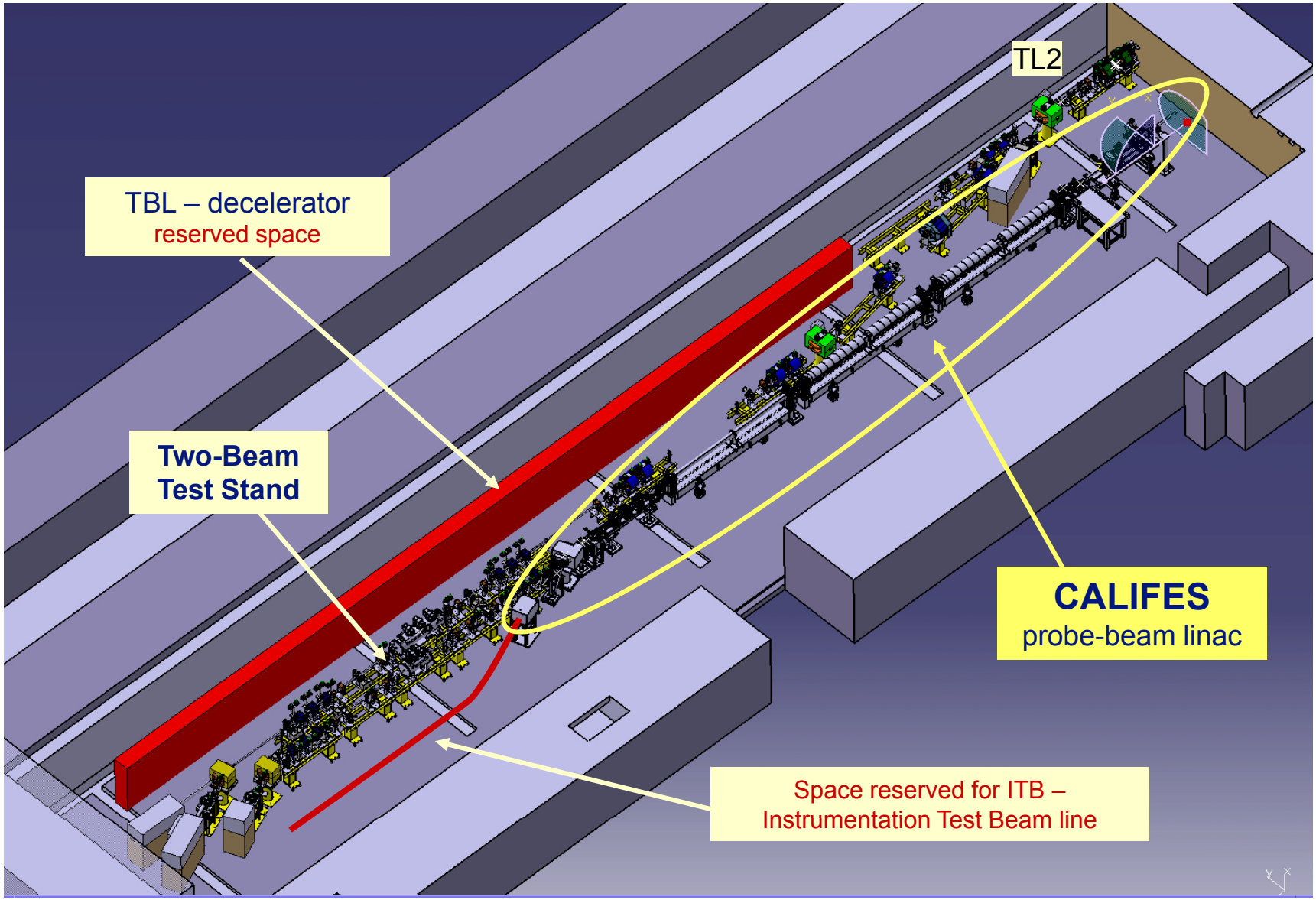
Status Report on CALIFES

F. Orsini on behalf of the Saclay's group

CLEX Layout : CALIFES line



CALIFES / CEA's contribution

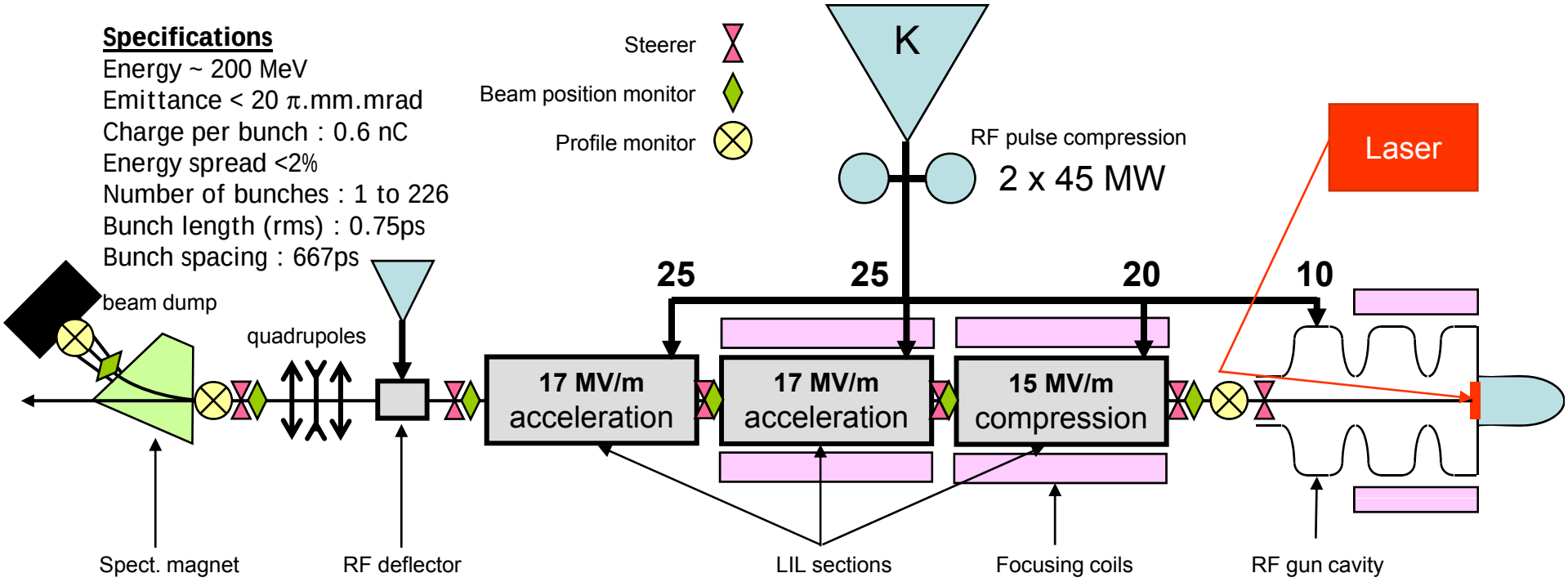
CEA's Contribution :

Laser system triggering the RF gun photocathode, accelerating line (3 LIL sections and vacuum chambers), RF System (modulator, power phase shifter, RF network, etc …), beam diagnostics (BPMs, VPMs, Spectrometer, …), beam dump, magnetic components (quadrupoles, steerers), mechanical supports, alignment of components and services (vacuum, hydraulic, cables, power supplies, control command)

Present Milestone:

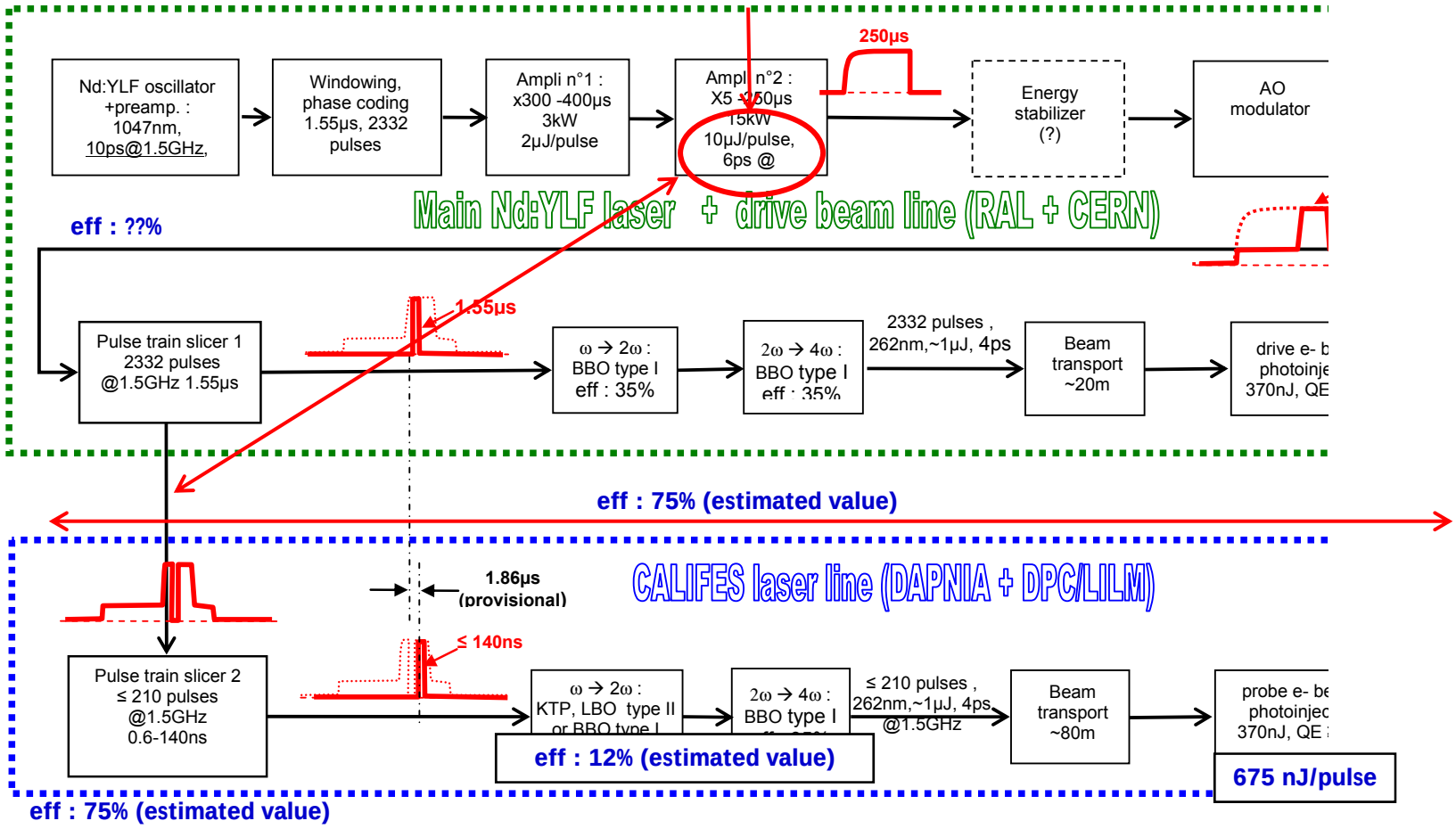
- Design, Construction, Installation of CALIFES : 2005 → 2008
- Commissioning CALIFES : start middle 2008 → end 2008 (?)

Specifications
Energy ~ 200 MeV
Emittance < 20 π.mm.mrad
Charge per bunch : 0.6 nC
Energy spread <2%
Number of bunches : 1 to 226
Bunch length (rms) : 0.75ps
Bunch spacing : 667ps



Impact of the LASER beam transmission efficiency on the e- beam

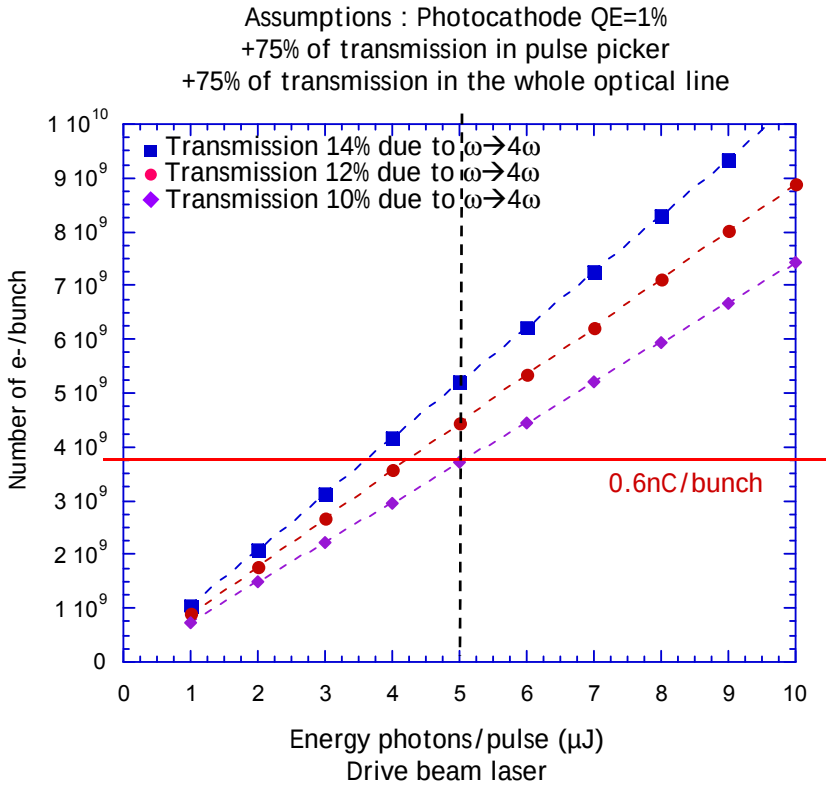
Initial specification

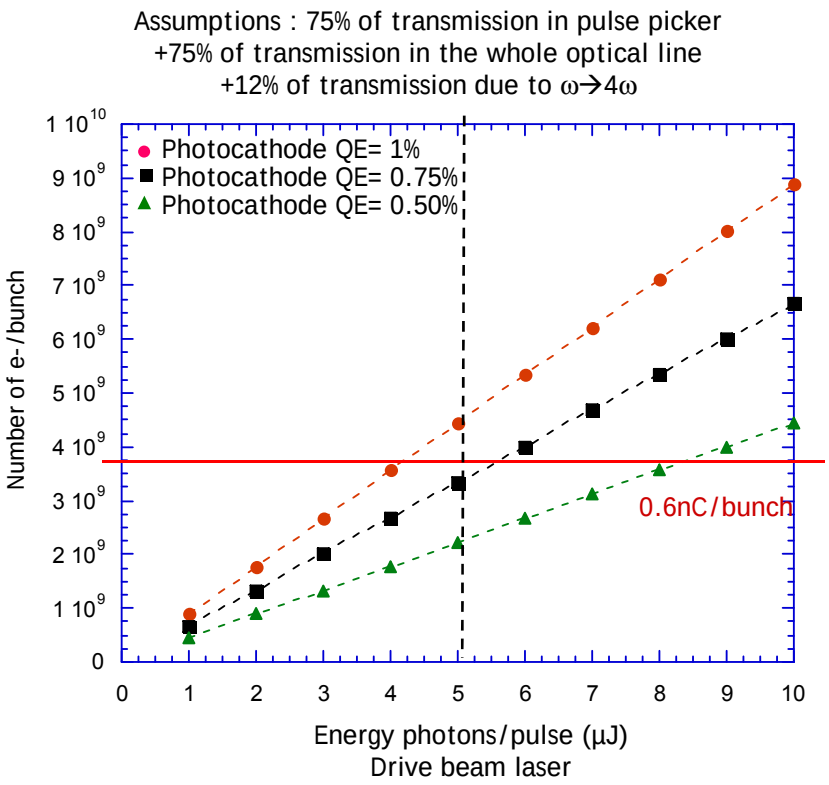


→ We have to take special care to keep transmission values as high as possible

Impact of the LASER beam transmission efficiency on the e- beam

Specification : 0.6nC/bunch → 3.75×10^9 e-/bunch (nominal)





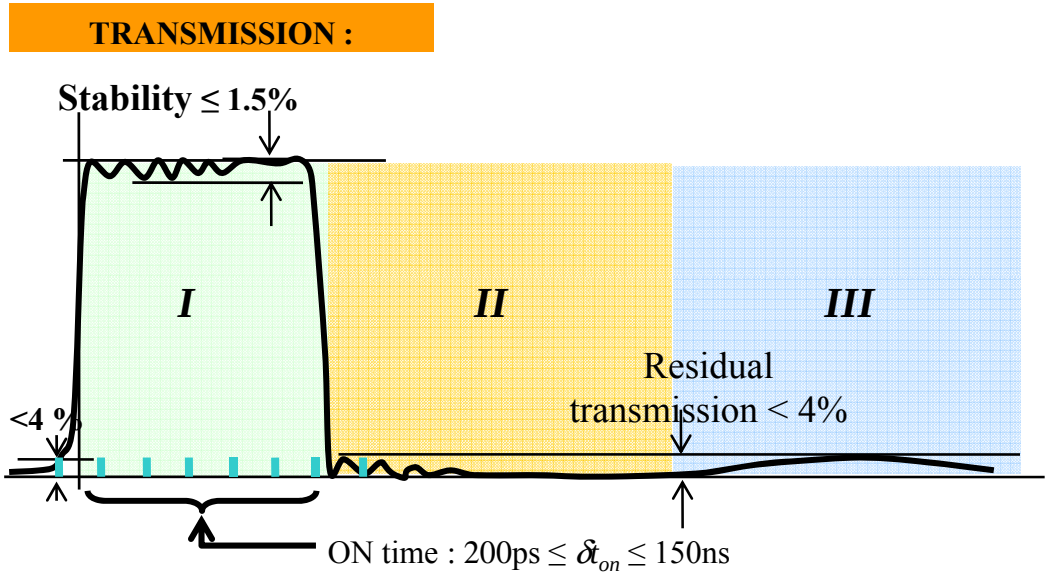
For a Photocathode with QE~1% and E_{laser}~5µJ/pulse, we need at least a transmission of 12% in our crystals

For a transmission of 12% in our crystals and E_{laser}~5µJ/pulse, we need at least photocathode with QE>=1%

Impact of the LASER beam pulse stability on the e- beam

Requirement on stability for the pulse picker :

- stability of transmission <1.5% during the pulses selection (1 up to 226)



- Real value of stability after realization : ~5%

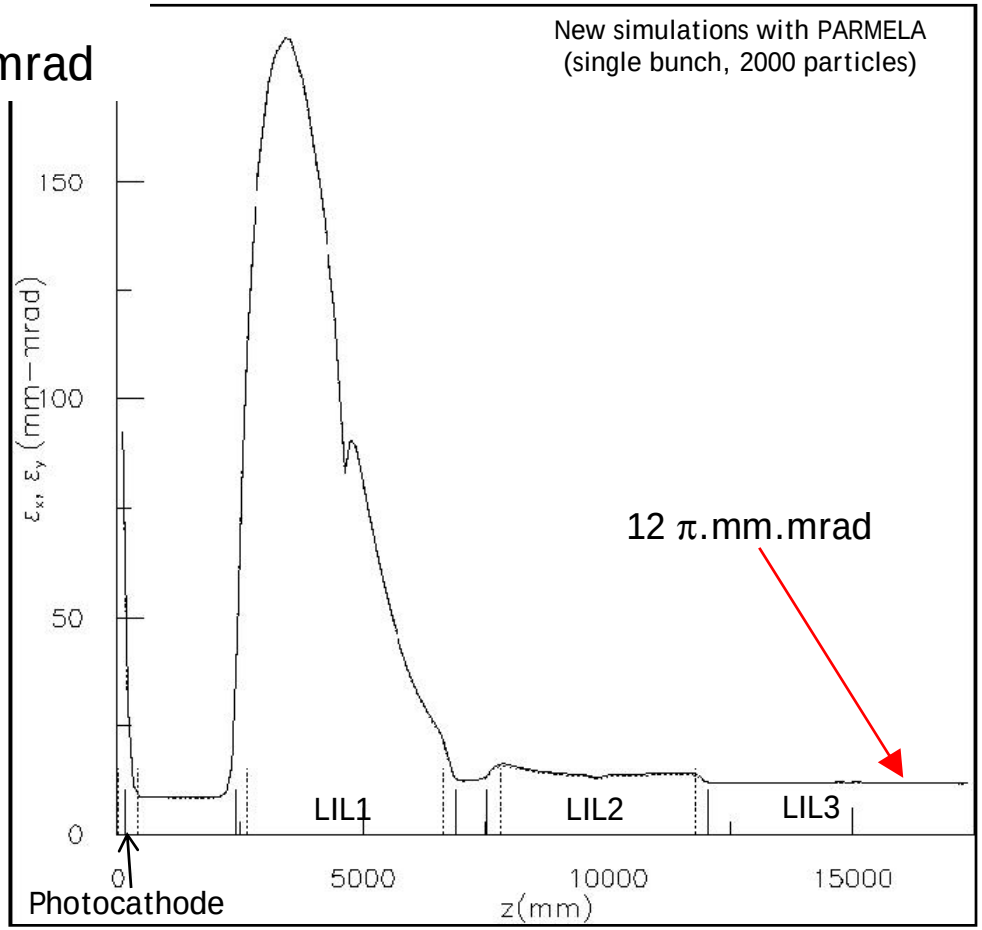
→This should affect the charge dispersion from one bunch to one another

→ this has to be simulated

Simulation of beam parameters

Goals :

- Bunching in section LIL#1
- Acceleration up to ~ 200 MeV ?
- Keep the emittance < 20 π.mm.mrad



A. Curtoni

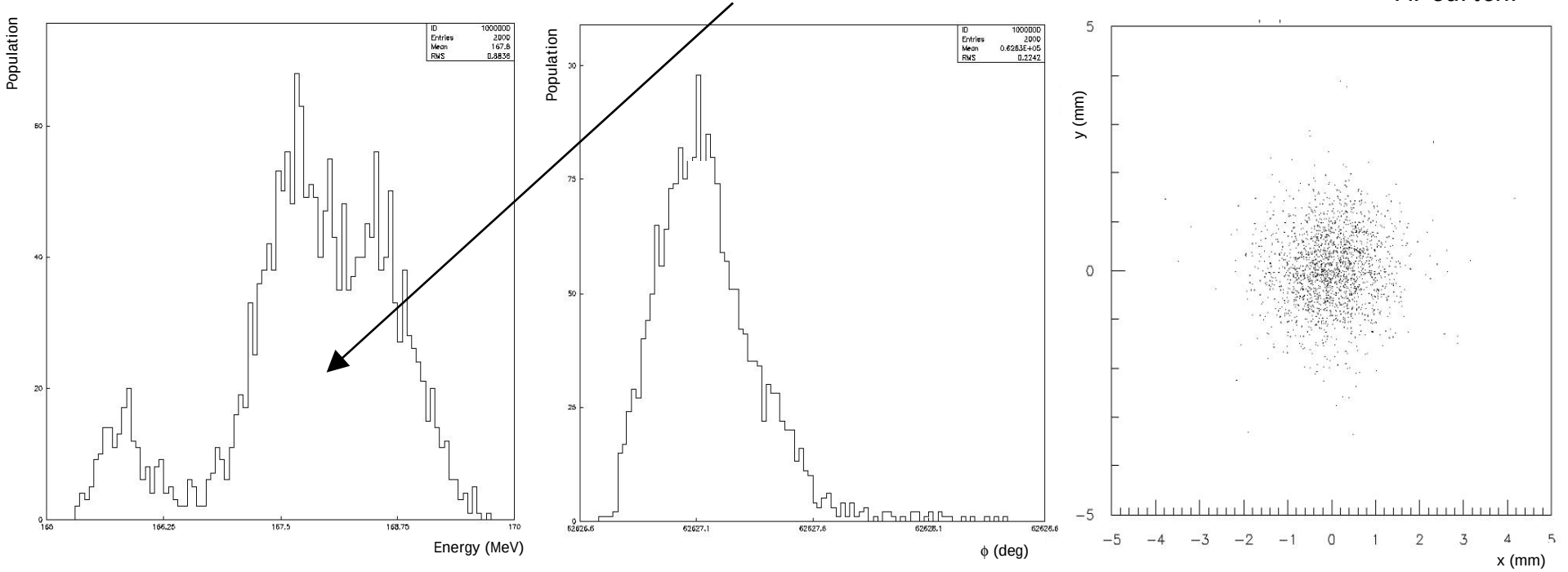
If we decrease the bunching in LIL#1
(0.75ps for 30GHz initially, is this parameter can be modified for 12 GHz operation ?)
→ possible to use LIL#1 also for acceleration and less bunching
→ we hope small gain in energy
→ must be confirmed by simulations

Simulation of beam parameters at the Linac output

New simulations with PARMELA (single bunch, 2000 particles),
taking into account realistic parameters for RF System, and laser beam (impulsion length 4ps)

This can still be optimized

A. Curtoni



Bunch charge	0.6 nC
Energy	~168 MeV
Energy spread	±0.6%
rms bunch length	±0.21 ps
Normalized rms emittance	~12 π mm.mrad

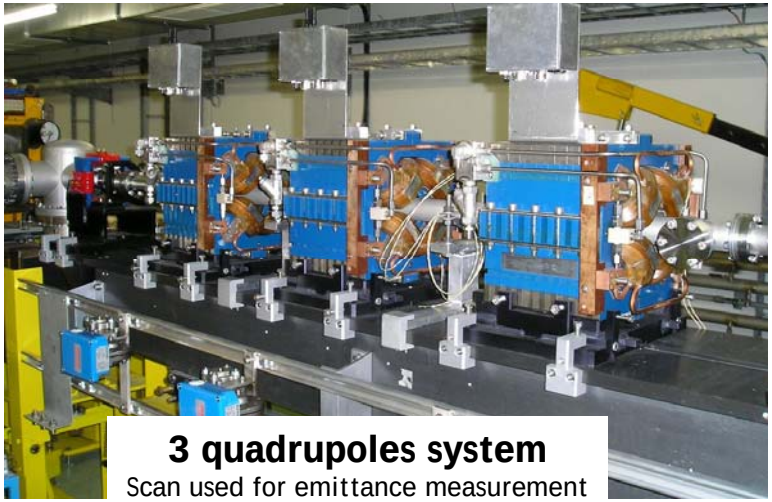
Mechanical installation

→ No particular difficulties during installation

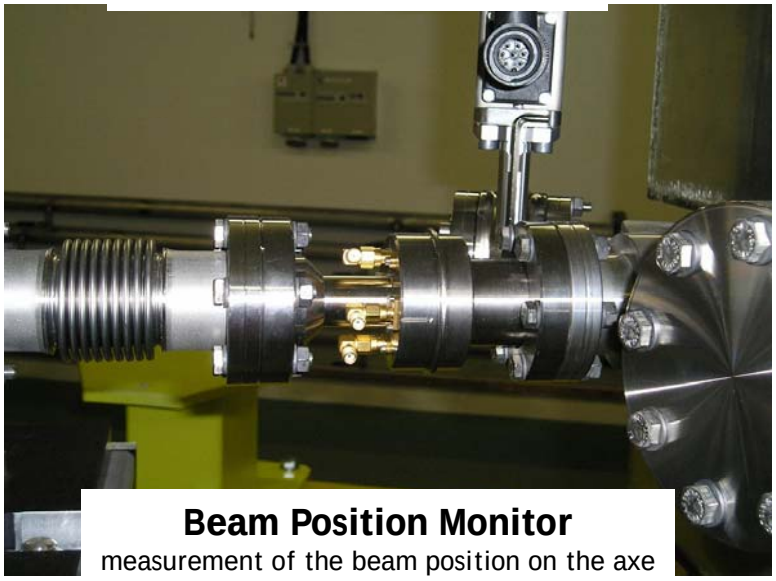
- all supports
- Beam DUMP
- 3 LIL sections
- Dipole (spectrometer)

Installation of Diagnostics

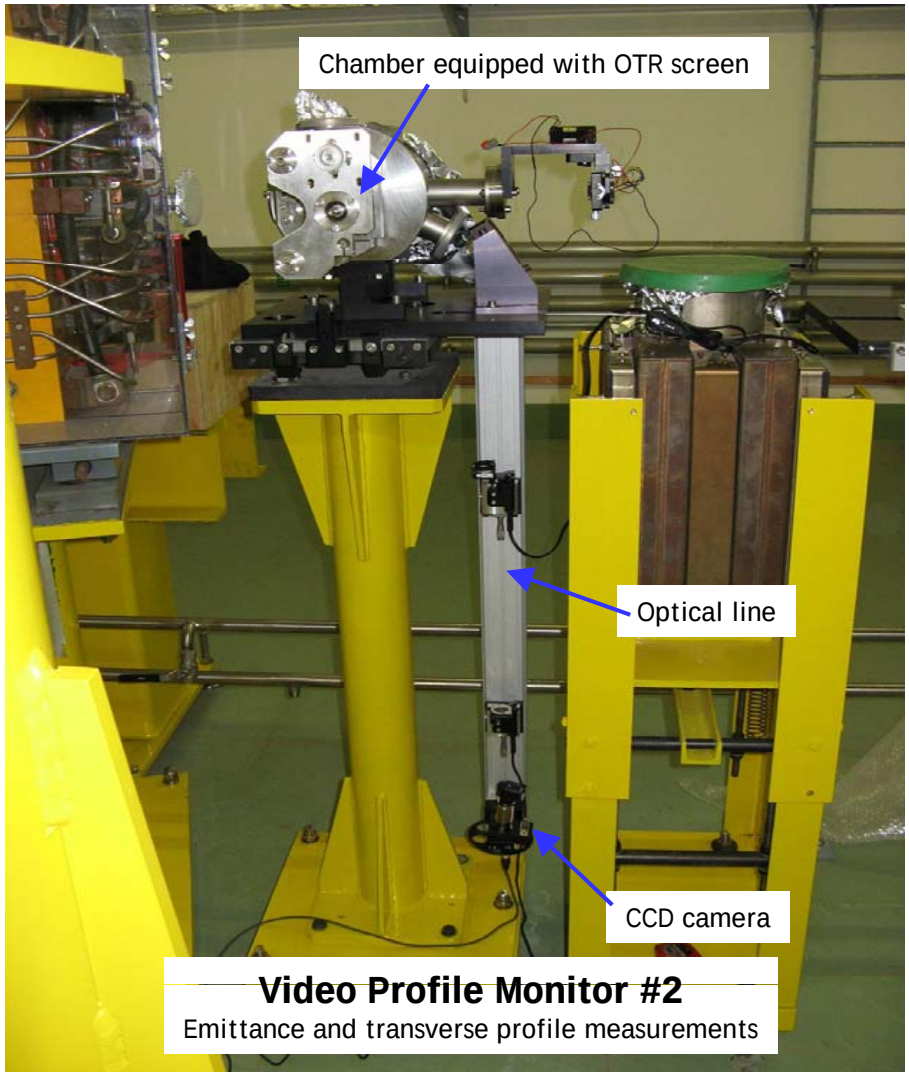
- only one VPM#2 was sent back to Saclay for small mechanical modifications



3 quadrupoles system
Scan used for emittance measurement



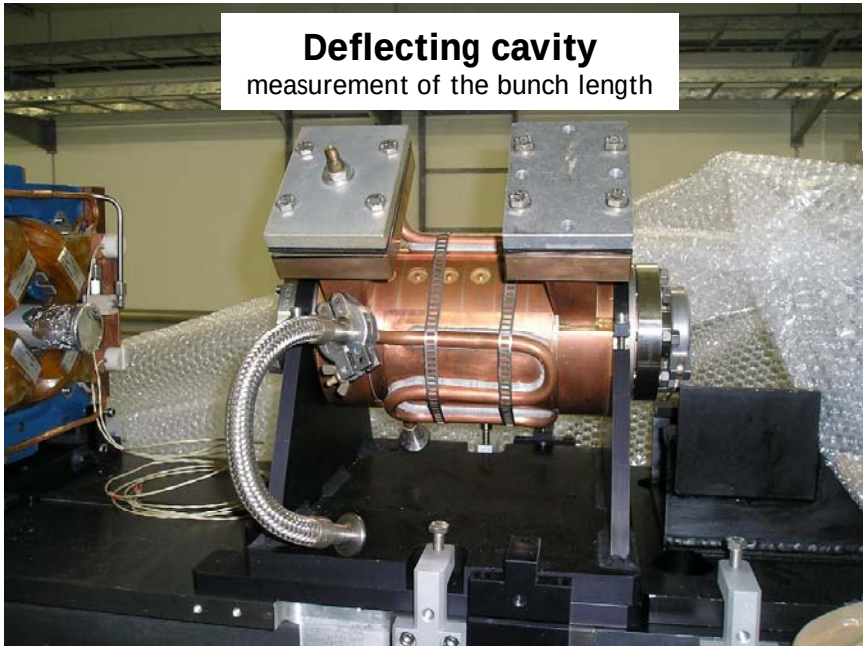
Beam Position Monitor
measurement of the beam position on the axe



Video Profile Monitor #2
Emittance and transverse profile measurements

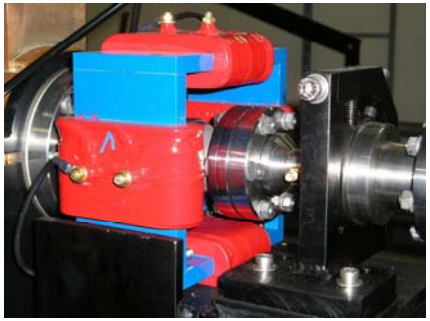
Installation of Diagnostics

RF Pick up : measurement of the bunch length (spectral analysis of a very short pulse)
→Study in progress at CEA
→Only a vacuum chamber is installed on CALIFES, waiting for the RF pick up in the future



Deflecting cavity
measurement of the bunch length

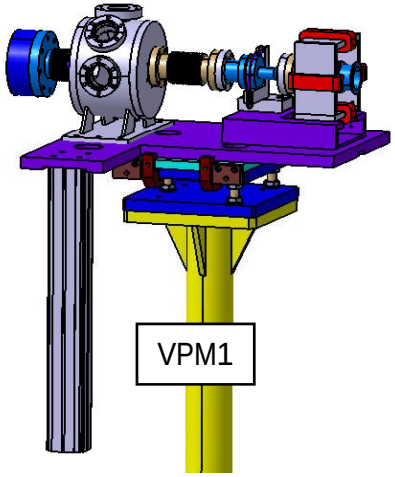
Beam Charge Monitor
measurement of the bunch charge

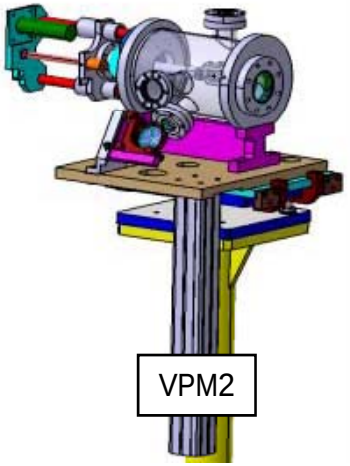


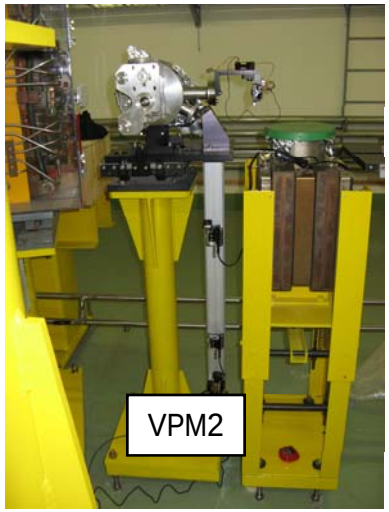
And also steerers …
Associated with BPMs

Dipole (spectrometer line)
Energy spread measurement

Video Profile Monitor

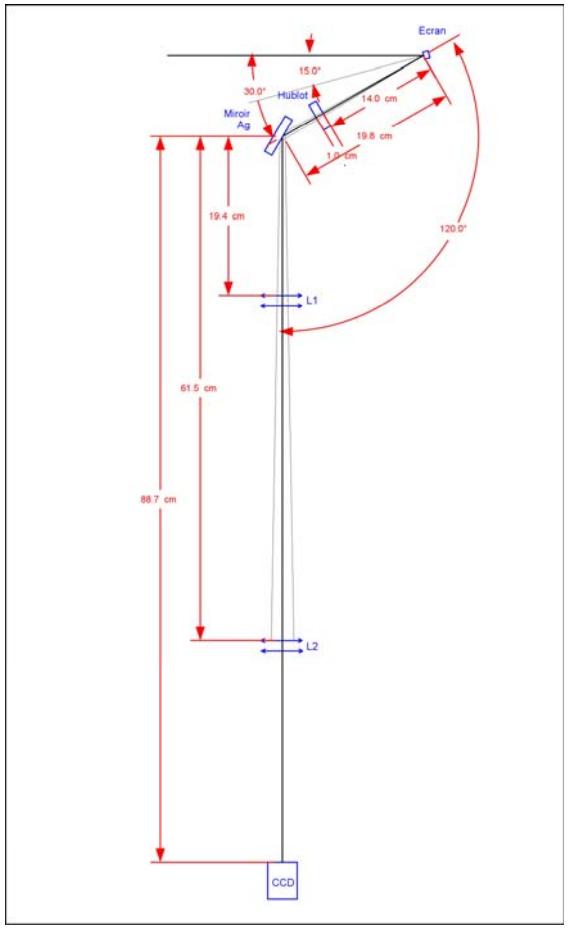




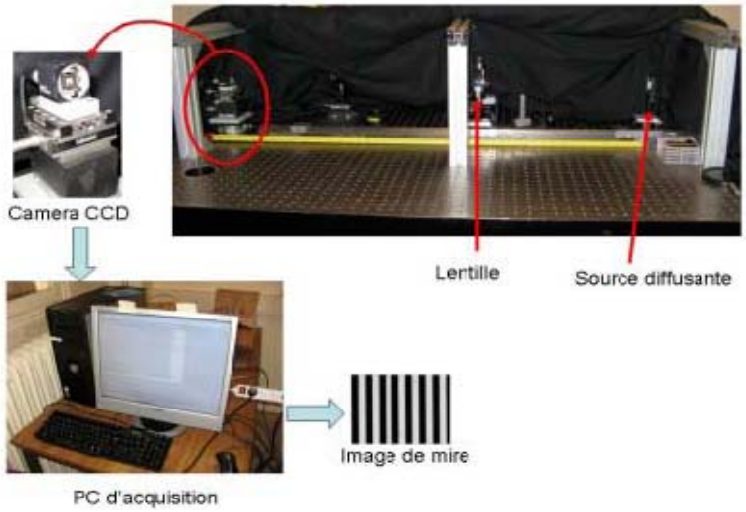


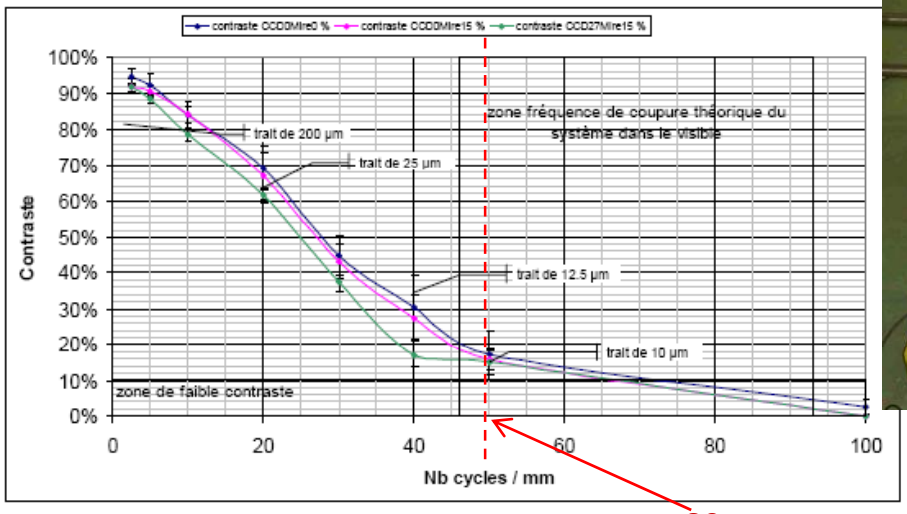
	VPM1	**VPM2**	**VPM3**
Position	After the RF gun	After the triplet	After the dipôle
Energy (MeV)	5	177	177
Screen type	YAG	YAG or OTR (Si)	YAG
Screen size (mm^2)	40 x 40	10 x 10	10 x 30
Tilt angle	45°	15°	45°
Magnification	0.15	1.75 or 0.35	0.25
Light control	Diaphragme	Filter wheel	Diaphragme
Resolution (µm)	**230**	**20 or 100**	**140**
Calibration	Screen marks	Movable grid	Movable grid

Conception, tests and Alignment of VPMs

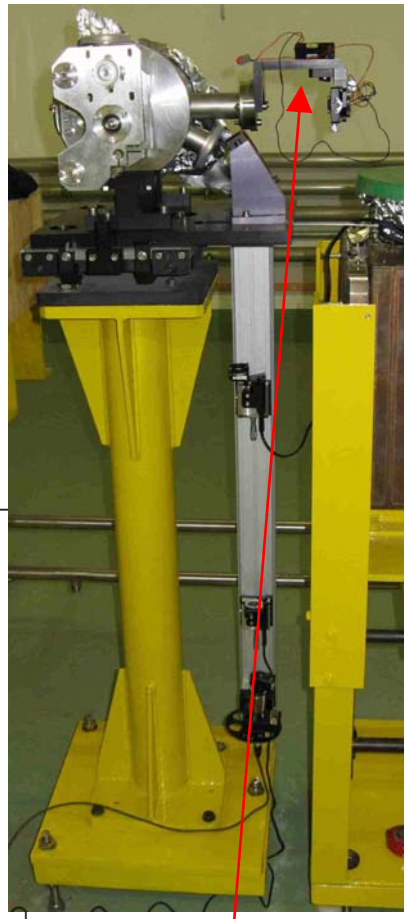


Optical design
with Apilux software





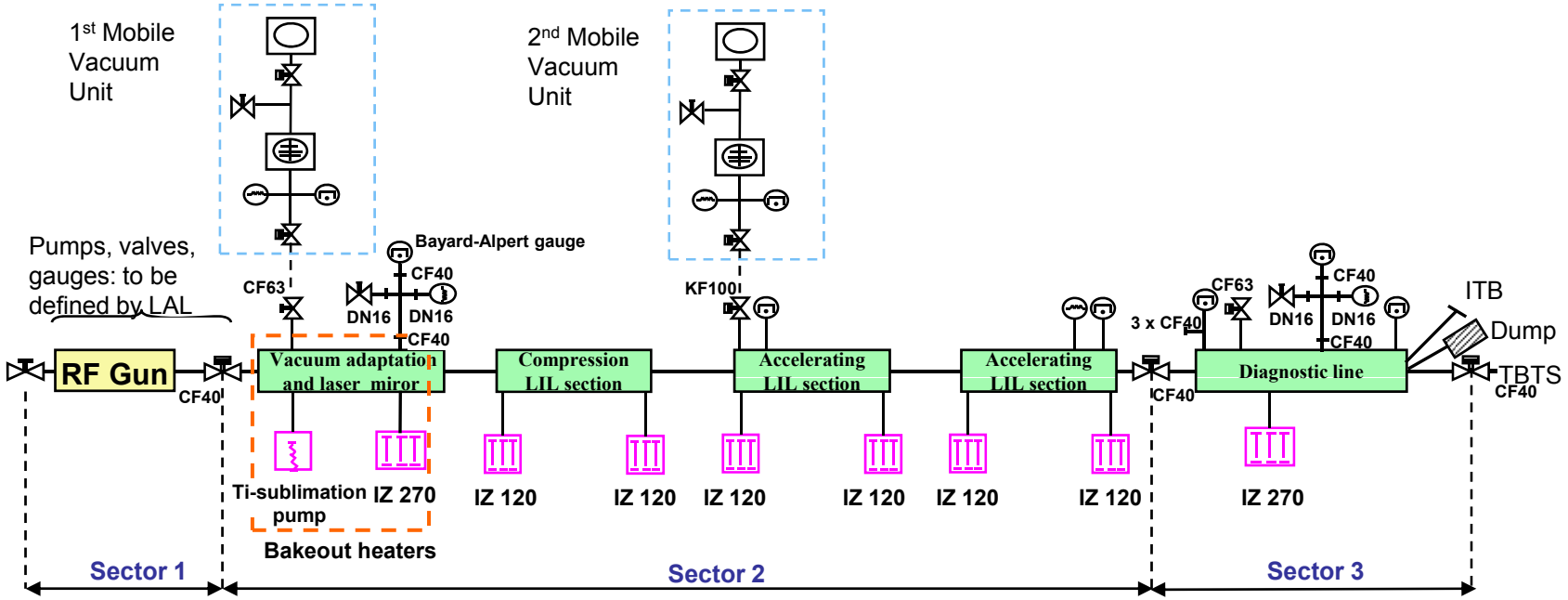
Modulation Transfer Function
measured on test bench



Alignment with
laser in CLEX

Status on CALIFES services Installation

- Vacuum : sectors 2 and 3 are ready → 2.10^{-8} mb (w/o using ionic pumps) → waiting for RF Gun to complete



- Hydraulics → OK
- Cables and connectors → in progress
- Power supplies for magnetic components → end in April 08 ?
- **control command (CEA and CERN) :** must drive and control the whole line CALIFES + including beam diagnostics → in progress .., we hope to finish in April 08

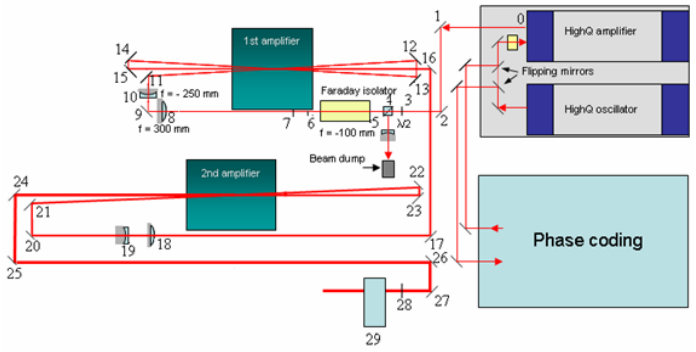
LASER system installation

Laser beam transportation under roof *(ground floor)*

- Pipes installed on ~80m
- completions foreseen end of Jan. 08

Installation on optical table In laser room *(1rst floor)*

- Measurements and beam optimization in progress end of 2007
- Specific Crystals IR→UV : order in progress
- Installation foreseen in Feb/March 2008

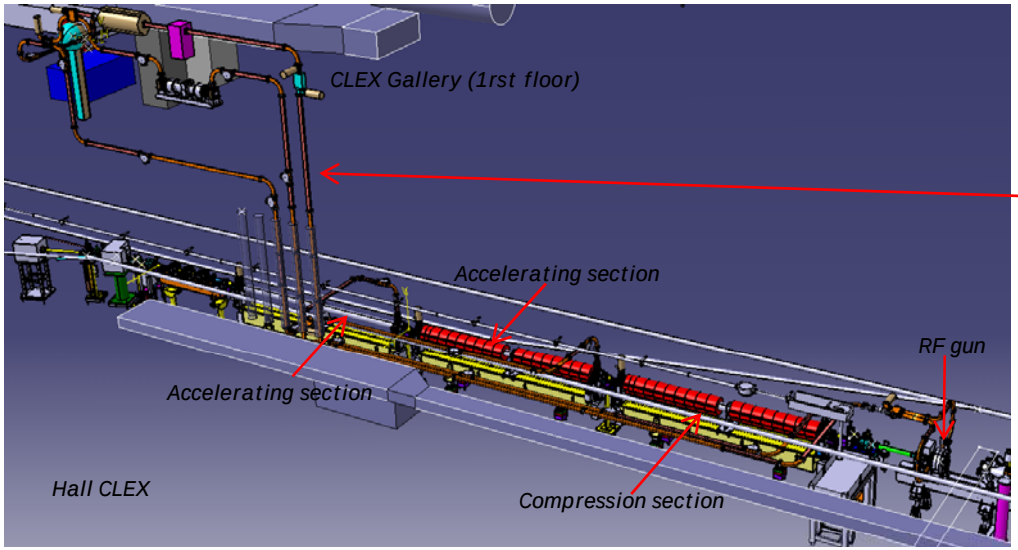


Laser layout for tests

Installation on optical table near Photo-injector *(ground floor)*

- all components are in Saclay
- Installation foreseen in February 2008

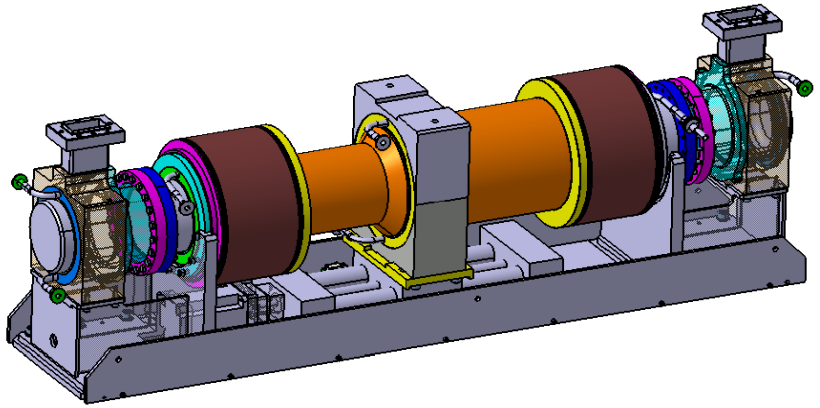
RF system installation / realization



RF Network:
problem of provisioning the bend wave guides

Modulator delivered and partially tested Dec. 2007
Quasi-nominal power is reached (38kV), but noise have to be eliminate

RF Power phase shifter
Problems during realization → delay of ~10 months



CALIFES installation Milestones

End of January 2008 : **CALIFES will be almost complete**
(except the RF gun, Laser system and RF system)

- Mechanical supports + Dump → July 07
- 3 LIL sections → October 07
- Dipole → October 07
- Deflecting Cavity → October 07
- BPMs (6) + steerers (5/6) → November 07 → see Claire's talk for BPMs

the last steerer will be installed on the RF gun support

- Quadrupoles → October 07
- Beam Charge Monitor → November 07
- VPMs (3) → December 07
- Start installation of RF System : Modulator → December 07 → see Franck's talk
- Start installation of Laser System : mechanical part → Dec 07 → see Guy's talk

- Final Alignment of the line → February 08
- RF Gun → February 08 → see Raphael's talk
- Laser System → April 08 ?
- RF System → June 08 ?
- **Start commissioning (w/o power phase shifter) → June/July 08?**
- **Start commissioning (with power phase shifter)→ October 08 ?**

Few ideas for commissioning

• Tests of services : vacuum, control command (tests of connections, launch distance command, etc …), tuning of VPMs optics, tuning of BPMs, etc …	2-3w?	Feb-March 08
• Bake out ?	1w	June 08?
• Power supplies tests	1w	June 08 (can start before)
• Laser System tests	2w	April-June 08
• HV and RF conditioning 1	2w	start in June 08 (w/o power phase shifter)
• HV and RF conditioning 2	2w	start in Oct 08 ? (with power phase shifter)

- **CALIFES start with beam** 3 months ?

  Phase 1 (w/o power phase shifter): start in June or July 08 ? 2 months ?

  - work on accelerating structures,
  - RF pulse compression,
  - diagnostics tuning

  → nominal beam parameters (increase current for nominal, increase pulse length to nominal)

  Phase 2 (with power phase shifter) : start in October 08 ? 1 month ?

  - optimization and complete characterization of nominal beam (play with the power phase shifter ?)
  - work on the different beam mode

Future of our collaboration after CALIFES
(2009 → ?)

Few ideas are currently in evaluation at CEA

1. CLIC : accelerating structures and CLIC Module
2. CTF3: exploitation of CALIFES, TBL equipment, additional klystron, ITB
3. Laser for PHIN: Participation to the commissioning
4. CLIC stand-alone X-band power test stand (12 GHz)

Current engagement of CEA

• CLIC Drive Beam klystron L-Band (1.5 GHz)
→ 2 actions engaged (1 PhD, 1 postdoc FP7 Marie Curie, in collaboration with Thales-TED)

CEA Saclay - CALIFES Team (2005-2008)

G. Adroit, M. Authier, D. Bogard, G. Bourdelle, G. Cheymol, P. Contrepois, A. Curtoni, G. Dispau, M. Dorlot, R. Duperrier, W. Farabolini, D. Farcage, M. Fontaine, M. Gilbert, P. Girardot, F. Gobin, R. Granelli, F. Harrault, J.L. Jannin, C. Lahonde, T. Lerch, P.A. Leroy, M. Luong, A. Mosnier, F. Orsini, F. Peauger, C. Simon

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D. Allard, N. Chritin, S. Curt, G. Rossat, E. Rugo, G. Yvon, etc ...