Dear GDE directors and BCD Excutive Committee,

after reading all the great work which has been done in the white papers and the BCD documents, I still have some concerns.

The most important point is that we get such a high precision machine at all. Therefore it has to be affordable. After discussions with some of the experts I get the impression that one of the major cost drivers is the possible TeV upgrade.

While an upgrade is of course desirable in the long run, at the present stage the focus should be on the 500 GeV machine. There is a compelling physics case for the 500 GeV machine, which is largely independent of what the LHC will find, but which is very likely to be even further strengthened by the first LHC results.

The BCD strategy should therefore mainly concentrate on providing an affordable, flexible machine up to an energy of 500 GeV at full luminosity. Concerning the possible upgrade designs, however, one definitly has to wait for the later LHC results as well as the ILC(500) results: is 1 TeV the best choice or should one go to higher energies? To get a reliable answer to this question one will have to wait much longer than to the year 2010. My guess would be the year 2020 to outline and precisely define the requirements we need for the LC upgrade. Therefore the possible upgrade options should not determine too much our basic ILC(500) design considerations now.

Let me shortly summarize the physics case for the 500 GeV machine and the requirements that the machine should fulfil in order to be optimized for that scale.

The 500 GeV physics case is given by:

- High-precision measurements of the properties of the top quark. As the top quark is by far the heaviest quark (and the heaviest fundamental particle observed so far), top quark physics provides a unique window to new physics. Knowing the properties of the top quark with high precision will be mandatory for identifying quantum effects of new physics. This physics programme can only be carried out at the ILC. No other machine can provide a comparable precision.

- If the Higgs mechanism is realised in nature, it is practically guaranteed that at least one Higgs boson will be detected at ILC(500). At the LHC, on the other hand, a Higgs boson with non-standard properties may be missed. Precision measurements of the mass, the couplings, the spin and the CP properties of the new particle will be indispensable to experimentally verify the Higgs mechanism and for identifying the underlying physics that is responsible for electroweak symmetry breaking.

- High precision measurements at GigaZ. These measurements provide a unique opportunity for detecting effects of new physics at much higher scales. The results from GigaZ and the other measurements at ILC(500) will allow to detect even tiny deviations from Standard Model expectations. The high-precision physics at ILC(500) will provide stringent constraints on any kind of new physics. It therefore sets the boundary conditions that models for physics at higher scales will have to obey. This information will be of utmost importance for constraining the scale of new physics and thus to outline future search strategies in HEP.

- ILC(500) has very good prospects for detecting the light states of various kinds of new physics in direct searches, for instance supersymmetric particles. The part of the spectrum accessible at ILC(500) is very likely to be complementary to the LHC. The precise measurements at ILC(500) will be crucial for revealing the underlying structure of the new physics, even if only a few new particles are accessible. The results from the LHC and the ILC taken together will clearly outline which kind of energy upgrade will be really needed.

Conclusion:
The strategy should be to optimize the baseline machine for excellent, flexible running at 500 GeV, so that the costs are kept as low as possible and so that the machine can be realised as soon as possible. Incorporating some 'safety margin' in the energy will be highly desirable (see below). The results of the LHC and the ILC(500) may be absolutely crucial for determining the most suitable upgrade scenario.

Therefore I am not really happy with the BCD document concerning the 'energy upgrade' and the recommendation for an operating gradient of 31.5 MeV/m. It may be more promising to run at 500 GeV with a gradient in the twenties, 25, 28 MeV/m and only a tunnel length which could accomodate –if needed and as a quick upgrade– that many of needed klystrons to run all cavities at the design values of 36 MeV/m with full luminosity. Such a possibility would allow to run the baseline design at about 650 GeV but with reduced luminosity and provides therefore an important safety margin in energy which reduces considerably the pressure for an immediate full upgrade of the 500 GeV stage. Providing a 20%-25% safety margin in energy increases the cavity cost by that amount. However, the decrease in power request when running at lower gradient, possible longer cavity life time etc. could maybe compensate that. Such an 'energy safety margin' may provide important input for choosing a suitable upgrade strategy and enables flexibility in performing new physics analyses.

Requirements on the ILC(500) design:
a) Threshold scans are a powerful and unique possibility at the ILC. However, the question will be how often it will be necessary to change the energy and which luminosity will be required at the different stages. Threshold scans are clearly needed for top quark and Higgs physics, but in principle one should have the flexibility to tune the energy to any wanted energy below 500 GeV in order to precisely determine the properties of a new particle. It should be noted in this context, however, that precise measurements are possible already in the continuum, which give important information on the most efficient luminosity strategy

for the respective treshold scan.

b) Polarized beams are a powerful tool for physics at all energy stages, but are particularly important for the 500 GeV stage. In case that the full spectrum of new physics is not accessible and only limited information exists about the underlying physics, the polarization of both beams is particularly important: it enables to analyse the couplings of the new particles uniquely, improves the precision to determine the properties of the particles, enlarges the flexibility to detect the processes, improves strongly suppression of possible background processes (more details are given in the POWER report). The polarization of both beams is a low cost possibility for strengthening strongly the physics potential of the ILC(500) but without critical impact on commissioning and operation (using a low intensity keep-alive source etc.). Therefore, it seems promising for me to schedule very early the polarization of both beams.

Summary in total:
It is of utmost importance that the BCD is cost opimized for the 500 GeV energy. The TeV upgrade considerations should not cause major cost-driving design specifications for the 500 GeV option. A clear physics case for ILC(500) exists, based on top physics, Higgs physics and a high potential for detecting effects of new physics both in direct as well as indirect searches. Early results from the LHC will most likely provide further support for this energy stage, so that an expeditious realization of the ILC(500) should be pursued.

Highly desirable features of ILC(500) are

a) a tunable energy to lower energies,

b) tunable energy to higher energies beyond 500 GeV at cost of reduced luminosity,

c) the polarization of both beams at a very early stage.

These features would allow to maximally exploit that energy stage, provide a promising 'safety margin' for the physics potential and allow to determine –together with the LHC results– the most suitable upgrade strategies.

All best wishes,

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