



**Collaboration Meeting
Mechanics session
GSI, March 8, 2010**

Thomas Würschig

**Mvd-2.1 versions:
A dedicated model for the inner tracker**

General comments



- Mvd-2.1: New versions uploaded to Wikipage

Mvd-2.1_AddDisk

- Zipped files:
 - Mvd-2.1_AddDisks_Fullversion
 - Mvd-2.1_Fullversion
 - Mvd-2.1_AddDisks_Sensitive
 - Mvd-2.1_Sensitive
- Based on Sv-3.3 and Pv-3.1 subversion
- [Download](#)
- [Link to documentation](#)

- Strip part: Sv-3.3ext: Additional components needed for Mvd-2.1 version (schematic)
- Pixel part: Pv-3.0 (mechanics) Pv-3.1c (simplified for simulation)

Sv-3.3ext.stp	Docu Sv-3.3	: Extended version of Sv-3.3 with additional components :
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Pixel subversions

- Download file -	- Link to documentation -	- Comment -
Pv-3.1.stp	Docu Pv-3.1	: Pixel subversion for MVD-2.0 including global MVD support frame:
Pv-3.1c.stp	Docu Pv-3.1	: Same version from above optimized for CAD converter:

General comments



- Mvd-2.1: New versions uploaded to Wikipage

- Based on the model presented at last meeting
- Additional input from electronics and mechanics
 - Fixation of input parameters
- Completion of upstream routing

Collaboration Meeting
MVD Subgroup
GSI, December 8, 2009

Thomas Würschig

Implementation of a dedicated routing concept for the updated MVD model

- Implementation into simulation framework

- Presentation (including results) during computing + mechanics session

Roadmap



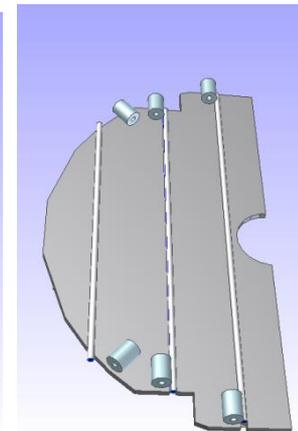
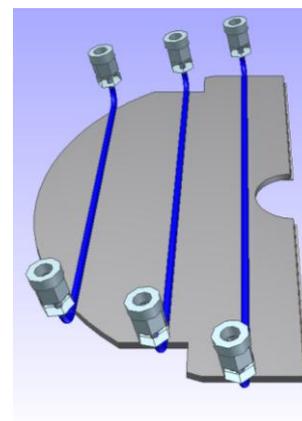
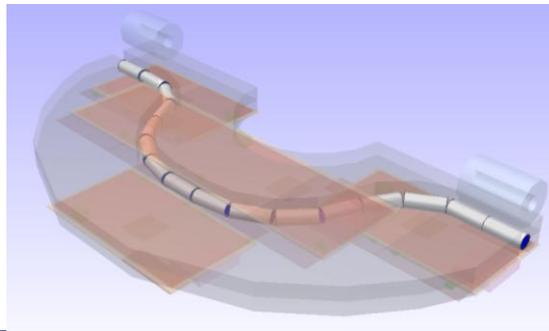
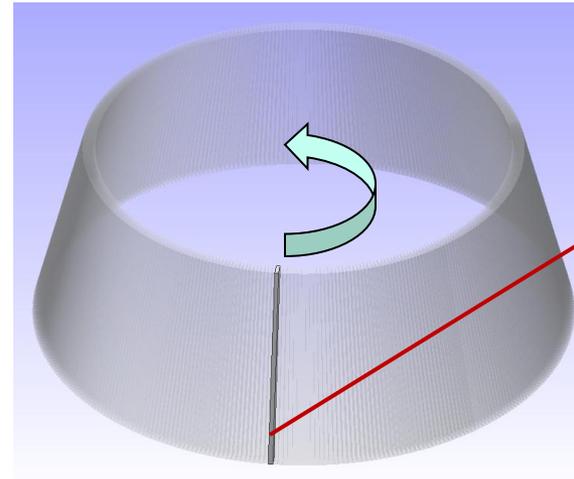
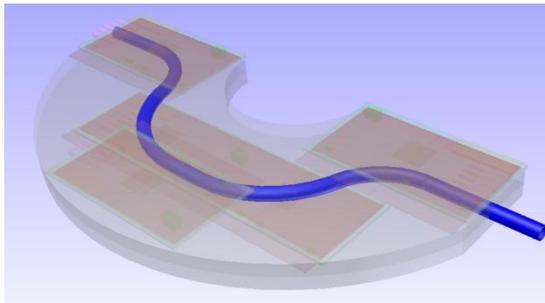
- Dedicated **MVD internal** meeting to fix input parameters ~ January 2010 ✓
- Implementation of updated MVD-2.1 model into simulation software before March 2010 ✓
- Design description and extraction of reliable numbers for TDR ~ June 2010

- Implementation
 - Complete, detailed CAD model
 - CAD converter: STEP file → ROOT geometry
 - Material definition of all components
 - New materials: Density-weighted modification
 - ✓ Z and A defined referring to main element
 - ✓ Density modulation of 2nd material:
$$\rho_{\text{eff}} = x \cdot \rho_1 + (1-x) \cdot \rho_2$$
- Extensive collision checks (CAD / Root)
- Simulation
 - Mapping of overall material budget
 - Study of influence of different components and layers

General comments

- Implementation: CAD conversion

- Cones made from single elements
- Simplification of mechanics details



Main versions available



- **Mvd-2.1_AddDisks_FullVersion**

- Full version of extended inner tracker:
MVD + Additional disks

- **Mvd-2.1_FullVersion**

- Full version of MVD

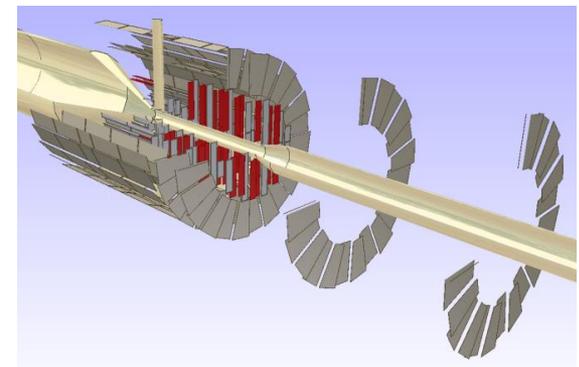
of volumes:
70.458
of different volume types:
597

- **Mvd-2.1_AddDisks_Sensitive**

- MVD + Additional disks:
Active detector volumes only

- **Mvd-2.1_Sensitive**

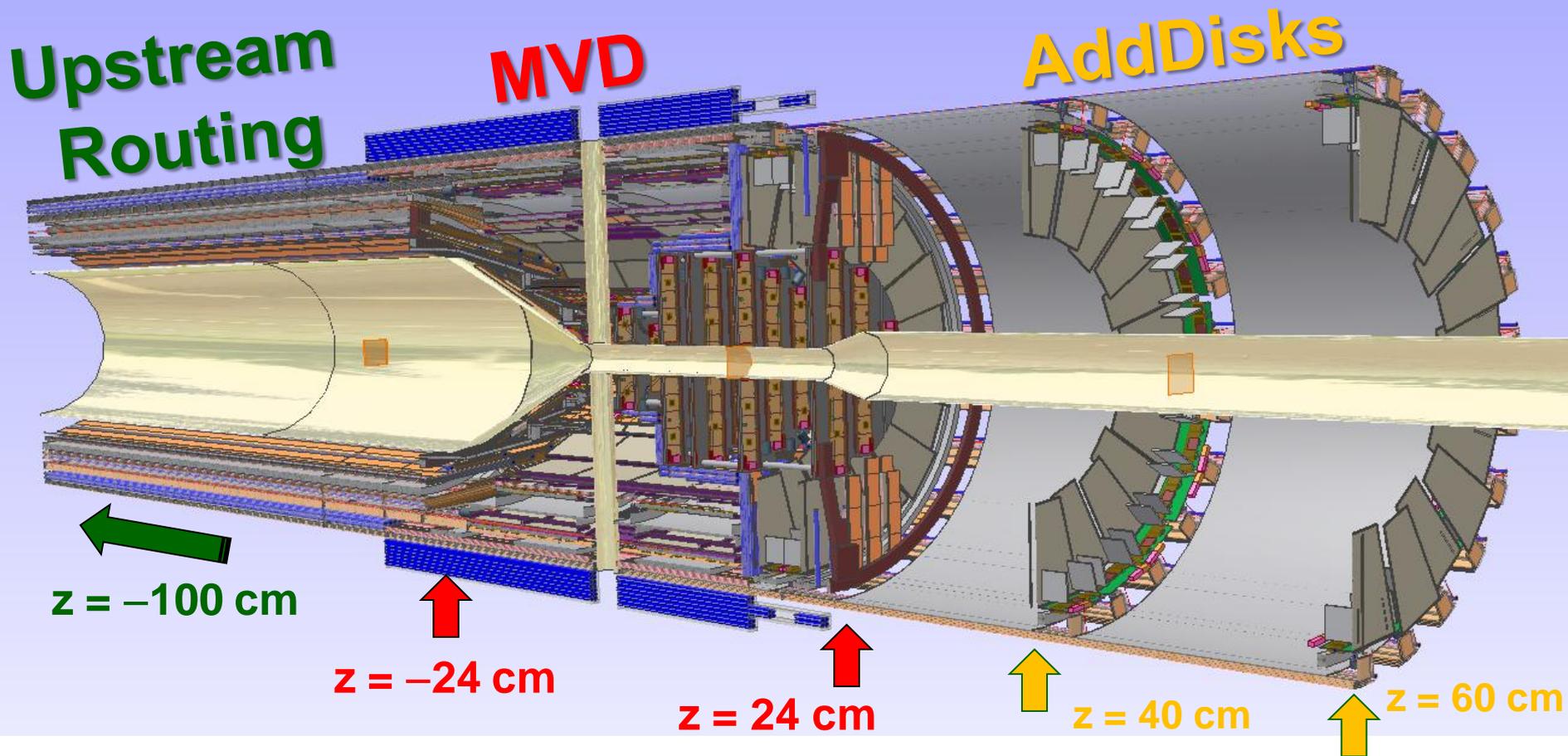
- Active MVD detector volumes only



Main versions available



- Illustration of MVD and additional forward disks



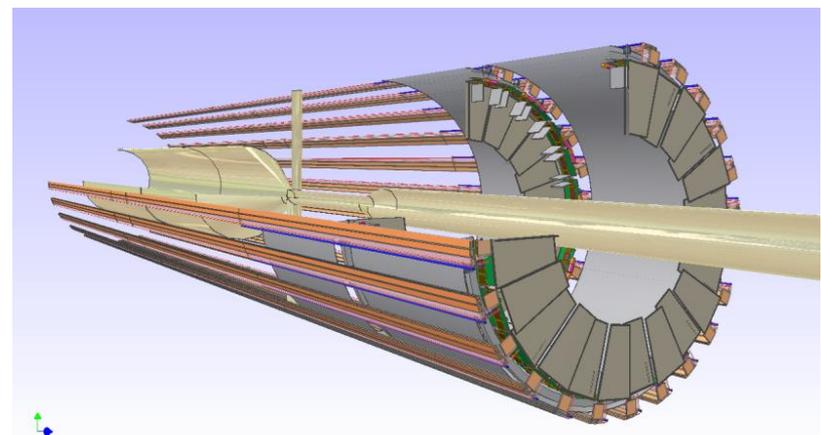
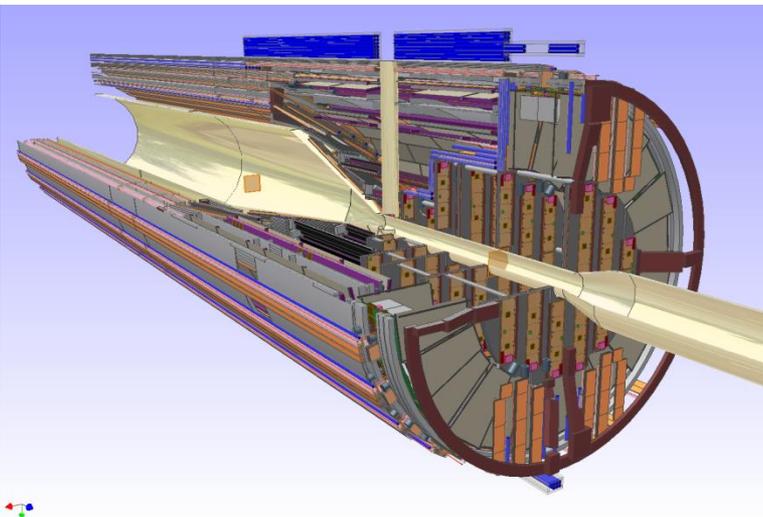
Main structure



Mvd-2.1_AddDisks_FullVersion

Mvd-2.1 (*Full version*)

AddDisks (*Full version*)



Main structure



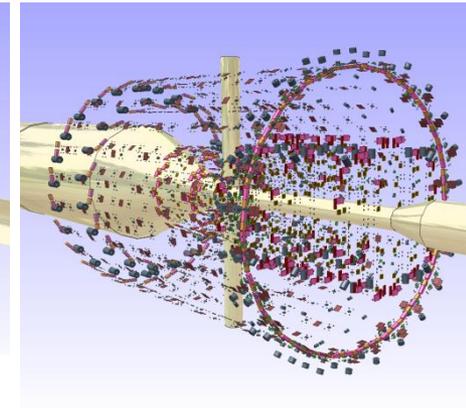
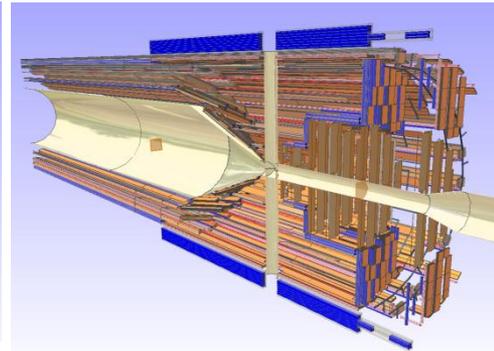
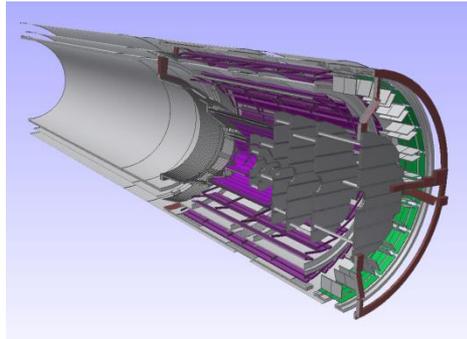
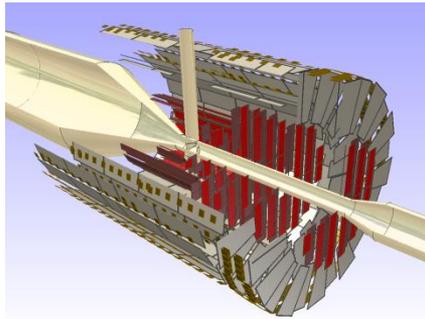
Mvd-2.1 / AddDisks (*Full version*)

Silicon

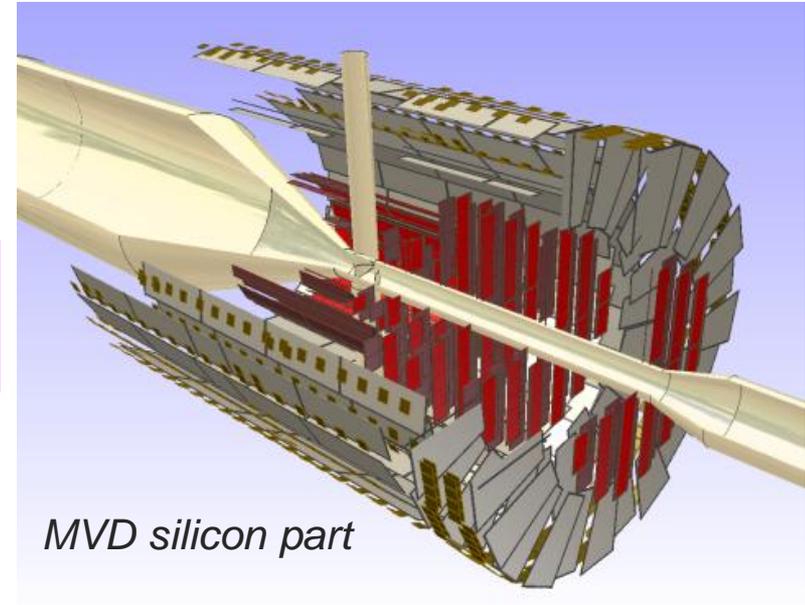
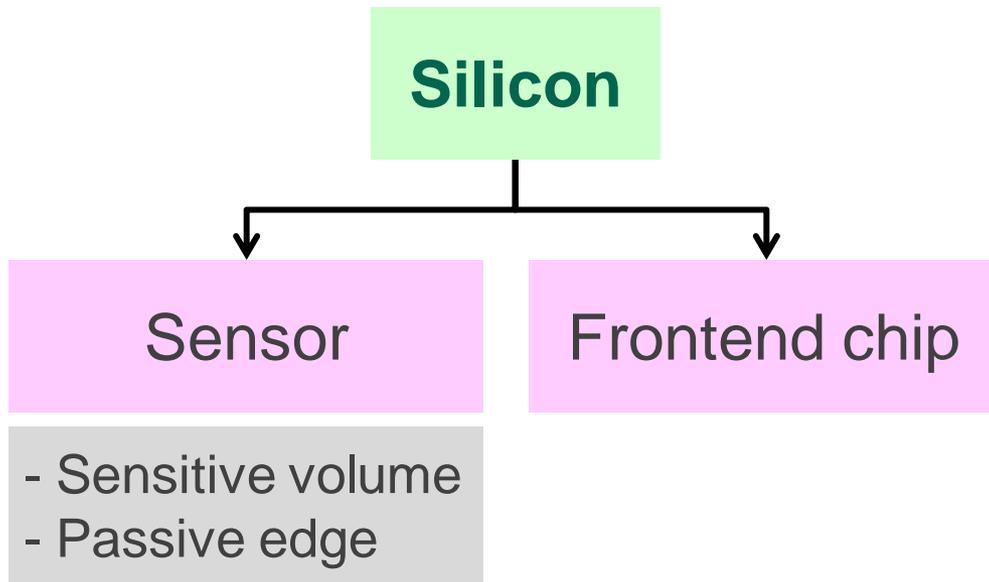
Support

Routing

Components



Structure of main parts



- Extracted from Sv-3.3 and Pv-3.1
- Design optimized for MVD part
→ Number of frontends defined by pixel cell size + strip pitch

Structure of main parts



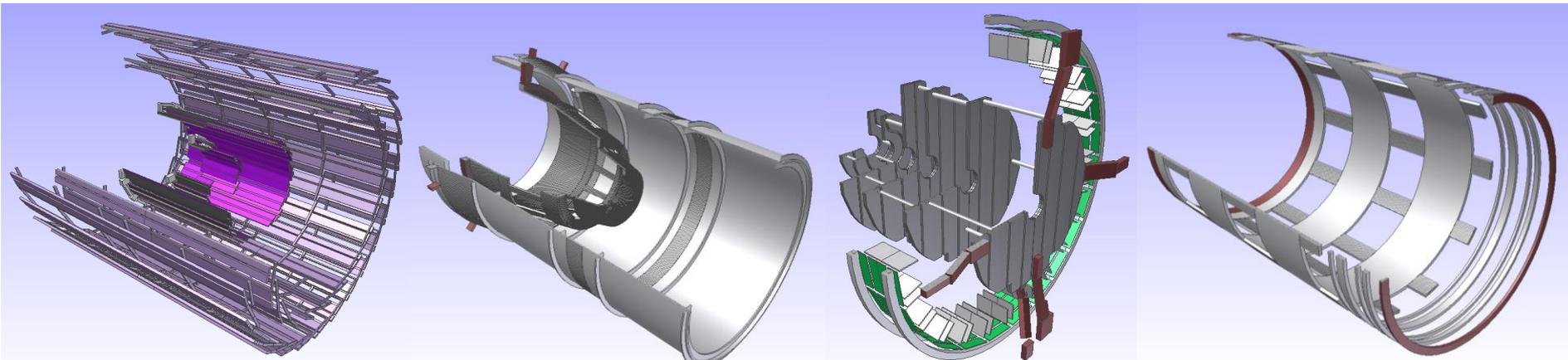
Support

Barrel staves*

Barrel layer*

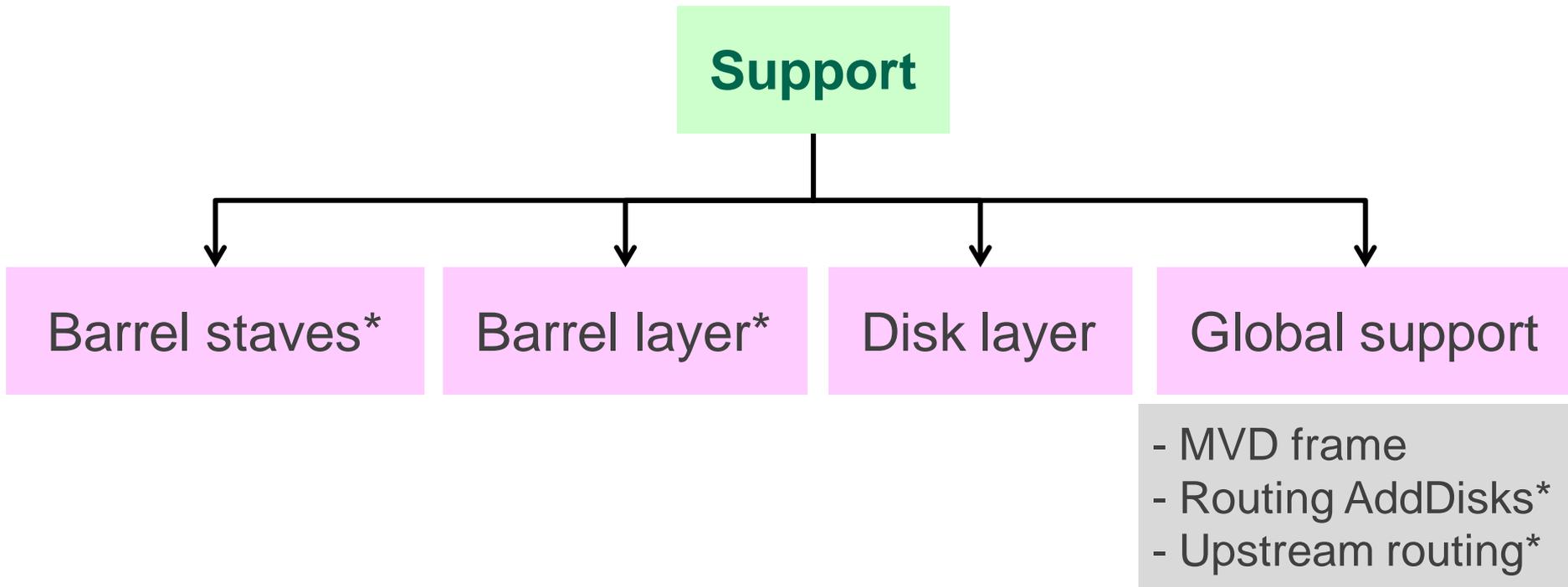
Disk layer

Global support



* MVD part only

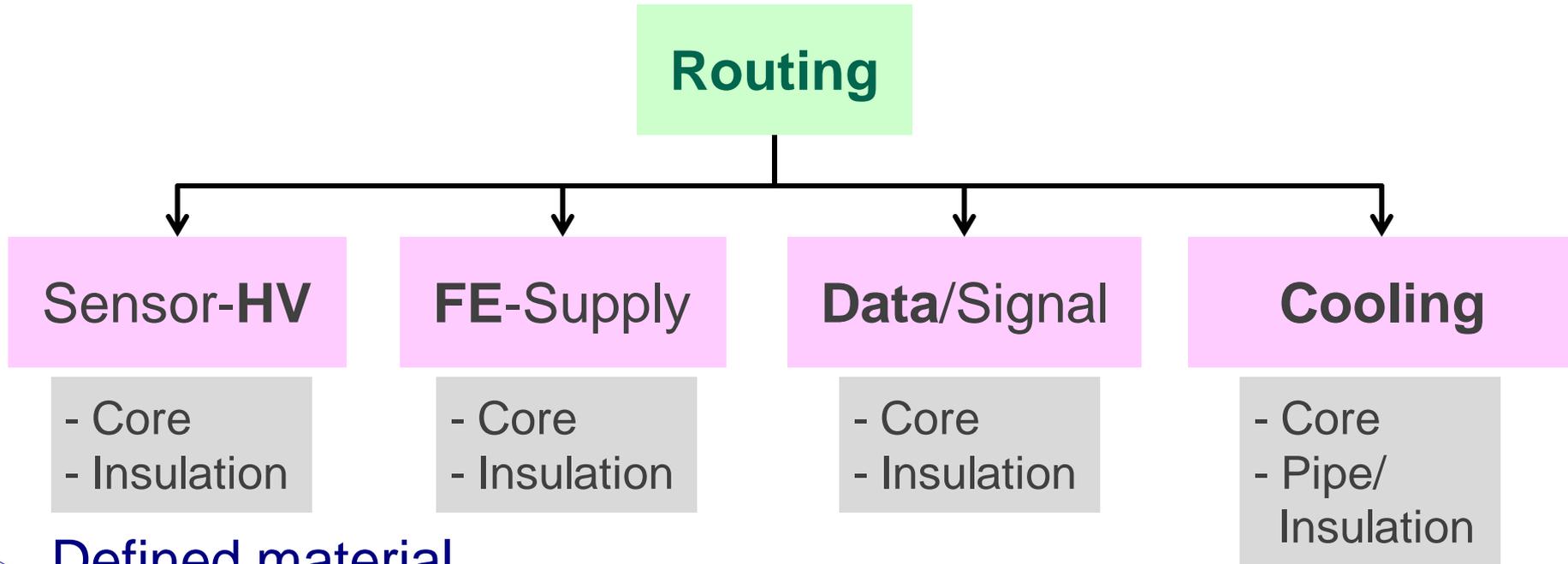
Structure of main parts



**schematic*

- Defined material: Carbon foam, Carbon, Different “light carbon” materials

Structure of main parts



- Defined material
 - ✓ Core: Aluminium (HV, Data) / Copper (FE) / Water (Cooling)
 - ✓ Insulation: PVC / Pipe (Cooling): Steel
- Substructure (MVD): Single barrel layer, Pixel disks, Strip disks

Structure of main parts



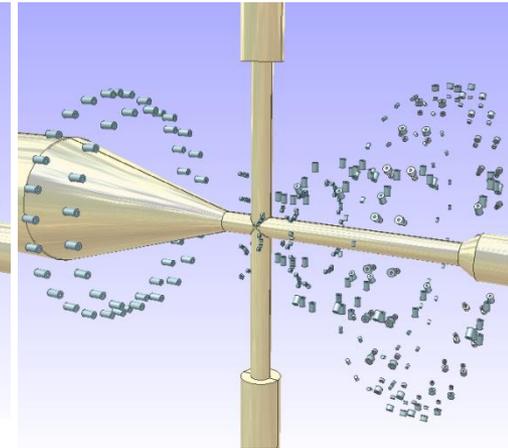
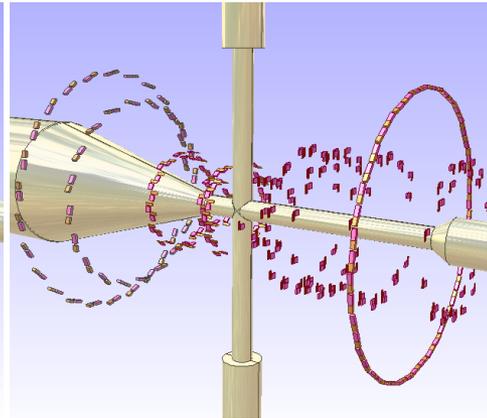
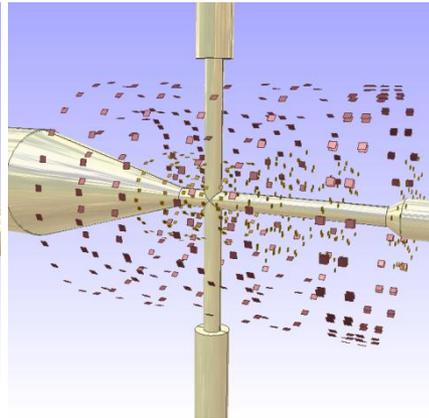
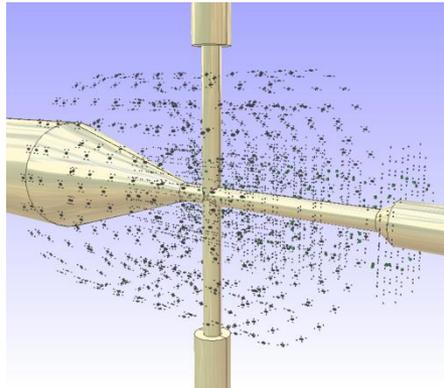
Components

Smd

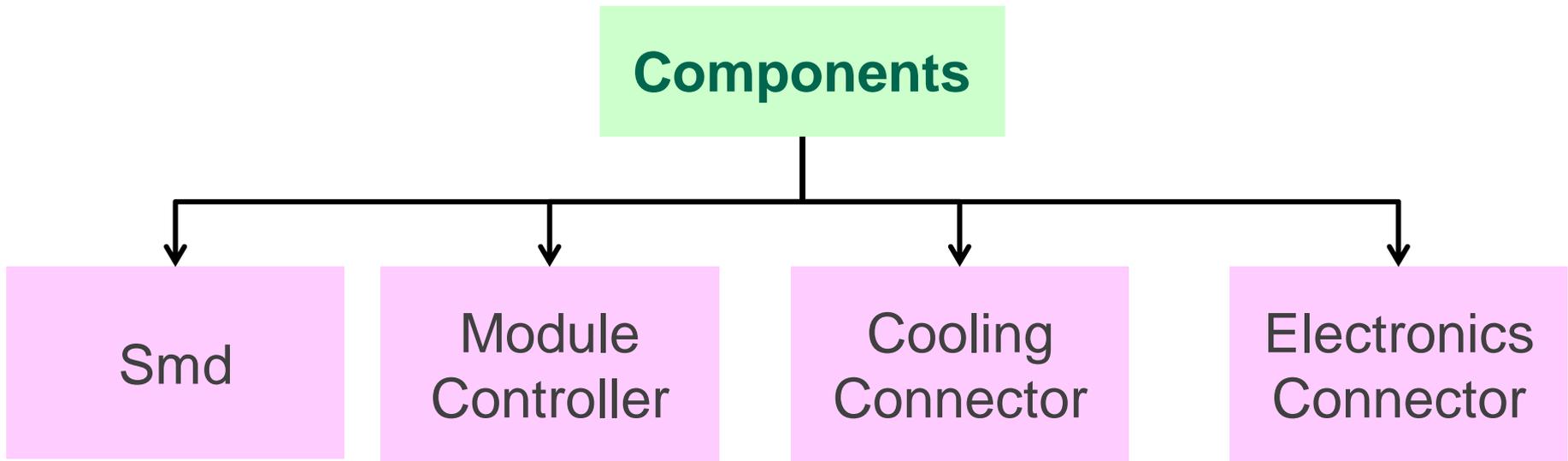
Module
Controller

Cooling
Connector

Electronics
Connector



Structure of main parts



- Defined material

Cooling connector: PVC / Module controller: Silicon

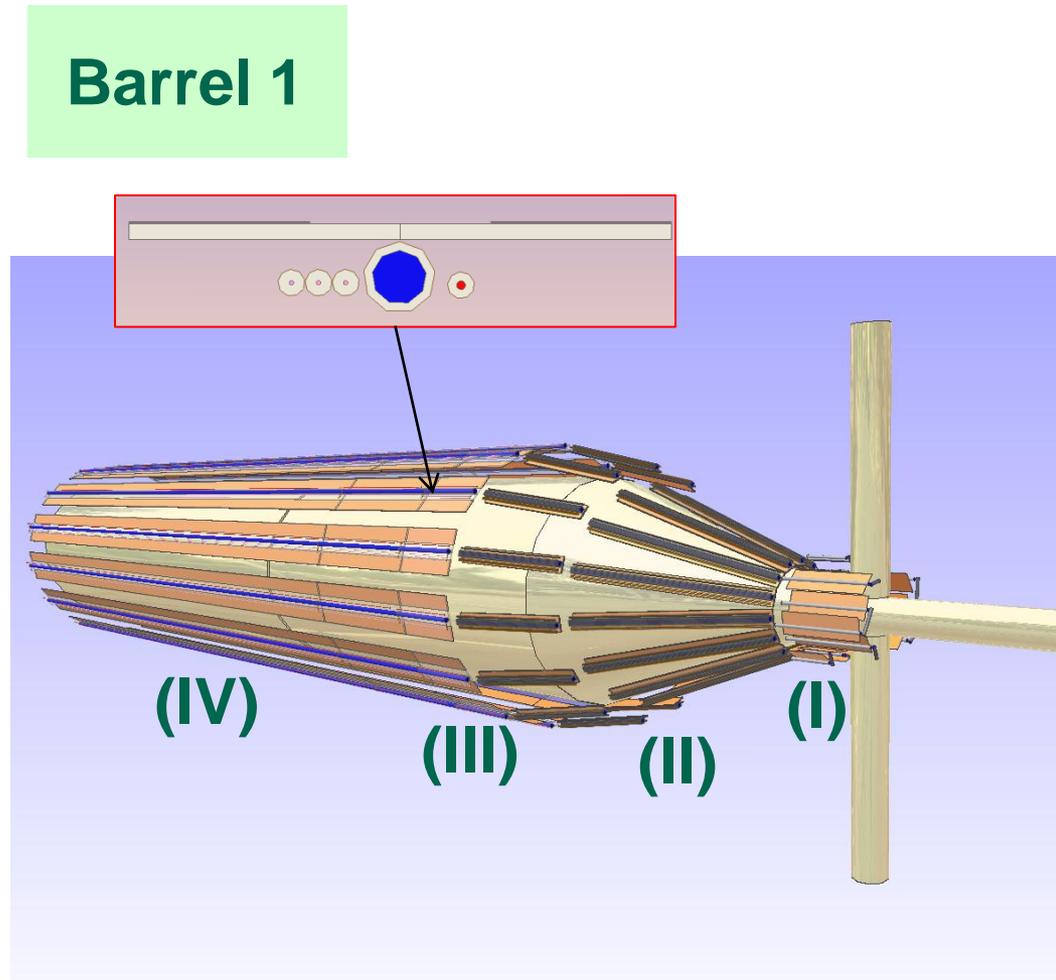
Smd: “Light” aluminium (reduced density) /

Electronics connectors: “Heavy” PVC (increased density)

- Simplified, more schematic implementation

Routing

- Implementation:
“Packets” for individual super-modules
- Routing regions:
 - (I) Within active region (super-module)
 - (II) Within MVD volume (MVD global frame)
 - (III) Until $z = -30$ cm (End of central frame)
 - (IV) Until $z = -100$ cm (End of EMC BW EC)

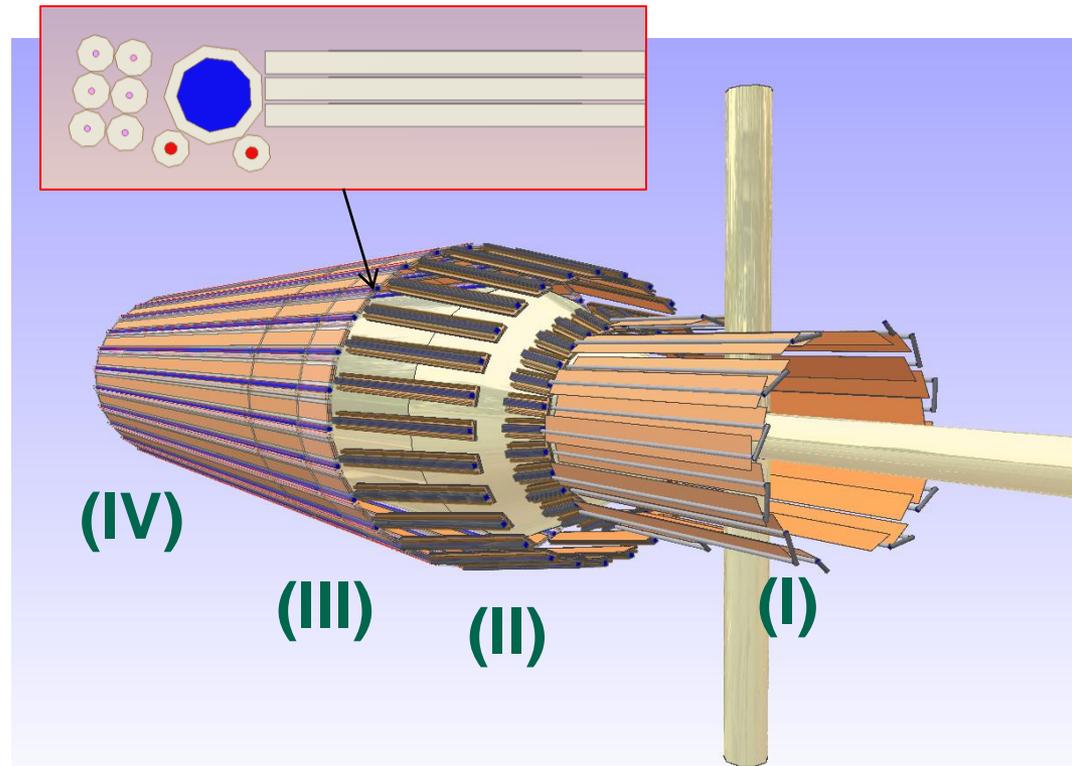


Routing



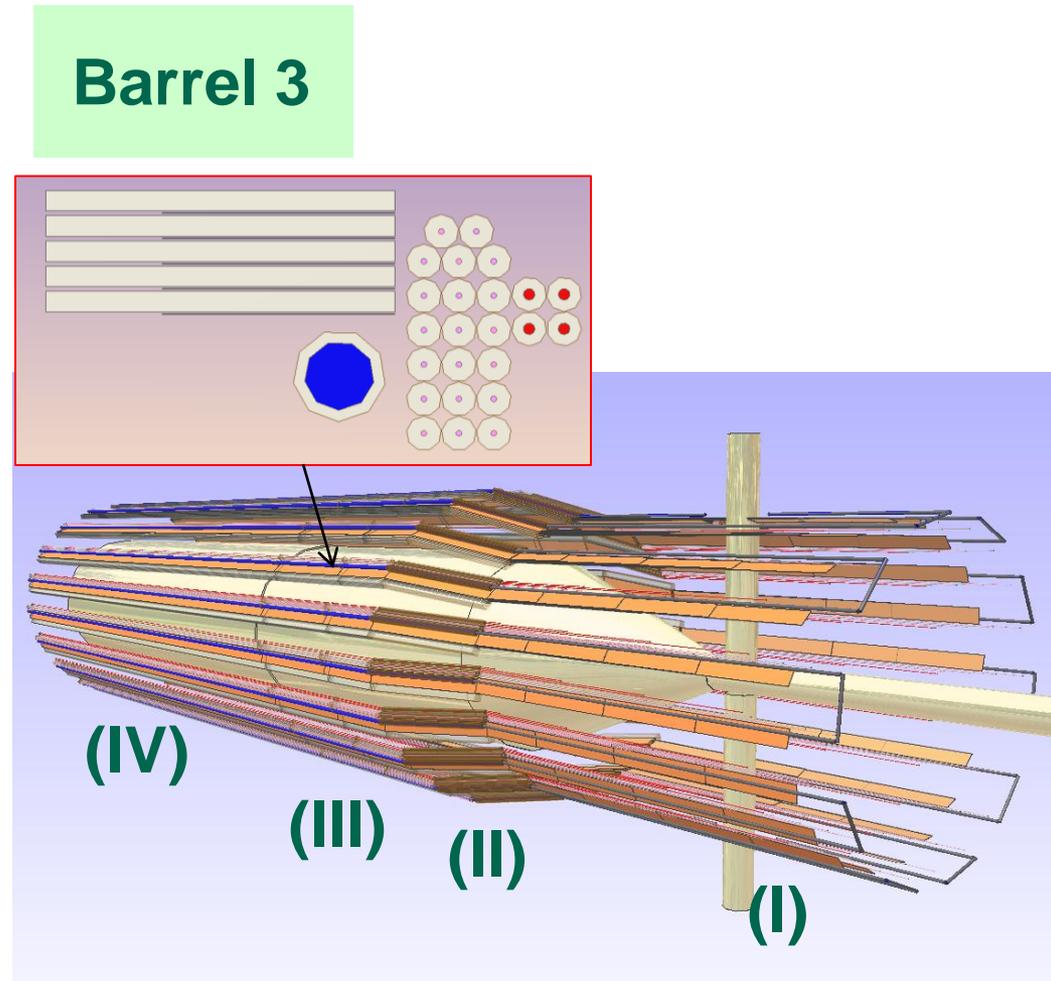
- Implementation:
“Packets” for individual super-modules
- Routing regions:
 - (I) Within active region (super-module)
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 - (IV) Until $z = -100$ cm (End of EMC BW EC)

Barrel 2



Routing

- Implementation:
“Packets” for individual super-modules
- Routing regions:
 - (I) Within active region (super-module)
 - (II) Within MVD volume (MVD global frame)
 - (III) Until $z = -30$ cm (End of central frame)
 - (IV) Until $z = -100$ cm (End of EMC BW EC)

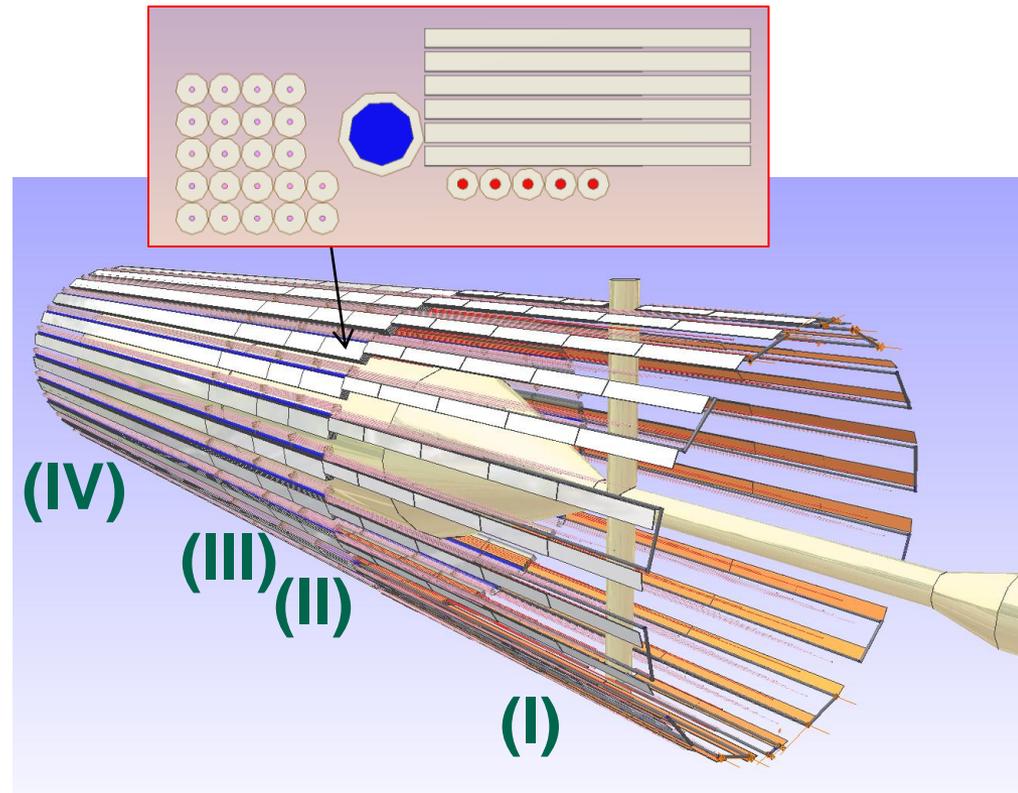


Routing



- Implementation:
“Packets” for individual super-modules
- Routing regions:
 - (I) Within active region
(super-module)
 - (II) Within MVD volume
(MVD global frame)
 - (III) Until $z = -30$ cm
(End of central frame)
 - (IV) Until $z = -100$ cm
(End of EMC BW EC)

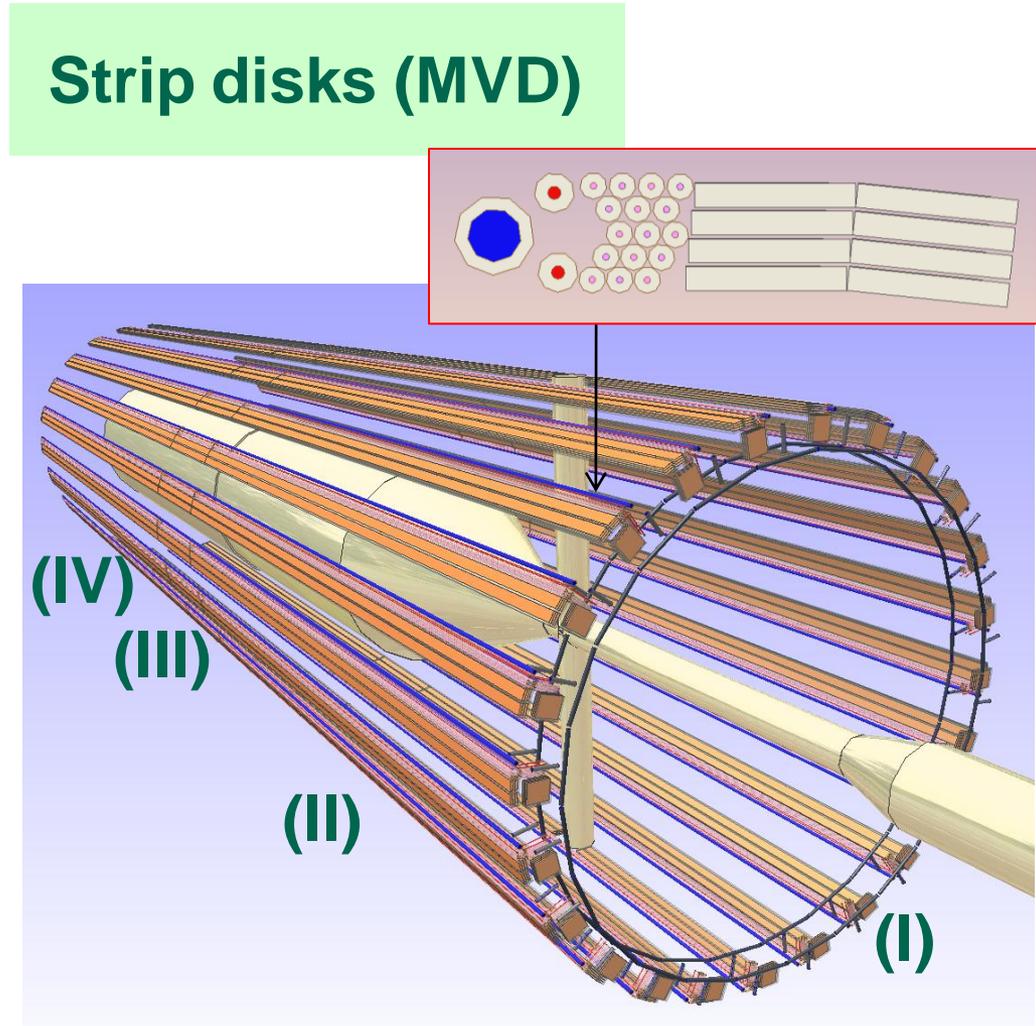
Barrel 4



Routing



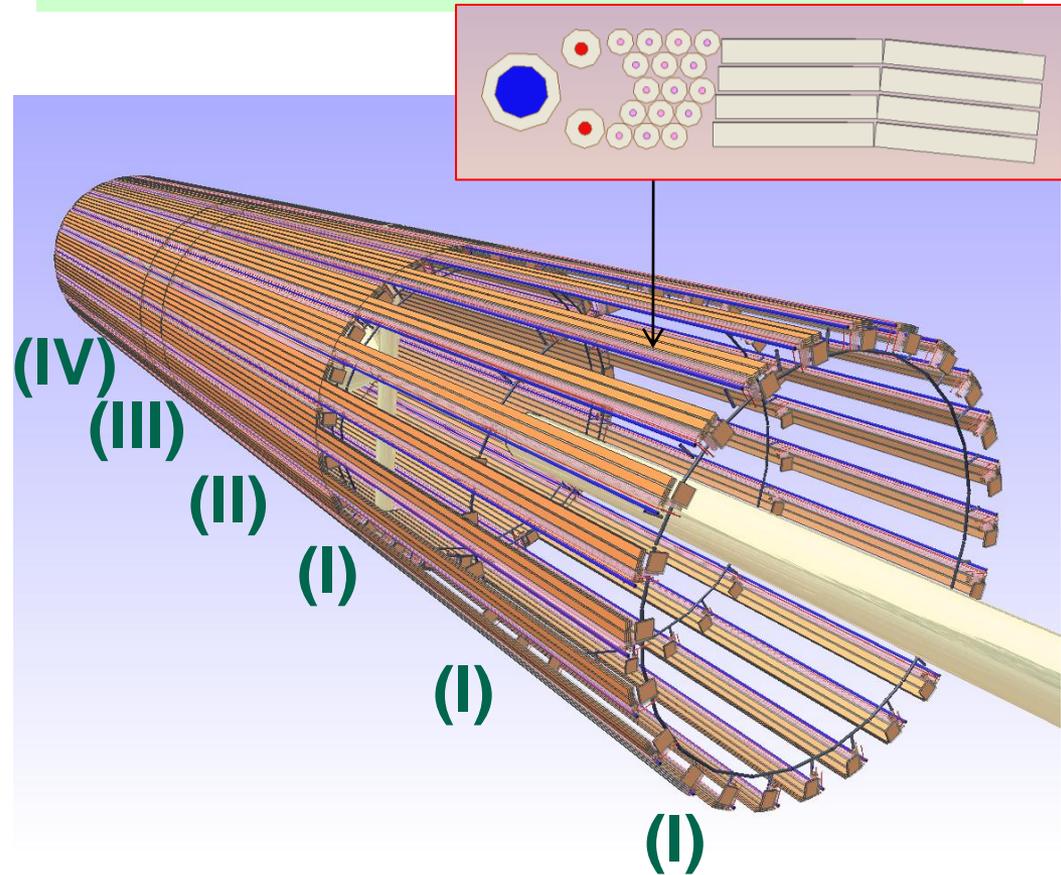
- Implementation:
“Packets” for individual super-modules
- Routing regions:
 - (I) Within active region
(super-module)
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(MVD global frame)
 - (III) Until $z = -30$ cm
(End of central frame)
 - (IV) Until $z = -100$ cm
(End of EMC BW EC)



Routing

- Implementation:
“Packets” for individual super-modules
- Routing regions:
 - (I) Within active region
(super-module)
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(MVD global frame)
 - (III) Until $z = -30$ cm
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 - (IV) Until $z = -100$ cm
(End of EMC BW EC)

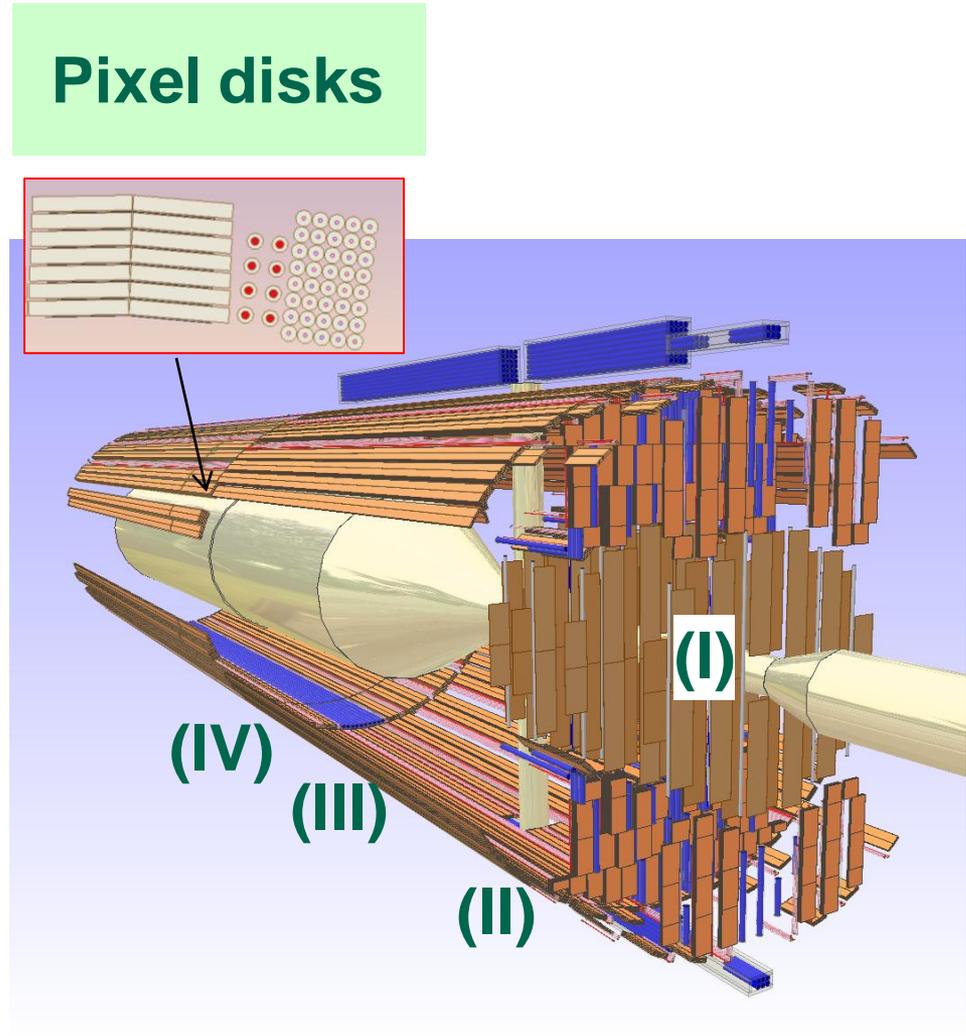
Strip disks (MVD + AddDisks)



Routing

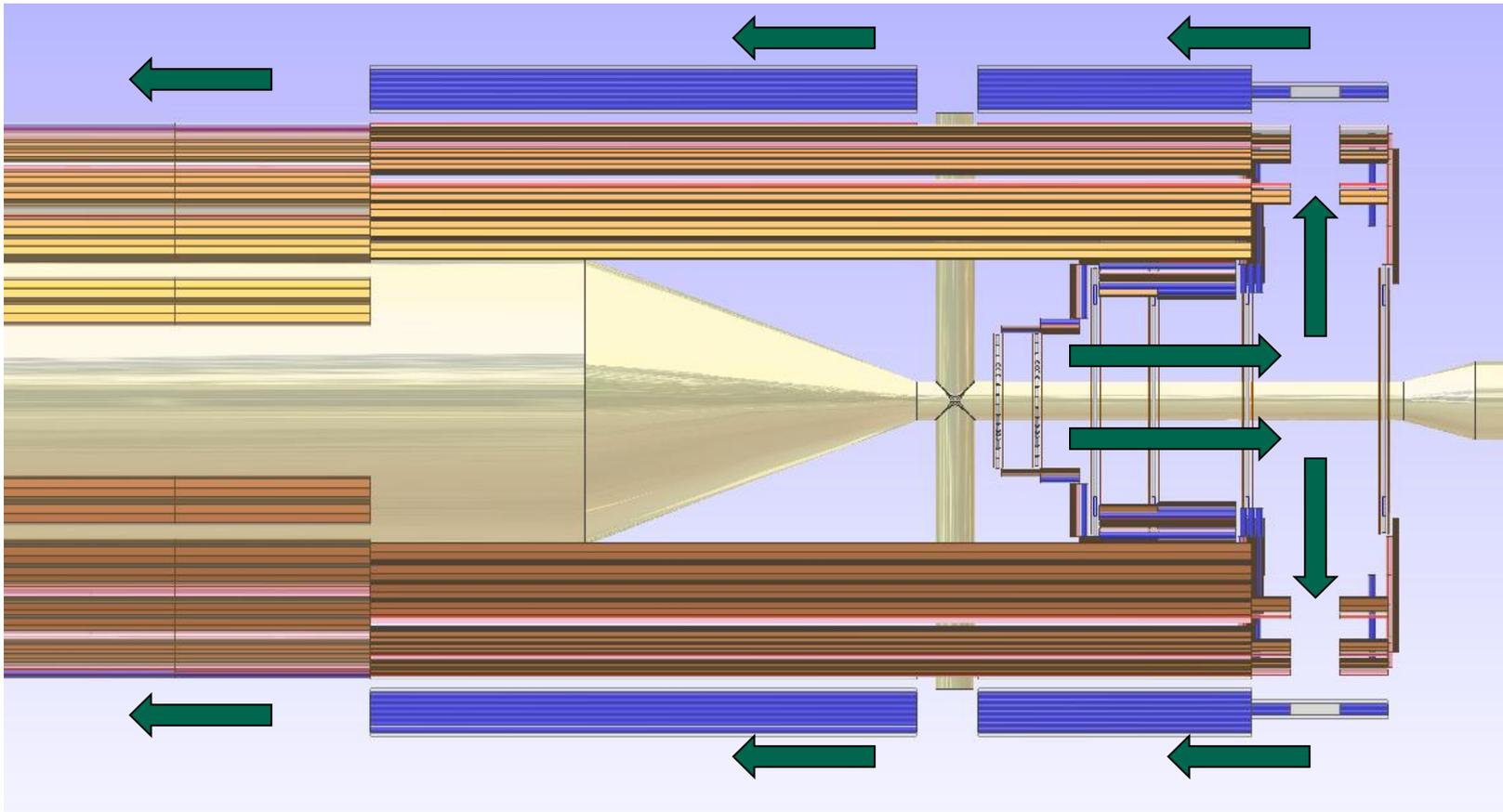


- Implementation:
“Packets” for individual super-modules
- Routing regions:
 - (I) Within active region
(super-module)
 - (II) Within MVD volume
(MVD global frame)
 - (III) Until $z = -30$ cm
(End of central frame)
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(End of EMC BW EC)

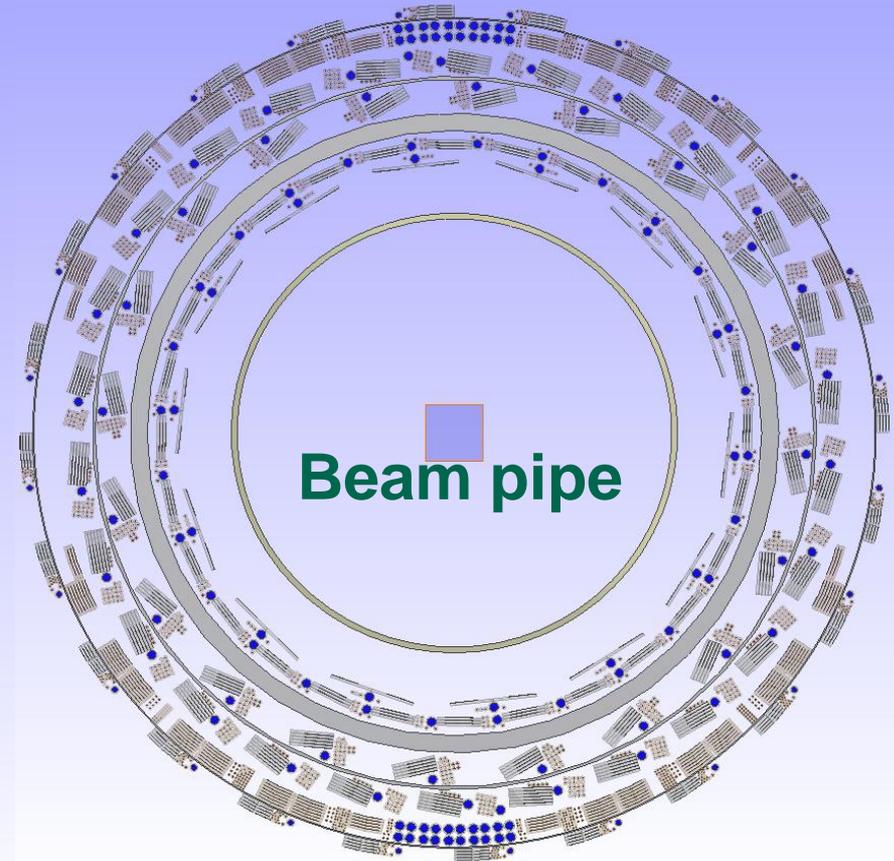
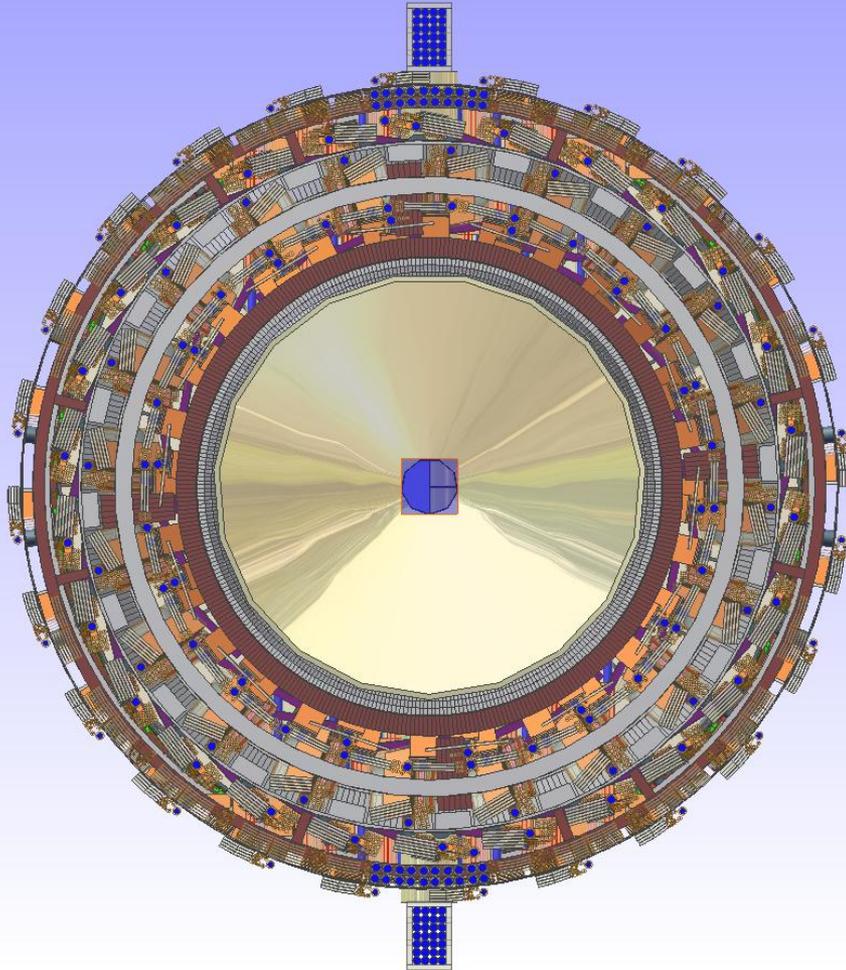


Routing

Pixel disks

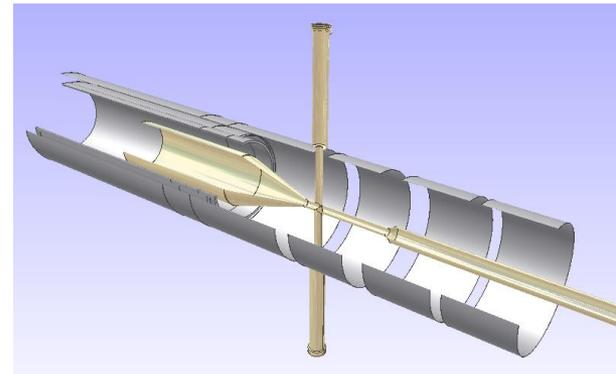
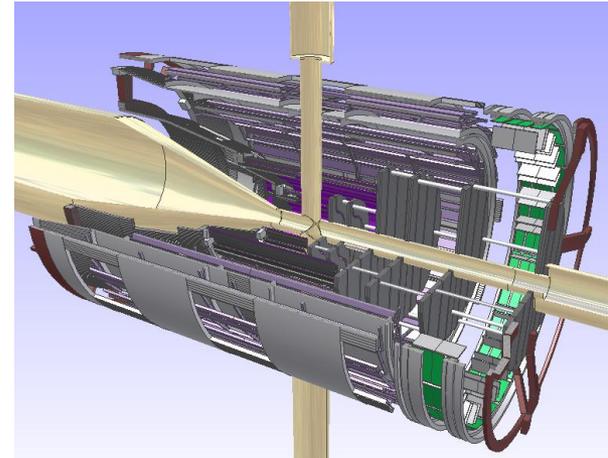


Routing: XY view



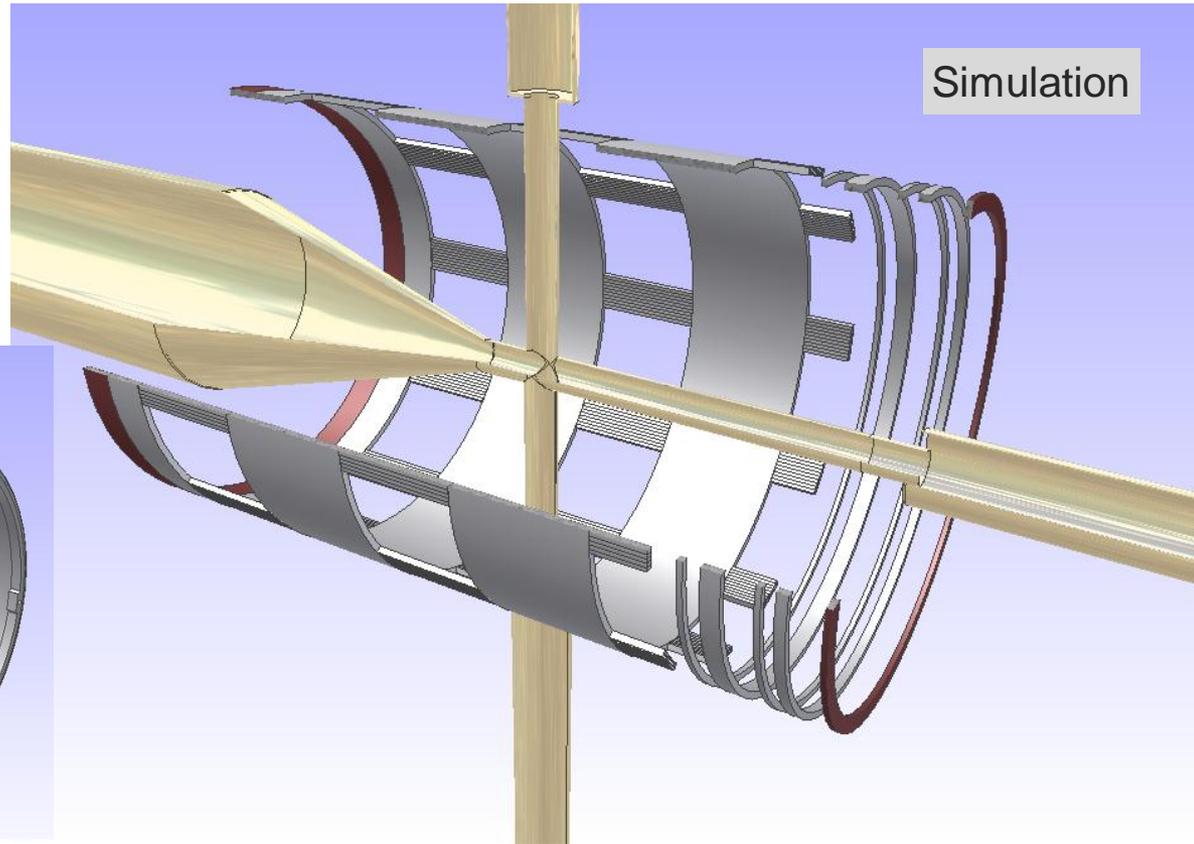
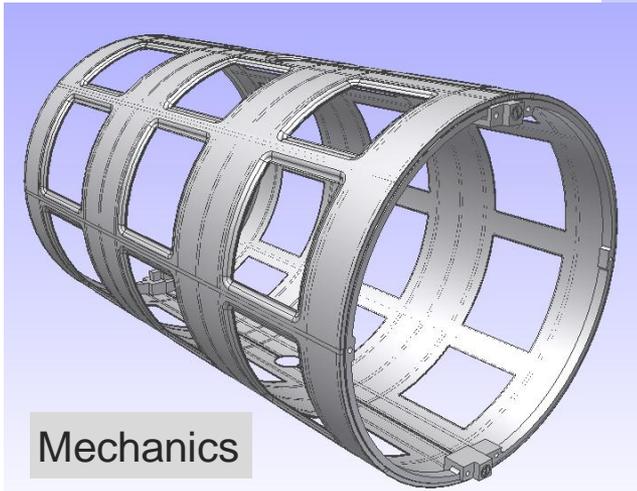
Support concept

- Detailed implementation for MVD
 - ✓ Global MVD (half-)frame(s) attached to central frame
 - ✓ Different MVD parts attached to global MVD frame
- Schematic support layers (no detailed solution so far):
 - ✓ Upstream routing
 - ✓ Additional forward disks



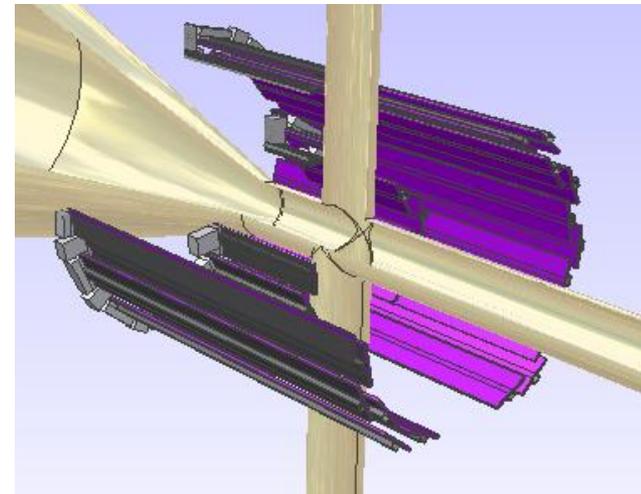
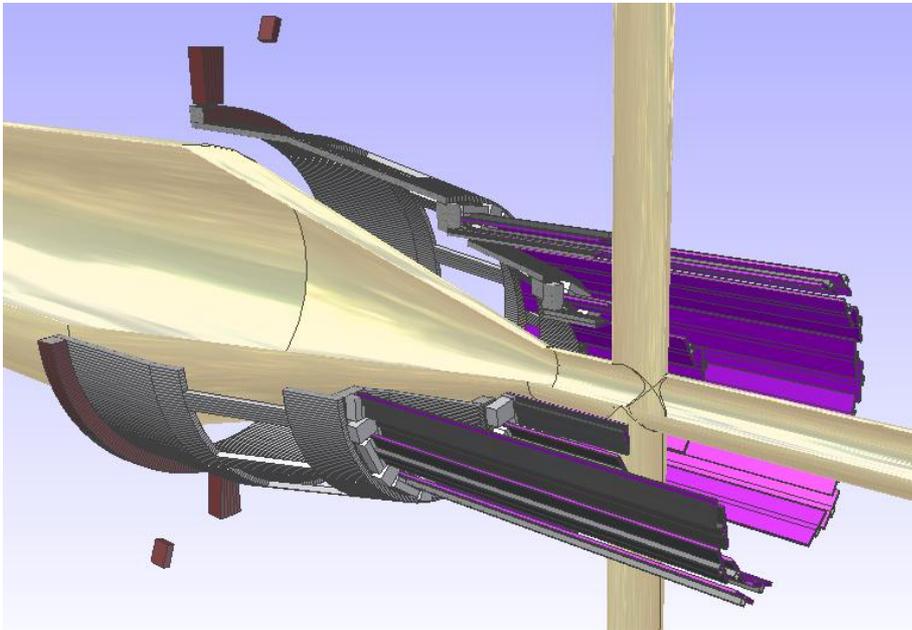
Support concept: MVD, sequence (1)

- Global MVD frame



Support concept: MVD, sequence (2)

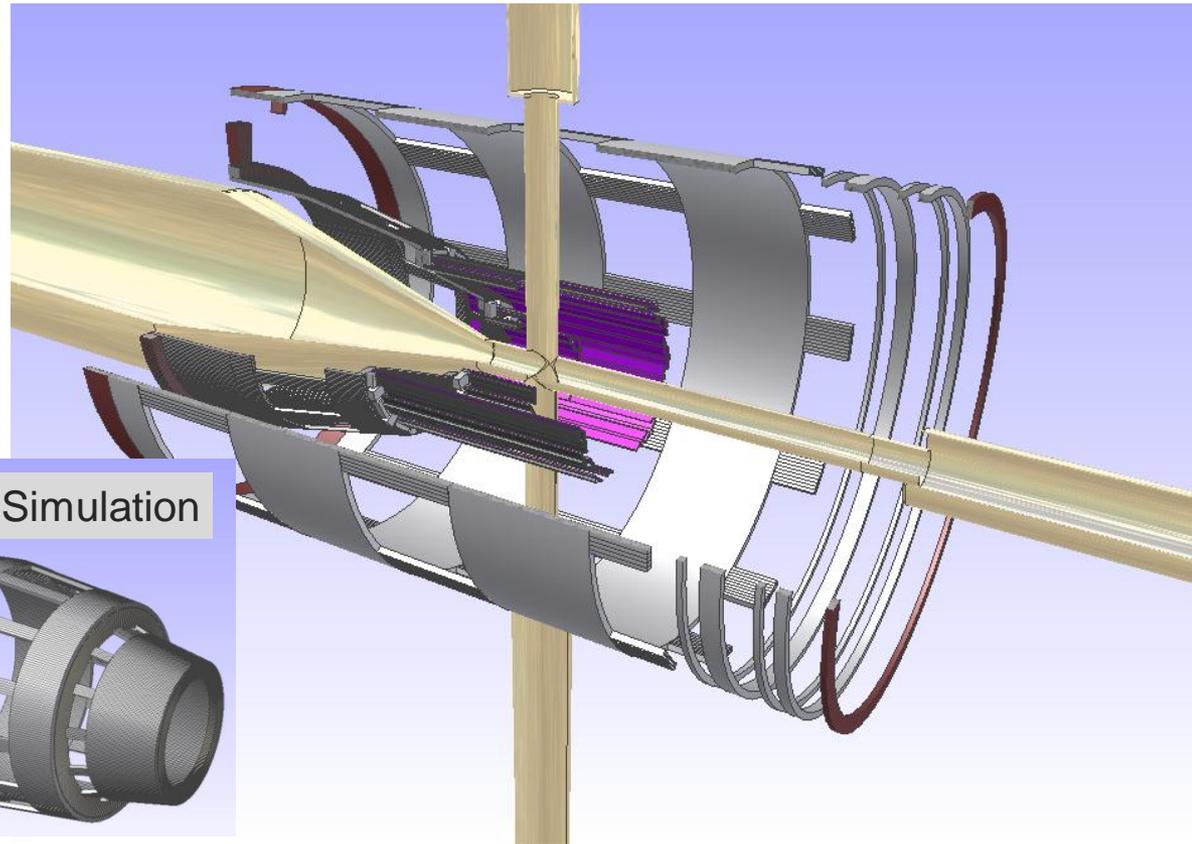
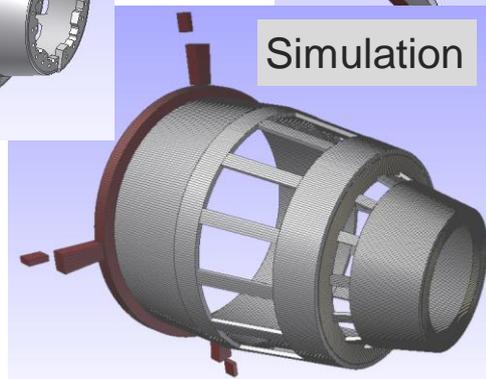
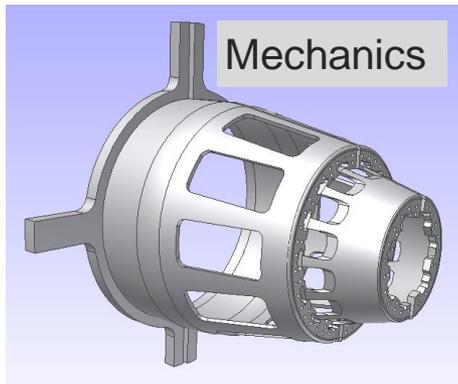
- Pixel barrel support
 - ✓ Staves for module support



- ✓ Staves attached to upstream cone

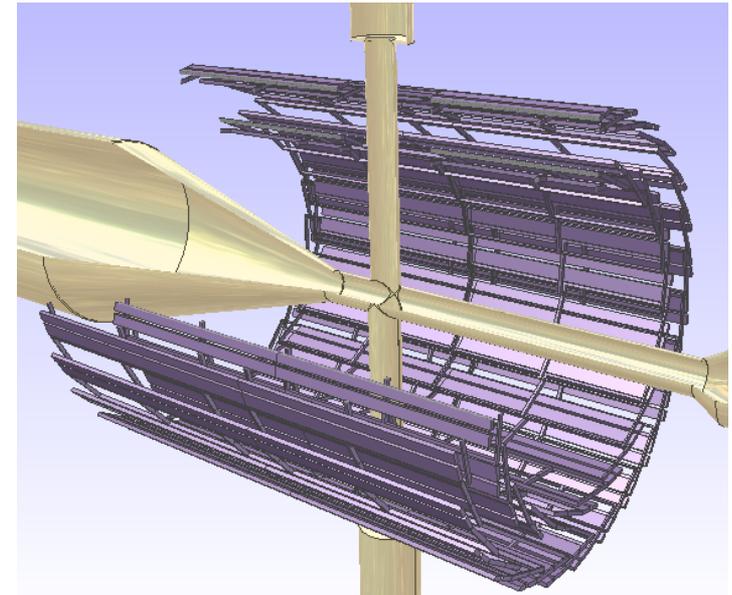
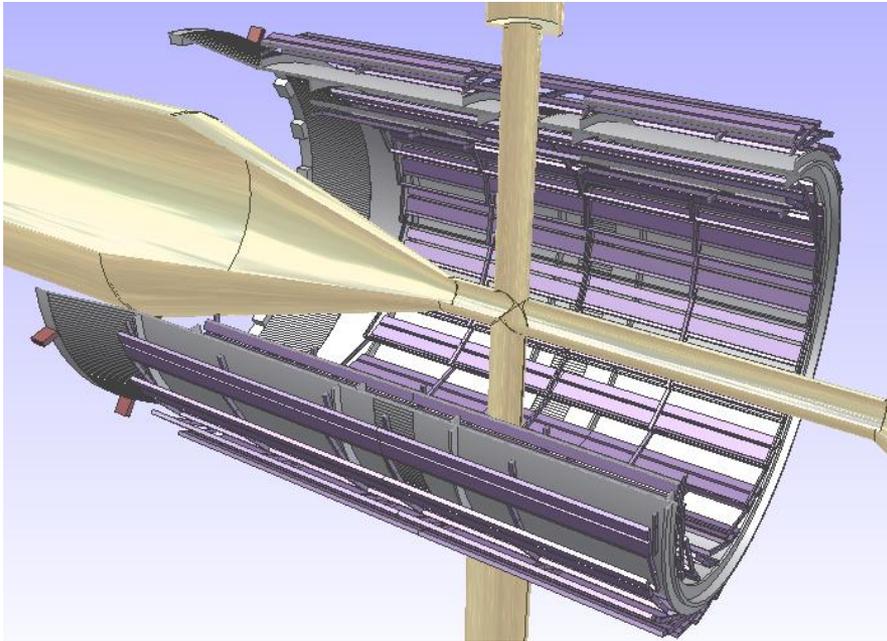
Support concept: MVD, sequence (2)

➤ Pixel barrel support



Support concept: MVD, sequence (3)

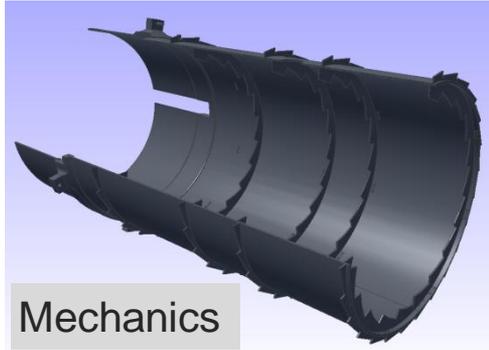
- Strip barrel support
 - ✓ Staves for module support



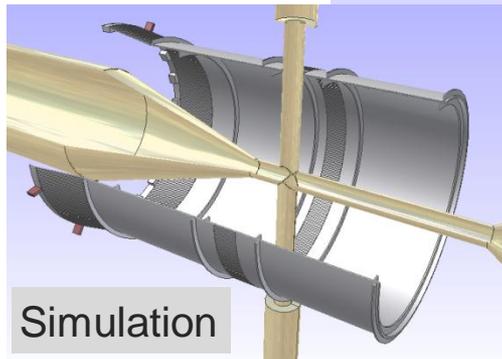
- ✓ Cylinder between barrel layer
- ✓ Saw-tooth for staves

Support concept: MVD, sequence (3)

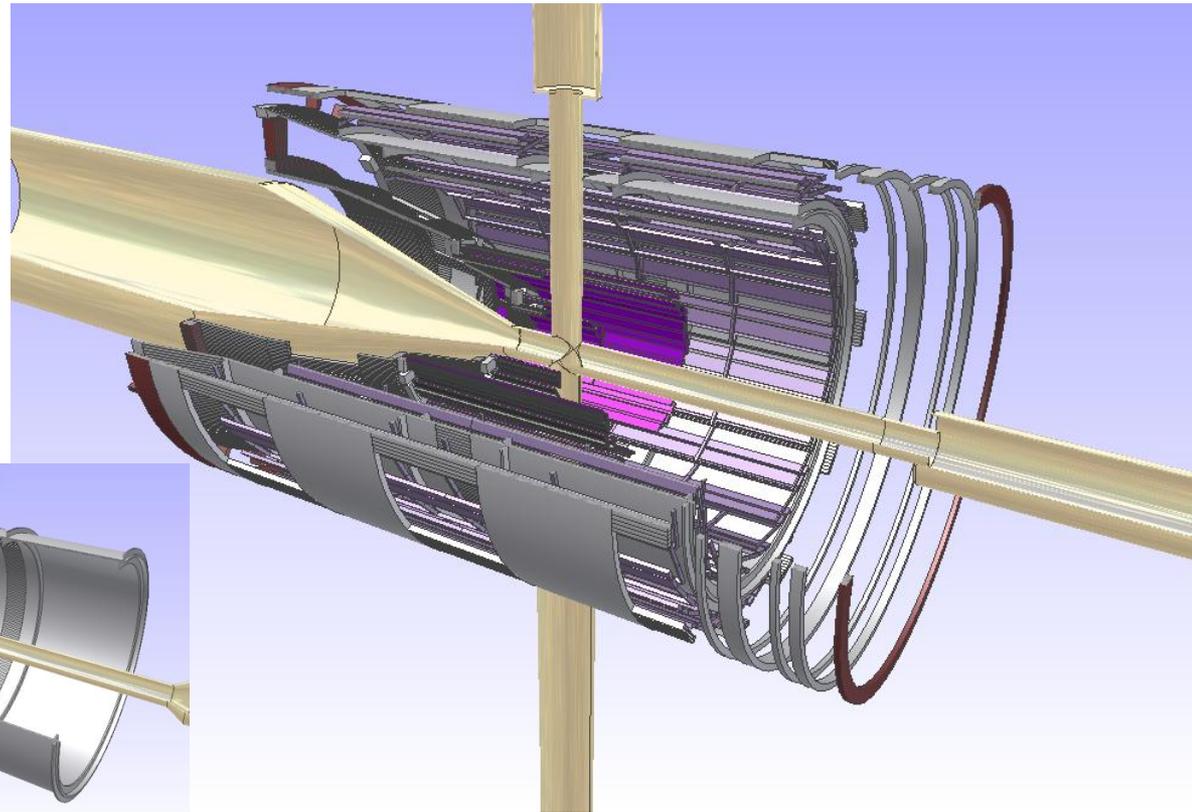
➤ Strip barrel support



Mechanics

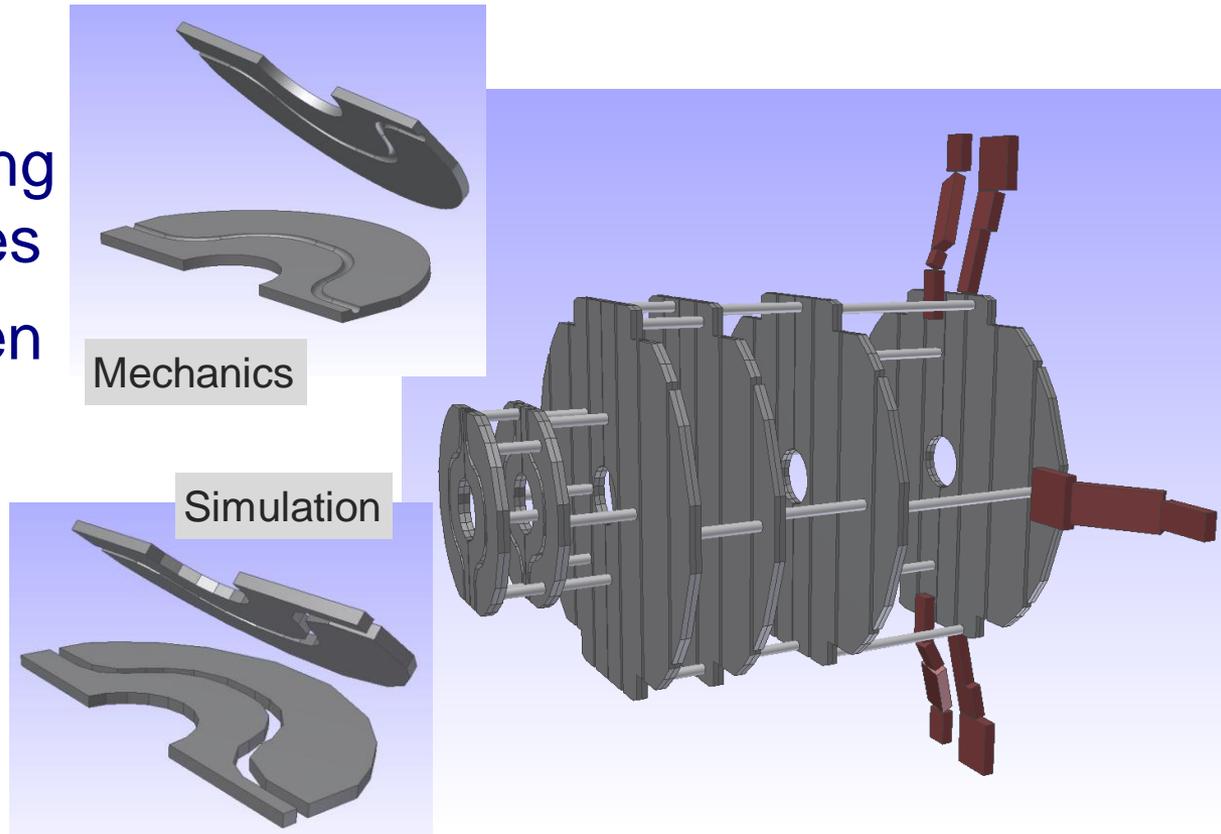


Simulation



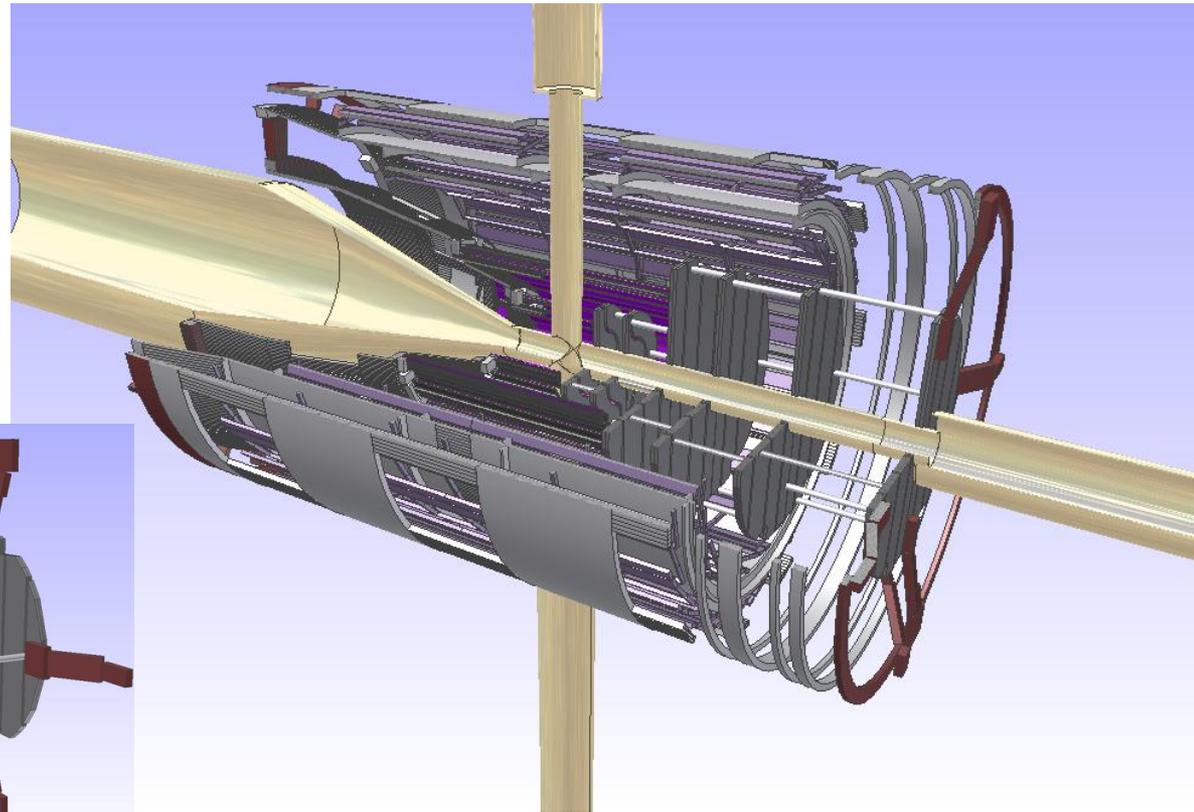
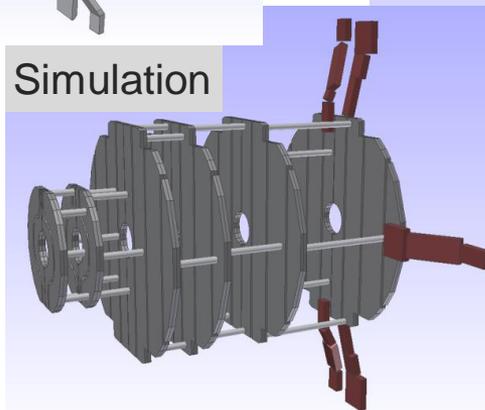
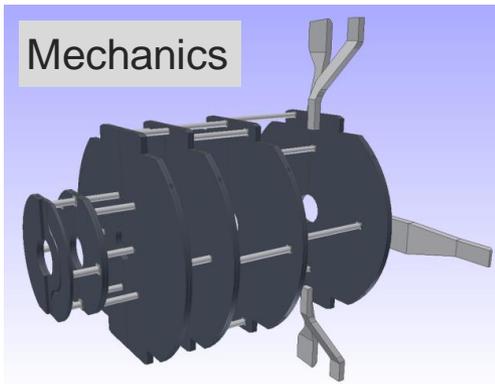
Support concept: MVD, sequence (4)

- Pixel disk support
 - ✓ Half-disks hosting detector modules
 - ✓ Spacers between disks
 - ✓ Suspensors to attach to global MVD frame



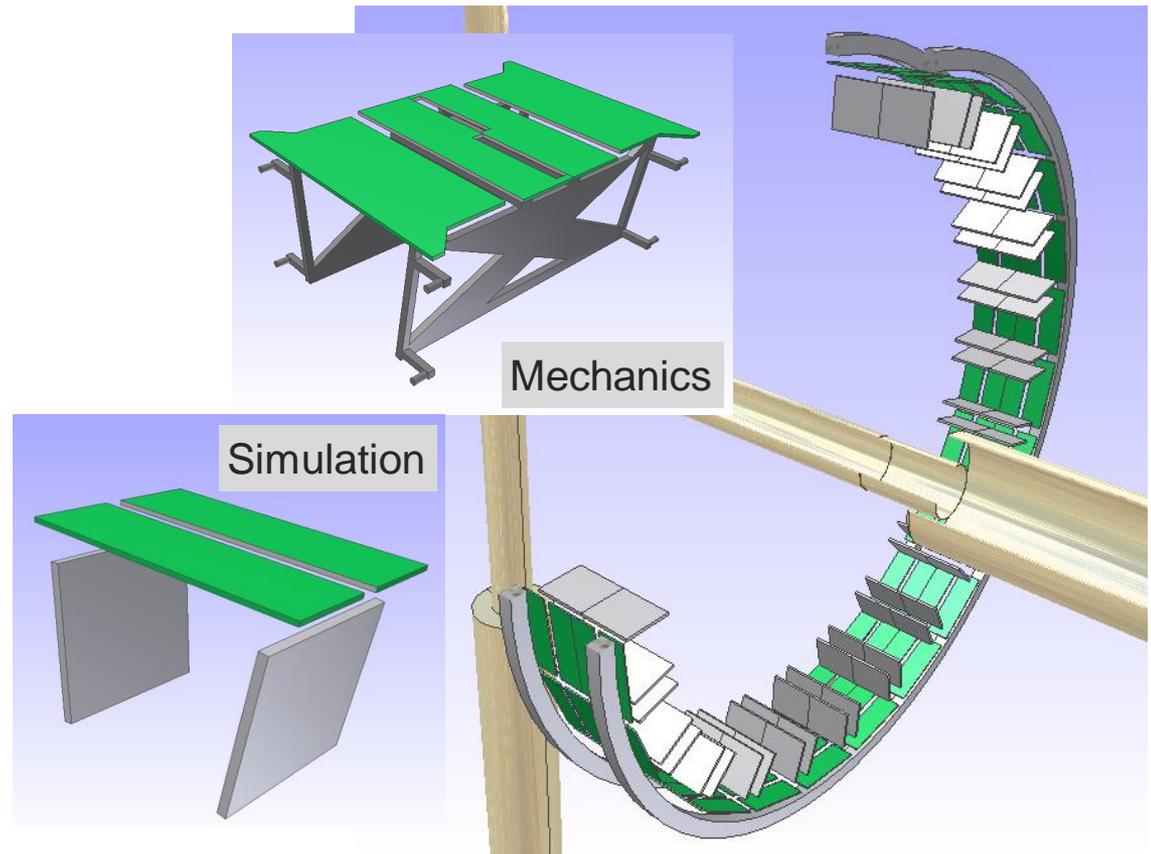
Support concept: MVD, sequence (4)

➤ Pixel disk support



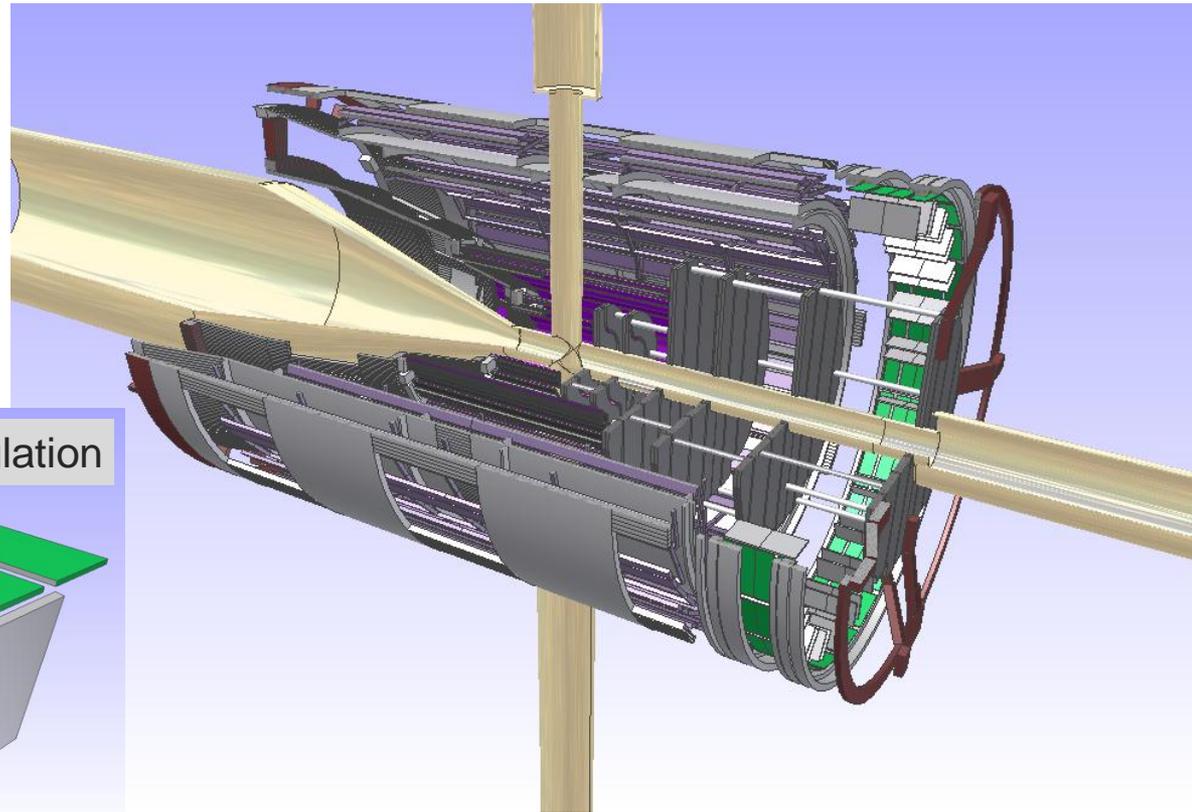
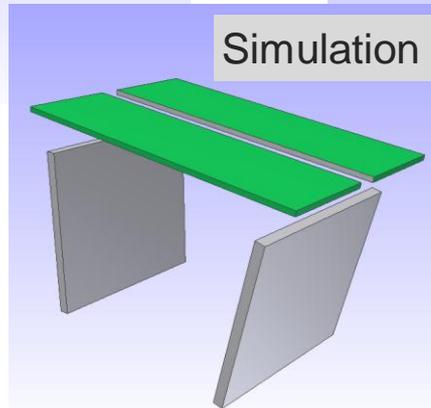
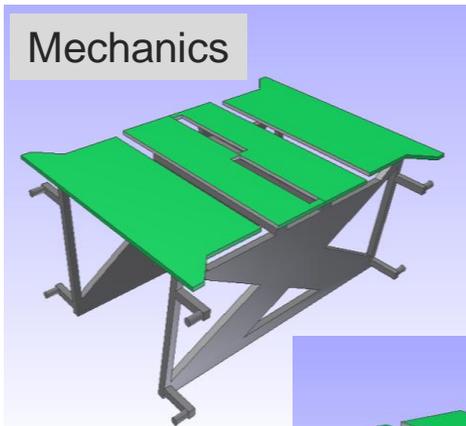
Support concept: MVD, sequence (5)

- Strip disk support
 - ✓ PCB between layers
 - ✓ Dedicated sensor support
 - ✓ Support structure for attachment to global MVD frame



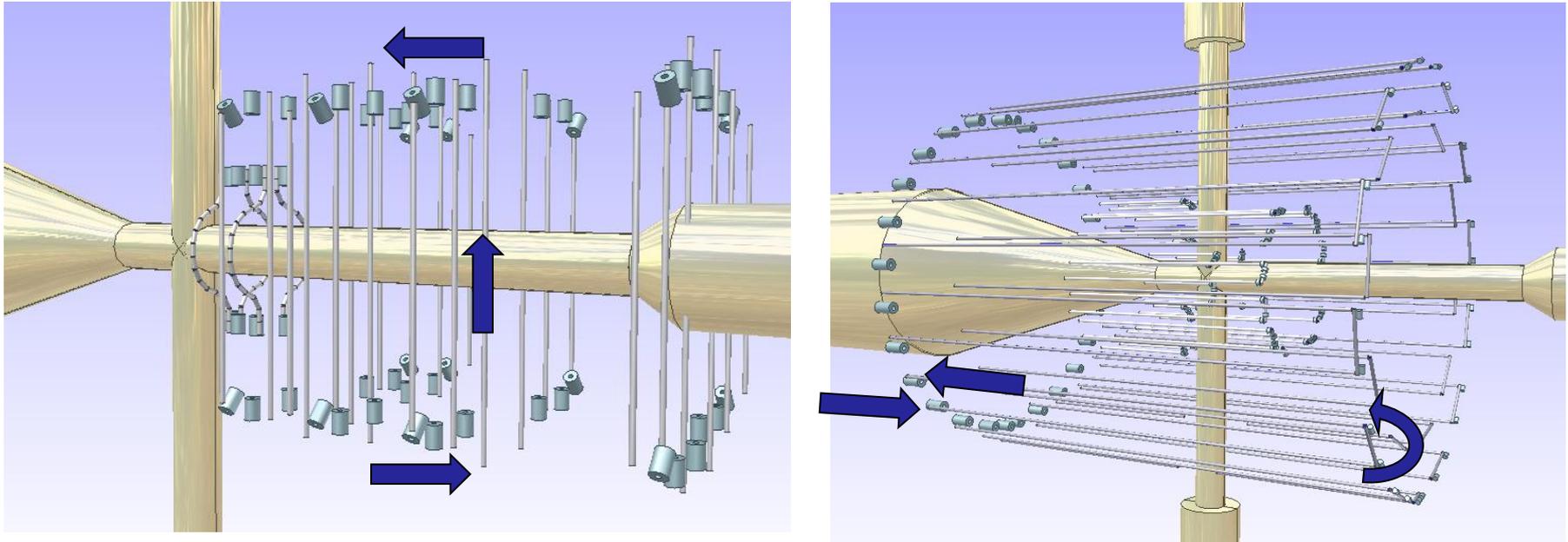
Support concept: MVD, sequence (5)

➤ Strip disk support



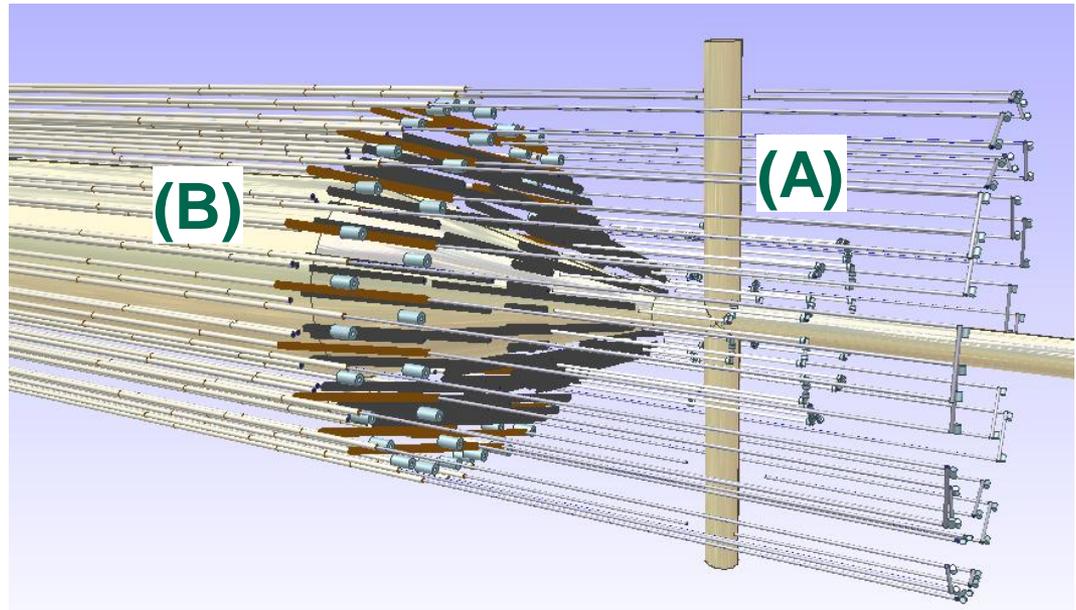
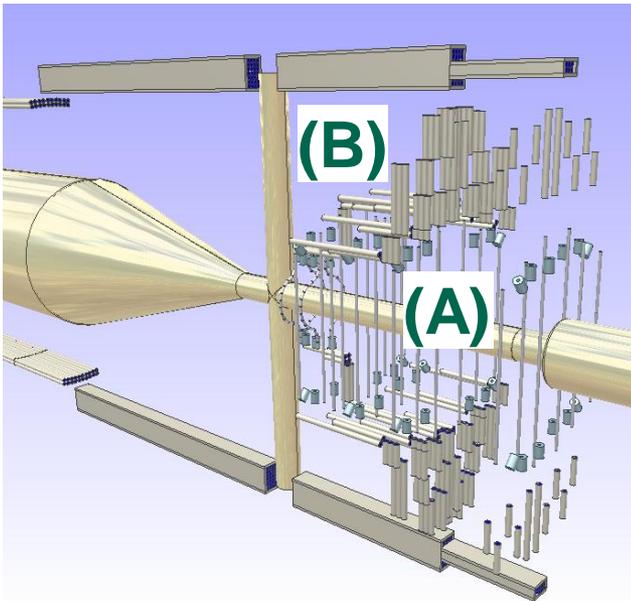
Mechanics aspects

Cooling



- \varnothing 2 mm pipes within detector modules (active cooling)
- Barrel: 1 pipe / stave ; Downstream connection
- Pixel disk: 1 pipe / module row

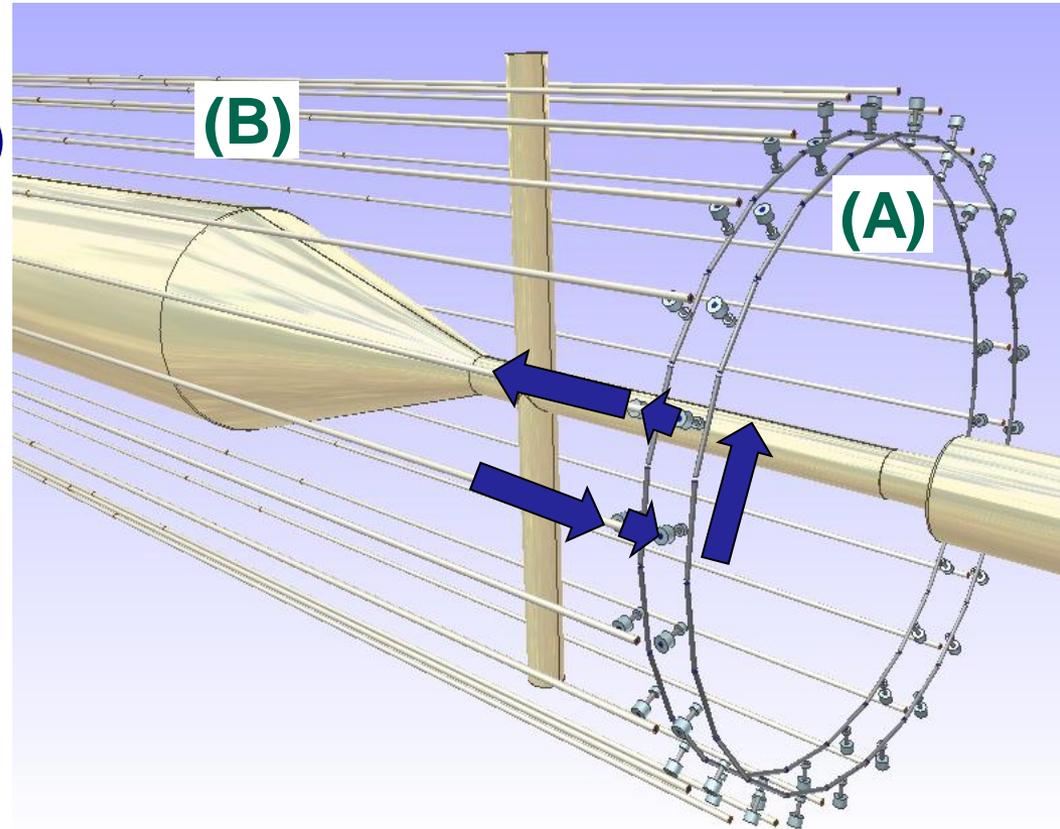
Cooling

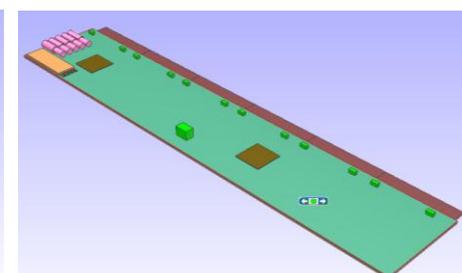
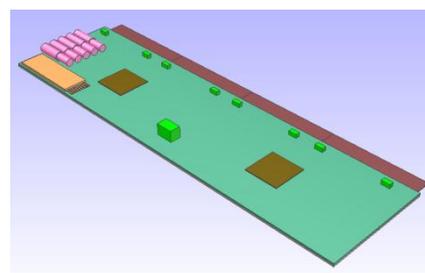
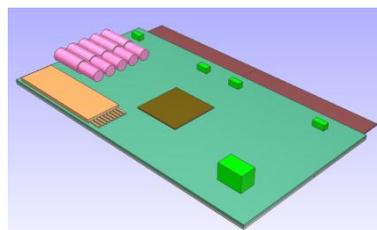
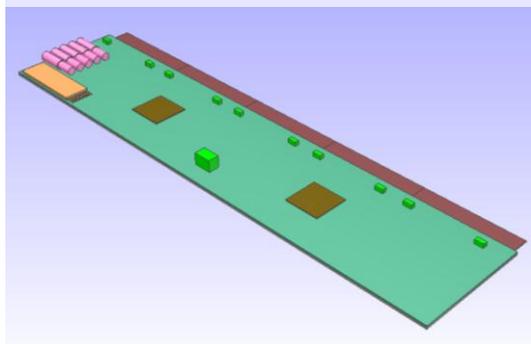
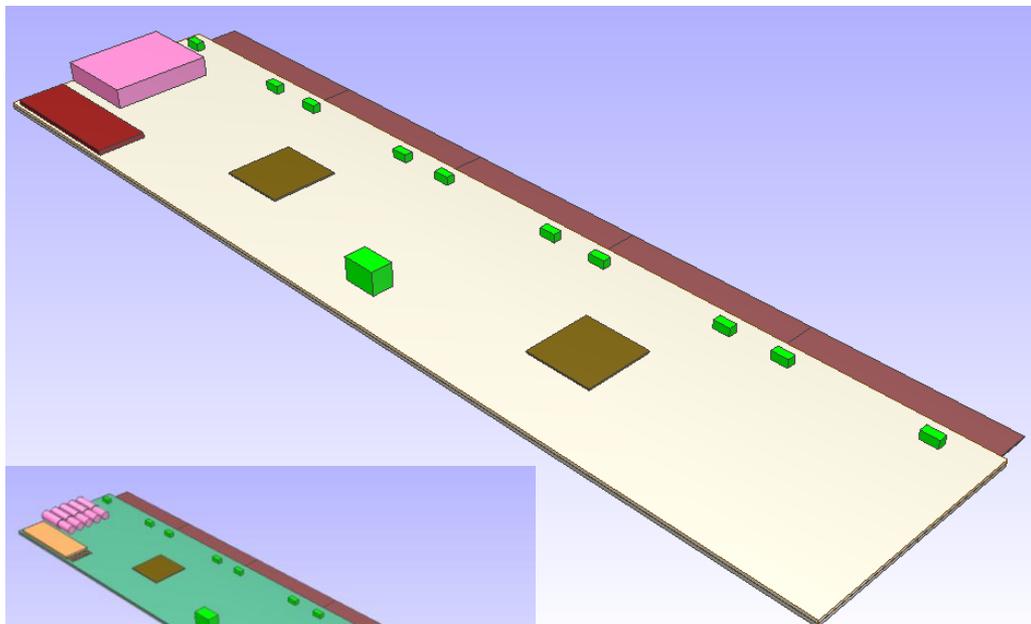


- Connector:
(A) \varnothing 2 mm pipes (steel) \rightarrow (B) \varnothing 4 mm flexible (plastic)

Cooling

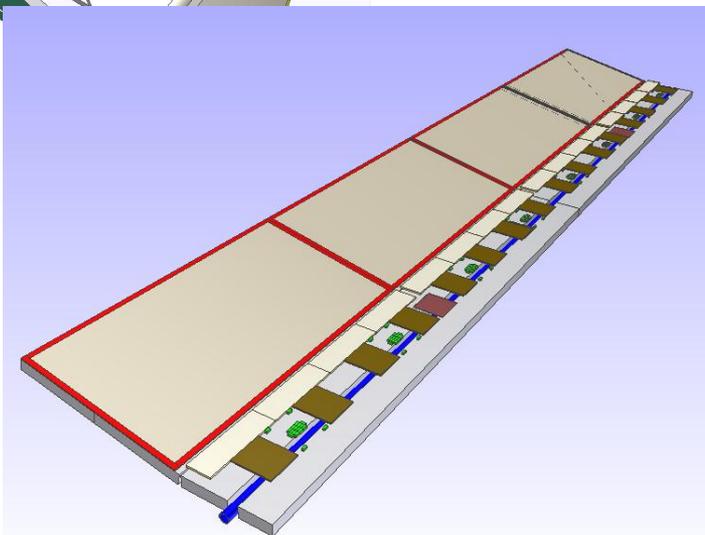
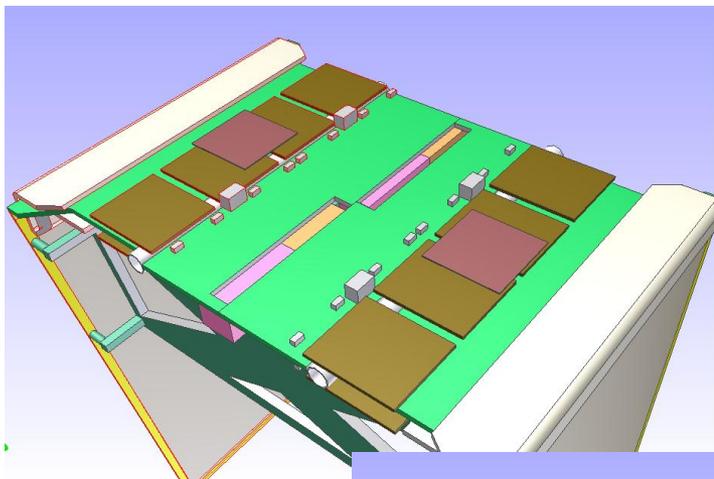
- Connector:
(A) \varnothing 2 mm pipes (steel)
→ (B) \varnothing 4 mm flexible (plastic)
- Strip disks:
Schematic implementation
→ 1 IN/OUT per super-module
→ 1 interconnection





Pixel modules

- SMD 0402: 2 / chip
- SMD 0805: 1 / module
- Module controller:
 - 1 / module (smallest)
 - 2 / module (all others)
- Connector: Data / Supply
 - 1 / module



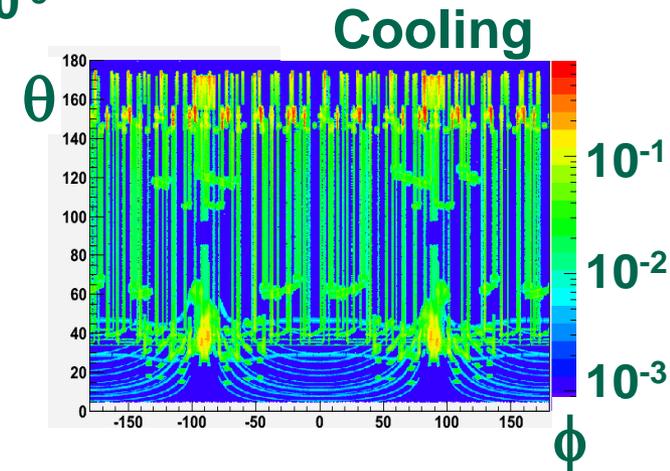
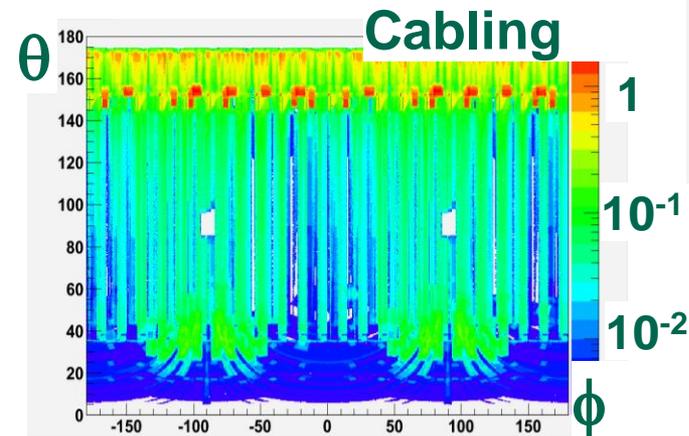
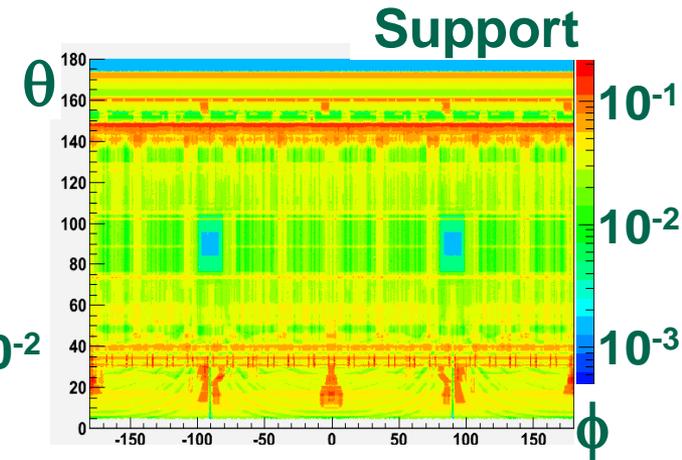
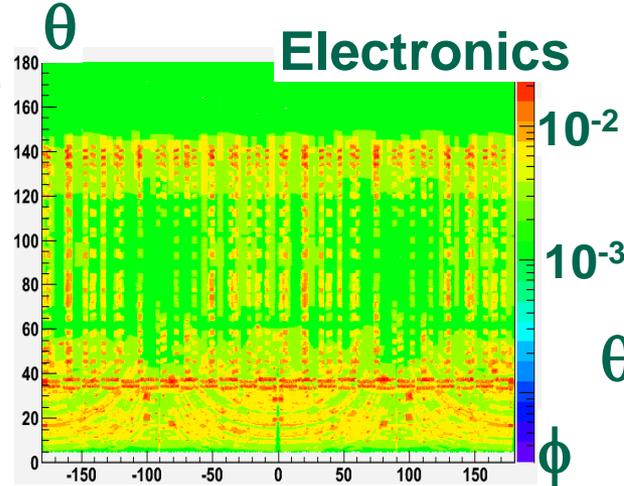
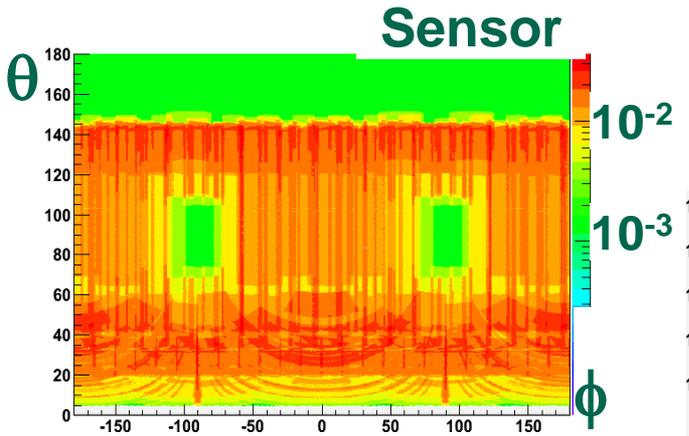
Strip part

- SMD 0402: 2 / chip
 - SMD 0805: 1 / 2 chip
 - Module controller:
→ 1 / sensors
- Connector:
→ 1 / super-module

Simulation



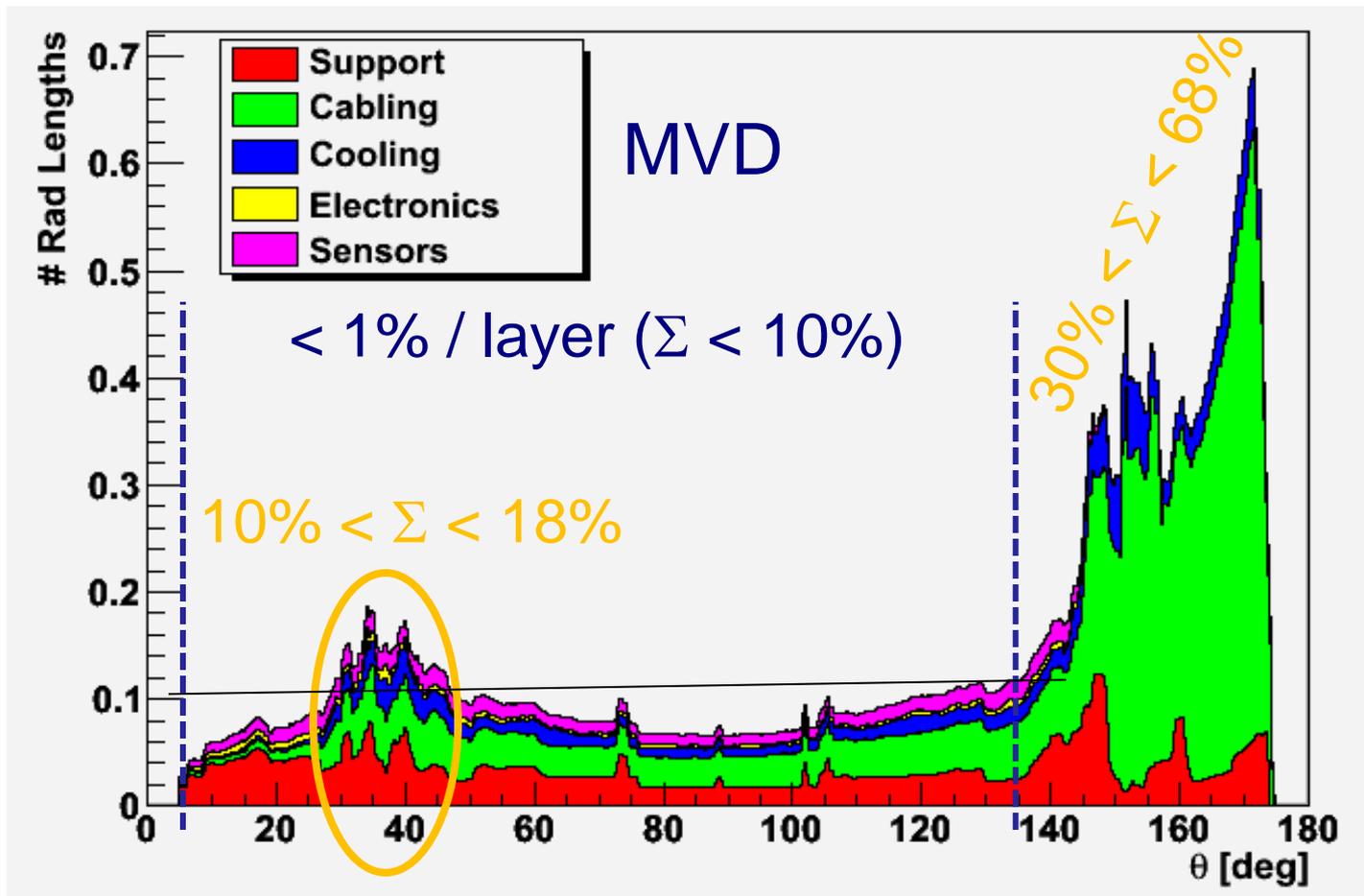
- Selected results of radiation length study
 - 2D mapping of main parts (MVD)



Simulation



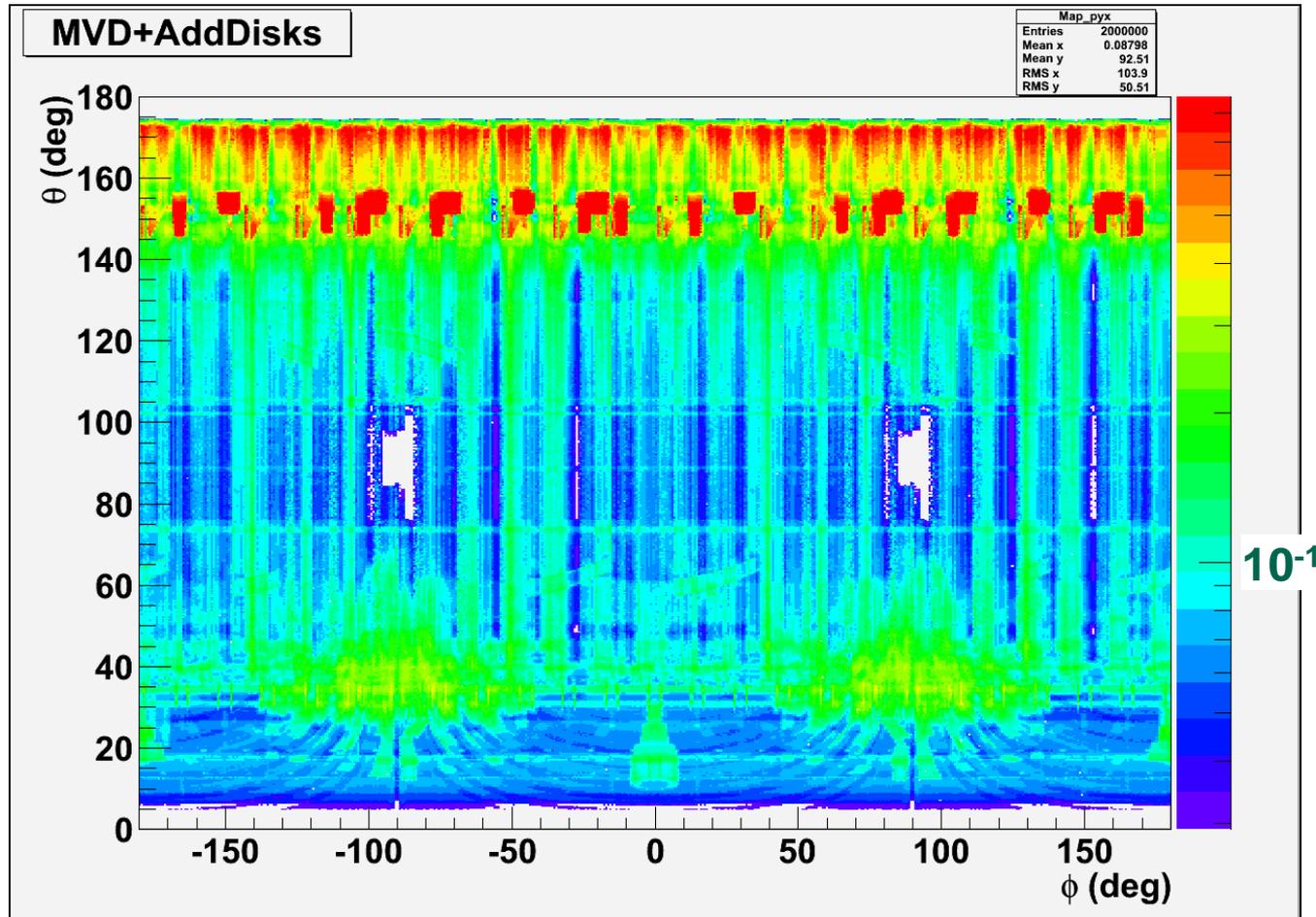
- Selected results of radiation length study



Simulation



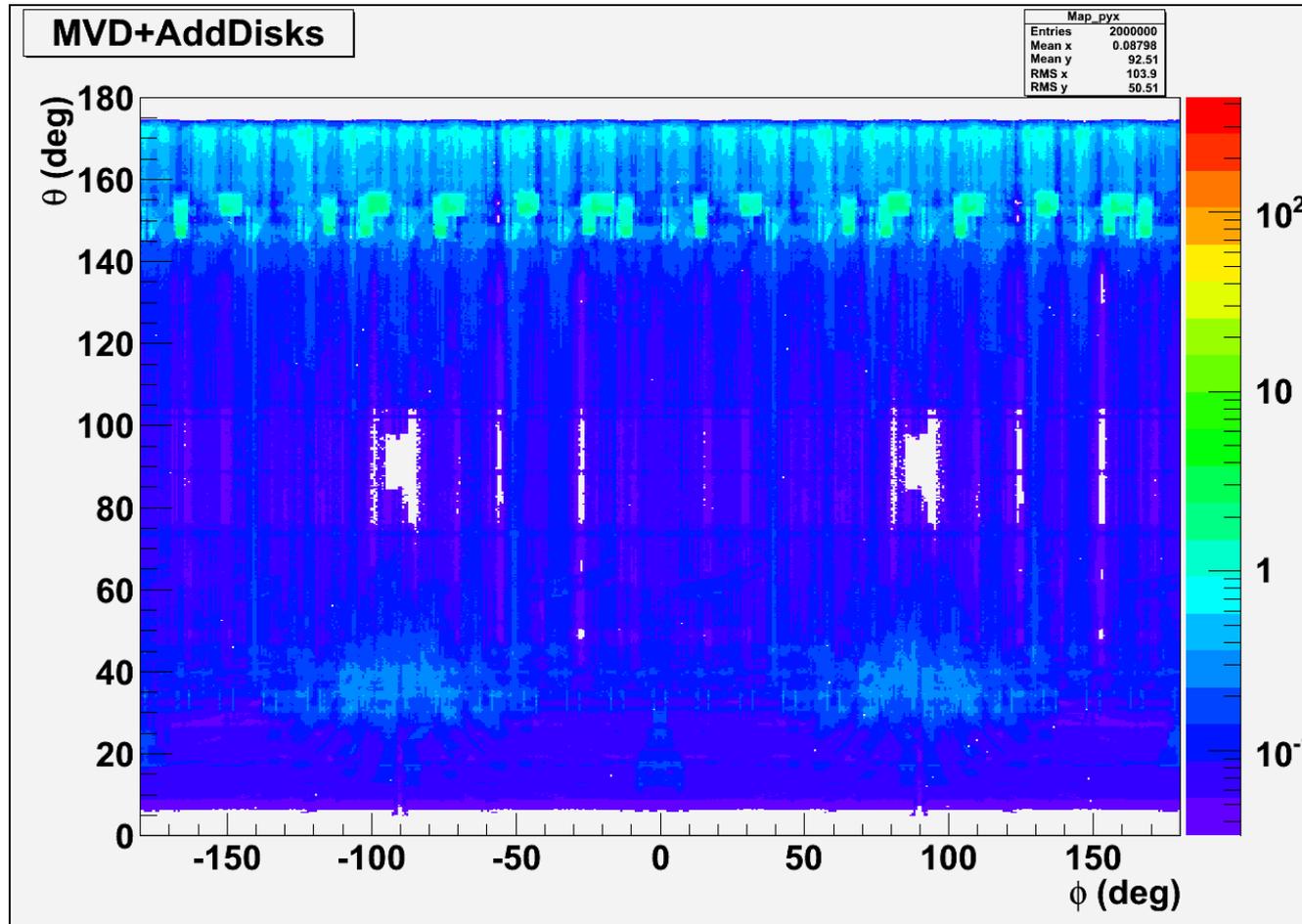
- Selected results of radiation length study



Simulation



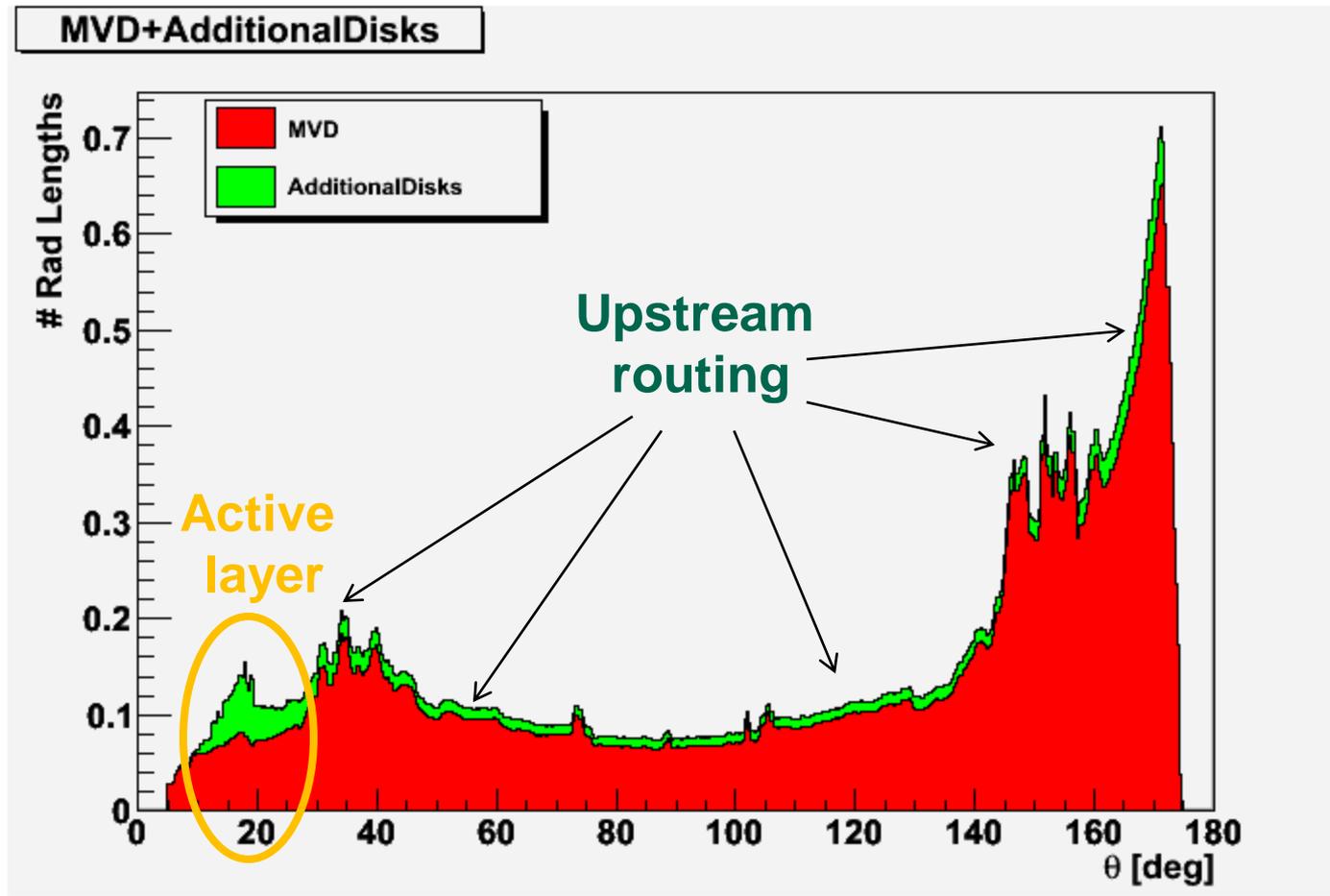
- Selected results of radiation length study



Simulation



- Selected results of radiation length study (*Geantinos*)



Final remarks



- Parts not implemented
 - Voltage regulator boards
 - Optical conversion
 - Upstream patch panels and cooling splitters
- Further study
 - Material effects
 - Asymmetry effects
 - Hot spots
- Optical conversion (earliest after cone)
 - Earliest after cone opening
 - No impact in terms of reduction of radiation length but, of course, is essential for signal quality

Summary



- Detailed model for MVD
 - Advanced description containing all information of current hardware development
 - Realistic input concerning overall material budget: Studies on material effects
 - Radiation length well below 10% in sensitive MVD volume
- Additional disks
 - Doubling of radiation lengths (>10%) between 10° and 20°
 - Detailed conceptual design derived from MVD
 - No dedicated concept of overall integration yet