Overview of the reconstruction software status

A. Sarti, V. Patera

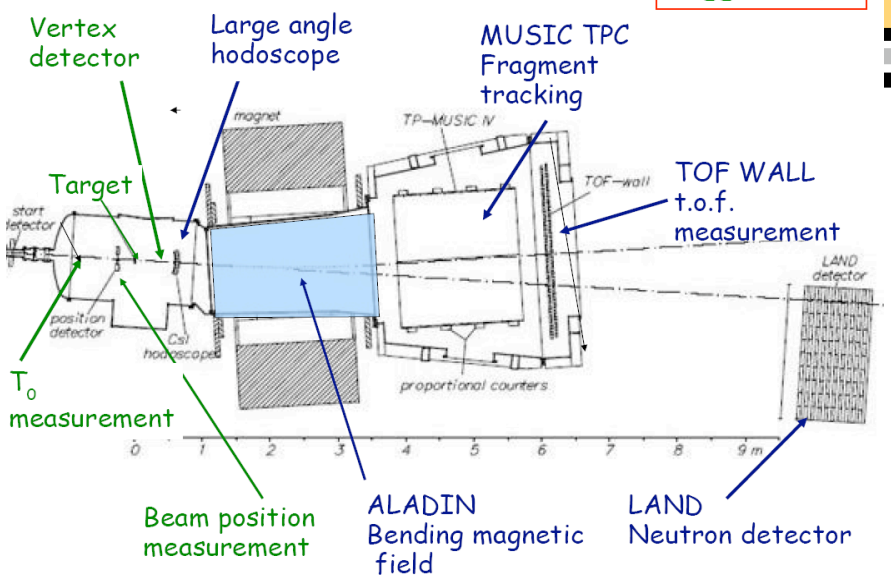
Aim of the talk

- Give an overview of the present status of the reconstruction software.
  - Definition of what we 'intend' as reconstruction for FIRST
  - Review of each sub-detector status
  - Define high-level goals for a full FIRST event reconstruction
- Care is taken in underlying the critical issues, needed manpower, critical deadlines.
  - Should be the 'starting point' for the plenary discussions on reconstruction software strategies
- MC status / prospects are not discussed here (see talk from V. Patera and T. Bohlen)
- Analysis level is not discussed either (what we do on the tracks that we have reconstructed is not object of this meeting)

Setup View

The existing setup plus...

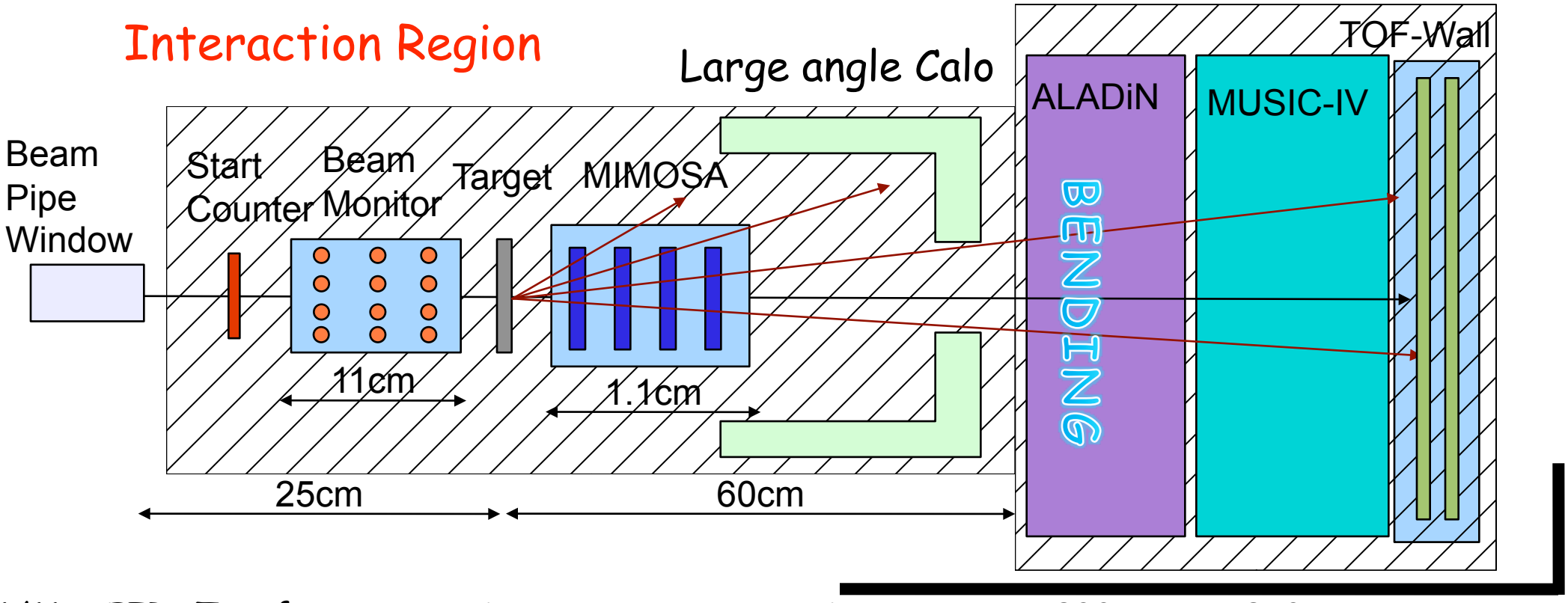
BLUE : existing
GREEN : new



Not to scale!!!

Large Detector Region

Interaction Region



FIRST reconstruction

- 'Raw Events' are written by MBS (ldm files)
- The '0 level' (0-L) from which the reconstruction starts is the 'digested' ldm output
  - The processing of ldm files can be 'easily' done by GO4 libraries producing the desired output (namely root files, but from now on you can substitute you favorite file type as 0-L output, we do not care at this stage...)
- Reconstruction should then take care of
  - Processing the 0-L 'root' files at sub detector level, reading the 'Digit' information from the input files.
  - Combining the 'Digit' information from 0-L into objects to be fed to the 'higher reconstruction level' (H-L). Those objects can be seen as : calo clusters, VTX tracks, BM tracks, Music/TofWall tracks
  - Combine, at H-L, all the event information in a full reconstruction of the event: track matching, Kalman fitting taking into account multiple scattering and magnetic field, track-calo matching, etc etc

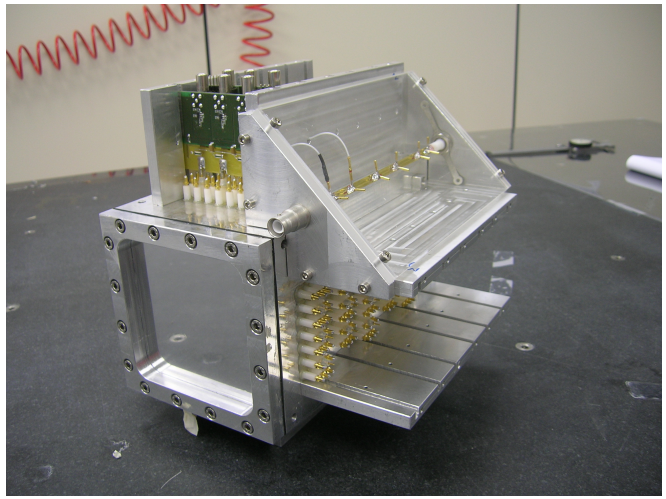
Reconstruction workflow

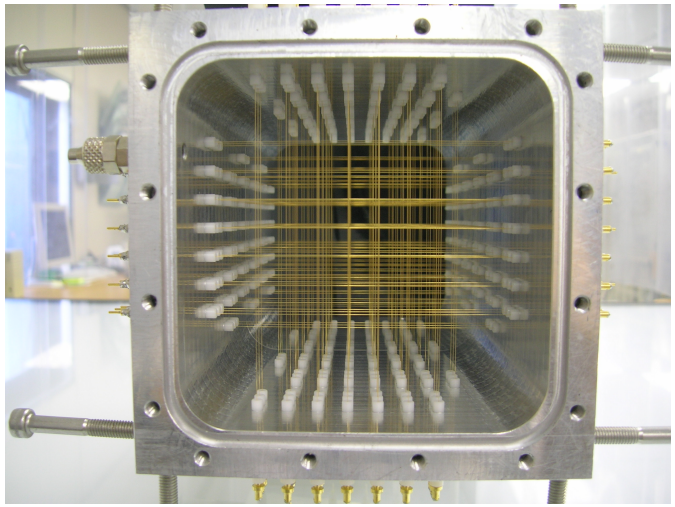
- The reconstruction software workflow will proceed in the following way. **For each event**:
  - The 'raw event' is read / decoded by the sub detector routines
    - Either GO4 or other 'ldm'-compliant libraries can be used....
  - Each subdetector produces a number of objects, per event, to be used for a full reconstruction [tracks, clusters,..]
  - For each event several H-L algorithms are executed, on O-L objects, for a full event reconstruction producing H-L objects for the event analysis
- In order to start working on that we need [the sooner the better]:
  - **MC 'raw-like' input** (See talk from V. Patera). Even a 'digested' MC (G04 like output) would be perfectly fine, since the RAW decoding is not an issue now.
  - **A general framework** that collects all the sub detector and H-L algorithms and runs the reconstruction job
    - Currently 'GAUDI' is being tested as a framework, but other solution can be checked/ tested as well.

Sub-detector status

IR status: Beam Monitor (BM)

- 0-L reconstruction is available:
  - takes as input ascii files : easily portable to read root input files
  - Has a geometry file implemented in c/c++
  - Creates the tracks using a patter recognition / track fitting in absence of Magnetic field
  - Provides monitoring histograms: charge and time histos, as well as track chisquare informations
  - Has a developed event display (root based)
- H-L reconstruction:
  - **To be developed**. We expect: track matching with VTX, track matching with Music/Tof wall.....





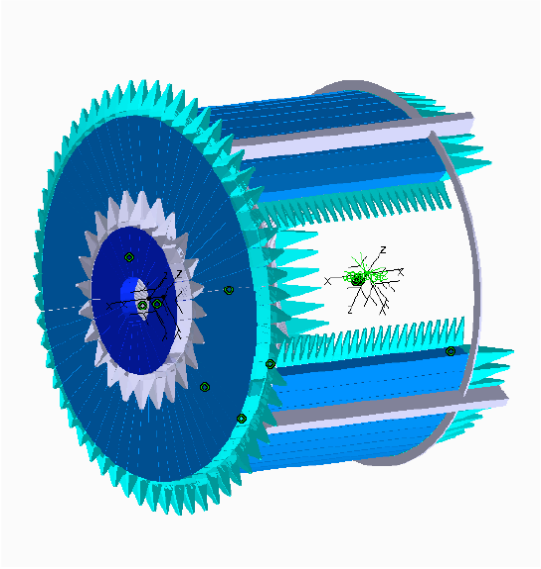
IR status: Vertex Detector (VTX)

- Mimosa reconstruction implemented so far:
  - Clustering algorithm: Neighbor search algorithm
  - Pattern recognition algorithm (track finding)
    - Based on:
      - Combinatorial approach + geometric cuts
      - Best track ranking with objective function (considering: Chi2, number of hits, cluster sizes)
  - Track fitting
    - Currently: Chi2-fitting
    - In future: Kalman filter for whole set-up?

T. Bohlen

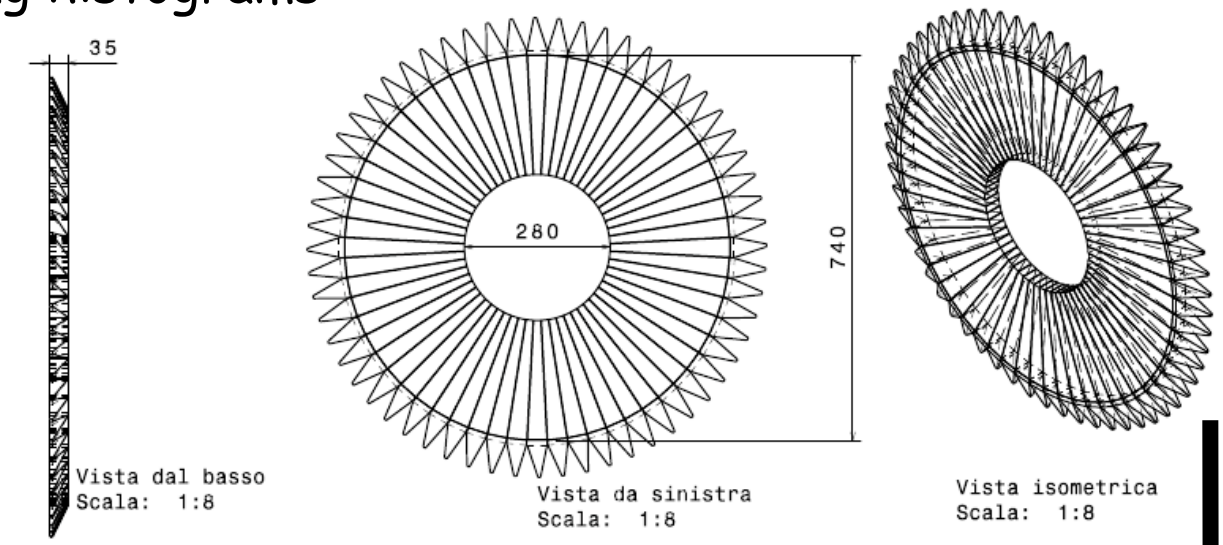
- We will hear more about that in the next talk (C. Fink)
- Long term plans
  - VTX tracks matching with BM, Music/TofWall, Calo
  - Implementation of monitoring histograms

IR status: Calorimeter (Calo)



- **Need to start from scratch**
  - Reading of O-L information should be straight forward
- Urgent issues
  - Define the detector geometry (also needed for MC simulation)
  - Implement O-L reading and cluster reconstruction
- Long term goals
  - Monitoring histograms

- VTX track - calo matching implementation: endcaps need the matching info to improve the time resolution (see later)



LDR: Music/TofWall Status

- 0-L reconstruction:
  - ldm reading is already implemented (the use of G04 should be checked)
  - 0-L objects creation already developed and used in other experiments
  - H-L reconstruction algorithms have been developed and are integrated: Music info is used to improve the TofWall reconstruction
- **Main issue here is how to integrate the existing software with the remaining of the code that is under development**
  - So far Music and TofWall were handled as an 'unicum': this needs to properly handled once moving forward towards a common framework that foresee a 2 level reconstruction workflow (0-L, H-L)
  - The implementation of the H-L objects matching/use for the overall event reconstruction is missing and needs to be implemented

H-L: Full event reconstruction

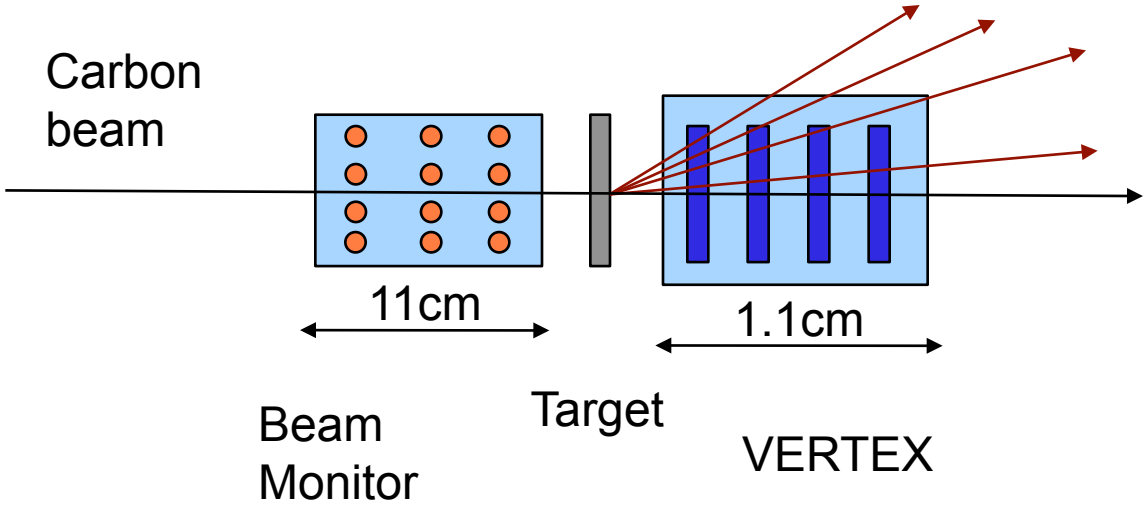
- Exploit the overall information for the entire FIRST setup
- Needs to put together the quantities from different subdetectors → needed the overall geometry: placement in the 'FIRST' coordinate system of all the various sub detectors
- **Crucial in order to check the physics quality of the data we are collecting and to compute efficiencies and/or acceptance.**
- **Mostly to be written**, with the important exception of the TOF-WALL & MUSIC reconstruction that are already fully integrated among themselves

H-L: Track candidates matching

- Needed the matching of the VERTEX tracks with the MUSIC track candidates. Tracks must be extrapolated through the ALADIN magnetic field (extrapolation software using the ALADIN filed map already existing) and through all the materials of the setup (windows, air, gas mixture..). Use of Kalman filter could be necessary to avoid mismatch. **To be almost totally written**
- Needed to link the vertex (hopefully) reconstructed from the VERTEX track candidates with the BM carbon track. For fragment with large angle and only 3 vertex planes crossed, could be needed to use both VERTEX and BM info to build a track candidate. **To be totally written**

H-L: BM and VTX trk matching

- Needed to link the vertex (hopefully) reconstructed from the VERTEX track candidates with the BM carbon track. For fragment with large angle and only 3 vertex planes crossed, could be needed to use both VERTEX and BM info to build a track candidate. **To be totally written**

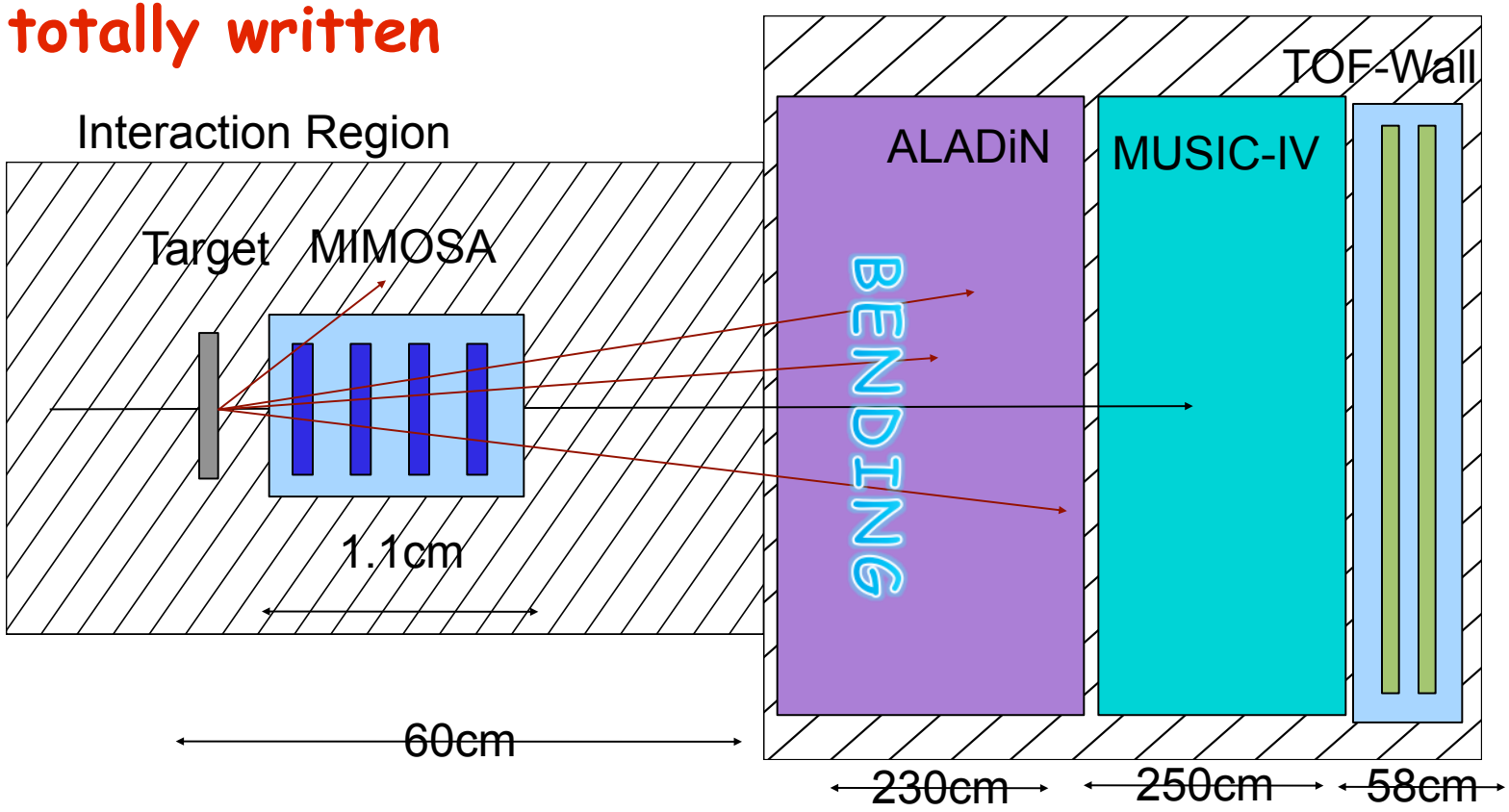


Not to scale!!!

H-L: Track candidates matching (II)

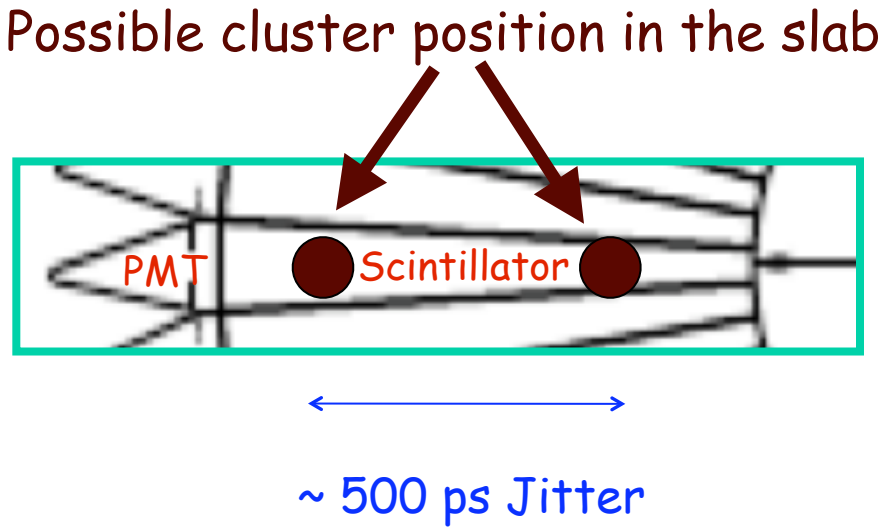
- Needed the matching of the VERTEX tracks with the MUSIC tracks. Tracks must be extrapolated through the ALADIN magnetic field (extrapolation software already existing) and through all the materials of the setup (windows, air, gas mixture..).
  To be almost totally written

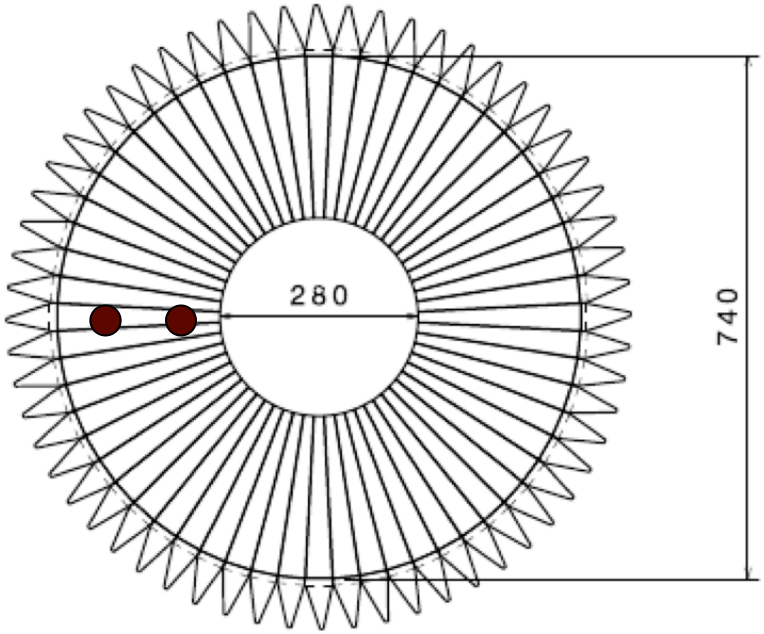
Not to scale!!!



H-L: track to cluster matching

- Already there for MUSIC and TOFWALL.
- Needed to be implemented to exploit the TOF capability of CALO. The cluster in the CALO detector should be paired with the track candidates of the VERTEX detector, since a time resolution below 300 ps must be achieved. **To be written.**





The 'subdetector table'

The 'URGENT' part is not only taking care of 'missing's

	DCH	SVT	CALO	Music	TofWall
MC	OK	OK	missing	OK	OK
ldm decoding	missing	missing	missing	OK	OK
0-L reco	OK	OK	missing	OK	OK
H-L reco	missing	missing	missing	OK	OK
geometry	OK	OK	missing	OK	OK

but ALSO taking care of the integration of the 'OK's

Conclusions

- Reconstruction software status has been reviewed:
  - IR Subdetectors ldm decoding is missing and needs to be implemented
  - 0-L reconstruction
    - DCH, Music, ToF wall: existing software to be 'merged'
    - Vertex: some code existing, need to be 'refined' and merged....
    - Calo: we need to start from scratch. Urgent: geometry implementation, 0-L reco
  - H-L reconstruction
    - Available only for Music/TofWall: needs to be merged with other detector reconstruction
- Crucial steps ahead:
  - Produce 'raw data like' MC in order to be able to play with it
  - Develop, in parallel, the skeleton of the reconstruction (0-L)
  - Adopt a common framework for the integration of all the reconstruction algorithms (0-L and H-L)

How do we proceed from now...

- Identify 'contact persons' for each subdetector
- Produce some MC for first reconstruction exercises
- Decide soon the Framework to be used for the integration
- For a data taking starting in Sept 2011, we must have ready
  - A working decoding / 0-L reconstruction software for each subdetector by April.
  - An integrated 0-L reconstruction software by May
  - An integrated H-L software by mid June
  - June/July would then be devoted to makes full exercises on MC and on TB data in order to
    - evaluate performances (timing, memory/disk usage, etc)
    - define monitoring algorithms / data quality checking procedures