

Advanced & Novel Accelerators Track (ANA) organized by ICFA/ANA panel

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Opportunities for an ANA-based linear collider

Overview

(edited from the ALEGRO study group -- [\[https://www.lpgp.u-psud.fr/icfaana/alegro\]](https://www.lpgp.u-psud.fr/icfaana/alegro))

Introduction

All colliders have a large number of important issues that have to be addressed before their realization. It is important to identify critical issues necessary to establish the feasibility of future ANA-based linear colliders (LCs). For LCs, such prioritization of issues has been performed repeatedly, both in a collaboration between different proposals and within individual projects. These processes have been very beneficial for defining the R&D goals and in focusing the work programs toward achieving these goals.

It is therefore critical to identify the R&D items that are key in establishing the use of novel technologies in future LCs. The purpose of this session is to help this process and prepare for a forthcoming ALEGRO21.

Some of the issues might be very fundamental, such as the potential to accelerate positrons. Other items might be linked to the final performance that can be achieved. One of the main current challenges regards the realization of the high luminosity that is required for physics. To help the discussion, questions based on the linear collider experience are given below.

Beam Parameter Evolution

In case that you have a concrete proposal please highlight the beam parameter evolution along the collider. In particular, the bunch charge, length, energy spread, and transverse emittance.

Beam Production

The production of bright beams is a key challenge in linear colliders. Please detail the concept to obtain the beam parameters at the beginning of the main accelerator and identify the key R&D required to achieve this. This may include the development of bright electron and positron sources or advanced phase-space cooling techniques. For beam-driven methods the drive-beam production process and requirement should also be discussed.

Beam Acceleration

Beam break-up is a key limitation of the beam parameters in linear colliders. Please indicate the theoretical and experimental studies that support that your choice of beam parameters is consistent with stable beam acceleration.

In LCs the beam transverse emittance degrades during acceleration. Detail the expected beam quality degradation during acceleration and the associated specifications for maximum imperfections (tolerance on alignment). Depending on the ANA technologies this could include for example:

- the allowed plasma density fluctuations
- the allowed fluctuations of the drive beam or laser pulse intensity and length
- the allowed phase jitter of drive beam or laser pulse and the main beam
- the allowed transverse jitter (angle and offset) of the drive beam or laser beam
- the tolerance on drive-bunch shaping precision
- the allowed misalignment between the drive beam or laser and the main beam
- the allowed misalignment of components
- the required stability of components

Beam Focusing

The focusing of the full energy beam to the small beam size at the collision point is a key challenge in linear colliders. Please detail the beam parameters before this beam delivery system and at the collision point. Describe the focusing system concept and highlight the studies that will be needed to demonstrate its feasibility. Please also give the tolerances that need to be met to achieve the target performance.

Positron production and acceleration

Depending on the technology the production and acceleration of positrons will pose additional challenges and devising solutions toward addressing these limitations should be discussed.

Power Requirement & efficiency

Please detail the target wall-plug to beam power efficiency, compared to the state-of-the-art, and indicate the R&D required to meet the target.