

# XML Description of HCal Geometry

*Version 1.0*

**Alexei Berdiouguine\***

*BINP, Novosibirsk*

January 21, 2002

## 1 Introduction

The XML description<sup>1</sup> of Hcal geometry is based on the engineering drawing of Hcal corresponding to the TDR [1]. Some simplification of real design is done.

## 2 XML File Structure

The XML description of Hcal can be found in the `$LHCBSOFT/Det/XmlDDDB/v*/DDDB/Hcal` directory. The whole Hcal, Hcal segmentation structure and installation of Cells into Hcal Sections are defined in “**Installation**” subdirectory of XML description. Inner structure of Cells is defined in “**Cells**” subdirectory. Structure of XML directories corresponds to Detector Transient Store.

`structure.xml` file contains the *detector elements* “Hcal”, “HcalInner”, “HcalOuter”.

The main `geometry.xml` file contains

- catalog<sup>2</sup> of *references* to “**Installation**” and “**Cells**” catalogs ;
- definition of all Hcal geometry parameters.

---

\*E-mail: [Alexei.Berdiouguine@cern.ch](mailto:Alexei.Berdiouguine@cern.ch)

<sup>1</sup>Det/Desc/v9r0 was used

<sup>2</sup>In the following LHCb XML terminology is used

Names of parameters are mnemonic and always start with “Hcal\*”. The basic parameters are Modules and Cells sizes. A full lists of parameters can be found in the Appendix.

**Installation.xml** file contains “/dd/Geometry/Hcal/Installation” catalog of *logical volumes* related to Hcal as a whole, Hcal Sections and Modules. **Cells.xml** file contains catalog of *logical volumes* “/dd/Geometry/Hcal/Cells” related to inner structure of Hcal Cells.

\*.xml files related to XML description of Hcal as a whole, Hcal Sections and Modules are located in \$LHCBSOFT/Det/XmlDDDB/v\*/DDDB/Hcal/Installation. Cells and Reinforces \*.xml files can be found in \$LHCBSOFT/Det/XmlDDDB/v\*/DDDB/Hcal/Cells.

Catalog “/dd/Materials/Hcal” of specific Hcal materials can be found in \$LHCBSOFT/Det/XmlDDDB/v\*/DDDB/materials/HcalMaterials.xml. The names of materials start also with “Hcal\*”.

### 3 Definition of Hcal Sections *Logical Volumes*

Hcal is segmented into Inner, Outer Section and the sloest to beam pipe Inner Support Frame.

Main “/dd/Geometry/Hcal/Installation/lvHcal” *logical volume* is defined as logical subtraction<sup>3</sup> of <box><sup>4</sup> with “HcalTotXSize”, “HcalTotYSize”, “HcalTotLength” and <tubs><sup>5</sup> providing cylindrical hole for beam pipe.

*Physical volumes* of Inner Support Frame with corresponing Z offset to the geometry centre of total Hcal space (“pvHcalInnerSupportFrame”), Inner and Outer Sections (“pvHcalInnerSection”, “pvHcalOuterSection”) are installed into “lvHcal” *logical volume*.

“lvHcalInnerSupportFrame” *logical volume* is defined as logical subtraction of <box> with “HcalSupportXSize”, “HcalSupportYSize”, “HcalSupportLength”, material = “HcalSupportSteel” and <tubs> with **outerRadius = “HcalInnerSupportRadius”** for beam pipe hole.

“lvHcalInnerSection”, “lvHcalOuterSection” *logical volume* are defined as logical subtraction of two boxes.

Inner (Inner Middle), Outer Half-Modules are installed into corresponding

---

<sup>3</sup><subtraction> in XML

<sup>4</sup><box> corresponds to box with faces perpendicular to the axes

<sup>5</sup><tubs> here corresponds to cylindrical tube

“lvHcalInnerSection”, “lvHcalOuterSection” *logical volume* using two dimensional loop<sup>6</sup> (Figure 1, 2).

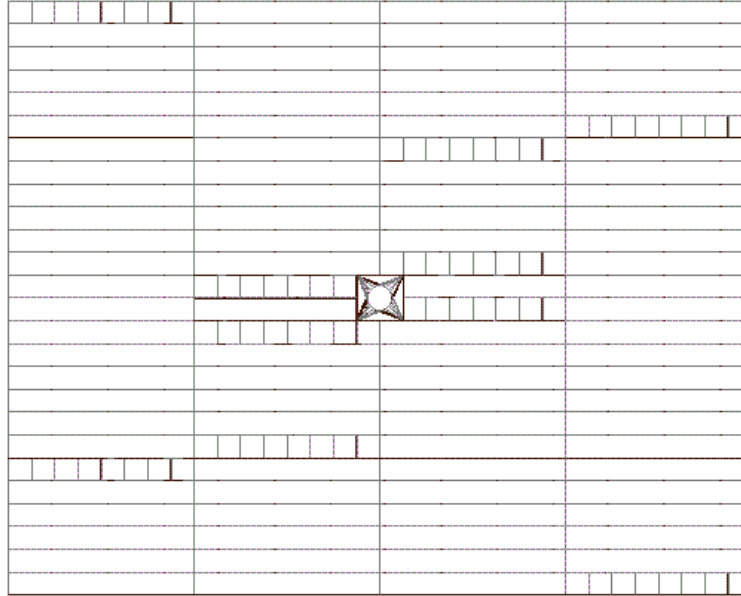


Figure 1: Hcal with Half-Modules are installed into Inner and Outer Sections. For illustration some Half-Modules are show with installed Working Part of the Half-SubModules and Reinforces. Inner Support Frame are located in the centre.

“lvHcalInnHalfModule (lvHcalInnMidlHalfModule)”, “lvHcalOutHalfModule” *logical volume* contains from 8(7) corresponding Half-SubModule’s Working Parts and Reinforces (Figure 3, 4).

*Logical volume* of the Half-SubModule’s Working Part (“lvHcalInnHalfSubModuleWorkPart”, “lvHcalOutHalfSubModuleWorkPart”) contains from Foward, Backward Face and one Working Stuff in case Outer Section or 4 Working Stuffs in case Inner Section (Figure 5).

## 4 Definition of Hcal Cells *Logical Volumes*

The Inner and Outer Cell’s structure permit to mark out a Common Part of Cell’s Working Stuff.

*Logical volume* “**Working Stuff**” (“lvHcalOutCellWorkStuff”) is defined as **<box>** with “HcalOutCellXSize”, “HcalMsPIHeight”, “6×HcalMsPIStepLength” sizes and installed by **<paramphysvol2D>** “Com-

<sup>6</sup><paramphysvol2D>

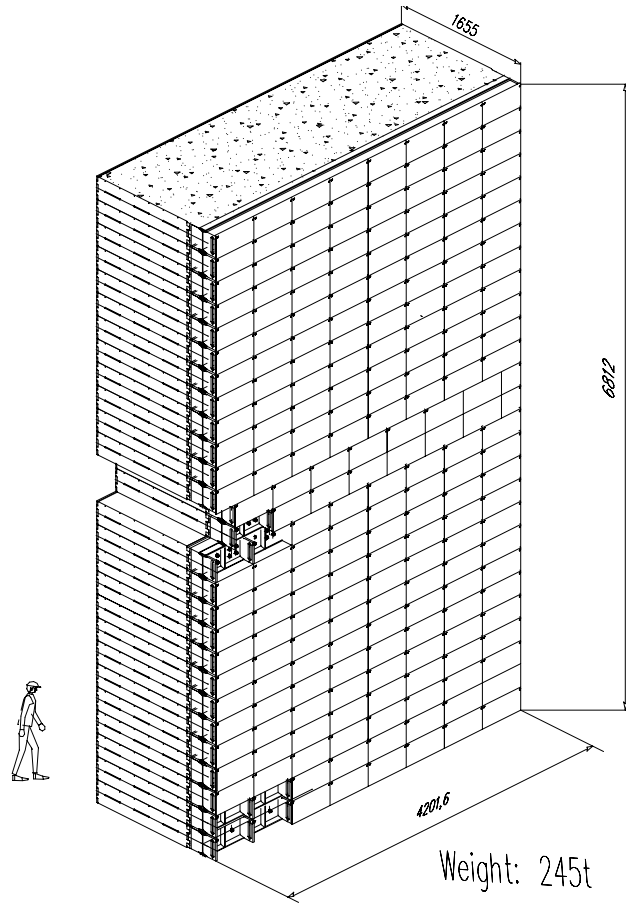


Figure 2: View of one half of the hadron calorimeter: there are 26 horizontal modules stacked on top of each other. Two central modules are shorted to allow the accelerator beam-pipe to traverse.

**mon Part of Working Stuff** (“pvHcalOutCellComPartWorkStuff”) *physical volumes* (Figure 6).

*Logical volume* **“Common Part of Working Stuff”** (“lvHcalOutCellComPartWorkStuff”) is defined as <box> with **“HcalCellPeriodWidth”**, **“HcalMsPIHeight”**, **“2×HcalMsPIStepLength”** sizes, material = **“Air”** and are filled 4 layers of *physical volumes*:

- **1st layer:** (at  $X = \text{HcalOutCellXPos1stLayer} \times \text{HcalCellPeriodWidth}$ )  
**“Master Plate”**
- **2nd layer:** (at  $X = \text{HcalOutCellXPos2ndLayer} \times \text{HcalCellPeriodWidth}$ )  
**“Small Forward Spacer”, “Scintillating Tile” and “Big Backward Spacer”**

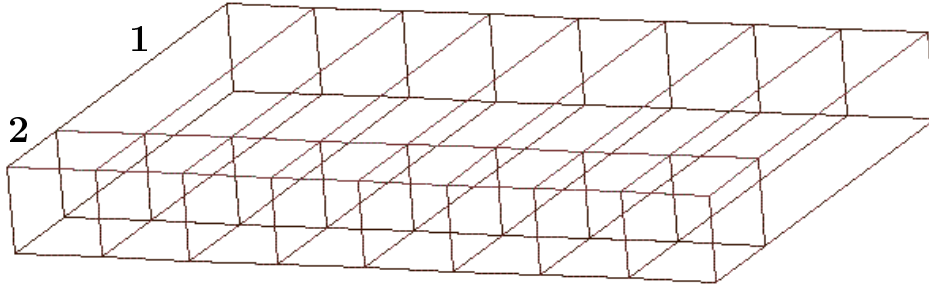


Figure 3: Hcal Half-Module with installed Working Parts and Reinforces. 1 – Working Part, 2 – Reinforce.

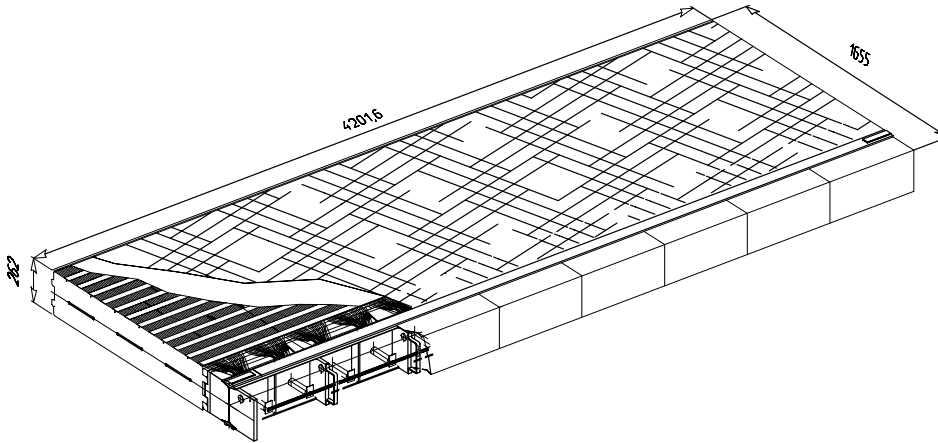


Figure 4: The module structure: eight submodule are assembled to one module, and an I-shape holder is mounted at the back. The whole module is covered with light protecting black paper show as hatched surface.

- **3d layer:** (at  $X = \text{Hcal0OutCellXPos3dLayer} \times \text{HcalCellPeriodWidth}$ )  
**“Master Plate”**
- **4th layer:** (at  $X = \text{Hcal0OutCellXPos4thLayer} \times \text{HcalCellPeriodWidth}$ )  
**“Big Foward Spacer”, “Scintillating Tile” and “Small Backward Spacer”**

*Logical volume* **“Working Stuff”** for Inner Cells are filled two types **“Common Part of Working Stuff”** because it don't have unbroken numbers of period:  $7 \times 3$  first type and  $6 \times 3$  second type in one case or  $6 \times 3$  first type and  $7 \times 3$  second type in another case. First type — 1st and 2nd laeys as in Outer Cell; second type — 3d and 4th layers as in Outer Cell.

*Logical volume* **“Master Plate”** (`“1vHcal0OutCellMsPl”`),  
**“Scintillating Tile”** (`“1vHcal0OutCellScTile”`), **“Big Spacer”**

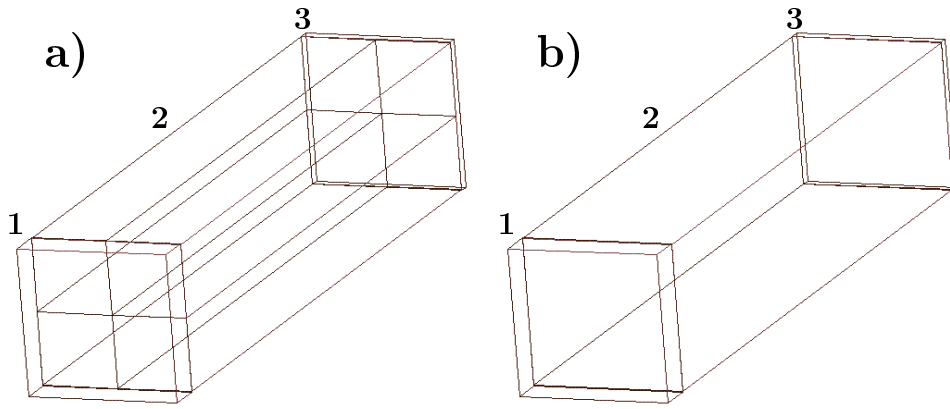


Figure 5: Half-SubModule's Working Part with installed Foward, Backward Face and Working Stuff. a) – Inner Section, b) – Outer Section. 1 – Backward Face, 2 – Working Stuff, 3 – Foward Face.

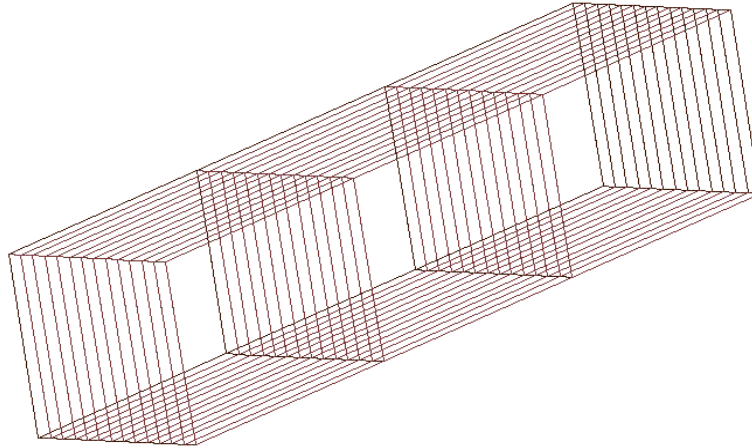


Figure 6: Cell's Common Part of Working Stuff (3×13) are installed into Cell's Work Stuff.

(“lvHcalOutCellFwBigSpacer”, “lvHcalOutCellBkBigSpacer”) for Outer Cell are defined as <box> with corresponding material (“HcalMsPSteel” and “HcalSc”) and including *physical volume* “Calibration Hole”.

*Logical volume* “Master Plate”, “Scintillating Tile”, “Big Spacer” for Inner Cell are defined as <box> with material = “Air” and including corresponding *physical volume* are defined as <subtraction> <box> and <tubs> with material “HcalMsPSteel” or “HcalSc”.

*Logical volumes* “Small Spacers” are defined as <box> with material = “HcalMsPSteel”.

*Logical volumes* “**Calibration Holes**” are defined as <tubs> with material = “**Air**”.

## 5 Definition of Hcal Foward, Backward Face of Half-SubModule and reinforce *Logical Volumes*

*Logical volumes* “**Foward Face**”, “**Backward Face**” are defined as <box> with material = “**Air**” and including *physical volumes* “**Strips**” (material = “**Hcal-StripSteel**”) for join Hcal SubModule and “**Foward (Backward) Parts of Working Stuff**” (material = “**HcalMsP1Steel**”).

*Logical volumes* “**Reinforce**” are defined as <box>. In this version its volume is empty.

## References

- [1] LHCb calorimeters : Technical Design report, **CERN-LHCC-2000-0036**; LHCb-TDR-2, 6 Sep 2000.

## 6 Appendix

### Hcal Geometry Parameters Definition

<b>Hcal Basic Parameters</b>	
HcalOutCellXSize	"262.6*mm"
HcalOutCellYSize	"262.0*mm"
HcalTotLength	"1655*mm"

<b>Hcal Installation Parameters</b>	
<b>Inner Support Frame: <math>1 \times 2</math> SubModule Size – Beam Pipe Hole</b>	
HcalSupportXSize	"525.2*mm"
HcalSupportYSize	"524*mm"
HcalSupportLength	"1655*mm"
HcalInnerSupportRadius	"140*mm"
HcalSupportOffset	"0.0*mm"

<b>Inner Structure Section: <math>2 \times 26</math> Modules, 1 Modules – 16 Outer Cells or <math>4 \times 16</math> Inner Cells</b>	
HcalInnCellXSize	"0.5*HcalOutCellXSize"
HcalInnCellYSize	"0.5*HcalOutCellYSize"
HcalSubModXSize	"2.0*HcalOutCellXSize"
HcalSubModYSize	"HcalOutCellYSize"
HcalModXSize	"8.0*HcalSubModXSize"
HcalModYSize	"HcalSubModYSize"
HcalTotXSize	"2.0*HcalModXSize"
HcalTotYSize	"26.0*HcalModYSize"



<b>Hcal Cells Parameters</b>	
<b>Design Cell's Elements</b>	
HcalMsPIWidth	"6*mm"
HcalMsPIHeight	"260*mm"
HcalMsPIStepLength	"200*mm"
HcalMsPICalHoleR	"5.7*mm"
HcalSpacerWidth	"4*mm"
HcalSpacerHeight	"255.5*mm"
HcalSpacerLength	"202*mm"
HcalScTileWidth	"3*mm"
HcalScTileHeight	"256*mm"
HcalScTileLength	"197*mm"
HcalScTileSlitWidth	"2*mm"
HcalScTileCalHoleR	"4.75*mm"
<b>Position Cell's Elements</b>	
HcalCellPeriodWidth	"20.2*mm"
HcalOutCellXPos1stLayer	"0.35"
HcalOutCellXPos2ndLayer	"0.1"
HcalOutCellXPos3dLayer	"-0.15"
HcalOutCellXPos4thLayer	"-0.4"
HcalInnCellXPos1stLayer	"0.1"
HcalInnCellXPos2ndLayer	"-0.15"
<b>Hcal Forward and Backward Parameters</b>	
HcalFaceWidth_for_CntStrip	"80*mm"
HcalFwFaceLength	"19*mm"
HcalFwFaceShelfLength	"15*mm"
HcalFwFaceShelfWidth	"40*mm"
HcalBkFaceLength	"64*mm"
HcalBkFaceShelfLength	"40*mm"
HcalBkFaceShelfWidth	"40*mm"
HcalBkFaceTotLength	"HcalBkFaceLength- HcalBkFaceShelfLength+ HcalBkOutStripWidth"

<b>Hcal Strip Parameters</b>	
HcalCntStripWidth	"19.0*mm"
HcalCntStripHeight	"79.5*mm"
HcalFwOutStripWidth	"14.8*mm"
HcalFwOutStripHeight	"50.8*mm"
HcalBkOutStripWidth	"40.8*mm"
HcalBkOutStripHeight	"40.8*mm"