Introduction WG4

Outline:

- Mandate of the WG
- Timescale
- How to proceed?
- Vertex detector requirements
- Collecting input on requirements
- Organisational and next meetings

- Note for newcomers to the CLIC detector study: we can organise a private seminar to introduce the CLIC accelerator environment, overall detector features, etc.

Mandate WG4

CLIC physics/detector CDR preparation WG4: vertex detector technology

WG4 coordinates the study of suitable technologies for a CLIC pixel vertex detector. Taking into account the CLIC physics requirements, WG4 studies ways to achieve these requirements through hardware implementation. It aims at identifying solutions that optimally combine high resolution and efficiency for physics observables with optimal background suppression capabilities. Special care will be devoted to **pixel sensor technologies, electronics, interconnects, mechanical support, cooling, power delivery and alignment, as well as their integration into an ultra-low mass vertex detector system**. **WG4 studies solutions for the effective integration of the vertex detector in the overall detector concept, both in a functional way (within the tracker system as a whole) and in terms of detector layout and mechanical integration.** **WG4 will provide appropriate input to the CLIC CDR Editors** and will make **recommendations for CLIC vertex detector R&D.**

Clarification / timescale WG4

CLIC conceptual design report

- April 2011
- Main CDR aim: describe the CLIC physics potential and convince reader that the physics can be measured with good precision
- CDR will have a section on vertex detector
- CDR will have a section on recommendations for R&D

<= WG4 will provide the input

Actual R&D work for CLIC vertex detector

- Many years

<= Requires resources, so responsibility is with the institute(s)

CLIC pixel vertex detector: how to proceed?

CLIC vertex detector is technologically very challenging

Multi-parameter problem, iterative process

• Set up an initial list of vertex detector requirements, and gradually update it. Address these requirements when looking at technology options.

• Review technology options in the domains of sensor technologies, electronics, interconnects, mechanical support, cooling, power delivery, alignment as well as on possibilities to integrate these technologies into (part of) a vertex detector system for CLIC. Compare with requirements. Define scope for improvement.

• Collect information and participate in the study of requirements (physics and environment). Requirements will change as a function of: proposed vertex detector implementation itself, layout and performance of surrounding detectors.

• Propose full-detector layout and technology solutions for the vertex detector in CLIC_SiD and CLIC_ILD and (in collaboration with other working groups), assess their performance.

• Make recommendations for a technology R&D roadmap for the CLIC vertex detector.

• Provide input on the vertex detector to the CLIC CDR editors.

CLIC pixel vertex detector requirements

Set up an initial list

Keep on updating

Branch-off as a function of…

- Barrel ⇔ end-cap
- Analog ⇔ digital readout
- ILD environment ⇔ SiD environment
- etc…….

Any review/study of detector options will be checked against the list

Requirements list (1)

First list, just to get started

Physics performance

Item	Requirement	Comment
Impact parameter resolution	5 μm ⊕ (15μm/p_t(GeV))	
Single point resolution	~3 μm	
Flavor tagging efficiency/purity for xx quarks	??	
Tau identification efficiency/purity	??	
Maximum occupancy at 3 TeV and full luminosity $L=6*10^{34}\ cm^{-2}s^{-1}$, and within the time-stamping interval	~1%	Include all machine-induced backgrounds and SM physics background, and include also a safety factor of ~3
Two-track separation capability	??	

Requirements list (2)

Technology target figures

Item	Target number	Comment
Pixel size with digital readout	Typically 20 µm by 20 µm	tbd
Pixel size with analog readout	Typically 20 µm by 20 µm	tbd
Analog: MIP signal to noise ratio	>12?	For analog readout
Time-stamping resolution for hits	Barrel <10ns?, forward disks <??ns	
Thickness per layer (including services)	<0.1% X_0	What is the flexibility on the (too) tight requirement?
Dead zones	<??%	
Overall single-layer hit efficiency	??	
Read-out	Trigger-less readout after the bunch train, though allowing for time-stamping of individual hits	
Readout time for full-train information	<400 µs??	Allows for at least factor 50 gain in dissipation through power-pulsing
Power dissipation per layer and per cm^2		Define it with and without power pulsing
Cooling,mechancis		Depends on other items

Collecting input on requirements

From WG3 (physics observables with tracks), from WG2 (physics observables with jets)

- needs for overall tracking performance
- which are the relevant observables, e.g for flavour tagging: impact parameter, decay length, momenta, vertex charge…)
- impact from background conditions, interplay of timing information from different detectors
- Which are the relevant benchmark processes to address the pixel vertex?

From WG5 (engineering, integration solenoid, cost)

- Environment constraints, support options, means for alignment, routing of services….

From MDI and FCAL environment

- Interplay due to back-scattered particles, influence of beam pipe, etc.

Next steps / meetings

- Volunteers to maintain requirements lists and to write short minutes:

Dominik Dannheim and Erik van der Kraaij

- Topical meetings (concentrate on 1 or 2 subjects)
    - time-stamping
    - pixel (electronics+sensor) technologies
    - power delivery
    - low-mass mechanical construction and low-mass cooling
    - interconnects or integrated technologies
    - alignment
    - data volume and readout flow

Next meetings: Thursday 15hrs on 6/5, 27/5, 17/6