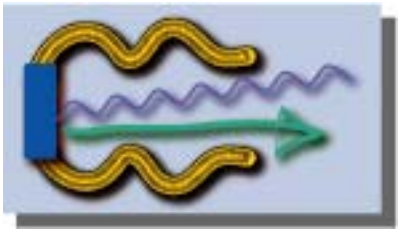

PHIN

NEPAL 3 GHz RF gun test at Orsay

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Abstract

Following the difficulty to produce the first PHIN RF gun for CTF3, the second RF gun foreseen for NEPAL has been sent to CERN in order to install it on CTF3. Nevertheless the NEPAL station has been implemented with a provisional RF gun called AlphaX. This note gives a report about the work done at LAL on the NEPAL station and the RF tests achieved.

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The objectives of this deliverable were to upgrade the NEPAL station in order to host the RF gun designed in the framework of the JRA PHIN, WP4 (it will be called PHIN gun in the rest of the document). In addition LAL should proceed to systematic measurements of the electron beam produced by this photo-injector in the NEPAL station.

To be clear about the results of LAL, the upgrade of the NEPAL station is nearly finished and it is possible that we get an electron beam by the end of 2008 or in the beginning of 2009. Details about the beamline construction will be given in the following. But the objective of the tests to be performed with this RF gun will not be fulfilled in 2008 for the simple reason that no PHIN gun is available anymore. There were 2 PHIN guns, one for the CERN and the other for LAL. For reasons which are expanded in previous notes [1,2], the issue for CERN is unusable. An agreement between CERN and LAL was found to give to CERN the LAL's PHIN gun. The fabrication of a third PHIN gun is begun at the LAL workshop. In taking into account all the different stages of the construction, it is probable this new gun will be not available before June 2009. Hence, experiments with this gun will be carried out in the second half of 2009.

In waiting for the PHIN gun it was decided to install in the NEPAL station another 3 GHz RF gun built by LAL called AlphaX RF gun [3]. So an electron beam could be produced in the NEPAL station in the beginning of 2009. The AlphaX gun is also a 3 GHz 2,5 cells (see figure 1), the biggest difference with respect to the PHIN gun consists in a coaxial coupling of the gun with the waveguide instead of hole coupling.

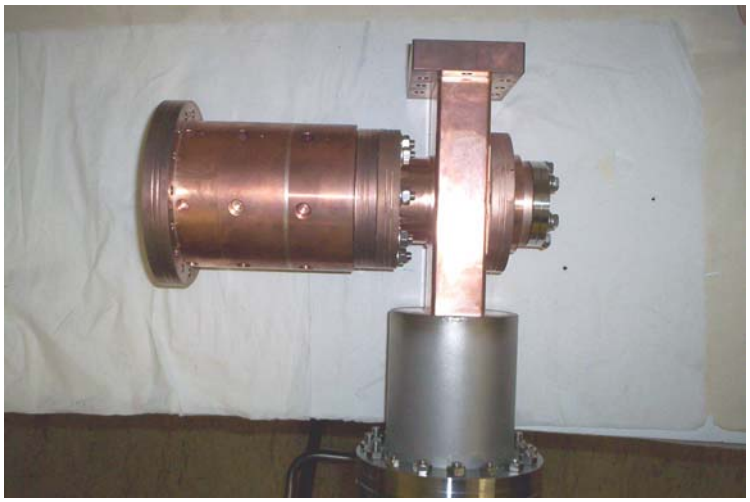

Figure 1: AlphaX RF gun.

As the PHIN gun, AlphaX was designed to be able to sustain high gradient and to reach very low emittance. It was installed in the beamline in June 2008, a picture showing the connection to the waveguide is given in figure 2.

Figure 2: RF gun AlphaX installed in the NEPAL beamline.

Finally, the major part of the beamline was completed in June 2008. A picture of the update state of the NEPAL station is shown in figure 3.

Figure 3: beamline in the NEPAL station.

As one can see on the figure, all the components are installed in the beamline: the AlphaX RF gun with the coils to compensate the emittance growth induced by the space charge forces, vacuum chambers with the required pumping capacity and jauges, steerers, Wall Current Monitors (WCM), dipole to analyse the beam energy and Faraday cup at the end of the beamline. The laser is installed in a hutch nearby and the UV optical beam is transported in the air with mirrors close to the beamline. The laser is available for 2 years and routinely produces roughly 100 µJ at 262 nm which are enough to get more than 1 nC electron bunch with CsTe photocathodes. However the construction of the photo-cathode preparation chamber was stopped due to errors in the technical drawings. So the RF gun will use copper photo-cathodes, therefore the maximum charge will be 100 pC.

Outside the shielding there is on one side the control room and on the other side all the power supplies, racks with electronics to control the accelerator and the modulator coupled to the klystron. Commissioning of the modulator began at the end of August 2008 and we quickly obtained good results which are illustrated in figure 4.

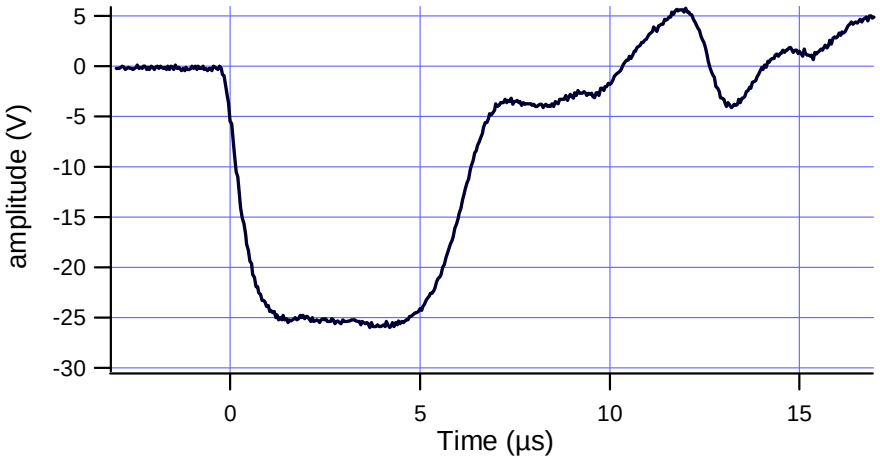

Figure 4: one typical measurement of the high voltage (after a divider) pulse produced by the modulator for -8 kV of the high voltage power supply.

The modulator shows a plateau with a duration about 3 µs which the flatness is better than 1 %, rms. Yet, there is also an overshoot (the voltage becomes positive instead of going to zero) too high to operate the klystron at the maximal power, e.g. 20 MW. Nevertheless for the AlphaX gun we only need 5 MW. So we will perform the start-up of the accelerator before to repair the modulator.

Magnetic measurements of the dipole have been performed at CERN, as for instance the magnetic field as a function of the current which is shown in figure 4. In the beamline, the 3 coils have been tested at 200 A and in situ measurements of the dipole allowed us to define the cycling to get a null field for the direct way.

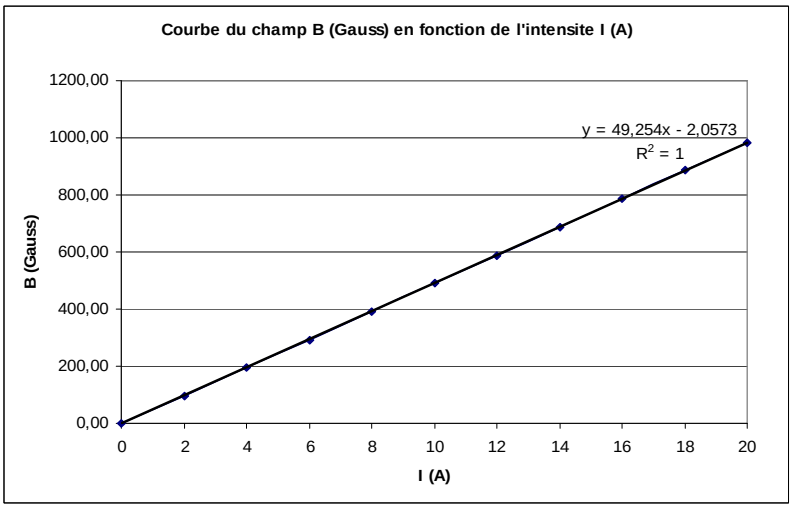

Figure 5: On axis magnetic field of the dipole as a function of the current.

Conclusion

The upgrade of the NEPAL test room is completed and an electron beam will be produced in the beginning of 2009. The tests with a third PHIN RF gun will be performed in the second half of 2009.

References

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[2] “Two 3 GHz RF guns construction”, G. Bienvenu, R. Roux, CARE-Report-08-013-PHIN.
[3] “Construction of the ALPHA-X photo-injector cavity”, T. Garvey *et a*l, EPAC’06, Edimburgh, June 2006, TUPCH113, p. 1277 (2006); http://www.JACoW.org

Acknowledgements

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