Summary

- **Problem overview**
- **The deflecting structures (F. Casper, T. Kroyer)**
- **The drivers**
- **Timing electronics**

Problem overview

The chopper establishes the beam time-structure for downstream users

- PSB :
  - injection into stationary bucket (f_{inj} ~*1MHz*)
  - Inject in stable area (*Burst length ~630ns*)
  - So, dump 133 Linac bunches out of 355
  - 0.4 ms beam time repeated at 2 Hz
- Other users :
  - Chopper designed for 45MHz, 1 ms beam time repeated at 50 Hz

The RFQ operated at 352 MHz

- 2.84 ns bunch spacing, 1 ns RMS bunch length
- 2 ns available for rise/fall time

To overcome kicker filling time problem

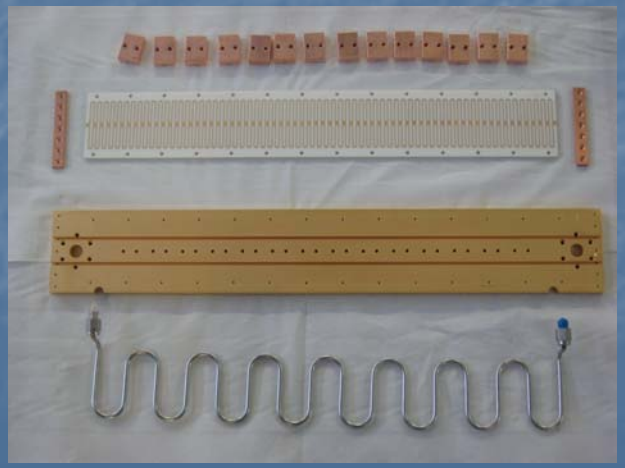
- 50 Ω traveling wave deflector
- β=v/c~8% to match beam velocity

To get the minimum extraction field

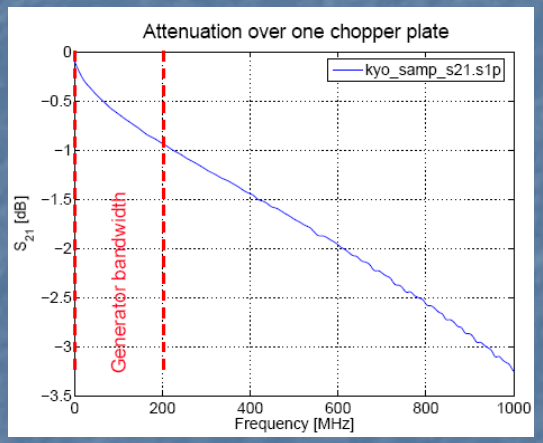
- +/- 500V on the two deflector plates (1kV differential)

The deflecting structures (1)

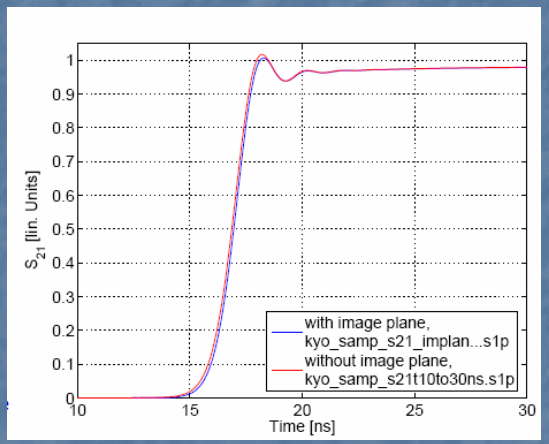
- Field propagation velocity matched to beam velocity using a meander line.
- Lines printed on alumina for reproducibility, robustness, cooling ease, radiation hardness, proven technology.
- Machining of groove on the metallic ground plane allows tuning of propagation velocity.
- Construction uses de-stressed stainless-steal plates to avoid bending the of the ceramic plates.
- Water cooled plates.
- Structure self-heating using line DC losses for bake-out.



The deflecting structures (2)



- **DC resistance : 1.1Ω**
- **Rise time : ~1.1ns**
- **S11 to 500MHz : <26dB**
- **Field coverage factor : ~75%**



- **Electrical, vacuum and cooling properties successfully tested.**
- **All part available for final assembly.**

The drivers (1)

Chopper drivers are a very critical part of the system.

Studies based on different approaches and technologies have been done in the last years.

Retained solution is based on industrial dedicated design of FID Technology, specialist of high voltage, high power, extremely fast transient generator in Russia.

FID Technology uses proprietary solid-state devices (Fast Ionization Dynistors) that they design, manufacture and integrate in their own products.

Positive and negative polarity units have been ordered.

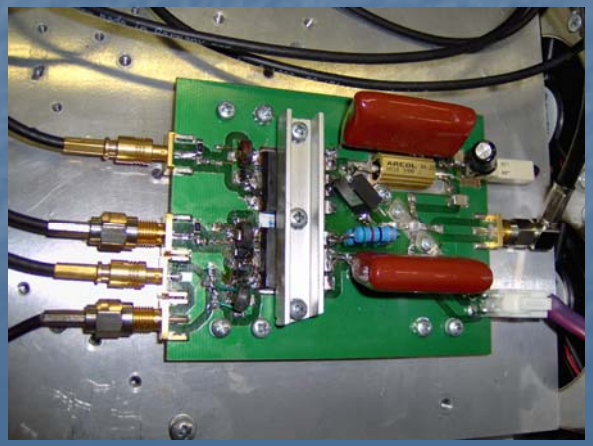
The drivers (2)

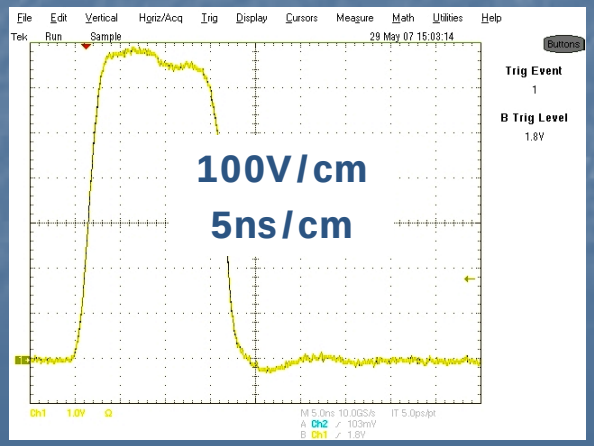
First positive polarity unit delivered beginning 2007 with almost 1 year delay on schedule.

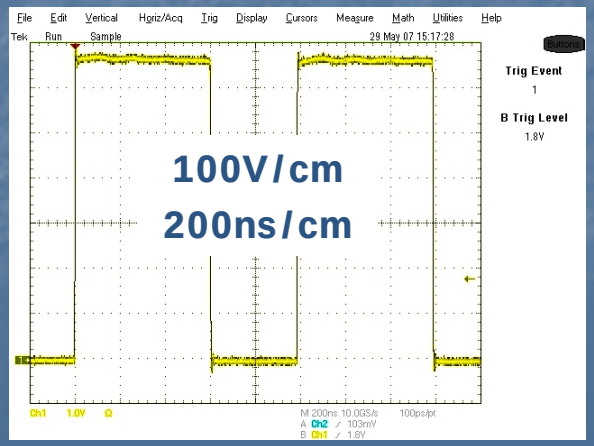
It partially achieves the parameters required for LINAC4 operation. It will be replaced by an improved version.

The unit has been operated 24 hrs/day during 2 weeks at 50Hz repetition rate (2Hz required).

Delivery of an improved version is scheduled in February 2008.





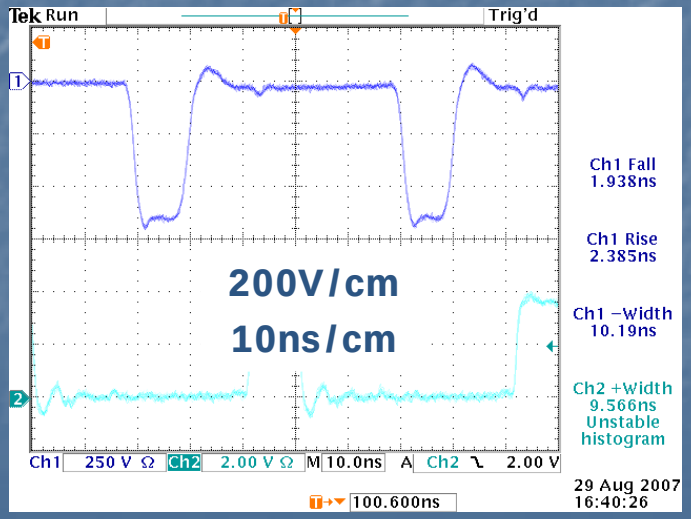


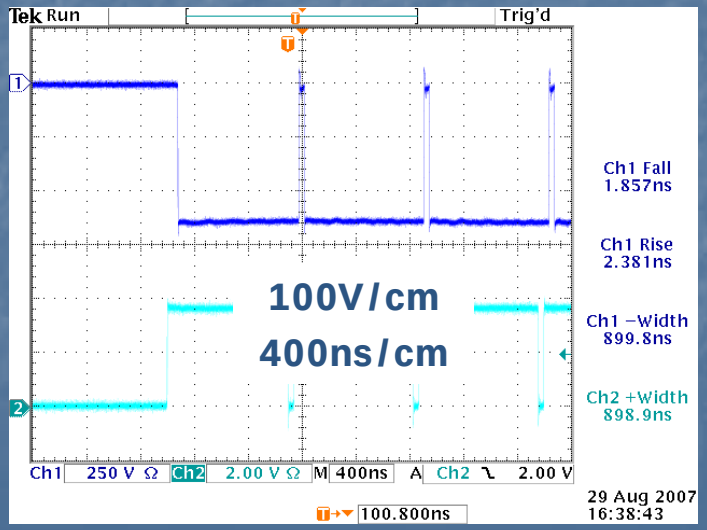
The drivers (3)

First negative polarity unit was delivered in October 2007.

It implements some important improvements as compared to the positive polarity unit.

The unit partially achieves the parameters required for LINAC4 operation but suffered from major problems in the driving electronics. The unit broke down twice and the problem is presently under study at FID.





Timing electronics

Beam and deflecting field transition must be synchronized within a fraction of ns.

- ► Synchronization with 352 MHz reference using commercial arbitrary function generator
- ► Precise time measurement
- ► Precise delay adjustment
- ► Active control and compensation of delays

Prototype electronics under development

- ► Synchronism detector discriminates ~20 ps
- ► Fast adjustable delay with 30 ps resolution
- ► Active loop insuring ±30 ps RMS error.