ePIC simulation status

Material scan

BIC simulation meeting

Pusan National University

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Jaehyeok Ryu

Overlap checking

material_scan.py

- Got the script's path and execution method from Maria

- python scripts/subdetector_tests/ material_scan.py epic_brycecanyon.xml --path-r=120 --eta-min=-2.0 --eta-max=1.7 --eta-nbins=3701

- Crucial argument
  -c, --compact : The path to the detector design file(.xml)

- Optional arguments
  --path-r : Scan stop R_xy (default: 400cm)
  --start-point : Starting point ('0,0,0' by default)
  --eta-min : Minimum eta (default: -2.0)
  --eta-max : Maximum eta (default: 2.0)
  --eta-nbins : Eta bins count (default: 401)
  --phi : Phi angle in degrees (default: 20)
  --epsilon : Material scan step size (default: 0.001)
  --value-type : Value type (X0 or λ, default: 'X0')
  --detectors : Detector names (default list : 'EcalBarrelScFi,EcalEndcapN,EcalEndcapP,Solen oidBarrel,HcalBarrel,HcalEndcapN,HcalEndcap P')

Overlap checking

material_scan.py

- Library import

- ThicknessCorrector
  - To fix missing first material layer issue in negative eta values (often vacuum)
  - Calculates missing thickness and adds it to path length for correction

- Main Execution Part
  - Parses user inputs(arguments)
  - Loads the specified detector design file
  - Scans material thickness across eta range using 'material_scan'
- Result Processing and Visualization
  - Aggregates and saves material thickness by detector and eta to CSV
  - Creates and saves graphs of material thickness distribution across eta to PDF

Overlap checking

material_scan.py

Mar25 version
with epic_full.xml

Mar24 version
with epic_brycecanyon.xml

forward_insert_homogeneous.xml

```xml
<documentation level="5">
   ## Main magnet and its field
</documentation>
<include ref="${DETECTOR_PATH}/compact/solenoid.xml"/>
<include ref="${DETECTOR_PATH}/compact/fields/marco.xml"/>
```

```xml
<documentation level="10">
   ## Central EM calorimetry
</documentation>
<include ref="${DETECTOR_PATH}/compact/ecal/forward_homogeneous.xml"/>
<include ref="${DETECTOR_PATH}/compact/ecal/forward_insert_homogeneous.xml"/>
<include ref="${DETECTOR_PATH}/compact/ecal/barrel_interlayers.xml"/>
<include ref="${DETECTOR_PATH}/compact/ecal/backward_PbWO4.xml"/>

<documentation level="10">
   ## hadronic calorimetry
</documentation>

<include ref="${DETECTOR_PATH}/compact/hcal/lfhcal_with_space_for_insert.xml"/>
<include ref="${DETECTOR_PATH}/compact/hcal/forward_insert.xml"/>
<include ref="${DETECTOR_PATH}/compact/hcal/barrel_gdml.xml"/>
<include ref="${DETECTOR_PATH}/compact/hcal/backward.xml"/>
<include ref="${DETECTOR_PATH}/compact/hcal/backward_endcap_flux.xml"/>
```

```
111  <documentation level="5">
112     ## Main magnet and its field
113  </documentation>
114  <include ref="${DETECTOR_PATH}/compact/solenoid.xml"/>
115  <include ref="${DETECTOR_PATH}/compact/fields/marco.xml"/>
116
117
137
138  <documentation level="10">
139     ## Central EM calorimetry
140  </documentation>
141  <include ref="${DETECTOR_PATH}/compact/ecal/forward_homogeneous.xml"/>
142  <include ref="${DETECTOR_PATH}/compact/ecal/forward_insert_homogeneous.xml"/>
143  <include ref="${DETECTOR_PATH}/compact/ecal/barrel_interlayers.xml"/>
144  <include ref="${DETECTOR_PATH}/compact/ecal/backward_PbWO4.xml"/>
145
146  <documentation level="10">
147     ## hadronic calorimetry
148  </documentation>
149
150  <include ref="${DETECTOR_PATH}/compact/hcal/lfhcal_with_space_for_insert.xml"/>
151  <include ref="${DETECTOR_PATH}/compact/hcal/forward_insert.xml"/>
152  <include ref="${DETECTOR_PATH}/compact/hcal/barrel_gdml.xml"/>
153  <include ref="${DETECTOR_PATH}/compact/hcal/backward.xml"/>
154  <include ref="${DETECTOR_PATH}/compact/hcal/backward_endcap_flux.xml"/>
155
```

```xml
<define>
  <documentation>
    #### Material Thickness
  </documentation>
  <constant name="EcalEndcapPInsertCoverThickness"
  <constant name="EcalEndcapPInsertAirThickness"
  <constant name="EcalEndcapPInsertPCBThickness"
  <constant name="EcalEndcapPInsertLightGuideThickness"
  <constant name="EcalEndcapPInsertScintillatorThickness"

  <documentation>
    - Insert N Layers and computed Thickness
  </documentation>

  <constant name="EcalEndcapPInsertSingleLayerThickness"
     value="EcalEndcapPInsertCoverThickness +
            EcalEndcapPInsertAirThickness +
            EcalEndcapPInsertPCBThickness +
            EcalEndcapPInsertLightGuideThickness +
            EcalEndcapPInsertScintillatorThickness "
  />
  <constant name="EcalEndcapPInsertLayer_NRepeat" value="1
```

```
--- cb_DIRC
Scanned 3701/3701 lines for -2.00 < eta < 1.70
No material found for detector EcalEndcapP in this scan, skipped it.
No material found for detector SolenoidBarrel in this scan, skipped it.
No material found for detector HcalBarrel in this scan, skipped it.
jug_xl> root@3f2787a9c8fd:/Users/jay.ryu/eic/Mar25Test/epic# ls
```

?

```
--- SolenoidBarrel
--- SolenoidEndcapN
--- SolenoidEndcapP
--- SweeperMag
--- VacuumMagnetElement
--- VertexBarrelSubAssembly
--- ZDC_Crystal
--- cb_DIRC
Scanned 3701/3701 lines for -2.00 < eta < 1.70
No material found for detector EcalEndcapP in this scan, skipped it.
No material found for detector SolenoidBarrel in this scan, skipped it.
No material found for detector HcalBarrel in this scan, skipped it.
jug_xl> root@3f2787a9c8fd:/Users/jay.ryu/eic/shorttest/epic#
```

Overlap checking
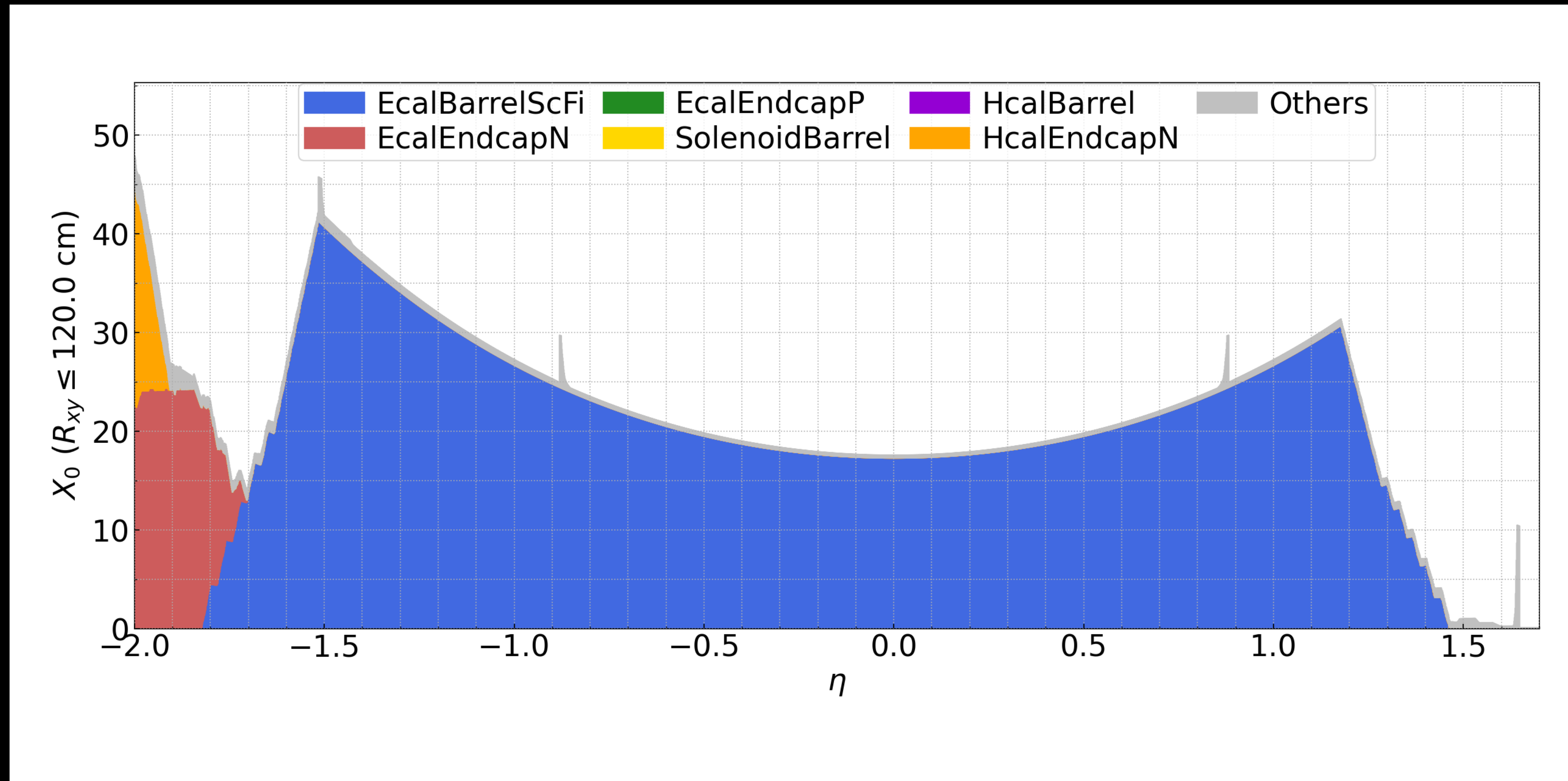
material_scan.py

Overlap checking

checkOverlaps.py

- python checkOverlaps.py epic_brycecanyon.xml -v >output.txt

- Output -> ~453 MB .txt file

- Crucial argument
  -c, --compact : The path to the detector design file(.xml)

- Optional arguments
  -r, --resolution : Number of surface points for overlap checks. Default: "10000"
  -t, --tolerance : Minimum distance in mm to report overlaps. Default: "0.1" mm
  -v, --verbose : Activates extra output for detailed overlap information.

Overlap checking

checkOverlaps.py

- python checkOverlaps.py epic_brycecanyon.xml -v >output.txt

- Output -> ~453 MB .txt file

  AV_922!fiber_grid_2_0_2#2! fiber_vol_359#359:362 (G4Tubs)

  ?

```
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_343#343:346 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_344#344:347 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_345#345:348 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_346#346:349 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_347#347:350 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_348#348:351 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_349#349:352 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_350#350:353 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_351#351:354 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_352#352:355 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_353#353:356 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_354#354:357 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_355#355:358 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_356#356:359 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_357#357:360 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_358#358:361 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_359#359:362 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_360#360:363 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_361#361:364 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_362#362:365 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_363#363:366 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_364#364:367 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_365#365:368 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
Checking overlaps for volume AV_922!fiber_grid_2_0_2#2!fiber_vol_366#366:369 (G4Tubs) ... OK!
Checking overlaps for volume fiber_core_vol_0:0 (G4Tubs) ... OK!
```