From: **Andre Sailer** andre.philippe.sailer@cern.ch
Subject: Re: Question about Z-running for CLIC
Date: 11 February 2025 at 11:03
To: Lucie Linssen Lucie.Linssen@cern.ch, Philipp Gerhard Roloff philipp.roloff@cern.ch, Aidan Robson Aidan.Robson@cern.ch
Cc: aidan.robson@glasgow.ac.uk, Dominik Dannheim Dominik.Dannheim@cern.ch, Eva Sicking Eva.Sicking@cern.ch

Hi Lucie,

The source code for the note seems to be this
https://gitlab.cern.ch/CLICdp/Publications/DraftDocuments/note_zcouplings
I attach a pdf of the current status.

I will try to get to the couple phrases about the backgrounds as soon as I can.

Cheers,
Andre

From: Lucie Linssen <Lucie.Linssen@cern.ch>
Sent: Tuesday, 11 February 2025 10:55
To: Philipp Gerhard Roloff; Aidan Robson
Cc: aidan.robson@glasgow.ac.uk; Dominik Dannheim; Eva Sicking; Andre Sailer
Subject: Re: Question about Z-running for CLIC

Hi Philipp and Aidan,

Thanks a lot for the quick reaction.

After a bit of searching I found the corresponding presentation by Philipp and Jean-Jacques at the CLICdp workshop of August 2019.
https://indico.cern.ch/event/792656/contributions/3528331/
The corresponding note, CLICdp-Note-2019-004, doesn't exist, unfortunately.

I attach a screen shot showing a comparison of the number of Z's at various facilities (Section 3.2, fig 3.5 of the briefing book, as indicated by Philipp).

To be discussed further on Friday, I guess.

Lucie

On 11 Feb 2025, at 00:05, Philipp Gerhard Roloff <philipp.roloff@cern.ch> wrote:

Dear Lucie, dear Aidan, dear all,

Jean-Jacques and I did some initial studies in 2019 which are discussed in Section 3.2 of the briefing book:
https://arxiv.org/pdf/1910.11775

These assumed 100/fb at the Z-pole from a few years of running at 0.36*10^34/cm2/s and +/-80% electron beam polarisation.

I can't comment quantitatively, but the prospect of running the 380 GeV machine at the Z-pole seems not very interesting for physics. But this would be a very useful tool for calibration purposes.

Best wishes,
Philipp

From: Aidan Robson <aidan.robson@glasgow.ac.uk<mailto:aidan.robson@glasgow.ac.uk>>
Sent: Monday, February 10, 2025 11:04 PM
To: Lucie Linssen <Lucie.Linssen@cern.ch<mailto:Lucie.Linssen@cern.ch>>; Dominik Dannheim <Dominik.Dannheim@cern.ch<mailto:Dominik.Dannheim@cern.ch>>; Aidan Robson <Aidan.Robson@cern.ch<mailto:Aidan.Robson@cern.ch>>; Philipp Gerhard Roloff <philipp.roloff@cern.ch<mailto:philipp.roloff@cern.ch>>; Eva Sicking <Eva.Sicking@cern.ch<mailto:Eva.Sicking@cern.ch>>; Andre Sailer <andre.philippe.sailer@cern.ch<mailto:andre.philippe.sailer@cern.ch>>
Subject: Re: Question about Z-running for CLIC

Dear Lucie,
Many thanks. I think there are two aspects for a Z-pole run: detector calibration; and physics. Eva and Philipp can probably say more on these two points respectively, but I think that at least for physics the answer really depends on the future plans: if high-energy running is planned then a Z-pole run is less relevant; whereas if there will be no high-energy running then a Z-pole run is more important.
Thanks,
Aidan

On 10/02/2025 21:43, Lucie Linssen wrote:
Dear all,

I received a question by Erik Adli and Steinar Stapnes about running at the Z-pole.
Erik gave me some numbers, see text at the bottom of this email.

In fact, there would essentially be 3 options:
* Do not foresee any running at the Z-pole.
* Start running CLIC first at the Z-pole with a dedicated machine => luminosity 0.36*10^34 cm-2s-1 => approx 45 fb-1 per year.
* Start running CLIC at 380 GeV, and then run at the Z-pole using that 380 GeV machine => luminosity 2.3*10^32 cm-2s-1 => approx 2.5 fb-1 per year.

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I am checking the numbers with Erik. They probably need some adjustment, even if that will not change the picture in a fundamental way.

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We are asked for our opinion on running at the Z at all / at first / after the 380 GeV run.

You can answer to this email, and we can discuss it als at our meeting this Friday.

Cheers, Lucie

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Text by Erik:
“” Operating the fully installed 380 GeV CLIC accelerator complex at the Z-pole
results in an expected luminosity of about 2.3 × 1032 cm−2s−1. In this scenario the
main linac gradient needs to be reduced by about a factor four. The bunch charge is
reduced by a similar amount but the normalized emittances and bunch length remain
the same. The beam size at the interaction point increases with the square root of 1/E
in the transverse planes. All this leads to a luminosity reduction roughly proportional to E^3.

Alternatively, an initial installation of just the linac needed for Z-pole energy fac- tory, and an appropriately adapted beam delivery system, would result in a luminosity of 0.36 × 1034 cm−2s−1 for 50 Hz operation. Or, one could operate with a short linac (approximately 1 km of main linac on each side), before the full 380 GeV machine is installed, quite feasibly using a klystron driven linac. In this scenario the bunch parameters remain unchanged, except for the beam energy, and hence the beam size, at the interaction point. In this case, the luminosity scales, roughly, with energy. The Z-pole operation could also be done before one moves to the next energy stage. Hence, at the Z-pole, between 2.5 fb−1 and 45 fb−1 can be achieved per year for an unmodified and a modified collider, respectively. “"
[Screenshot 2025-02-11 at 10.05.16.png]

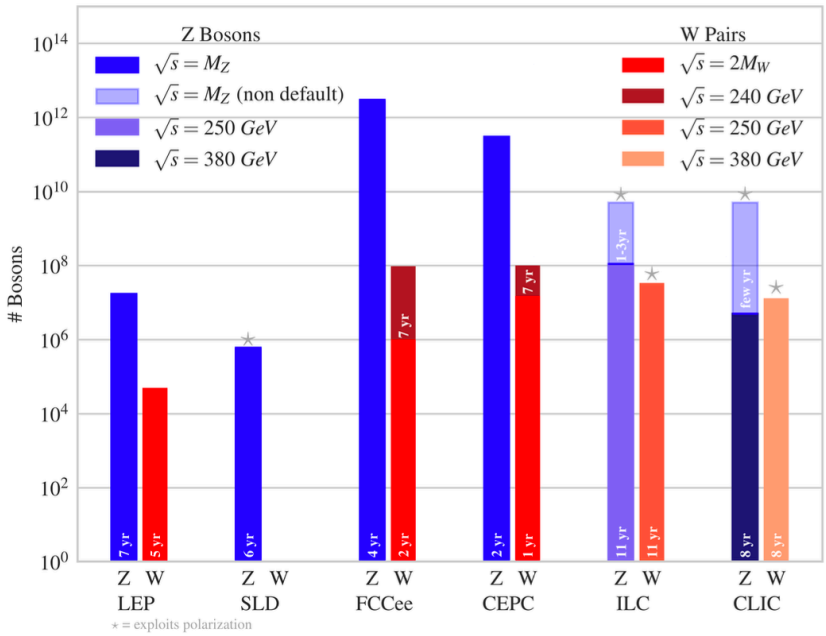

Fig. 3.5: Number of Z bosons and W^+W^- boson pairs at past and future e^+e^- colliders. Th
numbers are summed over experiments (four for LEP, two for FCC-ee and CEPC and one f

the other colliders). For LEP the number of W pairs shown includes all energies $\sqrt{s} \lesssim 2M_W$.

note_zcouplings.pdf