ELYSE FACILITY
Cs_2Te photoinjector

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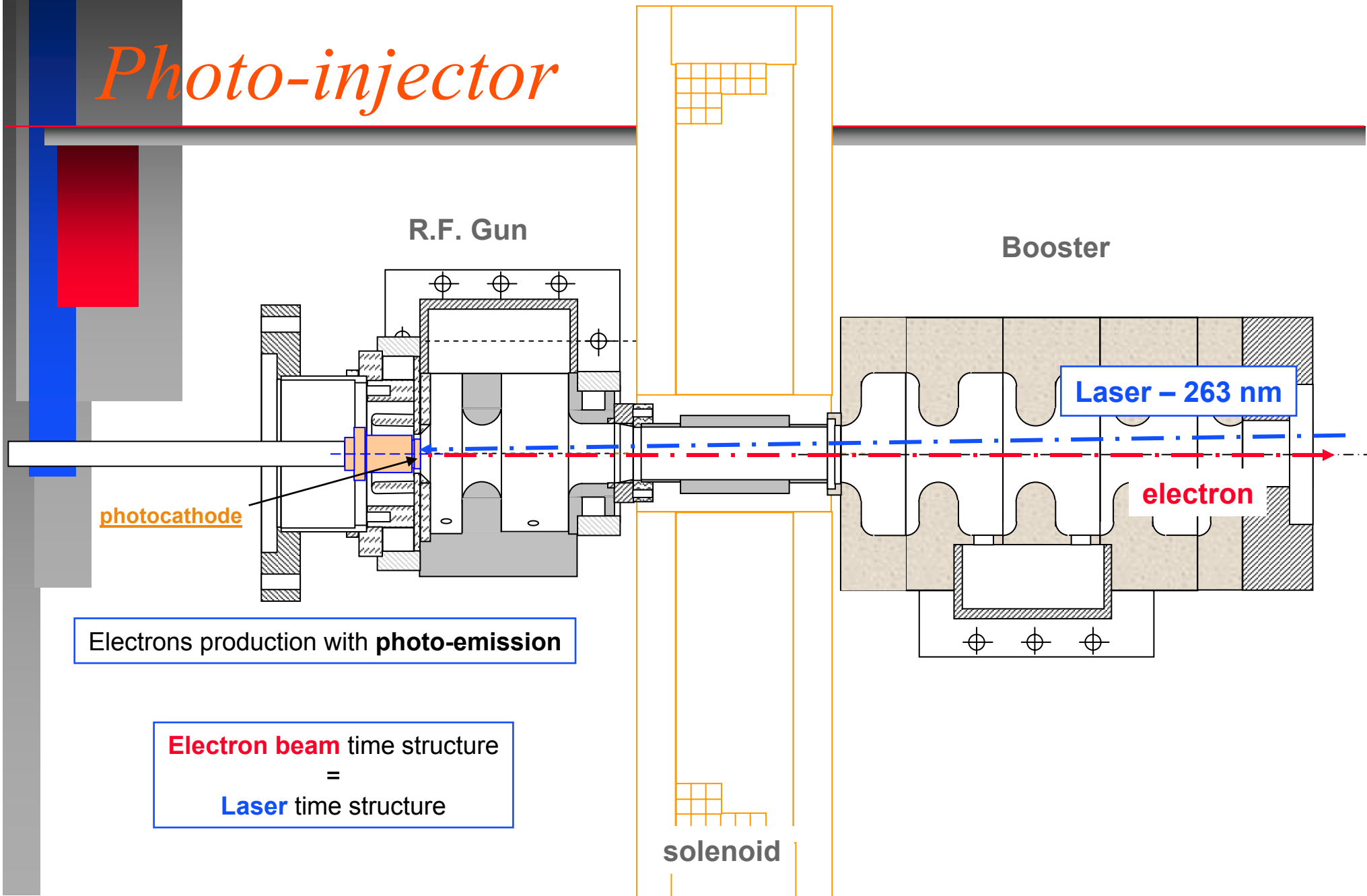
ELYSE, Orsay, France

Ultrafast Pusle Radiolysis – 2004 june 26-27

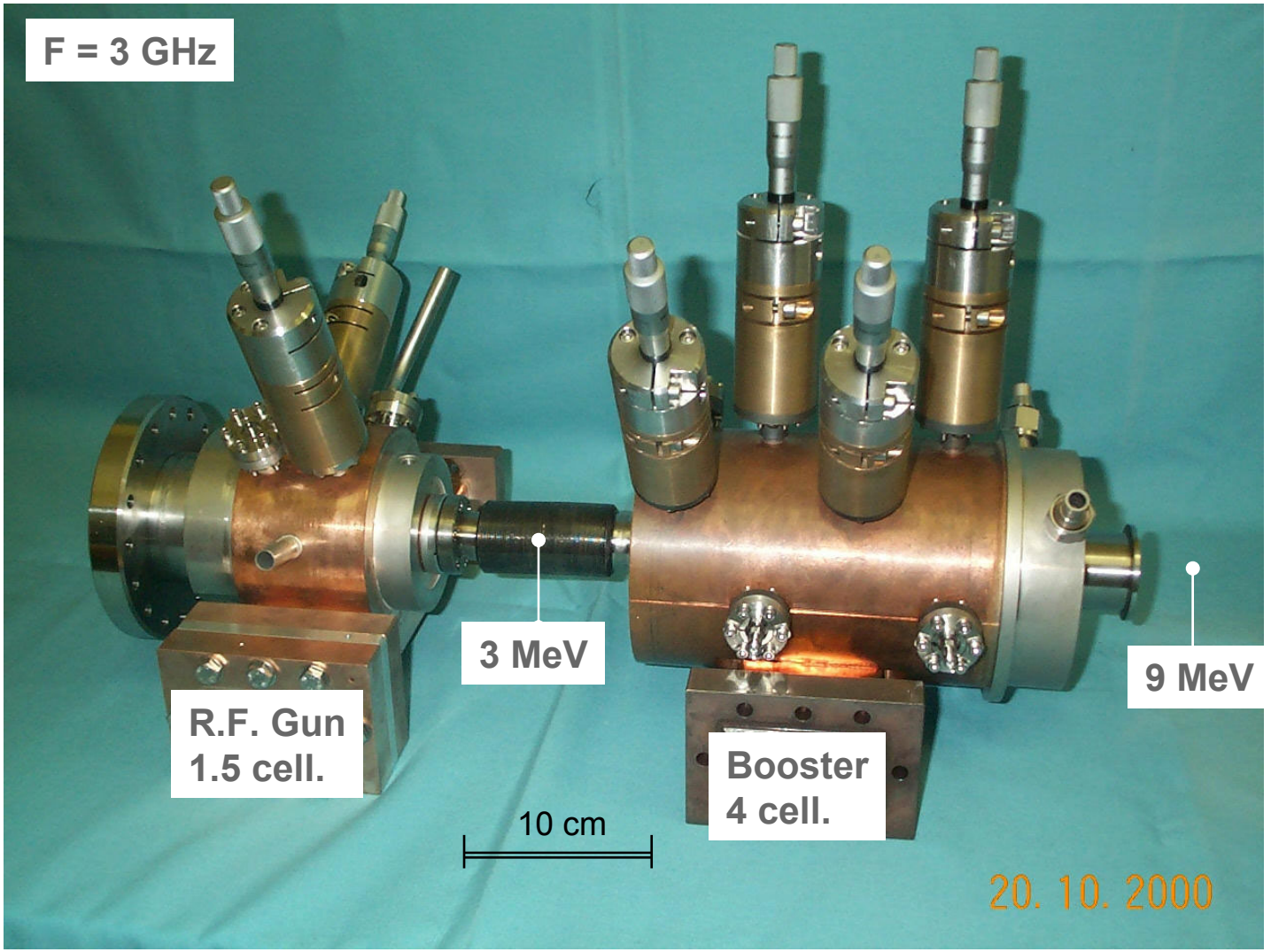
Photo-injector



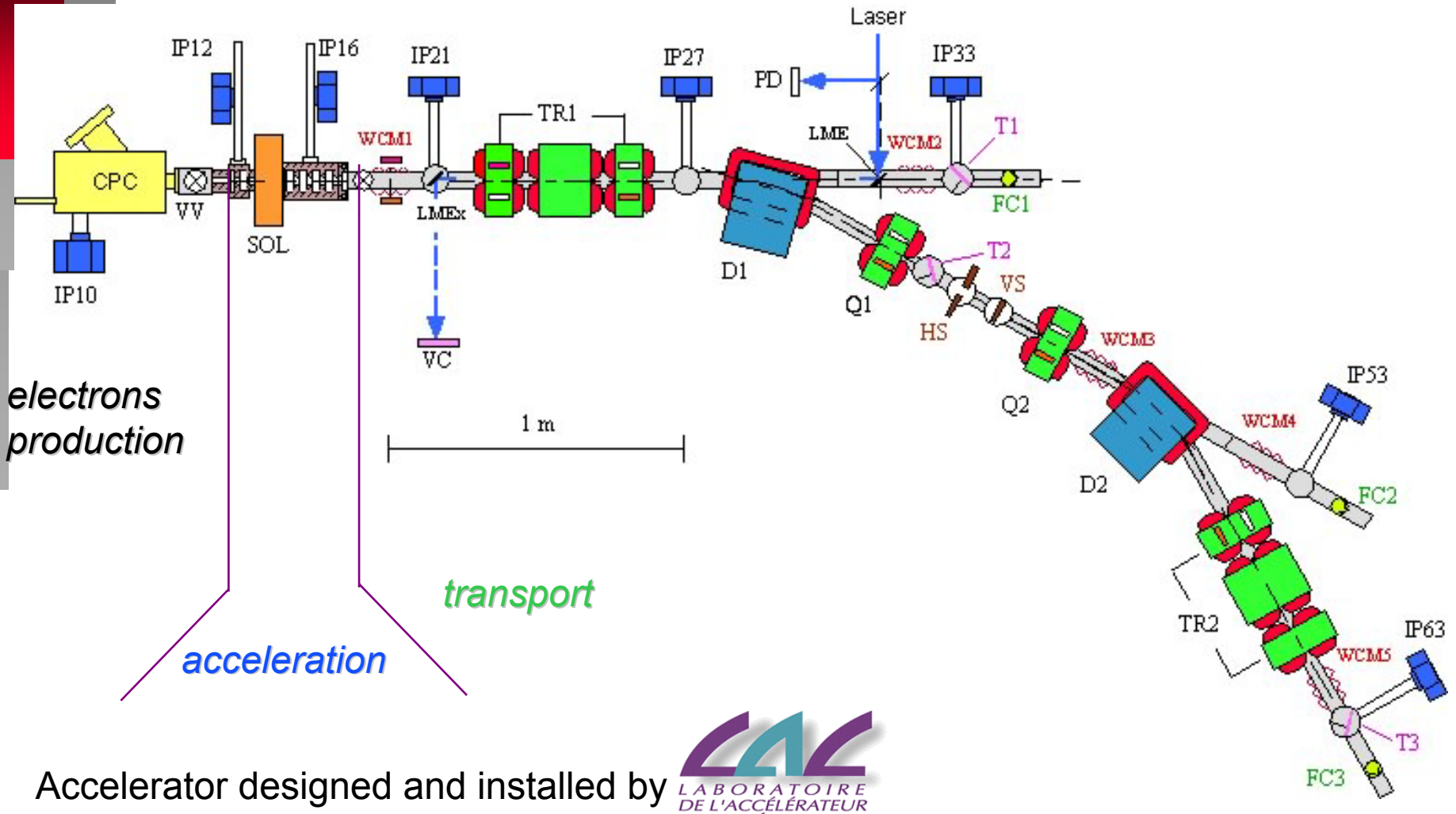
Electrons production with **photo-emission**

Electron beam time structure
=
Laser time structure

R.F. Gun + Booster

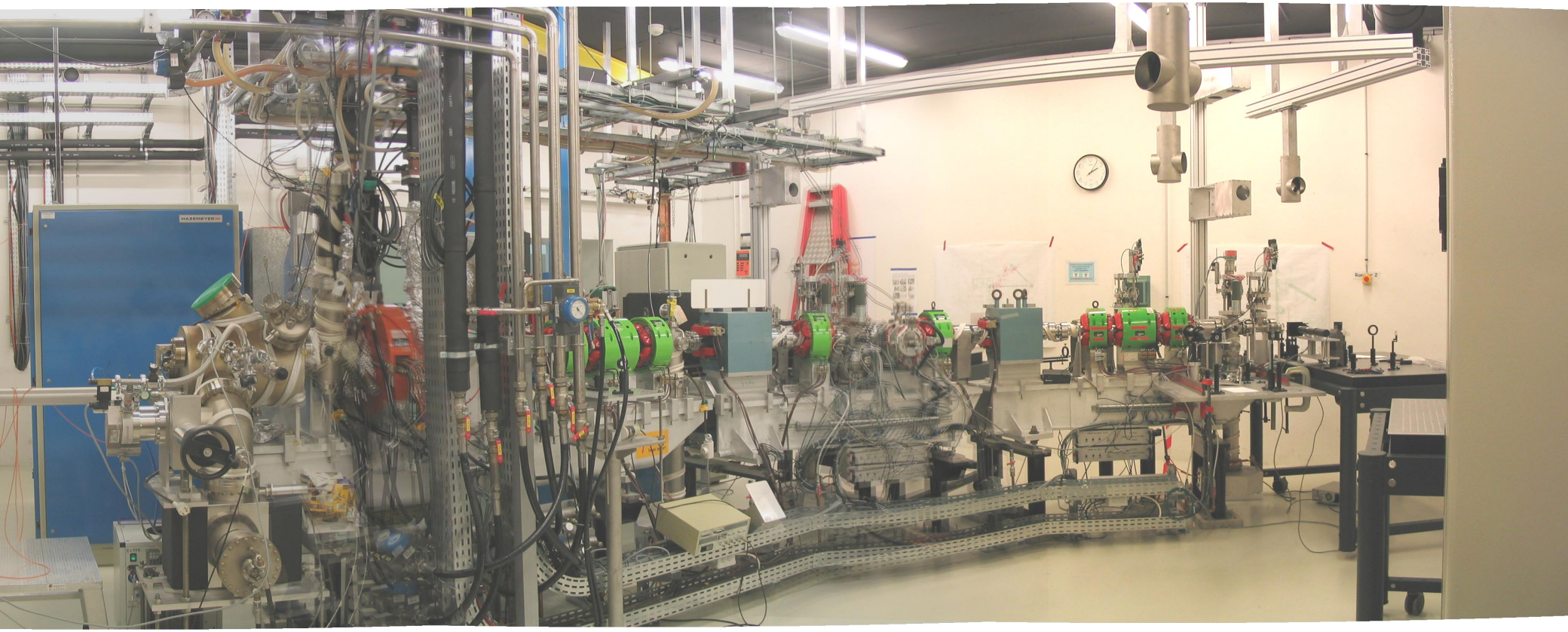


Accelerator layout



Accelerator designed and installed by LAL LABORATOIRE DE L'ACCÉLÉRATEUR LINÉAIRE

Accelerator room

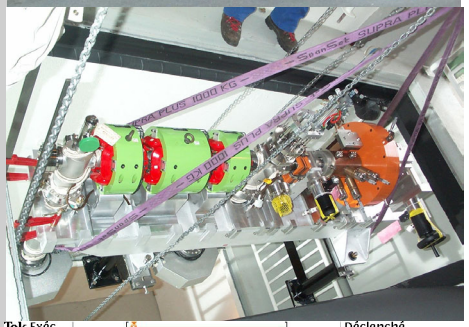


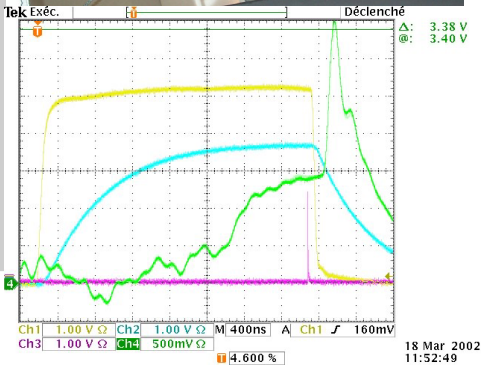
Accelerator history

- *March 2001* — *Ti:Saphire laser installation*
- *April 2001* — *accelerator installation bat. 349*
- *January 2002* — *cathode preparation chamber*
- *April 2002* — *first beam – 9 MeV (Cu cathode - 5 Hz)*
- *June 2002* — *RF commissionning 25 et 50 Hz*

  leak CPC, baking C+S, bat. 349 chiller problem…
- *April 2003* — *1st cathode Cs_2Te : 5 nC !*
- *May 2003* — *1st bunch length of 5 ps – 1,5 nC – 9 MeV*

  9 MeV and 5 MeV accelerator tunning
- *October 2003* — *1st experiments with local users*
- *April 2004* — *solvated e- absorption signals*
- *…*





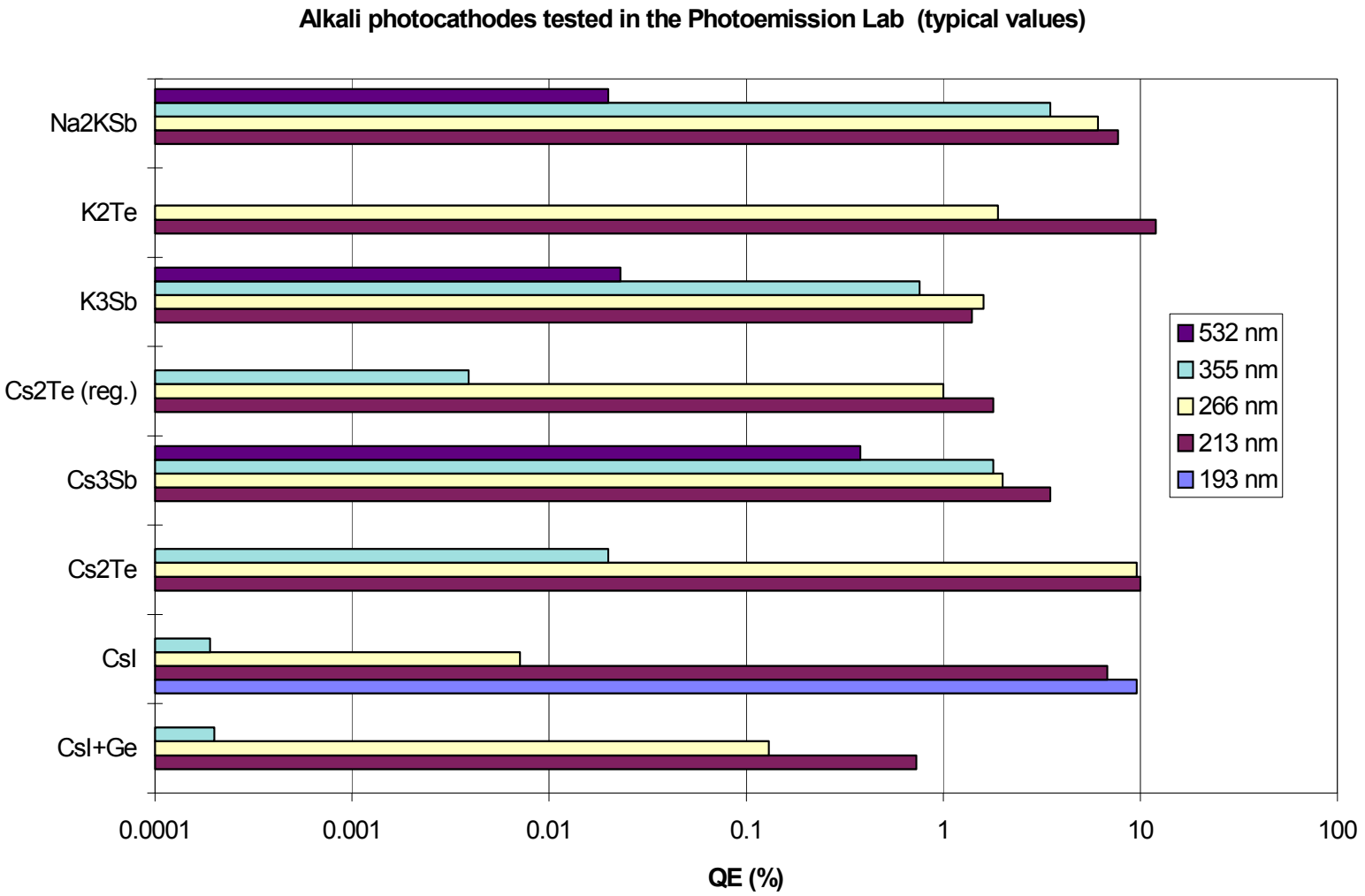
Photocathode choice of ELYSE

Cs_2Te

- *Good quantum efficiency ≥ 1%*
- *less laser energy (~ 20 µJ/pulse)*
- *Long life time (months)*

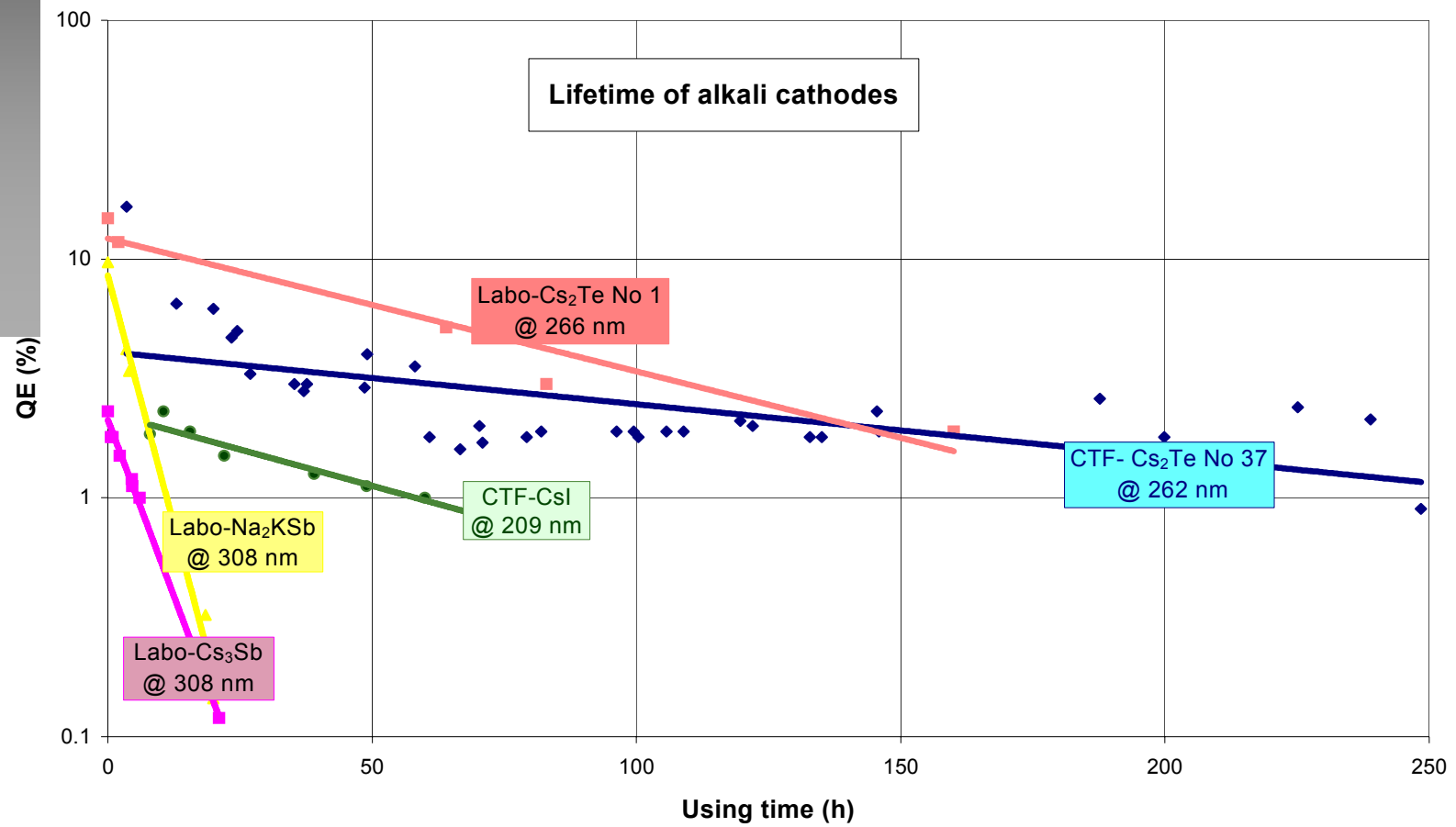
- *dedicated UHV preparation chamber*
- *Transfert under vacuum to RF gun*
- *Work with UV laser - 266 nm*

Photocathode QE



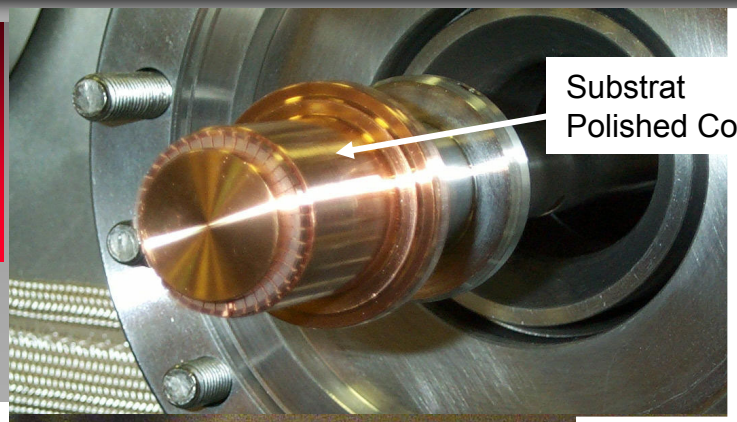
Photocathode life time

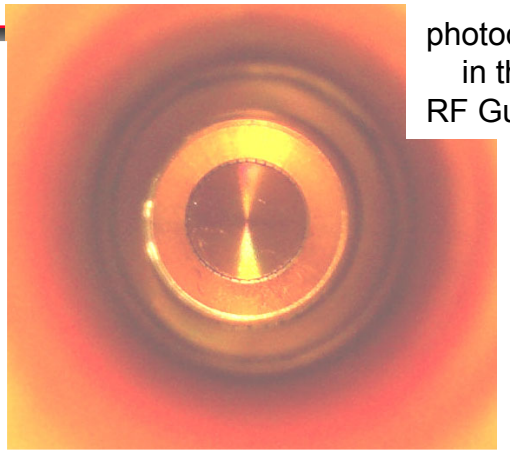
G. Suberlucq, CTF (CERN), FEL96



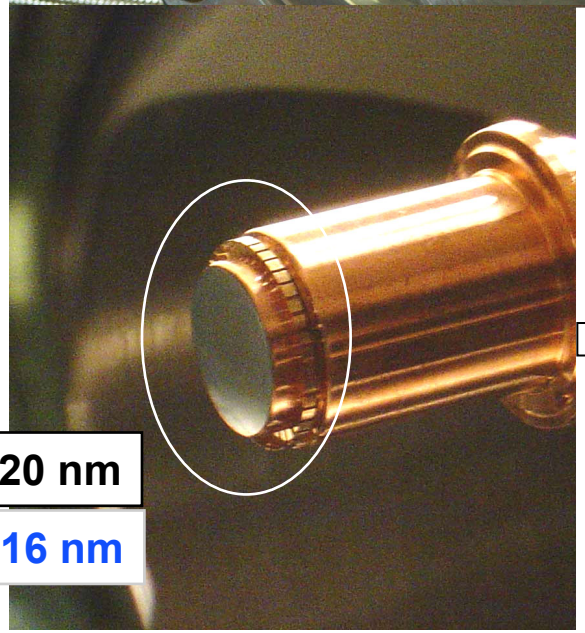
QE ~10% just after the preparation and falls to 1%

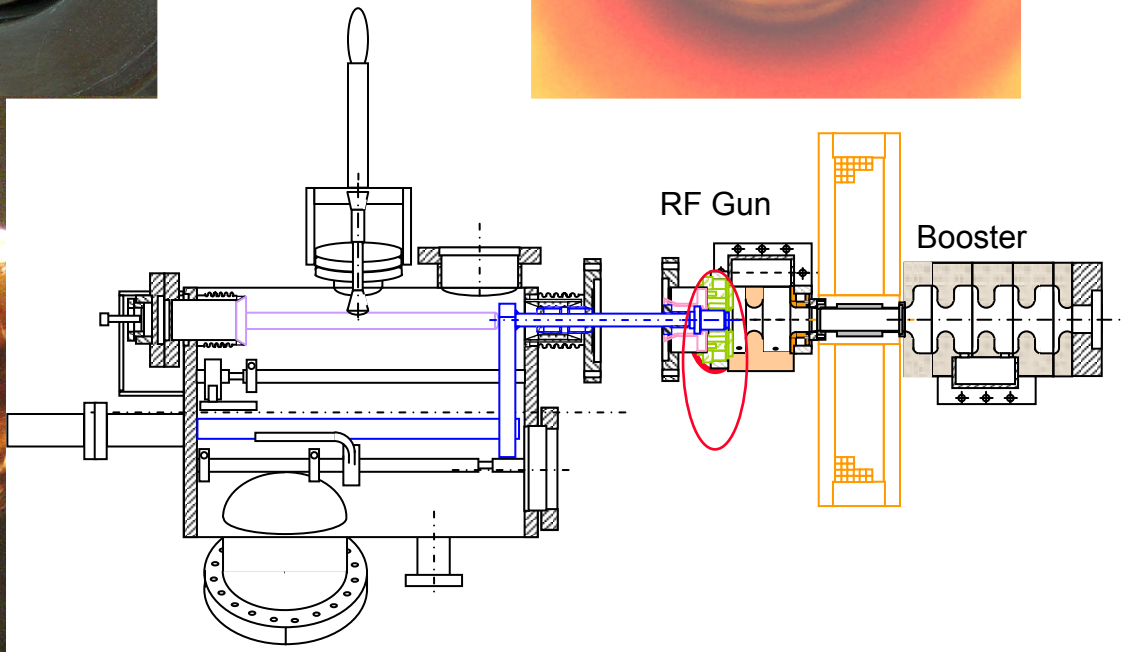
Photocathode Cs_2Te - $QE = 1\%$ - $\Phi = 20\ mm$





photocathode
in the
RF Gun

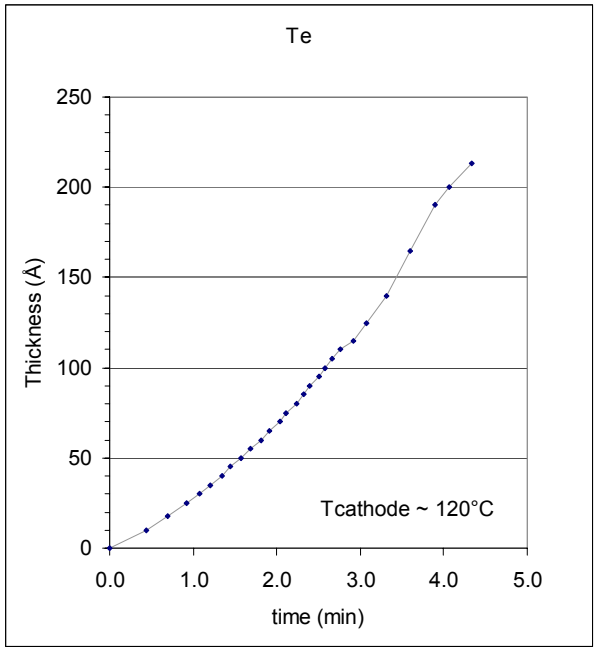


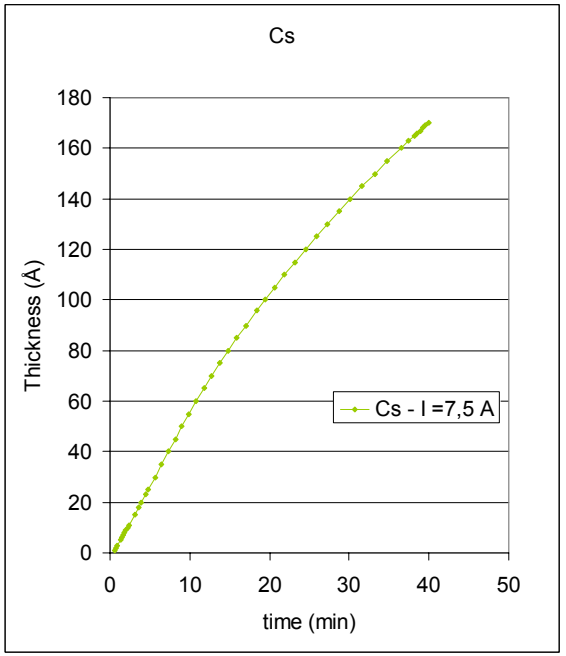


In situ Preparation Chamber

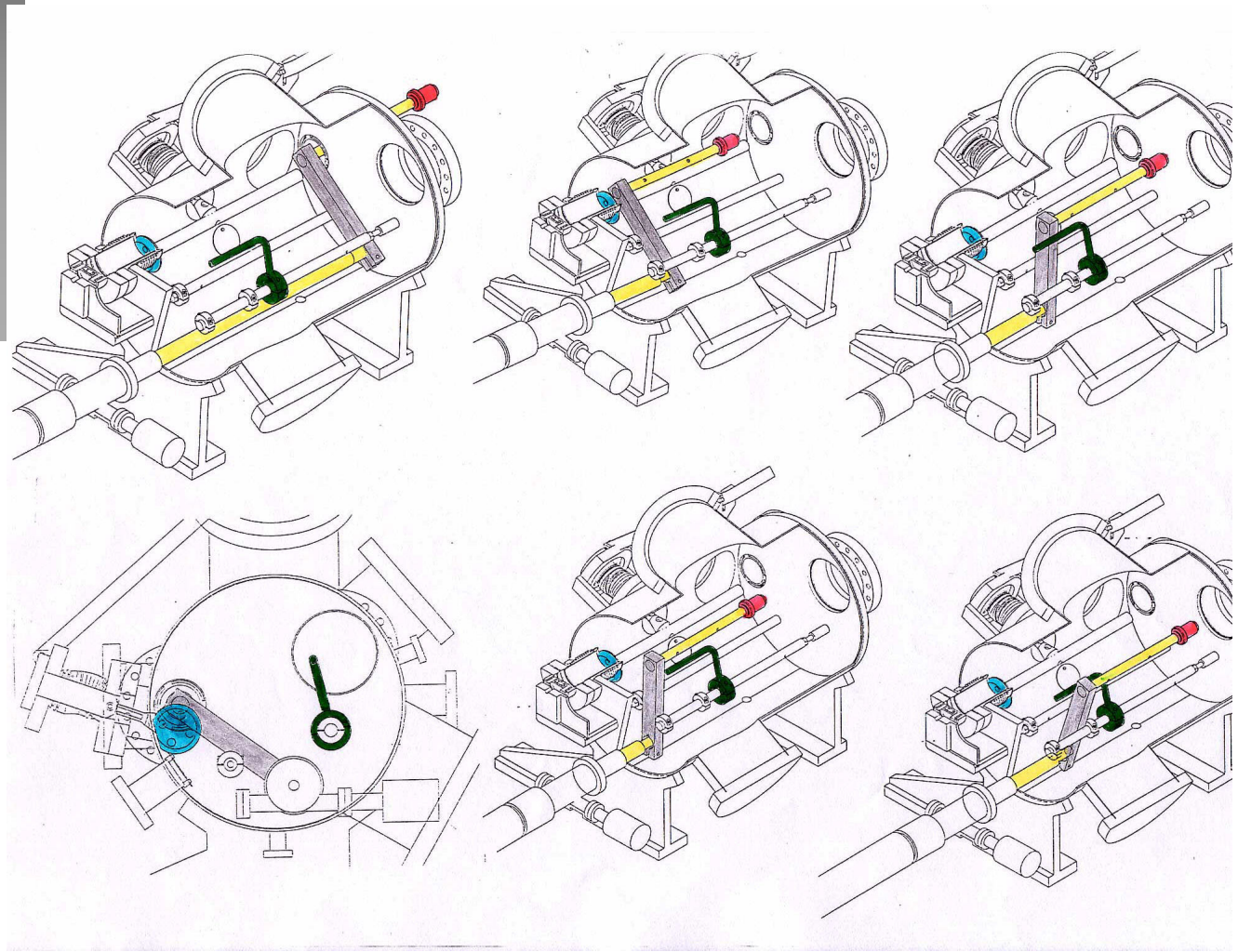
Photocathode preparation

- *Good vacuum < 1x 10^{-9} mbar (avoid O_2, CO_2)*
- *Photocathode at 120°C during evaporation*
- *Set evaporation rate before metal deposition*
- *Measure thickness with quartz micro-balance*

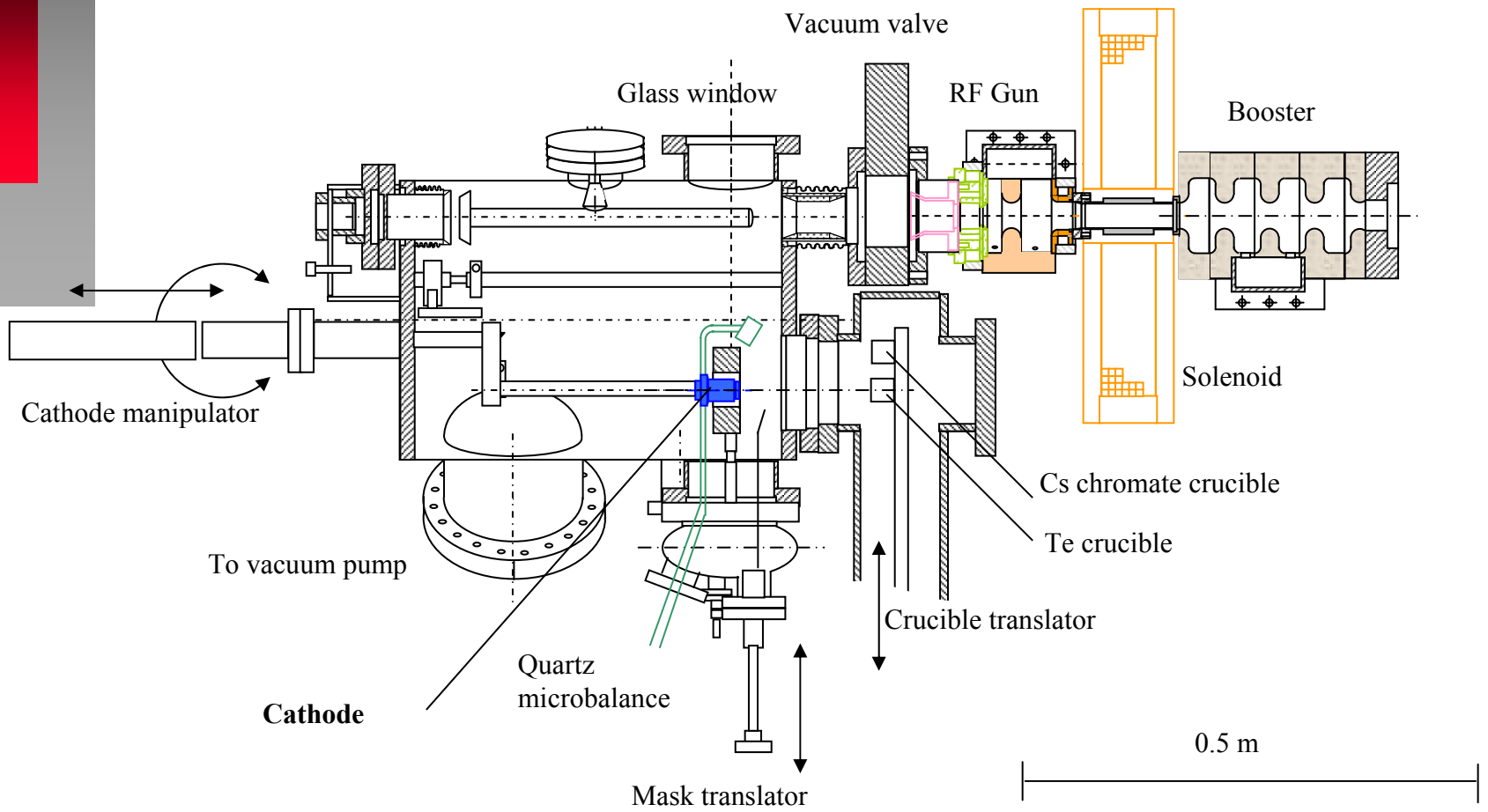




Cathode manipulation

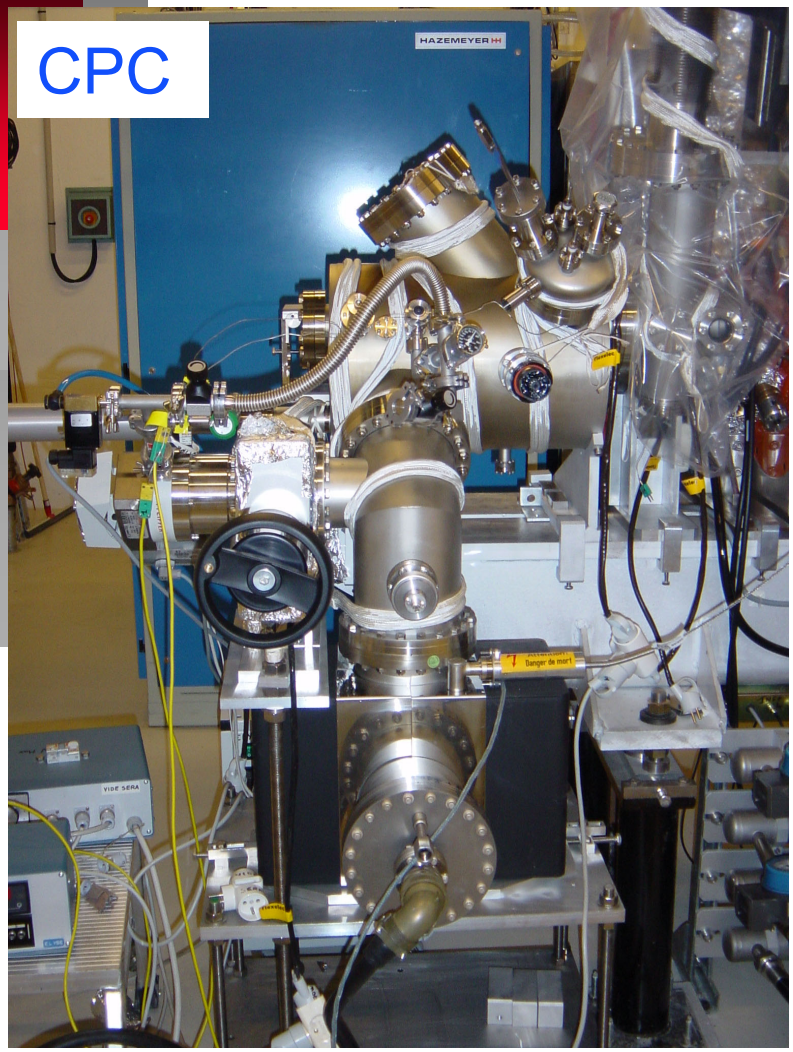


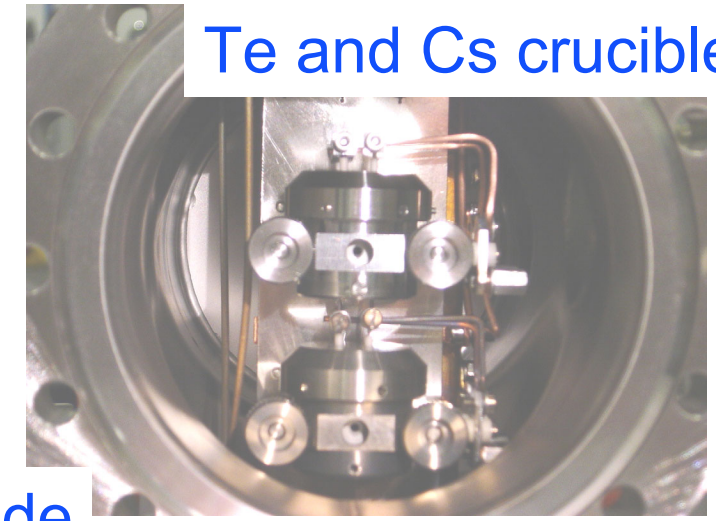
Cathode Preparation Chamber



Vacuum ~ 4 x 10^{-8} mbar : leak porosity of feedthrough

Cathode Preparation Chamber





cathode

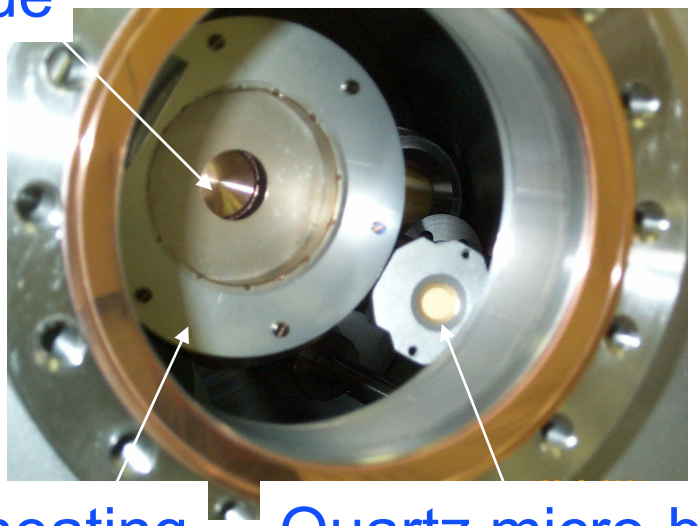
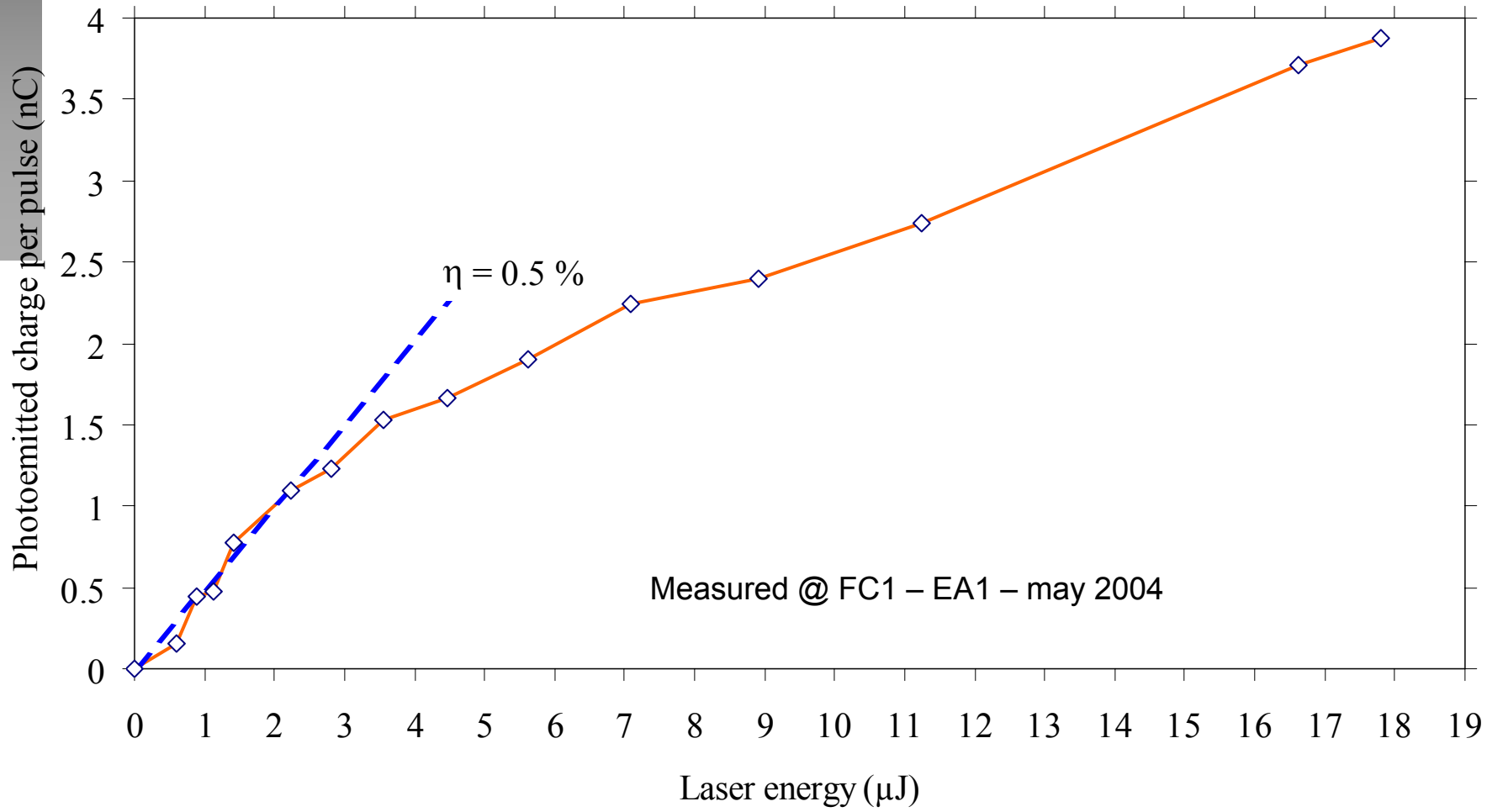


Photo-emitted charge vs laser energy



Same cathode since march 2003

Photocathode aging

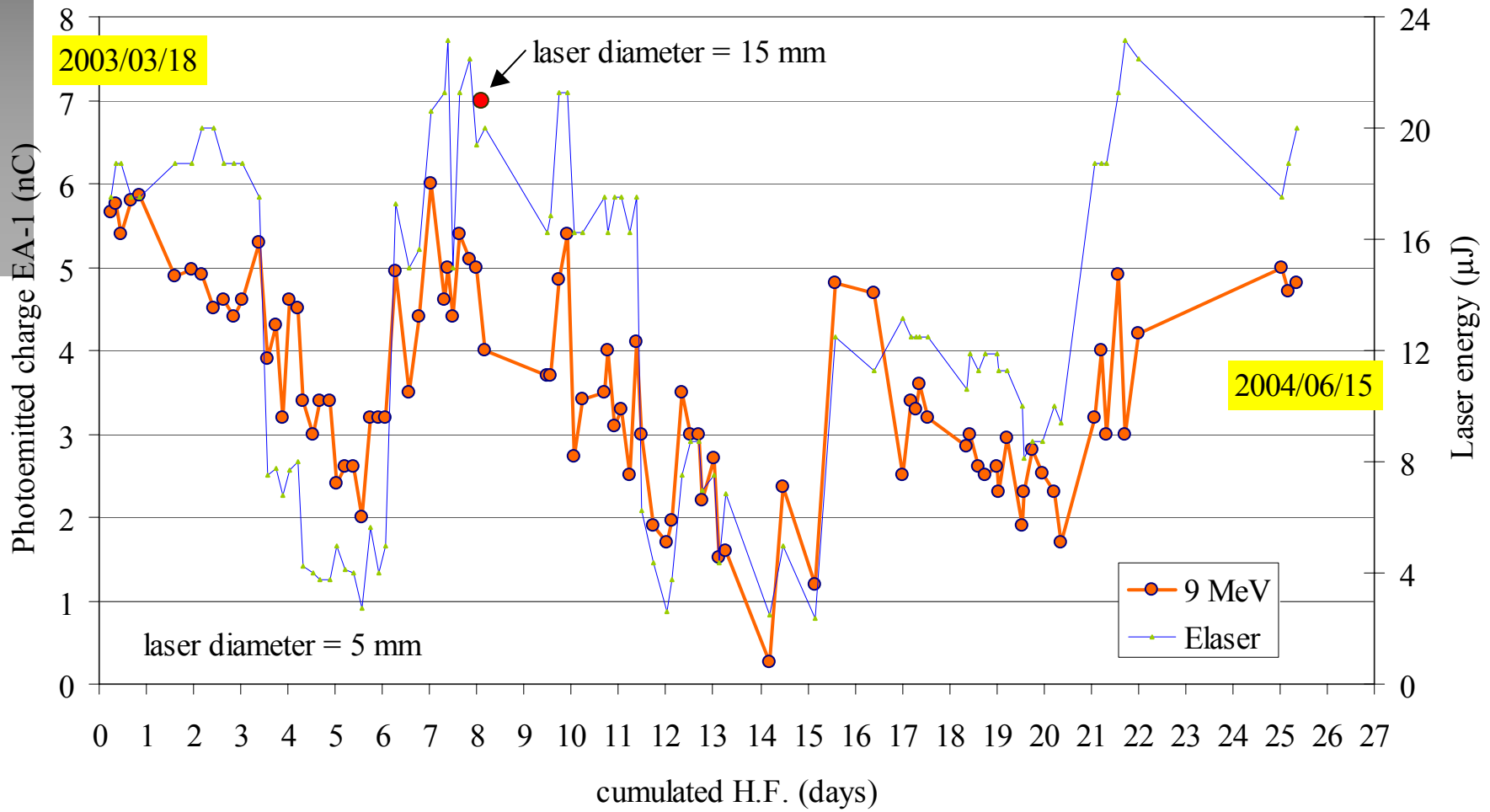
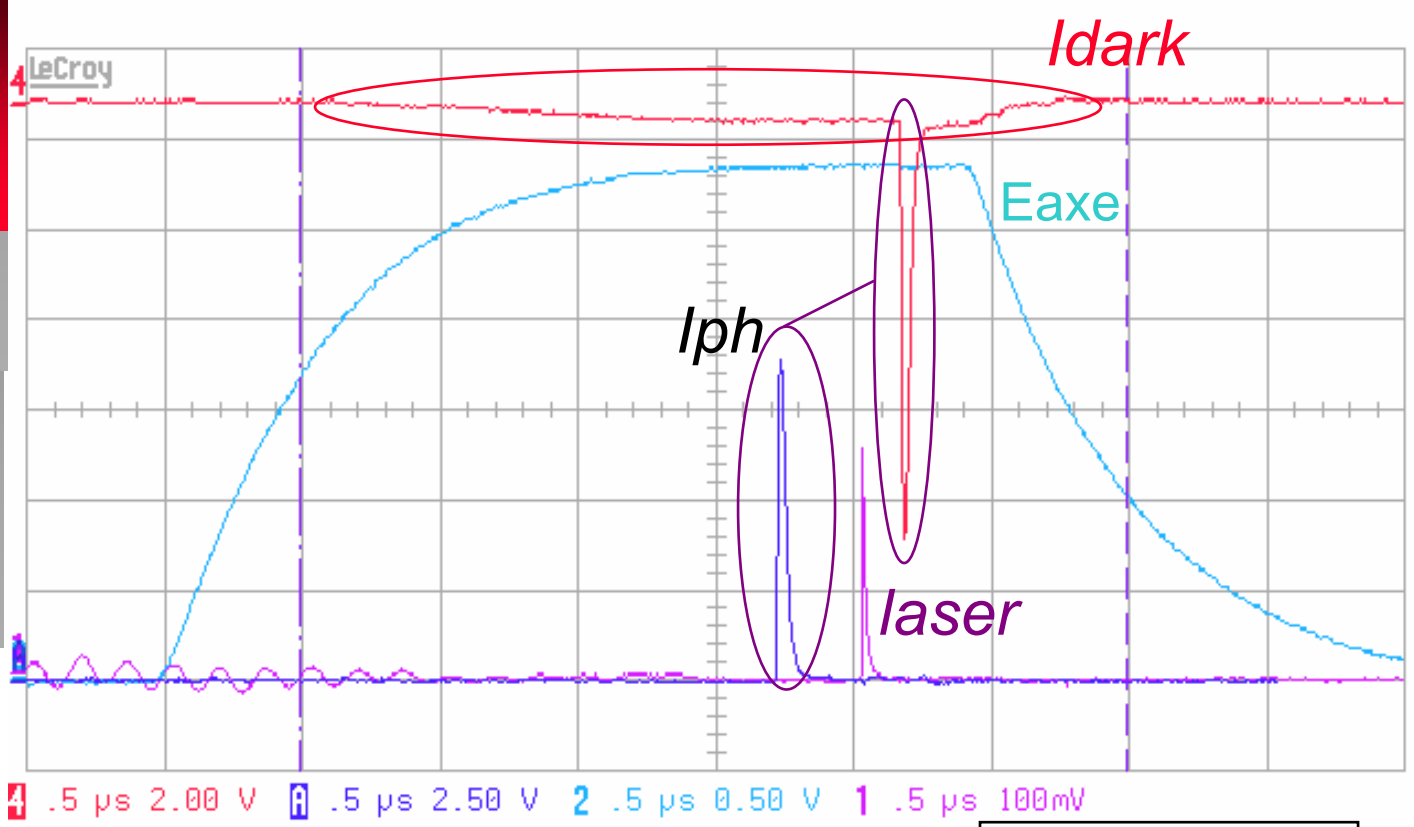
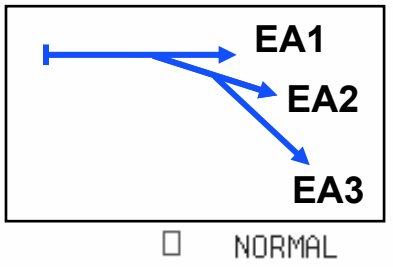


Photo-current / Dark current -EA1



area(A) 288.071 nVs / 50 Ω = **5,8** nC
maximum(1) 249mV
maximum(A) 8.88 V
maximum(2) 2.849 V



F = 10 Hz
HF = 3 µs
Laser = 2,7 µs

Straight line
9 MeV
Ea = 70 MV/m

Qph = 5,8 nC
Qdark = 3,9 nC

Qdark/Qph = 67%

Iph = 177 mA
Idark = 3 mA

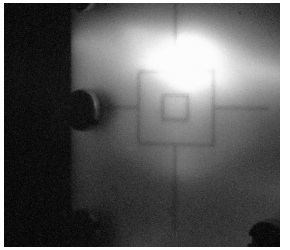
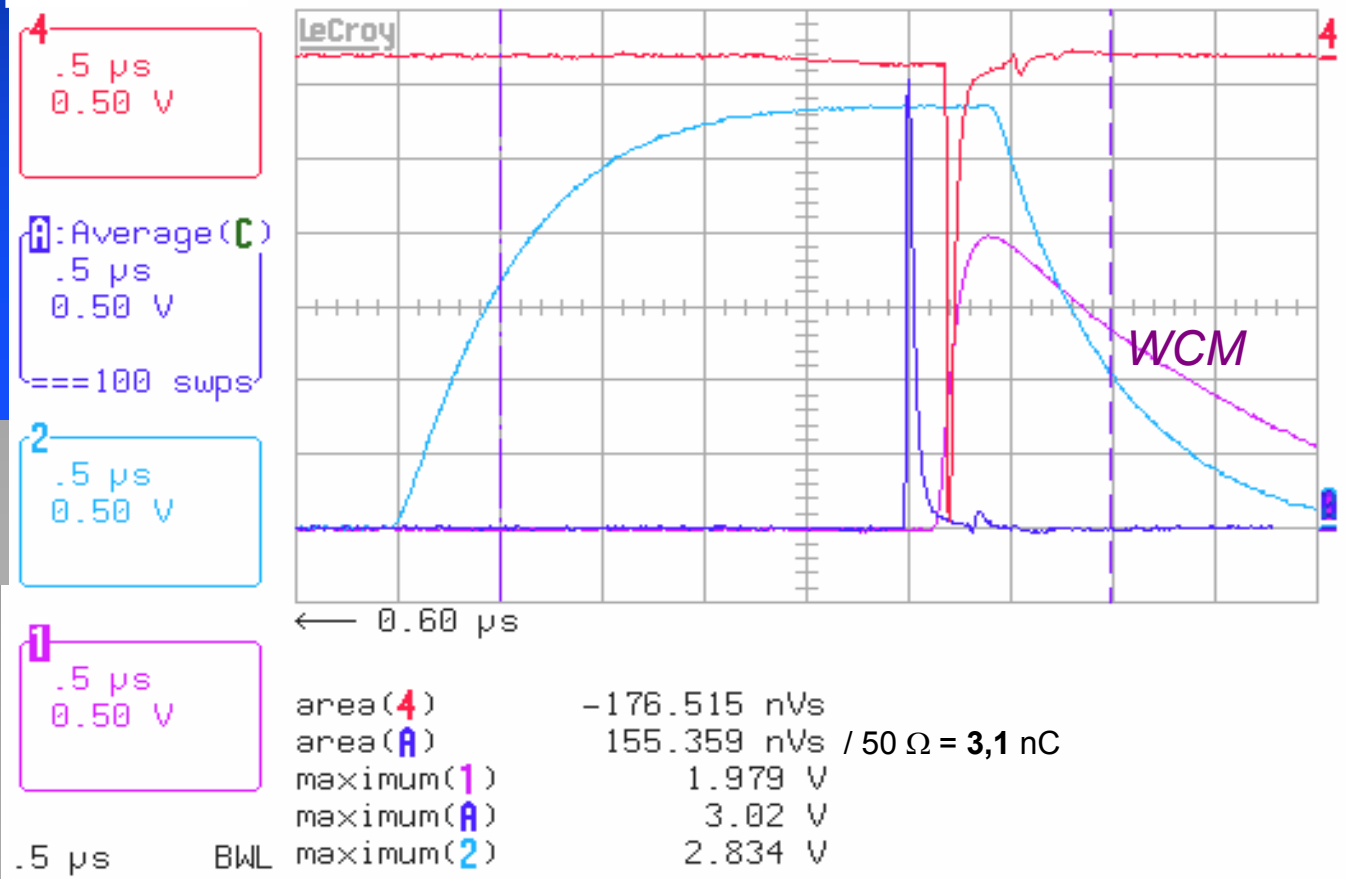


Photo-current / Dark current-EA3



F = 10 Hz
HF = 3 µs
Laser = 2,7 µs

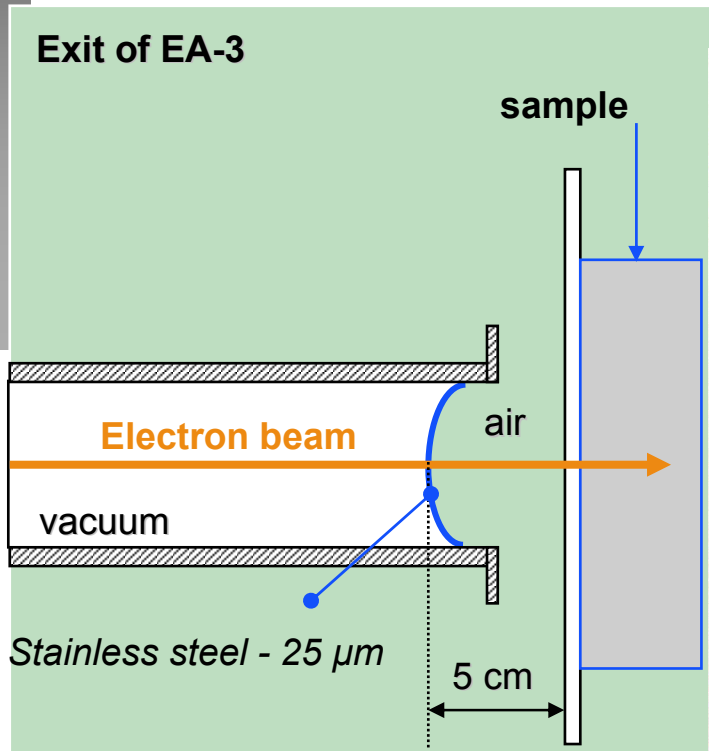
EA3
9 MeV
Ea = 70 MV/m

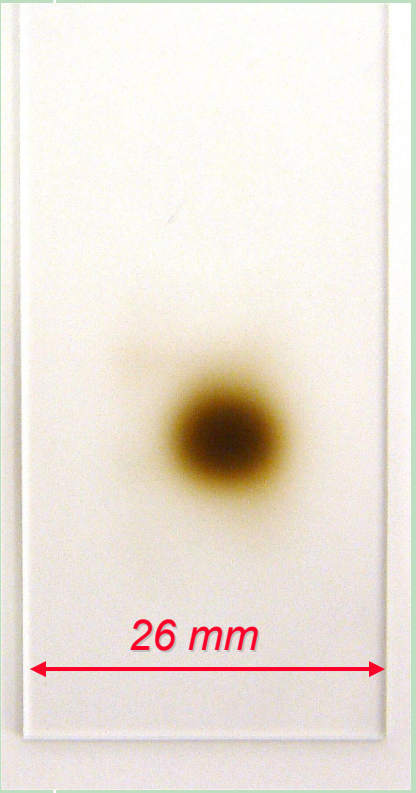
Qph = 3,1 nC
Qdark = 0,1 nC

Qdark/Qph = 3%

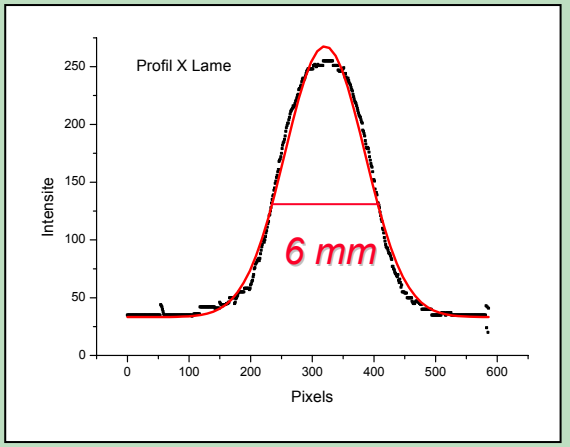
Iph = 60 mA
Idark = 1 mA

Beam spot size





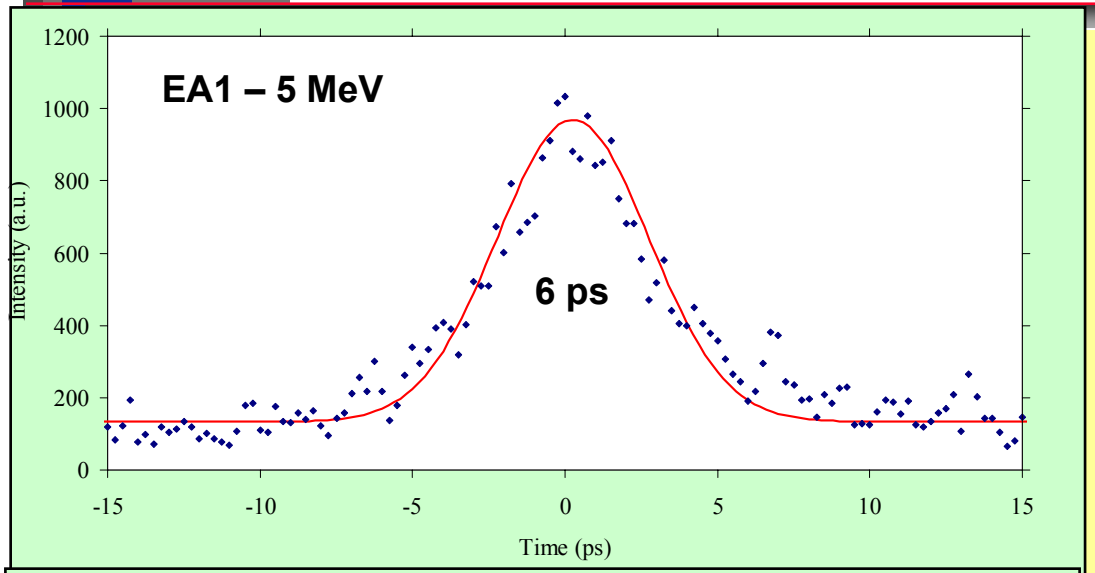
Glass screen

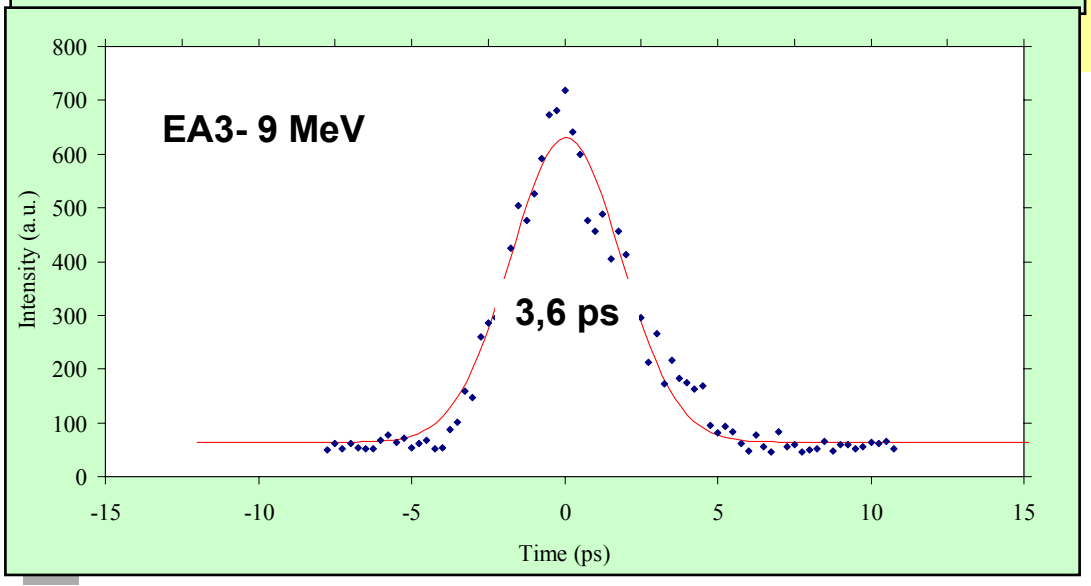


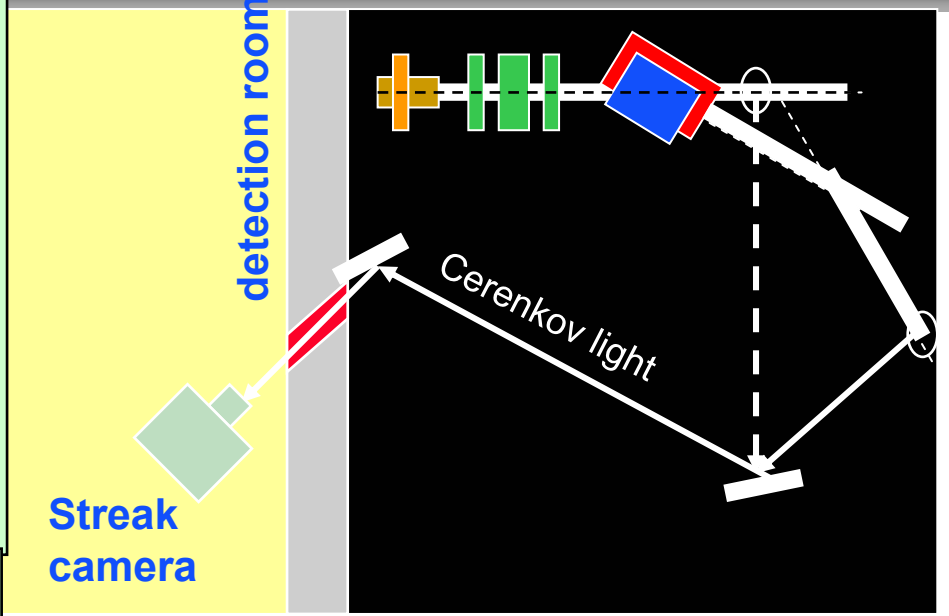
Q = 1,8 nC

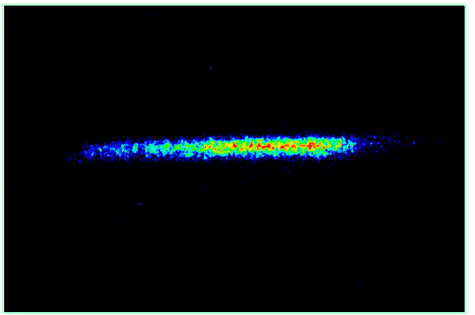
4 min @ 10 Hz

Pluse length – cerenkov radiation

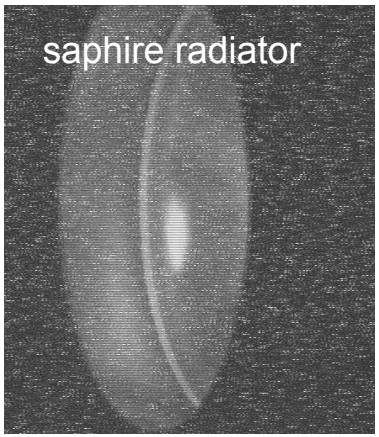




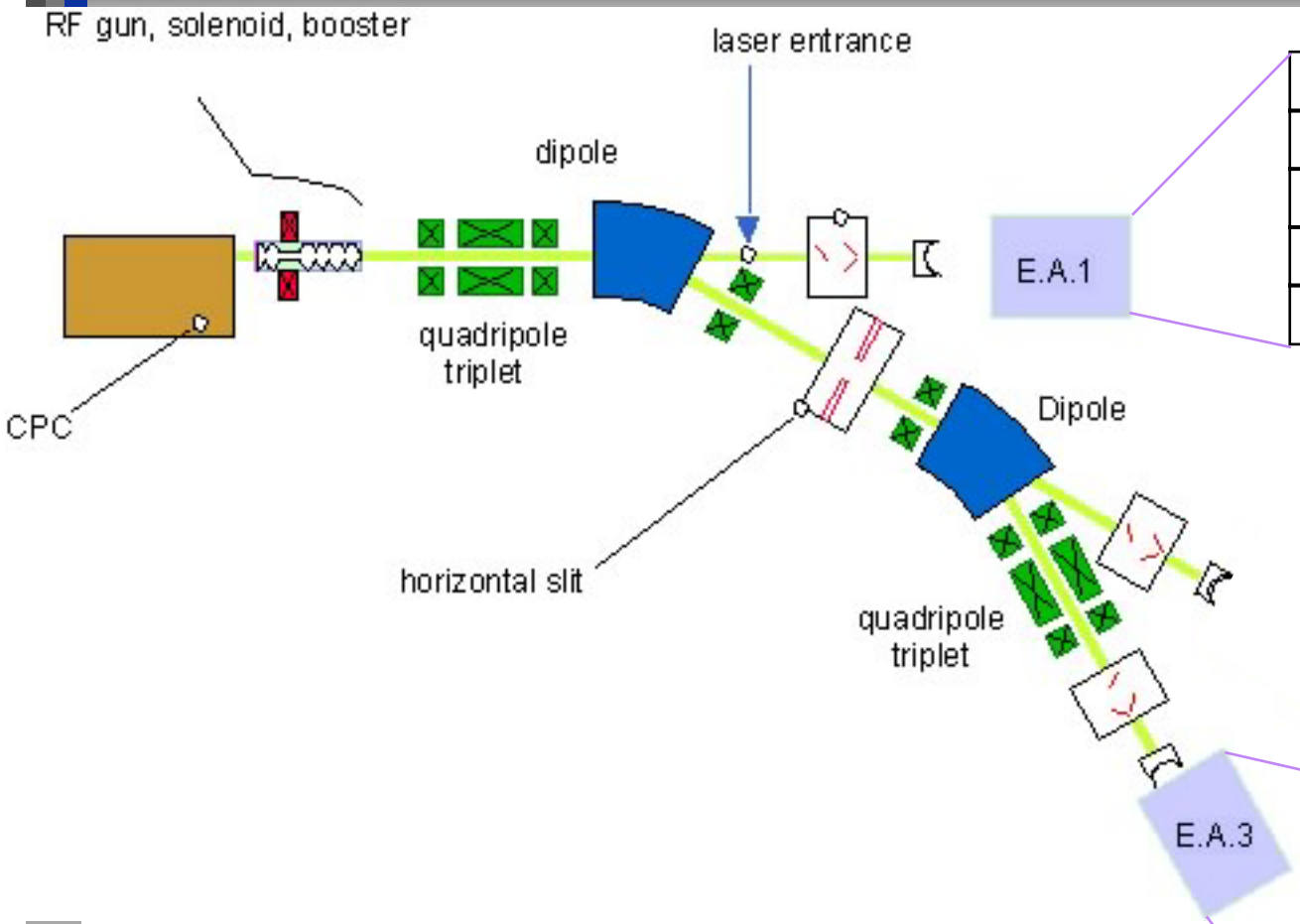




Qph = 1,5 nC



Beam caracteristics



Energy	9 MeV	5 MeV	9 MeV
dE/E	2%	3%	10%
b.length	**5 ps**	**5 ps**	**10 ps**
charge	**1,5** nC	**1,5** nC	**5 nC**
Q/Qdark	~120%	< 2%	~100%

Energie	9 MeV	5 MeV
dE/E	2%	2%
durée	**5** ps	**10** ps
charge	**1,5** nC	**1,2** nC
Ph/Ob	2%	0

Conclusion

- *ELYSE accelerator fully operating*
- *Cs_2Te cathode : high charge (5 nC) and long life (>1 year)*
- *5 ps bunch length (1,5 nC)*

- *First experimental results*