LDC Tracking Package
User's Manual

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1.Introduction

The ambitious physics program at the ILC sets stringent requirements on the detector. For the tracking system this means:

- excellent momentum resolution $\delta(1/p_t) \leqslant 5 \cdot 10^{-5}$
- very good flavour tagging capability; the vertex detector must measure impact parameter of tracks with resolution $\delta(IP)=5\mu m \oplus 10\mu m/p \cdot sin^{3/2}\theta$;
- efficient reconstruction of tracks in the dense jets, characterised by high local multiplicities of charge particles;
- full reconstruction of low p_t loopers, enabling precise extrapolation of tracks to the endcap calorimeters with subsequebt linkage of tracks with calorimeter clusters;
- efficient track reconstruction and unambigous determination of charge at very small polar angles.

Several detector concepts have emerged as a result of intensive R&D program for the ILC detector. This write-up describes the tracking software designed within the framework of the Large Detector Concept (LDC). The LDC Tracking system consists of the following components:

1) microvertex pixel detector surrounds the primary interaction point; detector has 5 coaxial Si layers, positioned at the distances between 1.55 mm (innermost layer) and 6.0 mm (outermost layer) away from the beam axis.
2) intermediate Si Tracker (SIT) has two layers at distances 160 and 300 mm away from the beam axis; strip-wise readout is foreseen for this detector; SIT serves as a bridge between VTX and TPC
3) large volum Time Projection Chamber represents the main component of the LDC Tracking system; it has inner radius of about
4) Forward Si tracking discs (FTD' s) cover the angular range from and ensure good track reconstruction in the forward/backward region; in the beaseline LDC detector design this the forward tracking detector consists of 7 discs in both semispheres, placed at distances between 200 and 1300 mm from the geometrical center; the three innermost discs on both sides will be instrumented with hybrid pixels, while for the remaining discs the strip readout is planned

The acceptance of various components is shown in Fig.1.

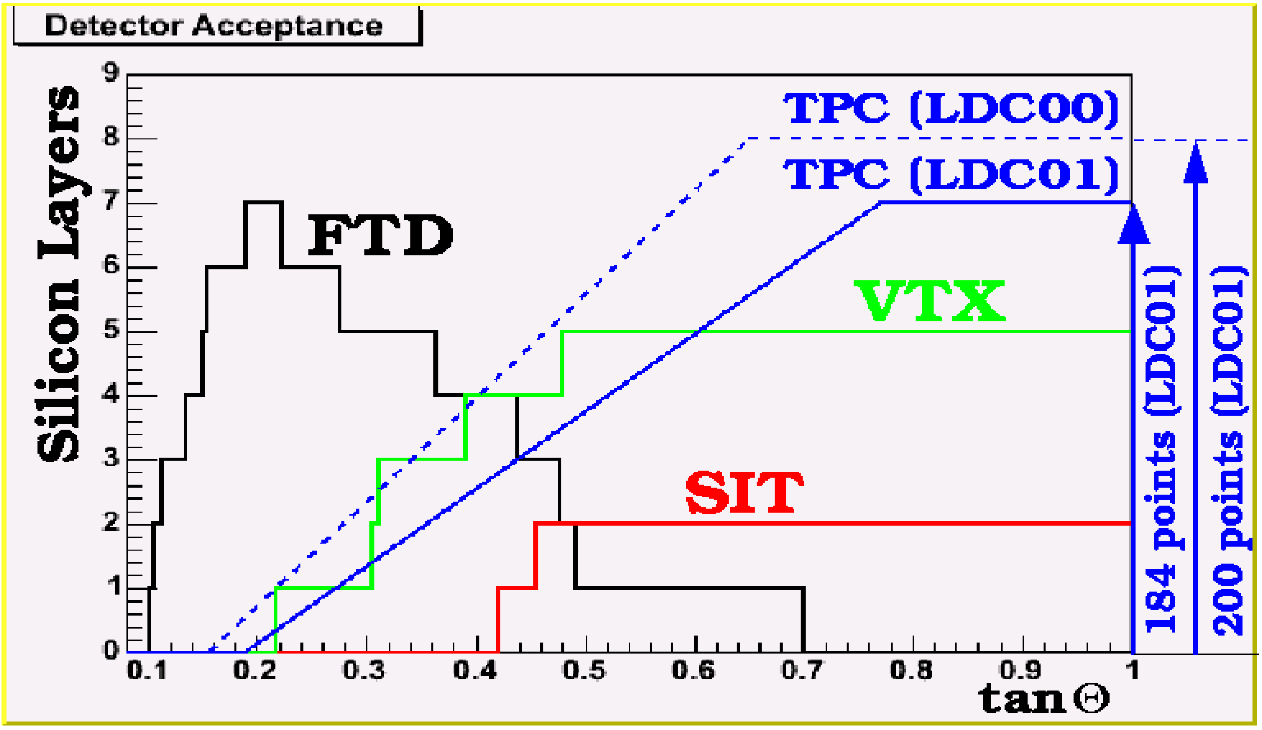

Figure 1Acceptance of various components of the LDC Tracking system

The LDC Tracking software, described in this write-up, is the part of the MarlinReco package. It represents a collection of Marlin processors, performing digitization of the Simulated Tracker Hits (LCIO objects SimTrackerHits), produced by the detector simulation run, pattern recognition in various tracking subdetectors, linkage of track segments found in the different subdetectors and track fitting.

2.Installation

2.1Getting package

As the part of the MarlinReco the LDC tracking package can be fetched from the Zeuthen CVS Repository for the ILC Software. In your working directory you should issue the following commands:

```
>    export CVS_RSH=ccvssh
>    export CVSROOT=:ext:anonymous@cvssrv.ifh.de:/marlinreco
>    cvs co MarlinReco
>    cvs co MarlinUtil
```

2.2Requirements

The LDC Tracking software as well as the entire MarlinReco package depends on the following libraries: CLHEP (version 1.8 or higher), GNU Scientific Library (version 1.6 or higher), GEAR (version 00-05 or higher) and CERNLIB. Make sure, that these packages are installed on your computer before setting up and running MarlinReco.

2.3 Building Libraries and Executable

Once packages MarlinReco and MarlinUtil are checked out from CVS, you should properly modify script, setting up environment variables, indicating paths to the libraries outlined above. Example of this script is given below:

```
#######################################################
#
# Example script, setting up environment variables
#
#  24/11/2005
#  A.Raspereza, MPI
#######################################################

export ROOTSYS=/remote/pcilc2/ILC/ROOT/v4.00-08

if [ $MARLIN ] ; then
 export MARLIN
else
 export MARLIN=$PWD
fi

echo "  MARLIN set to:" $MARLIN

# modify the following pathes as needed  ---->

# path to LCIO is required
#export LCIO=/remote/pcilc2/ILC/LCIO/v01-06
#export LCIO=/afs/desy.de/group/it/ilcsoft/lcio/v01-07
export LCIO=/remote/pcilc2/ILC/LCIO/v01-07
export PATH=$LCIO/bin:$PATH

#-- comment out for production
export MARLINDEBUG=1

# the following is optional (but recommended) comment
# out before compiling what you don't need/want
#---- CLHEP ---------
export CLHEP=/remote/pcilc2/ILC/CLHEP-1.9.2.1/build

#---- LCCD -----------
# use LCCD for conditions data (ConditionsProcessor)
#export LCCD=/afs/desy.de/group/it/ilcsoft/lccd/v00-01
# to make full use of LCCD also use the conditions data base
# Note: if you don't want to use CondDBMySQL you also
# need a LCCD library that
# has been build without CondDBMySQL !
#export CondDBMySQL=/afs/desy.de/group/it/ilcsoft/CondDBMySQL
#export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$CondDBMySQL/lib

#---- GEAR ---------------
export GEAR=/remote/pcilc2/ILC/gear/v00-05

#---- AIDA setup ---------
#--- fixes a bug in aida_env.sh with zsh
#    (provided by J.Samson) :
setopt shwordsplit > /dev/null 2>&1
export MARLIN_USE_AIDA=0
unset MARLIN_USE_AIDA

# modify the following pathes as needed
export JDK_HOME=/usr/local/java
export JAIDA_HOME=/remote/pcilc2/ILC/JAIDA/3.2.3
export AIDAJNI_HOME=/remote/pcilc2/ILC/AIDAJNI/3.2.3
. $JAIDA_HOME/bin/aida-setup.sh
. $AIDAJNI_HOME/bin/Linux-g++/aidajni-setup.sh
#-------------------------------------------

export LD_LIBRARY_PATH=${ROOTSYS}/lib/root:$LD_LIBRARY_PATH
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/remote/pcilc2
/ILC/gsl -1.6/lib
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$CLHEP/lib
```

```
#path to LCIO
export PATH=$LCIO/bin:$PATH
# path to ROOT installation
export PATH=${ROOTSYS}/bin:$PATH
# path to doxygen
export PATH=/remote/pcilc2/ILC/doxygen/bin:$PATH
export PATH=$LCIO/bin:$PATH
```

All libraries and Marlin executable are created by gmake utility. In your working directory type:

```
> gmake
```

2.4 Building doxygen documentation

A user can create doxygen documentation of the entire MarlinReco and MarlinUtil packages by perfoming command

```
> gmake doc
```

3. Structure of the Package

The LDC tracking software includes:

1) processors performing digitization of the signal in various tracking subdetectors;
2) processors implementing pattern recognition in the TPC and Silicon detectors;
3) track fitting based on the Kalman filter approach;
4) utility classes, extending functionality of native LCIO classes : Track and TrackerHit;
5) utility classes, facilitating fast and efficient pattern recognition
6) class MarlinTrackFit, providing and interface to the FORTRAN based DELPHI code;
7) FORTRAN code from DELPHI, which performs pattern recognition in the TPC; the interface of FORTRAN code to the MarlinReco package is realised in the form of C++ wrappers.

3.1 Digitization Processors

Digitization of the SimTrackerHits, produced by the detector simulation run, is performed in two different ways. The first approach is based on the Gaussian smearing of the SimTrackerHits according to a-priori known and specified spatial point resolutions. This approach is implemented in the Marlrin Processors `VTXDigiProcessor`, `FTDDigiProcessor` and `TPCDigiProcessor`. The module `VTXDigiProcessor` performs digitization of SimTrackerHits in the vertex detector and SIT, `FTDDigiProcessor` – in the forward tracking discs and `TPCDigiProcessor` – in TPC. All processors require SimTrackerHit collection names as an input parameters. The `VTXDigiProcessor` treats VTX and SIT as cyllindrical detectors. The two spatial point resolutions, one in the *r-*ϕ projection, another – along z should be provided by user as a Processor parameter. `FTDDigiProcessor` treats forward tracking discs as a rigid measurement planes at fixed positions in *z*. It is assumed that the hit position in the FTD' is measured "isotropically", thus an user has to provide only spatial point resolution in the r-ϕ projection. The TPC spatial resolution in *r-*ϕ is given by:

$$\sigma_{r\text{-}\phi}=\sigma_0\oplus D\cdot L_{DRIFT}$$

where σ_0 is the constant term, *D* is the diffusion coefficient, L_{DRIFT} is the drift length. Resolution along z, σ_z, is assumed to be independent of L_{DRIFT}. Parameters σ_0, *D* and σ_z *are*are specified in the TPC section of the GEAR steering (see Section).

For the DEPFET-based microvertex detector, a detailed digitization procedure is implemented in the Marlin processor VTXDigitizer. The procedure takes into account Lorentz effect, charge diffusion, electronic noise and energy loss fluctuations along charge particle path within sensitive silicon layer.

All digitization processors produce as an output collections of digitized TrackerHit. Each TrackerHit is attributed a 3D position and covariance matrix of the hit measurement. The covariant matrix of the hit position measurement is then used in the track fitting procedure.

3.2MaterialDB Processor – Material database builder

The Processor MaterialDB builds and keeps in RAM the information of the matreial volumes and their properties during the code execution time. This information is used in the track fitting procedure implemented in the DELPHI code. Geometry of the subdetectors and material properties, defined in terms of radiation lenghts and specific ioinization losses, are read in through the GEAR steering file. The processor does not require input LCIO collections and produces no output collections. The module belongs to the SiliconTracking subpackage and resides in the directory MarlinReco/Tracking/SiliconTracking.

3.3Pattern Recognition in TPC

Pattern recognition in the TPC is done using C++ wrappers of the LEP code. The main Marlin module is `LEPTrackingProcessor`, which invokes FORTRAN routines, which perform inward search for spatially continuous sequences of hits, compatible with the helix hypothesis, and fitting of these sequences. The LEP code is capable of finding only semiloops of the tracks. As a consequence, the low loopers are splitted into several segments, which are then identified and merged by the `FullLDCTracking` processor, described below. The `LEPTrackingProcessor` requires as an input LCIO collection of the TPC TrackerHits and produces LCIO collection of TPC tracks and track-MCParticle relations. To prevent the code from reconstruction of extremly low p_t loopers, leaving continuous in time signal on one or few neighboring TPC pads, the module `CurlKillerProcessor` is designed. Both `LEPTrackingProcessor` and `CurlKillerProcessor` belong to the BrahmsTracking subpackage and reside in the CVS directory MarlinReco/Tracking/BrahmsTracking. All FORTRAN routines, invoked by `LEPTrackingProcessor`, reside in the Zeuthen CVS directory MarlinReco/Tracking/BrahmsTracking/f77.

3.4Pattern Recognition in the Silicon Detectors

Combined pattern recognition in all silicon tracking devices (VTX, FTD and SIT) is implemented in the MarlinProcessor `SiliconTracking`, belonging to the SiliconTracking subpackage. The code resides in the directory MarlinReco/Tracking/SiliconTracking. The procedure starts with the search for hit triplets in the outermost layers of the combined VTX-SIT tracking system and in FTDOnce such a triplets are found, an inward extrapolation of the track candidates is performed and additional hits in the inner layers of VTX and FTD are assigned to the track candidates. A special procedure is implemented for the transition region in polar angle between VTX and FTD, where hit triplets, having 2+1 or 1+2 patterns (2 hits in VTX and 1 in FTD or 1 hit in VTX and 2 hits in FTD), are searched for. The SiliconTracking processor requires as an input collections of VTX, FTD and SIT TrackerHits and produces the collections of Silicon Tracks and track-MCParticle relations.

3.5Association of the Silicon and TPC track segments. Full LDC Tracking.

The final step of the track reconstruction in the LDC detector is association of track segments found in TPC and silicon detectors, merging splitted loopers in TPC and assignment yet non-assigned hits to already found tracks. All this is done by the `FullLDCTrackingProcessor`, which is the part of the FullLDCTracking subpackage. The `FullLDCTracking` requires as an input collections of VTX, FTD, SIT and TPC TrackerHits, collections of Silicon and TPC tracks. Optionally collections of TPC/Silicon track to MCParticle relations can be provided to facilitate some debugging printout statements.

3.6TrackCheater Processor

The `TrackCheater` processor is designed to construct true Monte Carlo tracks from the hits attributable to the same Monte Carlo particles. Thus, this processor just emulates perfect pattern recognition. An user can optionally determine track parameters, using generated values of the 4-momentum of charged particles or perform a fit of cheated tracks. The `TrackCheater` processor requires as an input collections of TrackerHits in various subdetectors and produces collections of true Monte Carlo tracks and track-MCParticle relations.

3.7MarlinTrackFit – Track fit Utilility

Interface to the DELPHI FORTRAN code, performing track fitting, is implemented in the class MarlinTrackFit. The fit is performed by invoking DoFitting method of this class. The routine is fed with the array of hit positions and covariance matricies, hit identifiers, encoding information about the detector, where they were produced, and returns fitted track parameters with the corresponding covariance matricies.

3.8Utility classes, extending native LCIO classes and implementing numerical operations with helicies

The classes `TrackerHitExtended`, `TrackExtended`, `TrackHitPair` and `GroupTracks` have been designed to extend functionality of the native LCIO classes. Additional cross relations between TrackerHits and Tracks and among Tracks, as well as new member functions and member data are needed to facilitate fast and robust tracking procedure. All this is implemented in classes mentioned above. Furthermore, classes `HelixClass` and `ClusterShapes` have been developed, which allow for manipulation of helicies and track fitting of track candidates, using simple helix hypothesis. For a detailed information about these utility classes, refer to the relevant `doxygen` documentation.

4.Running Tracking Code

The code is run by issuing command Marlin followed by the name of Marlin steering file:

> Marlin *{your_marlin_steering}*

The example Marlin and GEAR steerings are given below:

```
<!--################################################-->
<!--#                                             #-->
<!--#      Example steering file to run           #-->
<!--#          TrackCheater Processor             #-->
```

```
<!--# Author : A.Raspereza (MPI-Munich) 31/07/2007 #-->
<!--#                                              #-->
<!--################################################-->

<marlin>

 <execute>
   <processor name="MyMaterialDB"/>
   <processor name="MyTPCDigiProcessor"/>
   <processor name="MyVTXDigiProcessor"/>
   <processor name="MyFTDDigiProcessor"/>
   <processor name="MyTrackCheater"/>
 </execute>

 <global>
  <parameter name="LCIOInputFiles"> ZHllX_350.slcio </parameter>
  <parameter name="GearXMLFile"> gear_ldc01_tracking.xml </parameter>
  <parameter name="MaxRecordNumber" value="11" />
  <parameter name="SupressCheck" value="false" />
  <parameter name="BField"> 4.0 </parameter>
 </global>

 <processor name="MyMaterialDB" type="MaterialDB">
 <!--Material DB builder...-->
  <!--Use Extrapolations in Fit-->
  <parameter name="UseExtrapolations" type="int">1 </parameter>
  <!--Use material database-->
  <parameter name="UseMaterials" type="int">1 </parameter>
 </processor>

 <processor name="MyTPCDigiProcessor" type="TPCDigiProcessor">
 <!--Produces TPC TrackerHit collection from SimTrackerHit collection, smeared in RPhi and Z-->
  <!--Name of the SimTrackerHit collection-->
  <parameter name="CollectionName" type="string" lcioInType="SimTrackerHit">STpc01_TPC </parameter>
  <!--Name of the digitized TrackerHit collection-->
      <parameter   name="TPCTrackerHitsCol"   type="string"   lcioOutType="TrackerHit">TPCTrackerHits
</parameter>
 </processor>

 <processor name="MyVTXDigiProcessor" type="VTXDigiProcessor">
 <!--VTXDigiProcessor should create VTX TrackerHits from SimTrackerHits-->
  <!--Debugging option-->
  <parameter name="Debug" type="int">0 </parameter>
  <!--Momentum Cut For D Rays (MeV)-->
  <parameter name="MomentumCutForDRays" type="float">10 </parameter>
  <!--R-Phi Resolution in SIT-->
  <parameter name="PointResolutionRPhi_SIT" type="float">0.01 </parameter>
  <!--R-Phi Resolution in VTX-->
  <parameter name="PointResolutionRPhi_VTX" type="float">0.004 </parameter>
  <!--Z Resolution in SIT-->
  <parameter name="PointResolutionZ_SIT" type="float">0.01 </parameter>
  <!--Z Resolution in VTX-->
  <parameter name="PointResolutionZ_VTX" type="float">0.004 </parameter>
  <!--Remove D-rays ?-->
  <parameter name="RemoveDrays" type="int">0 </parameter>
  <!--Name of the SimTrackerHit collection-->
       <parameter    name="SITCollectionName"    type="string"    lcioInType="SimTrackerHit">sit00_SIT
</parameter>
  <!--Name of the sit TrackerHit output collection-->
      <parameter   name="SITHitCollection"   type="string"   lcioOutType="TrackerHit">SITTrackerHits
</parameter>
  <!--Name of the SimTrackerHit collection-->
       <parameter    name="VTXCollectionName"    type="string"    lcioInType="SimTrackerHit">vxd00_VXD
</parameter>
  <!--Name of the vxd TrackerHit output collection-->
      <parameter   name="VTXHitCollection"   type="string"   lcioOutType="TrackerHit">VTXTrackerHits
</parameter>
 </processor>

 <processor name="MyFTDDigiProcessor" type="FTDDigiProcessor">
 <!--FTDDigiProcessor creates FTD TrackerHits from SimTrackerHits-->
  <!--Name of the SimTrackerHit collection-->
  <parameter name="CollectionName" type="string" lcioInType="SimTrackerHit">ftd01_FTD </parameter>
  <!--Momentum Cut For D Rays (GeV)-->
  <parameter name="MomentumCutForDRays" type="float">10 </parameter>
  <!--Name of the TrackerHit output collection-->
```

```
    <parameter  name="OutputCollectionName"  type="string"  lcioOutType="TrackerHit">FTDTrackerHits
</parameter>
  <!--Point Resolution in FTD-->
  <parameter name="PointResolution" type="float">0.01 </parameter>
  <!--Remove D rays?-->
  <parameter name="RemoveDrays" type="int">0 </parameter>
 </processor>

  <processor name="MyTrackCheater" type="TrackCheater">
 <!--Creates true tracks...-->
  <!--Cut On Fit Chi2-->
  <parameter name="Chi2Cut" type="float">100 </parameter>
  <!--Cut on d0 to accept track-->
  <parameter name="CutOnD0" type="float">500 </parameter>
  <!--Cut on TPC hits for tracks with no Si hits-->
  <parameter name="CutOnTPCHits" type="int">35 </parameter>
  <!--Cut on Z0 to accept track-->
  <parameter name="CutOnZ0" type="float">500 </parameter>
  <!--Level of the printout info for the debuging purposes-->
  <parameter name="Debug" type="int">1 </parameter>
  <!--Energy Cut-->
  <parameter name="ECut" type="float">0.1 </parameter>
  <!--Flag to Fit True Track-->
  <parameter name="FitTrueTrack" type="int">1 </parameter>
  <!--Cut on distance from hit to helix-->
  <parameter name="HitToHelixDist" type="float">500 </parameter>
  <!--Cut on distance from hit to helix in fitting-->
  <parameter name="HitToHelixInFit" type="float">20 </parameter>
  <!--Name of the TrueTrack MC Relation collection-->
                   <parameter          name="MCTrueTrackRelCollectionName"          type="string"
lcioOutType="LCRelation">TrueTracksMCP </parameter>
  <!--Minimal Hits in Track Cluster-->
  <parameter name="MinimalHits" type="int">3 </parameter>
  <!--Track Fit Option-->
  <parameter name="OptFit" type="int">4 </parameter>
  <!--Store only hits used in fit?-->
  <parameter name="StoreHitsInFit" type="int">0 </parameter>
  <!--Tracker Hit Collection Names-->
   <parameter  name="TrackerHitCollections"  type="StringVec"  lcioInType="TrackerHit">VTXTrackerHits
FTDTrackerHits SITTrackerHits TPCTrackerHits  </parameter>
  <!--Collection of True Clusters-->
  <parameter name="TrueTrackCollection" type="string" lcioOutType="Track">TrueTracks </parameter>
  <!--Use Extra Point in Fit?-->
  <parameter name="UseExtraPoint" type="int">0 </parameter>
  <!--Parameter a to define minimal IP error-->
  <parameter name="aParameterForIPError" type="float">0.002 </parameter>
  <!--Parameter b to define minimal IP error-->
  <parameter name="bParameterForIPError" type="float">0.0076 </parameter>
  <!--Parameter s to define minimal IP error-->
  <parameter name="sParameterForIPError" type="float">0.75 </parameter>
</processor>

</marlin>
```

```
<!--##################################################-->
<!--#                                                #-->
<!--#       Example steering file to run             #-->
<!--#  LEPTrackingProcessor, SiliconTracking and     #-->
<!--#        FullLDCTracking processors              #-->
<!--# Author : A.Raspereza (MPI-Munich) 31/07/2007 #-->
<!--#                                                #-->
<!--##################################################-->


<marlin>
 <execute>
   <processor name="MyMaterialDB"/>
   <processor name="MyTPCDigiProcessor"/>
   <processor name="MyCurlKillerProcessor"/>
   <processor name="MyVTXDigiProcessor"/>
   <processor name="MyFTDDigiProcessor"/>
   <processor name="MyLEPTrackingProcessor"/>
   <processor name="MySiliconTracking"/>
   <processor name="MyFullLDCTracking"/>
```

```
 </execute>

 <global>
  <parameter name="LCIOInputFiles"> ZHllX_350.slcio </parameter>
  <parameter name="GearXMLFile"> gear_ldc01_tracking.xml </parameter>
  <parameter name="MaxRecordNumber" value="11" />
  <parameter name="SupressCheck" value="false" />
  <parameter name="BField"> 4.0 </parameter>
 </global>

 <processor name="MyMaterialDB" type="MaterialDB">
 <!--Material DB builder...-->
  <!--Use Extrapolations in Fit-->
  <parameter name="UseExtrapolations" type="int">1 </parameter>
  <!--Use material database-->
  <parameter name="UseMaterials" type="int">1 </parameter>
 </processor>

 <processor name="MyTPCDigiProcessor" type="TPCDigiProcessor">
 <!--Produces TPC TrackerHit collection from SimTrackerHit collection, smeared in RPhi and Z-->
  <!--Name of the SimTrackerHit collection-->
  <parameter name="CollectionName" type="string" lcioInType="SimTrackerHit">STpc01_TPC </parameter>
  <!--Name of the digitized TrackerHit collection-->
    <parameter  name="TPCTrackerHitsCol"  type="string"  lcioOutType="TrackerHit">  AllTPCTrackerHits
</parameter>
 </processor>

 <processor name="MyCurlKillerProcessor" type="CurlKillerProcessor">
 <!--CurlKillerProcessor: Using a 2D(r-phi) histogram, hits from patterns (curlers) traversing the
TPC in Z whilst retaining constant r-phi are removed from a new TrackerHit collection -->
  <!--Bin size in square root of pad multiples-->
  <parameter name="BinSize" type="int">2 </parameter>
  <!--Name of the cut away TrackerHit collection-->
    <parameter  name="CutCollectionName"  type="string"  lcioOutType="TrackerHit">  cutTPCTrackeHits
</parameter>
  <!--Name of the TrackerHit collection-->
    <parameter  name="InputCollectionName"  type="string"  lcioInType="TrackerHit">  AllTPCTrackerHits
</parameter>
  <!--Cut for the number of hits allowed in one bin-->
  <parameter name="MultiplicityCut" type="int">4 </parameter>
  <!--TPC PadHeight-->
  <parameter name="PadHeight" type="float">6.2 </parameter>
  <!--TPC PadWidth-->
  <parameter name="PadWidth" type="float">2.2 </parameter>
  <!--Name of the remaining TrackerHit collection-->
   <parameter  name="RemainingCollectionName"  type="string"  lcioOutType="TrackerHit">  TPCTrackerHits
</parameter>
 </processor>

 <processor name="MyVTXDigiProcessor" type="VTXDigiProcessor">
 <!--VTXDigiProcessor should create VTX TrackerHits from SimTrackerHits-->
  <!--Debugging option-->
  <parameter name="Debug" type="int">0 </parameter>
  <!--Momentum Cut For D Rays (MeV)-->
  <parameter name="MomentumCutForDRays" type="float">10 </parameter>
  <!--R-Phi Resolution in SIT-->
  <parameter name="PointResolutionRPhi_SIT" type="float">0.01 </parameter>
  <!--R-Phi Resolution in VTX-->
  <parameter name="PointResolutionRPhi_VTX" type="float">0.004 </parameter>
  <!--Z Resolution in SIT-->
  <parameter name="PointResolutionZ_SIT" type="float">0.01 </parameter>
  <!--Z Resolution in VTX-->
  <parameter name="PointResolutionZ_VTX" type="float">0.004 </parameter>
  <!--Remove D-rays ?-->
  <parameter name="RemoveDrays" type="int">0 </parameter>
  <!--Name of the SimTrackerHit collection-->
       <parameter    name="SITCollectionName"    type="string"    lcioInType="SimTrackerHit">sit00_SIT
</parameter>
  <!--Name of the sit TrackerHit output collection-->
      <parameter    name="SITHitCollection"    type="string"    lcioOutType="TrackerHit">SITTrackerHits
</parameter>
  <!--Name of the SimTrackerHit collection-->
       <parameter    name="VTXCollectionName"    type="string"    lcioInType="SimTrackerHit">vxd00_VXD
</parameter>
  <!--Name of the vxd TrackerHit output collection-->
      <parameter    name="VTXHitCollection"    type="string"    lcioOutType="TrackerHit">VTXTrackerHits
```

```
</parameter>
 </processor>

 <processor name="MyFTDDigiProcessor" type="FTDDigiProcessor">
 <!--FTDDigiProcessor creates FTD TrackerHits from SimTrackerHits-->
  <!--Name of the SimTrackerHit collection-->
  <parameter name="CollectionName" type="string" lcioInType="SimTrackerHit">ftd01_FTD </parameter>
  <!--Momentum Cut For D Rays (GeV)-->
  <parameter name="MomentumCutForDRays" type="float">10 </parameter>
  <!--Name of the TrackerHit output collection-->
  <parameter name="OutputCollectionName" type="string" lcioOutType="TrackerHit">FTDTrackerHits
</parameter>
  <!--Point Resolution in FTD-->
  <parameter name="PointResolution" type="float">0.01 </parameter>
  <!--Remove D rays?-->
  <parameter name="RemoveDrays" type="int">0 </parameter>
 </processor>

 <processor name="MyLEPTrackingProcessor" type="LEPTrackingProcessor">
 <!--Produces Track collection from TPC TrackerHit collections using LEP tracking algorithms-->
  <!--Name of the TPC Track MC Relation collection-->
  <parameter name="MCTPCTrackRelCollectionName" type="string" lcioOutType="LCRelation">TPCTracksMCP
</parameter>
  <!--Name of the Track MC Relation collection-->
  <parameter name="MCTrackRelCollectionName" type="string" lcioOutType="LCRelation">TracksMCP
</parameter>
  <!--Name of the SIT TrackerHit collection-->
  <parameter name="SITTrackerHitCollectionName" type="string" lcioInType="TrackerHit">SITTrackerHits
</parameter>
  <!--Name of the TPC Track collection-->
  <parameter name="TPCTrackCollectionName" type="string" lcioOutType="Track">TPCTracks </parameter>
  <!--Name of the TPC TrackerHit collection-->
  <parameter name="TPCTrackerHitCollectionName" type="string" lcioInType="TrackerHit">TPCTrackerHits
</parameter>
  <!--Name of the Track collection-->
  <parameter name="TrackCollectionName" type="string" lcioOutType="Track">Tracks </parameter>
  <!--Name of the VTX TrackerHit collection-->
  <parameter name="VTXTrackerHitCollectionName" type="string" lcioInType="TrackerHit">VTXTrackerHits
</parameter>
 </processor>

 <processor name="MySiliconTracking" type="SiliconTracking">
 <!--Pattern recognition in silicon trackers-->
  <!--Angle Cut For Merging-->
  <parameter name="AngleCutForMerging" type="float">0.1 </parameter>
  <!--Chi2 Fit Cut-->
  <parameter name="Chi2FitCut" type="float">100 </parameter>
  <!--Chi2 Prefit Cut-->
  <parameter name="Chi2PrefitCut" type="float">1e+10 </parameter>
  <!--Chi2WRphiQuartet-->
  <parameter name="Chi2WRphiQuartet" type="float">1 </parameter>
  <!--Chi2WRphiSeptet-->
  <parameter name="Chi2WRphiSeptet" type="float">1 </parameter>
  <!--Chi2WRphiTriplet-->
  <parameter name="Chi2WRphiTriplet" type="float">1 </parameter>
  <!--Chi2WZQuartet-->
  <parameter name="Chi2WZQuartet" type="float">0.5 </parameter>
  <!--Chi2WZSeptet-->
  <parameter name="Chi2WZSeptet" type="float">0.5 </parameter>
  <!--Chi2WZTriplet-->
  <parameter name="Chi2WZTriplet" type="float">0.5 </parameter>
  <!--Create Track To MCP Relations-->
  <parameter name="CreateMap" type="int">1 </parameter>
  <!--cut on D0 for tracks-->
  <parameter name="CutOnD0" type="float">100 </parameter>
  <!--cut on Pt-->
  <parameter name="CutOnPt" type="float">0.1 </parameter>
  <!--cut on Z0 for tracks-->
  <parameter name="CutOnZ0" type="float">100 </parameter>
  <!--Print out debugging info?-->
  <parameter name="Debug" type="int">1 </parameter>
  <!--FTD Hit Collection Name-->
  <parameter name="FTDHitCollectionName" type="string" lcioInType="TrackerHit">FTDTrackerHits
</parameter>
  <!--Fast attachment-->
  <parameter name="FastAttachment" type="int">0 </parameter>
```

```
  <!--Final Refit ?-->
  <parameter name="FinalRefit" type="int">1 </parameter>
  <!--Combinations of Hits in Layers-->
  <parameter name="LayerCombinations" type="IntVec">6 4 3 6 4 2 6 3 2 5 4 3 5 4 2 5 3 2 4 3 2 4 3 1
4 2 1 3 2 1  </parameter>
  <!--Combinations of Hits in FTD-->
  <parameter name="LayerCombinationsFTD" type="IntVec">6 5 4 5 4 3 5 4 2 5 4 1 5 3 2 5 3 1 5 2 1 4 3
2 4 3 1 4 3 0 4 2 1 4 2 0 4 1 0 3 2 1 3 2 0 3 1 0 2 1 0  </parameter>
  <!--MinDistCutAttach-->
  <parameter name="MinDistCutAttach" type="float">2 </parameter>
  <!--MinLayerToAttach-->
  <parameter name="MinLayerToAttach" type="int">-1 </parameter>
  <!--minimal hits-->
  <parameter name="MinimalHits" type="int">3 </parameter>
  <!--Number of divisions in Phi-->
  <parameter name="NDivisionsInPhi" type="int">40 </parameter>
  <!--Number of divisions in Phi for FTD-->
  <parameter name="NDivisionsInPhiFTD" type="int">3 </parameter>
  <!--Number of divisions in Theta-->
  <parameter name="NDivisionsInTheta" type="int">40 </parameter>
  <!--Option of prefit ?-->
  <parameter name="OptPrefit" type="int">0 </parameter>
  <!--SIT Hit Collection Name-->
     <parameter  name="SITHitCollectionName"  type="string"  lcioInType="TrackerHit">SITTrackerHits
</parameter>
  <!--Silicon track Collection Name-->
  <parameter name="SiTrackCollectionName" type="string" lcioOutType="Track">SiTracks </parameter>
  <!--Name of Si track MC particle relation collection-->
     <parameter  name="SiTrackMCPRelCollection"  type="string"  lcioOutType="LCRelation">SiTracksMCP
</parameter>
  <!--Simple Helix Fit ?-->
  <parameter name="SimpleHelixFit" type="int">1 </parameter>
  <!--Use Extra Point in Fit-->
  <parameter name="UseExtraPoint" type="int">0 </parameter>
  <!--Use SIT-->
  <parameter name="UseSIT" type="int">1 </parameter>
  <!--VTX Hit Collection Name-->
     <parameter  name="VTXHitCollectionName"  type="string"  lcioInType="TrackerHit">VTXTrackerHits
</parameter>
 </processor>

 <processor name="MyFullLDCTracking" type="FullLDCTracking">
 <!--Performs full tracking in LDC detector-->
  <!--Cut on Opening Angle for forced merging of Si and TPC segments-->
  <parameter name="AngleCutForForcedMerging" type="float">0.05 </parameter>
  <!--Cut on Opening Angle for merging Si and TPC segments-->
  <parameter name="AngleCutForMerging" type="float">0.1 </parameter>
  <!--Assign left over TPC hits-->
  <parameter name="AssignTPCHits" type="int">1 </parameter>
  <!--Cut on fit Chi2-->
  <parameter name="Chi2FitCut" type="float">100 </parameter>
  <!--Cut on fit Chi2-->
  <parameter name="Chi2PrefitCut" type="float">100000 </parameter>
  <!--Create Track to MCP Relations-->
  <parameter name="CreateMap" type="int">1 </parameter>
  <!--Cut on the number of the TPC hits for tracks with no Si hits-->
  <parameter name="CutOnTPCHits" type="int">35 </parameter>
  <!--Cut on the track parameter D0-->
  <parameter name="CutOnTrackD0" type="float">500 </parameter>
  <!--Cut on the track parameter Z0-->
  <parameter name="CutOnTrackZ0" type="float">500 </parameter>
  <!--Cut on D0 difference for forced merging of Si and TPC segments-->
  <parameter name="D0CutForForcedMerging" type="float">50 </parameter>
  <!--Cut on D0 difference for merging of Si and TPC segments-->
  <parameter name="D0CutForMerging" type="float">500 </parameter>
  <!--Cut on D0 difference for merging TPC segments-->
  <parameter name="D0CutToMergeTPCSegments" type="float">100 </parameter>
  <!--Activate debugging?-->
  <parameter name="Debug" type="int">1 </parameter>
  <!--Cut on dP/P difference for merging TPC segments-->
  <parameter name="DeltaPCutToMergeTPCSegments" type="float">0.1 </parameter>
  <!--FTD Hit Collection Name-->
      <parameter   name="FTDHitCollection"   type="string"   lcioInType="TrackerHit">FTDTrackerHits
</parameter>
  <!--Forbid overlap in Z for combining TPC segments with tracks having Si hits-->
  <parameter name="ForbidOverlapInZComb" type="int">0 </parameter>
```

```xml
  <!--Forbid overlap in Z for the merged TPC segments-->
  <parameter name="ForbidOverlapInZTPC" type="int">0 </parameter>
  <!--Force merging of Si and TPC segments?-->
  <parameter name="ForceSiTPCMerging" type="int">0 </parameter>
  <!--Force merging of TPC Segments?-->
  <parameter name="ForceTPCSegmentsMerging" type="int">1 </parameter>
  <!--LDC track collection name-->
  <parameter name="LDCTrackCollection" type="string" lcioOutType="Track">LDCTracks </parameter>
  <!--Collection name for the LDC track to MCParticle relations-->
  <parameter name="LDCTrackMCPRelCollection" type="string" lcioOutType="LCRelation">LDCTracksMCP </parameter>
  <!--Cut on Omega difference for forced merging of Si and TPC segments-->
  <parameter name="OmegaCutForForcedMerging" type="float">0.15 </parameter>
  <!--Cut on Omega difference for merging Si and TPC segments-->
  <parameter name="OmegaCutForMerging" type="float">0.25 </parameter>
  <!--Option for the LDC Track fit-->
  <parameter name="OptFit" type="int">4 </parameter>
  <!--Option for Si tracks refitting-->
  <parameter name="OptFitSi" type="int">2 </parameter>
  <!--Option for TPC tracks refitting-->
  <parameter name="OptFitTPC" type="int">2 </parameter>
  <!--Refitted TPC track collection name-->
  <parameter name="ReffitedTPCTrackCollection" type="string" lcioOutType="Track">RefittedTPCTracks </parameter>
  <!--Refit Si Tracks ?-->
  <parameter name="RefitSiTracks" type="int">0 </parameter>
  <!--Refit TPC Tracks ?-->
  <parameter name="RefitTPCTracks" type="int">1 </parameter>
  <!--Refitted Si track collection name-->
  <parameter name="RefittedSiTrackCollection" type="string" lcioOutType="Track">RefittedSiTracks </parameter>
  <!--Collection name for the refittedSi track to MCParticle relations-->
  <parameter name="RefittedSiTrackMCPRelCollection" type="string" lcioOutType="LCRelation">RefittedSiTracksMCP </parameter>
  <!--Collection name for the refitted TPC track to MCParticle relations-->
  <parameter name="RefittedTPCTrackMCPRelCollection" type="string" lcioOutType="LCRelation">RefittedTPCTracksMCP </parameter>
  <!--SIT Hit Collection Name-->
  <parameter name="SITHitCollection" type="string" lcioInType="TrackerHit">SITTrackerHits </parameter>
  <!--Si Track Collection-->
  <parameter name="SiTracks" type="string" lcioInType="Track">SiTracks </parameter>
  <!--Si Track to Collection-->
  <parameter name="SiTracksMCPRelColl" type="string" lcioInType="LCRelation">SiTracksMCP </parameter>
  <!--Store only hits used in fit?-->
  <parameter name="StoreHitsInFit" type="int">0 </parameter>
  <!--Store Refitted Si Tracks ?-->
  <parameter name="StoreRefittedSiTracks" type="int">0 </parameter>
  <!--Store Refitted TPC Tracks ?-->
  <parameter name="StoreRefittedTPCTracks" type="int">0 </parameter>
  <!--TPC Hit Collection Name-->
  <parameter name="TPCHitCollection" type="string" lcioInType="TrackerHit">TPCTrackerHits </parameter>
  <!--Cut on distance between track and TPC hits-->
  <parameter name="TPCHitToTrackDistance" type="float">25 </parameter>
  <!--TPC Track Collection-->
  <parameter name="TPCTracks" type="string" lcioInType="Track">TPCTracks </parameter>
  <!--TPC Track to MCP Relation Collection Name-->
  <parameter name="TPCTracksMCPRelColl" type="string" lcioInType="LCRelation">TPCTracksMCP </parameter>
  <!--Use Extra Point in Fit-->
  <parameter name="UseExtraPoint" type="int">0 </parameter>
  <!--VTX Hit Collection Name-->
  <parameter name="VTXHitCollection" type="string" lcioInType="TrackerHit">VTXTrackerHits </parameter>
  <!--Cut on Z0 difference for forced merging of Si and TPC segments-->
  <parameter name="Z0CutForForcedMerging" type="float">200 </parameter>
  <!--Cut on Z0 difference for merging of Si and TPC segments-->
  <parameter name="Z0CutForMerging" type="float">1000 </parameter>
  <!--Cut on Z0 difference for merging TPC segments-->
  <parameter name="Z0CutToMergeTPCSegments" type="float">5000 </parameter>
  <!--Parameter a to define minimal IP error-->
  <parameter name="aParameterForIPError" type="float">0.002 </parameter>
  <!--Parameter b to define minimal IP error-->
  <parameter name="bParameterForIPError" type="float">0.0076 </parameter>
```

```
  <!--Parameter s to define minimal IP error-->
  <parameter name="sParameterForIPError" type="float">0.75 </parameter>
 </processor>

</marlin>
```

```
<gear>

     <!-- Example XML file for GEAR describing tracking system -->
     <!--                  of the LDC00 Mokka model             -->
     <!-- A.Raspereza MPI Munich, rasp@mppmu.mpg.de, 12/2/2007 -->
  <BField type=”ConstantBField” x=”0” y=”0” z=”0” />

  <detectors>

    <!-- TPC -->
                <detector id="0" name="TPCTest" geartype="TPCParameters" type="UNKNOWN"
insideTrackingVolume="yes">
        <maxDriftLength value="2500"/>
        <driftVelocity value="" />
        <readoutFrequency value="10" />
        <PadRowLayout2D  type="FixedPadSizeDiskLayout"
                         rMin="386" rMax="1626"
                         padHeight="6.2" padWidth="2.2"
                         maxRow="200" padGap="0.0" />
       <parameter name="tpcRPhiResConst" type="double"> 0.160  </parameter>
       <parameter name="tpcRPhiResDiff" type="double"> 0.0 </parameter>
       <parameter name="tpcZRes" type="double"> 0.5  </parameter>
       <parameter name="tpcPixRP" type="double"> 1.0  </parameter>
       <parameter name="tpcPixZ" type="double"> 1.4  </parameter>
       <parameter name="tpcIonPotential" type="double"> 0.00000003  </parameter>
        <parameter name="tpcInnerRadius" type="double"> 320.0 </parameter>
        <parameter name="tpcOuterRadius" type="double"> 1690.0 </parameter>
        <parameter name="tpcInnerWallThickness" type="double"> 1.16 </parameter>
        <parameter name="tpcOuterWallThickness" type="double"> 1.51 </parameter>
        <parameter name="TPCWallProperties_RadLen" type="double"> 88.9253 </parameter>
        <parameter name="TPCWallProperties_dEdx" type="double"> 4.374e-4 </parameter>
        <parameter name="TPCGasProperties_RadLen" type="double"> 109831 </parameter>
        <parameter name="TPCGasProperties_dEdx" type="double"> 2.736e-7 </parameter>
       <parameter name="BField" type="double"> 4.0 </parameter>
     </detector>

     <!-- Vertex Detector-->
     <detector name="VXD" geartype="VXDParameters">
       <vxdType technology="CCD" />
       <shell halfLength="135.000000" gap="0.040000" innerRadius="65.000000" outerRadius="65.493920"
radLength="352.759946" />
       <layers>
       <layer nLadders="0" phi0="0.000000">
           <ladder distance="15.5" thickness="0.282240" width="13.000000" length="50.0"
offset="-1.455005" radLength="352.759946" />
              <sensitive distance="15.78224" thickness="0.037440" width="13.000000" length="50.0"
offset="-1.455005" radLength="93.676203" />
        </layer>
        <layer nLadders="0" phi0="0.000000">
                  <ladder distance="27.0" thickness="0.282240" width="22.000000" length="125.0"
offset="-1.398656" radLength="352.759946" />
             <sensitive distance="27.28224" thickness="0.037440" width="22.000000" length="125.0"
offset="-1.398656" radLength="93.676203" />
        </layer>
        <layer nLadders="0" phi0="0.000000">
            <ladder distance="38.000000" thickness="0.282240" width="22.000000" length="125.00000"
offset="-2.571633" radLength="352.759946" />
           <sensitive distance="38.28224" thickness="0.037440" width="22.000000" length="125.00000"
offset="-2.571633" radLength="93.676203" />
        </layer>
        <layer nLadders="0" phi0="0.000000">
            <ladder distance="49.000000" thickness="0.282240" width="22.000000" length="125.00000"
offset="-3.592945" radLength="352.759946" />
           <sensitive distance="49.28224" thickness="0.037440" width="22.000000" length="125.00000"
offset="-3.592945" radLength="93.676203" />
        </layer>
        <layer nLadders="0" phi0="0.000000">
            <ladder distance="60.000000" thickness="0.282240" width="22.000000" length="125.00000"
```

```
offset="-4.422448" radLength="352.759946" />
           <sensitive distance="60.28224" thickness="0.037440" width="22.000000" length="125.00000"
offset="-4.422448" radLength="93.676203" />
        </layer>
       </layers>
     </detector>

     <!-- Additional Information for VXD -->
                 <detector id="16" name="VXDInfra" geartype="GearParameters" type="UNKNOWN"
insideTrackingVolume="true">
       <parameter name="LadderGaps" type="DoubleVec"> 0.0 0.0 0.0 0.0 0.0 </parameter>
       <parameter name="ActiveLayerProperties_dEdx" type="double"> 0.00038678 </parameter>
       <parameter name="SupportLayerProperties_dEdx" type="double"> 0.00029415 </parameter>
       <parameter name="StripLineProperties_dEdx" type="double"> 0.0002414 </parameter>
       <parameter name="StripLineProperties_RadLen" type="double"> 286.0 </parameter>
       <parameter name="ElectronicEndThickness" type="double"> 0.19656 </parameter>
       <parameter name="ElectronicEndLength" type="double"> 10.0 </parameter>
      <parameter name="StripLineFinalZ" type="DoubleVec"> 136.0 136.0 140.0 145.0 150.0 </parameter>
       <parameter name="StripLineThickness" type="double"> 0.09438 </parameter>
       <parameter name="StripLineBeamPipeRadius" type="double"> 23.0 </parameter>
       <parameter name="VXDEndPlateInnerRadius" type="double"> 23.2 </parameter>
       <parameter name="BeamPipeRadius" type="double"> 10. </parameter>
       <parameter name="BeamPipeHalfZ" type="double"> 61. </parameter>
       <parameter name="BeamPipeThickness" type="double"> 0.5 </parameter>
       <parameter name="BeamPipeProperties_RadLen" type="double"> 352.759946 </parameter>
       <parameter name="BeamPipeProperties_dEdx" type="double"> 0.00029415 </parameter>
       <parameter name="CryostatAlRadius" type="double"> 100. </parameter>
       <parameter name="CryostatAlHalfZ" type="double"> 170. </parameter>
       <parameter name="CryostatAlThickness" type="double"> 0.5 </parameter>
       <parameter name="CryostatAlZEndCap" type="double"> 170. </parameter>
       <parameter name="Cryostat_RadLen" type="double"> 88.9253 </parameter>
       <parameter name="CryostatAlInnerR" type="double"> 23.2 </parameter>
       <parameter name="Cryostat_dEdx" type="double"> 4.374e-4 </parameter>
     </detector>

     <!--  Forward Tracking Discs -->
                  <detector id="17" name="FTD" geartype="GearParameters" type="UNKNOWN"
insideTrackingVolume="true">
          <parameter name="FTDZCoordinate" type="DoubleVec"> 200.0 320.0 440.0 550.0 800.0 1050.0
1300.0 </parameter>
          <parameter name="FTDInnerRadius" type="DoubleVec"> 38.0 48.0 59.0 68.0 90.0 111.0 132.0
</parameter>
        <parameter name="FTDOuterRadius" type="DoubleVec"> 140.0 140.0 210.0 270.0 290.0 290.0 290.0
</parameter>
        <parameter name="FTDDiskThickness" type="double"> 0.3 </parameter>
        <parameter name="FTDInnerSupportdR" type="double"> 2.0 </parameter>
        <parameter name="FTDOuterSupportdR" type="double"> 10.0 </parameter>
       <parameter name="FTDInnerSupportThickness" type="double"> 4.0 </parameter>
       <parameter name="FTDOuterSupportThickness" type="double"> 4.0 </parameter>
       <parameter name="zFTDOuterCyllinderStart" type="double"> 800.0 </parameter>
       <parameter name="zFTDOuterCyllinderEnd" type="double"> 1300.0 </parameter>
       <parameter name="zFTDInnerConeStart" type="double"> 550.0 </parameter>
       <parameter name="zFTDInnerConeEnd" type="double"> 1300.0 </parameter>
       <parameter name="FTDCopperThickness" type="double"> 0.08 </parameter>
       <parameter name="FTDOuterCyllinderThickness" type="double"> 1.0 </parameter>
       <parameter name="LastHeavyLayer" type="int"> 3 </parameter>
       <parameter name="Silicon_RadLen" type="double"> 93.6 </parameter>
       <parameter name="Silicon872_RadLen" type="double"> 25.0 </parameter>
       <parameter name="Kapton_RadLen" type="double"> 286.0 </parameter>
       <parameter name="Copper_RadLen" type="double"> 14.3 </parameter>
       <parameter name="Silicon_dEdx" type="double"> 0.00038678 </parameter>
       <parameter name="Silicon872_dEdx" type="double"> 0.00144752 </parameter>
       <parameter name="Kapton_dEdx" type="double">  0.0002414  </parameter>
       <parameter name="Copper_dEdx" type="double"> 0.0014336 </parameter>
     </detector>

     <!-- Silicon Intermediate Tracker -->
                  <detector id="18" name="SIT" geartype="GearParameters" type="UNKNOWN"
insideTrackingVolume="true">
        <parameter name="SITLayerRadius" type="DoubleVec"> 160.0 300.0 </parameter>
       <parameter name="SITLayerHalfLength" type="DoubleVec"> 380. 660.0 </parameter>
       <parameter name="SITLayerThickness" type="double"> 0.3 </parameter>
       <parameter name="SITLayer_dEdx" type="double"> 0.00144752 </parameter>
       <parameter name="SITLayer_RadLen" type="double"> 25.0 </parameter>
     </detector>
```

```
  </detectors>


</gear>
```

```
<gear>

     <!-- Example XML file for GEAR describing tracking system -->
     <!--                of the LDC01 Mokka model             -->
     <!-- A.Raspereza MPI Munich, rasp@mppmu.mpg.de, 12/2/2007 -->

  <BField type="ConstantBField" x="0" y="0" z="0" />

  <detectors>

    <!-- TPC -->
                <detector id="0" name="TPCTest" geartype="TPCParameters" type="UNKNOWN"
insideTrackingVolume="yes">
        <maxDriftLength value="1970"/>
        <driftVelocity value="" />
        <readoutFrequency value="10" />
        <PadRowLayout2D  type="FixedPadSizeDiskLayout"
                         rMin="371" rMax="1516"
                         padHeight="6.2" padWidth="2.2"
                         maxRow="184" padGap="0.0" />
       <parameter name="tpcRPhiResConst" type="double"> 0.160  </parameter>
       <parameter name="tpcRPhiResDiff" type="double"> 0.0 </parameter>
       <parameter name="tpcZRes" type="double"> 0.5  </parameter>
       <parameter name="tpcPixRP" type="double"> 1.0  </parameter>
       <parameter name="tpcPixZ" type="double"> 1.4  </parameter>
       <parameter name="tpcIonPotential" type="double"> 0.00000003  </parameter>
        <parameter name="tpcInnerRadius" type="double"> 305.0 </parameter>
        <parameter name="tpcOuterRadius" type="double"> 1580.0 </parameter>
        <parameter name="tpcInnerWallThickness" type="double"> 1.16 </parameter>
        <parameter name="tpcOuterWallThickness" type="double"> 1.51 </parameter>
        <parameter name="TPCWallProperties_RadLen" type="double"> 88.9253 </parameter>
        <parameter name="TPCWallProperties_dEdx" type="double"> 4.374e-4 </parameter>
        <parameter name="TPCGasProperties_RadLen" type="double"> 109831 </parameter>
        <parameter name="TPCGasProperties_dEdx" type="double"> 2.736e-7 </parameter>
       <parameter name="BField" type="double"> 4.0 </parameter>
     </detector>

     <!-- Vertex Detector-->
     <detector name="VXD" geartype="VXDParameters">
       <vxdType technology="CCD" />
       <shell halfLength="135.000000" gap="0.040000" innerRadius="65.000000" outerRadius="65.493920"
radLength="352.759946" />
       <layers>
       <layer nLadders="0" phi0="0.000000">
           <ladder distance="15.5" thickness="0.282240" width="13.000000" length="50.0"
offset="-1.455005" radLength="352.759946" />
              <sensitive distance="15.78224" thickness="0.037440" width="13.000000" length="50.0"
offset="-1.455005" radLength="93.676203" />
        </layer>
        <layer nLadders="0" phi0="0.000000">
                  <ladder distance="27.0" thickness="0.282240" width="22.000000" length="125.0"
offset="-1.398656" radLength="352.759946" />
             <sensitive distance="27.28224" thickness="0.037440" width="22.000000" length="125.0"
offset="-1.398656" radLength="93.676203" />
        </layer>
        <layer nLadders="0" phi0="0.000000">
            <ladder distance="38.000000" thickness="0.282240" width="22.000000" length="125.00000"
offset="-2.571633" radLength="352.759946" />
           <sensitive distance="38.28224" thickness="0.037440" width="22.000000" length="125.00000"
offset="-2.571633" radLength="93.676203" />
        </layer>
        <layer nLadders="0" phi0="0.000000">
            <ladder distance="49.000000" thickness="0.282240" width="22.000000" length="125.00000"
offset="-3.592945" radLength="352.759946" />
           <sensitive distance="49.28224" thickness="0.037440" width="22.000000" length="125.00000"
offset="-3.592945" radLength="93.676203" />
```

```xml
        </layer>
        <layer nLadders="0" phi0="0.000000">
            <ladder distance="60.000000" thickness="0.282240" width="22.000000" length="125.00000" offset="-4.422448" radLength="352.759946" />
            <sensitive distance="60.28224" thickness="0.037440" width="22.000000" length="125.00000" offset="-4.422448" radLength="93.676203" />
        </layer>
       </layers>
     </detector>

     <!-- Additional Information for VXD -->
     <detector id="16" name="VXDInfra" geartype="GearParameters" type="UNKNOWN" insideTrackingVolume="true">
       <parameter name="LadderGaps" type="DoubleVec"> 0.0 0.0 0.0 0.0 0.0 </parameter>
       <parameter name="ActiveLayerProperties_dEdx" type="double"> 0.00038678 </parameter>
       <parameter name="SupportLayerProperties_dEdx" type="double"> 0.00029415 </parameter>
       <parameter name="StripLineProperties_dEdx" type="double"> 0.0002414 </parameter>
       <parameter name="StripLineProperties_RadLen" type="double"> 286.0 </parameter>
       <parameter name="ElectronicEndThickness" type="double"> 0.19656 </parameter>
       <parameter name="ElectronicEndLength" type="double"> 10.0 </parameter>
       <parameter name="StripLineFinalZ" type="DoubleVec"> 136.0 136.0 140.0 145.0 150.0 </parameter>
       <parameter name="StripLineThickness" type="double"> 0.09438 </parameter>
       <parameter name="StripLineBeamPipeRadius" type="double"> 23.0 </parameter>
       <parameter name="VXDEndPlateInnerRadius" type="double"> 23.2 </parameter>
       <parameter name="BeamPipeRadius" type="double"> 10. </parameter>
       <parameter name="BeamPipeHalfZ" type="double"> 61. </parameter>
       <parameter name="BeamPipeThickness" type="double"> 0.5 </parameter>
       <parameter name="BeamPipeProperties_RadLen" type="double"> 352.759946 </parameter>
       <parameter name="BeamPipeProperties_dEdx" type="double"> 0.00029415 </parameter>
       <parameter name="CryostatAlRadius" type="double"> 100. </parameter>
       <parameter name="CryostatAlHalfZ" type="double"> 170. </parameter>
       <parameter name="CryostatAlThickness" type="double"> 0.5 </parameter>
       <parameter name="CryostatAlZEndCap" type="double"> 170. </parameter>
       <parameter name="Cryostat_RadLen" type="double"> 88.9253 </parameter>
       <parameter name="CryostatAlInnerR" type="double"> 23.2 </parameter>
       <parameter name="Cryostat_dEdx" type="double"> 4.374e-4 </parameter>
     </detector>

     <!--  Forward Tracking Discs -->
     <detector id="17" name="FTD" geartype="GearParameters" type="UNKNOWN" insideTrackingVolume="true">
        <parameter name="FTDZCoordinate" type="DoubleVec"> 200.0 320.0 440.0 550.0 800.0 1050.0 1300.0 </parameter>
        <parameter name="FTDInnerRadius" type="DoubleVec"> 38.0 48.0 59.0 68.0 90.0 111.0 132.0 </parameter>
        <parameter name="FTDOuterRadius" type="DoubleVec"> 140.0 140.0 210.0 270.0 290.0 290.0 290.0 </parameter>
        <parameter name="FTDDiskThickness" type="double"> 0.3 </parameter>
        <parameter name="FTDInnerSupportdR" type="double"> 2.0 </parameter>
        <parameter name="FTDOuterSupportdR" type="double"> 10.0 </parameter>
        <parameter name="FTDInnerSupportThickness" type="double"> 4.0 </parameter>
        <parameter name="FTDOuterSupportThickness" type="double"> 4.0 </parameter>
        <parameter name="zFTDOuterCyllinderStart" type="double"> 800.0 </parameter>
        <parameter name="zFTDOuterCyllinderEnd" type="double"> 1300.0 </parameter>
        <parameter name="zFTDInnerConeStart" type="double"> 550.0 </parameter>
        <parameter name="zFTDInnerConeEnd" type="double"> 1300.0 </parameter>
        <parameter name="FTDCopperThickness" type="double"> 0.08 </parameter>
        <parameter name="FTDOuterCyllinderThickness" type="double"> 1.0 </parameter>
        <parameter name="LastHeavyLayer" type="int"> 3 </parameter>
        <parameter name="Silicon_RadLen" type="double"> 93.6 </parameter>
        <parameter name="Silicon872_RadLen" type="double"> 25.0 </parameter>
        <parameter name="Kapton_RadLen" type="double"> 286.0 </parameter>
        <parameter name="Copper_RadLen" type="double"> 14.3 </parameter>
        <parameter name="Silicon_dEdx" type="double"> 0.00038678 </parameter>
        <parameter name="Silicon872_dEdx" type="double"> 0.00144752 </parameter>
        <parameter name="Kapton_dEdx" type="double">  0.0002414  </parameter>
        <parameter name="Copper_dEdx" type="double"> 0.0014336 </parameter>
     </detector>

     <!-- Silicon Intermediate Tracker -->
     <detector id="18" name="SIT" geartype="GearParameters" type="UNKNOWN" insideTrackingVolume="true">
        <parameter name="SITLayerRadius" type="DoubleVec"> 160.0 300.0 </parameter>
        <parameter name="SITLayerHalfLength" type="DoubleVec"> 380. 660.0 </parameter>
        <parameter name="SITLayerThickness" type="double"> 0.3 </parameter>
```

```
      <parameter name="SITLayer_dEdx" type="double"> 0.00144752 </parameter>
      <parameter name="SITLayer_RadLen" type="double"> 25.0 </parameter>
    </detector>


  </detectors>

</gear>
```

Please, be aware of the fact that GEAR steerings `gear_ldc00_tracking.xml` and `gear_ldc01_tracking.xml` describe only tracking system within Mokka models LDC00 and LDC01. If you intend to run full reconstruction, including calorimeter clustering and particle flow, you have to supplement these steerings with the description of the ECAL and HCAL.

The Marlin steering is meant to define the global parameters, governing the Marlin run, specify Processors to be activated and set parameters for these Processors.

Note, that the magnetic field is assumed to be uniform and parallel to the beam axis. The value of the magnetic field is specified in GEAR steering. Example Marlin and GEAR steering files and LCIO file `ZhllX_350.slcio` are located in the CVS directory `MarlinReco/examples`

For more information on the parameters of the processors, related to the LDC tracking, refer to `doxygen` documentation.

5.Performance Studies

Performance of the code has been evaluated on the samples produced with the Mokka program, simulating the ILC detector responce. Mokka model LDC01Sc was used.

First, a consistency check has been done by investigating pull distribution of the reconstructed track parameters and distribution of the χ^2 of the track fit divide by the number of degress of freedom. These distributions are shown in Fig. 2.

The resolution on the track parameters have been evaluated with the samples of single muons. Both momentum and polar angle of muons have been varied to study the dependence of resolutions as a function of track p and θ. This is illustrated in Figs. 3-5.

The track finding efficiency has been studied on the samples of hadronic events at the Z pole and 6-jet final states, resulting from the top quark pair production. Track finding efficiencies as a function of track transverse momentum, the magnitude of track momentum and polar angle are show in Figs. 6 and 7 for the top quark pair production. Overall track finding efficiency is 99.1% for tracks with momentum greater than 1 GeV and 97.6% for tracks with momentum greater than 500 MeV.

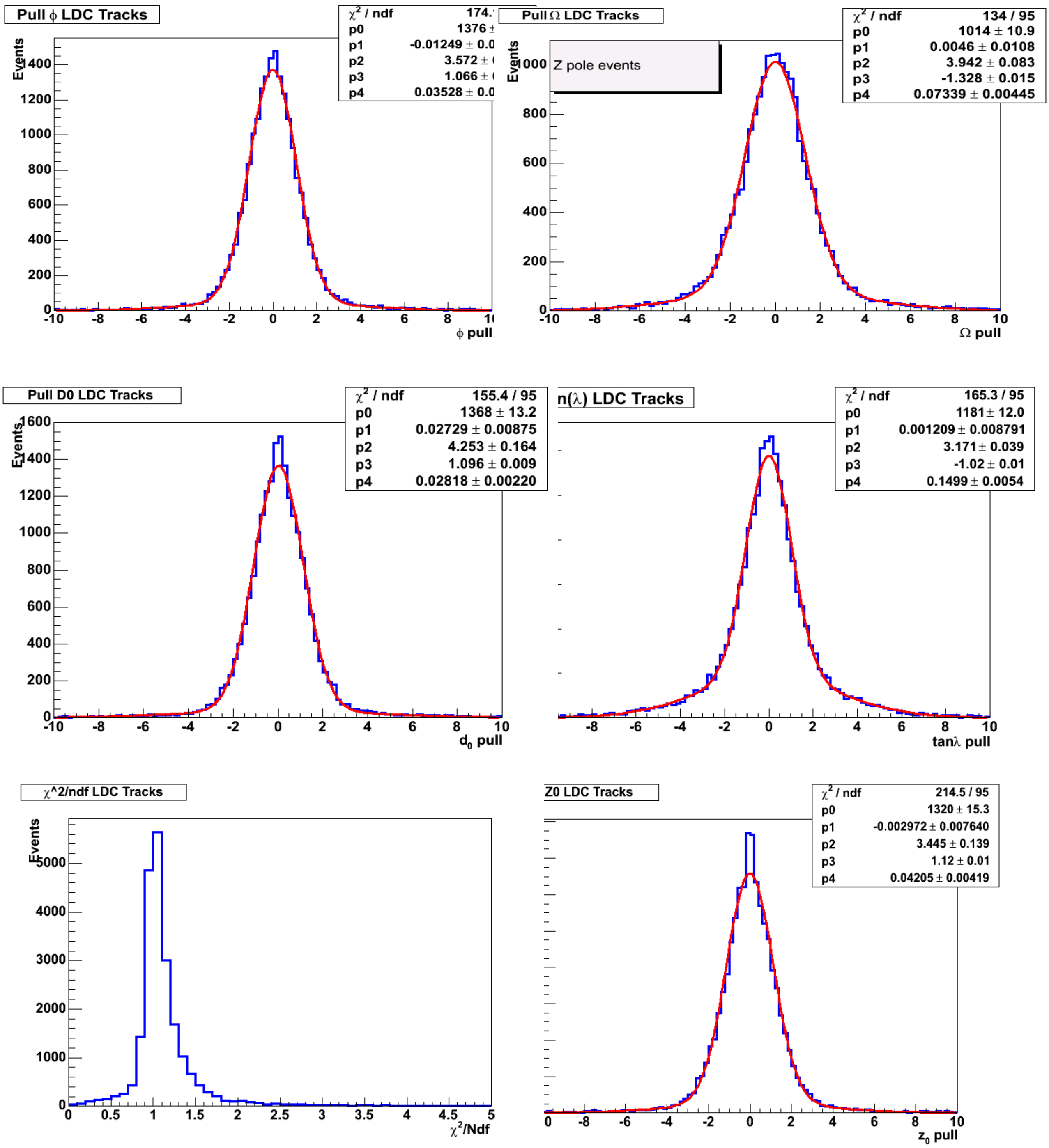

Figure 2. Distributions of track parameter pulls and the chi2/Ndf for the tracks in the 6-jet sample stemming from the top pair production

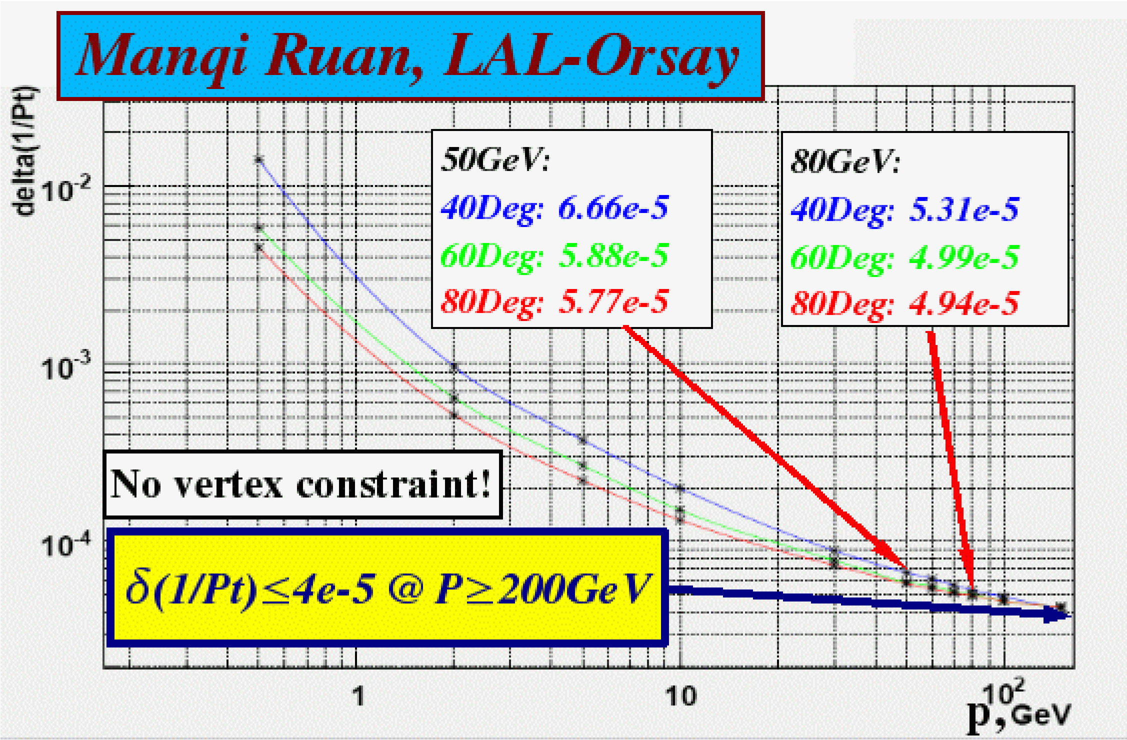

Figure 3. Transverse momentum resolution as a function of muon momentum for different polar angles

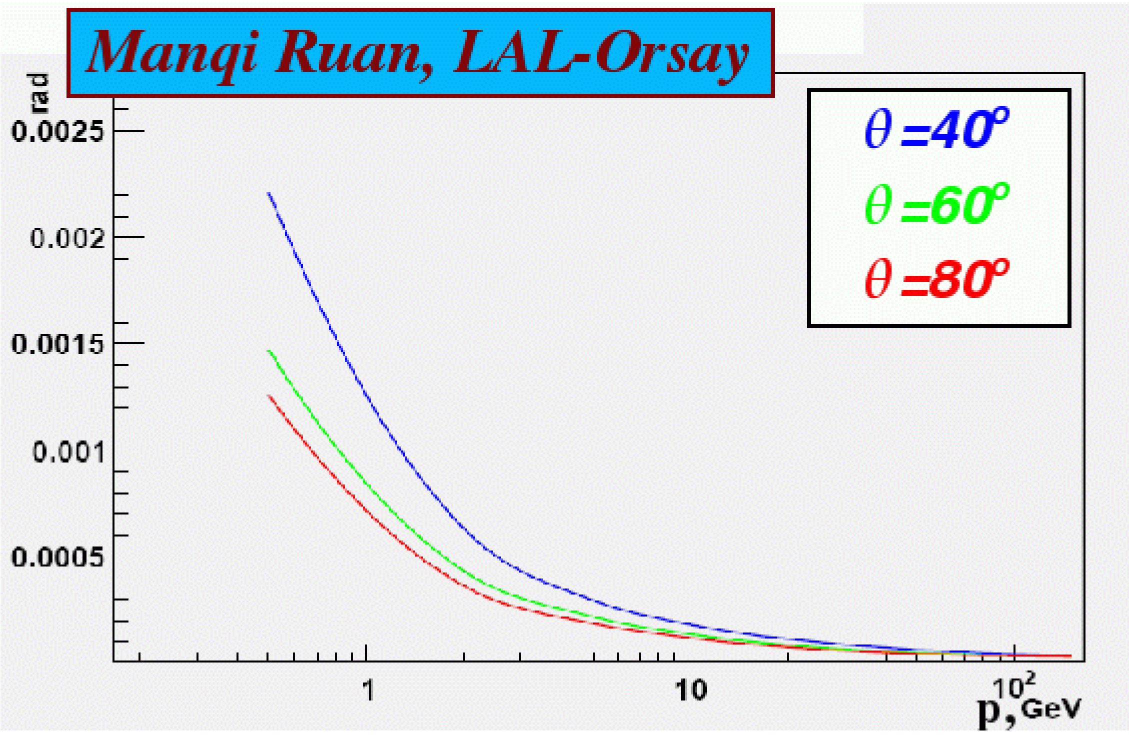

Figure 4. Azimuth angle resolution for single muons as a function of the track momentum for three different polar angles.

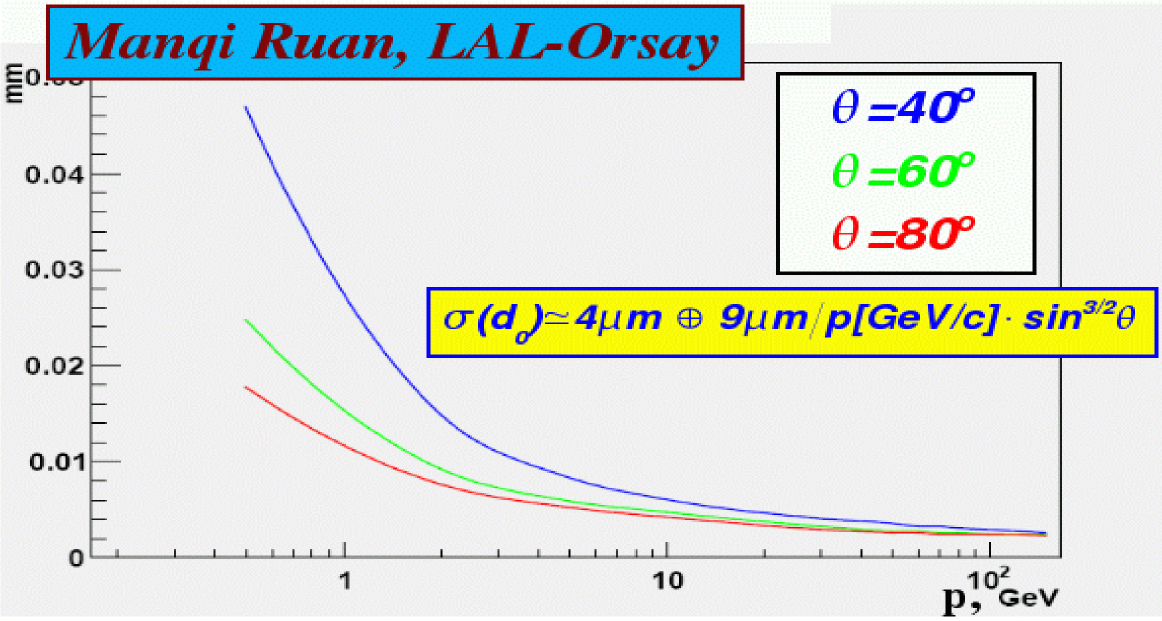

Figure 5. Impact parameter resolution for single muons as a function of track momentum.

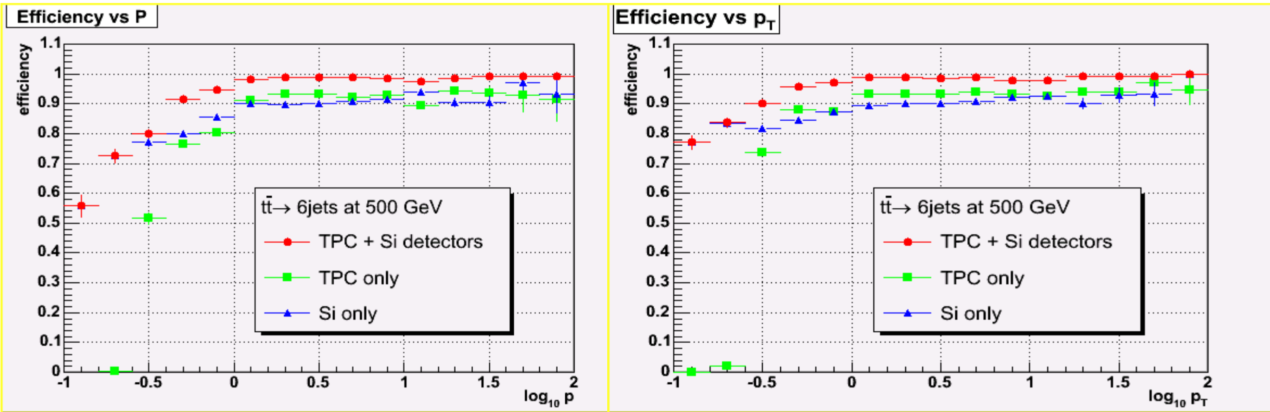

Figure 6. Track finding efficiency in the sample of the 6-jet events, resulting from the top quark pair production at 500 GeV as a function of track momentum (left plot) and transverse track momentum (right plot)

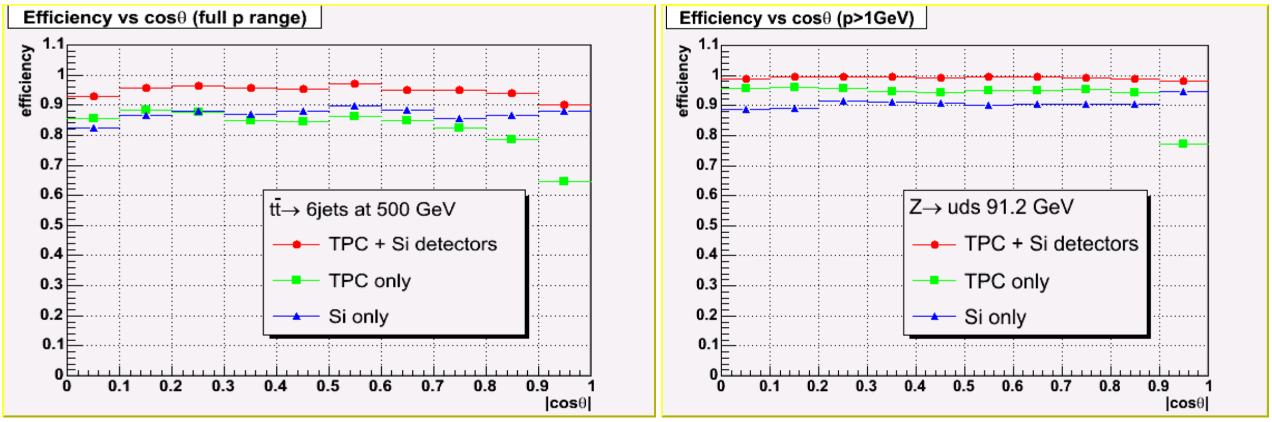

Figure 7. Track finding efficiency in the sample of 6-jet events, resulting from the top-quark pair production at 500 GeV as a function of polar angle for the entire momentum range (left plot) and only for those tracks with momentum greater than 1 GeV (right plot).