SWGO
The Southern Wide-field Gamma-ray Observatory

Implementing the MultiPMT Module in the simulations

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Aims

◎ The aim of the taskforce working on the simulations is to implement the MultiPMT module prototype in the hawcsim frame in a way that's:

→ **Non disruptive** of the previous code, so that it can be used to compare MultiPMTs with older designs and be left unused if needed

→ **Easy to use** with no need to dig deep into aerie and hawcsim to use it in simulations

→ **Representative** of the actual MultiPMT in the Lab

→ **Quickly implemented:** to understand the capabilities of the prototype, its strengths and weaknesses (need of optical gel and reflectors etc ..)

CONFIGURATION FILES

- The easiest way to manage the simulation is by means of configuration files as they do not need to be compiled and it's usually easy to understand their structure and content:

```
(swgo_env) grieco@lxauger09:~/SWGO-Soft/example_MultiPMT/hawcsim-gui-example-master/hawcsim_config$ ls
channelstatus.xml  materials.dat  survey_orig2.xml  survey.xml   tdcmap.xml
geometry.dat       settings.dat   survey_orig.xml   survey.xml~
```

This one concerns the geometrical quantities associated to tanks and PMTs

The survey file is the configuration file in which is given the full array of tanks, their position, the number of PMTs each with its own position and orientation relative to the tank and so on

The Module MultiPMT in the xml file

◎ The way the survey.xml works is by defining in an xsd file a «parent structure» such as <<tank >> with their own «elements» or «children» e.g. <<channels>> and making them modifiable on the spot

→ the goal is to implement the structure <<MultiPMT>> as a child of <<tank>> either by itself or with other <<channels>> as its own child

First Step

Parent , on the above level

Siblings, Children, on the same ''level''

```
<!--   MercedesMultiPMT Tank -->

<tank id="0">
  <name> MMPT </name>
  <type> 9 </type>
  <position>
    <x unit="cm"> 0 </x>
    <y unit="cm"> -375 </y>
    <z unit="cm"> 0 </z>
  </position>
  <channels>
    <channel id="1">
      <name> OR1 </name>
      <number> 1 </number>
      <type> 1 </type>
      <position>
        <x unit="cm"> 0 </x>
        <y unit="cm"> 0 </y>
        <z unit="cm"> 40 </z>
      </position>
    </channel>
  </channels>
  <MultiPMTs>
    <MultiPMT id = "0">
      <name>MultiPMTprova</name>
      <number>1</number>
      <position>
         <x unit="cm">0.0</x>
         <y unit="cm">0.0</y>
         <z unit="cm">0.0</z>
      </position>
    </MultiPMT>
  </MultiPMTs>
</tank>
```

Second Step: adding MultiPMT channels

''Grandparent''

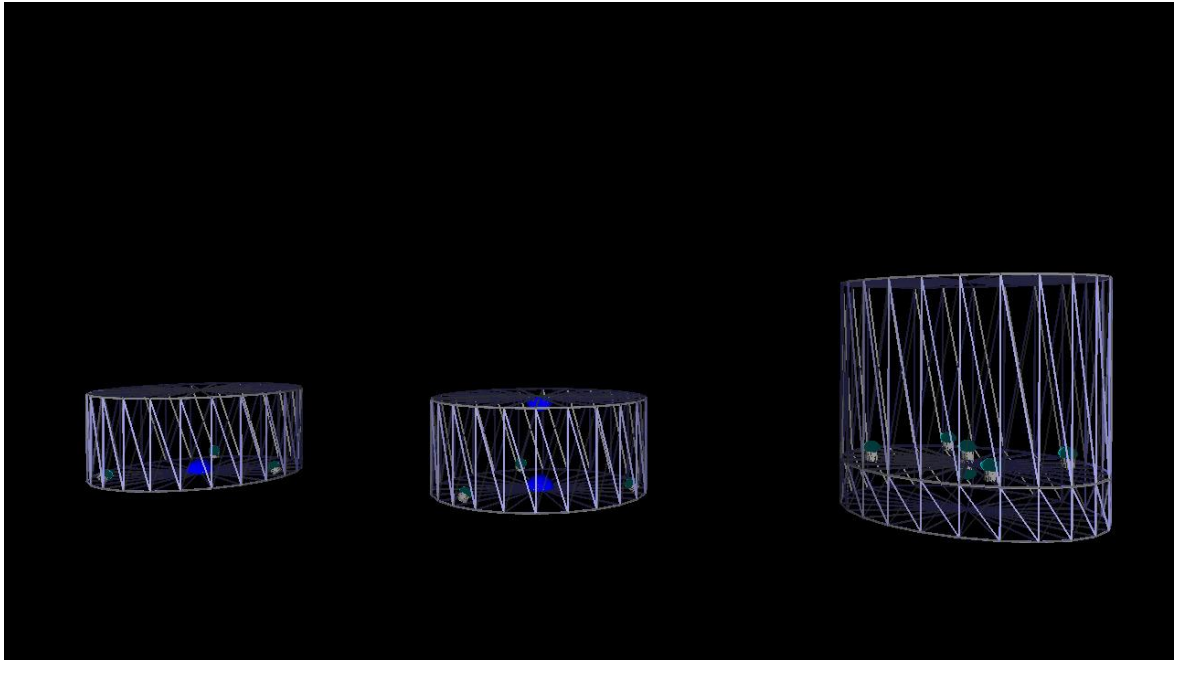
Parent

Child

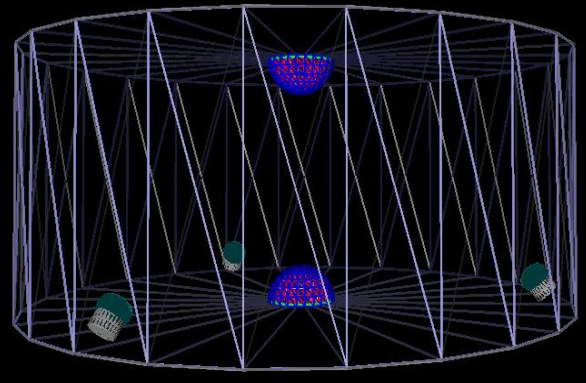
```
->

 <!--   MercedesMultiPMT Tank -->

<tank id="0">
  <name> TankMercedes </name>
  <type> 9 </type>
  <position>
    <x unit="cm"> 0 </x>
    <y unit="cm"> -375 </y>
    <z unit="cm"> 0 </z>
  </position>
  <MultiPMTs>
    <MultiPMT id = "0">
      <name>MultiPMTprova</name>
      <number>1</number>
      <position>
         <x unit="cm">0.0</x>
         <y unit="cm">0.0</y>
         <z unit="cm">0.0</z>
      </position>
      <channels>
       <channel id="1">
          <name> CANALE1</name>
          <number> 1 </number>
          <type> 1 </type>
          <position>
            <x unit="cm"> 0 </x>
            <y unit="cm"> 0 </y>
            <z unit="cm"> 40 </z>
          </position>
        </channel>
      </channels>
    </MultiPMT>
  </MultiPMTs>
</tank>
```

The progress so far

- For the moment the first step has been implemented and tested with different configurations. It allows to add an arbitrary number of dome structures with positions and rotations for each tank as well as single PMTs



The progress so far



```
    <type>1</type>
    <position>
      <x unit="cm">132.0</x>
      <y unit="cm">-76.0</y>
      <z unit="cm">18.0</z>
    </position>
    <rotation>
      <rotX unit="degree">40.0</rotX>
      <rotY unit="degree">0.0</rotY>
      <rotZ unit="degree">240.0</rotZ>
    </rotation>
  </channel>
</channels>
<MultiPMTs>
  <MultiPMT id = "1">
    <name>MultiPMTprova</name>
     <number>1</number>
     <position>
       <x unit="cm">0.0</x>
       <y unit="cm">0.0</y>
       <z unit="cm">-85</z>
    </position>
  </MultiPMT>
 <MultiPMT id = "3">
   <name>MultiPMTprova2</name>
    <number>2</number>
    <position>
      <x unit="cm">0</x>
      <y unit="cm">0</y>
      <z unit="cm">85</z>
    </position>
    <rotation>
      <rotX unit="degree">180</rotX>
      <rotY unit="degree">0.0</rotY>
      <rotZ unit="degree">0.0</rotZ>
    </rotation>
  </MultiPMT>
</MultiPMTs>
```

Upcoming work

- To implement the second step
- Which means adding << channels >> as a child structure of <<MultiPMTs>>
- The module has been implemented for just the mercedes at the moment but can easily be extended to all of the tanks
- We defined a «type» for the MultiPMT to accomodate for future or parallel designs, which ones?