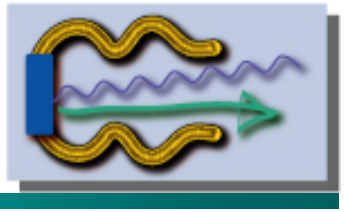


SUMMARY OF FIVE YEARS OF WORK ON THE PHIN PHOTOINJECTOR

R. Losito (EN/STI)
for the PHIN team
(in all institutes and CERN departments!!!)

CTF3 Collaboration Meeting, 28 Jan. 2009

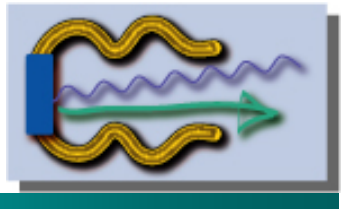
Acknowledgement

We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 "Structuring the European Research Area" programme (CARE, contract number RII3-CT-2003-506395).

Acknowledgement

More joined later… (FRASCATI, Milano, Saclay)

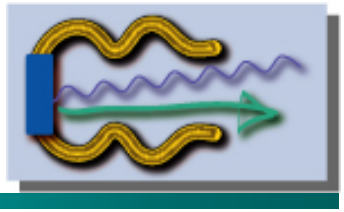
Acknowledgement



- We also acknowledge the support of the Institute of Applied Physics of the Russian Academy of Science (Novgorod)

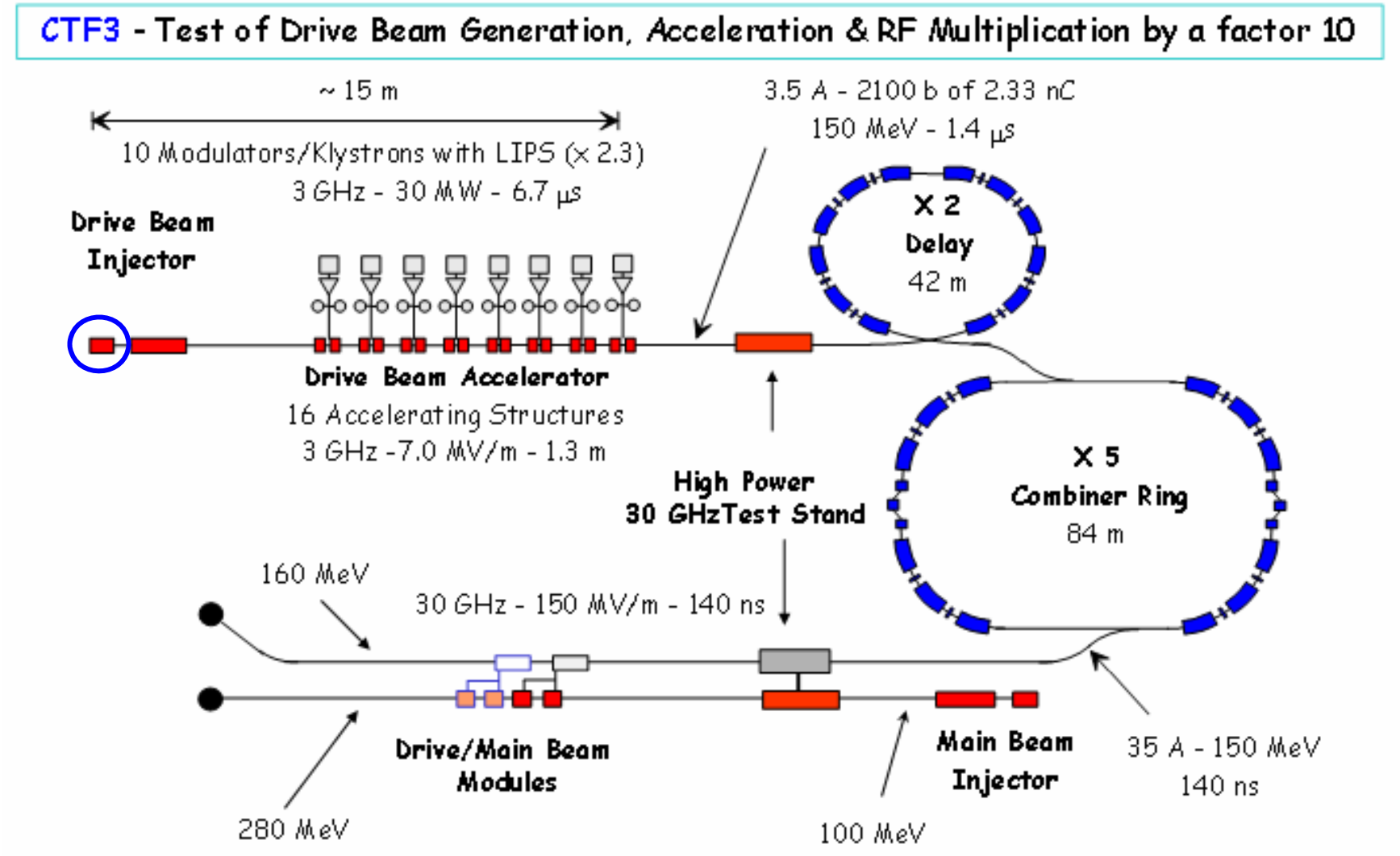
  - Collaboration for improving the beam conversion efficiency and the gain of the 2nd amplifier.

Outline

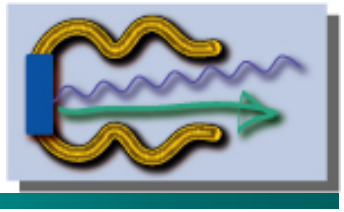


- History:
  - RF-gun
  - Laser
  - Photocathodes
- Results and perspectives

History…

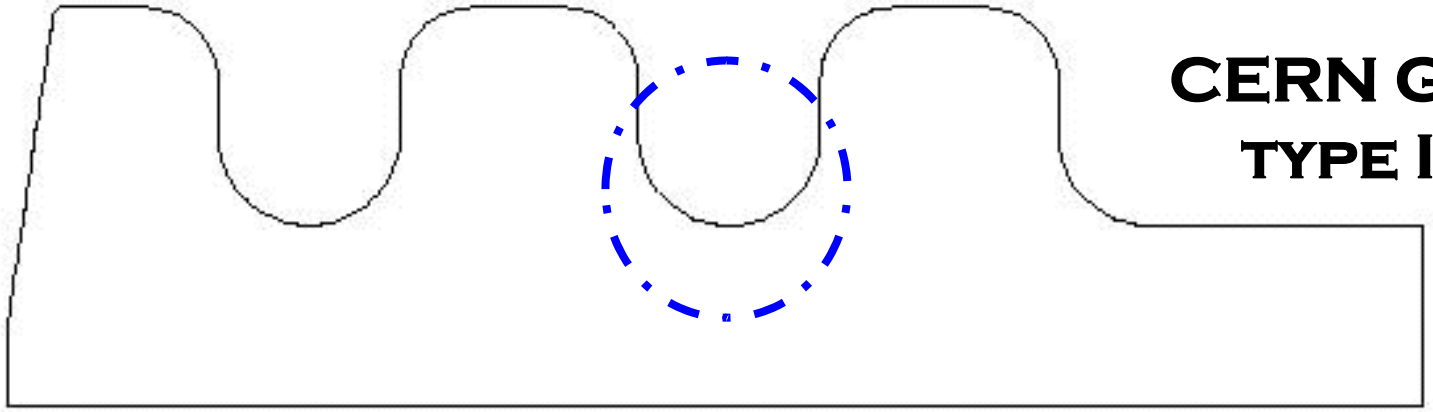

CTF3 - Test of Drive Beam Generation, Acceleration & RF Multiplication by a factor 10
~ 15 m
10 Modulators/Klystrons with LIPS (x 2.3)
3 GHz - 30 MW - 6.7 μs
3.5 A - 2100 b of 2.33 nC
150 MeV - 1.4 μs
Drive Beam
Injector
X 2
Delay
42 m
Drive Beam Accelerator
16 Accelerating Structures
3 GHz -7.0 MV/m - 1.3 m
High Power
30 GHzTest Stand
X 5
Combiner Ring
84 m
160 MeV
30 GHz - 150 MV/m - 140 ns
Drive/Main Beam
Modules
Main Beam
Injector
35 A - 150 MeV
140 ns
280 MeV
100 MeV

Outline

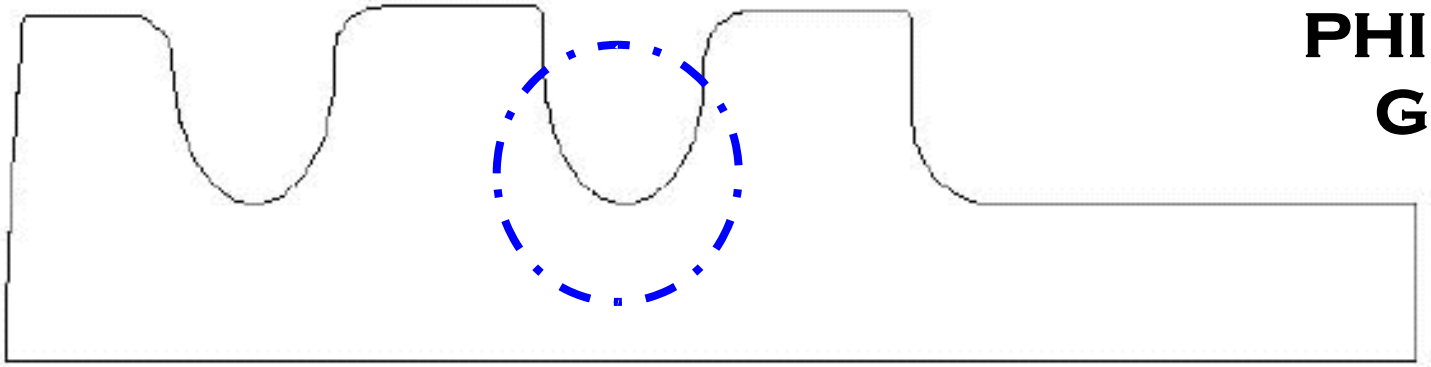


- Photoinjector Challenges:
  - Integrated charge: 2.33 nC/pulse, ~2000 pulses /train
  - Rep rate: 1÷50 Hz (nominal: 5 Hz) (thermal effects in laser/gun etc).
  - Tight specs on stability:
    - Amplitude: 0.25 % rms
    - Jitter: <1 psec

RF Gun (R. Roux, LAL)



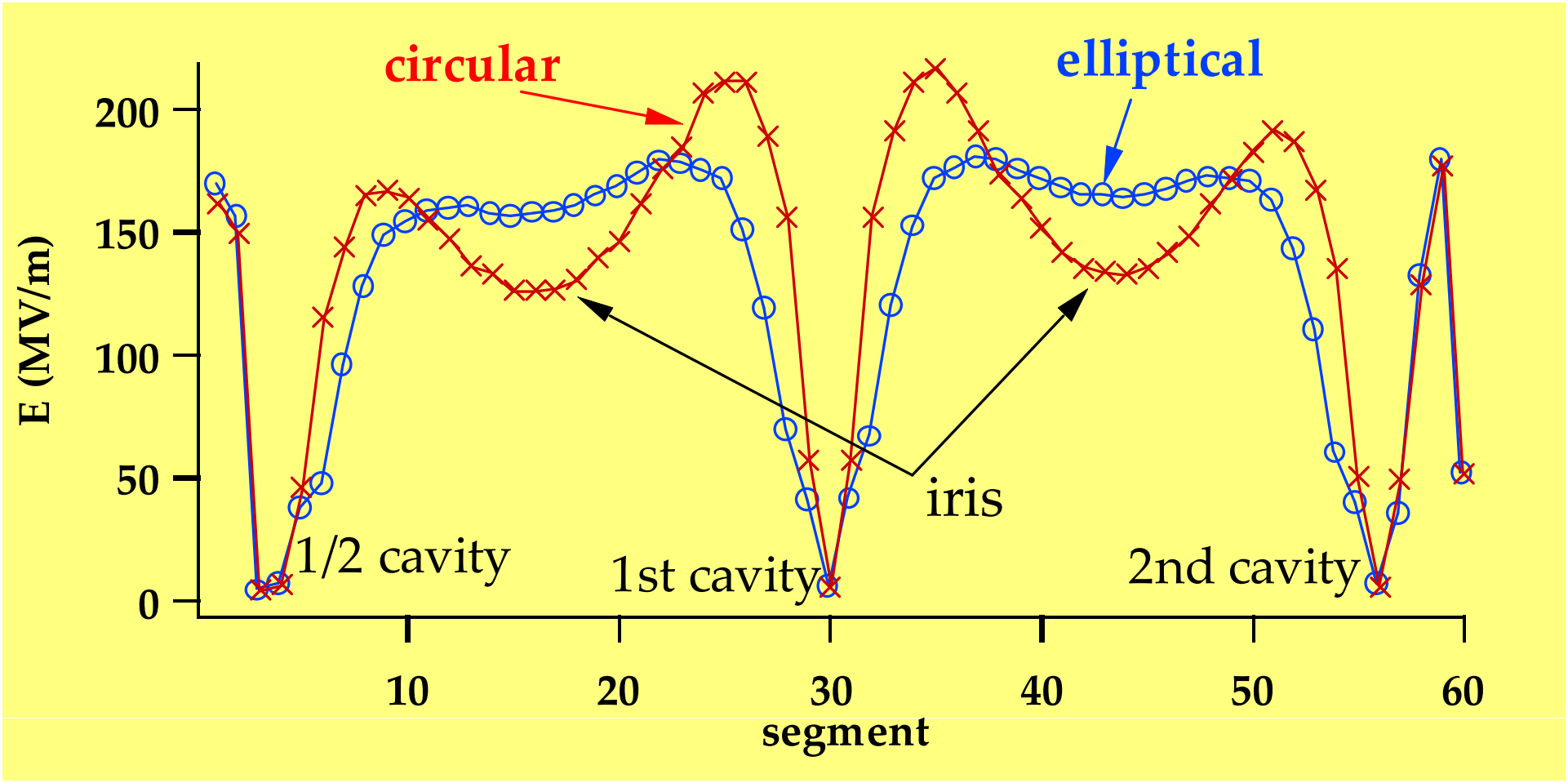
CERN GUN
TYPE IV



PHIN
GUN

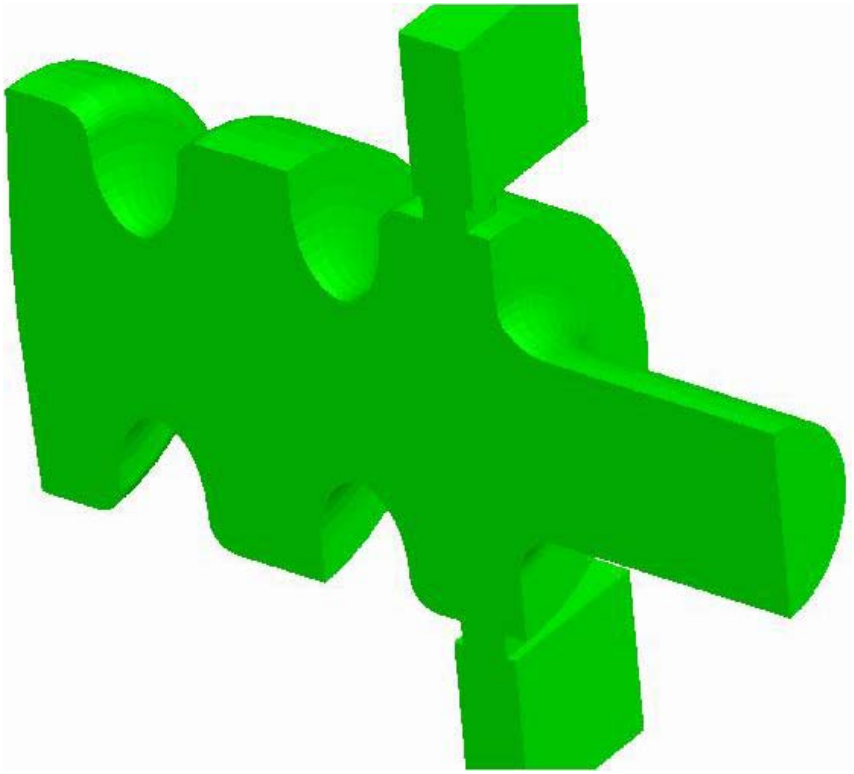
RF Gun (R. Roux, LAL)

- **Effect of Iris Shape**



RF Gun (R. Roux, LAL)

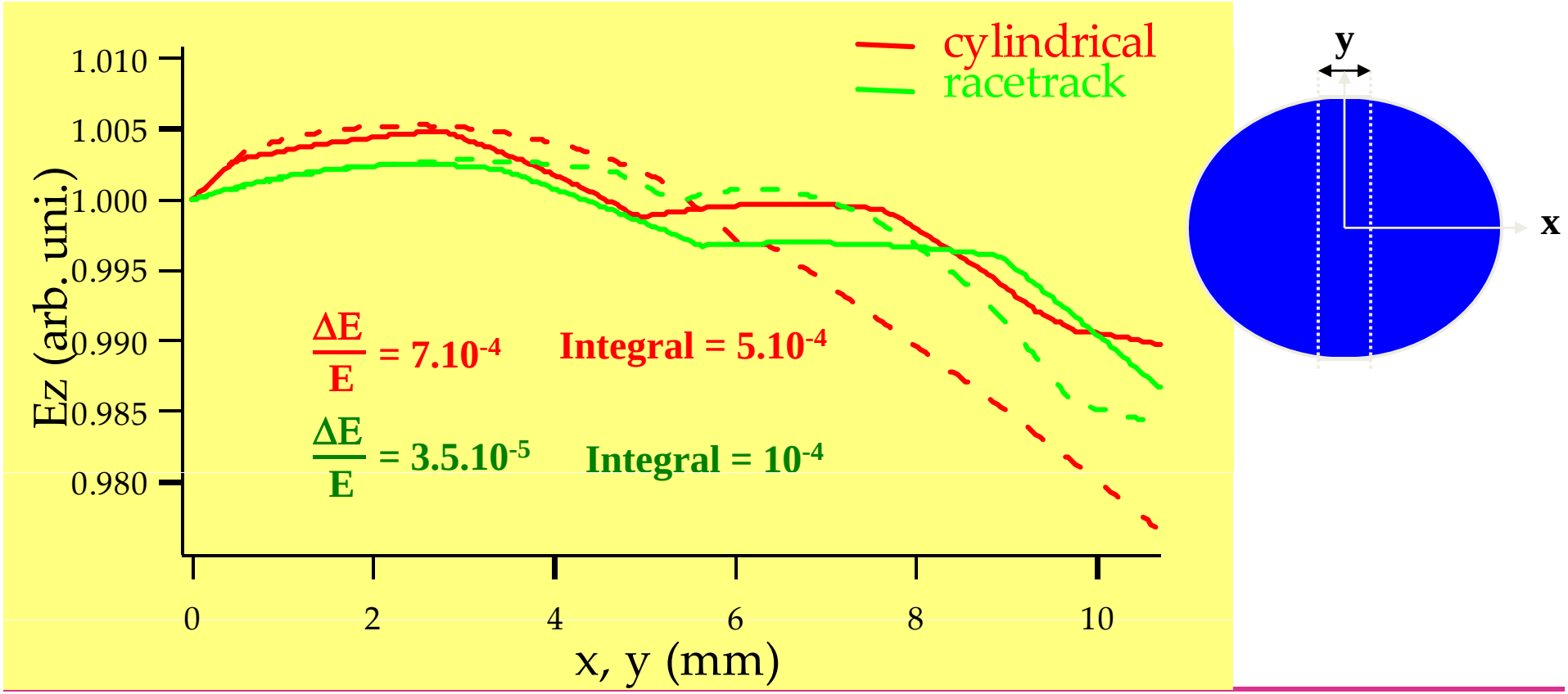
- Next step: 3D Simulations with HFSS



- **Two symmetric couplers to reduce transverse kick**
- **Overcoupled (b=2.9) to match the beam.**
- **30 MW are needed to compensate beam loading**

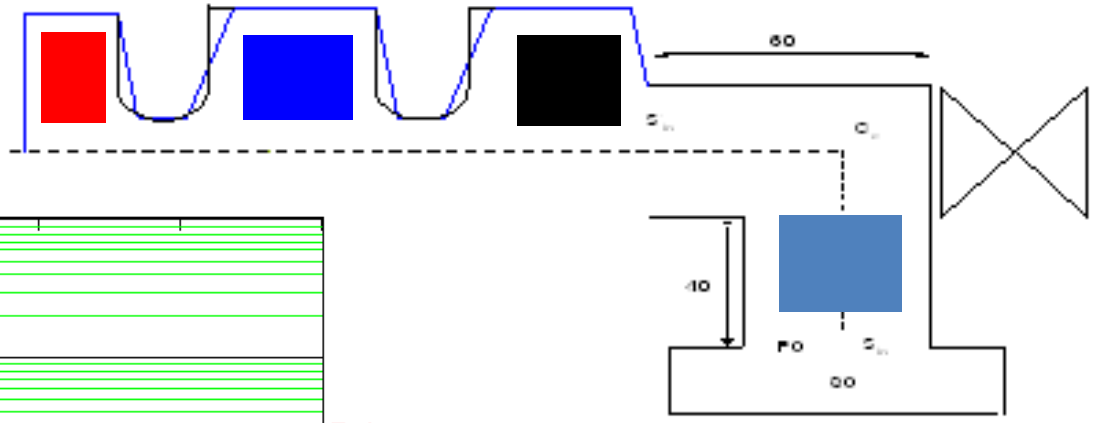
RF Gun (R. Roux, LAL)

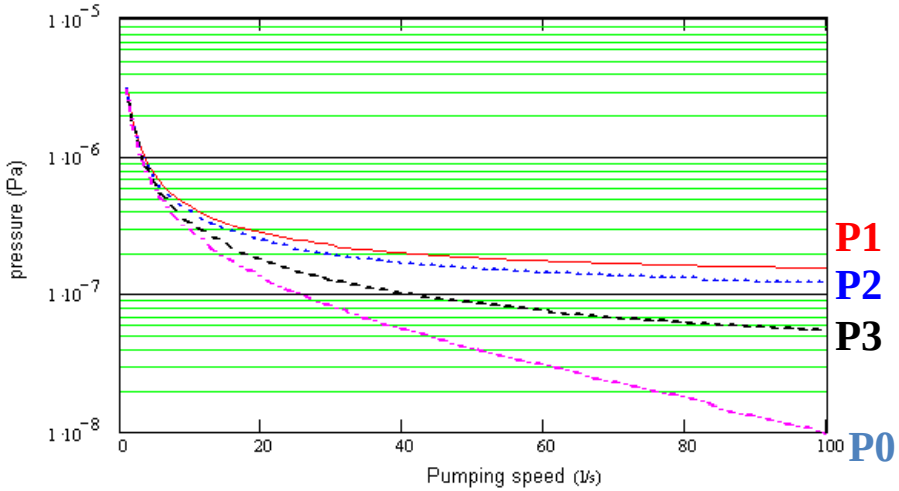
- An idea to symmetrise the fields: Racetrack shape for cell iris (Haimson)



RF Gun (R. Roux, LAL)

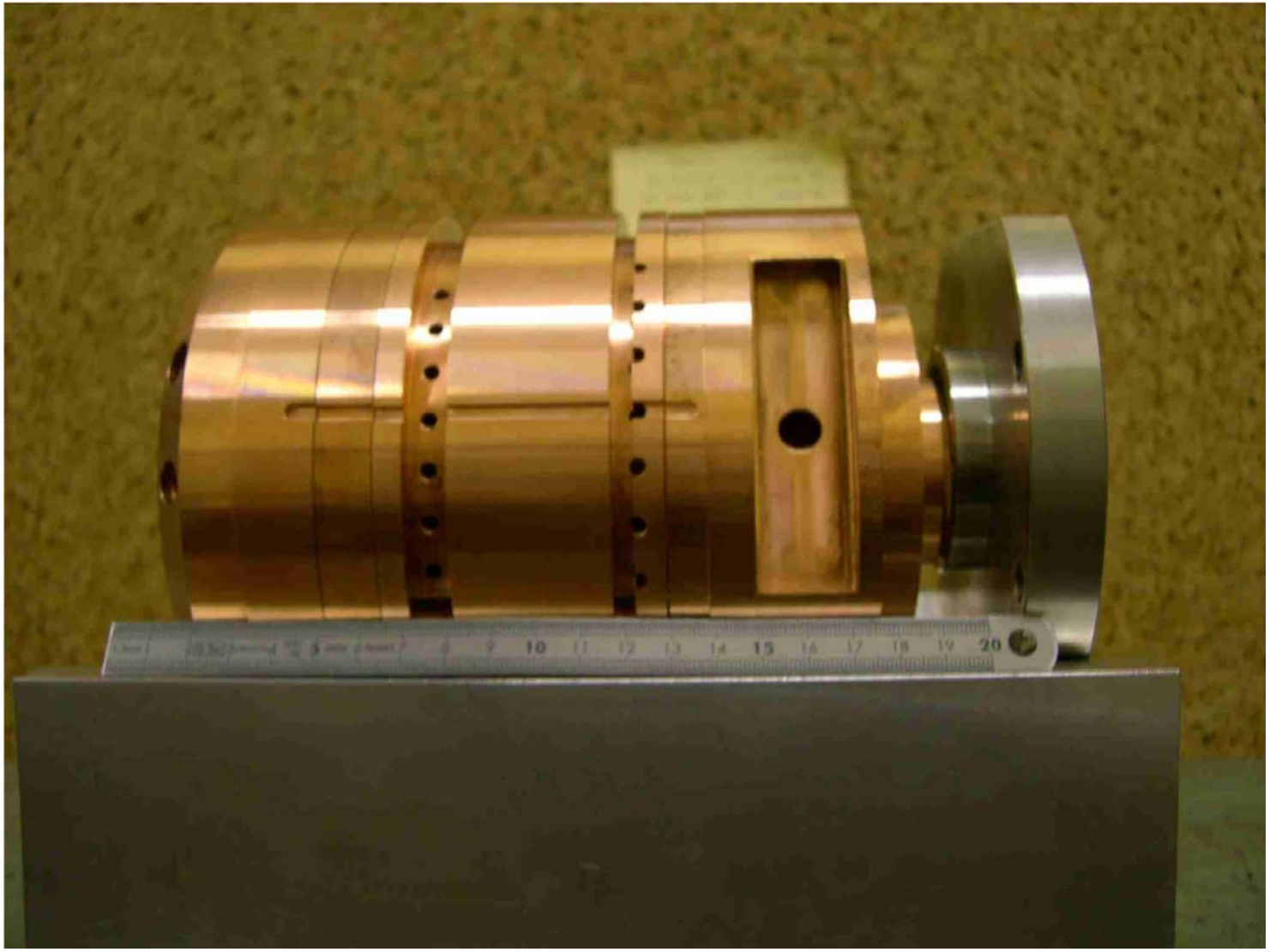
Monte-Carlo based simulations of the residual pressure



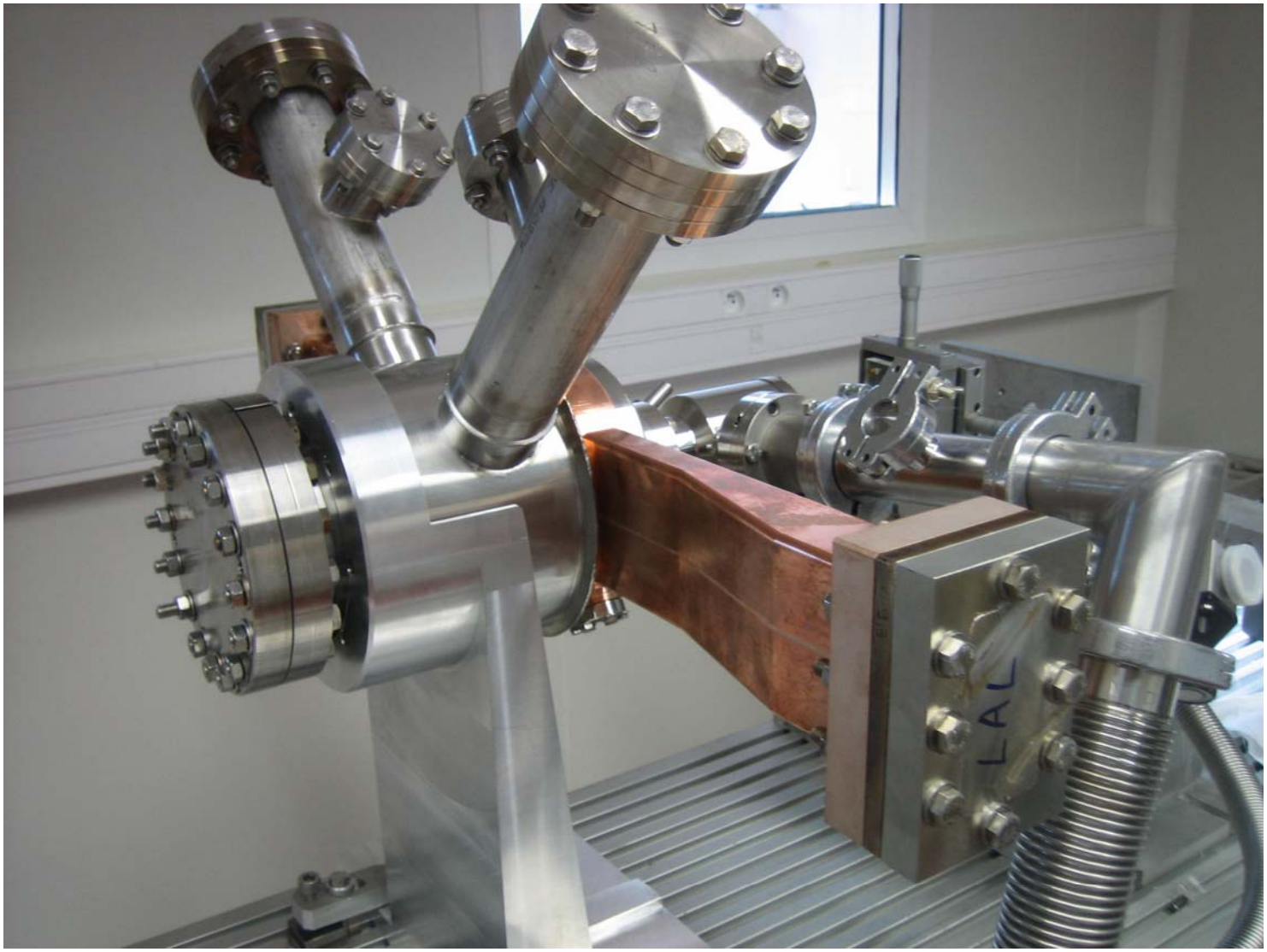


- **Useless above 40 l/s**
- **Weak help of a supplementary pumping**

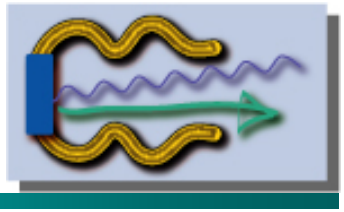
RF Gun



RF Gun

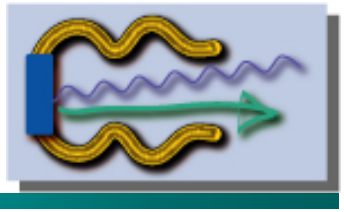


Laser (M. Divall, RAL)



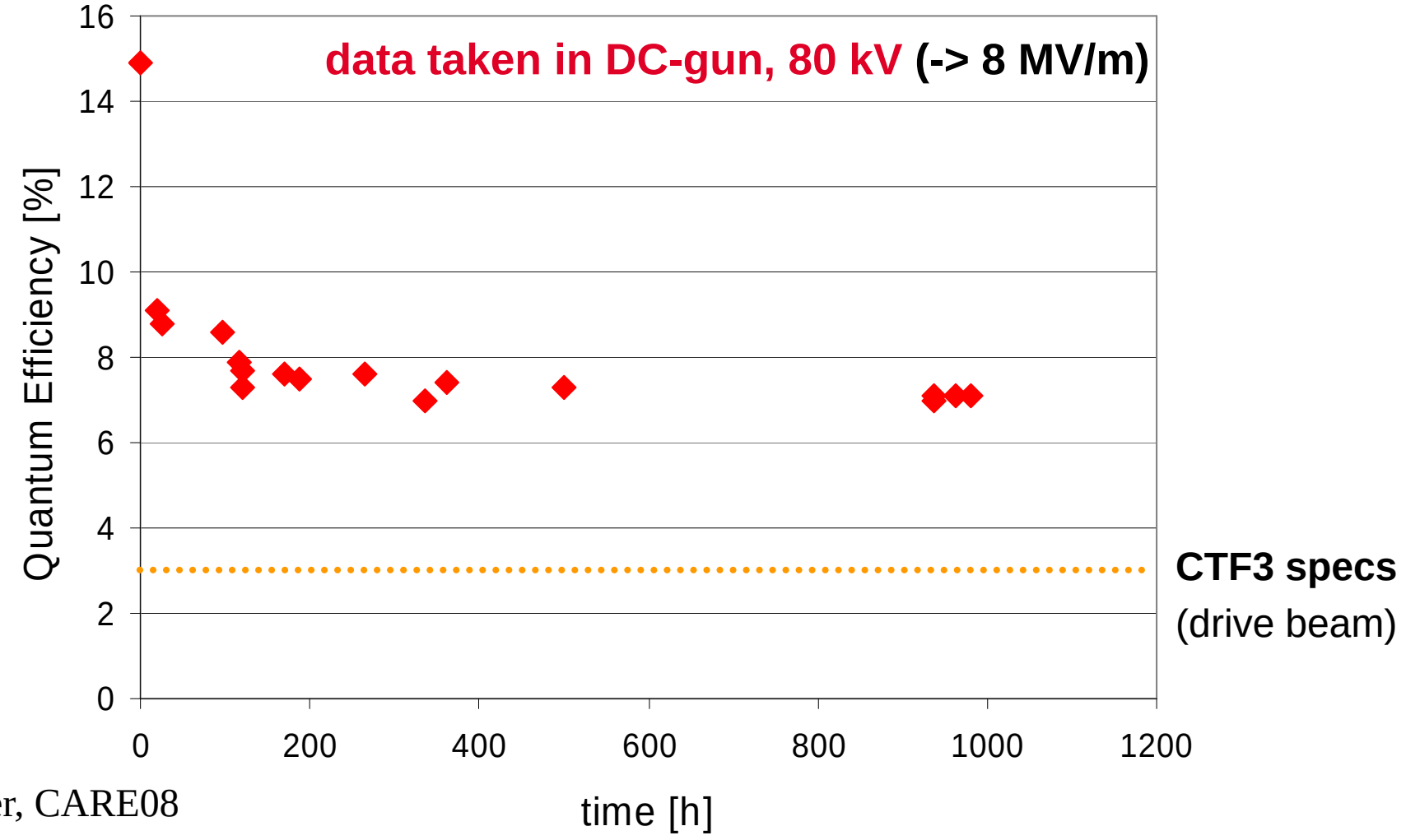
- See Massimo's talk

Photocathodes (CERN)



- Part of the program consisted in refurbishing the photocathode lab, add more controls and quality controls (spectrometer, vacuum, profilometer)
- Based on Cs_2Te co-evaporated technology developed at CTF2.
- Very sensitive to vacuum conditions and total charge.
- First photocathode worked quite nicely, even if not used in the best conditions

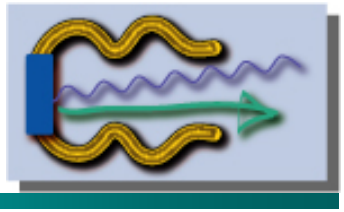
Photocathodes - No. 167 (E. Chevallay)



K. Elsener, CARE08

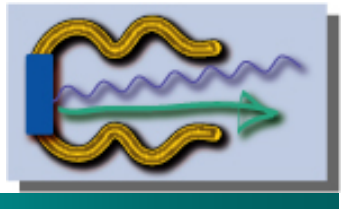
29 Nov. 2007 **Xmas break** **9 Jan. 2008**

Results: Photocathodes
(CERN)



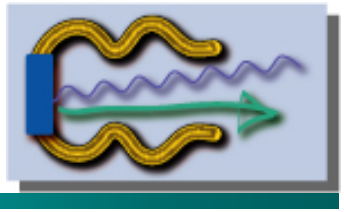
- QE during production of electrons in CTF3: ~1%
- To be measured for a longer period and under "stressing" condition during next run.
- 3 New photocathodes will be produced for next run:
  - It will not be possible to precisely measure the QE in the DC Gun because of a failure of the gun.

Results: Laser



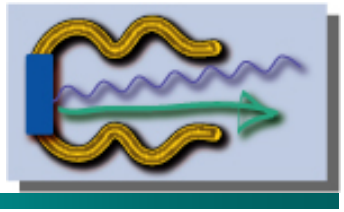
- Very good stability while working.
- UV Power available about ½ of nominal
  - one year ago I would have signed in blood for that!!!
  - Thanks Massimo & C. (Frascati, Marta)!!!
- Still, the failure at the end of the CALIFES run shows we need to improve the availability of spares ($$$)

Results: GUN



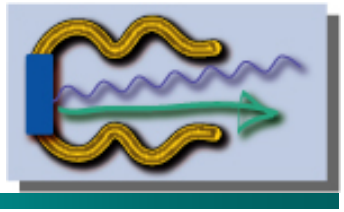
- Conditioned at full power (without beam)
- Calibrations to be crosschecked and be made available to CR.
  - Field extrapolated by the measurement of energy of the beam.
- If time was available, interesting work to understand effect of NEG coating: probably we won't have enough klystron time.

Results



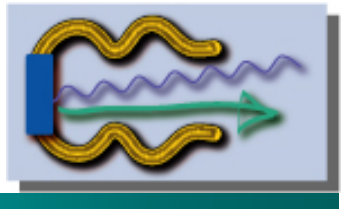
- What remains to be done:
  - Nominal (or nearly) charge production:
    - Lifetime of photocathodes (needs time..)
    - Beam loading compensation
  - Phase coding:
    - principle demonstration by University of Milano ok.
    - Need to mount it on real laser to check if unforeseen attenuation is acceptable
    - Need to check if jitter introduced is below the limit.
    - Needs a second (spare) oscillator
  - Check amplitude and phase stability (how?)

Perspectives: my view



- The test has shown that a reasonable operation can be done with the limited resources available.
- The Photoinjectors will be one of the main sources of downtime if we do not invest in spare parts and service contracts (to be discussed)
- Every part of the photoinjector depends on a single person (not necessarily a staff…)

Perspectives: my view



- The photocathode lab and laser development need more manpower. With the present level we can only operate but any development is (almost…) excluded.