

# **Working group on the use of advanced accelerator techniques CLIC workshop 2019**

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# Mandate

## Mandate for working group on use of novel accelerator schemes

- Look at interesting long term perspectives for LC installations
  - potential use of these in Linear Collider implementations as future stages of the existing plans for Higgs factory
  - Could be everything from reuse of tunnel, extend linac, afterburner, improvements of BDS ...
- The studies can also help to identify R&D priorities for novel accelerator schemes by considering their compatibilities with CLIC and ILC technologies.
- Input to European Strategy

# Meetings and outcome so far

January 2019	
18 Jan	CLIC Novel Accelerator Methods: Physics potential for multi TeV gamma-gamma collider
December 2018	
07 Dec	CLIC Novel Accelerator Methods: Simplified wakefield models for PWFA
June 2018	
27 Jun	CLIC Novel Accelerator Methods: Kharkov Institute of Physics and Technology
March 2018	
23 Mar	CLIC Novel Accelerator Methods: Physics opportunities and luminosity requirements at very high energies
December 2017	
15 Dec	CLIC Novel Accelerator Methods: Active Plasma Lenses
October 2017	
13 Oct	CLIC Novel Accelerator Methods: Hollow Channel Plasma Wakefield Accelerators
May 2017	
12 May	CLIC Novel Accelerator Methods: dielectric structure research at ANL/AWA
April 2017	
21 Apr	CLIC Novel Accelerator Methods: requirements from particle physics
March 2017	
24 Mar	CLIC Novel Accelerator Methods: overview of novel acceleration techniques
February 2017	
17 Feb	CLIC Novel Accelerator Methods: linear collider requirements

Managers
Erik Adli
Materials
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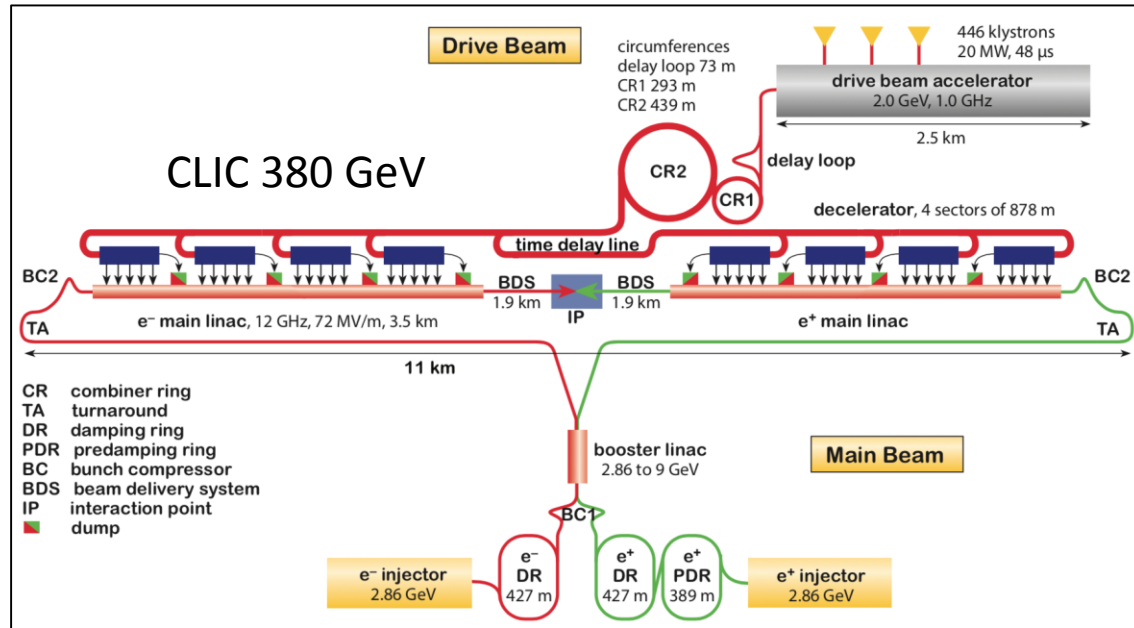
A summary was written up as a section in the CLIC Project Implementation Plan for the Particle Physics European Strategy Update : **"4.6 Energy Upgrades with Future Technologies"**-

*The Compact Linear Collider (CLIC) – Project Implementation Plan, CERN-2018-010-M*

<https://cds.cern.ch/record/2652600>

<https://cernbox.cern.ch/index.php/s/MZhxmhD21JltUir>

# “Reuse” opportunities of a CLIC machine



The following features of the CLIC machine may be of immediate benefit for a machine upgraded with future technology :

- **The Main Linacs tunnels of 2x3.5km.** Assuming 1 GV/m for future technology, beams of up to 3.5 TeV could be produced
- **The crossing angle of 20 mrad** optimal for 3 TeV CM energy collisions, also likely to be a good choice for higher c.m. energy collisions. Compatible with high-energy  $\gamma\gamma$  collisions
- Could be possible to modify parts of the **CLIC Drive-Beam Complex** to produce appropriately spaced drive beams, for e.g. a PWFA-LC
- **The injectors** providing 9 GeV low emittance electron and positron beams, could also inject into a main linac based on future technology
- **Tolerances on alignment and stability, both transverse and longitudinal,** will likely be at least an order of magnitude more stringent for linacs based on future technology than for CLIC. Significant effort have been put into developing methods for CLIC. Will be directly useful for the development of an advanced linear collider

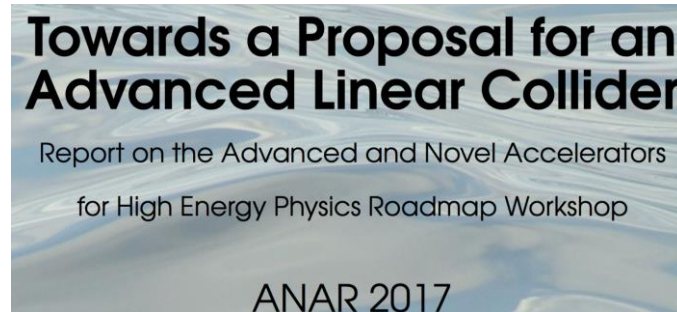
# Input to a “green-field” collider based on advanced accelerator technology

WG work continues, with specific topics being developed

- Optimal use of a different technology, PWFA, LWFA, DLA ... would require a top-level parameter re-optimization of collider design, **consistent designs, for fair technology comparison needed**. Not done for previous advanced collider concepts as it represents a very large design effort.
- Hard to quantify the upgrade potential for main linac as long as optimal use of novel technology for a green field machine is not clear
- For some technologies (e.g. PWFA e-) the status of theory and simulation is sufficient to advance collider design. I.e. not necessarily have to wait for more experiments to proceed. Examples of studies pursued related to this WG :
  - Parameter space for active plasma lenses (talk this session, Carl A. Lindstrøm)
  - Optimization of PWFA stage, considering transverse instabilities (talk this session, Ben Chen)
  - Performance of dielectric structures (talk on Tuesday, Yelong Wei)
- For PWFA e+ it is important to establish the best scheme for positron acceleration (talk this session, Sebastien Corde)
  - Possible alternative path: gg-collider? (talk this session, P. Roloff)

- Compared to resources for advanced accelerator **experiments**, resources for advanced accelerator design is very small.
- **Getting sufficient design resources to proceed on design questions is hard.**
- How to proceed?
- Synergies with ALEGRO, also in term on how to attracting funding, should be fully examined and exploited. Talk in this session by Patric Muggli plus following discussions.

ALEGRO – Advanced Linear Collider Study Group  
 B. Cros, P. Muggli. ICFA ANA initiative.



"Top down approach" This part perhaps underrepresented in the AA community.

Collider design, based on current state of technology (including simulation/theory), fulfilling physics requirements.

$$\mathcal{L} \propto H_D \frac{n_\gamma^{2/3}}{\sqrt{\sigma_z}} \frac{1}{\sqrt{\epsilon_y \beta_y}} \frac{R+1}{R} \frac{\eta P_{wall}}{mc^2}$$


updates/  
inspires

gives input to

Technology development and experiments to address the critical issues

"Bottom up approach" – see what comes out of technology  
 Development not necessary driven by linear collider requirements

# Session timeline

	<b>Multi-TeV gamma-gamma colliders</b>	<i>Philipp Roloff</i>
	<i>6-2-004, CERN</i>	08:30 - 08:55
09:00	<b>AAT working group status</b>	<i>Erik Adli</i>
	<i>6-2-004, CERN</i>	09:00 - 09:15
	<b>Parameter space for active plasma lenses (ONLINE)</b>	<i>Carl A. Lindstrøm</i>
		09:15 - 09:45
10:00	<b>Modelling and optimization of a PWFA-LC stage</b>	<i>Jian Bin Ben Chen</i>
		09:45 - 10:15
	<b>Coffee break</b>	
	<i>6-2-004, CERN</i>	10:15 - 10:45
11:00	<b>Status of positron acceleration in PWFA</b>	<i>Sebastien Corde</i>
		10:45 - 11:15
	<b>Status of the ALEGRO initiative</b>	<i>Patric Muggli</i> 
		11:15 - 11:45
12:00	<b>Discussion</b>	
	<i>6-2-004, CERN</i>	11:45 - 12:00