

CREATING STRONGER ACCELERATOR BEAMS

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INTRODUCTION

Many new designs for Particle Accelerators have been proposed including the ILC (The International Linear Collider) and the CLIC (The Compact Linear Collider). Both the ILC and the CLIC are high energy electron-positron colliders. The CLIC seems somewhat more impressive in its ability to operate up to 3TeV, but the ILC uses the more normal means of operation as a superconducting machine. The CLIC has a more ambitious output but with a more experimental approach. Prototypes of many of the subsystems of CLIC have been constructed at CERN and around the world, but the ILC has in general been subject to a more larger review in this authors view. Of course the ILD and SiD detectors were originally designed for the ILC, but have now become appendages of the CLIC design, showing that no good idea goes to waste. There has been some debate as to the physics obtainable using e+e- colliders, but the consensus is that this is a useful idea, but as always a greater beam strength would be better. Of course the LHC (the large Hadron Collider) has a potential range from 8 TeV to 14TeV . The demand for a stronger beam can be seen from the differences and trade-offs between the ILC and the CLIC. This paper is not meant to be comprehensive in the comparison between these designs.

CLIC DESIGN

The CLIC has a broad center-of-mass range from 500MeV to 3TeV, which may be crucial for some experiments. The discovery of a particle in the 125 GeV range at the LHC may warrant a collider that can “scope” this energy range out in greater detail. The CLIC design is currently in the 500 GeV range and the 3 TeV range. In the CLIC there are drive beam accelerators. The drive beam energy is transferred to the colliding beam through RF power through waveguides. The bunch spacing is 60cm. The major design difference between the 500 GeV range and the 3 TeV range is a greater number of Klystrons, which has a greater number due to the larger beam current. A larger bunch charge and more bunches per pulse gives the 500 GeV design more luminosity. The designs are about the same length, but the 3 TeV design has a larger gradient.

ILC DESIGN

The ILC has a narrower center-of-mass range from about 500 GeV to 1 TeV, and uses superconducting klystron tubes as its construction. A large number of Tubes have to be used and this like the CLIC is a linear device.

TRADE-OFFS

The major difference between CLIC and ILC seems to

be the amount of current in the beam. The CLIC claims to be able to produce 100 Amps (Is this true?) and do this because it is not technically a superconducting device (klystrons?). The ILC produces about 7milliamps, which is large compared to the average current at Fermilab.

NEW PHYSICAL IDEAS

From both designs, there could be an advantage to supplying more electrons and positrons. It may be possible to use very fine nanotubes as conduits to supply these particles. There is some evidence that the Quantum Field Theory allows for the tubes to act as springs in the Quantum Field that exists inside the klystron tubes of the Particle Accelerators. Experiments could be done to see if this is the case, and fine tubes could be attached to the klystrons. A mathematical model of this is available. It may be that it is not possible to generate and use such large currents with existing technology even if the large number of klystrons can be produced. Larger currents need to be produced, but it is this authors opinion that this can not be done without having larger sources and means for storing particles for creating larger bunch charges. Although this is without experimental evidence it may be possible to use nanotubes to store positrons, at least in very short time periods, but within the times allowed to create bunches. It is this authors opinion that the limits on these machines is going to be the storage of these particles and that research into nanotubes as storage devices may be more important than any other parameter in their construction.

CONCLUSION

Both systems seem to be designed for the same range, but neither seems to have enough klystrons available, in order to produce such large amounts of klystrons, a Japanese company has agreed to produce more sheet niobium which is needed in the production of these tubes. Both designs seem to be a little grand in their expectations of current and for that matter damage by using larger currents. Both designs lack for testing of their components, although both reports seem encouraging in their outlook. Of course both lack for funding.

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