

Issues of Reconstruction Software

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Skip simulation software issues (primary ions, ion disk, non-uniform B-field, and resultant distortion, etc.) -> Tomorrow by Thorsten Krauscheid

Our Goal

- LP1 Test Beam Analyses
 - We want to test primarily those features which we can test only with the large prototype:
 - Multi-module tracking in the presence of significant distortion due to non-uniform B-field; need to establish the correction procedure.
 - Resultant momentum resolution to be consistent with our design goal when extrapolated to ILC-TPC.
 - Effects of module boundaries
 - Gating in the multi-module environment?
 - Nevertheless we need to start with confirming the SP results, which is what we are mainly doing right now.
- Feed back to LC-TPC design
- Feed back to ILC tracking software
 - For the moment, the ILD tracking code is FORTRAN. It is useful if we can replace it with the C++ code with higher functionalities imported from the LP1 software.

A Little Bit about History

- The end of 2008 – the beginning of 2009: There was some general delay in the whole LP1 preparation
 - The LCIO-based DAQ system was(/is?) not yet available.
For the coming test beam we decided to use the local non-LCIO-based DAQ software developed at LUND for the ALTRO system R&D and to convert the data to LCIO so as to use MarlinTPC for the analyses. Notice that the software delay was coupled with hardware delay. Asian GEM modules were no exception: they became available just before the test beam.
 - Meanwhile Yukihiro Kato started testing MarlinTPC by trying to look at our small prototype (MP-TPC) data but there was a mismatch in the LCIO versions.
 - We started looking at beta ray tracks with the 1st Asian GEM module that became available at the head of 2009. A working event monitor software was in desperate need. We created a very primitive monitor program called yokaRawMon.
 - It turned out that no LUND to LCIO format convertor was available at that point. Martin was working on it, communicating with LUND experts.
 - Yukihiro Kato continued investigating MarlinTPC usability for the analysis. It turned out at this point that there was no usable helix/circle fitter implemented as opposed to our expectations that basic functionalities of “Multifit” had been implemented and tested for some small prototype.

History (Continued)

- Feb.-Mar. 2009: The 1st test beam with Asian GEM modules.
 - We concluded that we need to implement helix/circle fitter in MarlinTPC for the test beam analysis. We asked for a template complying with MarlinTPC design philosophy and coding rules to start with.
 - While waiting for the template the test beam started and we got in a situation where we had to do a kind of blind flight with only a very primitive semi-online (yokaRawMon) data monitor. Since the central module had a problem in this period, we decided that the data in this period should be used for debugging purpose.
- Apr. 2009: The 2nd test beam with Asian GEM modules with the bad connection in the central module (module 3) fixed.
 - The template for MarlinTPC was not yet available. We waited until the last minutes but had to decide to cook up a quick and dirty analysis program with a Kalman filter based helix fitter to make sure the data taken this time were OK, before the end of the test beam. This is how yokaRawMonNeo was born (product of a couple of days' effort). It was also necessary for TILC09.
- Apr. 2009 - Now: Analyses of the test beam data.
 - There is no essential development of the code except for the implementation of multi-module tracking.
 - We are still waiting for the template, which may be already somewhere.
 - **We are planning to implement what we have into MarlinTPC as originally planned.**

LCIO Issues

- An OO language like C++ imposes the software designer's philosophy to its users/co-developers, which has both bright side and dark side.
- The original design philosophy of LCIO:
 - We should not constrain various world-wide activities too much by imposing too many rules and design guide lines in particular when people are experimenting on various possibilities.
 - Instead, we should define and standardize input/output data structures at various stages of data simulation, reconstruction, and analysis, and facilitate the data exchange between various groups to test various software designs and algorithms.
 - LCIO defines data containers for transferring data between various stages (=processors) in order to make processors mutually as independent as possible.
- LCIO weak points
 - Containers lack high-level functionalities.
 - Makes inter-processor interaction difficult at the cost of inter-module independency.
 - Relation to ROOT: I think some misunderstanding here.

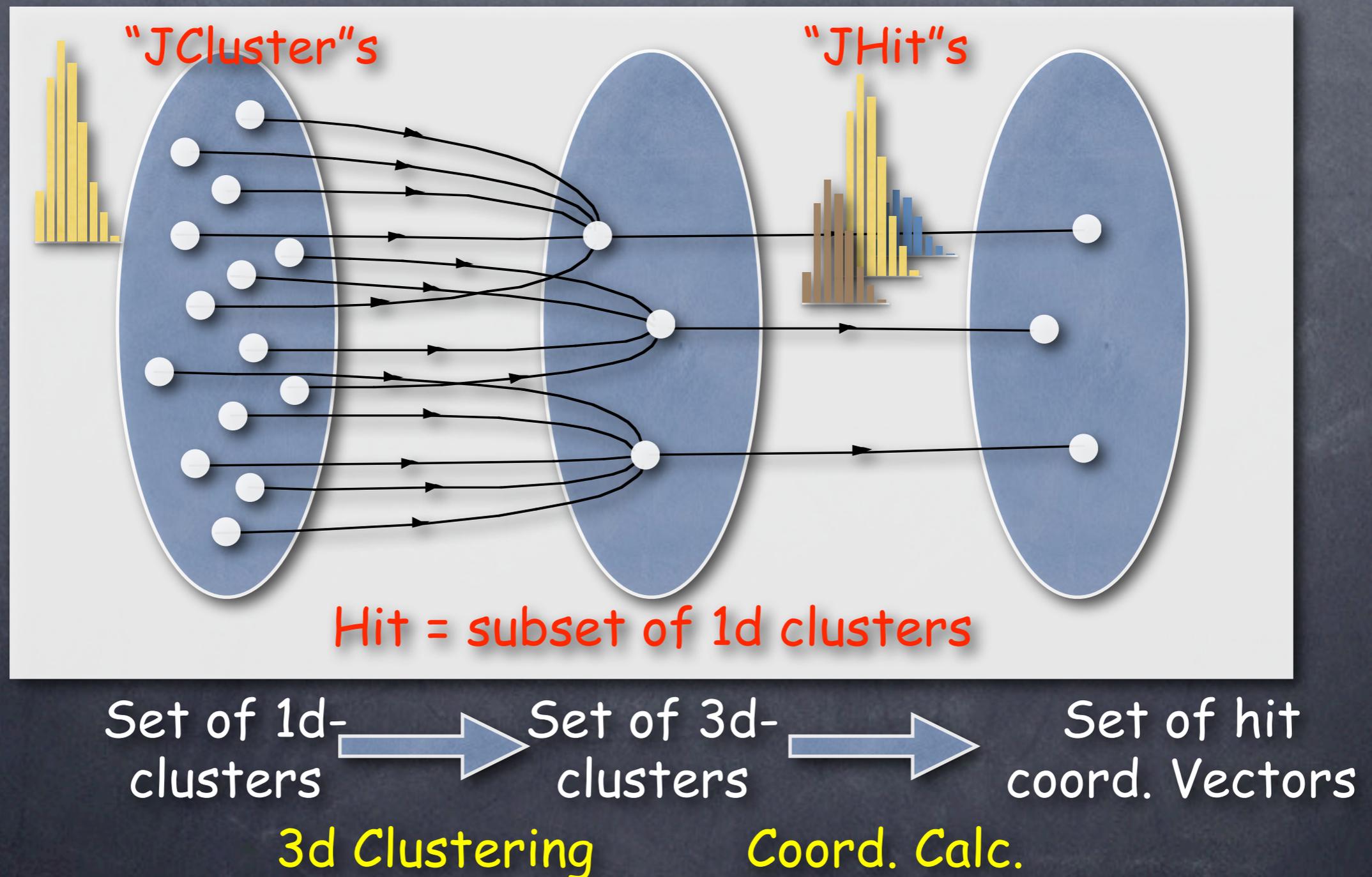
Necessary Functionalities

Wish List

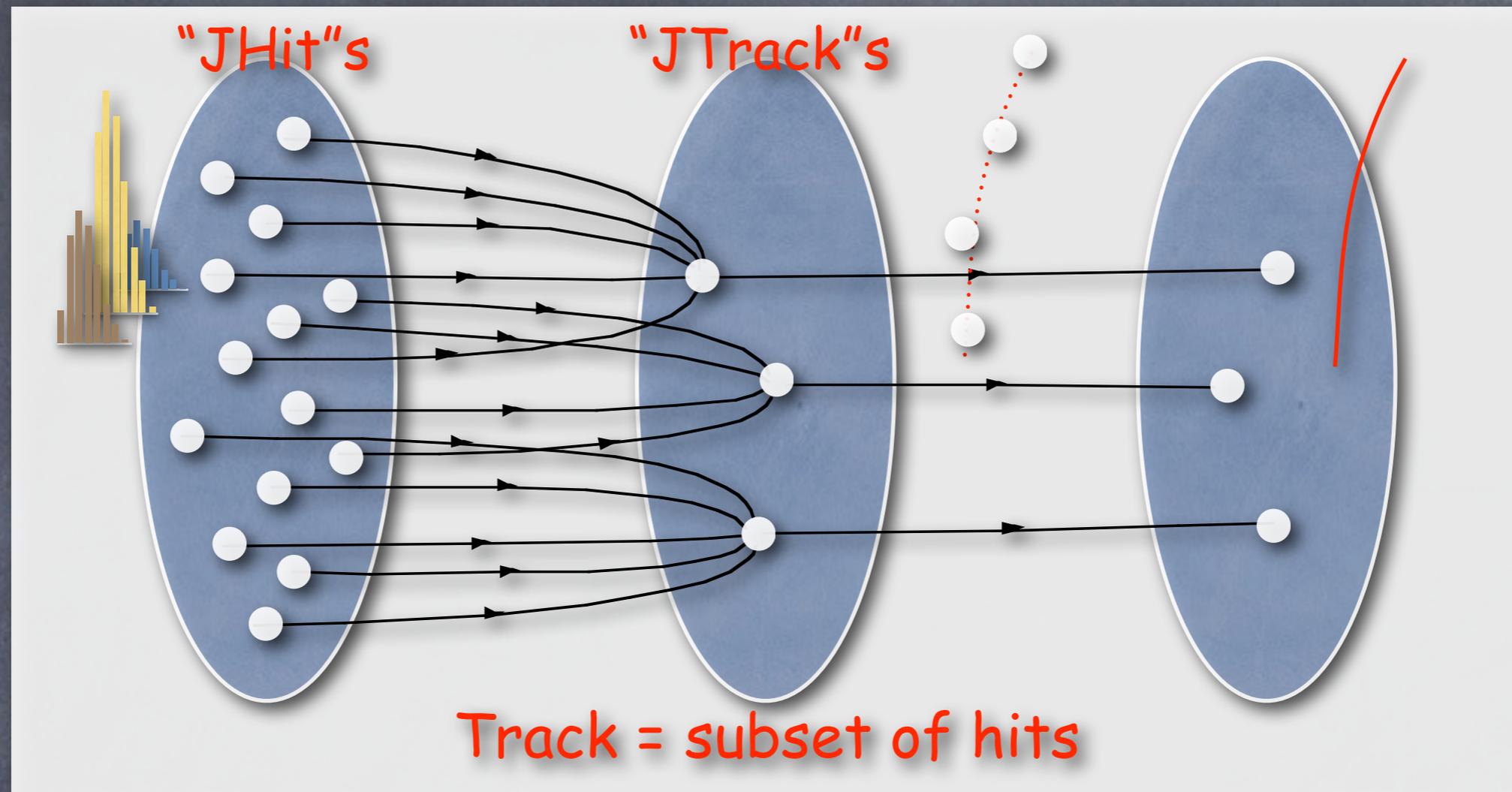
- For LP1 Test Beam Analyses
 - Data Monitoring (3D event display, various plots...)
 - Direct access to events, zoom up/down, rotate, ...
 - Direct access to objects like tracks, hits, clusters, pulses, ...
 - Plug-and-play user defined monitors
 - Facility to handle non-uniform B-field
 - Non-helical track model with B-field map implementation.
 - Distortion correctors.
 - Well designed virtual software layers to make the steering part of the software as independent as possible from particular hardware configurations.
 - Facilities for basic analyses on pad response, point resolution
 - Facility to easily add and remove hits from track fitting for instance with inverse Kalman filter
 - Direct access to objects like tracks, hits, clusters, pulses, ...
 - Direct access to track parameters at each hit point as available from Kalman filter smoothing for angle dependence ...
 - A mechanism that allows direct inter-processor interactions of high-level objects? super-processor including functions of multiple processors.
- For feed back to LC-TPC design
- For feed back to ILC tracking software

Basic Concepts in Tracking

Hit Making = 3d Clustering x Coordinate Calculation



Tracking = Track Fitting x Track Finding



Set of Hits



Set of Tracks



Set of Track Param. Vectors

Track Finding

Track Fitting

-> e.g. Kalman Filter

Inter-processor Interactions of Intelligent Objects

Future Direction

- Need a score sheet on what we need, what is available, what is being worked on, and what is to be assigned to someone or some group.
 - > Martin's talk
- Maybe this is one good chance for us to create one.