XML Description of ECAL Geometry

Version 1.2

Galina Pakhlova*
(ITEP, Moscow)

July 3, 2002

1 Introduction

The XML description[1] of Ecal geometry is based on the engineering drawings of Ecal corresponding to the TDR [1]. Some simplification of real design is done.

2 XML File Structure

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

structure.xml file contains the *detector elements* "Ecal" and "EcalInnerSection", "EcalMiddleSection", "EcalOuterSection".

The main geometry.xml file contains

- catalog[2] of *references* to "Installation" and "Modules" catalogs;

- definition of all Ecal geometry parameters.

*e-mail: Galina.Pakhlova@cern.ch

[1] Det/DetDesc/v10 was used.

[2] In the following LHCb XML terminology is used.

Names of parameters are mnemonic and always start with "Ecal∗". The basic parameters are Modules and Cells sizes. A full list of parameters can be found in the Appendix.

Installation.xml file contains "/dd/Geometry/Ecal/Installation" catalog of *logical volumes* related to Ecal as a whole and Ecal Sections. Modules.xml file contains catalog of *logical volumes* "/dd/Geometry/Ecal/Modules" related to inner structure of Ecal Modules.

∗.xml files related to XML description of Ecal as a whole and Ecal Sections are located in $LHCBSOFT/Det/XmlDDDB/v∗/DDDB/Ecal/Installation. Modules ∗.xml files can be found in $LHCBSOFT/Det/XmlDDDB/v∗/DDDB/Ecal/Modules.

Catalog "/dd/Materials/Ecal" of specific Ecal materials can be found in $LHCBSOFT/Det/XmlDDDB/v∗/DDDB/materials/EcalMaterials.xml. The names of materials start also with "Ecal∗".

3 Ecal Sections

Ecal is segmented into Inner, Middle and Outer Sections and the closest to beam pipe Inner Support Frame.

Main "Ecal" *logical volume* is defined as logical subtraction[3] of <box>[4] with "EcalXSize", "EcalYSize", "EcalZSize" and <tubs>[5] providing cylindrical hole for beam pipe.

Physical volumes of Inner Support Frame ("InnSupportFrame"), Inner, Middle and Outer Sections ("InnerSection", "MiddleSection", "OuterSection") are installed into "Ecal" *logical volume* with the corresponding Z offsets to the geometry centre of the total Ecal space.

"Support" *logical volume* is defined as logical subtraction of <box> with "EcalSupportXYSize" = "4∗EcalModXYSize" and <tubs> with outerRadius = "EcalSupportRadius" for beam pipe hole.

"InnSection", "MidSection", "OutSection" *logical volumes* are defined as logical subtraction of two boxes.

Inner, Middle, Outer Blocks of Modules are installed into corresponding "InnSection", "MidSection", "OutSection" *logical volumes* using two dimensional loop[6](Figure 1).

"InnBlock1(2)", "MidBlock", "OutBlock" *logical volumes* contains corresponding matrixes of 8x2(6x2) Inner Modules, 8x2 Middle Modules and 16x2 Outer Modules.

[3] <subtraction> in XML

[4] <box> corresponds to box with faces perpendicular to the axes

[5] <tubs> here corresponds to cylindrical tube

[6] <paramphysvol2D>

Three horizontal Stretching Steel Tapes of 0.1 mm thickness are installed into each Block surrounding Module raws.

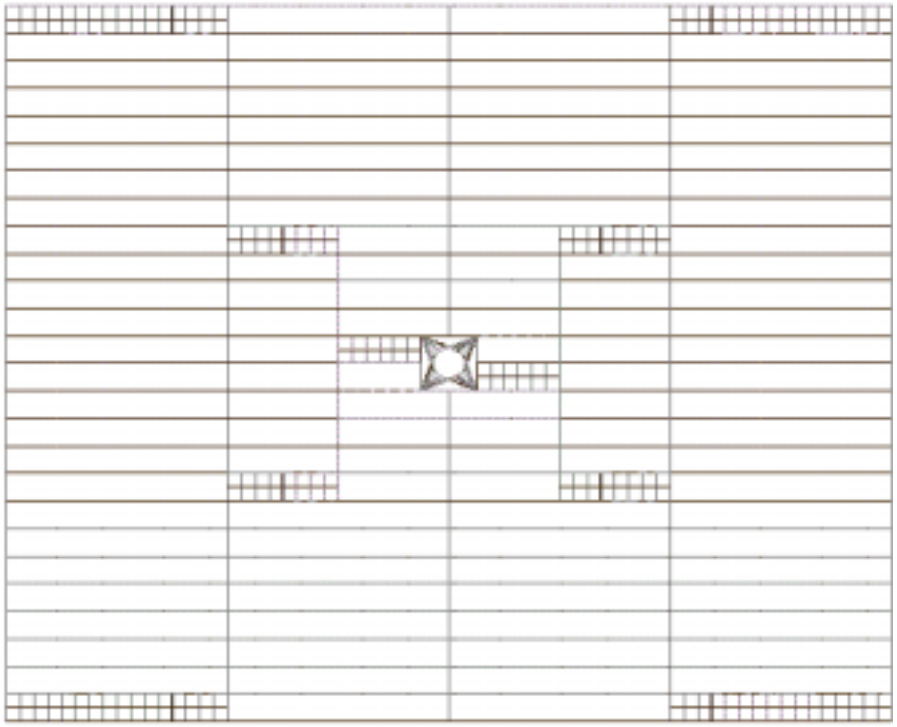

Figure 1: Ecal with Inner, Middle and Outer Block of Modules installed into Inner, Middle and Outer Sections. For illustration some Blocks are shown with installed Modules. Inner Support Frame are located in the centre.

4 Ecal Modules

Inner, Middle, Outer Modules have an identical square size and structure (which includes Front and Back Cover, Read Out box, lead/scintillator stack) but differ only by length and number of readout cells. In the following only Inner Module is described as example. Middle and Outer Modules inner structure is defined the similar way with "Mid∗", "Middle∗" and "Out∗", "Outer∗" names of corresponding parameters.

Logical volume of "Inner" Module is defined as <box> with "EcalModXYSize", "EcalInnModLength".

"InnerModuleFrontCover", "InnerModuleBackCover", "InnerModuleReadOut", "InnerModuleStack" *physical volumes* are installed into "Inner" *logical volumes* (Figure 2). "InnFrontCover", "InnBackCover", "InnReadOut" *logical volumes* in this version are **empty**.

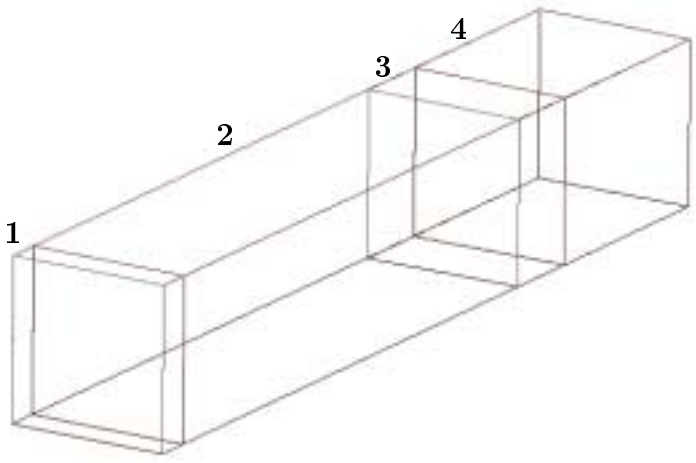

Figure 2: Ecal Module with Front (**1**) and Back(**4**) Covers, Read Out (**3**) and Lead/Scintillator Stack (**2**).

"InnStack" *logical volume* is defined as <box> with installed by <paramphysvol2D> "Inner_Cells_Matrix" *physical volumes*. Inner Stack contains matrix of 3x3 Cells, Middle Stack: matrix of 2x2 Cells, Outer Stack $\equiv$ 1 Cell.

To describe steel tapes of 0.08 mm thickness stretching every Module, Modules material = "Steel" is superseded by *physical volumes* installed in Modules *logical volumes*.

5 Cells

Logical volume "InnCell" is defined as <box> with installed stack of

- 2 Steel Matrixes "InnFrontSteelMatrix", "InnBackSteelMatrix";
- 2 Plastic Layers "InnFrontPlastic", "InnBackPlastic";
- 67 Scintillator Plates "InnerScCells";
- 66 Lead Plates "InnerPbCells"

physical volumes (Figure 3).

"InnCellPlastic" *logical volume* is defined as <box> with material="EcalPlastic". "InnCellSteel" *logical volume* is defined as <box> with installed matrix of SubCells. "InnSubCellSteel" *logical volume* is <subtraction> = <box> − <tubs> with tube outerRadius="EcalFiberHoleRadius". Central part of Steel Cell is presented as "InnCentSubCellSteel" *logical volume* with 5 holes, one in the center and four around.

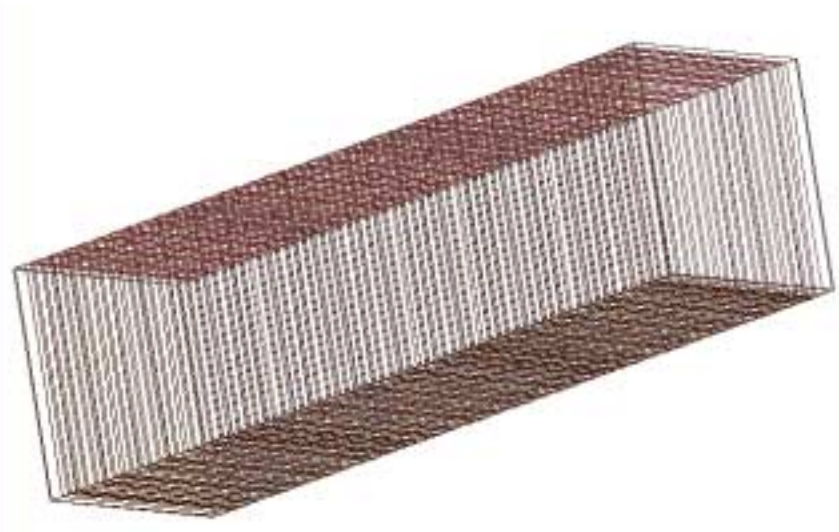

Figure 3: Outer Cell as stack of Steel pressing Plates, Plastic Plates and paper+Scintillator+paper+Lead sandwiches.

"InnCellSc" and "InnCellPb" *logical volumes* are defined the similar way as the Steel ones, but instead of holes "SubFiberSc(Pb)" *physical volumes* are installed into "InnSubCellSc(Pb)" *logical volumes* (Figure 4).

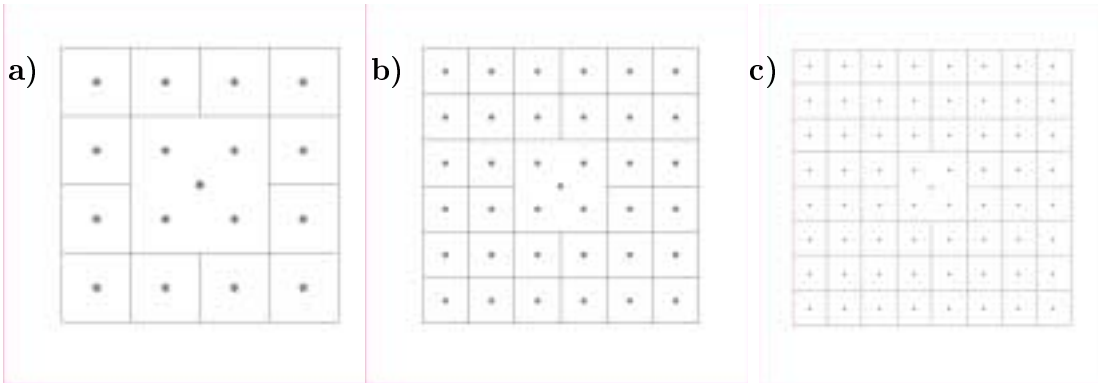

Figure 4: Inner **a)**, Middle **b)** and Outer **a)** Cell Plates with installed SubFibers (in different scale).

"FiberSc" and "FiberPb" *logical volumes* are <tubs> with sizeZ = "Ecal(Sc)PbThick"; outerRadius = "EcalFiberRadius"; material = "EcalFiber".

Instead of description paper sheets between lead and scintillator plates as numerous paper boxes ,"InnCell" *logical volume* is filled with material = "EcalPaper" which is superseded by installed Steel, Plastic, Pb and Sc Plates. **SubFibers are installed only into Pb and Sc SubCells without any holes. No Fibers are installed into Plastic and Steel Plates.**

References

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

6 Appendix:
Ecal Geometry Parameters Definition

Ecal Basic Parameters	
"EcalModXYSize"	"121.7∗mm"
"EcalInnModLength"	"679.0∗mm"
"EcalMidModLength"	"699.0∗mm"
"EcalOutModLength"	"699.0∗mm"
Ecal Installation Parameters	
Inner Support Frame: *4 x 4 Module Sizes - Beam Pipe Hole*	
"EcalSupportXYSize"	"4∗EcalModXYSize"
"EcalSupportRadius"	"180.0∗mm"
"EcalSupportLength"	"510.0∗mm"
Inner Section: *2 x 6 InnBlock Sizes - 4 Module x 2 InnBlock Sizes*	
"EcalStretchTapeThick"	"0.1∗mm"
"EcalBlockYSize"	"2∗EcalModXYSize+3∗EcalStretchTapeThick"
"EcalInnBlock1XSize"	"8∗EcalModXYSize"
"EcalInnBlock1YSize"	"EcalBlockYSize"
"EcalInnBlock2XSize"	"6∗EcalModXYSize"
"EcalInnBlock2YSize"	"EcalBlockYSize"
"EcalInnXSize"	"2∗EcalInnBlock1XSize"
"EcalInnYSize"	"6∗EcalBlockYSize"
Middle Section: *4 x 10 MidBlock Sizes - 2 x 6 InnBlock Sizez*	
"EcalMidBlockXSize"	"8∗EcalModXYSize"
"EcalMidBlockYSize"	"EcalBlockYSize"
"EcalMidXSize"	"4∗EcalMidBlockXSize"
"EcalMidYSize"	"10∗EcalBlockYSize"
Outer Section: *4 x 26 OutBlock Sizes - 4 x 10 MidBlock Sizes*	
"EcalOutBlockXSize"	"16∗EcalModXYSize"
"EcalOutBlockYSize"	"EcalBlockYSize"
"EcalOutXSize"	"4∗EcalOutBlockXSize"
"EcalOutYSize"	"26∗EcalBlockYSize"
Dimensions of Ecal	
"EcalXSize"	"EcalOutXSize"
"EcalYSize"	"EcalOutYSize"
"EcalZSize"	"835∗mm"
Z Offset of Modules geometry center to the Ecal center	
"EcalSupportOffset"	"-107.5∗mm"
"EcalInnOffset"	"-23.0∗mm"
"EcalMidOffset"	"-13.0∗mm"
"EcalOutOffset"	"-13.0∗mm"

Ecal Modules Basic Parameters	
Ecal Modules consist of Stack, Front and Back Covers, ReadOut	
"EcalStackLength"	"432.0∗mm"
"EcalTapeThick"	"0.08∗mm"
Inner Module Parameters	
"EcalInnFrontCoverLength"	"26.0∗mm"
"EcalInnBackCoverLength"	"60.0∗mm"
"EcalInnReadOutLength"	"161.0∗mm"
"EcalInnFrontCoverOffset"	"-0.5∗EcalInnModLength+0.5∗EcalInnFrontCoverLength"
"EcalInnStackOffset"	"-0.5∗EcalInnModLength+EcalInnFrontCoverLength+ 0.5∗EcalStackLength"
"EcalInnBackCoverOffset"	"0.5∗EcalInnModLength−EcalInnReadOutLength− 0.5∗EcalInnBackCoverLength"
"EcalInnReadOutOffset"	"0.5∗EcalInnModLength−0.5∗EcalInnReadOutLength"
Middle Module Parameters	
"EcalMidFrontCoverLength"	"26.0∗mm"
"EcalMidBackCoverLength"	"60.0∗mm"
"EcalMidReadOutLength"	"181.0∗mm"
"EcalMidFrontCoverOffset"	"-0.5∗EcalMidModLength+0.5∗EcalMidFrontCoverLength"
"EcalMidStackOffset"	"-0.5∗EcalMidModLength+EcalMidFrontCoverLength+ 0.5∗EcalStackLength"
"EcalMidBackCoverOffset"	"0.5∗EcalMidModLength−EcalMidReadOutLength− 0.5∗EcalMidBackCoverLength"
"EcalMidReadOutOffset"	"0.5∗EcalMidModLength−0.5∗EcalMidReadOutLength"
Outer Module Parameters	
"EcalOutFrontCoverLength"	"26.0∗mm"
"EcalOutBackCoverLength"	"60.0∗mm"
"EcalOutReadOutLength"	"181.0∗mm"
"EcalOutFrontCoverOffset"	"-0.5∗EcalOutModLength+0.5∗EcalOutFrontCoverLength"
"EcalOutStackOffset"	"-0.5∗EcalOutModLength+EcalOutFrontCoverLength+ 0.5∗EcalStackLength"
"EcalOutBackCoverOffset"	"0.5∗EcalOutModLength−EcalOutReadOutLength− 0.5∗EcalOutBackCoverLength"
"EcalOutReadOutOffset"	"0.5∗EcalOutModLength−0.5∗EcalOutReadOutLength"

Stack Basic Parameters	
Ecal Stack consist of Front and Back Steel Matrix Plates, Front and Back Plastic Plates, Paper+Sc+Paper+Pb sandwiches	
Z Geometry	
"EcalSteelThick"	"1.0∗mm"
"EcalPlasticThick"	"7.0∗mm"
"EcalScThick"	"4.0∗mm"
"EcalPbThick"	"2.0∗mm"
"EcalPaperThick"	"0.12∗mm"
Offset to the Geometry Center of Ecal Stack	
"EcalSteelOffset"	"−215.50∗mm"
"EcalPlasticOffset"	"−211.50∗mm"
"EcalScOffset"	"−205.88∗mm"
"EcalPbOffset"	"−202.76∗mm"
XY Geometry	
Outer Module Stack: **1 Outer Cells**	
"EcalOutCellXYSize"	"121.2∗mm"
Middle Module Stack: **2x2 Middle Cells**	
"EcalMidCellXYSize"	"EcalOutCellXYSize/2"
Inner Module Stack: **3x3 Inner Cells**	
"EcalInnCellXYSize"	"EcalOutCellXYSize/3"
Inner Cell: **4x4 SubCells**	
"EcalInnSubCellXYSize"	"EcalInnCellXYSize/4"
Middle Cell: **6x6 SubCells**	
"EcalMidSubCellXYSize"	"EcalMidCellXYSize/6"
Outer Cell: **8x8 SubCells**	
"EcalOutSubCellXYSize"	"EcalOutCellXYSize/8"
SubFiber *goes through each SubCell*	
"EcalFiberRadius"	"0.6∗mm"
"EcalFiberHoleRadius"	"0.75∗mm"