Report on Luminosity Tuning and Control Strategies.

E. Adli[1,2], I. Ahmed[3], H. Burkhardt[1], P. N. Burrows[4], R. Corsini[1], A. Dabrowski[1], P. Eliasson[1,5], J. B. Jeanneret[1], M. Korostelev[1], D. Kruecker[6], J. Gao[7], A. Grudiev[1], A. Latina[8], I. Melzer-Pellmann[6], L. Neukermans[1], F. Poirier[6], D. Schulte[1], S. H. Shaker[1], P. Skowronski[1], J. Resta Lopez[4], G. Rumolo[1], F. Tecker[1], R. Tomas[1], N. Walker[6], D. Wang[7], G. White[9], R. Zennaro[1], F. Zimmermann[1]

December 18, 2008

Abstract

The luminosity goals for the International Linear Collider (ILC) and CLIC are very demanding. They require very small transverse beam size (transverse emittance) and sub-nanometre level beam stability at the interaction point (IP). In this context, detailed integrated simulations, covering different sub-systems and time-scales of the collider, are vital for assessing the reliability of the design luminosity. We provide here an overview report on the work that has been done in these areas. We provide a complete bibliography of EUROTEV reports that describe the work in full detail.

[1] CERN, Geneva, Switzerland
[2] Oslo University, Norway
[3] CERN-NCP
[4] JAI, Oxford University, UK
[5] Uppsala University, Sweden
[6] DESY, Hamburg, Germany
[7] IHEP, Beijing, China.
[8] FNAL, Chicago, USA
[9] SLAC and Oxford University

1 Introduction

Historically, the impact of "machine errors" (alignment, field errors *etc*.) are separated into two categories: static errors and dynamic errors. Static errors are those errors resulting from (for example) initial installation alignment errors. Dynamic errors, as their name suggests, correspond to time varying errors, which themselves range from relatively slow drifts (diurnal temperature variations, slow ground motion) to fast effects such as component vibration, field fluctuations and diagnostic 'noise'.

To combat the emittance dilution caused by the static errors Beam-Based Alignment (BBA) and beam emittance tuning techniques are required. These relatively slow and invasive tuning techniques are typically required during commissioning of the machine (both initial and during start-up after some prolonged down time). Dynamic imperfections such as ground motion will strongly degrade the luminosity if not actively compensated using beam-based feedback (FB) systems, of which there will be many required in different parts of the machine.

2 Correction of Static Errors in the Main Linac

Small misalignments of quadrupoles and accelerating structures can lead to significant emittance growth, when the beam is transported through the main linacs of ILC and CLIC. The required component alignment tolerances to maintain acceptable emittance degradation are beyond those achievable with conventional metrology techniques. Thus beam-based alignment and emittance tuning techniques are required. The procedures foreseen for CLIC and ILC proceed in several steps. First, a simple one-to-one correction is applied to steer the beam to the centre of the beam position monitors. Second, one of several possible beam-based quadrupole alignment procedures is applied, of which Dispersion Free Steering (DFS) or Ballistic Alignment have been the focus of the studies reported here. In the case of CLIC, the RF accelerating structures (which are remotely translatable) are then aligned to the beam. Final tuning directly on the beam emittance (or luminosity) is achieved using techniques such as applying dispersion-generating beam bumps to correct the remaining chromatic aberrations, and wakefield bumps (in the case of CLIC).

2.1 Dispersion Free Steering

DFS relies on minimising the resulting offset between the nominal energy beam and one or more off-energy beams. Extensive simulations by many groups around the world have shown that correct application of such techniques can result in acceptable emittance growth in the Main Linac. Several variants of DFS have been studied which differ in their approach; for example, there are several possible options for generating the required 'off energy' beams. As part of the EUROTeV programme, these possibilities have been systematically studied using specially developed simulation tools [1, 2]. The studies have concluded that a modification of the initial beam energy at the entrance of the Main Linac provides the best performance (as opposed to other techniques such as klystron shunting in the Main Linac itself). Simulations indicate that the upstream bunch compressors can successfully be used to generate such off-energy beams [3].

2.2 Simulations of a machine following the Earth's curvature

As the tunnel layout has an impact on the cost of a future linear collider, we evaluated the impact on the beam dynamics of a machine that follows the average Earth's curvature, as opposed to a laser-straight one, the latter, simpler, geometry having been both exclusively and extensively simulated prior to this work. Following the Earth's curvature results in a small but non-zero design vertical dispersion which must be accounted for in the beam-based alignment algorithm. A variant of DFS, called *Matched Dispersion Steering* (MDS), has been developed, which includes the *design non-zero* offset of nominal and off-energy beams. Initial studies for the ILC main linac [4] indicate that there was no discernable difference between laser-straight (DFS) and curved (MDS) geometries, providing the dispersion was correctly matched into and out of the linac. Later studies [5] include additional effects such as BPM scale (calibration) errors, to which MDS is sensitive. (DFS, by comparison, is essentially a nulling technique, and is ultimately less dependent on scale errors.) For the ILC, BPM calibration errors need to be <10%. When additional dispersion tuning bumps are included in the simulation, calibration errors as high as 20% seem tolerable.

Similar studies have also been performed for the CLIC main linac [6], where it was found that the BPM scale error must be kept below 2% for a curved geometry. In addition the tolerance on the quadrupole power supply stability becomes quite tight, being of the order of $3x10^{-5}$. We conclude that the emittance preservation of a curved CLIC main linac becomes more challenging, although it is not an insurmountable obstacle. The impact of a curved tunnel has also been studied for the CLIC Drive Beam [6], for which there appears to be no degradation in performance for the curved geometry.

2.3 Impact of dynamic errors on static tuning

The application of these alignment procedures may take from minutes to possibly many hours. During this time, alignment drifts due to ground motion and other "dynamic imperfections" may occur (for example quadrupole vibrations, and jitter in the gradients of the accelerating cavities). These imperfections impact the measurements that are performed during beam-based alignment, potentially limiting their performance. In [7] we evaluated the impact of such imperfections in the main linac of ILC and CLIC. We simulated a beam pulse in full detail during DFS, considering the quadrupole and beam jitters that occur in the interval between two subsequent pulses of test beams. The result for CLIC, after application of the complete alignment procedure including RF structures, and assuming the specified vibration tolerances, is well within the emittance growth budget.

Similar results are obtained for ILC, although very significant differences exist with respect to CLIC, both in the assumed vibration amplitudes, pulse time structure and curved tunnel geometry. The long ~1 ms pulse with ~3000 bunches of an ILC train are advantageous because they allow the use of intra-pulse beam orbit feedbacks to correct for the entrance beam jitter, thus reducing the relative induced emittance growth. While ~100 nm RMS quadrupole jitter does not cause a significant emittance growth in the ILC, the impact of pulse-to-pulse accelerating gradient jitter appears non-negligible although it depends on the precise alignment scheme used.

2.4 Global tuning using dispersion and wakefield trajectory bumps

It is expected that application of beam-based alignment will not be sufficient to achieve the desired emittance preservation, and additional ‘global’ tuning techniques using direct measurement of the beam emittance will be required. Application of so-called beam trajectory ‘bumps’ has been studied, generally in conjunction with simulations of DFS or ballistic alignment. In [8] we showed that a 50% luminosity loss remaining after ballistic alignment could be nearly completely recovered using 10 or 20 knobs per linac, however with slow convergence. The bumps were also seen to be rather insensitive to noise in the tuning signal. Various bump configurations were studied for ILC in [9]. It was shown that two dispersion and one wakefield bump provide a very powerful complement to DFS (with a reduction of emittance growth by one order of magnitude). In both studies, two wide laserwires (fixed, not for scanning) were used to measure the beam quality and provide a useful tuning signal. It was shown in [8] that the position of the wide laserwire has to be adjusted regularly but not very frequently.

A method for design of orthogonal knobs with optimal convergence and emittance reduction performance has been developed [10]. For ILC, as few as four such orthogonal knobs for controlling the vertical displacements of the main linac quadrupoles were sufficient to reduce emittance growth by two orders of magnitude after initial DFS. For CLIC, ten orthogonal knobs for controlling RF structure displacements showed similar performance. In both cases convergence was nearly instant. The impact of dynamic errors on the performance of these bumps in CLIC has also been studied [11]. Without dynamic errors the bumps reduced emittance growth to 0.44 nm (i.e. < 10%). When quadrupole, RF cavity, and incoming beam jitter, as well as ground motion, BPM noise, and emittance measurement errors were taken into account the tuned emittance growth was instead 0.64 nm. During this study, a more realistic tuning procedure was also used, including the time-consumption of element movers and emittance measurements.

For both ILC and CLIC, application of closed trajectory bumps to generate dispersion has been simulated. For CLIC, use of the RF structure movers allows a local control over the transverse wakefield (a wakefield bump). Generally, these “bumps” are applied at one or more specific locations and are used to cancel the corresponding correlations in the beam arising from the residual errors in the linac after application of DFS. In many cases, a single bump at the exit of the Main Linac will suffice, which opens up the possibility of post-linac correction in the BDS. Allowing for such post-linac global corrections for linear correlations can significantly relax tolerances of the initial main linac alignment and the performance of the BBA. This is particularly attractive in ILC, where the relatively low chromaticity and small energy spread in the main linac results in only a small amount of beam phase space filamentation. In [12] systematic studies were performed assuming global correction at the end of the ILC main linac for the linear correlations resulting from anomalous cross-plane coupling (due to quadrupole rotation errors) and residual dispersion (from transverse alignment errors). It was found that post-linac corrections decrease the sensitivity to component alignment by generally a factor of two, and in some cases a factor of three. This was also shown to have an impact on the long-term luminosity stability, where the degradation of emittance due to ground motion could effectively be compensated by re-tuning of the global correction.

2.5 Impact of Coupler Kicks in ILC cavities

One of the critical issues in the design of the superconducting cavities for the ILC is the influence of the RF couplers and the higher-order mode couplers on the beam dynamics. Both types of couplers break the rotational symmetry of a cavity and introduce non-vanishing transverse wakefields and transverse RF components even on the cavity axis. These effects have been studied in main linac simulations [13]. The initially claimed [14] severe emittance dilution within the main linac could be confirmed (about 9 nm increase due to coupler transverse wakefields at the end of the main linac), but further studies based on new calculations (steady state solution for the coupler wakefields [15]) only give a negligible emittance increase. In addition, we demonstrated that a proposed modification [14] to the coupler design (relative rotation of up- and downstream couplers) could mitigate wakefield effects but at the cost of a 10 times larger transverse RF field kicks. Such RF kicks would give a dispersion corrected emittance increase of about 1.8 nm. We conclude that there is no good reason for a coupler design change in the ML since coupler wakefield effects in the ML are less severe then initially expected. However, these effects still require further study in the ILC bunch compressor linac sections.

2.6 Impact of initial correlations in installation alignment

Historically, installation alignment tolerances were mostly specified (and simulated) assuming uncorrelated random distributions. In reality, the survey and metrology techniques used always introduce "long wavelength" correlations in the component alignment. There has been significant activity to attempt to develop better (more realistic) models for the initial alignment which includes these correlations for the LiCAS survey technique [16]. Simulations using this model have been made for ILC [17] using a curved linac trajectory and MDS. The results show that there is no additional emittance growth due to the correlations, *providing* the assumed LiCAS performance is achieved.

2.7 Application to CTF3

An automatic beam steering application for CTF3 is being designed [18] in order to provide a test-bed for advanced steering algorithms for CLIC, and help operation of the machine. Beam-based correction of the CTF3 linac, including dispersion free steering, has been investigated. An approach based on a PLACET on-line model has been tested. Model-based all-to-all corrections were applied successfully in a robust way to the CTF3 linac. The model-machine discrepancy was in the order of 10%. Dispersion-Free Steering was applied successfully, using machine-based responses. Dispersion-Free Steering was shown to perform superior to all-to-all correction in a test-case where artificially large BPM misalignment were simulated.

3 Beam-based alignment in other collider sub-systems

3.1 CLIC Beam Delivery System

The alignment of the CLIC Beam Delivery System has been addressed in [19]. There are two major challenges: the tight tolerances for the emittance preservation and its strong non-linear beam dynamics. For these reasons conventional beam-based alignment techniques, like dispersion free steering, are only partially successful and need to be followed by optimization algorithms based on other observables, like beam sizes. It has been proved via realistic simulations that dispersion free steering can be used to align the CLIC collimation section with an emittance growth below 5%. These pure alignment techniques fail in the FFS and more general tuning algorithms have to be used for this more complex CLIC system. A more refined version of the tuning algorithm including non-linear dispersion free steering does not completely improve the situation. The current conclusion is that 80% of the seeds converge to a luminosity above 80% of the design case and that algorithms need to be improved to reach 100% success.

3.2 CLIC Drive Beam

The CLIC Drive Beam decelerator requires the beam to be transported with very small losses, in order to provide stable and uniform power production for the accelerating structures. The large energy spread of up to 90% implies that simple 1-to-1 steering would not be sufficient. In [22] we have investigated various beam based alignment schemes in order to minimize the drive beam envelope. We have shown that dispersion-free steering is an excellent candidate for the decelerator; the effect of quadrupole kicks on the beam-envelope is almost perfectly mitigated, and in addition an appropriate test-beam with empty buckets can be easily generated using delayed switching. For initial alignment one can use reduced current test beams, and then increase the current to nominal. We estimate a BPM resolution of 2 microns to be adequate in order to obtain optimal performance.

4 Start-end beam tracking, feedback and luminosity optimisation

A number of start-end beam tracking simulations have been performed for the purpose of studying realistic luminosity degradation effects, and their amelioration via steering algorithms and feedback systems. Several studies [23,24,25] have been based on MERLIN [26] for simulation of beam dynamics in the linacs and BDS. Other studies [27,28] have been based on PLACET [26]. All use GUINEA-PIG for simulation of the beam-beam interactions.

4.1 Feedback studies

Three levels of beam-based feedback system are being developed: a slow feedback correcting the beam orbit to compensate for low frequency ground motion, an inter-pulse feedback acting in a few locations to correct accumulated errors that occur in between the action of the slow system and to provide the possibility of straightening the beam; finally, a fast intra-train feedback system acting at the IP to keep the beams in collision, correcting for the high frequency ground motion that moves the final quadrupole doublet. Aspects of the orbit feedback in the ILC main linac and the impact of the ground motion in the CLIC beam delivery system have been studied in [27]. In [29], a potential way of optimising the orbit feedback design was investigated, indicating that the emittance preservation performance may be improved by one order of magnitude.

4.2 Short-term luminosity recovery

Studies [28] have simulated the ILC main linac plus the beam delivery system based on the tracking code PLACET, using the nominal beam parameters. For the BDS we have used the 14 mrad crossing angle optics (version 2007). Static and dynamic imperfections have been inserted in the model. In order to reduce the emittance growth in the main linac we have applied 1-to-1 and dispersion free steering (DFS) with the PLACET code. We have studied the performance of a fast intra-train feedback system at the IP for the ILC in order to correct both position and angle jitter. The result of the luminosity for a single seed of GM as a function of bunch number in a train is shown in Fig. 1, where different scenarios of GM are compared. For the noisiest site (model C), applying fast position and angle FB stabilisation, a recovery of the luminosity up to 85 % of the nominal value (2 × 1034 cm−2s−1) is obtained. For quiet sites (models A and B) practically 100% of the nominal luminosity would be achievable.

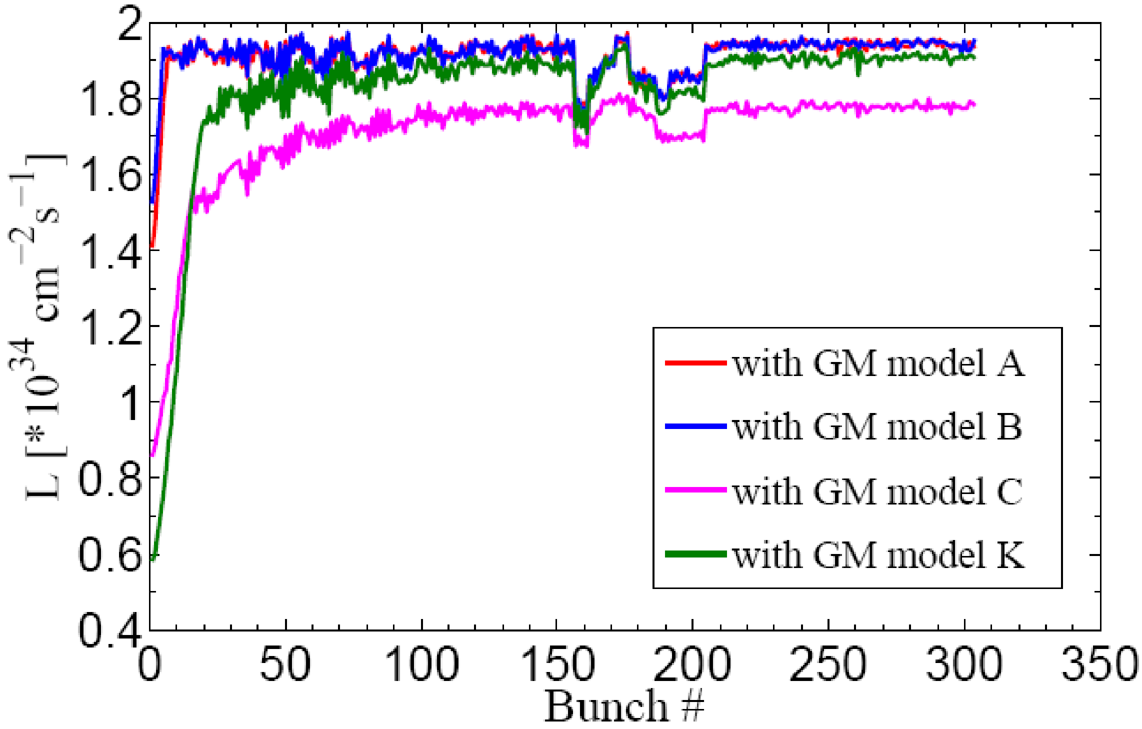

Fig. 1: Luminosity recovery vs. bunch number. Example for a single random seed for different models of ground motion: A, B, C and K.

4.3 Long-term luminosity recovery

Several studies [23,24,25] have been based on MERLIN for simulation of beam dynamics in the linacs and BDS. The luminosity is calculated with GUINEAPIG and normalised to L(t = 0). At the start of the main linac the emittance is set to γϱy = 20 nm and γϱx = 8000 nm. Since the model does not contain any other alignment errors the resulting luminosity (L = 2.8 · 1034 cm−2 s−1) is large compared to the ILC reference design report and the relative luminosity loss will be overestimated slightly. The one-to-one steering (red line in Fig. 2) keeps the luminosity for about 1.5 days above the 80% level. In reality luminosity tuning in the final focus system will help to preserve the luminosity even longer.

To investigate the potential improvement the following tuning parameters has been chosen: the beam waists wx and wy, the dispersions dx and dy, and the coupling between x and y′. We do not define any realistic tuning knobs but apply the corresponding similarity transformation directly to the bunch particles. In an iterative procedure first the beam matrix is calculated from the bunch particles and used to estimate the tuning parameters. These parameters are then applied one after the other until there is no significant improvement. With this procedure the luminosity can be kept for about 15 days (blue line in Fig 2). The RMS over different random seeds, i.e. random machine configurations, covers the range from 8 days to 1 month. Considering the idealistic tuning approach and other simplifications in our model, we expect a somewhat worse behaviour of the real accelerator.

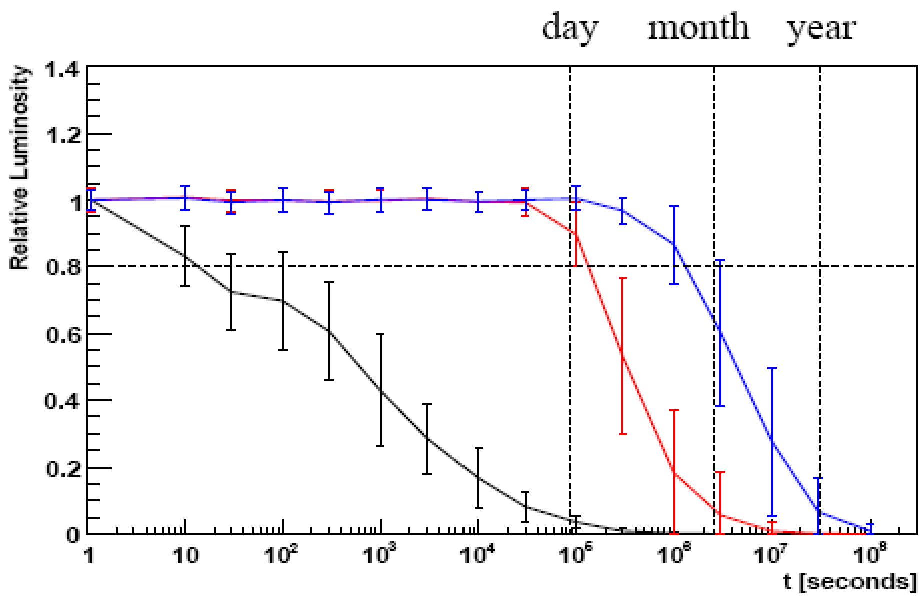

Figure 2: Relative luminosity over time. ATL ground motion (A = 4 · 10−18 m/s) with one-to-one steering. Each point shows the average over 80 random configurations i.e. ground motion seeds corresponding to 40 colliding bunch pairs. The error bars show the RMS over these random configurations.

5. IP luminosity tuning

Luminosity is sensitive to both vertical beam-beam offset and crossing angle. These effects were first identified as potential performance limitations during the TESLA linear collider study. As part of the EUROTeV programme, the effects were systematically studied [30] for the ILC parameter plane, using the beam-beam simulation GUINEA-PIG. Compared to the TESLA parameters, the sensitivity to collision offset and angle was found to be the same order of magnitude for the ‘LARGEY’ and ‘LOWP’ ILC parameter sets (both of which have a relatively high vertical disruption parameter, comparable to the original TESLA number), and about a factor of three smaller for the ‘LOWQ’ option. Some luminosity loss is also expected from internal bunch deformations like those induced by single-bunch wakefields in the linac (the so-called “banana effect”); this was also studied with GUINEA-PIG, with single-bunch correlated emittance growth of 6% on average. The effects were shown to be negligibly small.

In order to achieve maximum luminosity in a collision between two low-emittance beams, it is crucial that a number of IP beam parameters are accurately tuned. For each of the two beams, the offset, angle, longitudinal waist position, and dispersion need to be tuned at the IP. In [31], five sextupoles of the CLIC final focus system were used to construct realistic knobs for waist and dispersion tuning in the horizontal and vertical planes. Appropriate linear combinations of horizontal and vertical sextupole displacements were determined such that the knobs could change the parameters independently. For the presumably trivial offset and angle knobs, a realistic implementation was not considered, and their effect was instead added "by hand".

A tuning strategy was developed and tested using either the luminosity or beamstrahlung losses as a tuning signal. Ideally the luminosity itself would be used for tuning. It can, however, not be directly measured fast enough and the use of beamstrahlung energy losses was investigated as an alternative. While tuning using the luminosity signal simply requires maximisation of the signal, the use of the beamstrahlung signals from the two beams is slightly more complex. For the horizontal parameters, the total beamstrahlung losses of the two beams have to be maximised. For the vertical parameters, except the waist, the total losses should instead be minimised. For the waist we need to maximise/minimise the difference in energy loss from the two beams.

We showed that a luminosity loss of more than 70% caused by random IP parameter errors could be nearly completely recovered using the tuning strategy based on the beamstrahlung signals. An insufficient linear range of the horizontal knobs was identified as a potential problem, but is likely a consequence of the way the parameter errors were chosen (the magnitude of each error was such that it would cause a luminosity loss of the order of 10%, consequently requiring large errors in the horizontal plane).

6 Vacuum Level and Fast Beam Ion Instability

The fast beam-ion instability is a concern for CLIC. In this process ions from rest gas in the beam pipe are ionised by the beam and then trapped inside the beams. The accumulated ions can lead to a multi-bunch instability. Analytic estimates have been performed and showed that a safe vacuum level is 0.1 ntorr in most parts of the machine. In the main linac these estimates suffer from some uncertainty. Due to the required high precision of the components, a safe vacuum level of 0.1 ntorr will not be easy to achieve. Such a vacuum quality requires bake-out of the beam line components. The heating of the beam line components is in contradiction with the very tight accuracy requirements arising from beam dynamics. Achieving the 01nTor vacuum level seems very challenging and would need a very ambitious R&D programme. There are two main reasons why the analytic estimate is significantly too conservative in the main linac. Firstly, the transverse oscillation frequency of the ions will vary along the beam line, since the optics and the beam energy change. Hence different parts of the beam noise spectrum will be amplified in different parts of the linac, avoiding a coherent exponential growth. Secondly, the ion oscillation frequency is in the largest part of the linac high enough, such that the ions are not fully trapped. It is therefore important to estimate the required vacuum level more precisely than the analytic estimates allow.

A new tracking has been developed to quantitatively study the problem [26]. Studies based on this code show that a vacuum level of 0.1ntorr is required in the long transfer lines that transport the beam from the central site to the beginning of each linac [32]. This result is in excellent agreement with the analytical estimate, as expected. The vacuum level will require NEG coating or bake-out, but these methods can be easily applied in these beam lines. Further studies show that the beam remains stable in the main linac even if the vacuum level reaches 10ntorr, a value significantly relaxed compared to the simplified analytic estimate. This vacuum level can be achieved using conventional techniques, mainly efficient vacuum pumps.

7. CLIC Parameter Optimisation

A systematic overall optimization of the CLIC parameters has been performed in order to minimise the machine cost. Beam dynamics constraints have been taken into account as well as those arising from the accelerating structures [33]. The three most important accelerating structure parameters that determine the beam dynamics in the main linac are the accelerating gradient, the accelerating frequency and the size of the irises of the structure cells. A three dimensional scan of these parameters has been performed and for each point the beam parameters have been determined, based on the emittance preservation in the main linac. The corresponding luminosity has then been calculated taking into account the impact of damping ring and beam delivery system as well as the beam-beam effects. For each of these points a large number of potential accelerating structures has been investigated. The structure yielding the lowest cost has then been chosen.

The optimization procedure led to a change of the acceleration frequency of CLIC from 30 to 12GHz and of the gradient from 150MV/m to 100MV/m, as this will result in a significantly cheaper machine.

An important ingredient of the beam dynamics studies in the main linac are the short range wakefields, they need to be known for distances much shorter than the typical bunch length. In the case of CLIC, these cannot be calculated using standard electro-magnetic simulation codes. The length of the bunch is much shorter than the typical dimensions of the structure (a few tens of micrometres compared to millimetres). Approximate formulae had been derived by K. Bane based on analytic considerations. For a general parameter optimisation of CLIC, it has been necessary to understand the validity of the formulae, in particular since they needed to be applied for parameters that have been outside of the original range of validity as defined in the original paper. Very detailed simulations have been performed in order to establish that the formulae are indeed reasonable for a larger range of parameters than original specified. Also a more precise approximation has been derived including the impact of rounded irises [34]. A further important point has been to establish a link between the machining tolerances and the relevant beam dynamics modelling [35]. This study indicated that the structures could have strong transverse deflections which needed to be counteracted by the appropriate choice of parameters for the beam-based alignment procedures.

8 Conclusion

The impact of machines errors on the luminosity goals of International Linear Collider (ILC) and CLIC has been studied by means of detailed integrated simulations, covering different sub-system and time scales of the collider. Methods to correct machines errors have been implemented and studied. These studies have led to the optimization of several machine parameters.

Acknowledgement

This work is supported by the Commission of the European Communities under the 6th Framework Programme "Structuring the European Research Area", contract number RIDS-011899.

References

[1] D. Schulte, 'Different Options for Dispersion Free Steering in the CLIC Main Linac', EUROTeV-Report-2005-004.

[2] D. Kruecker, F. Poirier et al , 'Energy Adjustment Strategy for Dispersion Free Steering at the ILC using the MERLIN Package ILCDFS', EUROTeV-Report-2006-106.

[3] A.Latina, D.Schulte, P.Eliasson, 'Bunch Compressor for Beam-Based Alignment', EUROTeV-Report-2007-066.

[4] N. Walker, 'Emittance Preservation in a possible ILC Main Linac which follows the Earth's Curvature', EUROTeV-Report-2005-017.

[5] D. Schulte et al., 'Study of an ILC Main Linac that Follows the Earth Curvature', EUROTeV-Report-2006-050.

[6] A. Latina et al., 'Implications of a Curved Tunnel for the Main Linac of CLIC', EUROTeV-Report-2006-031.

[7] D. Schulte, A. Latina et al., 'Dynamic Effects During Beam-Based Alignment', EUROTeV-Report-2007-068.

[8] P. Eliasson, D. Schulte, 'Luminosity Tuning Bumps in the CLIC Main Linac', EUROTeV-Report-2005-006.

[9] P. Eliasson, D. Schulte, 'Dispersion Free Steering and Emittance Tuning Bumps in the ILC Linac', EUROTeV-Report-2005-021.

[10] P. Eliasson, D. Schulte, 'Design of main linac emittance tuning bumps for the Compact Linear Collider and the International Linear Collider', Phys. Rev. ST Accel. Beams **11**, 011002

[11] P. Eliasson, D. Schulte, 'Performance of CLIC Emittance Tuning Bumps in a Dynamic Environment', EUROTeV-Report-2008-013.

[12] D. Krücker, F. Poirier et al., 'Evaluation of the Component Tolerances for the ILC Main Linac Assuming Global Linear Corrections', EUROTeV-Report-2007-020.

[13] D. Kruecker, I. Melzer-Pellmann et al., Simulation Studies on Coupler Wakefield and RF Kicks for the International Linear Collider with MERLIN, EUROTeV-Report-2008-003;

F. Gross et al., Simulations of Coupler Kicks and Failure Modes, EUROTeV-Memo-2008-001

[14] I. Zagorodnov and M. Dohlus, LCWS/ILC, Hamburg 2007.

[15] M. Dohlus et al., MOPP013, EPAC08, Genoa 2008.

[16] A. Reichold et al., The LiCAS-RTRS – a Survey System for the ILC, EUROTeV-Report-2006-075.

[17] Fr. Poirier, D. Krücker et al., 'Simulation Studies of Correlated Misalignments in the ILC Main Linac and the Influence of Ground Motion', EUROTeV-Report-2008-017.

[18] E. Adli, R. Corsini et al, 'Status of an Automatic Beam Steering for the CLIC Test Facility 3', EUROTeV-Report-2008-062.

[19] A. Latina, R. Tomas et al., 'Beam-based Alignment of the CLIC Beam Delivery System', EUROTeV-Report-2008-040.

[20] D. Wang et al. 'Design Study of the CLIC Booster Linac with FODO Lattice', EUROTeV-Report-2008-092.

[21] J.B. Jeanneret, E. Adli et al, 'Beam Dynamics Issues in the CLIC Long Transfer Line', EUROTeV-Report-2008-035.

[22] E. Adli, D. Schulte, 'Beam-Based Alignment for the CLIC Decelerator', EUROTeV-Report-2008-042.

[23] G. White, D. Schulte, N. Walker, 'Multi-bunch Simulations of the ILC for Luminosity Performance Studies', EUROTeV-Report-2005-001.

[24] G. White, N. Walker, 'Design and Simulation of the ILC Intra-train Orbit and Luminosity Feedback Systems', EUROTeV-Report-2006-088.

[25] D. Krücker, F. Poirier et al., 'Merlin-based Start-to-End Simulations of Luminosity Stability for the ILC', EUROTeV-Report-2007-019

[26] ILPS Deliverable 1 Report: EUROTeV-Report-2008-088.

[27] A. Latina, G. Rumolo et al., 'Feedback Studies', EUROTeV-Report-2007-065.

[28] J. Resta-López, P. N. Burrows, 'Placet Based Start-To-End simulations of the ILC with Intra-Train Fast Feedback System', EUROTeV-Report-2008-052.

[29] P. Eliasson, 'Dynamic imperfections and optimized feedback design in the Compact Linear Collider main linac', Phys. Rev. ST Accel. Beams **11**, 051003

[30] I. Melzer-Pellmann, 'Study of Beam-Beam Effects with Offset and Angle Scans', EUROTeV-Report-2007-021.

[31] P. Eliasson, M. Korostelev et al., 'Luminosity Tuning at the Interaction Point', EUROTeV-Report-2006-039.

[32] G. Rumolo, D. Schulte, 'Fast Ion Instability in the CLIC Transfer Line and main linac', EUROTeV-Report-2008-036.

[33] A. Grudiev, D. Schulte et al, 'Optimum Frequency and Gradient for the CLIC Main Linac', EUROTeV-Report-2006-099.

[34] R. Zennaro, 'Considerations on Short Range Wakefield for CLIC Main Beam Accelerating Structures', EUROTeV-Report-2007-072.

[35] R. Zennaro, 'Study of the machining and Assembly Tolerances for the CLIC Accelerating Structures', EUROTeV-Report-2008-081.