

# BRAHMS

a full detector  
simulation framework  
for a detector at TESLA

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What is BRAHMS

What can BRAHMS do

Why do we use BRAHMS

main BRAHMS authors:

Grahame Blair, Kristian Harder, Markus Elsing, Klaus Moenig, Ties Behnke  
and contributions from many others

# Event Simulation Framework

Basic decision in ECFA DESY workshop:

- Use for the moment (TDR) proven technologies
- GEANT3 as main simulation frame
- FORTRAN as main programming language
- ASCII as main platform independent
- All public domain software

Two main simulation roads:

- Full simulation (GEANT3 based)
- Fast simulation (SIMDET: see J.Schreibers talk)

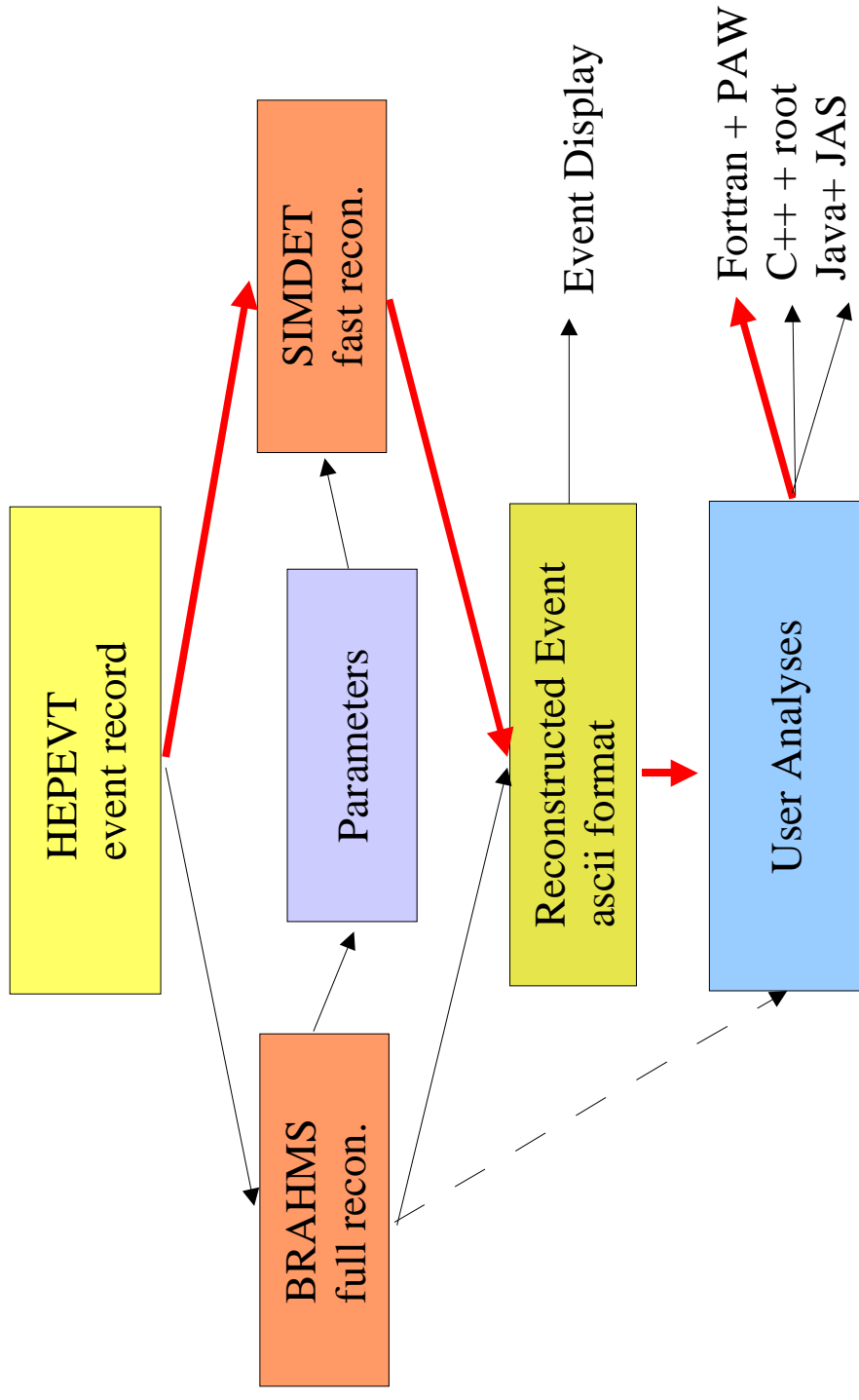
Secondary route:

- Use of "modern" technologies" in some detectors (calorimeter)

Medium to long term perspective: **GEANT4**

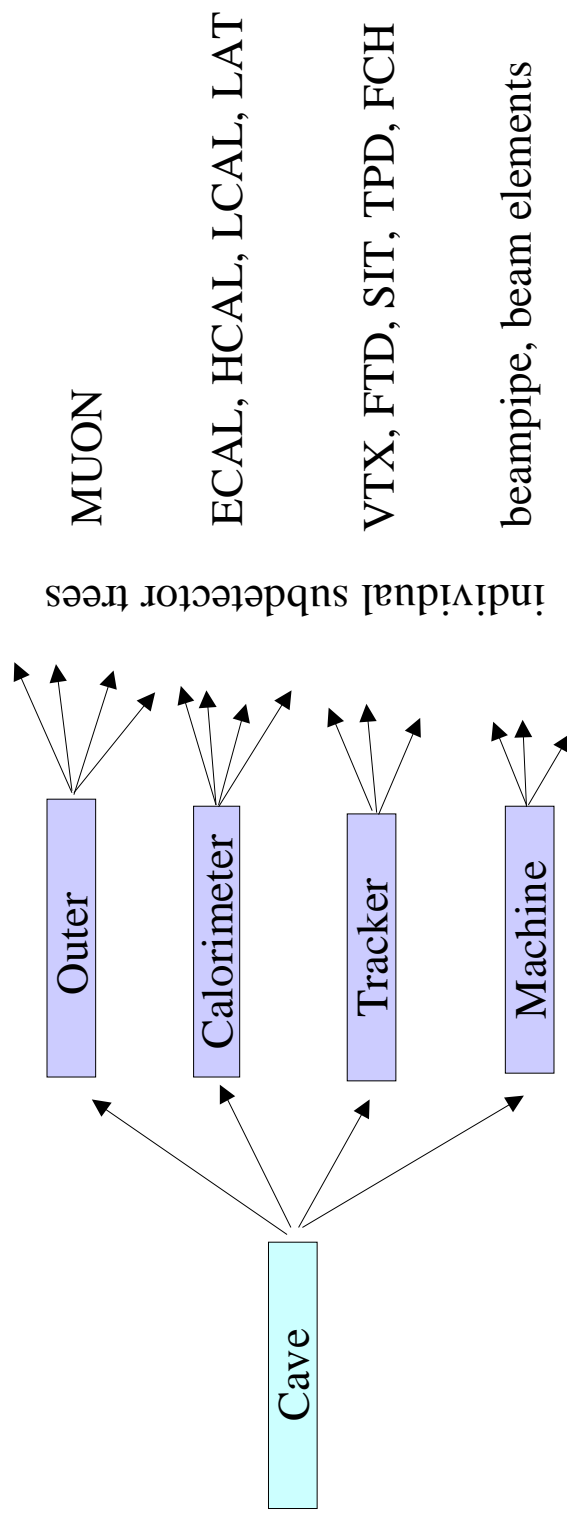
# Event Flow

Simplified flow chart:



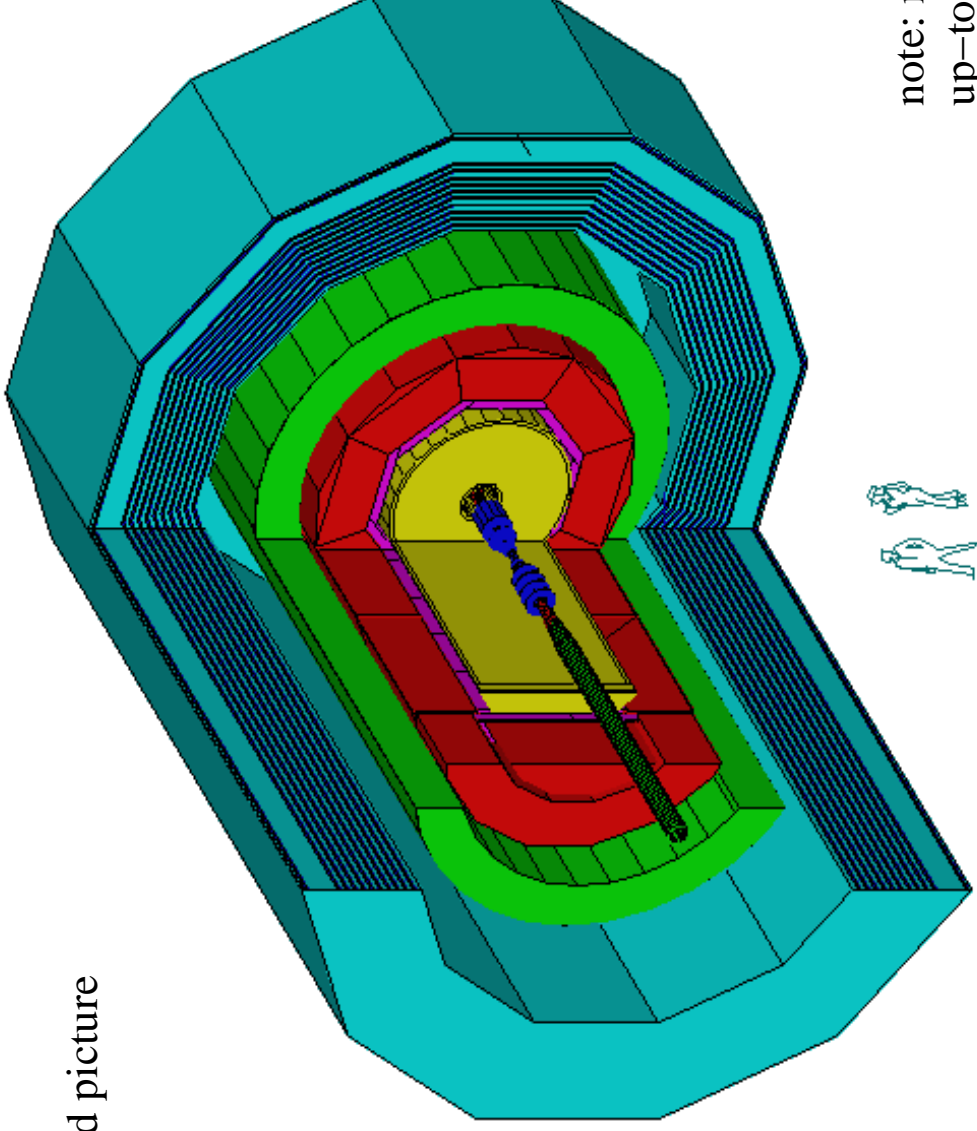
# BRAHMS Structure: Geometry

- Detector definitions:
  - Materials and geometries defined in **BRGEOM** package
  - Hierarchical structure of geometries
  - Each detector is built by its own **BLD** (e.g., **TPCBLD**) routine



# Detector Picture

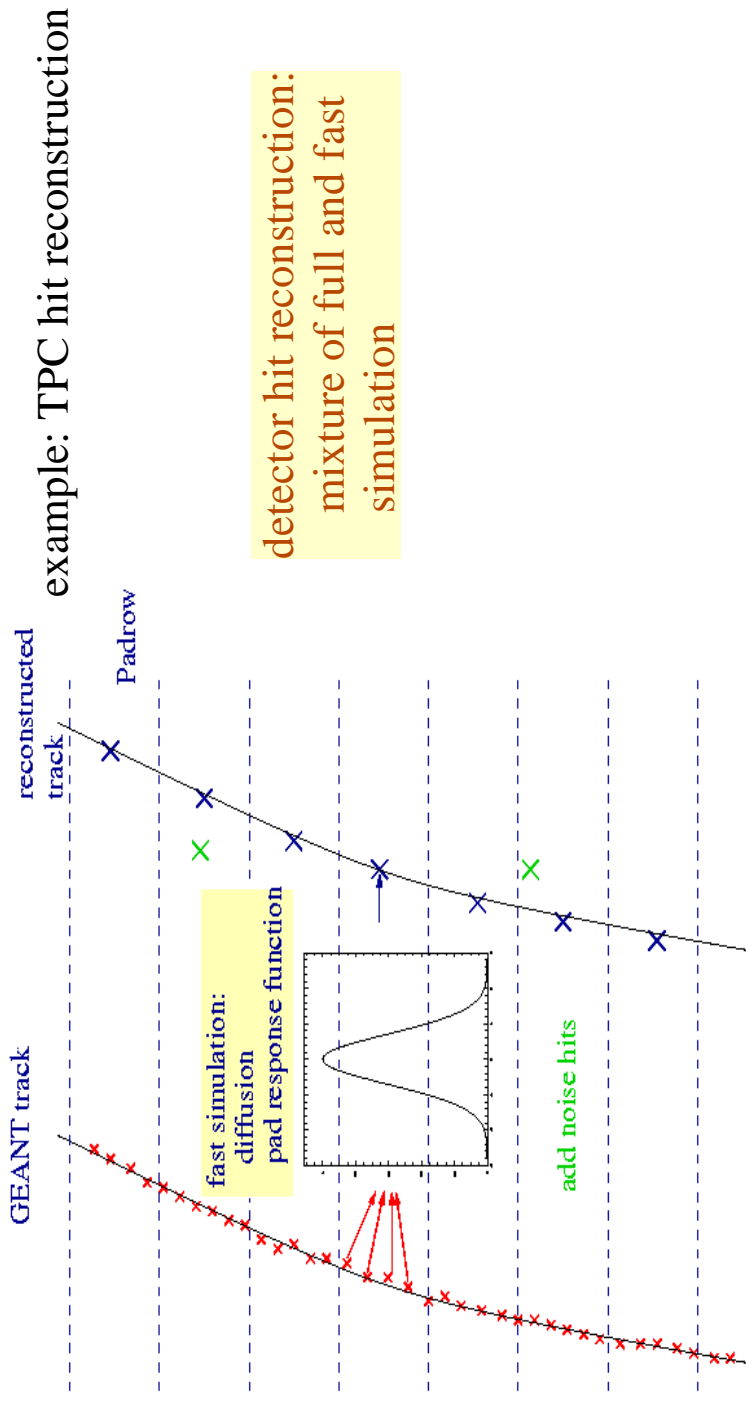
- a BRAHMS generated picture of the detector



note: muon system is not up-to-date!

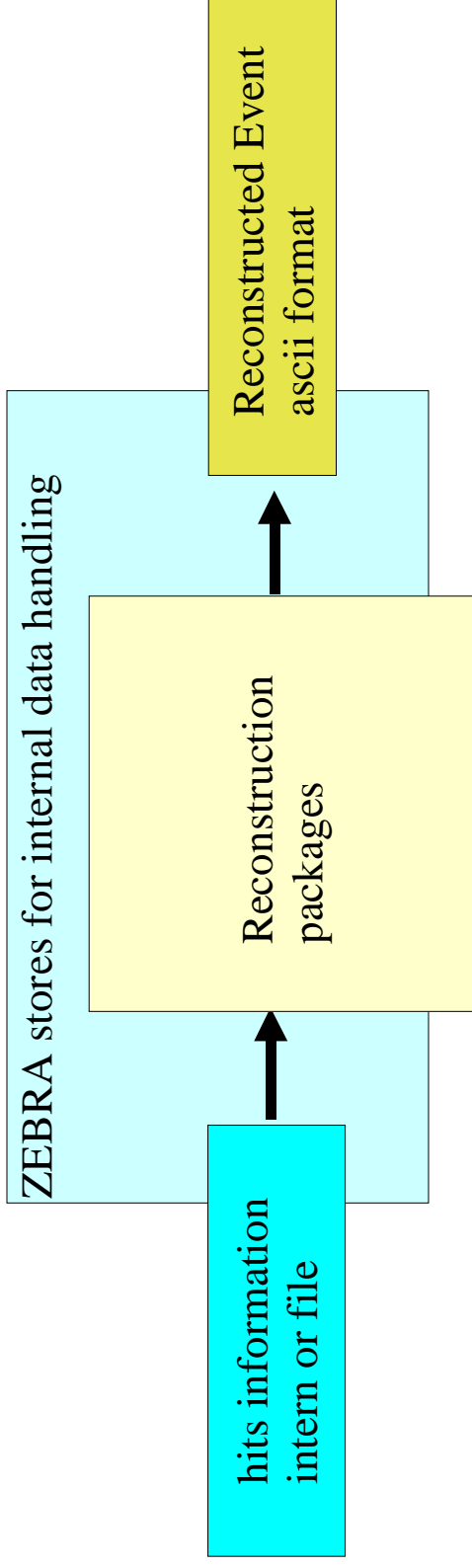
# BRAHMS structure: Hits

- after particle tracking by GEANT:
  - simplified building of detector hits output information
  - includes simple resolution effects for things like digitization, efficiencies etc
    - no full first principle simulation of the digitization step (yet)



# RECONSTRUCTION

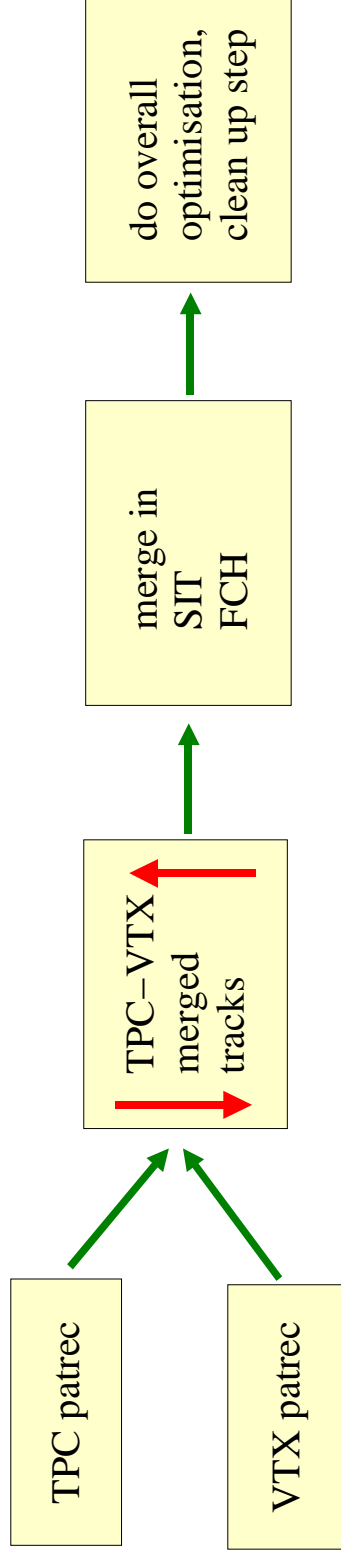
- reconstruction packages exist for tracking system (VTX, SIT, FTD, TPC, FCH: see Kristian Harders talk) calorimeter under development



# Track Reconstruction

- for a more detailed discussion: see talk by [Kristian Harder](#) in tracking session
- basic ingredients:

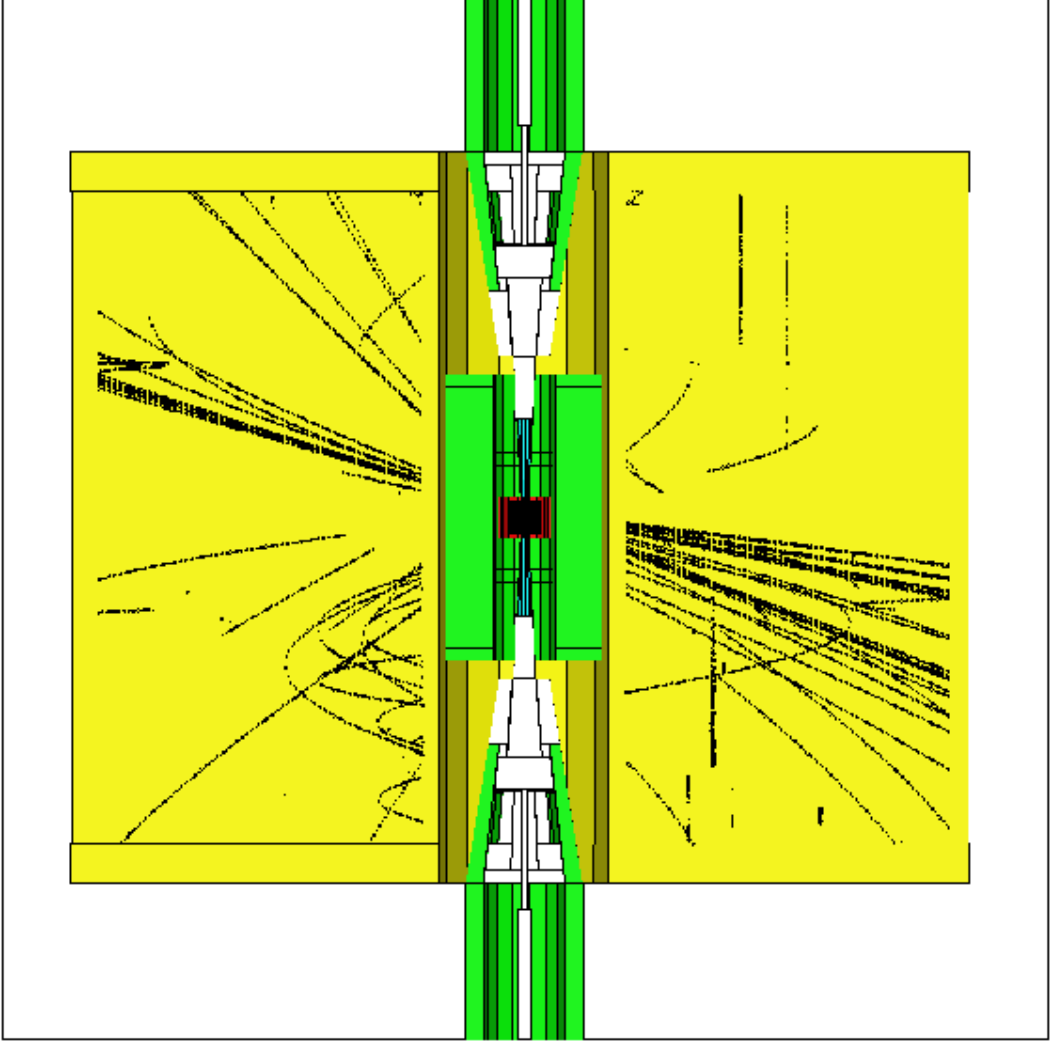
TPC pattern recognition based on ALEPH software  
VTX pattern recognition based on OPAL software  
merging processor based on DELPHI software  
global track fit based on DELPHI software





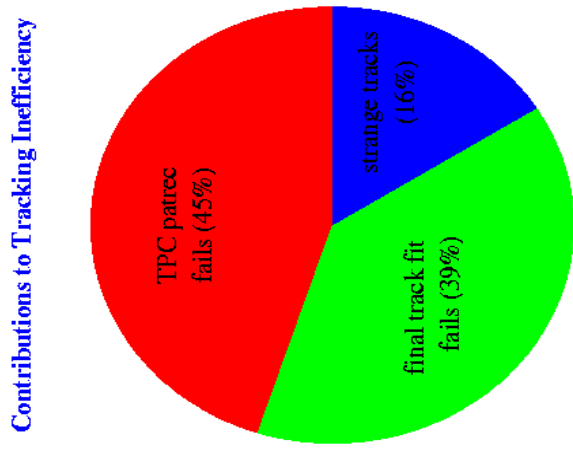
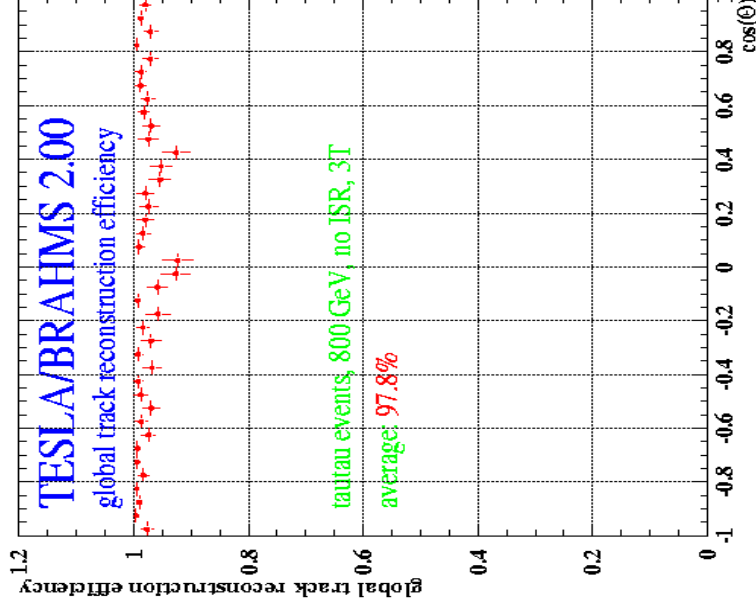
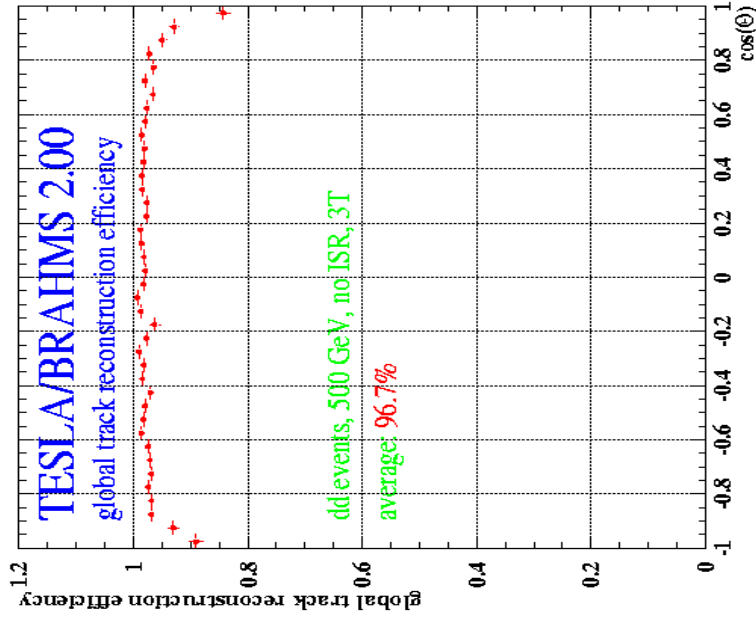
# A TPC Event

event picture of a dd event in the TPC  
with background superimposed



# Tracking Performance

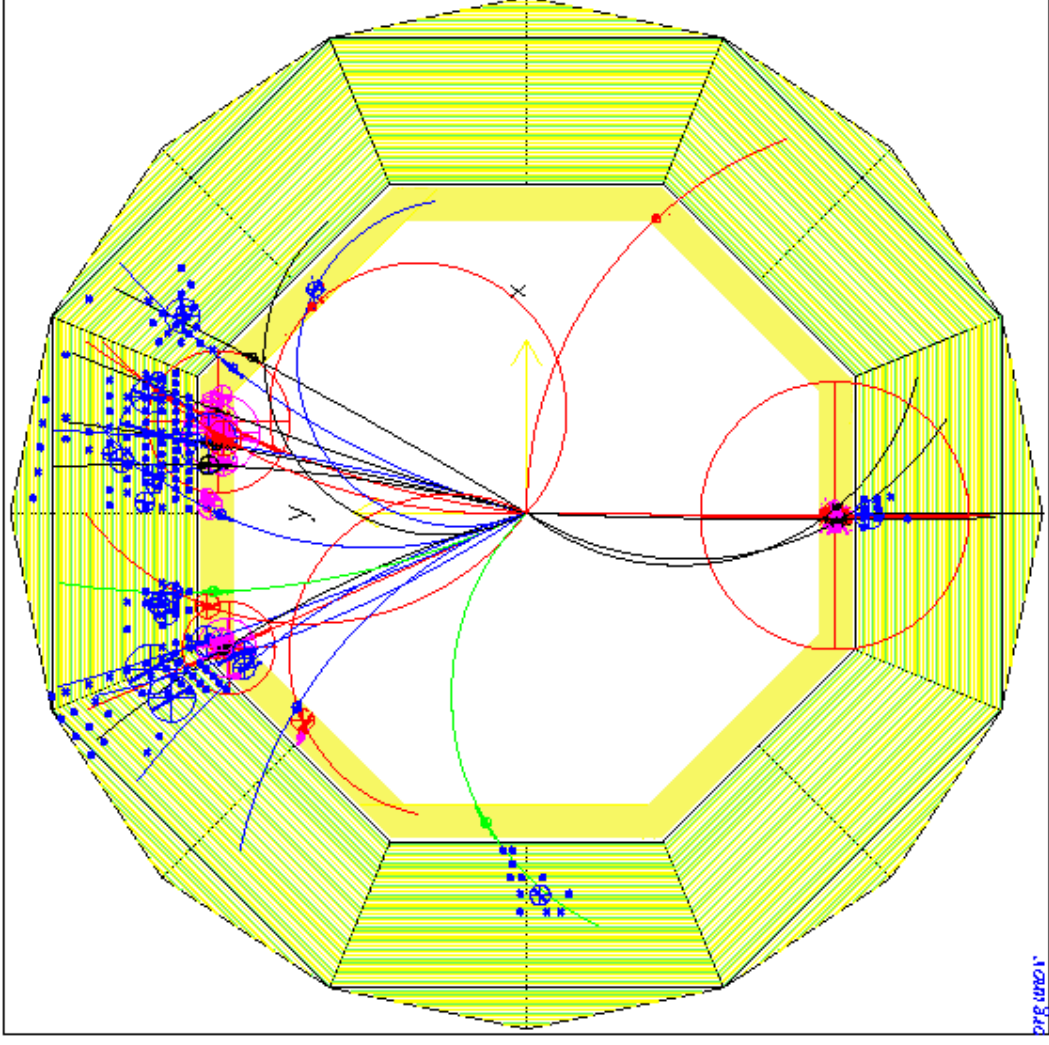
- preliminary results for tracking performance:
  - look at dd and tt events



- excellent reconstruction efficiencies even in complicated environment

# Calorimeter Reconstruction

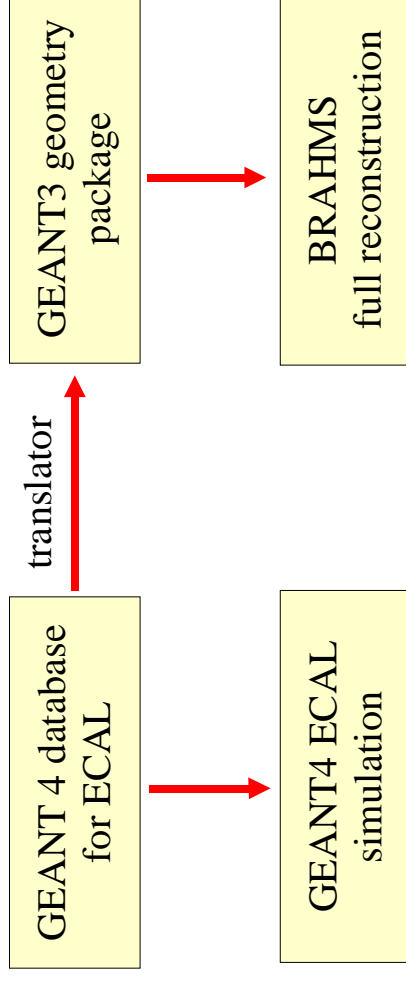
- calorimeter reconstruction software under development
- significant effort by many people starting from GEANT4 simulation: FRANCE starting from BRAHMS: DESY
- first version of clustering and energy determination for BRAHMS exists
- see detailed talk in Calorimeter session



# An amusing side effect:

- development of ECAL done in Paris
- main simulation tool is GEANT 4 geometry is defined in GEANT4
- to ensure the same geometry between GEANT4 and BRAHMS:

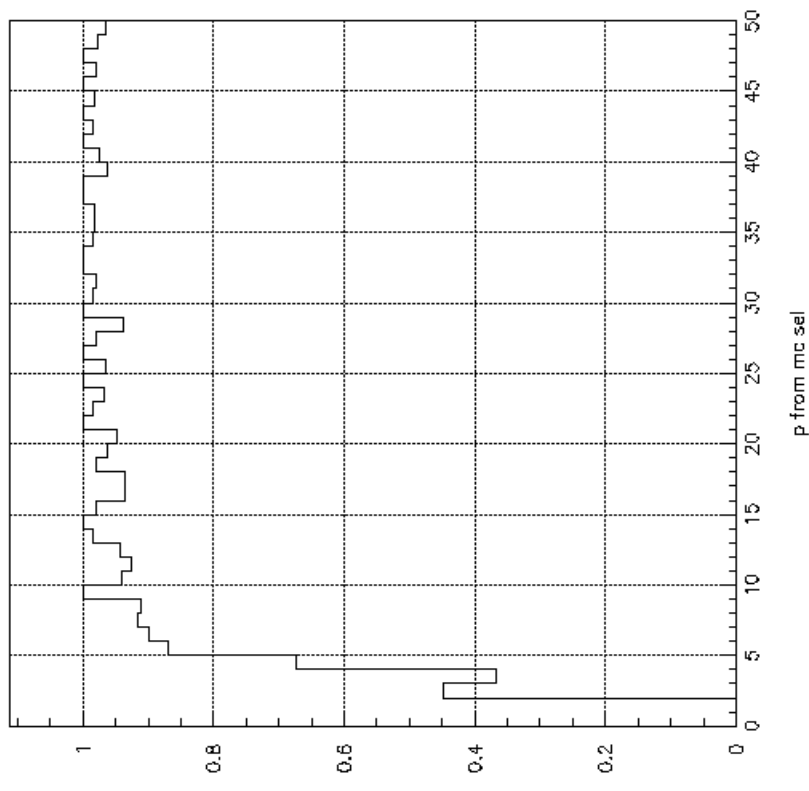
automatic translator GEANT4 geometry  $\rightarrow$  GEANT3 (BRAHMS) geometry



- very useful in development stage to make sure that the geometry in both packages agrees
- problem: code is not very efficient, final version will have to be optimized by hand

# Muon System

- simple muon reconstruction software exists:
  - rather good efficiency of finding an isolated muon
  - more work is needed for muon-ID in jets
- zeroth order implementation of muon reconstruction existing in BRAHMS
- **to be done:**
  - muon finding in jets
  - proper merging to the rest of the detector
  - include muon information in output file



# Problems

- Current (basic) problems with the BRAHMS implementation:
  - the problems of the 80th/90th are haunting us
  - memory management
  - code management
  - modularity
  - portability

this is the price to pay  
for using out-dated  
software....

- Advantages:
  - large base of existing software
  - large number of experienced people
  - stable and well tested product (GEANT3)

in particular given the very small  
number of people doing software  
development for ECFA/DESY this  
was probably the right decision

# Conclusion and Outlook

- BRAHMS offers a (nearly) complete suite of simulation and reconstruction programs.
  - full tracking reconstruction
  - full calorimeter/ energy flow reconstruction close to being finished
  - easy-to-use event interface for user analysis (nearly complete)

- BRAHMS is written in the "old" world of Fortran/ Zebra/ GEANT3 non-object oriented languages
- BRAHMS can draw on a vast array of experience and software from LEP, SLD, etc
- BRAHMS runs now (well, nearly...).
- BRAHMS will be with us for a while to come, even beyond the TDR.

- The future:
  - object oriented technologies
  - GEANT4 implementation has started (calorimeter)
  - new analysis framework (root, JAS, ...)

