

# More Details: Validation of Modified Geometry by Hitmap

ZHENG Xiangyu<sup>1,2</sup> YANG Yujiao<sup>1,2</sup> XU Yin<sup>1</sup> RUAN Manqi<sup>2</sup> YU Chunxu<sup>1</sup>

1 NanKai University

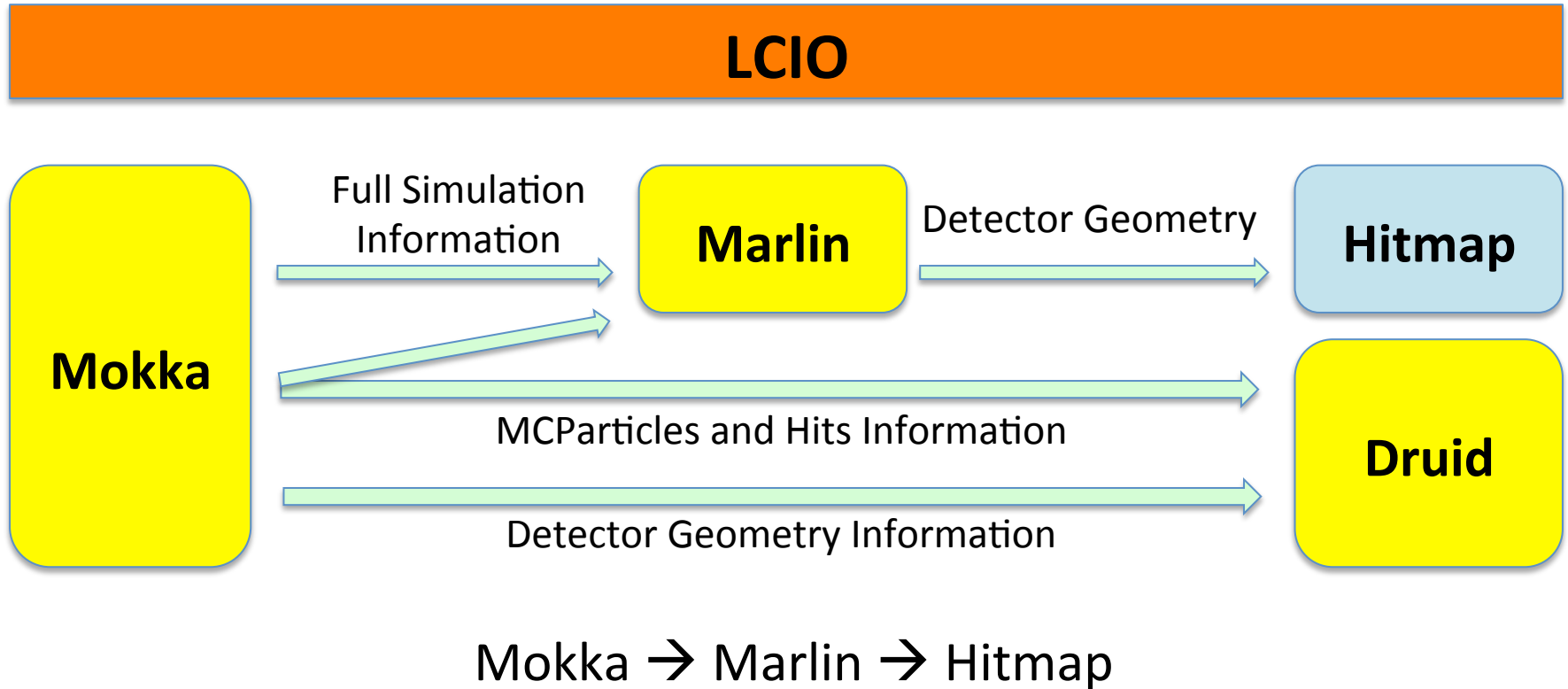
2 Institute of High Energy Physics Chinese Academy of Sciences

# Outline

- Overview
- Preparation
- Environment setting
- Example : make Hitmap step by step
- Summary
- Backup

# Overview

- Flow Chart



# ILCSoft

- LCIO, Mokka, Marlin and Druid

```
[zhengxy@lxslc502 v01-17-05]$ cd /besfs/groups/higgs/users/zhengxy/ilcsoft/v01-17-05/
[zhengxy@lxslc502 v01-17-05]$ ls
bbq          FastJetClustering  ilcutil      lcio          Mokka
CED          ForwardTracking    init_ilcsoft.sh ICTuple
CEDViewer    Garlic             java         Marlin
cernlib      GBL               KalDet       MarlinFastJet
CLHEP        gdml              KalTest      MarlinKinfit
Clupatra     geant4            KiTrack      MarlinPandora
CMake        gear              KiTrackMarlin MarlinReco
CondDBMySQL  gsl               lcd          MarlinTPC
DD4hep       heppdt            lcd          MarlinTrk
Druid        ILCSoft.cmake     LCFIPlus     MarlinTrkProcessors
FastJet      ILCSoft.cmake.env.sh LCFIVertex   MarlinUtil
             xercesc
```

Over 40 packages with complex dependence...

# Preparation

- Virtual Box
- Image file: cepec.vdi
- Put cepec.vdi into Virtual Box
- **After that it's OK!!!**

# Login in

- Account : **ihep**
- Password : **cepc**
- Then type command : **startx**

# Environment Setting

- \$Path:/home/ihep/Training
- vi env\_ilcsoft.sh

```
#!/bin/bash

export LCIO=/home/ihep/ilcsoft/v01-17-05/lcio/v02-04-03
export MARLIN=/home/ihep/ilcsoft/v01-17-05/Marlin/v01-05
export MOKKA=/home/ihep/ilcsoft/v01-17-05/Mokka/mokka-08-03
export DRUIDDIR=/home/ihep/ilcsoft/v01-17-05/Druid
export CMAKE=/home/ihep/ilcsoft/v01-17-05/CMake/2.8.12
export PATH=$LCIO/bin:$MARLIN/bin:$MOKKA/bin:$DRUIDDIR/bin:$PATH

alias HFcmake='cmake -C /home/ihep/ilcsoft/v01-17-05/ILCSoft.cmake ..'

source $MOKKA/build_env.sh

echo "ILCSoft Env Loaded"
```

# Environment Setting

- `source env_ilcsoft.sh`
- If you can see these, when type “root”



```
*****  
*                                     *  
*      W E L C O M E  t o  R O O T    *  
*                                     *  
*   Version   5.34/07    26 April 2013 *  
*                                     *  
* You are welcome to visit our Web site *  
*      http://root.cern.ch             *  
*                                     *  
*****
```

```
ROOT 5.34/07 (tags/v5-34-07@49362, Jun 20 2014, 23:09:51)
```

```
CINT/ROOT C/C++ Interpreter version 5.18.00, July 2, 2010  
Type ? for help. Commands must be C++ statements.  
Enclose multiple statements between { }.
```

**You have set your environment successfully**



# Example : to make Hitmap

- Mokka → Marlin → Hitmap/Druid
- Generate Full simulation file and detector geometry files (xx.slcio & xx.gdml) by Mokka
- Read LCIO informations and write it into root files by Marlin
- Verify the Detector Geometry by Hitmap
- Add both event display and detector geometry information by Druid

# Usage of Mokka

- Mokka can be told what geometry to build using Mokka steering files
- In files Which Database to use, user ,password, Detector model, changes in Geometry, physics list, name of output files, .....
- Use the Geant4-Shell or a Geant4 Macro
- .....

# Simulation by Mokka

- Two types output files: Lcio data file, gear/gdml geometry description file
  1. LCIO file containing MCParticles and Hits in the Subdetectors
  2. GDML/XML File (Gear) containing geometry used for Simulation

# Exercises about Mokka

- Generate gdml geometry description file

PATH: /home/ihep/hitmap/mokka/Geo

- Define mokka steering file:

vi Geo\_ild\_o2\_v06.macro

- You can see like these lines

```
/Mokka/init/detectorModel ILD_o2_v06
/Mokka/init/EditGeometry/rmSubDetector SServices_02_v00
#/Mokka/init/EditGeometry/rmSubDetector all
#/Mokka/init/EditGeometry/addSubDetector tpc10_01
#/Mokka/init/EditGeometry/addSubDetector yoke05
#/Mokka/init/subDetector SHcalRpc01
#/Mokka/init/EditGeometry/addSubDetector SEcal03p01
#/Mokka/init/EditGeometry/addSubDetector SField01
```

# Write steering file by yourself

- Detector model

```
/Mokka/init/detectorModel ILD_o2_v06  
/Mokka/init/EditGeometry/rmSubDetector SServices_O2_v00  
#/Mokka/init/EditGeometry/rmSubDetector all  
#/Mokka/init/EditGeometry/addSubDetector tpc10_01  
#/Mokka/init/EditGeometry/addSubDetector yoke05  
#/Mokka/init/EditGeometry/addSubDetector SEcal03p01  
#/Mokka/init/EditGeometry/addSubDetector SField01
```

# Write steering file by yourself

- Mysql server

/Mokka/init/dbHost localhost → Local Server  
/Mokka/init/user **root**  
/Mokka/init/dbPasswd **cepc**

#/Mokka/init/dbHost 202.122.37.75 → Ihep Server  
#/Mokka/init/user consult  
#/Mokka/init/dbPasswd consult

If don't define it, it will connect to Servers at France

# Write steering file by yourself

- Changing the Geometry

```
/Mokka/init/globalModelParameter TPC_outer_radius 1365
/Mokka/init/globalModelParameter TPC_Ecal_Hcal_barrel_halfZ 1900
/Mokka/init/globalModelParameter Ecal_Barrel_halfZ 1900
/Mokka/init/globalModelParameter Ecal_Sc_Si_mix 00000000
/Mokka/init/globalModelParameter Ecal_nlayers1 10
/Mokka/init/globalModelParameter Ecal_nlayers2 5
/Mokka/init/globalModelParameter Ecal_nlayers3 0
/Mokka/init/globalModelParameter Ecal_radiator_layers_set1_thickness 4.2
/Mokka/init/globalModelParameter Ecal_radiator_layers_set2_thickness 8.4
/Mokka/init/globalModelParameter Ecal_radiator_layers_set3_thickness 0
/Mokka/init/globalModelParameter Ecal_Si_thickness 0.8 mm
/Mokka/init/globalModelParameter Hcal_nlayers 45
/Mokka/init/globalModelParameter Hcal_cells_size 1
/Mokka/init/globalModelParameter DHcal_max_step 1
/Mokka/init/globalModelParameter PadSeparation 0
```

# Models Database Browser

- You can refer to Models Database Browser  
[http://www-flc.desy.de/ldoptimization/tools/mokkamodels.php?model=ILD\\_o2\\_v06](http://www-flc.desy.de/ldoptimization/tools/mokkamodels.php?model=ILD_o2_v06)
  - Select the Detector
  - All **subdetectors** and **parameters** are listed

Mokka Detector Model Database Browser

Model name:

---

**Detector Model “ILD\_o2\_v06”**

<i>Description</i>	ILD simulation reference Model using SD HCal
<i>Status</i>	unstable

**Detector Concept “ILD”**

<i>Description</i>	The ILD detector concept
<i>World Box</i>	9000 × 9000 × 14000 mm <sup>3</sup> (octant)
<i>Tracker Region</i>	$r < 1842 \text{ mm},  z  < 2500 \text{ mm}$
<i>Calo Region</i>	$r < 3490 \text{ mm},  z  < 4044 \text{ mm}$

---

**Subdetector “vxd07”**

<i>Description</i>	vxd dl update
<i>C++ Driver</i>	SVxd04 (superdriver for vxd04)
<i>MySQL Database</i>	vxd07
<b>Parameters</b>	<a href="#">VXD active side band electronics option</a> , <a href="#">VXD active silicon thickness</a> , <a href="#">VXD cryostat optio</a> <a href="#">VXD foam spacer material</a> , <a href="#">VXD foam spacer thickness</a> , <a href="#">VXD inner radius</a> , <a href="#">VXD layer gap</a> , <a href="#">VXD</a> <a href="#">VXD side band electronics thickness</a> , <a href="#">VXD side band electronics width</a> , <a href="#">VXD width r1</a> , <a href="#">VXD w</a>
<i>Build Order</i>	20



# Mokka command

- Mokka -U Geo\_ild\_o2\_v06.macro

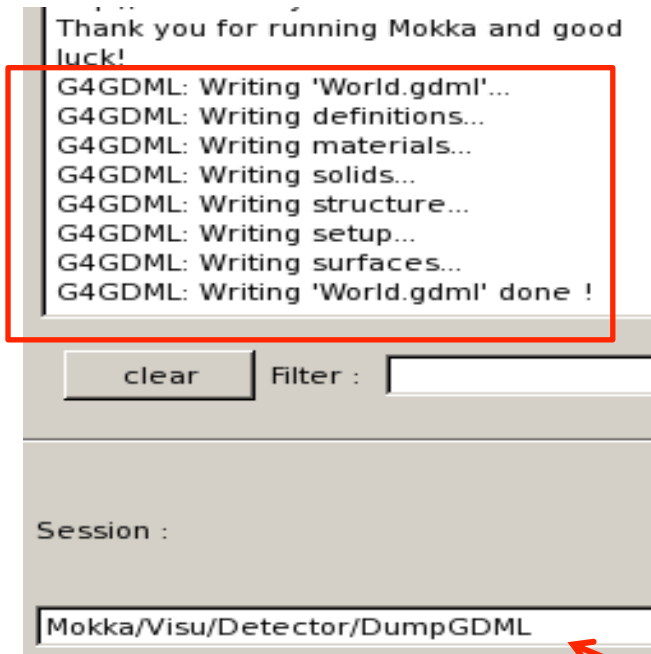
```
[zhengxy@lxslc502 Geo]$ Mokka -U Geo_ild_o2_v06.macro
```

```
**** Mokka started at Tue Jul 22 17:25:01 2014
```

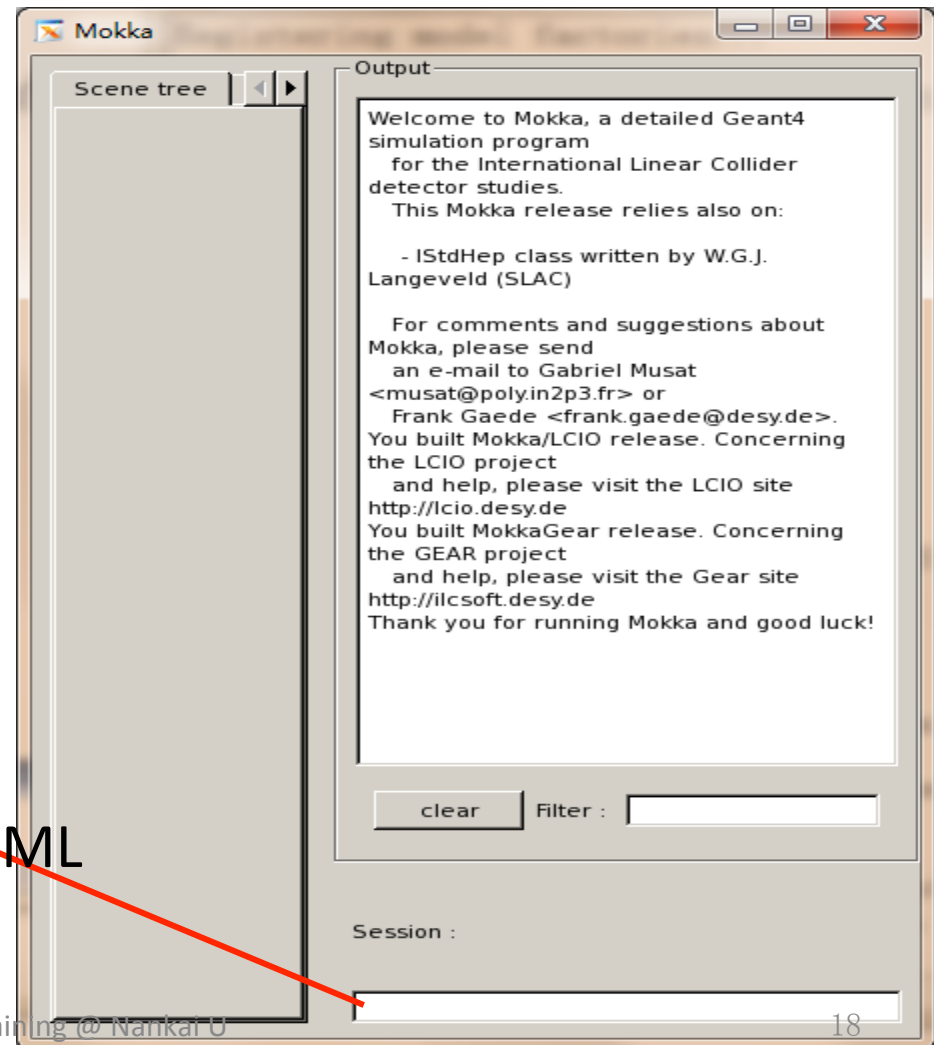
```
Initialisation: /Mokka/init/detectorModel ILD_o2_v06
Initialisation: /Mokka/init/EditGeometry/rmSubDetector SServices_02_v00
Initialisation: /Mokka/init/globalModelParameter TPC_outer_radius 1365
Global model parameter "TPC_outer_radius" set to "1365"
Initialisation: /Mokka/init/globalModelParameter TPC_Ecal_Hcal_barrel_halfZ 1900
Global model parameter "TPC_Ecal_Hcal_barrel_halfZ" set to "1900"
Initialisation: /Mokka/init/globalModelParameter Ecal_Barrel_halfZ 1900
Global model parameter "Ecal_Barrel_halfZ" set to "1900"
Initialisation: /Mokka/init/globalModelParameter Ecal_Sc_Si_mix 00000000
Global model parameter "Ecal_Sc_Si_mix" set to "00000000"
Initialisation: /Mokka/init/globalModelParameter Ecal_nlayers1 10
Global model parameter "Ecal_nlayers1" set to "10"
Initialisation: /Mokka/init/globalModelParameter Ecal_nlayers2 5
Global model parameter "Ecal_nlayers2" set to "5"
Initialisation: /Mokka/init/globalModelParameter Ecal_nlayers3 0
Global model parameter "Ecal_nlayers3" set to "0"
```

# Dump World. gdml file

- Use the Geant4-Shell



Mokka/Visu/Detector/DumpGDML  
Dump gdml file out!



# Generate root file

- Root file with geometry information

```
ihep@localhost:~/hitmap/mokka/Geo
File Edit View Terminal Tabs Help
[ihep@localhost Geo]$ pwd
/home/ihep/hitmap/mokka/Geo
[ihep@localhost Geo]$ ls
GearOutput.xml  Geo.C  Geo_ild_o2_v06.macro  World.gdml
[ihep@localhost Geo]$ vi Geo.C
```

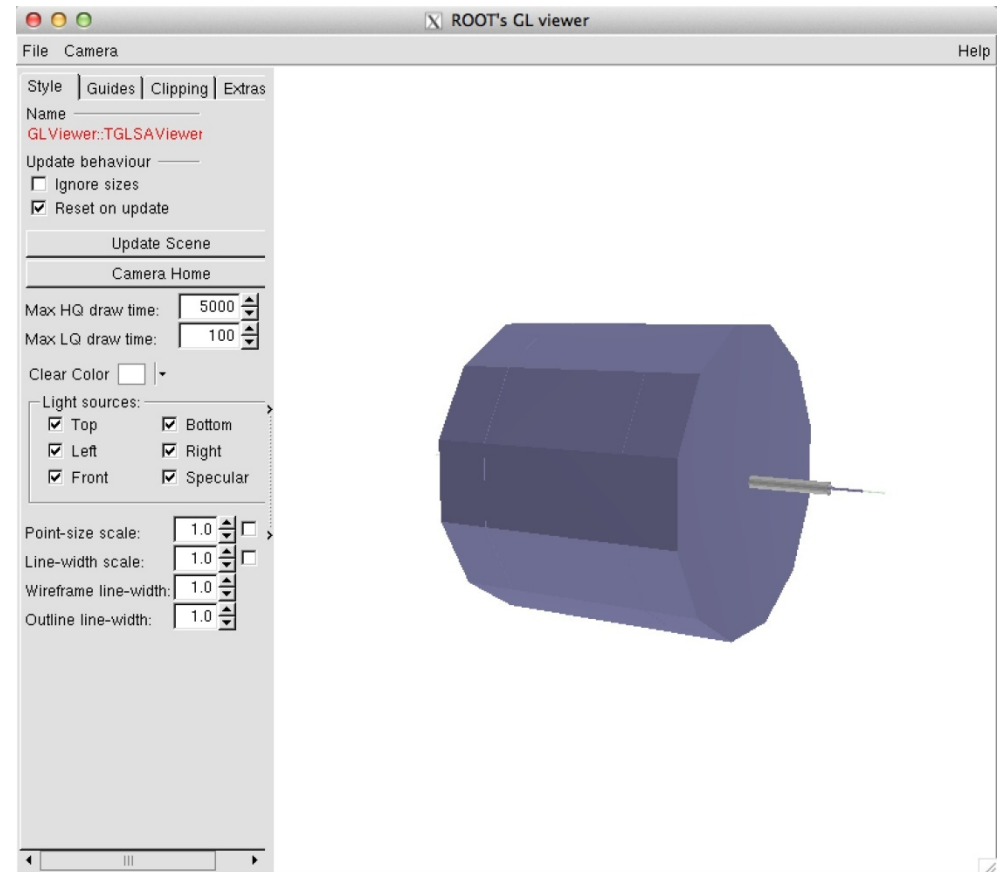
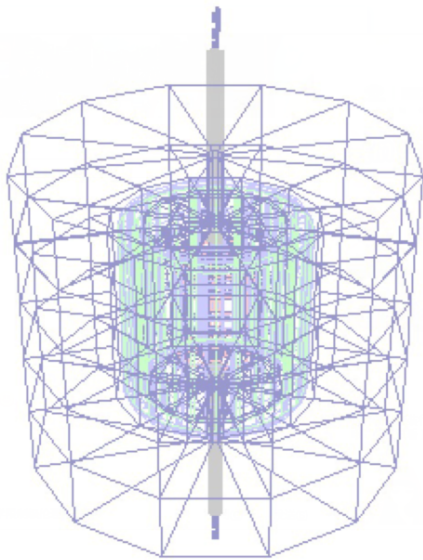
```
{
    TGeoManager::Import("World.gdml");
    gGeoManager->GetTopVolume()->Draw("ogl");
    TFile *f = new TFile("ild_o2_v06_TPC1365.root","recreate");
    gGeoManager->Write();
    f->Close();
}
```

# Visualization

- `root -l Geo.C`

Generate `ild_o2_v06_TPC1365.root`

Geant4 & Root Panel



# Full Simulation by Mokka

- Generate Icio data file containing MCParticles and Hits in the Subdetectors

PATH: `/home/ihep/hitmap/mokka/Fullsimu`

- Write the script to run Mokka full simulation

```
#!/bin/bash
source /home/ihep/ilcsoft/v01-17-05/init_ilcsoft.sh
/home/ihep/ilcsoft/v01-17-05/Mokka/mokka-08-03/bin/Mokka -U /home/
ihep/hitmap/mokka/Fullsimu/tmp_steer/init_ild_o2_v06.macro
```

```
[ihep@localhost Fullsimu]$ pwd
/home/ihep/hitmap/mokka/Fullsimu
[ihep@localhost Fullsimu]$ ls
GearOutput.xml ild_o2_v06.sh* tmp_steer/
[ihep@localhost Fullsimu]$
```

# Mokka steering file

- `cd /tmp_steer`
- `event.macro` and `init_ild_o2_v06.macro`

```
ihep@localhost:~/hitmap/mokka/Fullsimu/tmp_steer
File Edit View Terminal Tabs Help
[ihep@localhost Fullsimu]$ pwd
/home/ihep/hitmap/mokka/Fullsimu
[ihep@localhost Fullsimu]$ cd tmp_steer/
[ihep@localhost tmp_steer]$ ls
event.macro  init_ild_o2_v06.macro  init_ild_v05.macro
[ihep@localhost tmp_steer]$
```

# Event

- Specify event type
- vi event.macro

```
/generator/generator particleGun  
/gun/position 0 0 5 mm  
/gun/direction 0.0 0.0 1.0  
/gun/energy 10.0 GeV  
/gun/momentumSmearing 0.0 GeV  
/gun/phiSmearing 180 deg  
/gun/thetaSmearing 90 deg  
/gun/directionSmearingMode uniform  
/gun/particle mu+  
/run/beamOn 100
```

exit

Particle  
beamOn  
Energy

.....

# Geometry

- Select/edit geometry
- vi `init_ild_o2_v06.macro`
- Just like we write into `Geo_ild_o2_v06.macro`
- But add others parameters




# Write steering file by yourself

- Detector model

```
/Mokka/init/detectorModel ILD_o2_v06  
/Mokka/init/EditGeometry/rmSubDetector SServices_O2_v00  
#/Mokka/init/EditGeometry/rmSubDetector all  
#/Mokka/init/EditGeometry/addSubDetector tpc10_01  
#/Mokka/init/EditGeometry/addSubDetector yoke05  
#/Mokka/init/EditGeometry/addSubDetector SEcal03p01  
#/Mokka/init/EditGeometry/addSubDetector SField01
```

# Write steering file by yourself

- Mysql server

/Mokka/init/dbHost localhost       Local Server  
/Mokka/init/user root  
/Mokka/init/dbPasswd cepc

*#/Mokka/init/dbHost 202.122.37.75       Ihep Server*  
*#/Mokka/init/user consult*  
*#/Mokka/init/dbPasswd consult*

If don't define it, it will connect to Servers at France,  
Germany.....

# Write steering file by yourself

- Changing the Geometry

```
/Mokka/init/globalModelParameter TPC_outer_radius 1365
/Mokka/init/globalModelParameter TPC_Ecal_Hcal_barrel_halfZ 1900
/Mokka/init/globalModelParameter Ecal_Barrel_halfZ 1900
/Mokka/init/globalModelParameter Ecal_Sc_Si_mix 00000000
/Mokka/init/globalModelParameter Ecal_nlayers1 10
/Mokka/init/globalModelParameter Ecal_nlayers2 5
/Mokka/init/globalModelParameter Ecal_nlayers3 0
/Mokka/init/globalModelParameter Ecal_radiator_layers_set1_thickness 4.2
/Mokka/init/globalModelParameter Ecal_radiator_layers_set2_thickness 8.4
/Mokka/init/globalModelParameter Ecal_radiator_layers_set3_thickness 0
/Mokka/init/globalModelParameter Ecal_Si_thickness 0.8 mm
/Mokka/init/globalModelParameter Hcal_nlayers 45
/Mokka/init/globalModelParameter Hcal_cells_size 1
/Mokka/init/globalModelParameter DHcal_max_step 1
/Mokka/init/globalModelParameter PadSeparation 0
```

# Write steering file by yourself

- Output file: ild\_o2\_v06.slcio

/Mokka/init/lcioFilename /home/ihep/hitmap/marlin/slcio/ild\_o2\_v06.slcio

Define where and what's the name of the LCIO output file

- Initial Macro file

/Mokka/init/initialMacroFile /home/ihep/hitmap/mokka/Fullsimu/tmp\_steer/event.macro

Initial Macro file to be run, once the geometry is build

- .....

# ild\_o2\_v06.macro

- Add all before lines into a steer file:

```
Mokka/init/detectorModel ILD_o2_v06
/Mokka/init/EditGeometry/rmSubDetector SServices_02_v00
#/Mokka/init/EditGeometry/rmSubDetector all
#/Mokka/init/EditGeometry/addSubDetector tpc10_01
#/Mokka/init/EditGeometry/addSubDetector yoke05
#/Mokka/init/EditGeometry/addSubDetector vxd07
#/Mokka/init/EditGeometry/addSubDetector SEcal05
#/Mokka/init/EditGeometry/addSubDetector LHcal01
#/Mokka/init/subDetector SHcalRpc01
#/Mokka/init/EditGeometry/addSubDetector SEcal03p01
#/Mokka/init/EditGeometry/addSubDetector SField01

/Mokka/init/dbHost 202.122.37.75
/Mokka/init/user consult
/Mokka/init/dbPasswd consult

/Mokka/init/lcioFilename /besfs/groups/higgs/users/zhengxy/workarea_zxy/marlin/slci/ild_o2_v06.s
lcio
/Mokka/init/initialMacroFile /besfs/groups/higgs/users/zhengxy/workarea_zxy/mokka/Fullsimu/tmp_st
eer/event.macro
#/Mokka/init/MokkaGearFileName /besfs/groups/higgs/users/zhengxy/Geo/cooking/ild_o2_v06_TPC1365.x
ml

/Mokka/init/globalModelParameter TPC_outer_radius 1365
/Mokka/init/globalModelParameter TPC_Ecal_Hcal_barrel_halfZ 1900
/Mokka/init/globalModelParameter Ecal_Barrel_halfZ 1900
```

init\_ild\_o2\_v06.macro

# Execute Mokka Full Simulation

- `sh ./ild_o2_v06.sh`

```
>>> Event 95, scanning sub-detectors
>>> Event 96, scanning sub-detectors
>>> Event 97, scanning sub-detectors
>>> Event 98, scanning sub-detectors
>>> Event 99, scanning sub-detectors

Graphics systems deleted.
Visualization Manager deleting...
[ihep@localhost Fullsimu]$
```

- After that, you can find the output Lcio file at the path: `/home/ihep/hitmap/marlin/slciio`

```
[ihep@localhost marlin]$ cd slciio/
[ihep@localhost slciio]$ ls
ild_o2_v06.slciio MLSteer/
```

# Usage of Marlin

- Undertake the above, Geometry could also be checked from Hitmap
- Hitmap: scan your detector with lots of particle gun events, read the hit positions...
- Marlin: read LCIO informations and write it into root files
- Marlin → Make Hitmap

# But first step is using Icio

- Dumpevent: dump the data information

```
[zhengxy@lxslc504 slcio]$ pwd
/besfs/groups/higgs/users/zhengxy/workarea_zxy/marlin/slcio
[zhengxy@lxslc504 slcio]$ ls
ild_o2_v06.slcio
```

← Here, do you remember?

```
[zhengxy@lxslc504 slcio]$ dumpevent ild_o2_v06.slcio 4 | less
[zhengxy@lxslc504 slcio]$ dumpevent ild_o2_v06.slcio 4 | grep collection
collection name : COILCollection
----- print out of SimTrackerHit collection -----
collection name : EcalBarrelSiliconCollection
----- print out of SimCalorimeterHit collection -----
collection name : EcalBarrelSiliconPreShowerCollection
----- print out of SimCalorimeterHit collection -----
collection name : HcalBarrelCollection
----- print out of SimCalorimeterHit collection -----
collection name : MCParticle
----- print out of MCParticle collection -----
collection name : MuonBarrelCollection
----- print out of SimCalorimeterHit collection -----
collection name : SETCollection
----- print out of SimTrackerHit collection -----
collection name : SITCollection
----- print out of SimTrackerHit collection -----
collection name : TPCCollection
----- print out of SimTrackerHit collection -----
collection name : VXDCollection
----- print out of SimTrackerHit collection -----
```

Dumpevent \*slcio EventNumber  
(Detailed output of a single event)



# LCIO

- Anajob: output the general event information and number of objects in each collection

```
[zhengxy@lxslc504 slcio]$ anajob ild_o2_v06.slcio | less  
[zhengxy@lxslc504 slcio]$ anajob ild_o2_v06.slcio █
```

COLLECTION NAME	COLLECTION TYPE	NUMBER OF ELEMENTS
COILCollection	SimTrackerHit	14
EcalBarrelSiliconCollection	SimCalorimeterHit	23
EcalBarrelSiliconPreShowerCollection	SimCalorimeterHit	1
HcalBarrelCollection	SimCalorimeterHit	21
HcalEndCapRingsCollection	SimCalorimeterHit	10
HcalEndCapsCollection	SimCalorimeterHit	32
MCParticle	MCParticle	1
MuonEndCapCollection	SimCalorimeterHit	29
SETCollection	SimTrackerHit	2
SITCollection	SimTrackerHit	6
TPCCollection	SimTrackerHit	148
VXDCollection	SimTrackerHit	6

**Anajob \*slcio**

**(Information about a given LCIO file)**

```
100 events read from files:  
ild_o2_v06.slcio
```

# Marlin

- Write/Modify your own source code  
(Example: Add SITCollection)
- PATH: /home/ihep/hitmap/marlin/src
- vi PrintHit.cc

.....

```
LCCollection * trackhitcol = evtP->getCollection("SITCollection");  
int nHit = trackhitcol->getNumberOfElements();  
TrackHitPosX=-99999.;  
TrackHitPosY=-99999.;  
TrackHitPosZ=-99999.;
```

.....

# PrintHit Header

- PATH: /home/ihep/hitmap/marlin/include

```
#ifndef _PrintHit_hh_  
#define _PrintHit_hh_  
#include <string>  
#include <iostream>  
#include <fstream>  
#include <marlin/Processor.h>  
#include <EVENT/CalorimeterHit.h>  
#include <IMPL/LCEventImpl.h>  
#include <TNtuple.h>  
#include <TObject.h>  
#include <TTree.h>  
#include <TFile.h>  
#include <TH1.h>  
#include <TH2.h>  
#include <TH3.h>
```

.....

# Usage of Marlin

- Define the steering parameters

---

```
PrintHit::PrintHit()
: Processor("PrintHit"),
  _output(0)
{
  _description = "Print MC Truth" ;

  _treeFileName="MCTruth.root";
  registerProcessorParameter( "TreeOutputFile" ,
    "The name of the file to which the ROOT tree will be written"
    , _treeFileName ,
    _treeFileName);

  _colName="MCParticle";
  registerProcessorParameter( "MCOBJECTS" ,
    "The name of the PFOs" ,
    _colName ,
    _colName);

  std::vector<std::string> hcalCollections;
  hcalCollections.push_back(std::string("HCALBarrel"));
  hcalCollections.push_back(std::string("HCALEndcap"));
  hcalCollections.push_back(std::string("HCALOther"));
  hcalCollections.push_back(std::string("ECALBarrel"));
  hcalCollections.push_back(std::string("ECALEndcap"));

  registerInputCollections( LCIO::CALORIMETERHIT,
    "HitCollections" ,
    "Hit Collection Names" ,
    _hcalCollections ,
    hcalCollections);
```

# Output

- Define the output root file

```
void PrintHit::init() {
    printParameters();

    TFile *tree_file=new TFile(_treeFileName.c_str(), (_overwrite ? "RECREATE" : "UPDATE"))

    if (!tree_file->IsOpen()) {
        delete tree_file;
        tree_file=new TFile(_treeFileName.c_str(), "NEW");
    }

    _outputTree = new TTree(_treeName.c_str(), _treeName.c_str());
    _outputTree->SetAutoSave(32*1024*1024); // autosave every 32MB
    _outputTree->Branch("EventNr", &_eventNr, "EventNr/I");
    _outputTree->Branch("NumHit", &_NHits, "NumHit/I");
    _outputTree->Branch("NHitT", &_NHitsT, "NHitT/I");
    _outputTree->Branch("PosX", &HitPosX, "HitX/F");
    _outputTree->Branch("PosY", &HitPosY, "HitY/F");
    _outputTree->Branch("PosZ", &HitPosZ, "HitZ/F");
    _outputTree->Branch("HitEn", &HitE, "HitEn/F");
    _outputTree->Branch("HitEnErr", &HitEnError, "HitEnErr/F");
    _outputTree->Branch("MCPID", &MCPID, "MCPID/I");
    _outputTree->Branch("MCTrkID", &MCTrkPID, "MCTrkID/I");
    _outputTree->Branch("MCPEX", &MCPEX, "MCPEX/F");
    _outputTree->Branch("MCPEY", &MCPEY, "MCPEY/F");
    _outputTree->Branch("MCPEZ", &MCPEZ, "MCPEZ/F");
    _outputTree->Branch("MCPER", &MCPER, "MCPER/F"); //Radius of EndP
    _outputTree->Branch("HitFlag", &HitFlag, "HitFlag/I");
    _outputTree->Branch("IDO", &_IDO, "IDO/I");
    _outputTree->Branch("ID1", &_ID1, "ID1/I");
    _outputTree->Branch("M", &_M, "M/I");
}
```

# Marlin

- Event loop: fill your root file

```
void PrintHit::processEvent( LCEvent * evtP )
{
    if (evtP)
    {
        try
        {
            _eventNr=evtP->getEventNumber();
            _Num++;
            if(_Num%100==0)
            {
                std::cout<<_Num<<" events have been processed"<<std::endl;
                std::cout<<" Number of Collections " << _hcalCollections.size() <<std::endl;
            }

            ...

            } _outputTree->Fill();
        }
        else
        {
            std::cout<<"Cannot found Simulated CaloHits or CaloHits!"<<std::endl;
        }
    } catch (lcio::DataNotAvailableException zero) { }
}
} catch (lcio::DataNotAvailableException err) { }
}
```

# Usage of Marlin

- Output the root file

```
void PrintHit::end()
{
    if (_outputTree) {
        TFile *tree_file = _outputTree->GetCurrentFile(); //just in case we switched to a new file
        tree_file->Write();
        delete tree_file;
    }
}
```

# Four preparative steps to Marlin

- Delete files which are generated last time

PATH: [/home/ihep/hitmap/marlin](#)

1. `rm -rf build`

2. `rm -rf lib`

```
[ihep@localhost build]$ cd ..  
[ihep@localhost marlin]$ ls  
build/  clean.sh*  CMakeLists.txt  include/  lib/  loadLDD.sh*  slcio/  src/  
[ihep@localhost marlin]$ . loadLDD.sh  
[ihep@localhost marlin]$
```

---

```
removed `build//CMakeFiles/ContinuousConfigure.dir/progress.make'  
removed directory: `build//CMakeFiles/ContinuousConfigure.dir'  
removed directory: `build//CMakeFiles'  
removed `build//cmake_install.cmake'  
removed `build//CTestTestfile.cmake'  
removed directory: `build/'  
[ihep@localhost marlin]$ rm -rf lib/
```

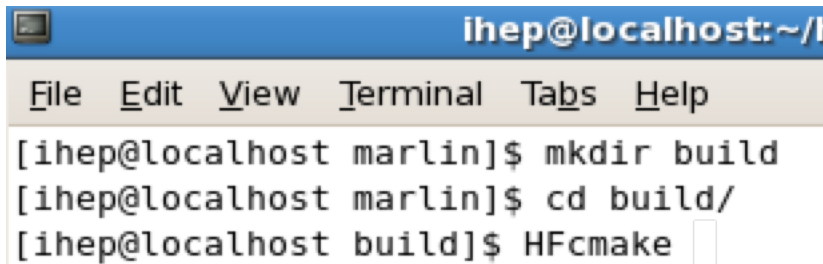


# Four preparative steps to Marlin

- Generate the make file using Cmake

1. mkdir build
2. cd build
3. HFcmake

HFcmake='cmake -C /home/ihep/  
Ilcsoft/v01-17-05/ILCSoft.cmake ..'



```
ihep@localhost:~/t
File Edit View Terminal Tabs Help
[ihep@localhost marlin]$ mkdir build
[ihep@localhost marlin]$ cd build/
[ihep@localhost build]$ HFcmake
```

```
/home/ihep/Ilcsoft/v01-17-05/ILCSoft.cmake ..
-- /home/ihep/ilcsoft/v01-17-05/Marlin/v01-05;
-- /home/ihep/ilcsoft/v01-17-05/Mokka/mokka-08-03;
-- /home/ihep/ilcsoft/v01-17-05/root/5.34.07;
-- /home/ihep/ilcsoft/v01-17-05/CLHEP/2.1.3.1;
-- /home/ihep/ilcsoft/v01-17-05/gsl/1.14;
-- /home/ihep/ilcsoft/v01-17-05/QT/4.7.4;
-- CMAKE_MODULE_PATH =
-- /home/ihep/ilcsoft/v01-17-05/ilcutil/v01-01/cmakemodules;
.....
--
--
-- Configuring done
-- Generating done
-- Build files have been written to: /home/ihep/hitmap/marlin/build
[ihep@localhost build]$
```

# Four preparative steps to Marlin

- Compile

1. make

2. make install

```
[ihep@localhost build]$ make
Scanning dependencies of target AnaGeo
[ 50%] Building CXX object CMakeFiles/AnaGeo.dir/src/PrintTrack.cc.o
[100%] Building CXX object CMakeFiles/AnaGeo.dir/src/PrintHit.cc.o
Linking CXX shared library lib/libAnaGeo.so
[100%] Built target AnaGeo
..... ■
```

```
[ihep@localhost build]$ make install
```

```
[100%] Built target AnaGeo
```

```
Install the project...
```

```
-- Install configuration: "RelWithDebInfo"
```

```
-- Installing: /home/ihep/hitmap/marlin/lib/libAnaGeo.so.0.0.0
```

```
-- Installing: /home/ihep/hitmap/marlin/lib/libAnaGeo.so.0.0
```

```
-- Installing: /home/ihep/hitmap/marlin/lib/libAnaGeo.so
```

```
-- Set runtime path of "/home/ihep/hitmap/marlin/lib/libAnaGeo.so.0.0.0" to "/home/ihep/hitmap/marlin/lib:/home/ihep/ilcsoft/v01-17-05/Marlin/v01-05/lib:/home/ihep/ilcsoft/v01-17-05/lcio/v02-04-03/lib:/home/ihep/ilcsoft/v01-17-05/mysql/usr/lib64:/home/ihep/ilcsoft/v01-17-05/gear/v01-04/lib:/home/ihep/ilcsoft/v01-17-05/CLHEP/2.1.3.1/lib:/home/ihep/ilcsoft/v01-17-05/ilcutil/v01-01/lib:/home/ihep/ilcsoft/v01-17-05/root/5.34.07/lib"
```

# Four preparative steps to Marlin

- Load your module to Marlin: export the Marlin\_LDD variable

1. cd ..

2. . loadLDD.sh

```
[ihep@localhost build]$ cd ..  
[ihep@localhost marlin]$ ls  
build/ clean.sh* CMakeLists.txt include/ lib/ loadLDD.sh* slcio/ src/  
[ihep@localhost marlin]$ . loadLDD.sh  
[ihep@localhost marlin]$ █
```

```
#!/bin/bash  
unset MARLIN_DLL  
export MARLIN_DLL=$PWD/lib/libAnaGeo.so  
#export MARLIN_DLL=$PWD/lib/libPrintHit.so:/home/llr/ilc/ruan/MarlinTools/Marlin  
Digi/lib/libRPCDHCCALCaloDigi.so  
~
```

# Put four steps into one script

- Write clean.sh by myself

```
[ihep@localhost marlin]$ ls  
clean.sh* CMakeLists.txt include/ lib/ loadLDD.sh* slcio/ src/  
[ihep@localhost marlin]$
```

---

```
#!/bin/bash
```

```
rm -rf build  
rm -rf lib
```

```
#--- Generate the make file using Cmake -----  
mkdir build  
cd build  
HFcmake
```

```
#--- Compile -----  
make  
make install
```

```
█--- Load your module to Marlin: export the Marlin_LDD variable -----  
cd ..  
#rm -rf *.root *.slcio  
. loadLDD.sh
```

. clean.sh

# Marlin steering file

- Write your Marlin steering file
- Path: /home/ihep/hitmap/marlin/slciio/MLSteer
- vi MIP\_ild\_o2\_06\_TPC1365.steer

```
LCIOInputFiles /home/ihep/hitmap/marlin/slciio/ild_o2_v06.slciio
ActiveProcessors MyPrintHit
#ActiveProcessors MyPrintTrack
MaxRecordNumber 20000
.end
-----
.begin MyPrintHit
ProcessorType PrintHit
# HitCollectionName HcalBarrelCollection
# HitCollections HCALBarrel HCALEndcap HCALOther ECALBarrel ECALEndcap
HitCollections EcalBarrelSiliconCollection EcalBarrelSiliconPreShowerCollec
tion EcalEndcapSiliconCollection EcalEndcapSiliconPreShowerCollection HcalBarrel
Collection HcalEndCapsCollection HcalEndCapRingsCollection MuonBarrelCollection
MuonEndCapCollection COILCollection
# HitCollections LHcalCollection LumiCalCollection
## The name of the PF0s
# type: [string]
# default: MCParticle
# MObjects MCParticle

OverwriteFile 0

TreeName HCAL
TreeOutputFile /home/ihep/hitmap/marlin/slciio/MLSteer/ild_o2_06_TPC1365.root
```

Tell Marlin which Lcio file(s) to open  
(sequentially)  
and what Processors to run with given  
Parameters

Define where and what's the name of  
output root file containing MCParticles  
and Hits in the Subdetectors

# Execute Marlin command

- Marlin MIP\_ild\_o2\_06\_TPC1365.steer

```
[ MESSAGE "Marlin" ] Events skipped by processors :
[ MESSAGE "Marlin" ] Total: 0
[ MESSAGE "Marlin" ] -----
[ MESSAGE "Marlin" ] -----
[ MESSAGE "Marlin" ] Time used by processors ( in processEvent() ) :
[ MESSAGE "Marlin" ]
[ MESSAGE "Marlin" ] MyPrintHit 5.000000e-02 s in
  100 events ==> 5.000000e-04 [ s/evt.]
[ MESSAGE "Marlin" ] Total: 5.000000e-02 s in
  100 events ==> 5.000000e-04 [ s/evt.]
[ MESSAGE "Marlin" ] -----
[ihep@localhost MLSteer]$ ls
draw_hit4map.C ild_o2_06_TPC1365.root MIP_ild_o2_06_TPC1365.steer
[ihep@localhost MLSteer]$
```

Output root file

# Hitmap

- Write root steering file: draw\_hit4map.C

```
void draw_hit4map()
{
    char filename_open[80]; char filename_out[80];

    sprintf(filename_open, "ild_o2_06_TPC1365.root")
    sprintf(filename_out, "ild_o2_06_TPC1365.pdf");

    TFile *file = new TFile (filename_open);
    TTree *tree = (TTree*) file -> Get("HCAL");

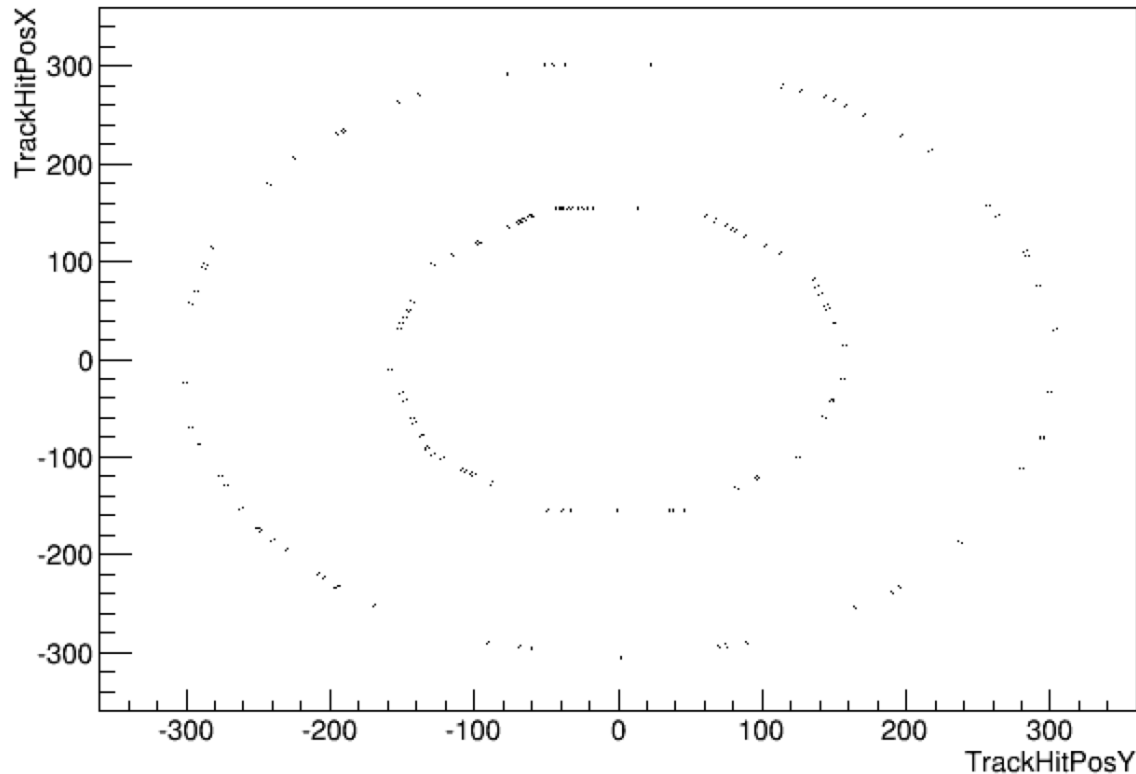
    if (tree == 0)
    {
        cout << "Problem of Opening the root-tree of Polythene Simulation!"
        << endl;
    }
}
```

Input root file

# Hitmap

- `root -l draw_hit4map.C`

TrackHitPosX:TrackHitPosY



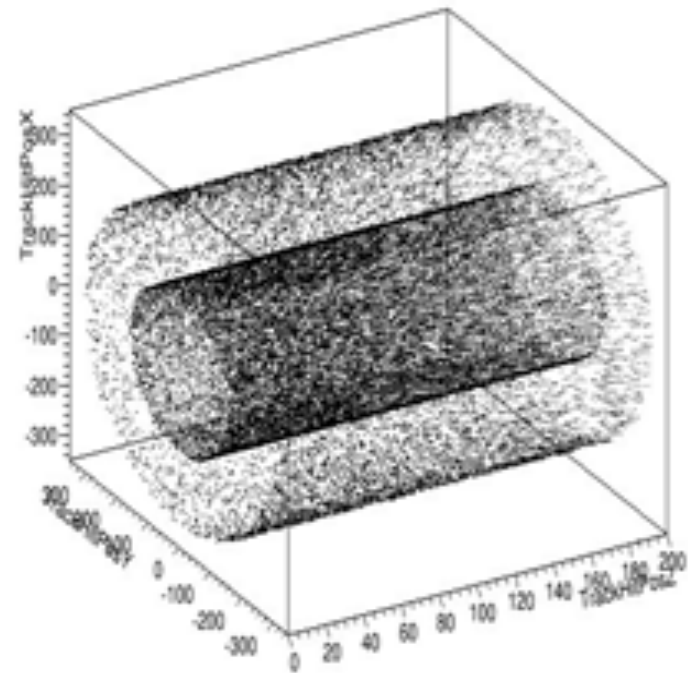
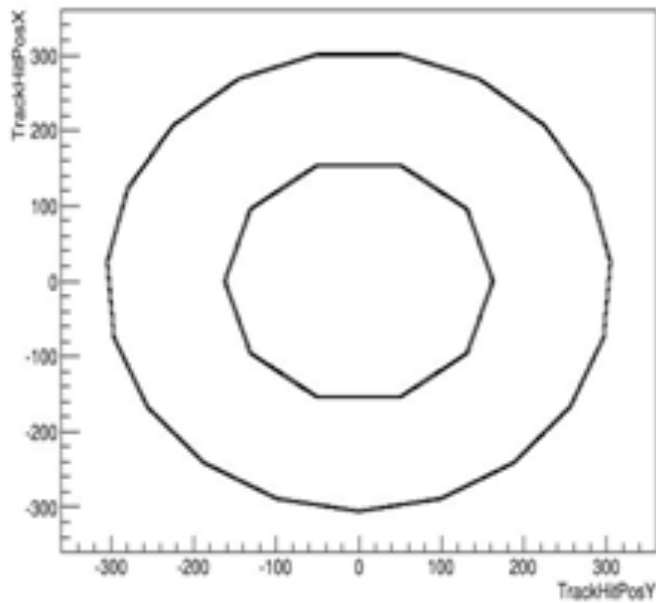
Just because of  
beamOn is 100

If beamON is 10000?



# Hitmap

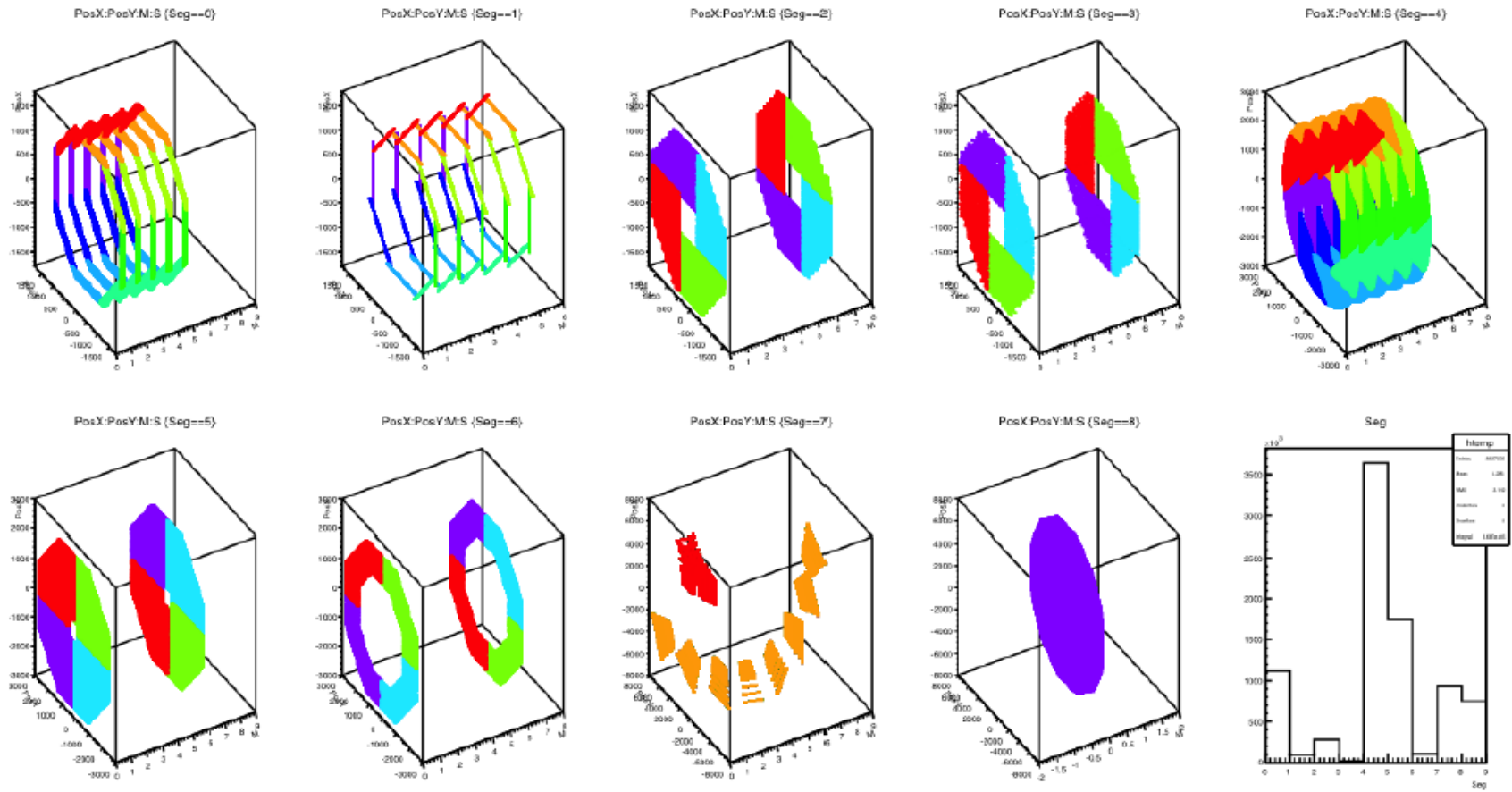
- beamOn 10000



SIT Hitmap

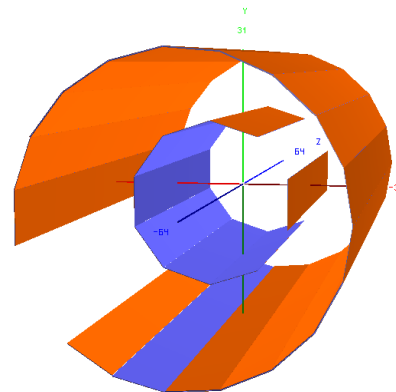
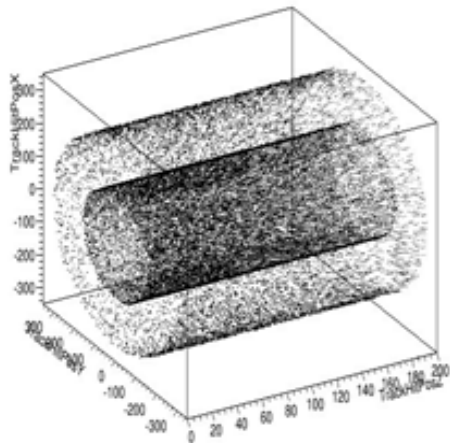
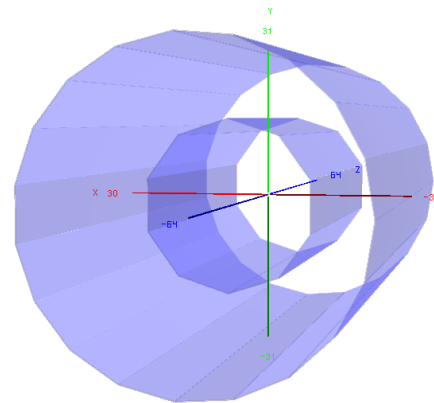
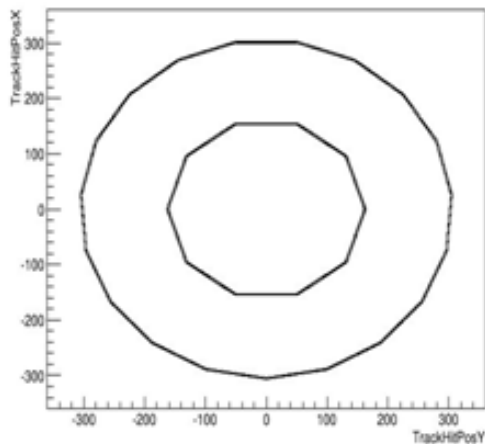
# Hitmap

- Example



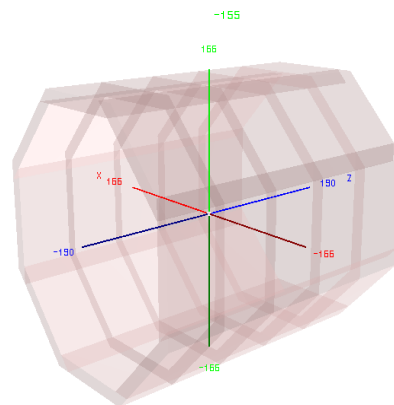
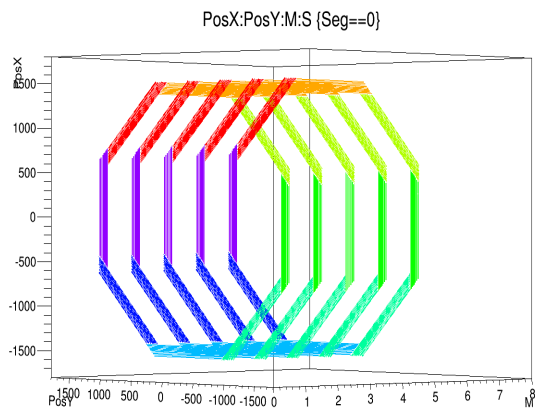
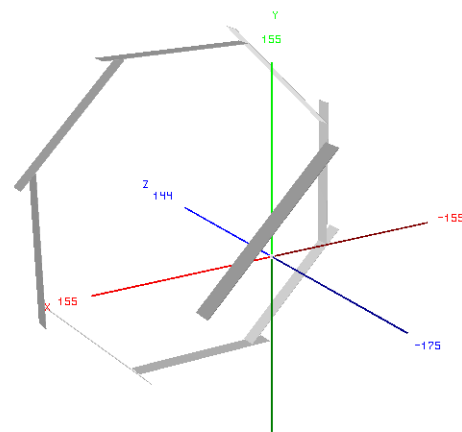
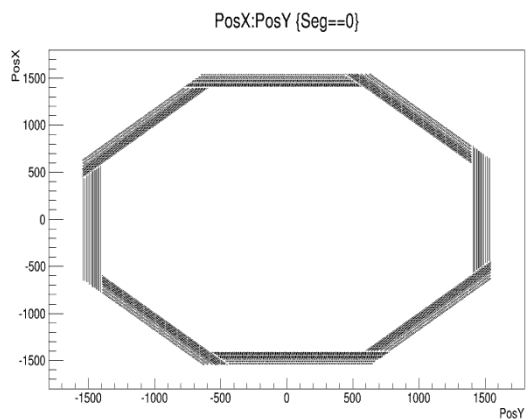
# Hitmap

- Check Geometry comparing with Druid (SIT)



# Hitmap

- Check Geometry comparing with Druid (Ecal)



# Usage of Druid : two types of file

- Geometry display (*GDML/xml file*)

```
[ihp@localhost Geo]$ ls
GearOutput.xml  Geo ild o2 v06.macro      World.gdml
Geo.C          ild_o2_v06_TPC1365.root
[ih@localhost Geo]$ pwd
/home/ihep/hitmap/mokka/Geo
[ih@localhost Geo]$
```

GDML/XML File (Gear) containing geometry used for simulation

- Event display (*LCIO file*)

Do you remember them?

```
[ihp@localhost slcio]$ ls
ild_o2_v06.slcio  MLSteer/
[ih@localhost slcio]$ pwd
/home/ihep/hitmap/marlin/slcio
[ih@localhost slcio]$
```

LCIO file containing MCParticles and Hits in the Subdetectors

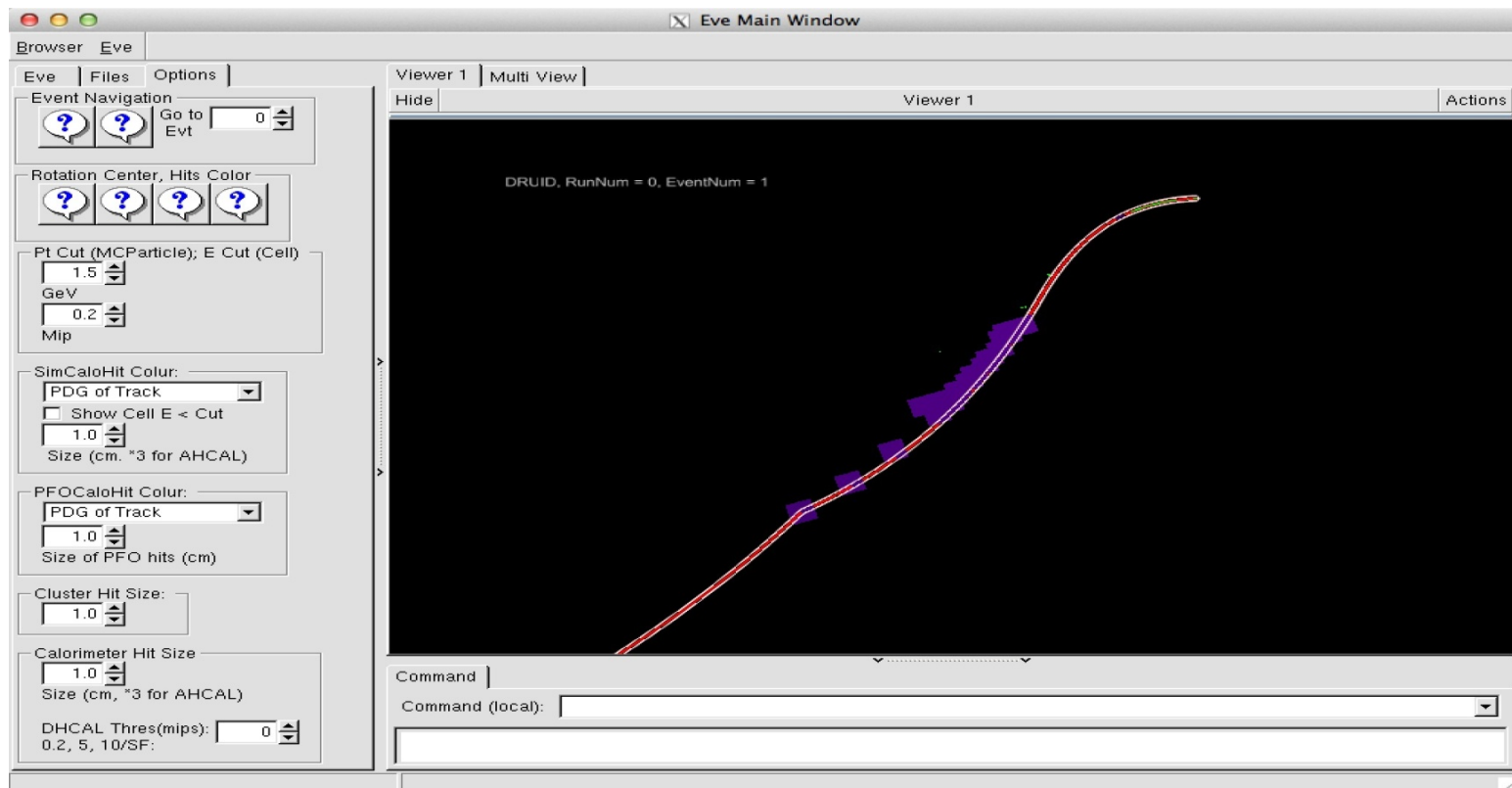
```
[ihp@localhost druid]$ pwd
/home/ihep/hitmap/druid
[ih@localhost druid]$ ls
backup/ ild_o2_v06.slcio ild_o2_v06_TPC1365.root
[ih@localhost druid]$
```

Copy them into the same Table of Contents

# Display events in slcio file

- Druid \*.slcio

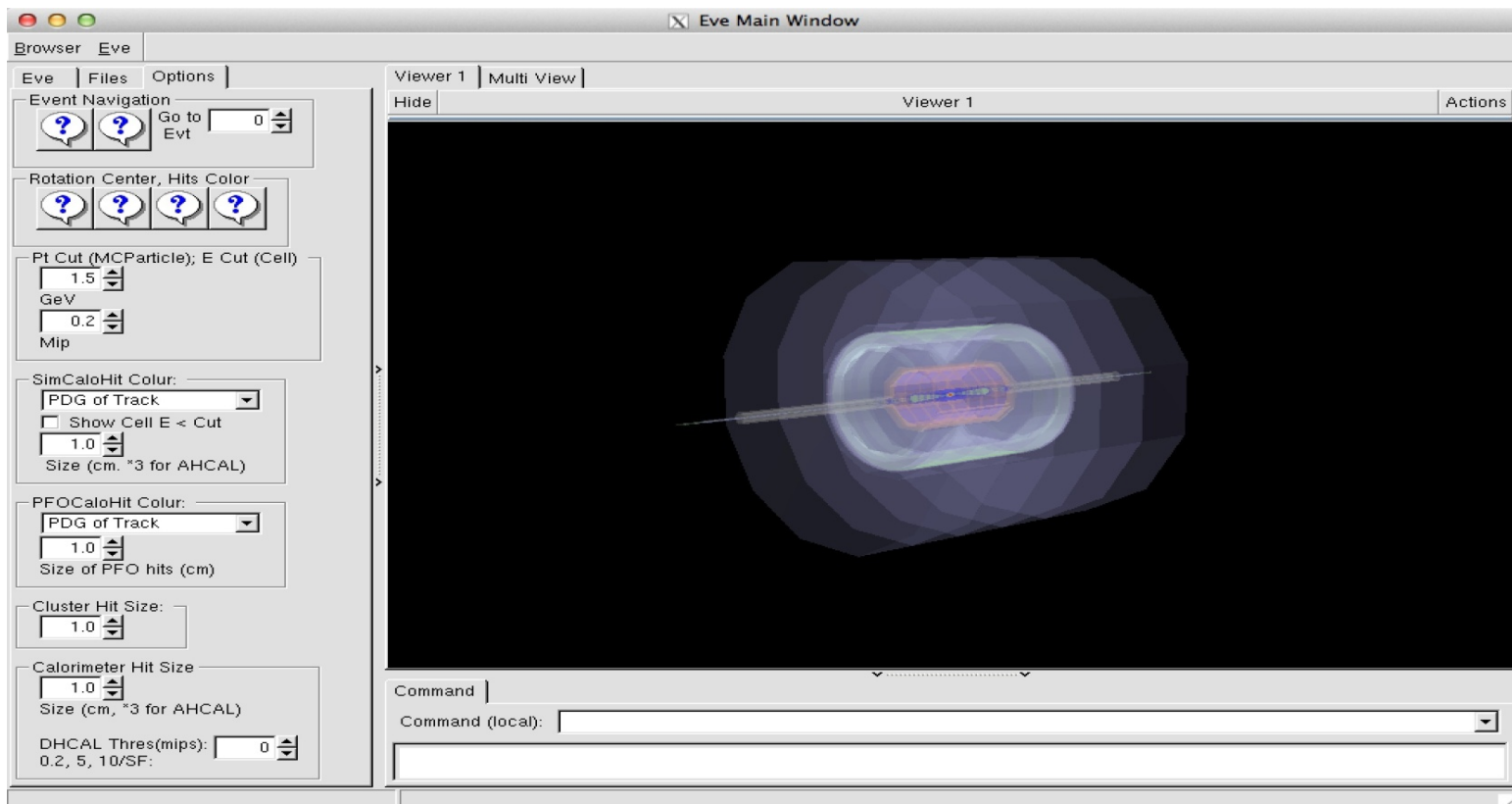
```
[ihp@localhost druid]$ Druid_ild_o2_v06.slcio
```



# Display detector geometry

- Druid \*.gdml.root

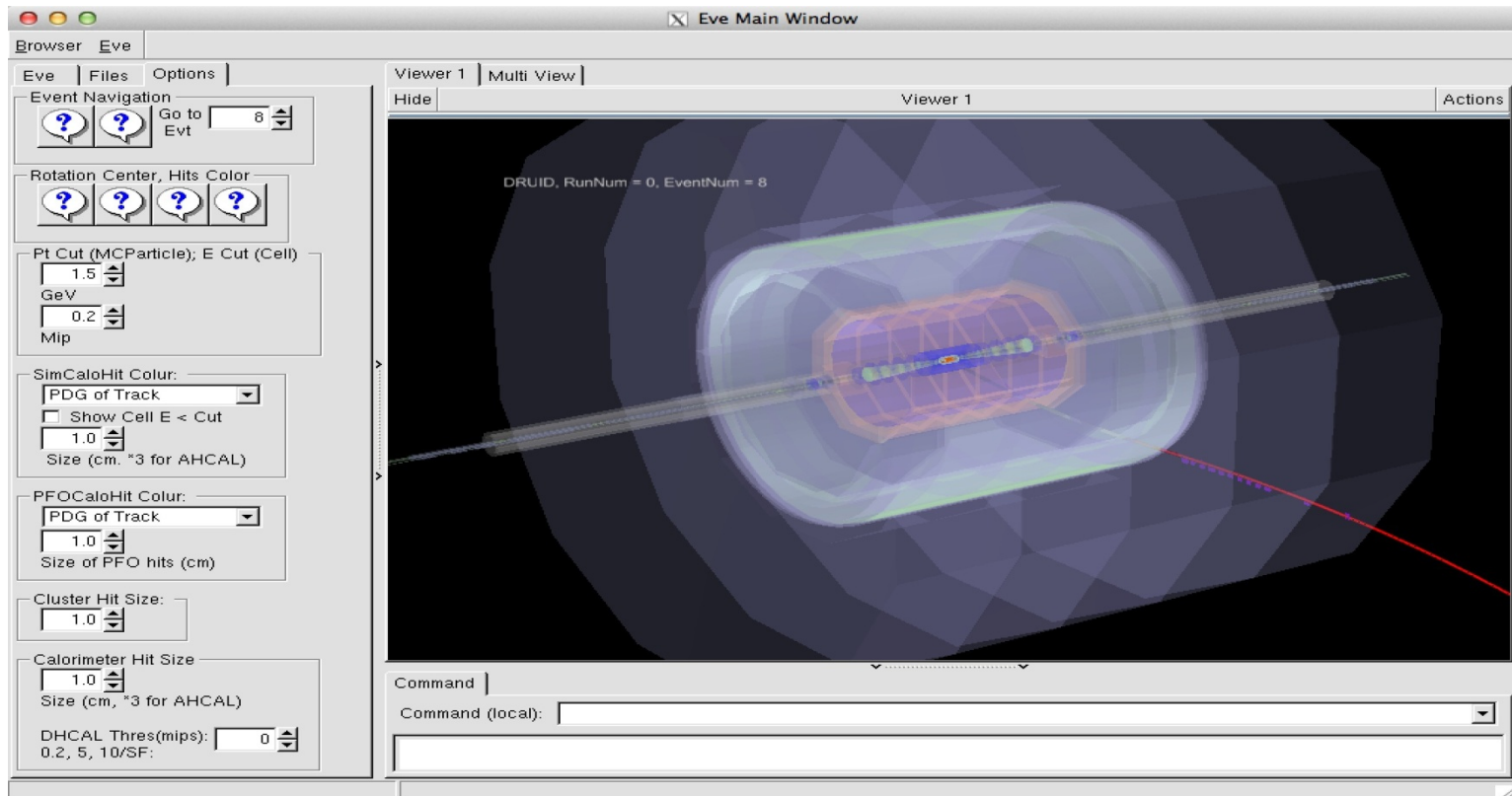
```
[ihep@localhost druid]$ Druid_ild_o2_v06_TPC1365.root
```



# Events & geometry

- Druid \*.slcio \*.gdml.root

```
[ihep@localhost druid]$ Druid ild_o2_v06.slcio ild_o2_v06_TPC1365.root
```





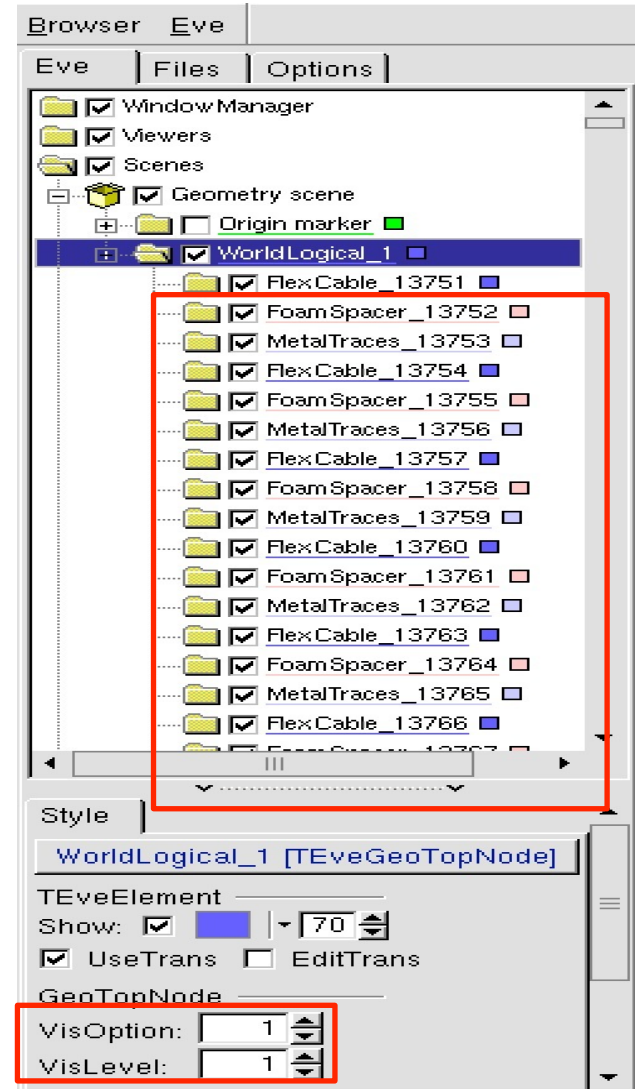
# Usage of Druid

- GDMML Geometry browser

Tunable transparency, color, bkgrd, mount/unmount sub detectors...

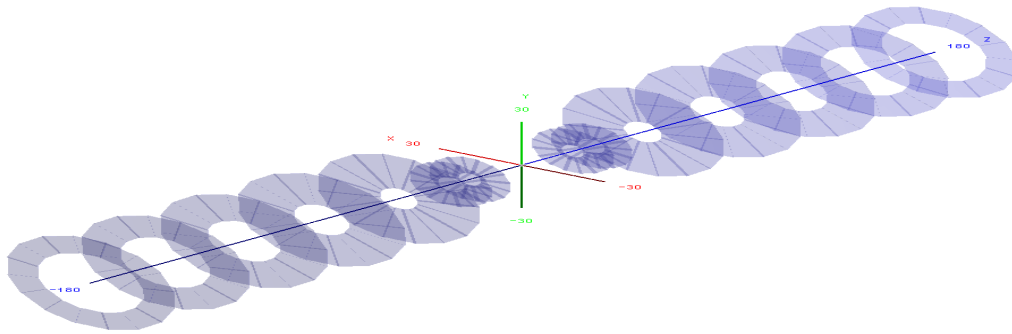
- Display depth

Hierarchy of geometrical volume in gdml file. Higher Depth = More detailed information

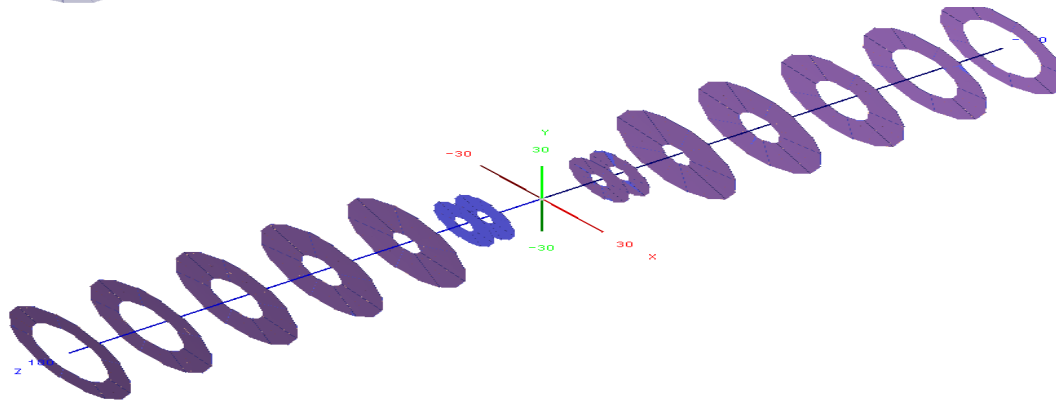


# Usage of Druid

- Examples(FTD)



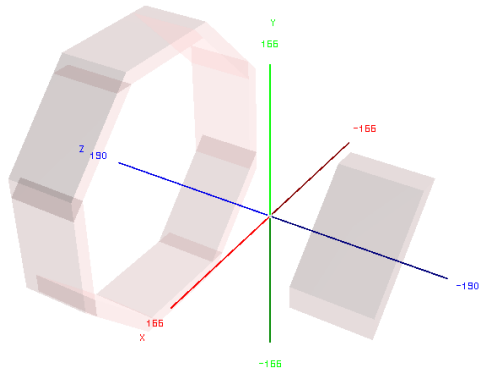
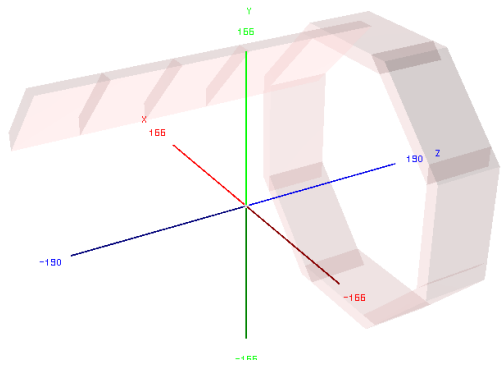
VisLevel = 2



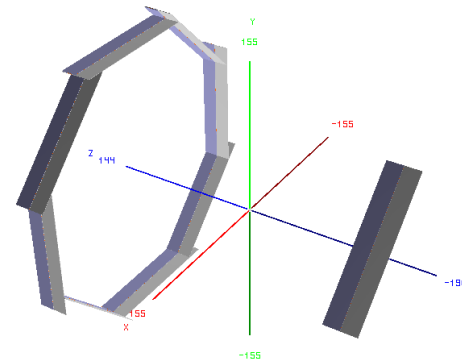
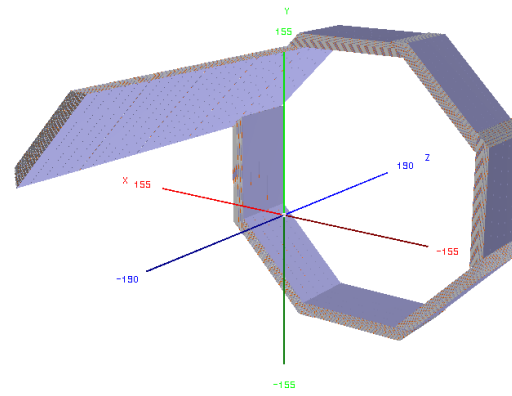
VisLevel = 3

# Usage of Druid

- Example (EcalBarrel)



VisLevel = 1



VisLevel = 3

# Summary

- Mokka: Geant4 Full Simulation
- Marlin: data manger
- Validation of Modified Geometry by Hitmap
- Druid: Display root module used for ILC Detectors

The **validation** of detector geometry for the **CEPC** Physics Analysis by **Hitmap& Druid** is feasible and successful !

# Important Executable

- LCIO: dumpevent, anajob
- Mokka: sh ./ild\_o2\_v06.sh
- Marlin:
  1. Usage:
    - . loadLDD.sh
    - Marlin MIP\_ild\_o2\_06\_TPC1365.steer
  2. Compile:
    - Cmake: Hfcmake = cmake -C ILCSoft.cmake
    - Make install
- Druid: Druid \*.slcio \*gdml.root

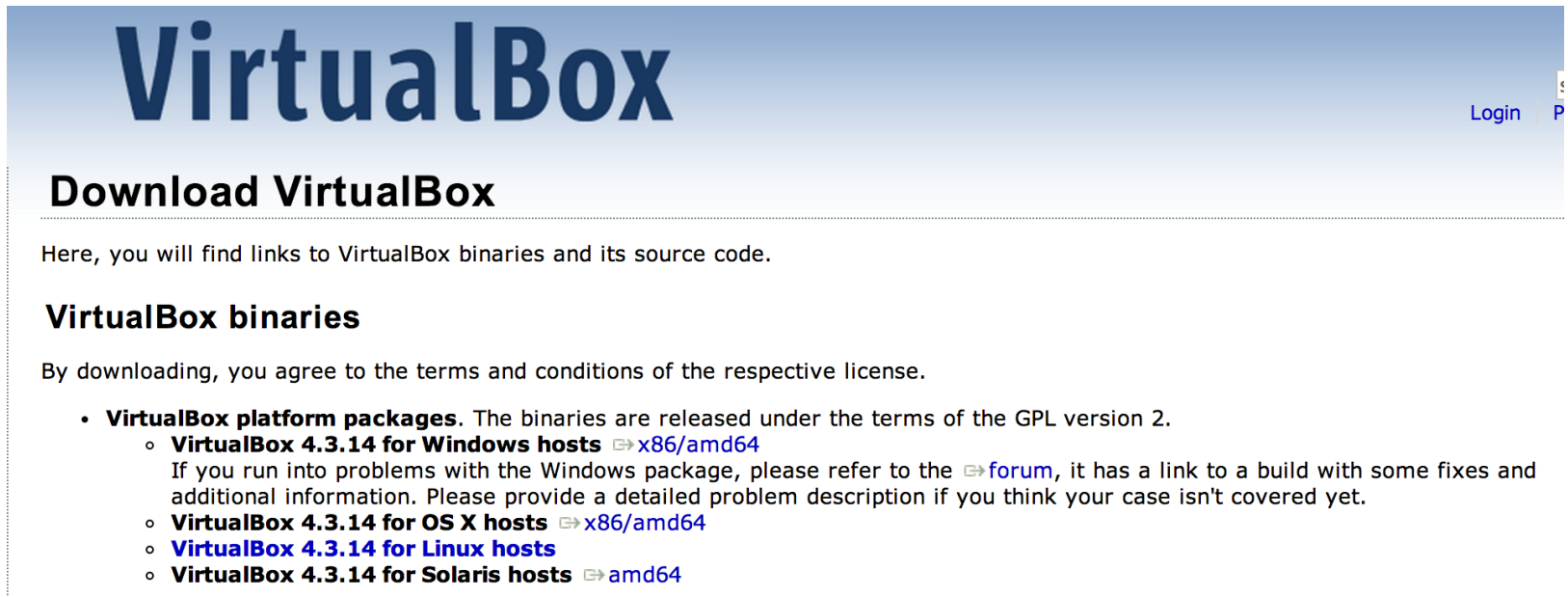
# Thanks

Backup

# Download VirtualBox

- According your systems, choose different VirtualBoxes from Website (**Version 4.2.14**)

<https://www.virtualbox.org/wiki/Downloads>



The screenshot shows the VirtualBox website's download page. At the top, the word "VirtualBox" is written in a large, dark blue font. To the right of the header, there are links for "Login" and "P...". Below the header, the page title "Download VirtualBox" is displayed in a bold, black font. A horizontal dotted line separates the title from the main content. The main content begins with the text "Here, you will find links to VirtualBox binaries and its source code." followed by the sub-section "VirtualBox binaries". Below this, a paragraph states "By downloading, you agree to the terms and conditions of the respective license." and a bulleted list of download links for various operating systems: Windows hosts (x86/amd64), OS X hosts (x86/amd64), Linux hosts, and Solaris hosts (amd64). Each link includes a small icon of a document.

## VirtualBox

Login P

### Download VirtualBox

Here, you will find links to VirtualBox binaries and its source code.

#### VirtualBox binaries

By downloading, you agree to the terms and conditions of the respective license.

- **VirtualBox platform packages.** The binaries are released under the terms of the GPL version 2.
  - **VirtualBox 4.3.14 for Windows hosts** ⇨ x86/amd64  
If you run into problems with the Windows package, please refer to the ⇨ [forum](#), it has a link to a build with some fixes and additional information. Please provide a detailed problem description if you think your case isn't covered yet.
  - **VirtualBox 4.3.14 for OS X hosts** ⇨ x86/amd64
  - **VirtualBox 4.3.14 for Linux hosts**
  - **VirtualBox 4.3.14 for Solaris hosts** ⇨ amd64



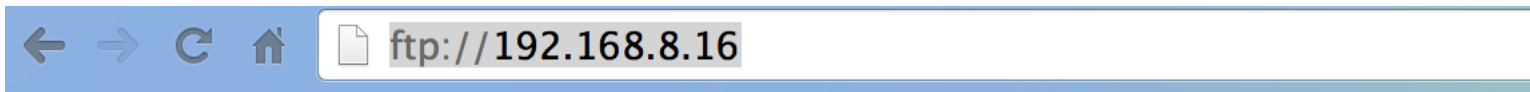
# Download image file

- From website





1. Account: cepec

<ftp://192.168.8.16/>

2. Password: cepec



## / 的索引

姓名	大小	修改日期
 VirtualBox-4.3.14-95030-OSX.dmg	116 MB	14-8-10 下午4:29:00
 VirtualBox-4.3.14-95030-Win.exe	111 MB	14-8-10 下午4:30:00
 cepec.vdi	12.1 GB	14-8-10 下午3:41:00
 cepec.vdi.zip	3.0 GB	14-8-11 上午12:08:00

# Install Virtual Box

- Linux/Windows/OS X.....
- Double click to Install VirtualBox application
- Follow the steps to install VirtualBox
- After installation, click VirtualBox Flag, you can see.....

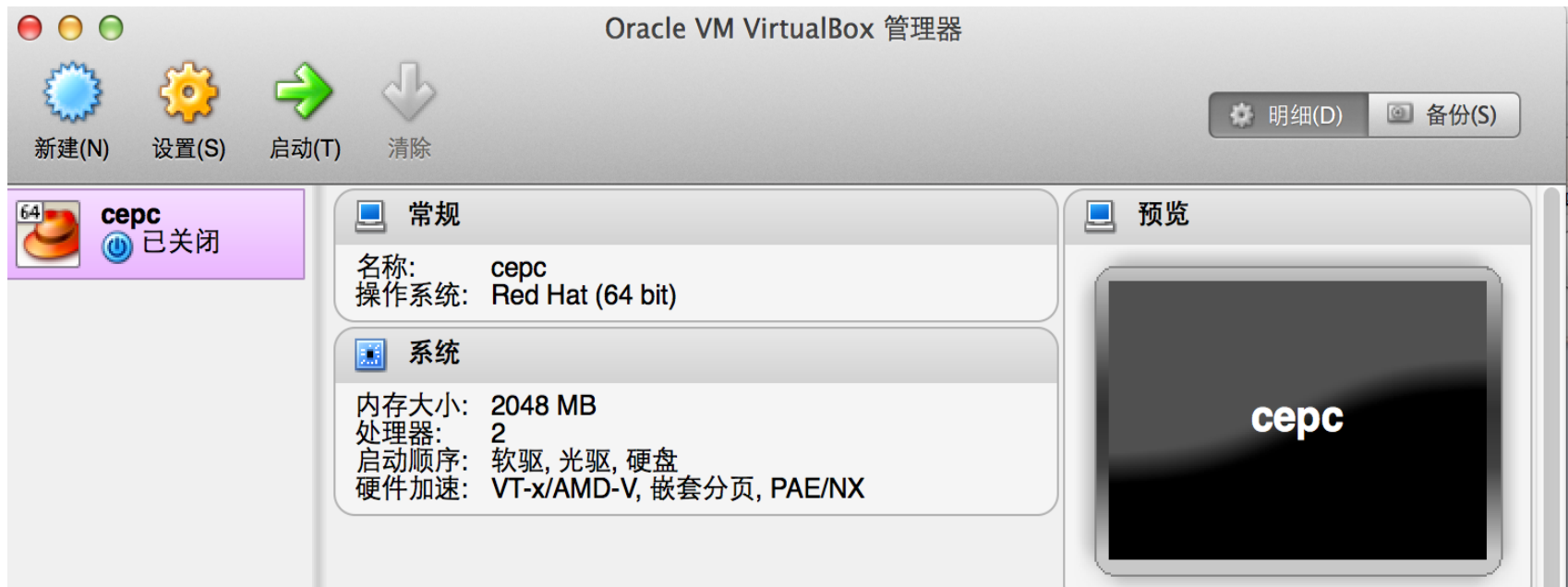


# Download image file

- From Nankai local PC
- ssh [root@10.0.1.10](ssh://root@10.0.1.10)
- Password: **cepctraining**
- scp [root@10.0.1.10:/home/root/cepc.vdi.zip](scp://root@10.0.1.10:/home/root/cepc.vdi.zip) .
- Password: **cepctraining**
- tar -zxvf cepc.vdi.zip

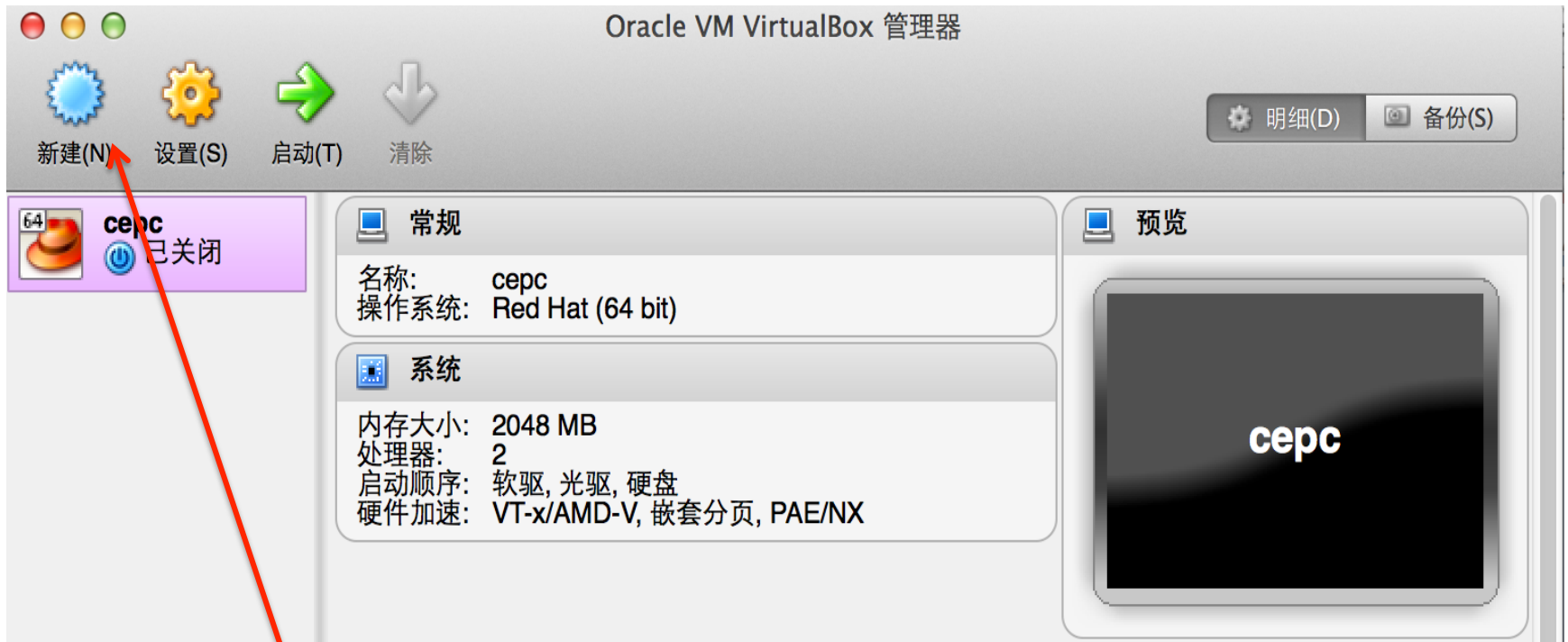
# For Linux users especially

- After installation, open the **Terminal** and type **virtualbox**
- You can also see.....



# Put ihep.vdi into VBox

- Open the Virtual Box



Click to build new Virtual machine

# Set up Configuration

- Name, system and version



# Choose RAM

- RAM (**more than 1024MB**)



# Add virtual hard disk

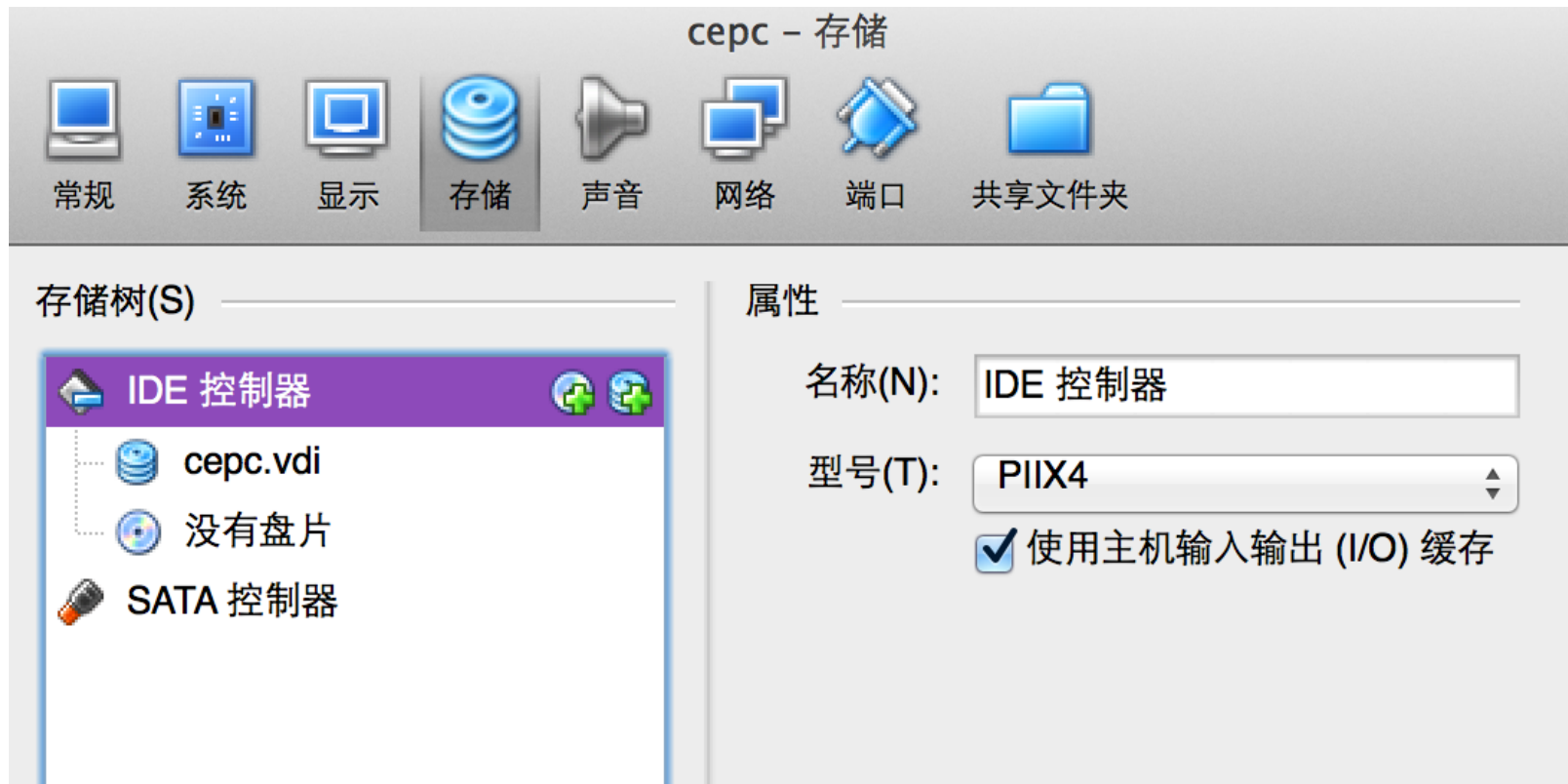
- Add cepc.vdi here





# Especially IDE Controller

- Move cepc.vdi from **SATA** to **IDE** Controller



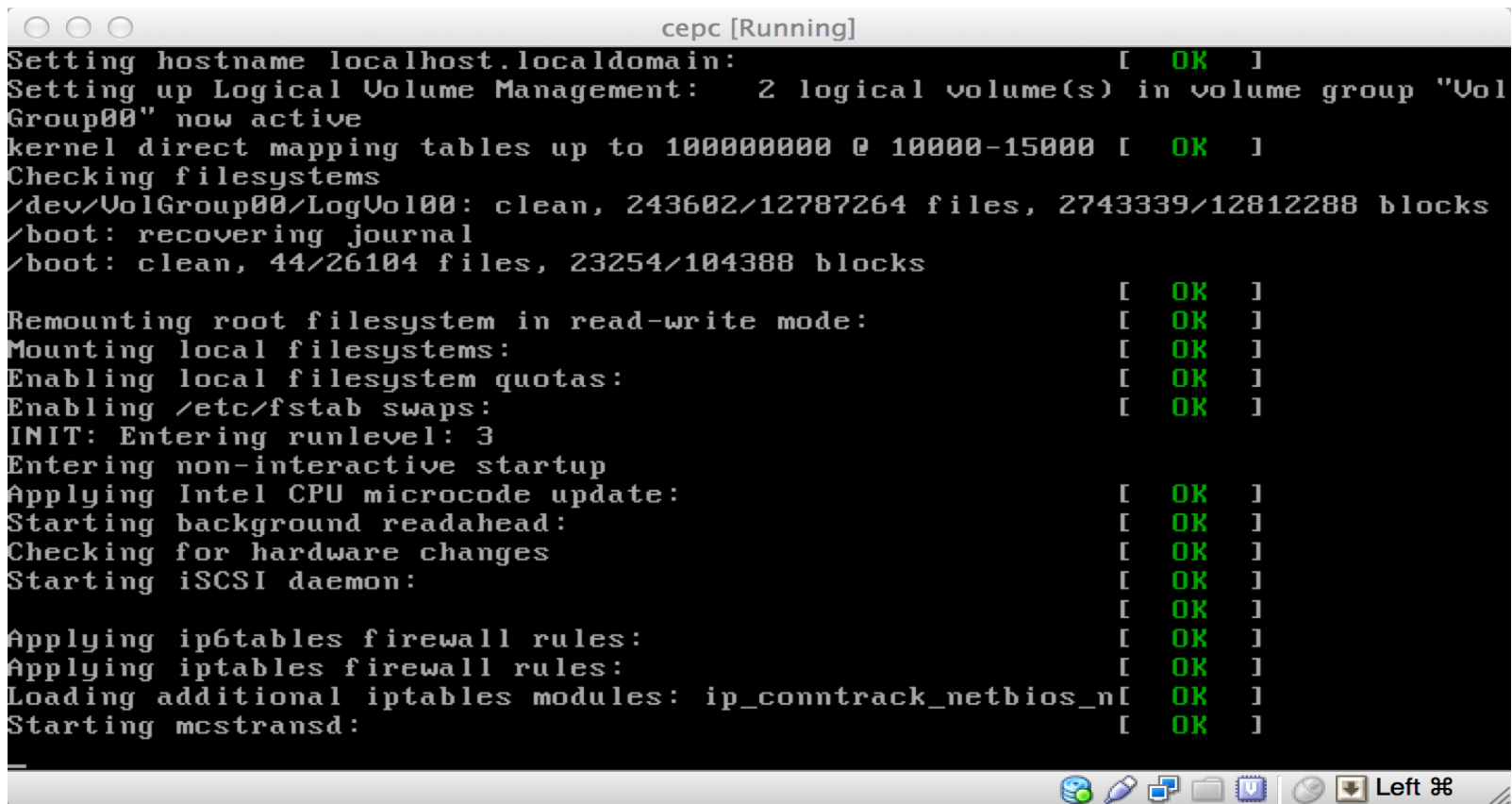
# Start

- Start up



# Start

- Wait munitus

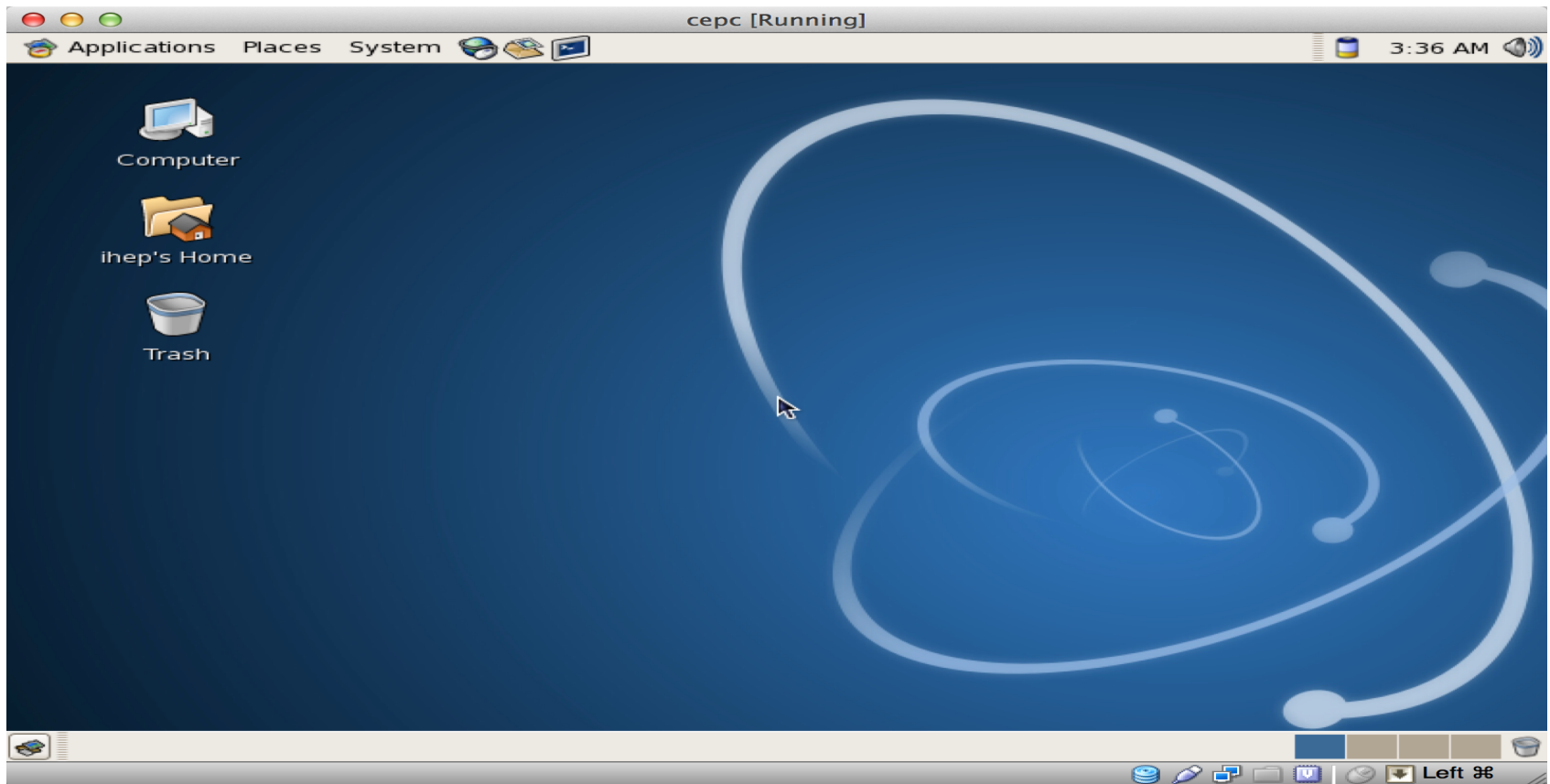


```
cepc [Running]
Setting hostname localhost.localdomain: [ OK ]
Setting up Logical Volume Management: 2 logical volume(s) in volume group "Vol
Group00" now active
kernel direct mapping tables up to 100000000 @ 10000-15000 [ OK ]
Checking filesystems
/dev/VolGroup00/LogVol00: clean, 243602/12787264 files, 2743339/12812288 blocks
/boot: recovering journal
/boot: clean, 44/26104 files, 23254/104388 blocks

Remounting root filesystem in read-write mode: [ OK ]
Mounting local filesystems: [ OK ]
Enabling local filesystem quotas: [ OK ]
Enabling /etc/fstab swaps: [ OK ]
INIT: Entering runlevel: 3
Entering non-interactive startup
Applying Intel CPU microcode update: [ OK ]
Starting background readahead: [ OK ]
Checking for hardware changes [ OK ]
Starting iSCSI daemon: [ OK ]
[ OK ]
Applying iptables firewall rules: [ OK ]
Applying iptables firewall rules: [ OK ]
Loading additional iptables modules: ip_conntrack_netbios_n[ OK ]
Starting mcstransd: [ OK ]
```

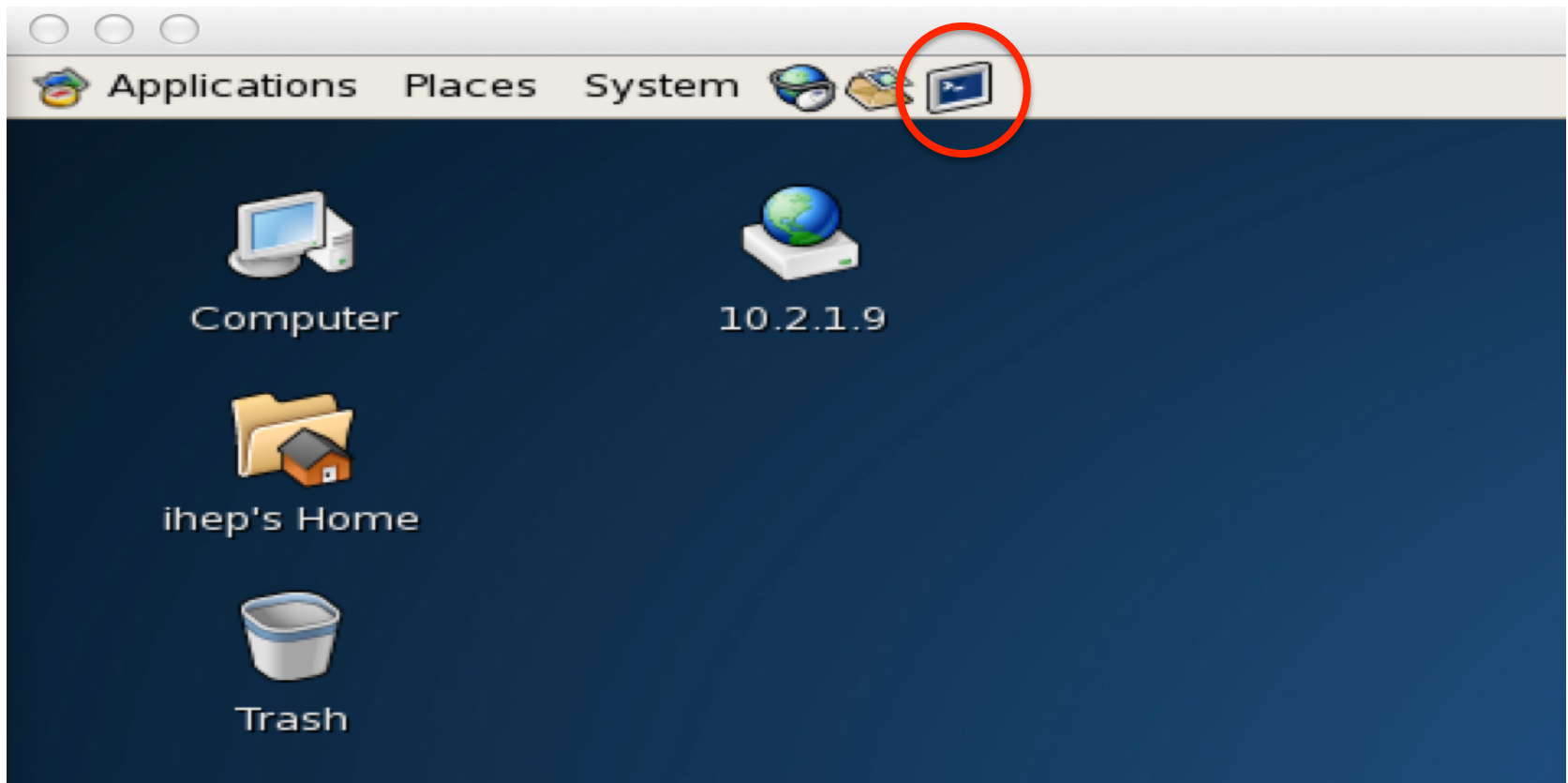
# Open the Visual interface

- Graphical User Interface



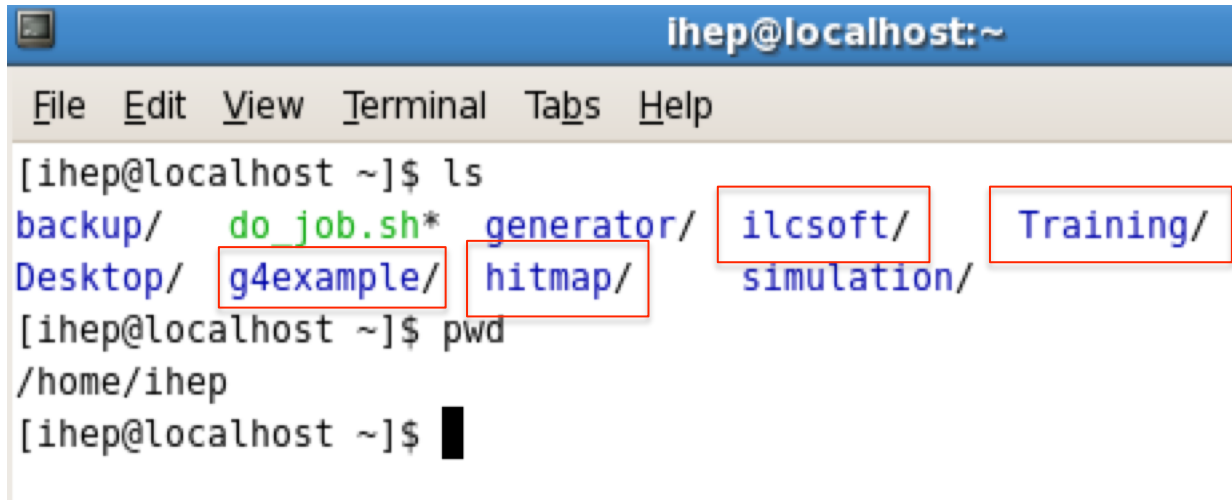
# Open Terminal

- Click here



# Work Directory

- Ihep directory



```
ihep@localhost:~  
File Edit View Terminal Tabs Help  
[ihep@localhost ~]$ ls  
backup/  do_job.sh*  generator/  ilcsoft/  Training/  
Desktop/  g4example/  hitmap/    simulation/  
[ihep@localhost ~]$ pwd  
/home/ihep  
[ihep@localhost ~]$
```