ILD: A detector for particle flow

The ILD concept

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on behalf of the ILD concept group

not to be confused inadvertently with the International Women's Leadership Conference

Outline

What has driven the ILD conception?

The main features of the concept

The ILD group

Preparing for the DBD, where do we go, where do we stay.

A large effort stemming from the R&D developments
taking place in the R&D collaborations (see JC.Brient talk).

Physics aims

The physics under consideration:
everything you can dream of seeing, directly or indirectly produced
in the energy range under consideration, Z to TeV.

Specific goals: top, Higgs properties, sleptons, WW scattering, Z' s...

To maximise the use of the luminosity, we need
an efficient and precise detector

We want an excellent lepton identification and measurement
but we need to exploit fully the hadronic decays of the bosons, W, Z, H.

To extract the best out of each sub-system, vertexing, tracking, calorimetry
optimally combining their informations
<u>we intend to design the detector along the principles of PFA:</u>

measure at best in the relevant sub-system the different particle species
isolated or in jets,
which means first separating them.

Accelerator constraints

The detectors have to cope
with a certain number of constraints coming from the accelerator design:

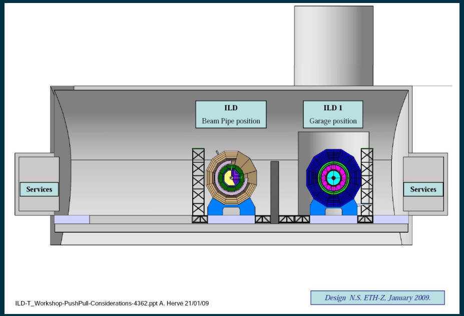
the energy range, from the Z peak to 1 TeV,
a lot of particles is at low energy, but high tails

the time structure, long trains (1ms) at 5Hz. offers power pulsing possibility

the crossing angle, may impose, together with background a DID,
generates an asymmetry

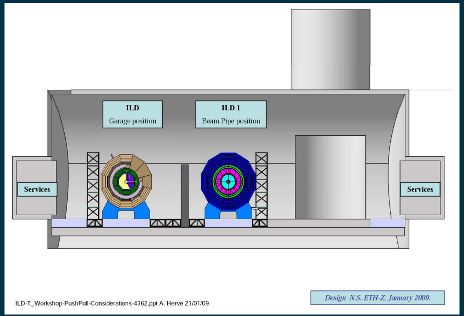
the beamstrahlung, induces a flux of pairs to be contained by a large B,

the L*, the last quadrupoles sit inside the detector, hermeticity, vibrations



But also the constraints coming from the hall design, deep or not, …

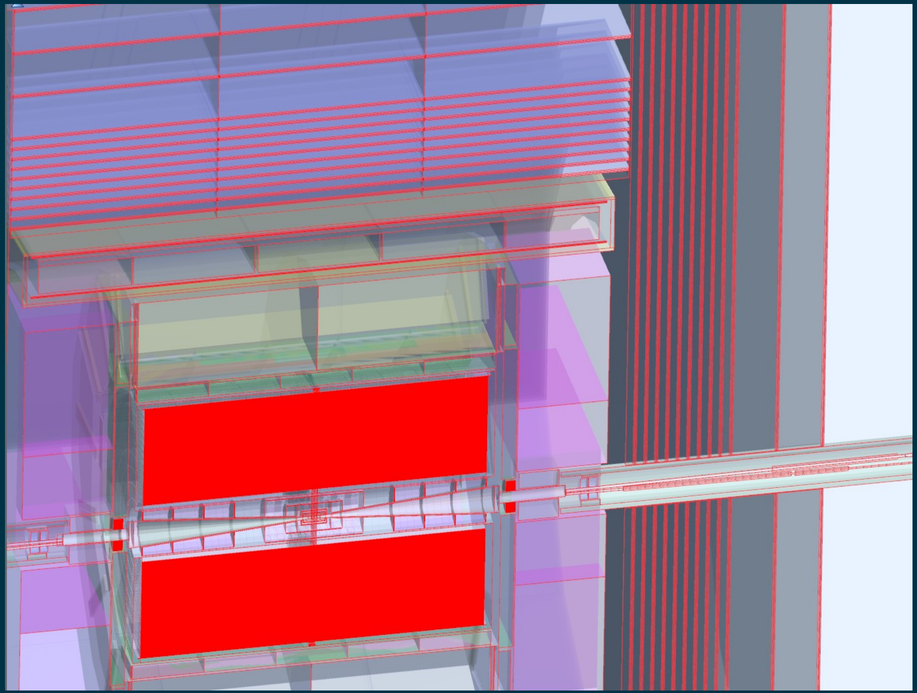
and from the concept of push-pull, what do we gain, what do we loose?
Can we switch the detectors fast enough not to waist luminosity?
What is the impact on the detector design?



The main features of the concept

a question of topology

It is meant to be
not a collection of beautiful sub-systems
but a detector globally optimised and integrated



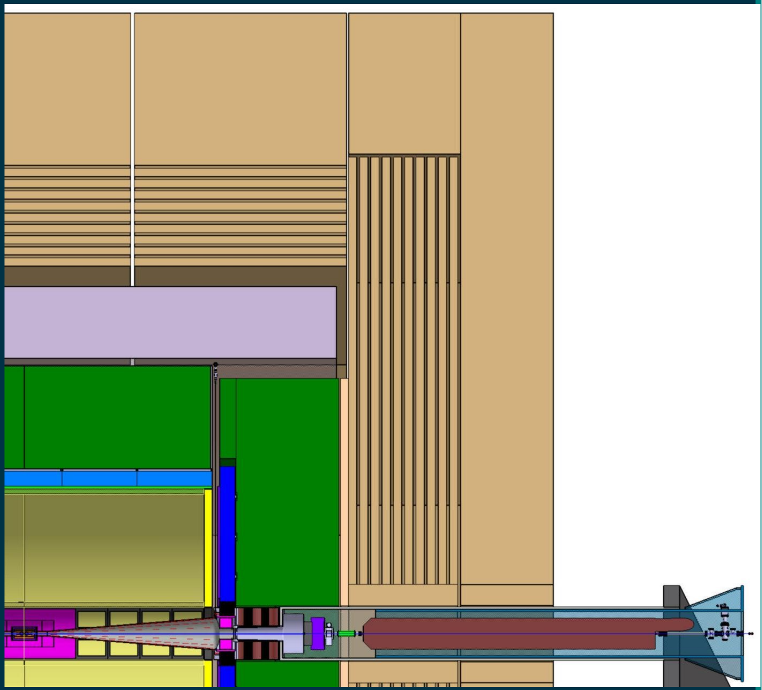
We try to reach
an equilibrium between
very advanced technologies developed in R&D collaborations
and a strong integration in ILD.

The driving idea:
A strong commitment to the “image quality”
precision, resolution

Large
precise and redundant for pattern
offering as much as possible a continuity: TPC, tracking calorimetry
hermetic, small angle coverage, no pointing cracks, thick enough
reduce inefficiencies and fakes.

Some sub-detectors exist in different options

The main features of the concept



Global mechanical design

a cylindrical aspect with a barrel and two end caps
a strong axial field (3.5T) at 7mrad with the beams
meant to provide good p_T measurement and
to keep the background inside the beam tube
a heavy return yoke
to keep the stray field acceptable for the others. Muon detection

an inner ensemble of detectors in silicon,
vertex detector, intermediate and forward tracking
efficiency at low p_T , precise impact parameter, transparency

a large (180 cm) TPC for tracker,
redundancy and dE/dx, V^0's, backscattering, electrons
transparency, distortions, track resolution (for eg taus in 3 prongs)
backed by a silicon envelope

a calorimeter inside the coil, in two sections electromagnetic and hadronic,
with a very fine grain, 25mm² for ecal, 1 to 9 cm² for the hcal digital or analogue

a calorimeter closing at small angle: luminosity monitor, Lhcal, beam cal

The main features of the concept

The number of electronic channels is very large, e.g. ~10^8 for calorimeters
and the front-end (including digitalisation) is embedded in the detector
There is no global trigger, each channel is self-triggered.
The power consumption , hence the heat, is reduced by power pulsing

The full detector is simulated in detail in a Geant4 application: MOKKA

A common software framework, MARLIN, hosts the reconstruction tools

The ILD group

ILD is not a formal collaboration with clear commitments
but rather a congregation
or a partnership
between individuals more than institutions
to produce a realistic design for a detector.

It has a light organisation: JSB for more political issues
Executive Board for more technical points,
congressional meetings.

A common spirit rather than a common structure

It has produced a Letter of Intent accepted by IDAG
and goes for something more elaborate and more proven
from the technical point of view:

a DBD

The LoI has been signed by hundreds of people from all around the world

Preparing for the DBD, where do we go, where do we stay.

Our roadmap for publishing in 2012 a Detector Baseline Document has been defined by the Research Director

We can extract the following:

- Demonstrate proof of principle on critical components.
  When there are options, at least one option for each subsystem will reach a level of maturity which verifies feasibility.
- Define a feasible baseline design.
  While a baseline will be specified, options may also be considered.
- **Complete basic mechanical integration** of the baseline design
  accounting for insensitive zones such as the beam holes, support structure, cables, gaps or inner detector material.
- Develop a **realistic simulation model** of the baseline design,
  including the identified faults and limitations.

Following these lines

Preparing for the DBD, where do we go, where do we stay.

It is the role of ILD to select technologies proposed by R&D collaborations
to fulfil the needs of the design described above.
It is the role of these R&D collaborations to bring the proof of principle.
The procedure for selecting an item is not yet defined but contains surely:

- the proof of principle
- the demonstration that it can be properly integrated in the detector, mounted, serviced
- the existence of a detailed simulation and a proof of performances

The agreement on putting an option in the baseline implies certainly
the existence of reviews asserting the state of these options,
we start discussing their organisation.

An important step is to provide a global model of detector
implementing the different options in situ with all their services.

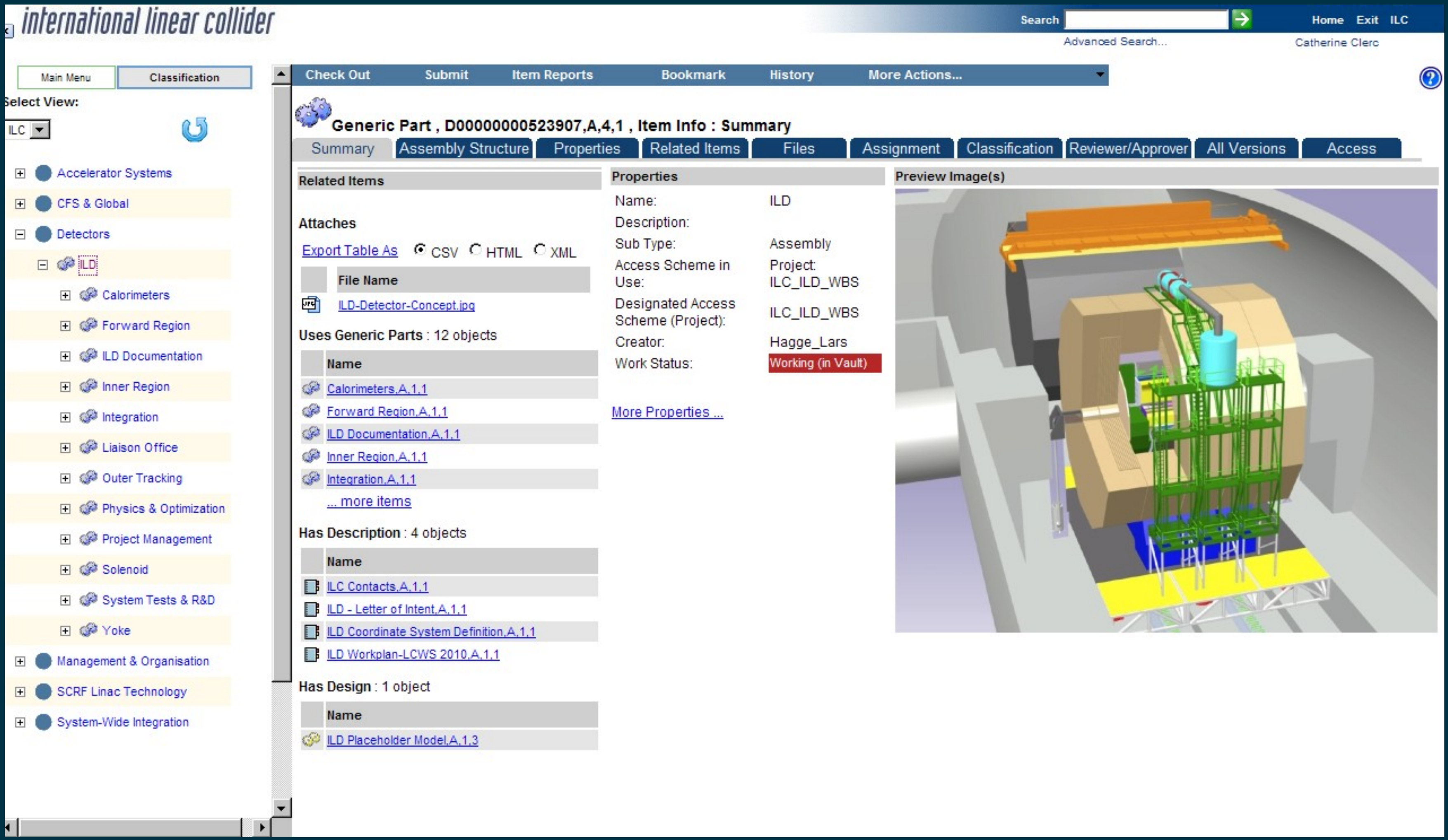
The way ILD has chosen is to elaborate a global CAD model
integrating contributions by the different sub-detectors.
To make available the related information and in particular dimensions,
a structure has been created in the ILC-EDMS

Enforcing the compliance

A parallel step is to provide a detailed simulation for every option, in adequacy with the CAD.

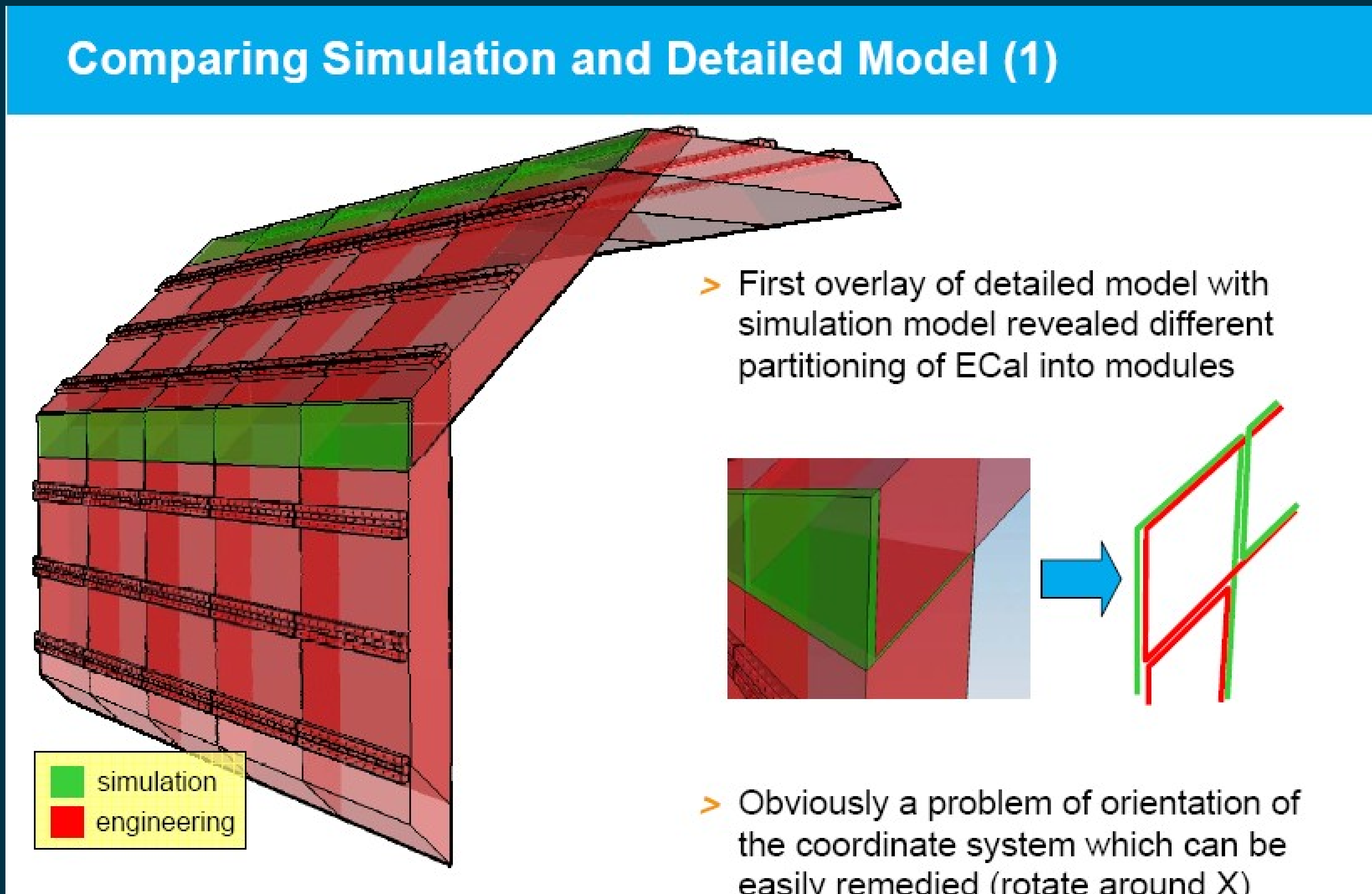
ILD engineering documentation under ILC-EDMS

Goal: Handling and sharing ILD information
parameter definition, CAD models, simulation models, technical documents



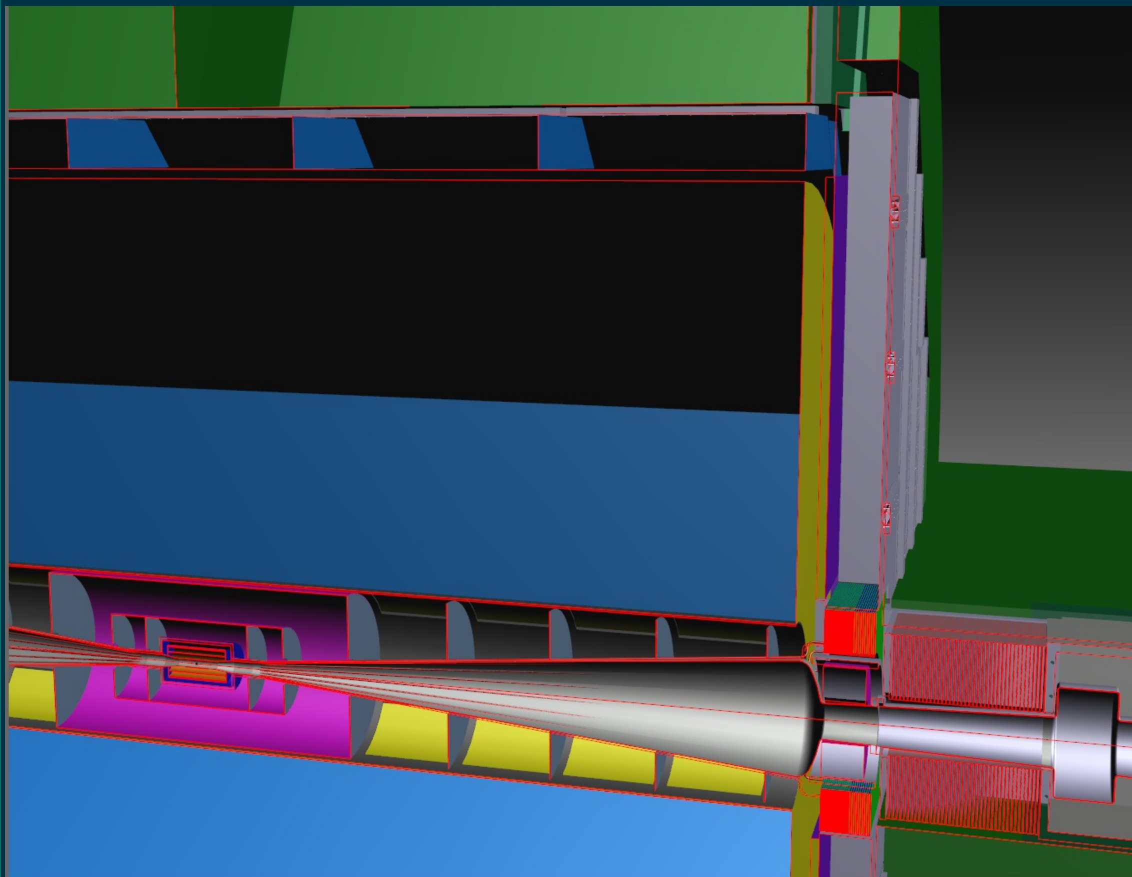
ILD engineering documentation under ILC-EDMS

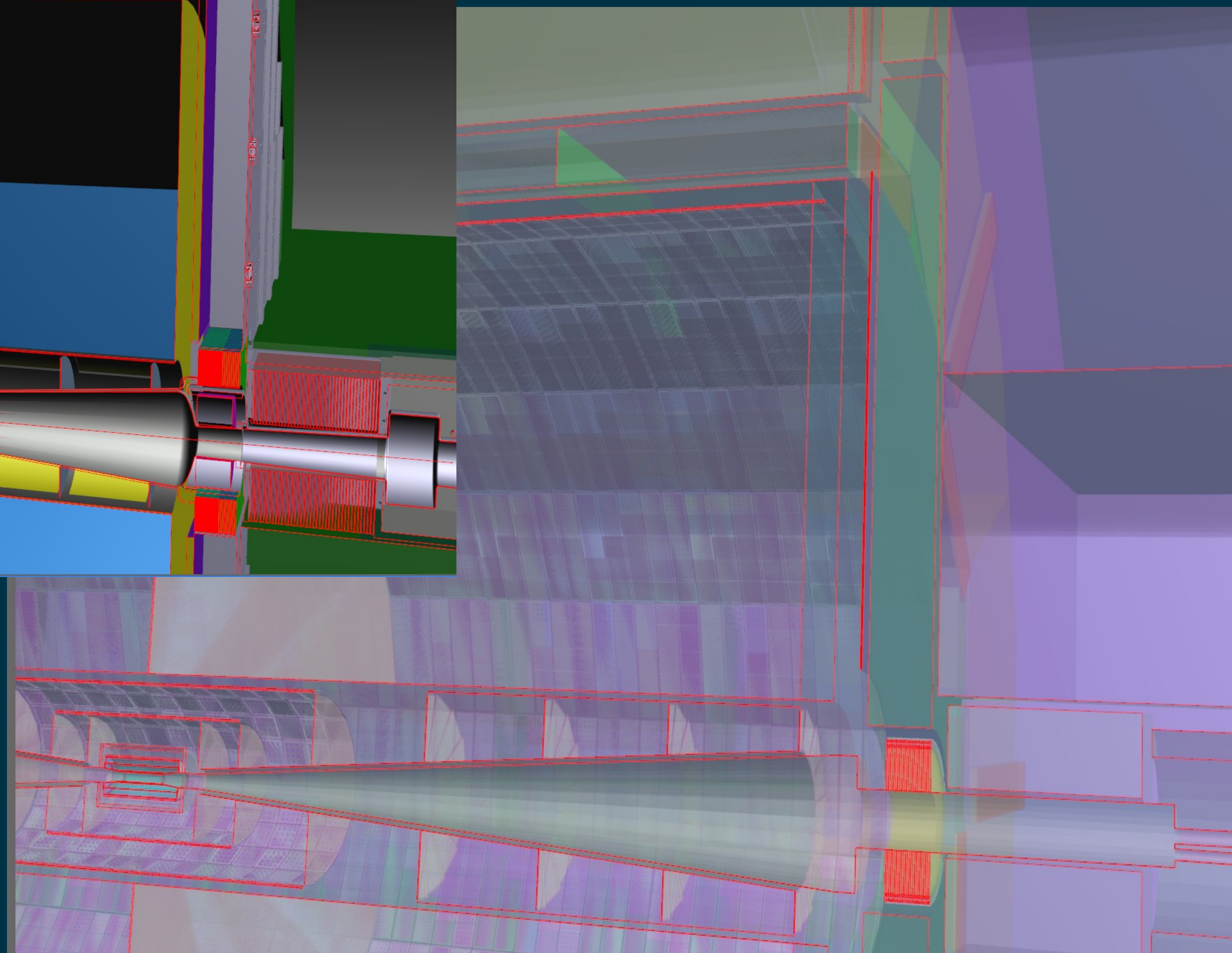
EDMS has a viewer to manipulate the models and compare them.



Example: superposing ECAL CAD with simulation

CAD and MOKKA provide 3d pdf of their models





Integration

The ongoing effort in designing globally the detector is in two steps

From the actual proposals for sub-detectors, derive their envelopes,
and define the corresponding place holder. Publish them.
The different options have then to fit in the corresponding place holders
ensuring that there is no conflict.

The second step consists in defining the space needed for services:
cables, cooling, etc.
and make sure that there is no conflict.
The space taken by the services is part of the evaluation of options
since it may have a direct impact on physics
for example dead material in the inner part of the detector
or region between barrel and end cap.

There has to be a schematics for assembly, and for accessing parts for maintenance
this implies ways to get the services into the different regions and places to disconnect

The detailed simulation will contain these pieces to infer their impact.

Defining the
dead zones
and the materials

Defining the minimal gaps
between sub-detectors

Implementing dead zones and materials,
imposing gaps in the simulation model

up to what detail?

Dead material

Services:
- cables (size and number)
- cooling pipes
- supports and screens

Electronics protruding out of the space holders

Sub-detectors supports

Patch panels needed for
- assembly or maintenance

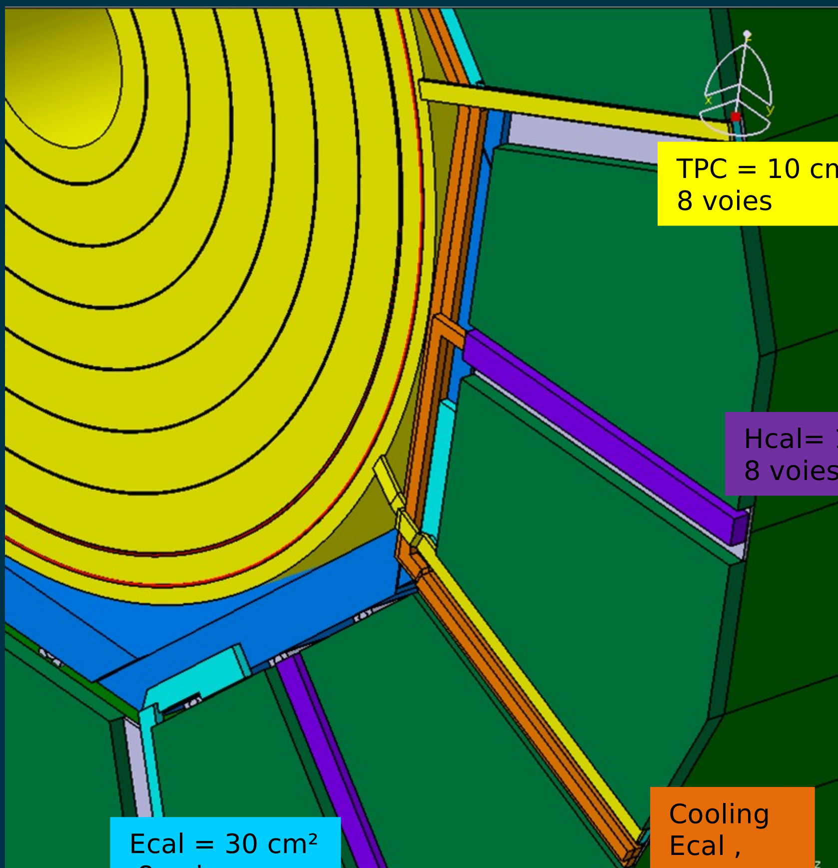
Gaps

Space for services, supports, screens, patch panels

Space for assembling tools

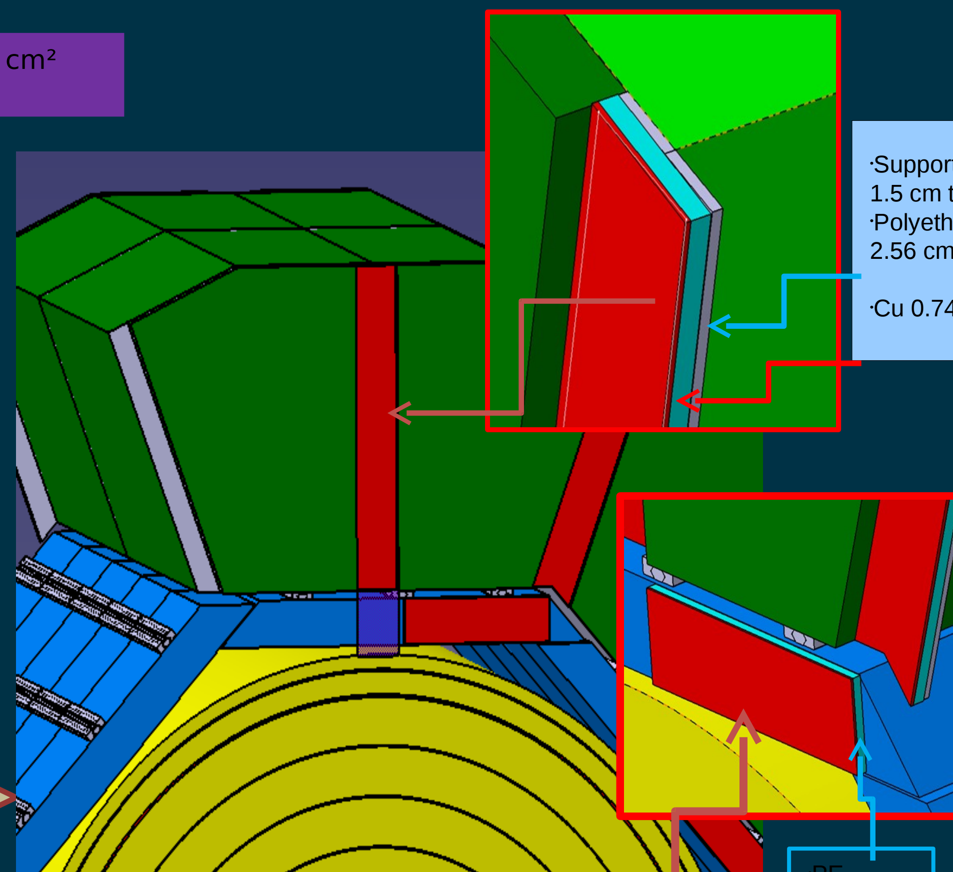
Watching plays imposed by
- construction
- alignment,
- mechanical deformations,

Example of services crossing the overlap region

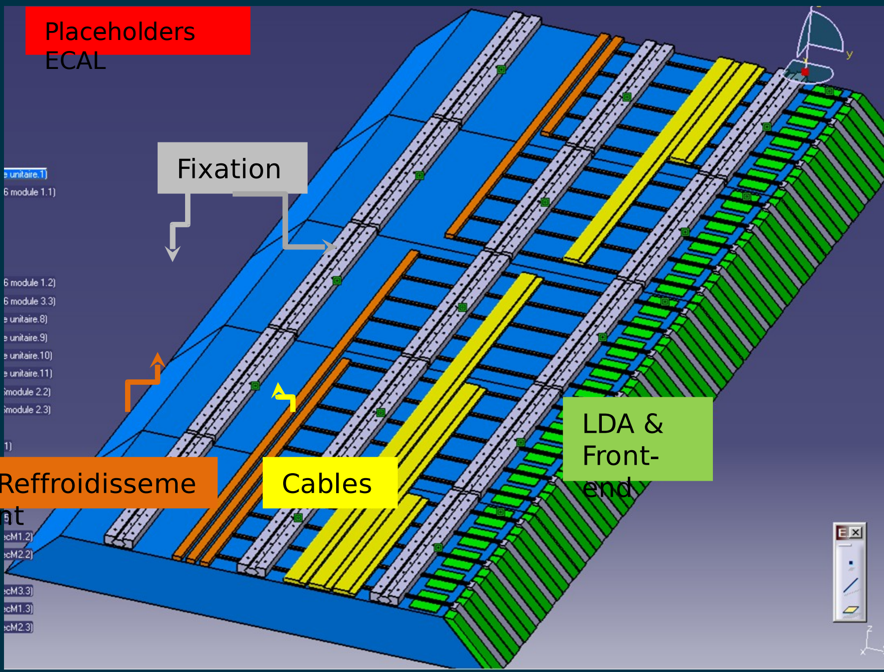


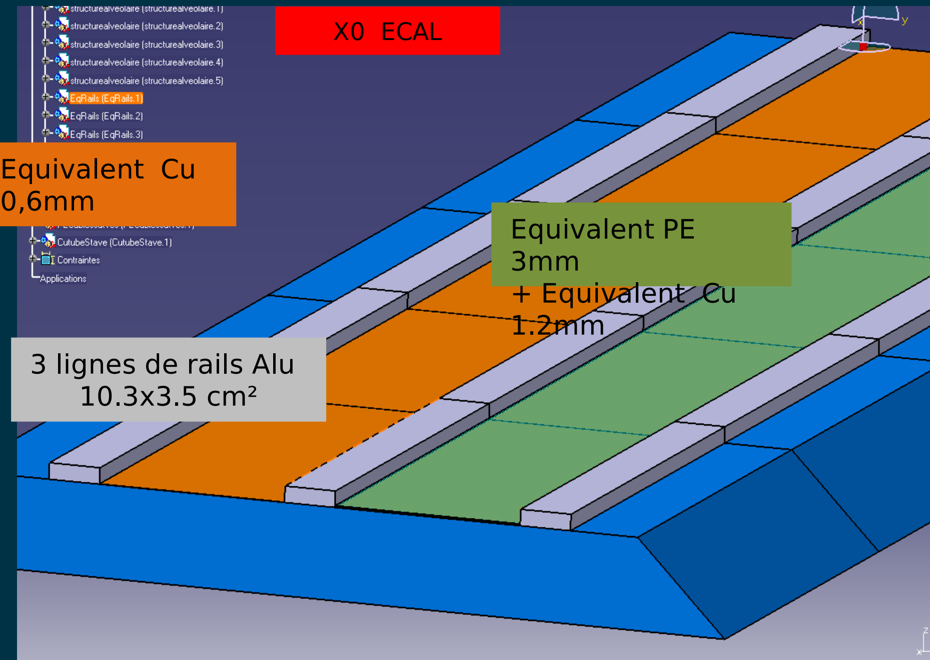
Placeholders:
space reserved for services and plays

equivalent X^0's for the simulation

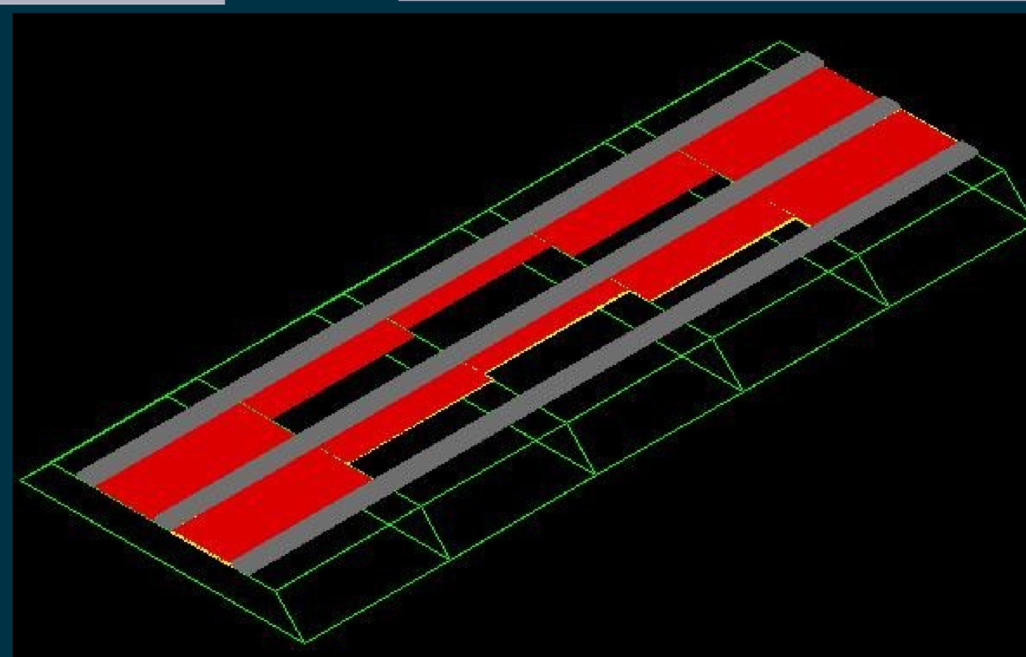


Transposing in the simulation





Mokka



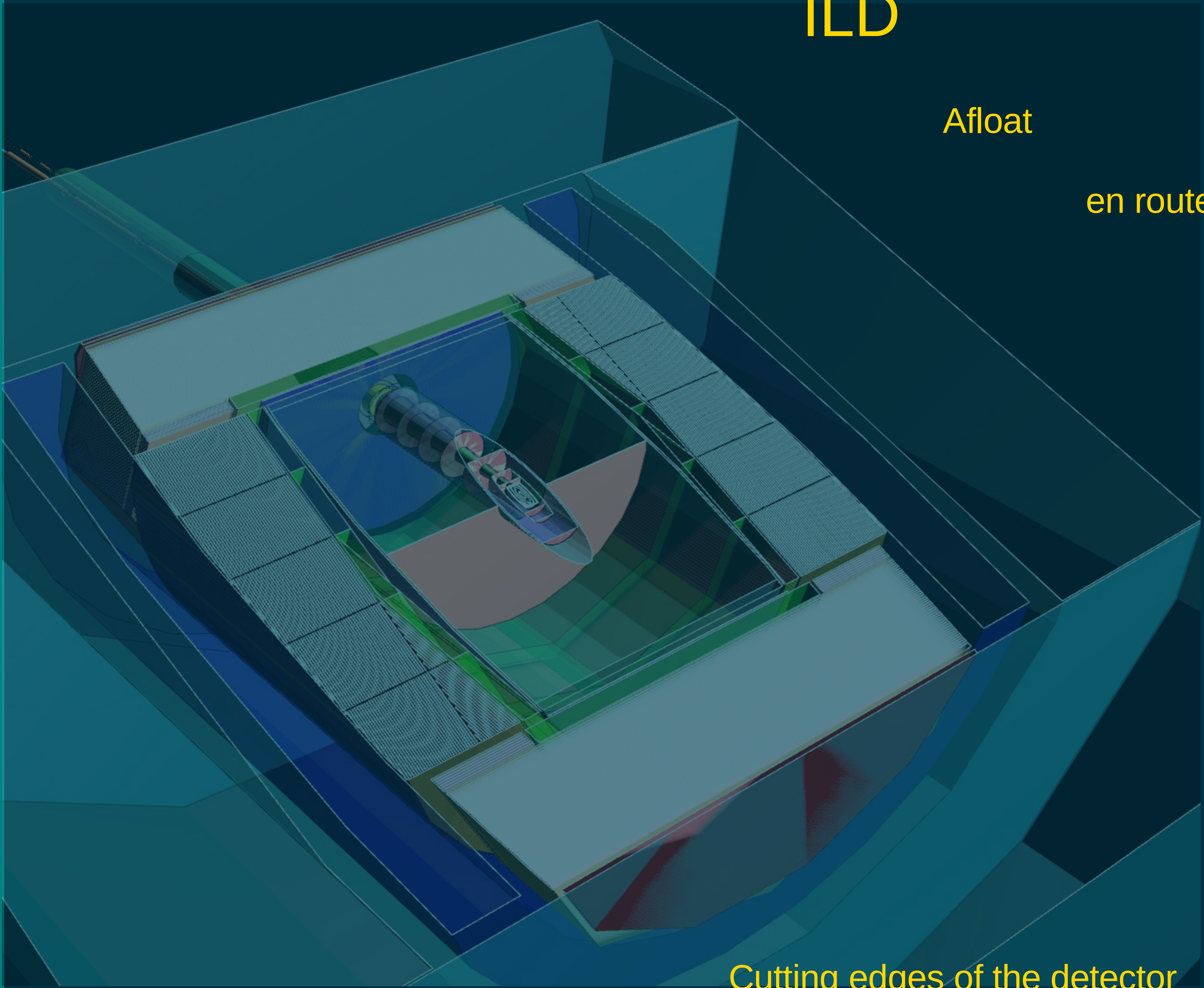
We are currently elaborating all the elements of a **software** baseline

i.e. a baseline to run large samples of events for a fine tuning
of the defined benchmarks and any reaction
likely to measure the physics impact of
still pending options.

We intend to have an iteration of discussions by May 2011 in KEK
and get to a final baseline at the latest at the time of the LCWS 2011 in Granada

The proper evaluation of options will take place later
but we will have first to identify where we lack an option.

ILD



Afloat

en route for 2012 DBD

and more if affinity

Cutting edges of the detector