SUMMARY REPORT OF THE WORKING GROUP 1 ON FEL AND IFEL

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The two topics, FEL as accelerator driver and IFEL as accelerator, have been investigated in this working group by taking into account, as starting points, the conclusions of the Oxford Workshop[1] for the IFEL and the Castelgandolfo Conference[2] for the FEL. In this short note I summarize the main conclusions derived during the four days work. A more detailed analysis can be found in other articles submitted to these proceedings.

In particular the FEL as accelerator driver has been discussed by A. Renieri, the transverse stability in IFEL by E.D. Courant and A.A. Kolomensky, and, finally, the problems connected with laser beam handling and laser-electron beam coupling by A. Cutolo and M. Placidi.

The main conclusions we derived can be summarized as follows:

a) FEL sources are quite suitable for laser acceleration apart from the IFEL. Indeed the typical FEL peak electric field, which can be of the order of some GV/m, is too low for driving an efficient IFEL device in which the gradient is only a small fraction of the laser electric field (10^{-2}-10^{-3}).

b) The IFEL, which is not a linear accelerator but a circular one, is not suitable for colliders operating at an energy of the order of the TeV. Namely synchrotron radiation losses limit the maximum energy at about 300 GeV. In principle it is possible to operate up to 1 TeV but in this case, the gradient is comparable with that obtained in standard accelerating structures[3].

c) Some preliminary estimates seem to require additional focusing (with quadrupoles or strong focusing undulators) for the IFEL. The effects of focusing on the acceleration mechanism must be carefully analyzed.

d) Laser beam handling is a very crucial point for a multistage IFEL accelerator. In particular tolerances on phasing between the various stages are very critical, but it seems that the state of the art will allow a correct timing for a few tens of stages at least. Various schemes have been suggested for the coupling between laser and electron beams. The most promising one seems to be that based on the utilization of a hollow mirror, or a mirror with a very thin (few microns) reflecting foil in the centre which allows the passage of the electron beam, followed by a metallic waveguide. We stressed that this topic requires a more careful theoretical and experimental investigation.

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REFERENCES

1) Proceedings of the ECFA-RAL meeting "The Challenge of Ultra-High Energies" Oxford, Sept. 1982, Report ECFA 83/68 (1983).

2) Proceedings of the "1984 FEL Conference" Castelgandolfo, Sept. 1984, J.M.J. Madey and A. Renieri Eds (to appear in Nucl. Instrum. and Meth. in Phys. Res.).

3) C. Pellegrini, Proc. of 12th Int. Conf. "High Energy Accelerators", Fermilab 1983, p. 473.

Discussion

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I should like to comment that the expression for maximum energy in an IFEL (balancing acceleration rate against radiation loss) is the same as for a storage ring if one replaces the storage-ring voltage-per-turn by the IFEL "transverse-voltage-gain" per wiggler period and the storage ring bending radius by the wiggler bending radius.