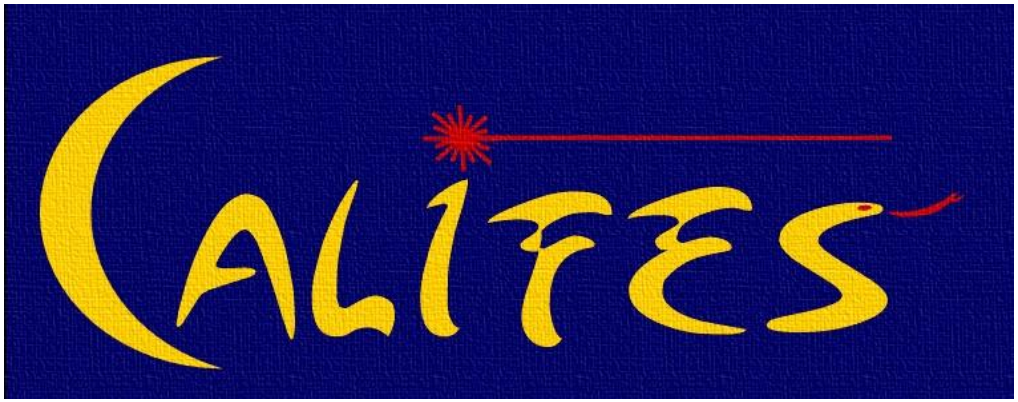
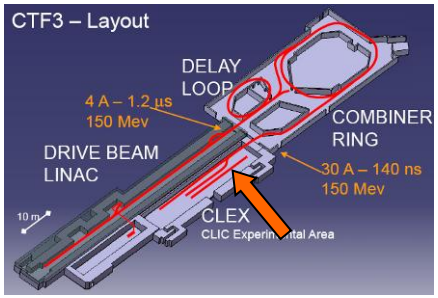
Status and progress of the CTF3 probe beam



CALIFES layout



CALIFES performances

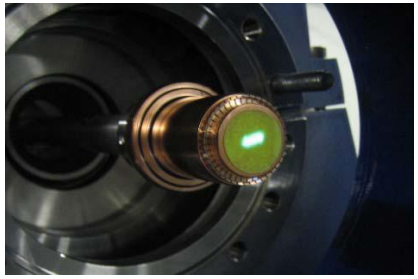
	CALIFES specifications	Obtained
Bunch charge	0.6 nC	0.25 nC
Energy	~ 170 MeV	<144 MeV
Energy dispersion	± 2%	2%
Emittance	<20 π mm.mrad	21.3 π mm.mrad
Bunch train	1 – 32 – 226	any number from 1 to 226
Bunch spacing	0.667 ns	0.667 ns
Bunch length	0.75 ps	1.42 ps
repetition rate	5 Hz	5 Hz

Beam transport : nearly 100%
Beam stability: to be quantified and improved

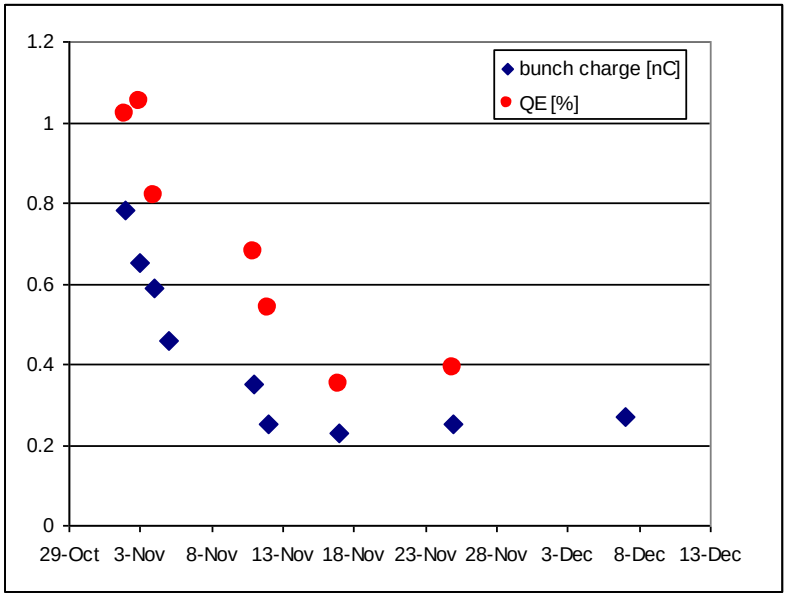
Bunch charge

- Requested bunch charge 0.6 nC for short train, but only 0.08 nC for long train.
- Photo-cathode regenerated end October 2010
- QE decays rapidly from 1% down to 0.35 % (nominal 0.3%), then stable (requested lifetime 200 h)
- Laser power decays during the day (thermal effect ?)

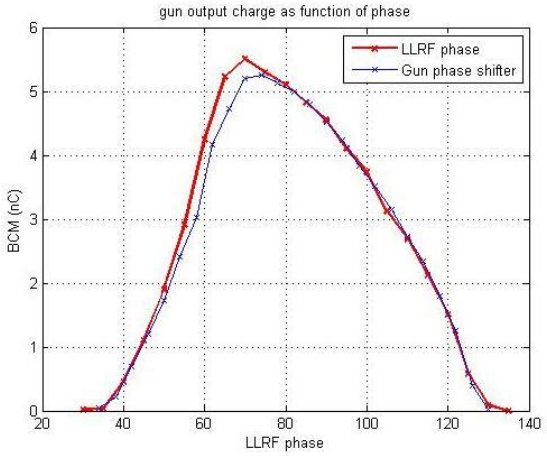
➡ improve laser power, transport and stability (dedicated laser for CALIFES ?)
[see next talk: CTF3 Laser, M. Petrarca]



Laser beam on the photocathode



Bunch charge and QE evolution with time

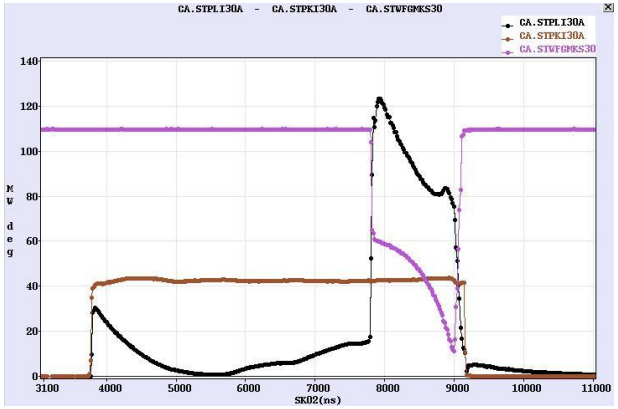


Charge vs. gun phase

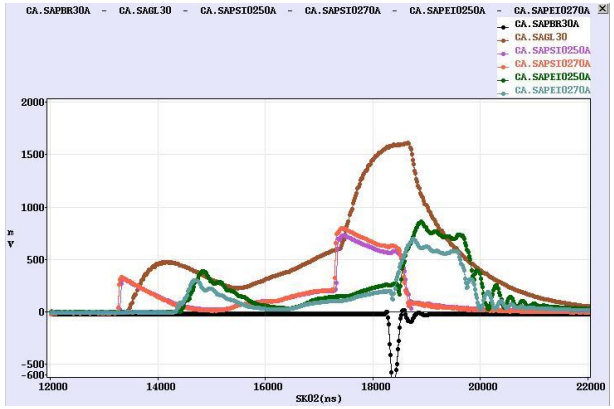
Energy

- Requested energy ~ 177 MeV, maximum reached 144 MeV
  - various RF compression laws tried (up to 123 MW peak)
  - bunch timing optimized for energy
  - LIL structures temperature checked
  - Power at structures input/output measured (but diodes calibration to be resumed)
  - RF phase between structure checked

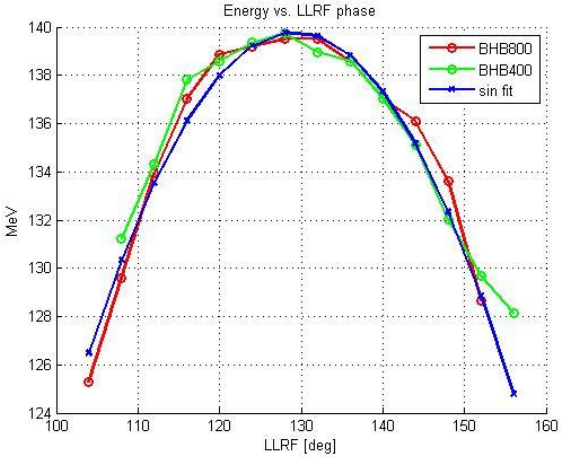
➡ use the recently installed RF power phase shifter to place the change the phase of the 1st structure (more acceleration, less bunch compression)



RF klystron and BOC pulses, compression law



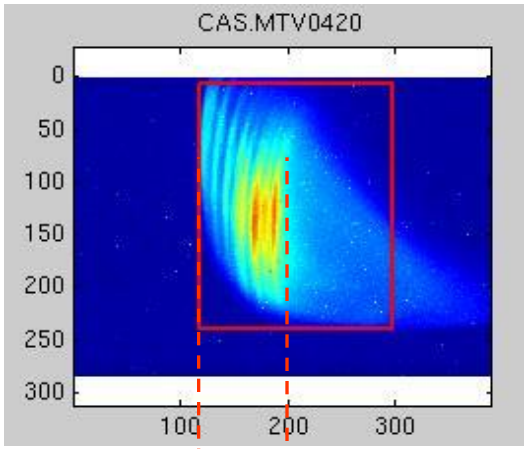
Gun loop, structures in/out and BPM signals



Energy vs. LLRF phase measured with both spectrometer lines

Energy spread

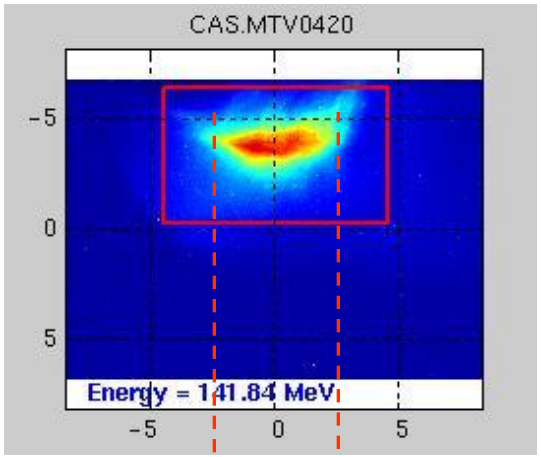
- Requested max. energy spread ± 2%, obtained 2.1 %



120.6 MeV

ΔE/E = 1.5 %

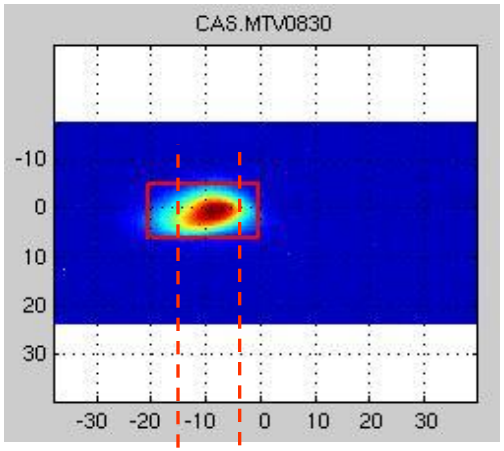
118.8 MeV



143.4 MeV

ΔE/E = 2.1 %

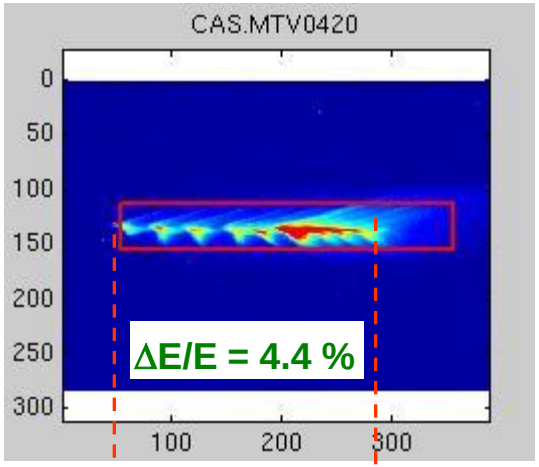
140.4 MeV



139.9 MeV

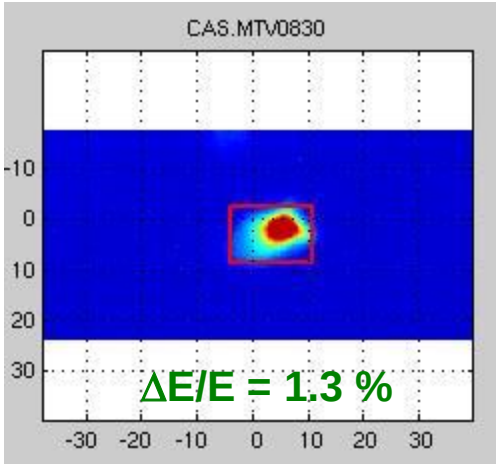
ΔE/E = 2.7 %

136.2 MeV



133 MeV

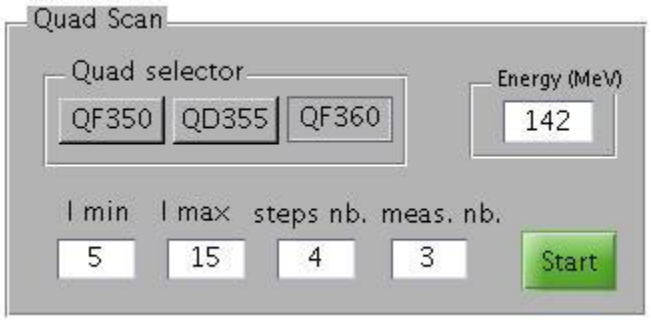
127.3 MeV



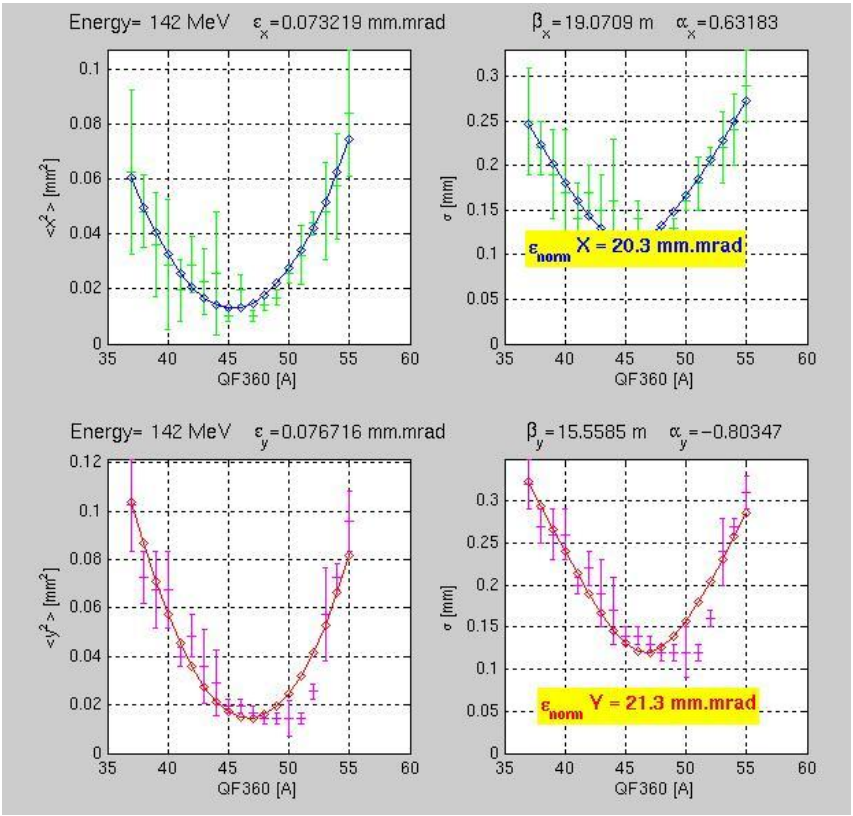
Emittance

- Requested emittance ~ < 20 mm.mrad, obtained ~ 21.3 mm.mrad
  - Emittance has been a concern for a long time
  - solved with the use of the OTR screen, the accurate tuning of the gun solenoids and an automatic scanning method.

➡ replace Ceramic screen by a thinner YAG one and metalize the OTR screen for a better yield.



Quad scan control



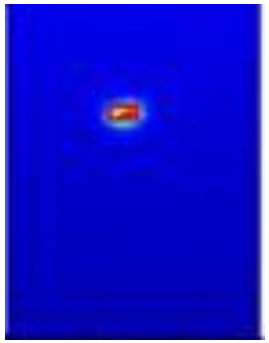
Quad scan results

Bunch length

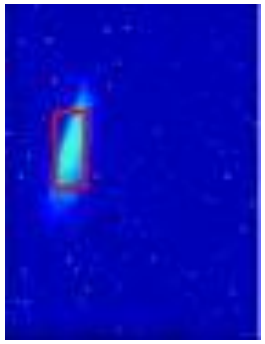
- Requested bunch length 0.75 ps, obtained 1.42 ps (without phase shifter)
- Calibration 0.94 mm of vertical deflection per degree on MTV0390
- Vert. beam size due to the deflecting cavity: 1.45mm bunch length 1.42 ps at 1σ

➡ recently installed power phase shifter will allow tuning the bunching structure

Deflecting Cavity



Cavity OFF
σy = 0.24 mm



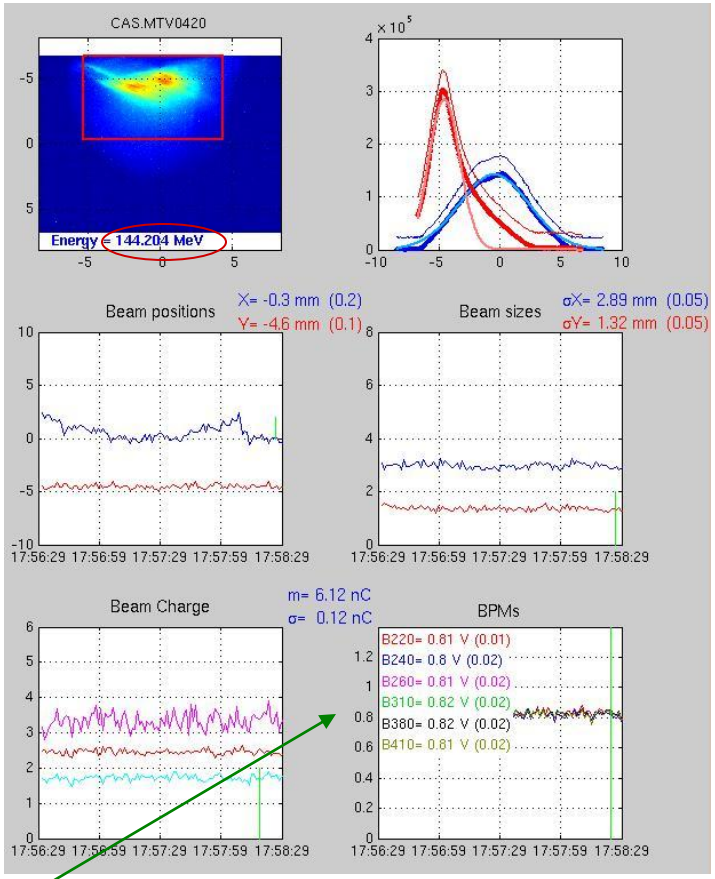
Cavity ON
σy = 1.47 mm

RF power phase shifter in the CLEX gallery

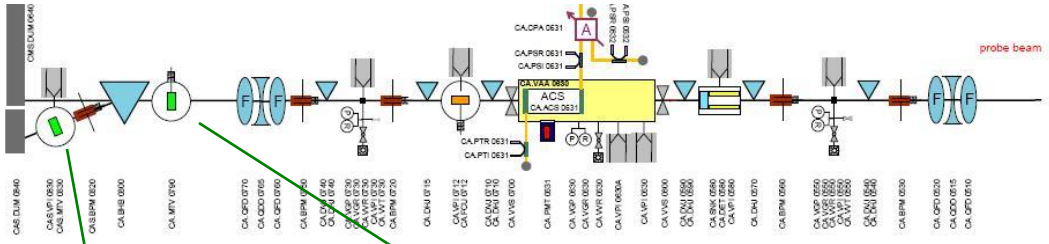
Beam transport

- Practically 100% up to the CALIFES dump
- Beam easily sent through the TBTS line (without ACS structure)

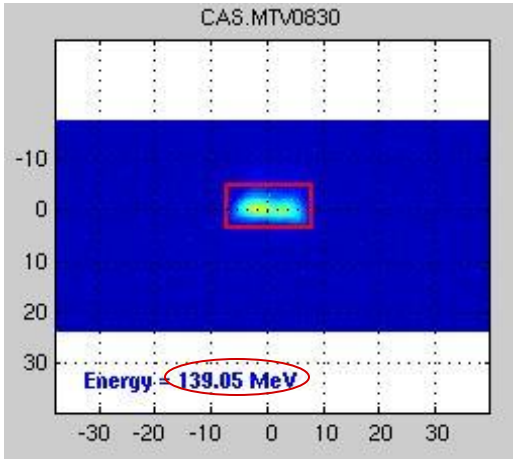
➡ solve the discrepancy between spectrometers results by replacing steel chamber supports



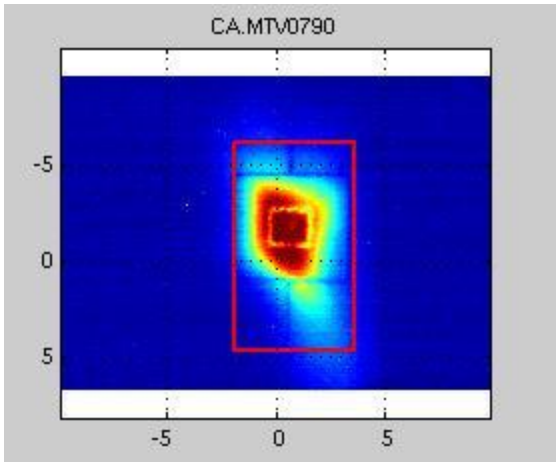
Sum signals of the 6 CALIFES BPMs



TBTS line



Beam on TBTS spectrometer screen

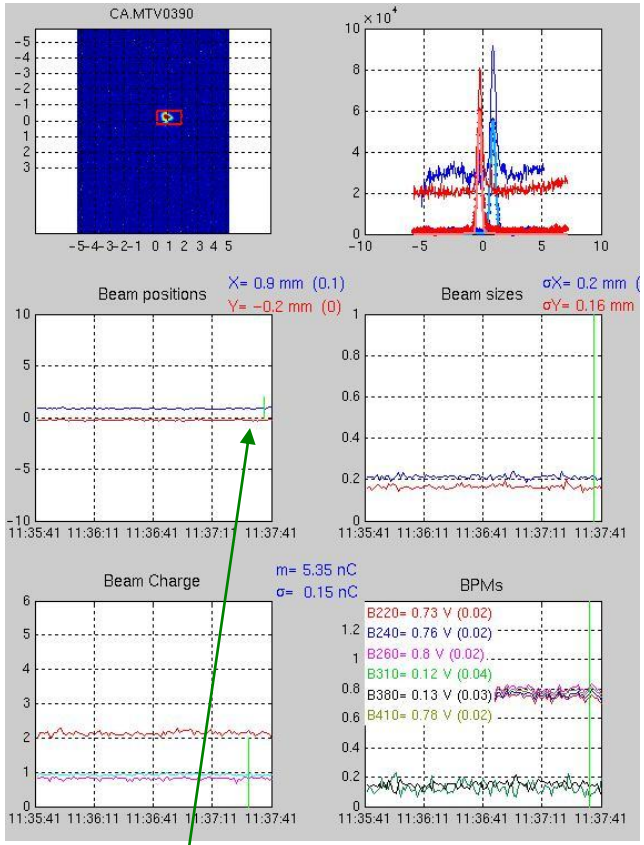


Beam on MTV790

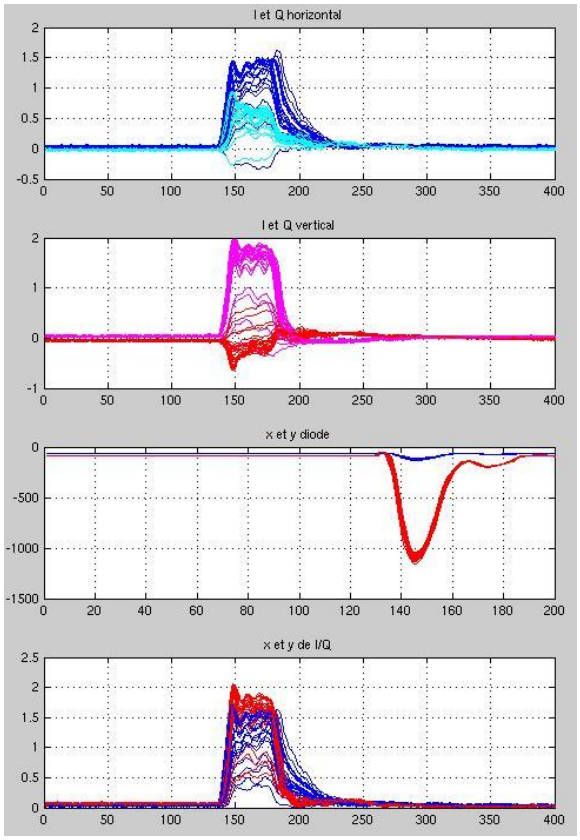
Beam stability

- Beam seems very stable in position on MTV screens
- But when measured with BPMs (resolution 5 μm) it appears largely fluctuating

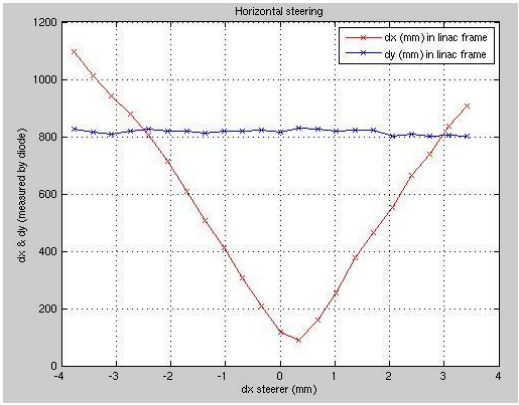
➡ make the BPMs fully operational (phase noise in the reference signal) and stabilize the beam (modulator HV ripple, laser position on the photocathode…)



Beam on MTV390



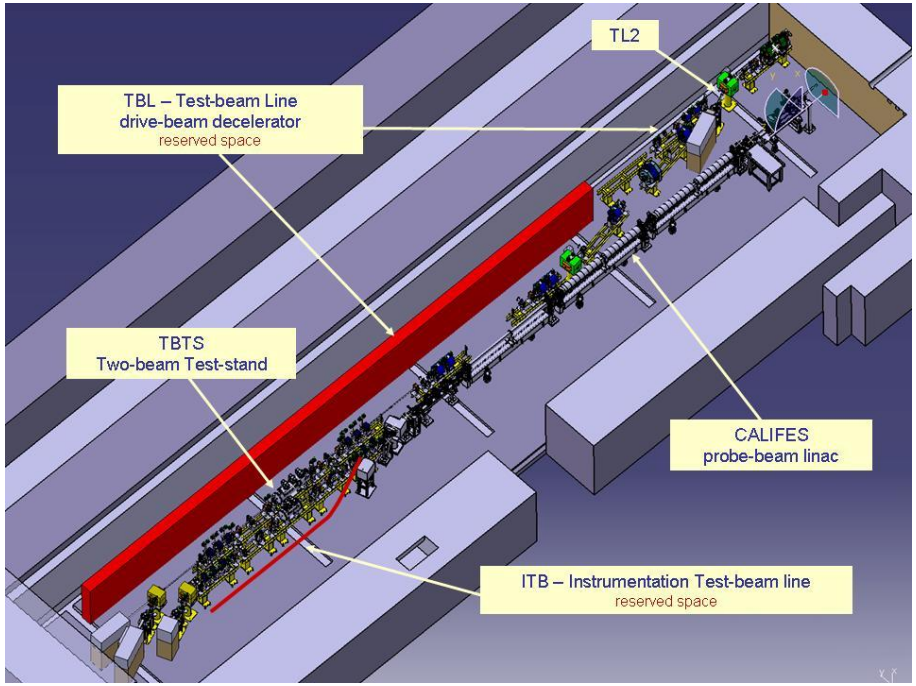
BPM difference signals I/Q demodulated and diode demodulated



Position scan with corrector DH0320 on BPM0390

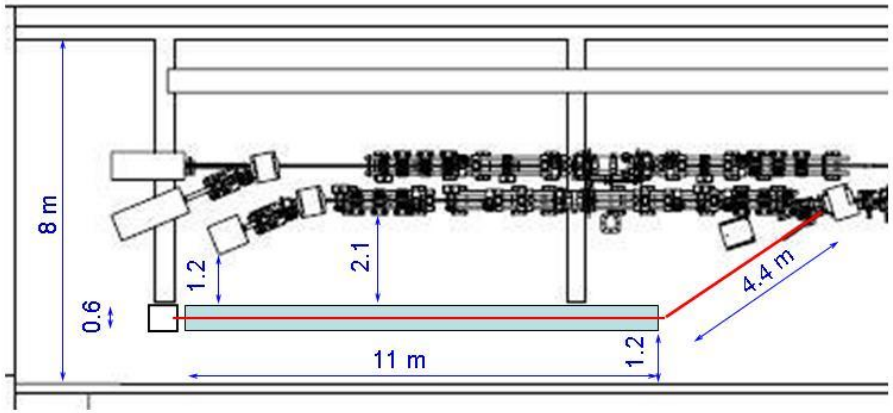
Another use of CALIFES beam: the ITB project

- Several institutes have shown interest for testing diagnostics with the CALIFES beam (RHUL, Uppsala University, LLR) and/or are ready to participate to the development of the ITB (CEA Saclay, Uppsala U.)
- The reservation for the ITB was foreseen from the initial CLEX construction sketch.
- But now this place is used for TBTS tank installation, then for complete module installation.



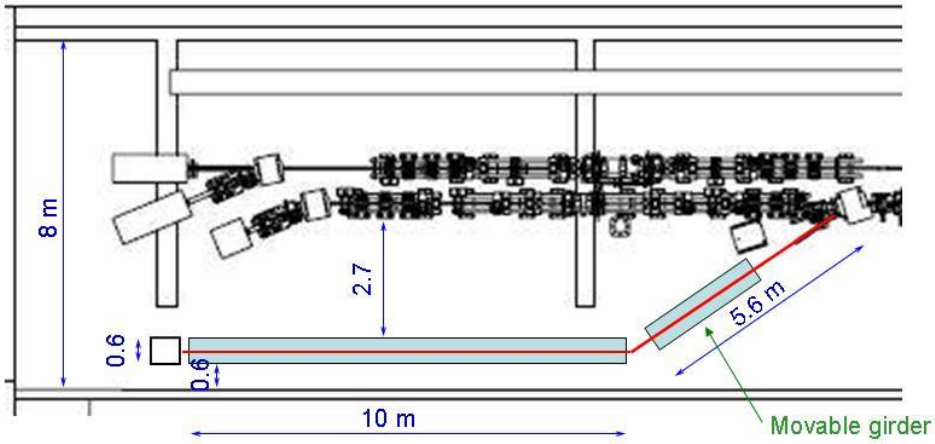
ITB line alternatives

1



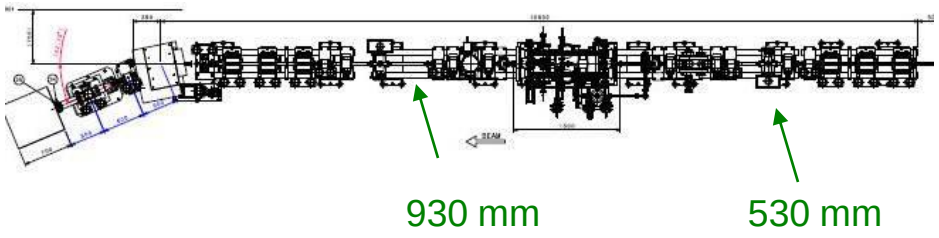
- The clearance for ACS tank trolley (1.2m) is marginally respected.
- But the complete module will request even larger space to be installed

2



- The clearance for the complete module is foreseen
- But a movable girder is to be used

3



- No new line but use of available space in the actual TBTS
- Cheap, immediately available and less intrusive solution
- But limited space and no chicane for R_{56}

Conclusions

- CALIFES is operational for injecting beam in the 12 GHz accelerating structure

- Its performances remain to be consolidated but we are reasonably confident to be able to fulfill the requirements
  - the newly installed power phase shifter will help
  - more operation time is necessary (up to now CALIFES has been working only 63 days with beam)
  - CEA team is engaged for long term in the CTF3 projects

- Using the beam for testing instrumentation will valorize the project and federate energy to push further the performances.
  - Manifestation of interest and offers to help are welcomed

Thank you for your attention and your support