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Questions to the experiments

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Introduction: Detector challenges at CLIC are somewhat different from the LHC detector challenges. In a snapshot:

- Vertex detector with <20 micron pixels, 0.1 X0 per layer, time-stamping of the hits at the ~5 ns level, pulsed power delivery
- High-precision tracking with low material (TPC and silicon strips), time-stamping of the hits at the ~5 ns level, pulsed power delivery
- Calorimetry at high density and high granularity, typically on 7 mm thickness available per active layer, time-stamping of the hits at the ~5 ns level, pulsed power delivery
- High-field CMS-type solenoid (up to 5 Tesla)
- Radiation levels typically ~10^3 lower than at LHC (tbc), apart from the small-angle calorimetry (Lumical, Beamcal), where high radiation levels are expected.

Work package 4:

(1) What is the relevance of this WP fitting for your experimental program?

As radiation is less of an issue at CLIC, this WP is not so important for us. Nevertheless we will profit from the LHC experience for our small-angle calorimetry (silicon-based or diamond-based).

(2) Are the deliverables expected by end of 2011 meeting your requirements?

a. *If yes, how many of these deliverables should be available and when and what else are you expecting (production, integration, ...)?*
b. *If not, what are the extra developments needed and in which time scale?*

NA

(3) Which resources are you able to inject in that particular project either to reach completion of new requirements or to customise or to integrate? With which time scale?

NA

(4) How do you see the long term future (beyond 2011) of this WP ? (e.g. extension, reduction, re-focus, conversion to service, absorption in experiment specific upgrade projects, …).

NA

(5) General comments

Work package 5:

(1) What is the relevance of this WP fitting for your experimental program?

Even if the CERN PH-LCD group currently does not participate in MPGD studies, there are many MPGD-related activities in the linear collider community. In particular, the TPC detector relies fully on MPGD (micromegas, GEM or INGRID-type). GEMs and micromegas are also studied as HCAL active layer options. In this case, large areas are important. It is not yet clear to me whether GEM and Micromegas will be chosen as future HCAL options, or rather glas-RPC or scintillator.

(2) *Are the deliverables expected by end of 2011 meeting your requirements?*
   a. *If yes, how many of these deliverables should be available and when and what else are you expecting (production, integration, ...)?*
   b. *If not, what are the extra developments needed and in which time scale?*

The new large-area MPGD facility is very relevant for the linear collider detector R&D.

(3) *Which resources are you able to inject in that particular project either to reach completion of new requirements or to customise or to integrate? With which time scale?*

Nothing, because this R&D is currently not the focus of the PH-LCD group itself.

(4) *How do you see the long term future (beyond 2011) of this WP ? (e.g. extension, reduction, re-focus, conversion to service, absorption in experiment specific upgrade projects, …).*

Maintain some of the facilities as a service. In my view, the R&D itself shall become rather project-specific, once we have learned how to make MPGD at larger surfaces.

(5) *General comments*

Work package 6, both the quality control and the interconnect part:

(1) *What is the relevance of this WP fitting for your experimental program?*

This WP is very important for CLIC, in particular for vertex detector development. With very small cells sizes and severe constraints on material, the interconnect and QA part will require much attention

(2) *Are the deliverables expected by end of 2011 meeting your requirements?*
   a. *If yes, how many of these deliverables should be available and when and what else are you expecting (production, integration, ...)?*
   b. *If not, what are the extra developments needed and in which time scale?*

For the interconnect we need to explore small pitches, at the 20 micron level. We also need to look into technologies that allow for 4-side buttable solutions like through-silicon vias (TSV). We also follow with interest the 3D interconnect efforts pursued outside CERN. For the QA, I cannot judge yet whether this satisfies our needs, or whether we need something in addition.

(3) *Which resources are you able to inject in that particular project either to reach completion of new requirements or to customise or to integrate? With which time scale?*

Within our vertex detector R&D, we can probably inject a fraction of an FTE (30% fellow or DOCT) into the development of Michael Campbell et. Al. for interconnect studies.

(4) *How do you see the long term future (beyond 2011) of this WP ? (e.g. extension, reduction, re-focus, conversion to service, absorption in experiment specific upgrade projects, …).*

Keep the interconnect as a common R&D activity, and add TSV-type studies to it (see above).
Maintain the QA as a service.

(5) *General comments*

Work package 7:

(1) *What is the relevance of this WP fitting for your experimental program?*

As radiation is less of an issue at CLIC, this WP is not so important for us. Nevertheless we will profit from the LHC experience for our small-angle calorimetry. There are some linear collider groups that work with RPC's (e.g. IPNL Lyon). They are currently performing some long-term operation properties at GIF. It is expected that the extend/duration of these GIF tests for the linear collider will be much smaller than for LHC applications.

(2) *Are the deliverables expected by end of 2011 meeting your requirements?*
   a. *If yes, how many of these deliverables should be available and when and what else are you expecting (production, integration, ...)?*
   b. *If not, what are the extra developments needed and in which time scale?*

NA

(3) *Which resources are you able to inject in that particular project either to reach completion of new requirements or to customise or to integrate? With which time scale?*

NA

(4) *How do you see the long term future (beyond 2011) of this WP ? (e.g. extension, reduction, re-focus, conversion to service, absorption in experiment specific upgrade projects, …).*

NA

(5) *General comments*

Work package 11:

(1) *What is the relevance of this WP fitting for your experimental program?*

Building up experience with low-mass cooling will be very important for the linear collider detector project. CO2 cooling will certainly be a serious option in some areas. In other areas, we have to go to even lower masses, so we would have to use gas-flow solutions or micro-channels directly on/through the chips. We would rely on creating powering options (such as power-pulsing) to reach this goal.

(2) *Are the deliverables expected by end of 2011 meeting your requirements?*
   a. *If yes, how many of these deliverables should be available and when and what else are you expecting (production, integration, ...)?*
   b. *If not, what are the extra developments needed and in which time scale?*

LCD has a different time-scale and different requirements from the LHC in this field. Nevertheless, we follow the R&D in CO2 cooling and micro-channel cooling with much interest,

(3) *Which resources are you able to inject in that particular project either to reach completion of new requirements or to customise or to integrate? With which time scale?*

I expect that from 2011 or 2012 onwards, PH-LCD will inject 1 FTE in cooling studies. This would be for modelling and hardware studies. However, as I said above, this could be quite project-specific and could be directed into gas-flow options (still to be defined). These resources could be placed in the PH-DT group. We hope to profit from upcoming LHC experience for CO2 cooling and hope that we do not need to inject LCD resources into that.

(4) *How do you see the long term future (beyond 2011) of this WP ? (e.g. extension, reduction, re-focus, conversion to service, absorption in experiment specific upgrade projects, …).*

Partly conversion into a service, partly with injection of experiment resources for project-specific developments.

(5) *General comments*