Development of a Compact Load Lock System and a New Tuning Structurer for a Cs2Te Cathode RF Gun

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Motivation of this study

In Waseda Univ., Photo-Cathode RF Gun has been studied for mainly two applications

== Soft X-ray biological microscope
== Pico-seconds pulse radiolysis system

Please see a poster presentation (id=271)

Higher current is better for the applications !!

Study of New RF Gun with Cs2Te Cathode has been started.
Cu to Cs2Te Cathode

Now: Cu cathode
QE about 0.1% - 0.01%

Change to: Cs2Te cathode
QE about 10% - 1%

Higher current is expected

or Small (Stable) laser system can be used for Gun drive

Existing RF Gun at Waseda Univ.
Start point of the development

Cs2Te cathode guns are working with good performance at the KEK-ATF and KEK-LUCX.

Plug-cathode and load lock system for cathode attachment are adopted for two gun system.

These are start points of the new Gun system development.
ATF RF Gun

High quality Multi-bunch beam is generated.
1 ~ 20 bunches/pulse, 2.8ns spacing
~ 2 x 10^{10} electrons/bunch
RF Gun Test Bench (RFGTB->LUCX)

100 bunches/pulse, 2.8ns Spacing

Separated System

300 nC/pulse

Beam before dump

Laser

VSHQE, INFN, Milan 10/4-6/2006
Modifications (1)

Existing RF Gun at Waseda Univ.

- Make the **compact load lock system** to fit on Waseda’s space
- Separate an evaporation chamber from the load lock system
Compact Load Lock System

Total Length is about 90 cm

Carrying Chamber

Main Chamber

Separated System
Benefits from the plug-cathode system

Not Only
- can easily replace the cathode when its QE get low
- can easily test different type of cathodes

But Also
- do not need to use the Helicoflex seal on the end plate attachment
Modifications (2)

End plate can be attached by brazing

Cathode guide

Cathode Plug

Helicoflex with SUS Plate

Laser Port

Beam Line

50mm
needs of compact RF tuner

Helicoflex play a role as a tuner for half cell by changing screw tightening torque on the end plate.

To remove the Helicoflex, we need alternative tuners for the half cell.

Therefore, development of a compact tuner, which can also be attached on the half cell, is needed.
Existing Tuner on the Full Cell

Existing RF Gun at Waseda Univ.
**Tuner structures**

(a) Existing Tuner
- Tuned by moving a rod
- Need hole on the cavity inside wall

(b) New Tuner
- Tuned by deformation of the wall
- Do not need hole on the wall
Tuning ability test

Tuning ability: 220 kHz/turn/1 tuner

Enough for Gun!! —> Start fabrication with the new tuners
Process of gun fabrication

Start

First machining

Make drawings

Make drawings

First machining

Fine machining on the cavity wall by diamond bit

Iteration

measuring resonant frequency of the cavity

If can get a target resonance ...

Brazing the cells

Fine tuning by tuners

Conditioning by High Power RF
Process of gun fabrication

- Start
- Make drawings
- First machining
- Fine machining on the cavity wall by diamond bit
- We are here!!
- Iteration
- measuring resonant frequency of the cavity
- If can get a target resonance ...
- Brazing the cells
- Fine tuning by tuners
- Conditioning by High Power RF
After first machining

- Full Cell
- Half Cell
- End Plate
Assembly image
Resonance measurement

Measure the resonant frequencies using a Network Analyzer.

Target frequency is 2855.2 MHz on pi-mode for our system.
Fine machining
Iteration history

Order of Iteration
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5

Resonant Frequency [MHz]
2850
2855
2860
2865
2870
2875
2880
2885
2890

Target Frequency
Conclusion

- Compact load lock system and new tuner structure are developed for a Cs2Te cathode RF Gun.
- The load lock system was assembled. We are going to do a vacuum test.
- We are fabricating the new gun cavity with the compact tuners. Now brazing procedure is going on.