RENEWAL OF KU-FEL FACILITY

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Abstract

We have started construction of new FEL facility (Kyoto University FEL: KU-FEL) which will be used for research on energy science. In the past, we have developed the KU-FEL parasitically at a shared experimental facility. Thus construction time was quite limited, and we had no space for future applications of the IR-FEL. Therefore we decided to renew an old experimental hall. In this paper, status of construction and future plans are described.

INTRODUCTION

Users demands in the area of energy-related science to a high-power tunable IR lasers are increasing in Japan, such as basic study of high-efficiency solar cells, generation of sustainable energy source of alcohol and/or H_2 from polluted gas, and separation of DNA and/or RNA. To satisfy these demands, we decided to renew our FEL facility to be more user friendly and to operate more flexibly.

DESIGN

Experimental hall

Construction and fundamental studies on the KU-FEL have been carried out parasitically at a building belonging to the Institute of Chemical Research where a few other accelerators were operating. Therefore, available machine time for our experiments was quite limited. We decided recently to move the KU-FEL to our own building and reconstruct the machine. The building used to be for plasma experiments and there was no provision for radiation shielding. We modified the room by adding concrete walls of 2-m thickness and some space for users.

A Schematic drawing of the experimental hall is shown in fig.1. The room with the shielding was completed in June, 2004. We decided not to use a costly shielding door by use of stairs to step up to the top of the shielding wall and down to the accelerator room. Concrete blocks can be removed temporarily when large equipment is to be carried in.

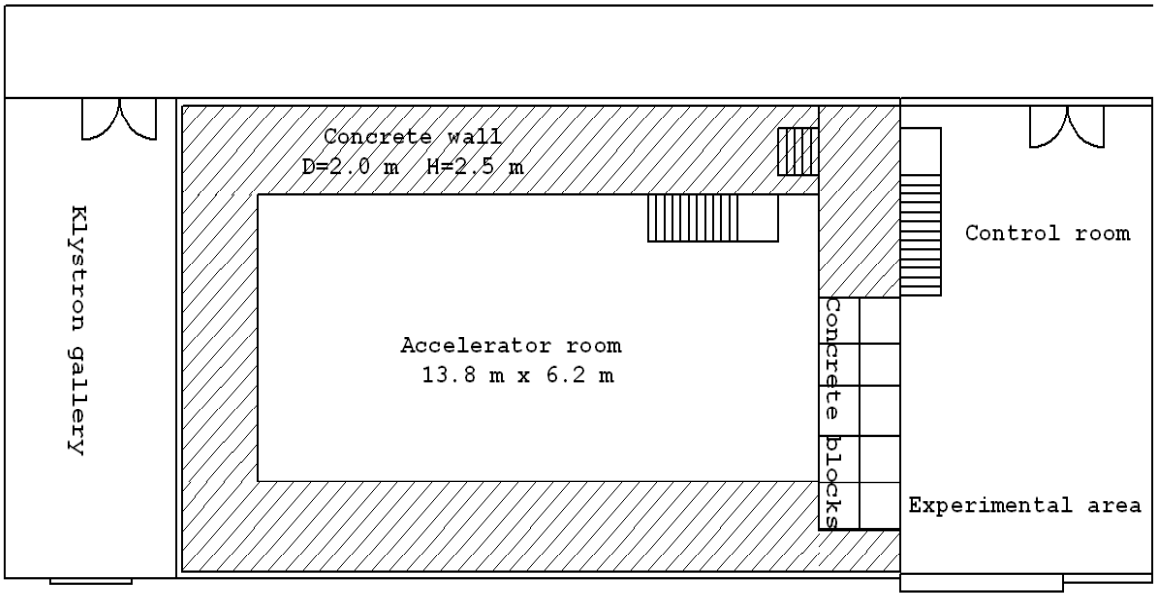

Fig. 1 Experimental hall

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Initial plan

As a first step, we are planning to construct a compact IR-FEL system, which consists of a 4.5 cell thermionic RF-gun, a 3 m accelerator tube and 1.6 m Halbach type undulator. Schematic view of the system is shown in fig. 2.

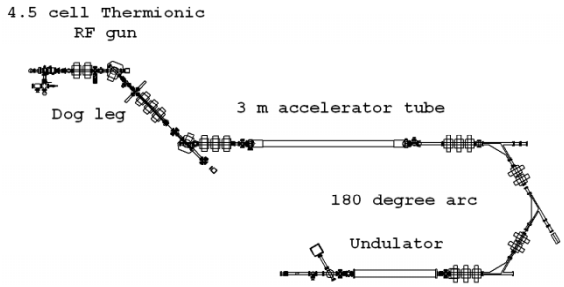

Fig.2 4.5 cell gun and linac

The electron beam of about 30 MeV will be provided by the thermionic RF gun and the linac. The configuration has been already designed to achieve a FEL lasing from 4 to 13 μm [1,2], and acceleration test has been carried out at the previous experimental hall.[3, 4]

All devices were moved to the new hall in July, 2004. We hope to resume the operation of the linac in fall of 2004. The FEL is expected to lase next year. However, the lasing wavelength will be limited to around 13 μm because the undulator is an old one which used to be used for a different system and not adequate to the present system.

Future plans

A 1.6 cell photocathode RF-gun system will be added to the system in the near future and it will be used alternately with the present thermionic RF-gun according to the demands of users. The photocathode material will be Cs_2Te.[5]

Fig. 3 shows a schematic view of the photocathode upgrade.

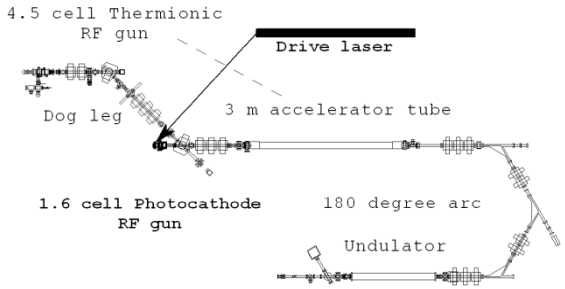

Fig.3 Photocathode upgrade

After the photocathode upgrade, we will install an energy recovery system using a normal conducting accelerator tube.[6] This upgrade is mainly to reduce shielding duty to the radiations from used electrons.

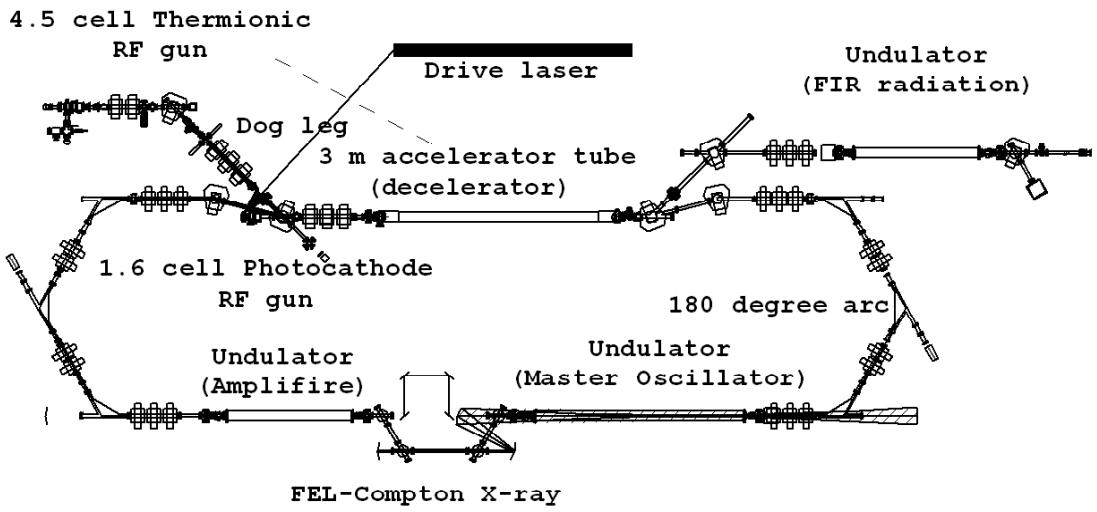

Fig. 4 Future upgrades

Some experiments on material science and bio science will need polarized laser light, and a helical undulator will be needed to satisfy some users' demands. APPLE-II type undulator[7] or Onuki type undulator[8] is considered at present. Two-stage FEL system to increase the FEL power[9] is also planned for the future. Generation of FEL-Compton backscattering x-rays is also planned. In order to compensate for the low yield of this method, the IR FEL in a cavity will be directly used. The expected x-ray energy is from 2 keV to 20 keV by using 32-MeV electron beam and 10-100 μm FEL. FIR radiation is also planned using thermionic RF gun.

These upgrades are shown in fig. 4.

SUMMARY

We have renewed an experimental hall for FEL experiments. The accelerator and the IR-FEL system will be installed shortly. The building is completed, and beam commissioning will be started in this year.

After lasing in the 10 μm wavelength region, we are planning to upgrade our facility to satisfy users' demands. By using various types of radiations (e. g. FIR radiation, IR FELs, Compton X-ray), material and bio/chemical science will be studied.

REFERENCES

[1] T. Yamazaki, et al., Nucl. Instr. And Meth. A 483 II (2002) 13.
[2] H. Ohgaki, et al., Nucl. Instr. And Meth. A 507 (2003) 150.
[3] S. Murakami, et al., Proceedings of the 1st Annual Meeting of Particle Accelerator Society of Japan and the 29th Linear Accelerator Meetings in Japan, (2004) 599
[4] K. Masuda, et al., in these proceedings
[5] H. Ohgaki, et al., in these proceedings
[6] K. Masuda, et al., Nucl. Instr. And Meth. A 507 (2003) 133.
[7] A. Bhowmik et al., Nucl. Instr. And Meth. A272 (1988) 183.
[8] H. Onuki et al., Appl. Phys. Lett. 52 (1988) 173.
[9] O. Chubar et al., J. Synchrotron Rad. (1998) 5, 481.