

## **A proposal for an affordable FCC – FCC – a Feasible Future Collider**

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LHC magnets cost 0.5 million CHF each.

Increasing the field to 15 T needs 3.5 times more superconductor per magnet and the superconductor has to be niobium tin which is 5 times as expensive. Coil costs are 30% of the total magnet in the LHC. The cost per magnet will be 6.3 times the LHC cost i.e. 3.15 MCHF per magnet. LHC has 1232 dipoles (532 MCHF). FCC will have about 5000. The FCC magnet cost will be  $0.532 \times 4 \times 6.3 = 13$  BCHF

This would mean that FCC would be roughly equal to the total cost of a linear collider and is not in my opinion politically viable. Moreover the magnet cost is by far the predominant component and it is worth considering drastic reductions in its cost.

The FCC is designed on the assumption that it would meet the scaled luminosity target of the LHC but no-one knows what physics it will be required to study. This luminosity and energy extrapolation implies not only an expensive magnet but one that reaches 13T, uses niobium-tin and has an inner bore big enough to beat coupled bunch-instabilities for the scaled bunch current. Synchrotron radiation loading of the vacuum chamber wall is an unsolved problem.

Considerable savings could be had by reducing the energy and luminosity. It would still a factor 4 bigger than LHC but these savings could bring the project back into the range that might just be affordable. The luminosity would of course very much reduced but remember that the SPPbarS luminosity was small but still enough for a discovery worthy of a Nobel Prize. The same could be said for the J-psi. If we are looking for something as little understood as dark matter, do we have to still believe that luminosity must follow the square of the inverse of the beam energy? Anyway we cannot afford to do so!

The choice may be between a machine that is good for physics but will never be built and one that might be built but will demand more experimental ingenuity from the physics community.

We should therefore consider a design with a smaller beam tube scaled with the root of the injection energy and magnets constructed from Niobium Titanium and LHC field. It is all the physics community can reasonably hope to get!