New FTD Mokka Driver

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New Mokka sub-detector SFtd09

Overview

The new *SFtd09* Mokka sub-detector describes the new geometry for the FTD based in the mechanical design from the IFCA-IFIC group. The SFtd09 sub-detector is composed by a database *ftd08*, which contains the parameters description of the detector, and a driver which construct the detector in Mokka.

ftd08 database : keep same tables as ftd07 (common_parameters and disks), but with new rows and columns to fit the new requirements.

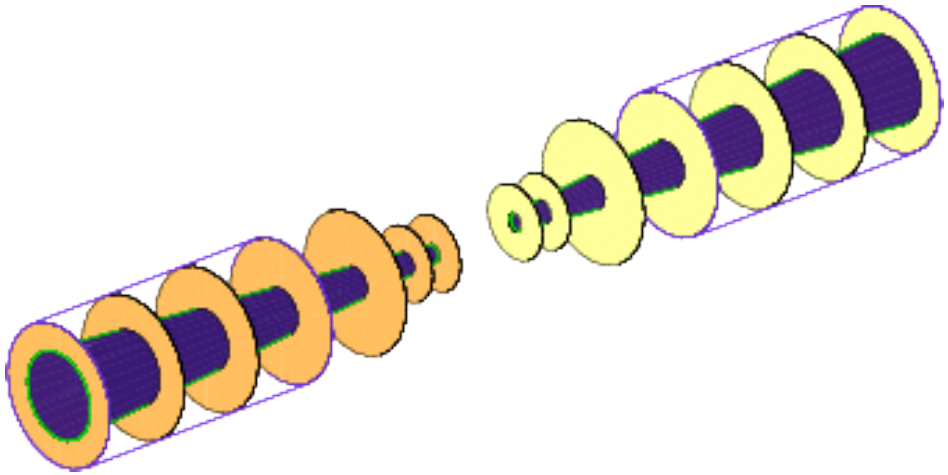
SFtd06 driver : same data processing as SFtd04 driver, same parameters set in model parameters database, same parameter share with other drivers.

```
/Mokka/init/globalModelParameter SIT1_Half_Length_Z 371.309
/Mokka/init/globalModelParameter SIT2_Half_Length_Z 644.906
/Mokka/init/globalModelParameter SIT1_Radius 165
/Mokka/init/globalModelParameter SIT2_Radius 309
/Mokka/init/globalModelParameter TUBE_IPOuterTube_end_z 230
/Mokka/init/globalModelParameter TUBE_IPOuterTube_end_radius 24
/Mokka/init/globalModelParameter TUBE_IPOuterBulge_end_z 2364.5
/Mokka/init/globalModelParameter TUBE_IPOuterBulge_end_radius 184
/Mokka/init/globalModelParameter Ecal_endcap_zmin 2450
/Mokka/init/globalModelParameter TPC_Ecal_Hcal_barrel_halfZ  2350
/Mokka/init/globalModelParameter TPC_inner_radius 329
/Mokka/init/globalModelParameter TUBE_IPOuterBulge_start_z 150
/Mokka/init/globalModelParameter TUBE_IPOuterBulge_start_radius 24
/Mokka/init/globalModelParameter VXD_length_r3 125
```

Parameters set passed to Mokka to load the FTD stand-alone

SFtd04 driver

- Self-scaling driver: significant parameters and positioning defined w.r.t surrounding components (VTX, SIT, SET, beam pipe, ...) following the LOI specifications*
- Sensitive layers defined as silicon's disks.
- Supports:
  - Inner cylinder: supports the whole disks structure w.r.t beam tube
  - Outer cylinder: supports the micro-strips disks (4,5,6,7) w.r.t TPC
- Cables located in the inner cylinder as a cone.



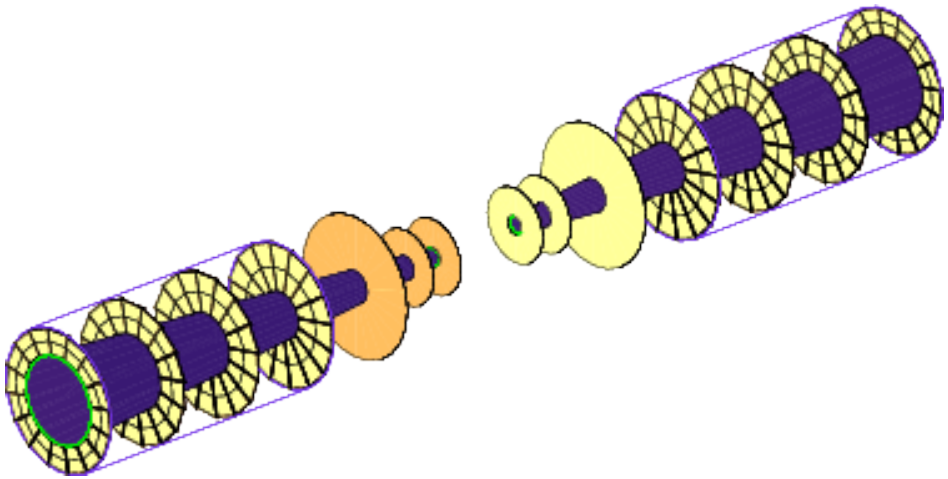
* LOI specifications for FTD

Disk Number	z_{pos} (mm)	R_{inner} (mm)	R_{outer} (mm)
1	220	39	164
2	371.3	49.6	164
3	644.9	70.1	308
4	1046.1	108.3	309
5	1447.3	130.	309
6	1848.5	160.5	309
7	2250	190.5	309

Sub-detector Mokka Name: **SFtd07**, Driver: **SFtd04**, Database: **ftd07**

NEW SFtd06 driver

- Self-scaling driver: significant parameters and positioning defined w.r.t surrounding components (VTX, SIT, SET, beam pipe, ...) following the LOI specifications*
- Each disk is generated from petals, each petal contains 4 Sensitive layers defined as pads.
- FTD Structure Supports:
  - Inner cylinder: supports the whole disks structure w.r.t beam tube
  - Outer cylinder: supports the micro-strips disks (4,5,6,7) w.r.t TPC
- Cables located in the inner cylinder as a cone.



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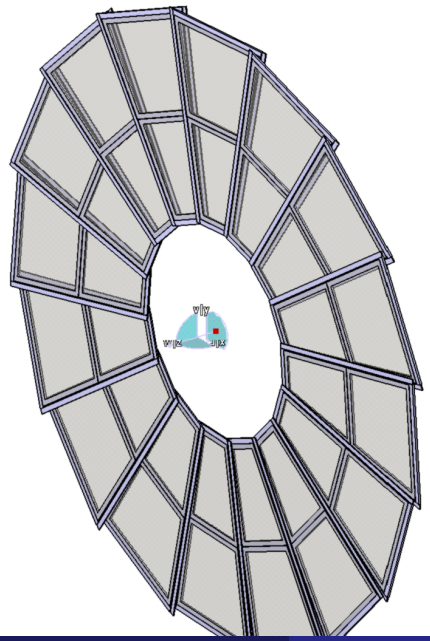
Sub-detector Mokka Name: **SFtd09**, Driver: **SFtd06**, Database: **ftd08**

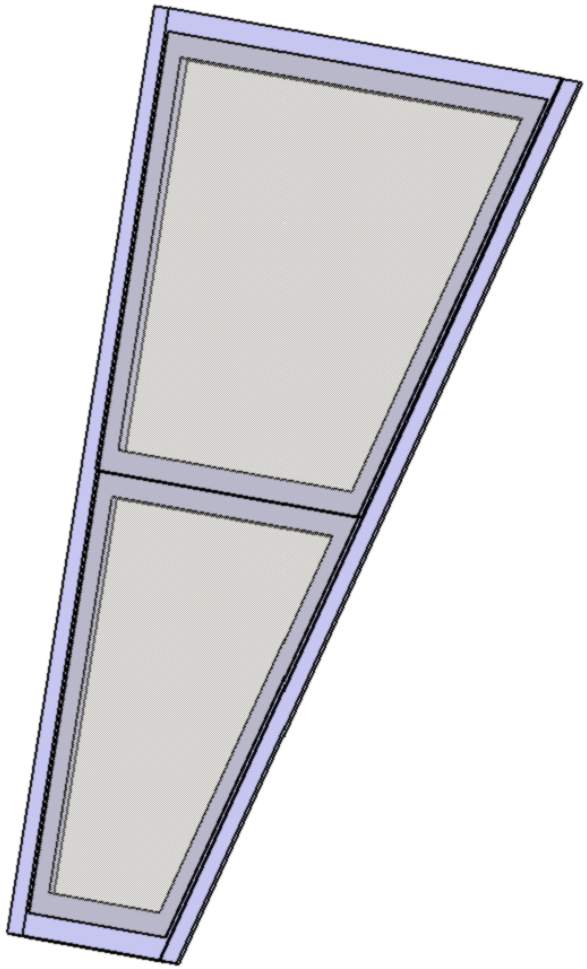
FTD Description

Micro-strip silicon disks: 4,5,6,7

Mechanical Design

- Use same fixed outer radius to define petal width in order to build a disk with 16 petals.
- Use 4th disk dimension to design the petal. The design is propagated to the others disks.
- Petals are rotated on its own plane in order to overlap themselves.





FTD Mokka Implementation

Overview Implementation

- Air Disk: mother volume for all disk structure. Dimension defined by R_{inner} and R_{outer}, placed (7x2 copies) in the world volume at z_{pos} following LOI specifications. FTDDiskAir
- Air Petal: mother volume of the *real* petal support. Each petal is rotated around its plane 4 deg. and placed 16 copies inside the Air Disk, each i-th copy is rotated around the z-axis $i \cdot 45$ deg. FTDPetalAir
- Petal Support: made in two parts, central part and wings. The central part is a trapezoid with two holes to place the sensors, and the wings are thinner extensions to drive the cables out. It place in the Air Petal. FTDPetalSupport
- Silicon Sensors, sensitive detector, placed inside the FTDPetalAir covering the petal support holes. FTDSiSensor

Physical Volume Name	Daughter of	Material	Copies	Copy Number
WORLD	–	Air	1	–
FTDDiskAir	WORLD	Air	7x2	$\pm 1, \ldots, \pm 7$
FTDPetalAir	FTDDiskAir	Air	16	$1, \ldots, 16$
FTDPetalWingsSupport	FTDPetalAir	Carbon Fiber	1	0
FTDPetalSupport	FTDPetalAir	Carbon Fiber	1	0
FTDPetalSupportHoleUp	FTDPetalSupport	Air	1	0
FTDPetalSupportHoleDown	FTDPetalSupport	Air	1	0
FTDSiSensor[Up|Down][Front|Rear]	FTDPetalAir	Silicon	4	1,2,3,4

FTD Mokka Implementation

Air Disk

Cylinder made of air, mother of each disk. It's placed inside the world volume.

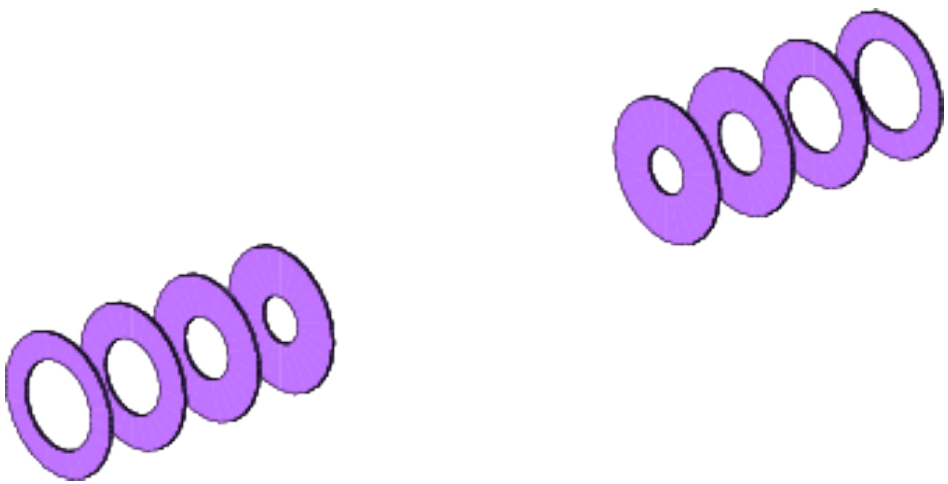
Solid Parameters :

- R_{inner}, cylinder inner radius*.
- R_{outer}, cylinder outer radius*.
- thickness, calculated to fit everything in (petal support, silicon sensors, ...)

Placement Parameters :

- z_{pos}, z position in world coordinates*.

*) These values are extracted from database with respect other components (VTX, SIT, beam tube, ...)



FTD Mokka Implementation

Air Petal

Trapezoid made of air, mother of the *real* petal support and the silicon sensors. Placed 16 copies inside the Air Disk.

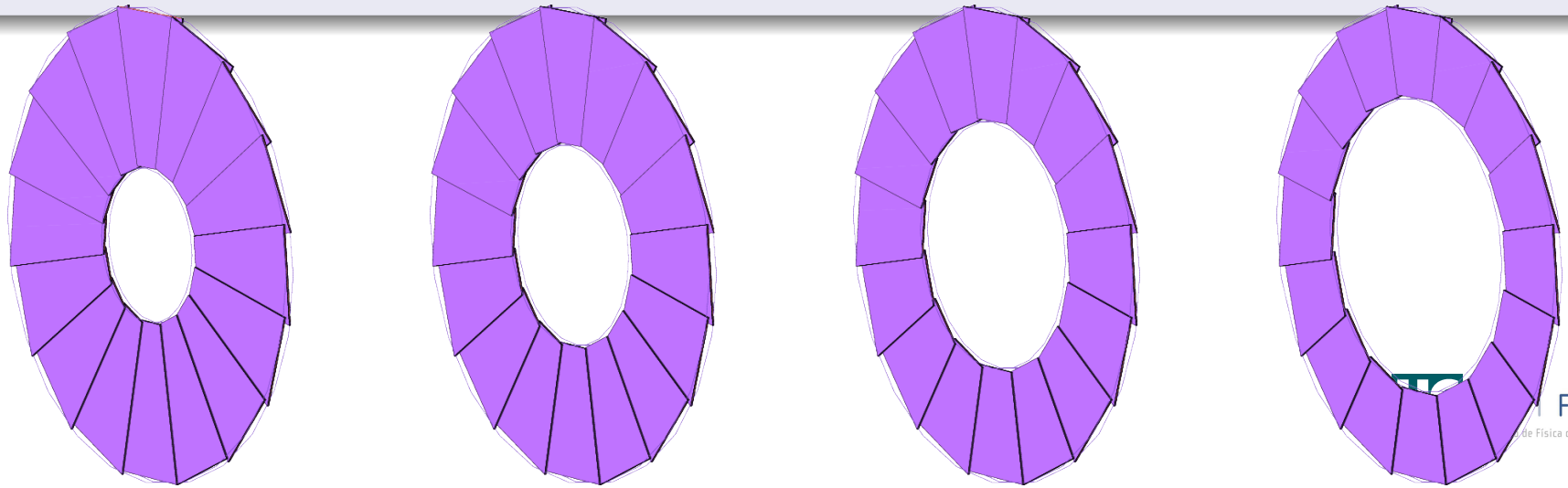
Solid Parameters :

- Top width, Dx_{max}, constant value for all disks
- Bottom width, Dx_{min}, depends of the R_{inner} of each disk*
- Height, Dy, depends of the R_{inner} of each disk*
- Thickness, dz, 2xsilicon sensor thickness + petal support thickness

Placement Parameters :

- α, rotation angle around the plane of the petal
- $i \cdot \theta$, rotation angle around z-axis, for the i-th petal
- y distance from the center of the air disk

*) These values are calculated via trigonometrical relations from the 4th disk mechanical design



FTD Mokka Implementation

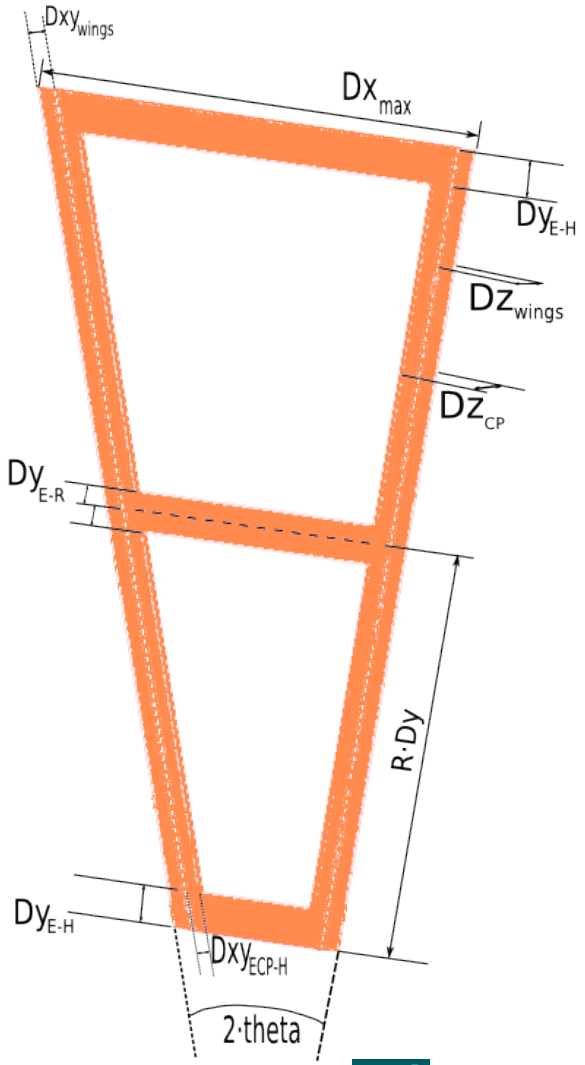
Petal Support

Made in two parts, central part and wings. The central part is a trapezoid with two holes to place the sensors. The wings are thinner extensions to drive the cables out. Placed inside the Air Petal.

Solid Parameters:

- Top width of the petal (wings+central part): Dx_{max}
- Width of the wings: Dxy_{wings}
- Angle defined by the trapezoid: 2θ
- Thickness of the central part: Dz_{cp}
- Thickness of the wings: Dz_{wings}
- Height middle point ratio*: R
- y distance between the edges of the petal and the holes: Dy_{E-H}
- y distance between the middle point and the holes: Dy_{E-R}
- Width of the laterals between the hole edge and the central part edge: Dxy_{ECP-H}
- Total petal height, Dy, dependent of R_{outer} and R_{inner}
- Bottom width of the petal (wings+central part), Dx_{min}, dependent of R_{inner})

*) The petal is divided in two semi-petals, up and down; the division is not in the exact middle, i.e. $Dy/2$, but in $(Dy \cdot R)/2.0$



FTD Mokka Implementation

Silicon Sensors

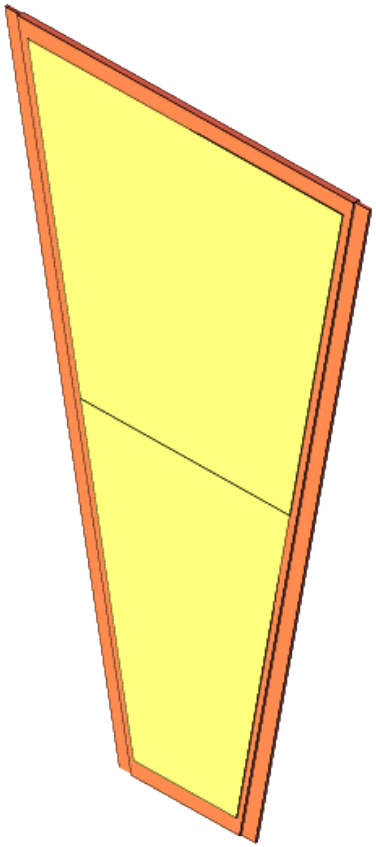
Sensitive detector, placed covering the holes of the petal support. Daughters of the Air Petal.

Solid Parameters :

- Top width for the up pad sensor, constant for all the disks
- Botton width for the up pad sensor, dependent of R_{inner},..
- Top width for the down pad sensor, dependent of R_{inner},..
- Botton width for the up pad sensor, dependent of R_{inner},..
- Height for up and down pads.
- Thickness

Placement Parameters :

- y distance from the center of the air petal



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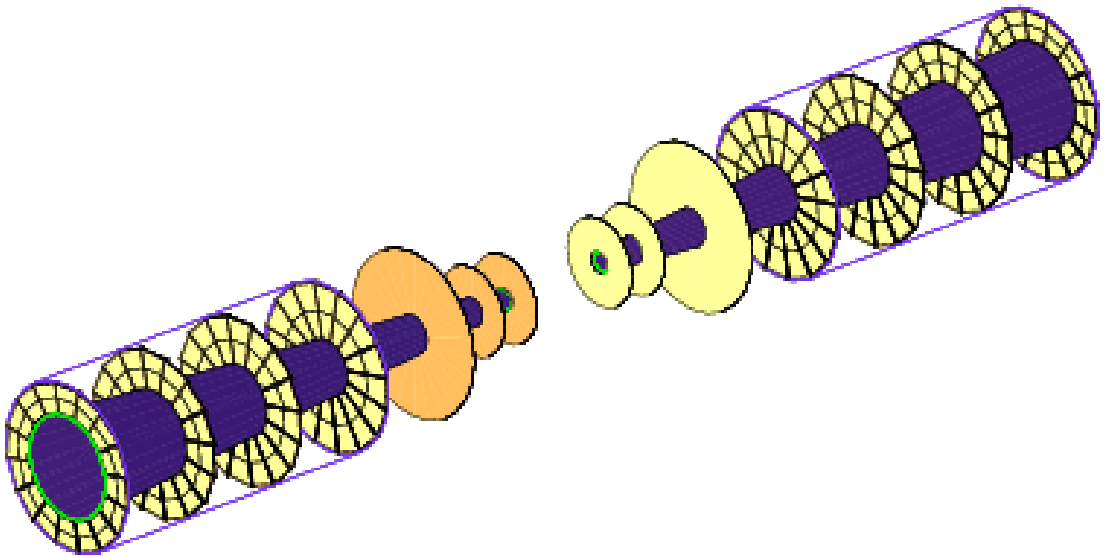
FTDSiSensor[Up|Down][Front|Rear]	FTDPetalAir	Silicon	4	1,2,3,4

To keep track of the silicon sensor which stores a hit, the *TRKSD00* class should be modified.
Now it takes the id from the *G4StepPoint::GetPhysicalVolume()*, should be *G4StepPoint::GetTouchable()*, since the identification of the sensors implies to know all its mothers.

TO-DO List

- Si pixels disks, waiting a detailed design. As soon as it arrives, they will be implemented
- Front-end electronics, DC-DC conversors, ... to be included (this week).
- Cables estimation and implementation (this week and/or next)
- Validation and reconstruction issues to be check.



Summary

- New sub-detector for the FTD has been implemented: *SFtd09*, which uses *SFtd06* driver and *ftd08* database
- New realistic design for micro-strip disks (4,5,6,7) implemented in the SFtd06 driver.
- Checked overlaps for 4,5,6,7 disks (eye, Geant4 built-in commands and DAVID): seems fine.
- Some improvements (cables, services,...) planned during this and next week.
- No modifications done for the Si pixels disks (1,2,3), to do as soon as possible.