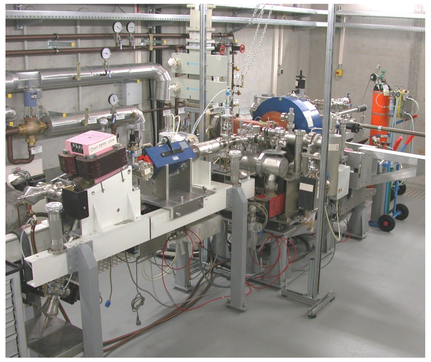
Photo Injector Test Facility in the Commissioning Phase at DESY Zeuthen

I. Bohnet[a], J. Bähr[a], K. Flöttmann[b], D. Lipka[a], F. Stephan[a], M. Winde[a], Q. Zhao[a]

[a]DESY, Platanenallee 6, 15738 Zeuthen, Germany

[b]DESY, Notkestr. 85, 22603 Hamburg, Germany

Photo Injector Test Facility at DESY Zeuthen



A photo injector test facility for free electron lasers (FEL) and the TESLA linear collider is under construction at DESY Zeuthen and will be commissioned in autumn 2001. The project is a common effort of a collaboration originated by the following institutions: BESSY Berlin, DESY (Hamburg and Zeuthen), Max-Born-Institut Berlin, Technical University Darmstadt.
It is funded partially by the HGF-Vernetzungsfonds.

Plans

- Operate a test facility for laser driven rf guns and photo injectors to optimize injectors for different applications: free electron lasers and future linearcolliders:
  => small transverse emittance(1 mm mrad@1nC).
  => stable production of short electron bunches.
  => small energy spread.
- Comparisons of detailed experimental results with simulations.
- Conditioning and test of optimized rf guns for subsequent operation at the TESLA Test Facility/FEL.
- Test of new developed components (laser, cathodes, beam diagnostics).
- Study new concepts for flat beam with rf electron sources.
- Investigations for the design of polarised electron sources.

Schedule and status:

- Installation of the laser system (Max-Born-Institut Berlin).
- Setting up the rf interlock systems.
- Setting up the control system.
- The vacuum system including cathode section, cavity section and diagnostic section is ready.
- Preparation of diagnostic subsystems.

Next steps

- Commissioning of the rf system.
- Conditioning of the rf gun.
- First photo electrons expected in autumn 2001.
- Commissioning of the complete facility.

Future

- Upgrade of the photo injector with booster cavity.

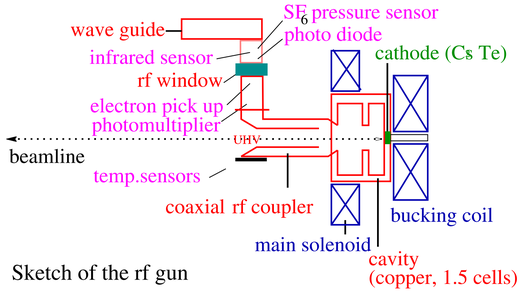
Conditioning of the rf gun using the Automatic Conditioning Program

Motivation

Conditioning of a normal conducting cavity is the successive increase of rf power in the cavity in order to achieve high gradients. It is a time consuming and boring work. To increase the efficiency and to protect the rf gun it is planned to develop an Automatic Conditioning Program (ACP). The aim is to get even higher gradients (>35MV/m) in the rf gun than achieved

Goal

- Successive increase of the rf power in the cavity in order to achieve high gradients in the rf gun.
- If necessary sweep the solenoidal field.
- Interruption of the rf power in case of interlock signals.
- Restart of the conditioning program.



Sketch of the rf gun

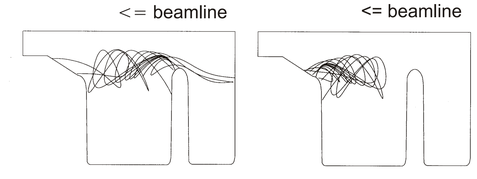
Which events could happen during conditioning?

- Field emission of electrons from protrusions.
- Multipacting which is a resonat phenomenomof low energy electrons from field emission.
- Spark effect which is accompanied by a strong light emission, a strong reflected power signal and an increase of the vacuum pressure.

Attention!

=> All these effects guide to an increase of vacuum pressure.
=> Probably destruction of cathode, cavity, rf window or rf coupler.

Simulation of dark current emission



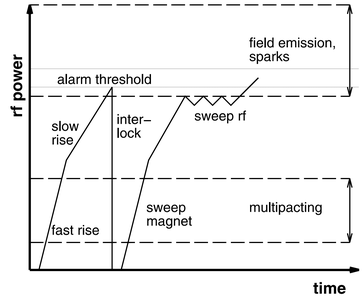
Dark current emission from the middle iris of the rf gun. Gradient on the cathode: 40 MV/m. Solenoid off (left diagramm), solenoid on (right diagramm).

Automatic Conditioning Program

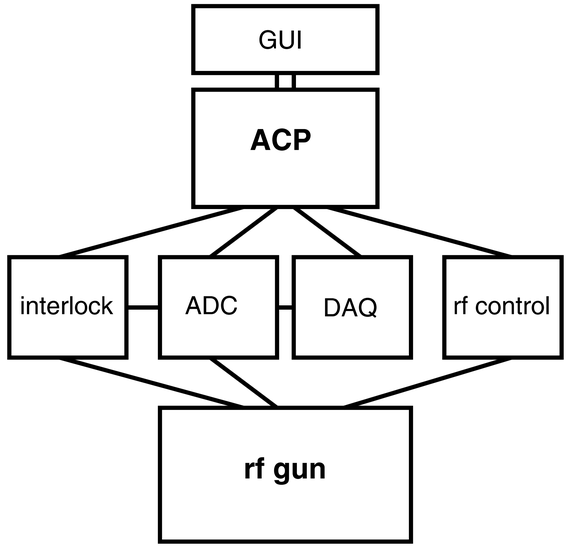
The ACP is connected with a Graphical User Interface, the interlock, the rf control system and the Data Acquisition.

- The ACP has to control the rf power.
- It has to react appropriatly on interlock signals => several fast and slow detectors are installed close to the rf coupler, rf window and cavity.
- To condition multipacting effects the program is able to sweep the solenoidal field additionally.

During the conditioning process of cavity slow and fast signals will be read out, so that a huge amount of data will grow up. However, presently a deeper analysis of the ACP data will be realized by an event recorder reading out the fast signals just in case of significant data content.



Scheme of the rf power control of the ACP



Block diagram of the Automatic Conditioning Program (ACP)