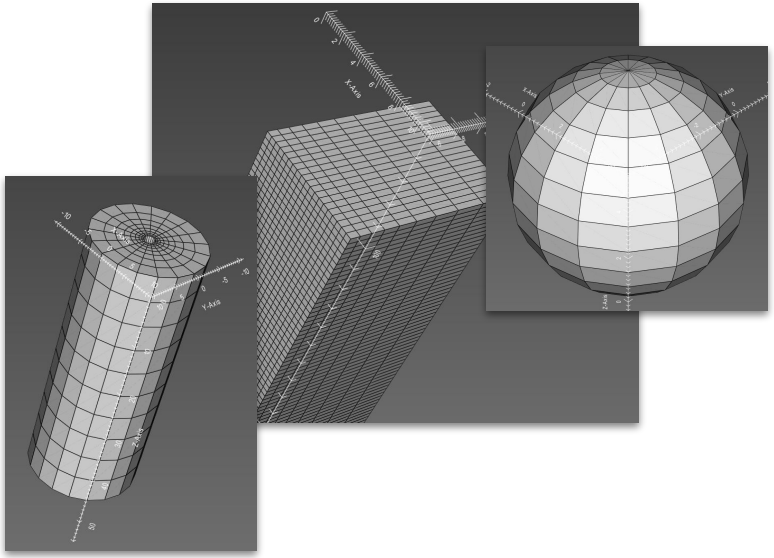
Structured/Periodic/Unstructured Meshes

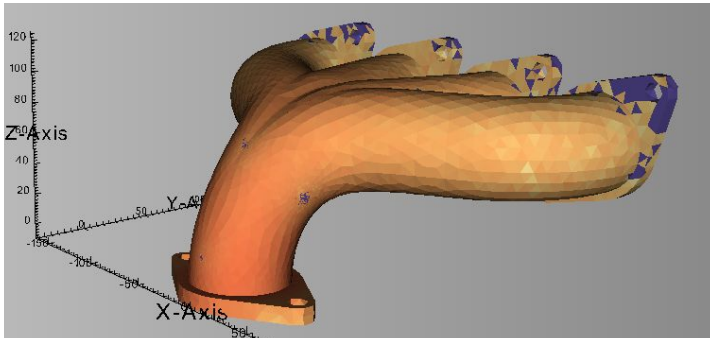
[18]:
```
material_1_data = expanded_data[:, :, :, 0, ...]

mesh.write_data_to_vtk('material_1_flux.vtk',
                       datasets={'mat_1_flux': material_1_data})
```

[18]:
```
<vtkmodules.vtkCommonDataModel.vtkStructuredGrid(0x6340cdc53960)
```

[19]:
```
ls *.vtk
```

```
material_1_flux.vtk
```





A Shame-filled Plug

Home

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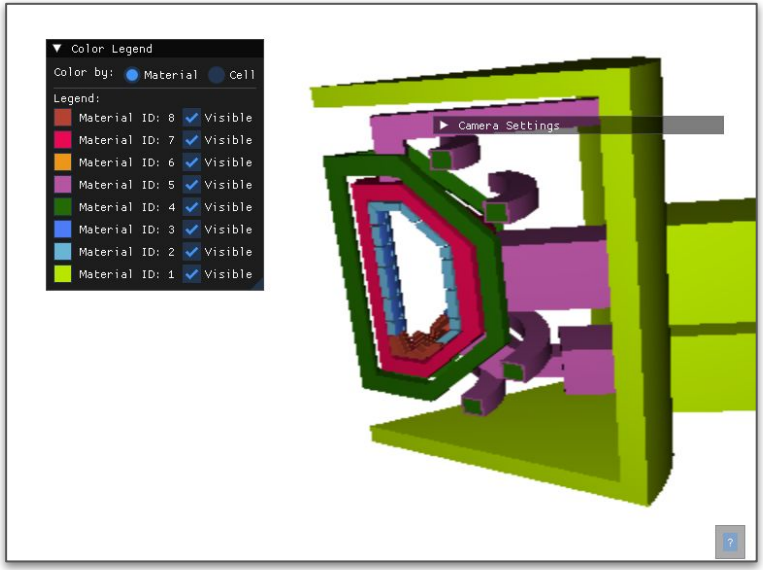
Registration is now open! more details can be found on the registration page.

Key Dates: Abstract Submission Deadline: January 15, 2025 Registration opens: February 5, 2025 SOLD OUT ! Notification of Acceptance: by February 14, 2025 Conference Dates: March 18, 2025

Acknowledgements

This work was supported by the U.S. Department of Energy, Office of Science, Office of Fusion Energy Sciences under Contract DE-AC02-06CH11357.



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