ARGONNE WAKEFIELD ACCELERATOR UPDATE '92*

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The Argonne Wakefield Accelerator (AWA) is an experiment designed to test various ideas related to wakefield technology. Construction is now underway for a 100 nC electron beam in December of 1992.

The original design [1] has been modified somewhat as shown in figure 1. The major change was to create a witness beam with its own separate electron source. Simulations of the beam optics using different energies for the source and witness bunches showed that it would be extremely difficult to optimize the drive bunch without major divergence problems in the witness bunch. The design of several witness gun geometries is underway and the final decision on which particular design to use will be made within the next year.

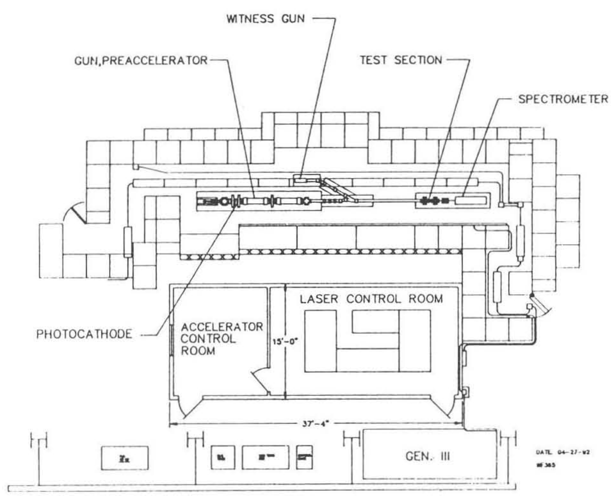

Figure 1. AWA area layout.

A minor design change has been to split the linac into two sections. The original design called for a single 36 cavity linac which would be two meters long. We had worried that shipping two meters of soft annealed copper as well as mounting it may have been a problem so we split it into two sections. In the process we added one more solenoid between the linac sections. The second section can be moved downstream in case we decide to put in a quadrupole triplet instead.

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The fundamental parameters of the AWA have not changed. These include a 100 nC driving bunch with a 30 picosecond full width, 30 Hz repetition rate, and 20 MeV energy. One major component used to create these parameters is now installed and operational. This is the 5 millijoule, 2 picosecond laser system. Details of this laser are described in reference [2]. The parameters of the laser are:

Wavelength	248 nm	
Pulse length	3 ps	(measured)
Energy	8 mJ/pulse	(measured)
Timing jitter	~ 3 ps	
Energy jitter	~ 10 %	

The two other major components required are the Linac tanks and the RF power supply. The copper sections used to create the Linac will ship out for brazing the first week of September 1992. Unfortunately we have been experiencing difficulties with machine shop time to fabricate some parts which has delayed us by two months but this is not considered serious. The klystron for the 1.3 GHz, 25 MW RF power supply has been delivered. The Pulse Forming Network has not yet arrived, but is expected some time in September of 1992.

A schematic drawing of the driving bunch source is shown in figure 2. It is this system which should be operational some time in December of 1992 assuming delivery of the RF and linac tanks by early October. The iron for the solenoids will be cut sometime in September and the copper windings were delivered several months ago.

As shown in figure 3 a majority of the components to move the photo-cathode plug between the surface preparation chamber and the photo-cathode cavity have been fabricated. The central rod which holds the photoemission surface has yet to be built but the design is finished. Long lead items such as bellows have arrived and within the next three months they will be welded into place.

A photograph of the linac cell stack is shown in figure 4. The cells were fabricated using standard technology and then polished using optical methods. The cells are stacked on a stainless steel plate that is part of the oven fixture which will hold the stack in place during brazing.

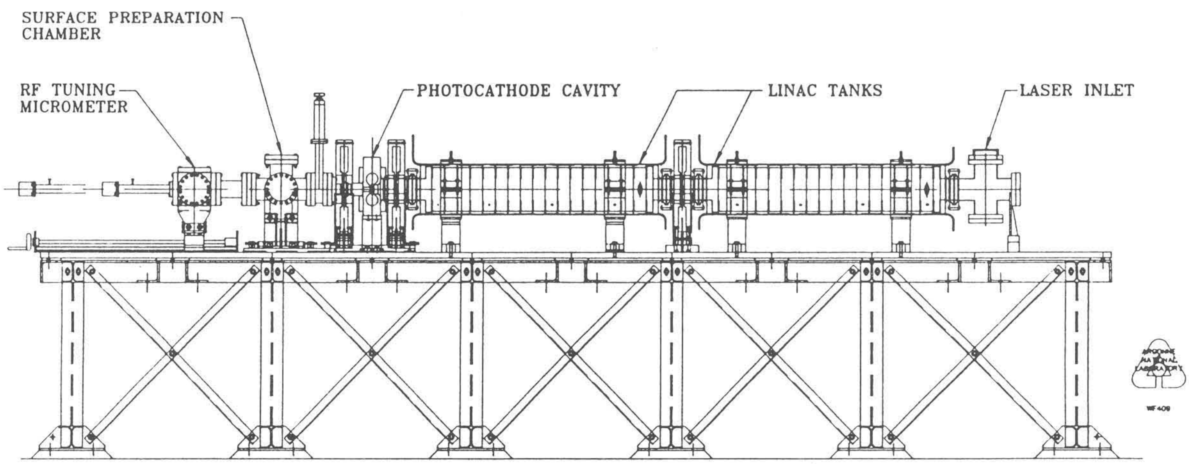

Figure 2. AWA photocathode gun and preaccelerator.

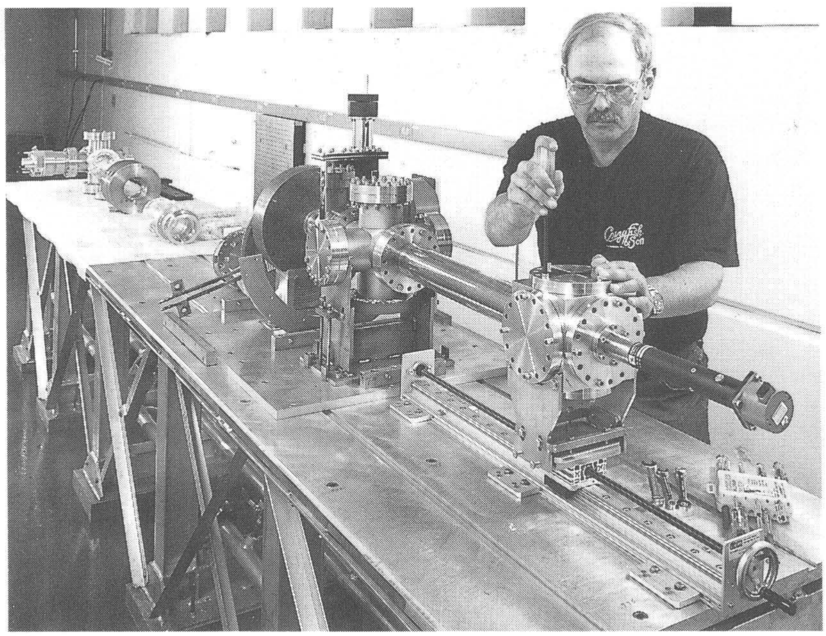

Figure 3. Photocathode and associated components.

The table that the entire electron source sits on was fabricated from a single piece of aluminum tool plate. It was mounted as shown in figure 3 and the entire surface is flat (with respect to local gravitational field) to within .2 mm.

Two chillers have been delivered to maintain the temperature of the photocathode cavity and the linac tanks to +/- .5 degree F. Electrical power and plumbing are all well under way and should be completed before the end of September. The chillers have computer interfaces to allow monitoring in the control room. They can be seen on the roof of the concrete tunnel in Figure 5.

The computer control system has been delivered. It consists of one HP-750 workstation and an associated VME crate with 68030 independent controller. A CAMAC crate is connected via interface to the VME crate. Slow signals come through the CAMAC and high speed signals through the VME bus. A BIT 3 interface between the HP and VME has 1 Megabyte of dual ported RAM. This allows the HP to send commands and get picture data without having to do any real time control.

The interface between the RF supply and computer system is via fiber-optic link. The RF system, magnet supplies, chillers and vacuum control all go through CAMAC. Picture data from CCD's will connect directly to VME. The reason for use of CAMAC is historical, we simply have lots of it around. For slow speed items it is perfectly adequate. The step to VME for future expansion will be more important in later phases of the project.

A radiation safety interlock system has been devised [3] and most parts have been ordered to construct it. A Safety Analysis Report (SAR) is now in preparation. The

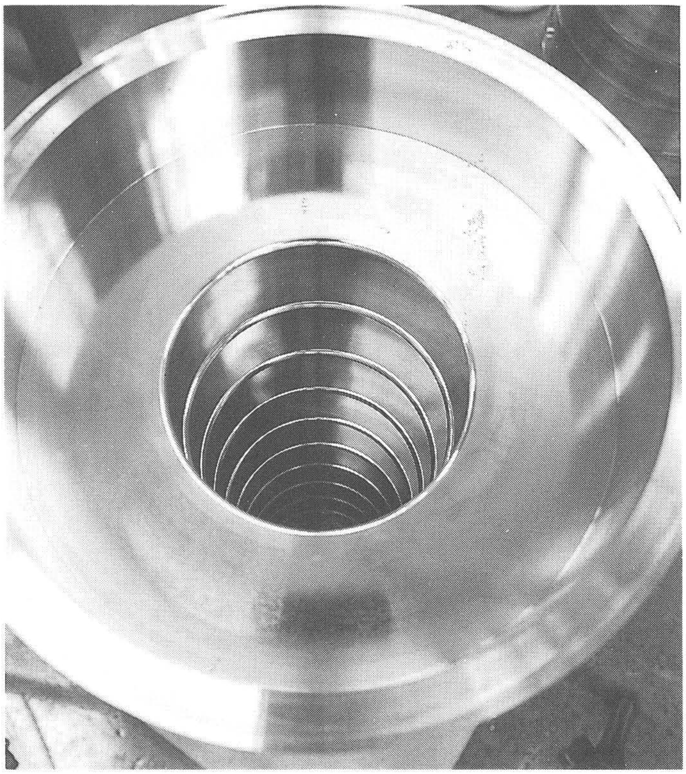

Figure 4. Linac cell stack.

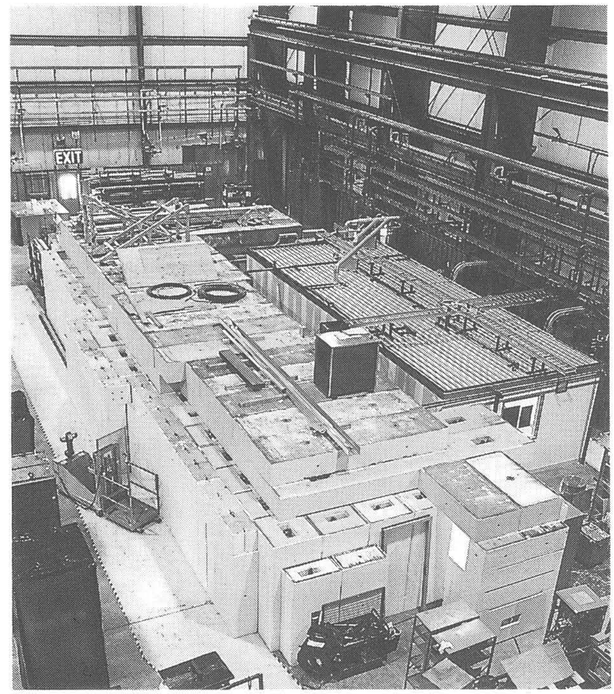

Figure 5. AWA overhead view

laser safety system has already been installed. An interlock to allow the laser beam into the linac tunnel with RF off is part of the radiation safety system.

Many new devices are being constructed to make the electron bunch work at the 100 nC level. The interested reader may wish to read [4] for work being done on shaping the laser pulse and future experiments with staging. The pulse shaper is a set of tubes which can be independently positioned to create an appropriate wave front delay. The staging experiments include numerical and analog studies to compress the RF bunch of the driving beam into a different tube for the witness beam. Bench top studies have shown that a step up in gradient by a factor of 3 is possible.

Conclusion

As seen in figure 5, the construction of AWA is well underway. The majority of the hardware is about to be delivered or is already installed. Radiation safety systems are in the review process and the laser system is fully operational. We hope to see 100 nC bunches some time in December of 1992.

References

[1] M. Rosing, E. Chojnacki, W. Gai, C. Ho, R. Konecny, S. Mtingwa, J. Norem, P. Schoessow, J. Simpson, "An Update on Argonne's AWA," IEEE PAC '91 p. 555

[2] W. Gai, R. Konecny, J. Power, "The Argonne Wakefield Accelerator (AWA) Laser System and its Associated Optics,", to be published in Proceedings of HEACC XV International Conference July 1992

[3] M. Rosing, internal note, June 1992.

[4] J. Simpson, "Argonne's New Wakefield Test Facility," to be published in Proceedings of HEACC XV International Conference July 1992