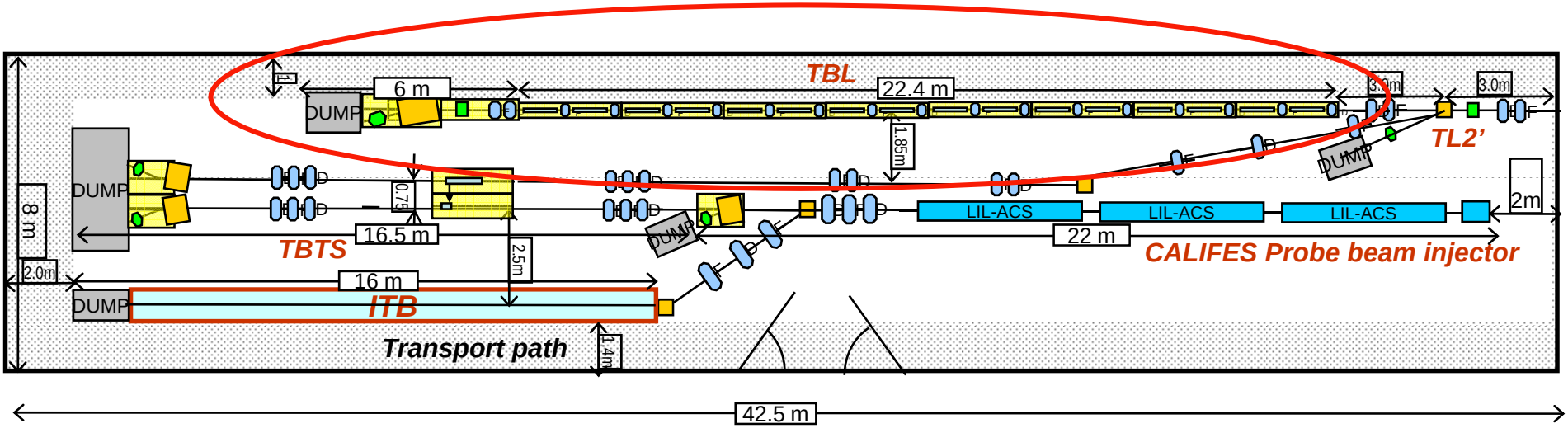
The CTF3 Test Beam Line (TBL)

General and Planning



Goals and Requirements

- 'Realistic' show case of a CLIC decelerator
- High energy spread beam transport, low losses
  (Bench mark simulations)
- RF Power Production, Stability
  (End Energy <50%, 2.4 GW of RF power)
- Alignment (Test procedures for BBA)
  100 microns alignment for PETS, test of CLIC alignment equipment)
- Drive Beam Stability, Wake fields
  (no direct measurement of the wake fields)
- Industrialization of complicated RF components

TBL-cell

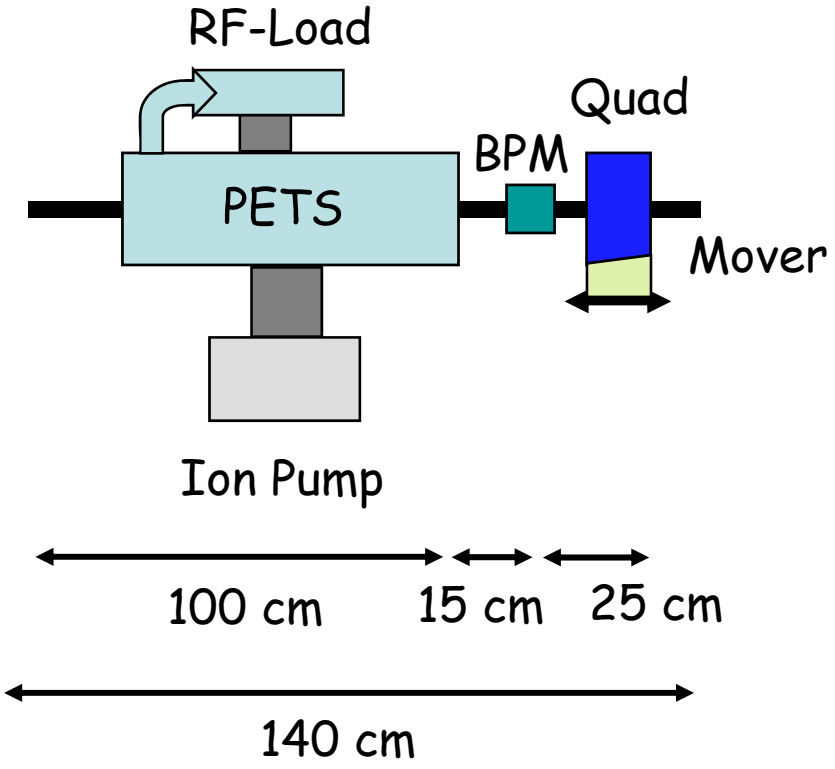
TBL cell length 140 cm

PETS: active length max 80 cm

16 cells planned = 22.4 m

23 mm aperture in PETS

24 mm max in Quads/BPM's



FODO lattice:

β-max = 4.72 m

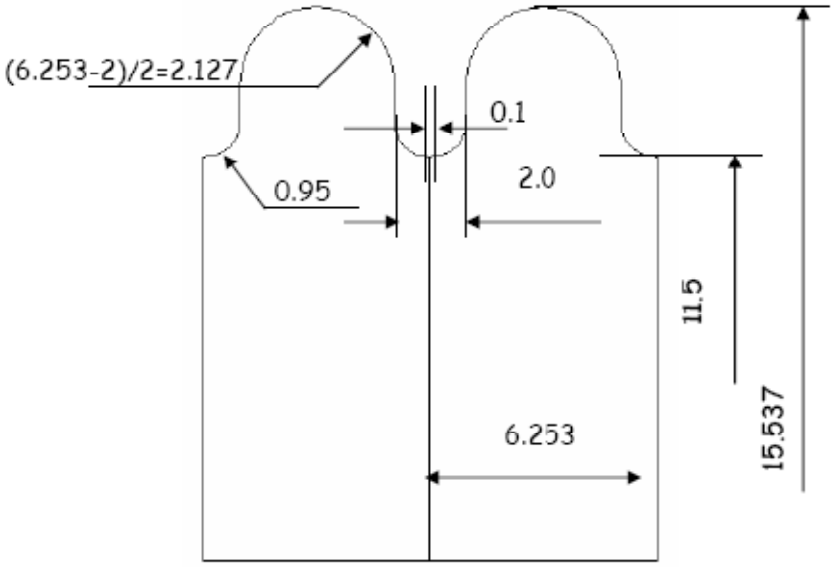
β-min= 0.83 m

μ-cell = 90 deg

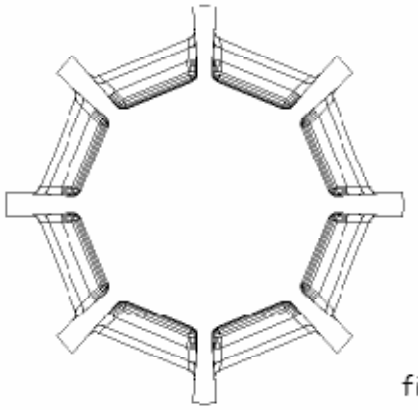
PETS design

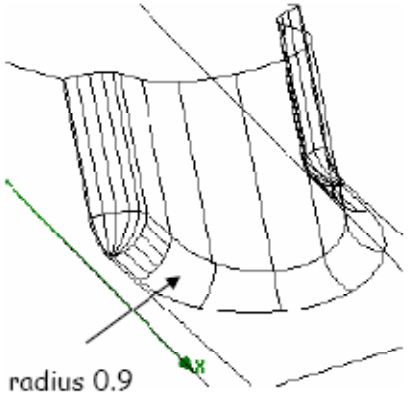
Regular cell

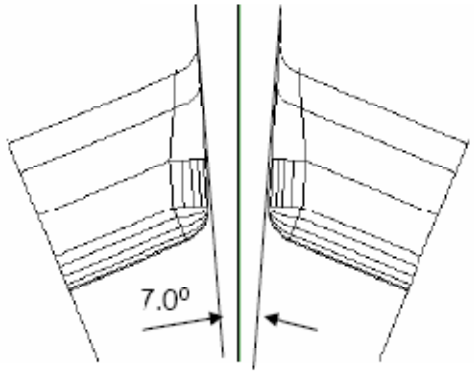
PETS parameters:
- Frequency = 11.9942 GHz
- Aperture = 23 mm
- Period = 6.253 mm (90°/cell)
- Iris thickness = 2 mm
- R/Q = 2258 Ω
- V group= 0.453
- Q = 7210
- E surf. (174 MW)= 64 MV/m
- H surf. (174 MW) = 0.1 MA/m
  (ΔT max (140 ns, Cu) = 2.0 C°)



X-band PETS cross-section



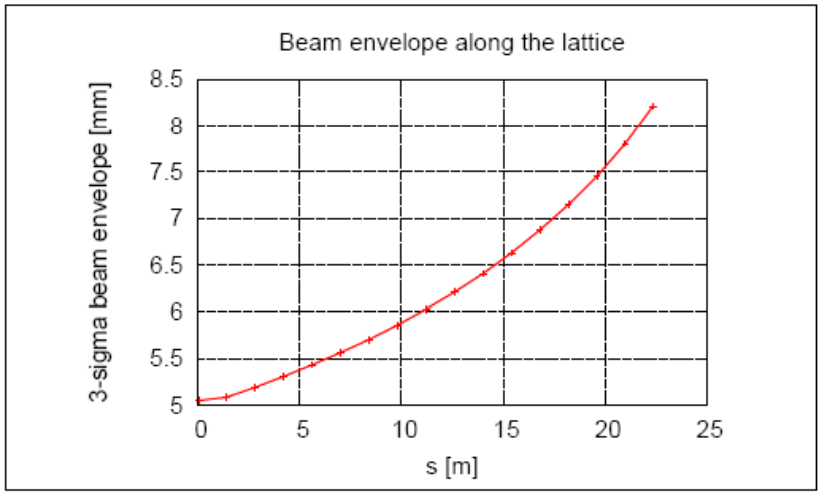




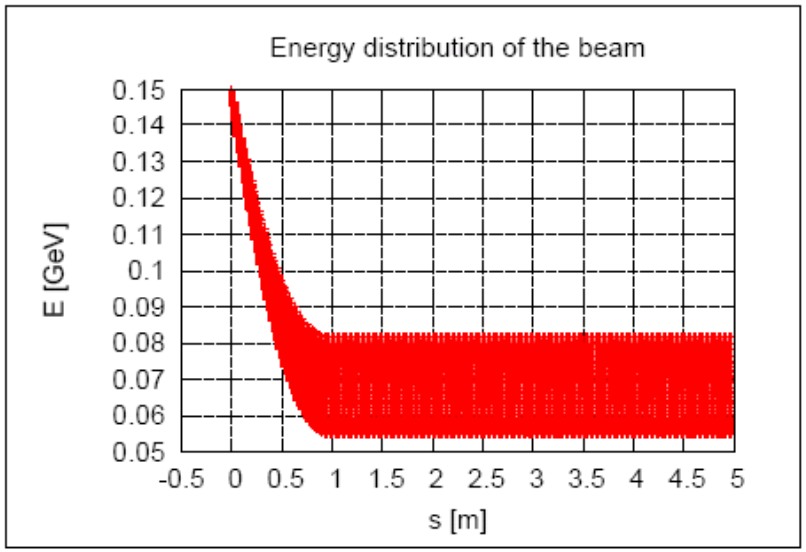
HFSS project:

12_GHz_cell hfss

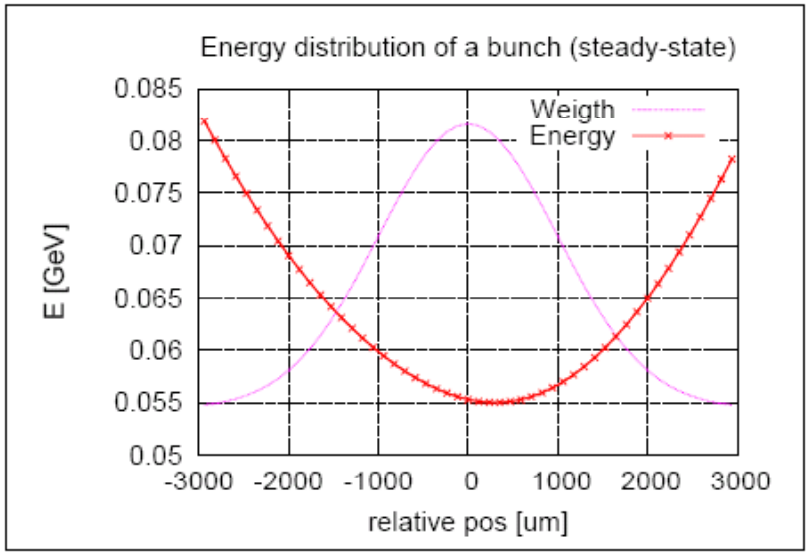
TBL beam dynamics



3-σ beam envelope along lattice (adiabatic effects alone)



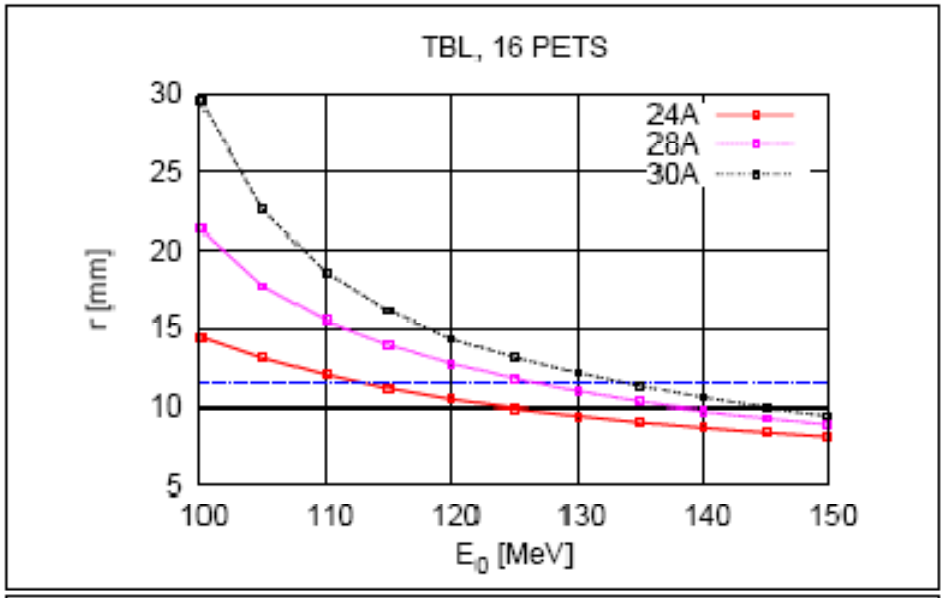
Beam energy after lattice



Steady state bunch energy profile

1m ~ 3 ns

TBL beam dynamics



TBL beam envelope for different current and energies

Nominal PETS Q = Q_0

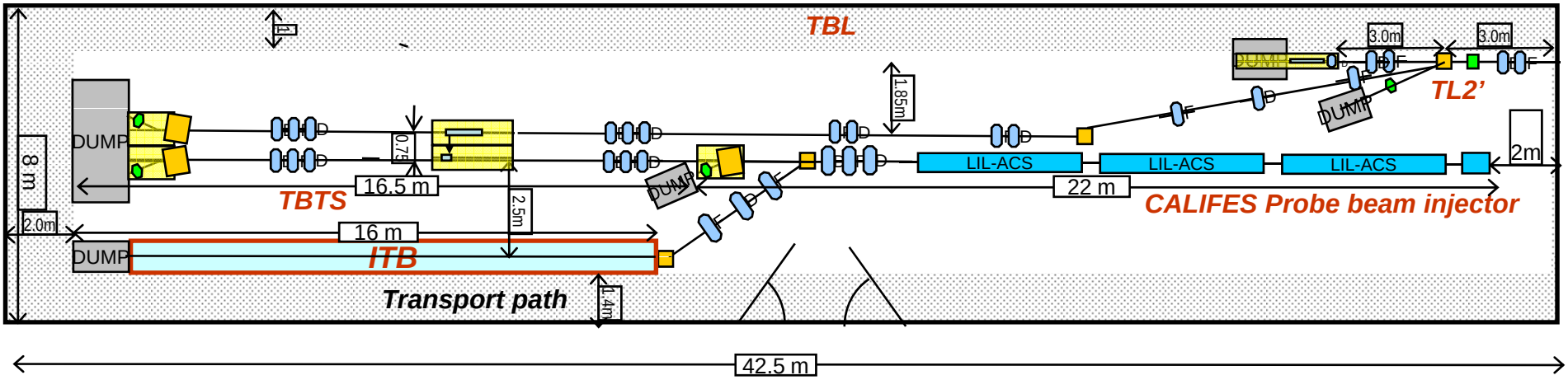
Beam jitter 0.5σ ~ 1 mm

Misalignment: σ_{PETS} = 200 μm; σ_{quad} = 20 μm

Results for 90/100 machines simulated

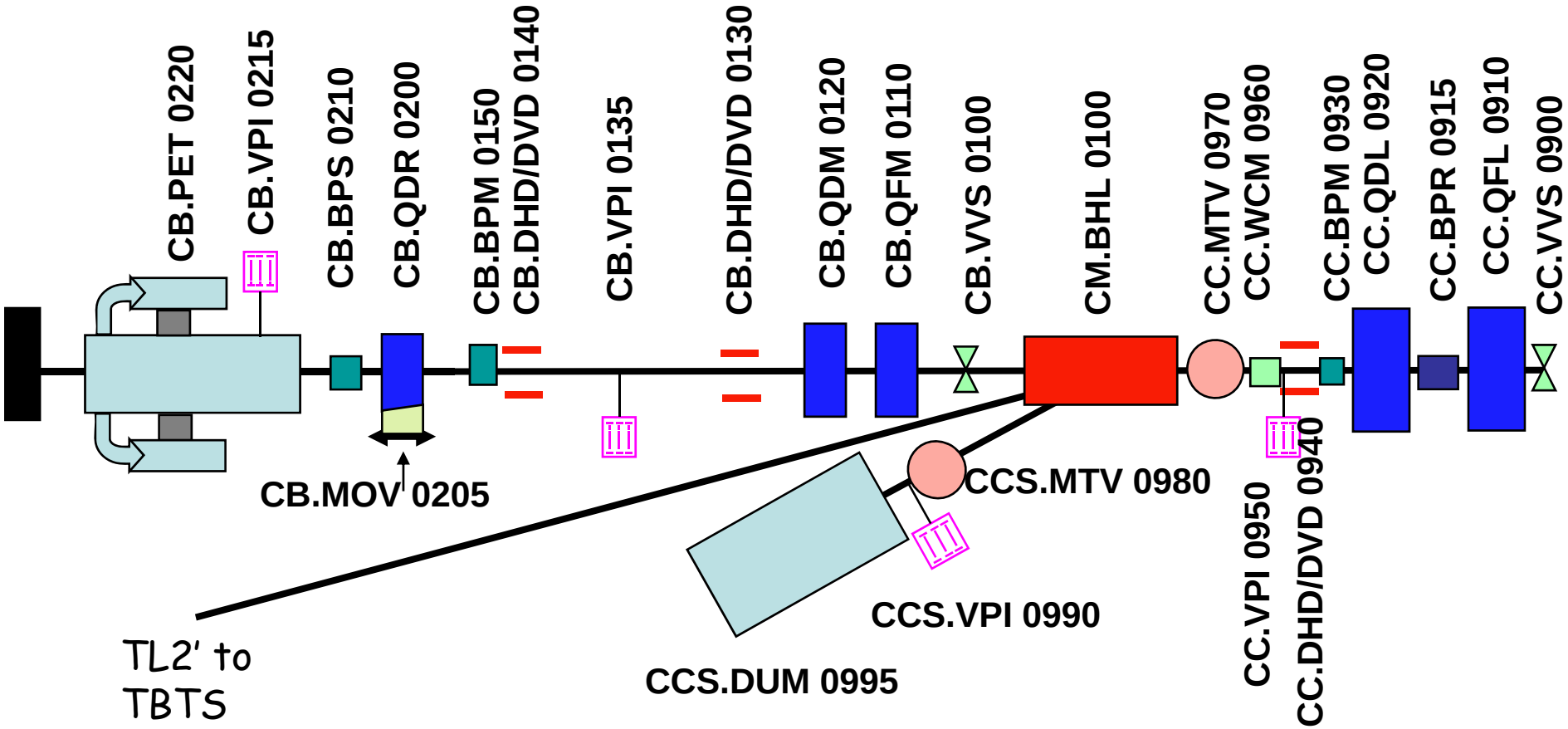
Plans for shutdown 2007/2008

o Only one module to test the prototype elements

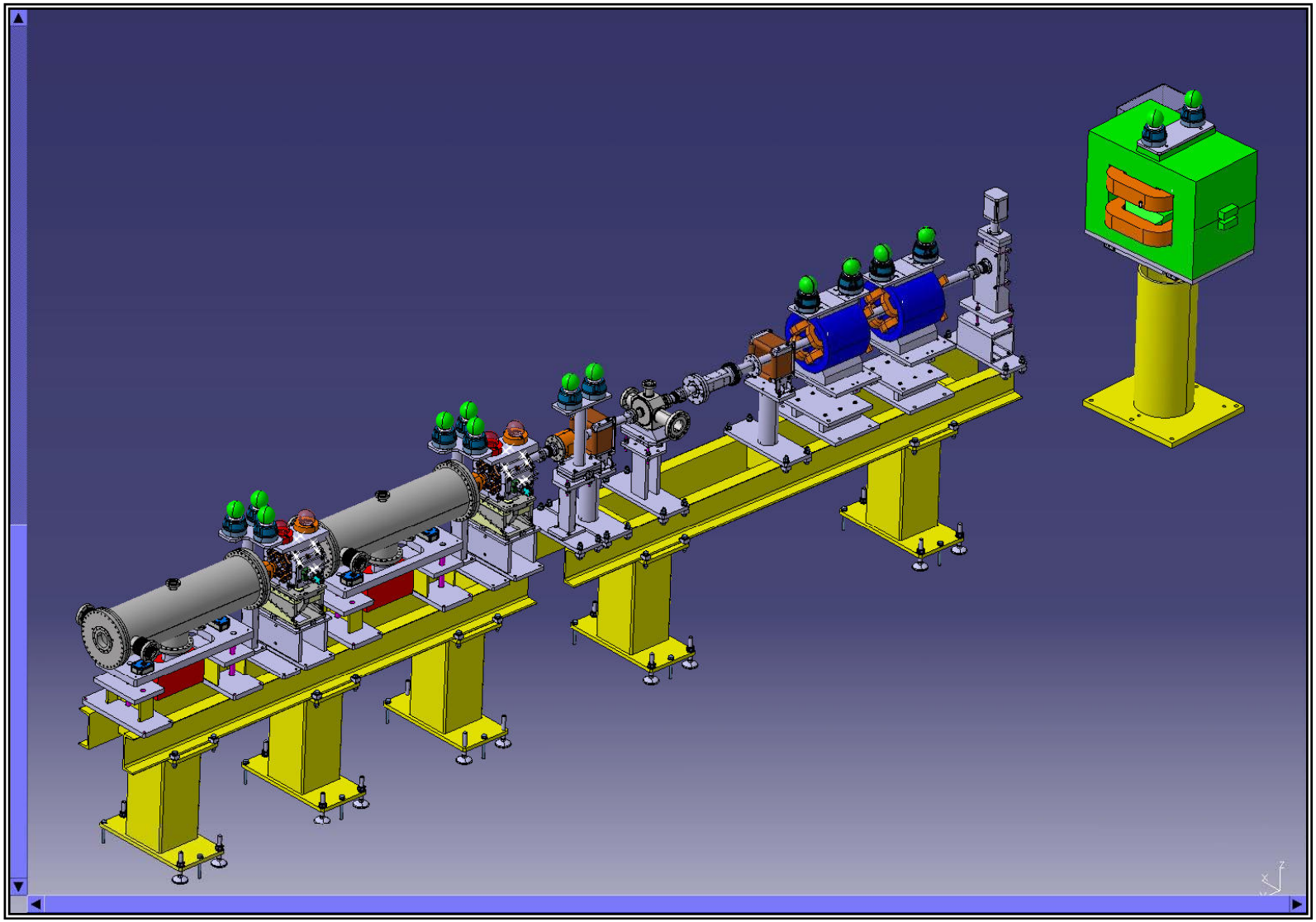


TL2 and TBL in CLEX 2008

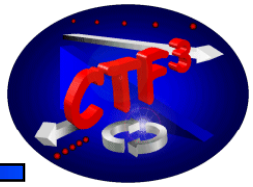
TBL Prototype Module



Module integration



Status of the prototype components

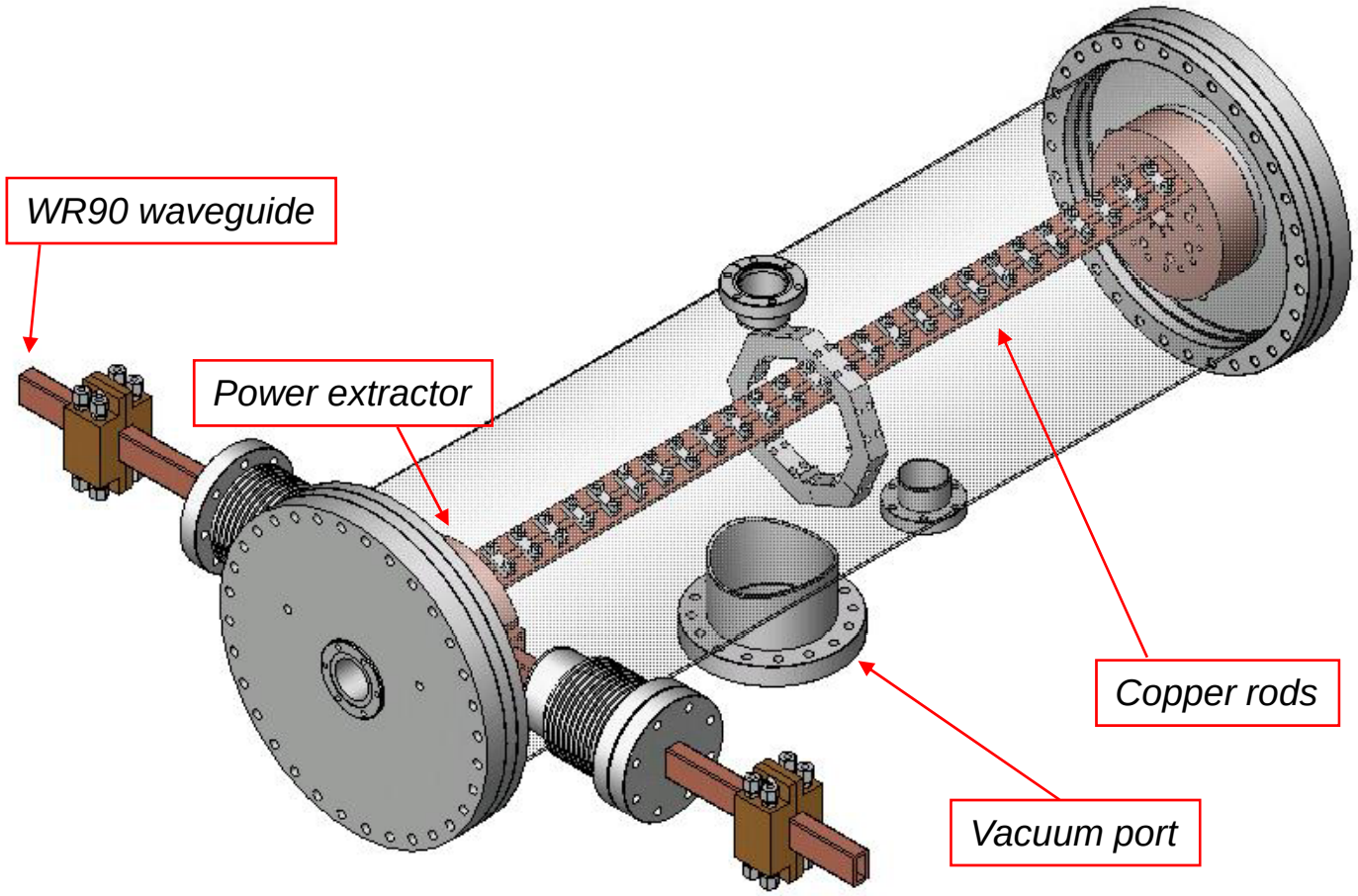


- PETS (CIEMAT): rf design finished,
  PETS manufacturing and tank design progressing
- BPM's (Valencia and Barcelona):
  one analog unit finished and tested at CERN,
  2 BPM prototypes under assembly
- Quads (CERN): New design by Th. Zickler finished,
  prototype in April
- Quad-Movers (CIEMAT): prototype under test at CERN
- High power rf (CERN): directional couplers,
  loads and waveguide components ordered
- Low Level rf (CERN): being manufactured
- TL2' diagnostics (CERN): Currently installed
- End of line diagnostics (CERN): currently studied

PETS tank (CIEMAT)

PETS tank, under mechanical design,

PETS test pieces successfully produced, full length bar ordered

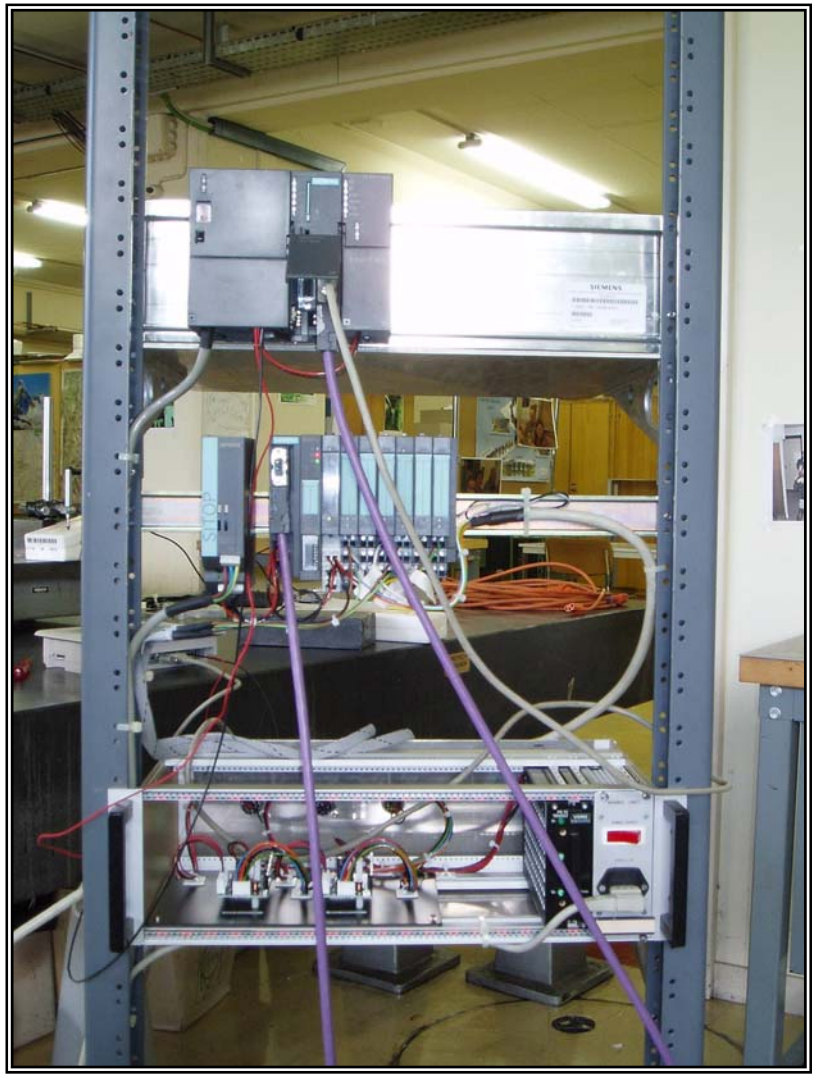


Quad movers (CIEMAT)

Quad moving table, Prototype finished'

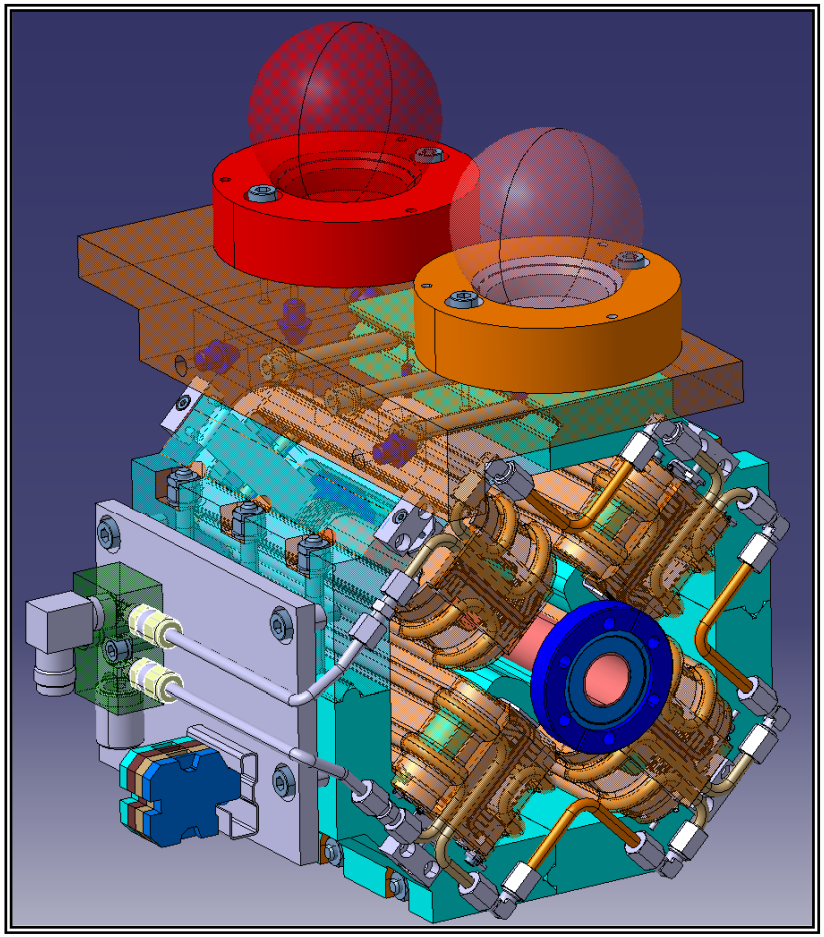
Currently under test at CERN

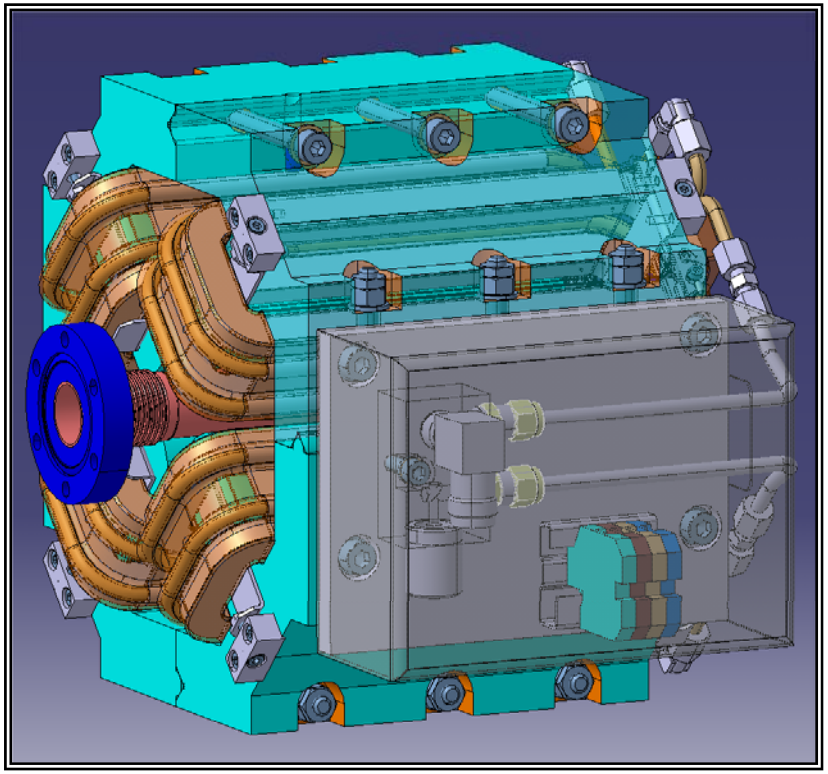
< 5 μm reproducibility confirmed
horizontal excellent: rel. in one sense 2 μm
back lash ~ 5 μm



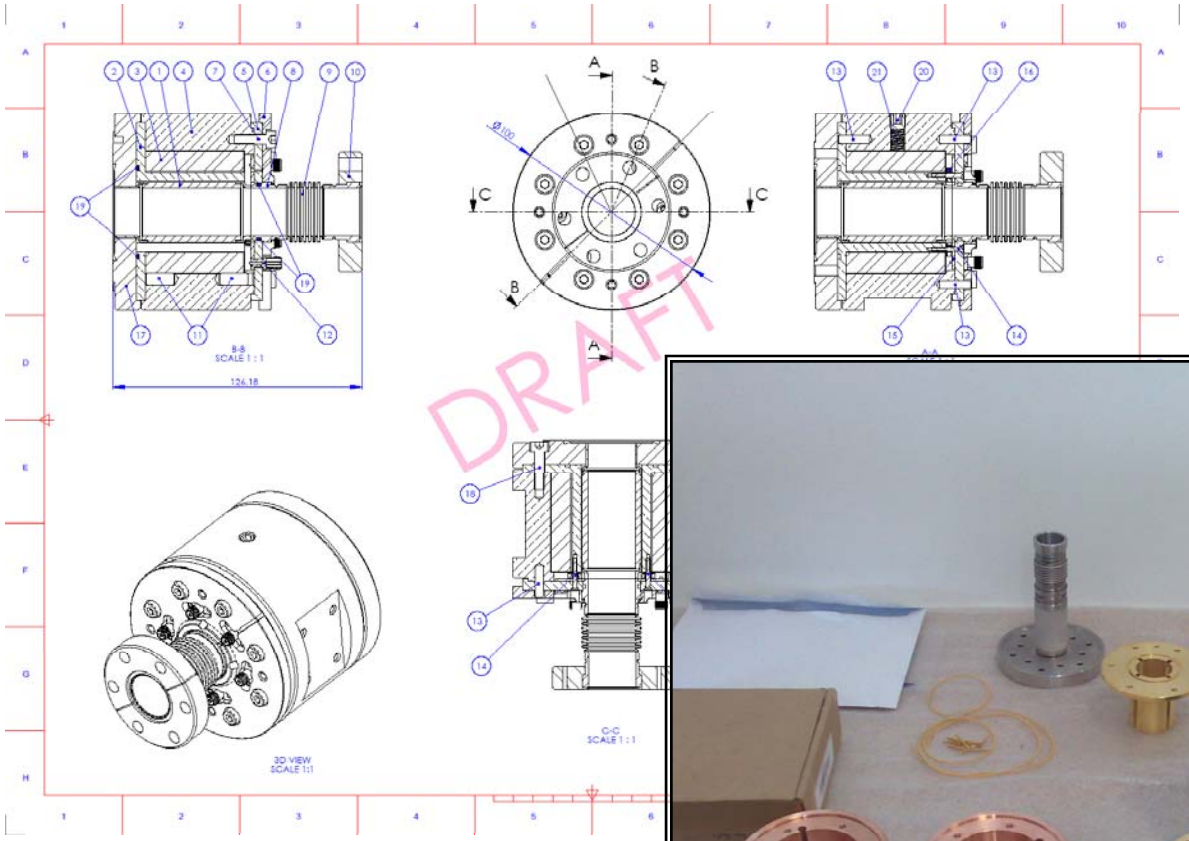
Quad

New Quad type-R, wire machining, manifold cooling,
multiple coils per pole





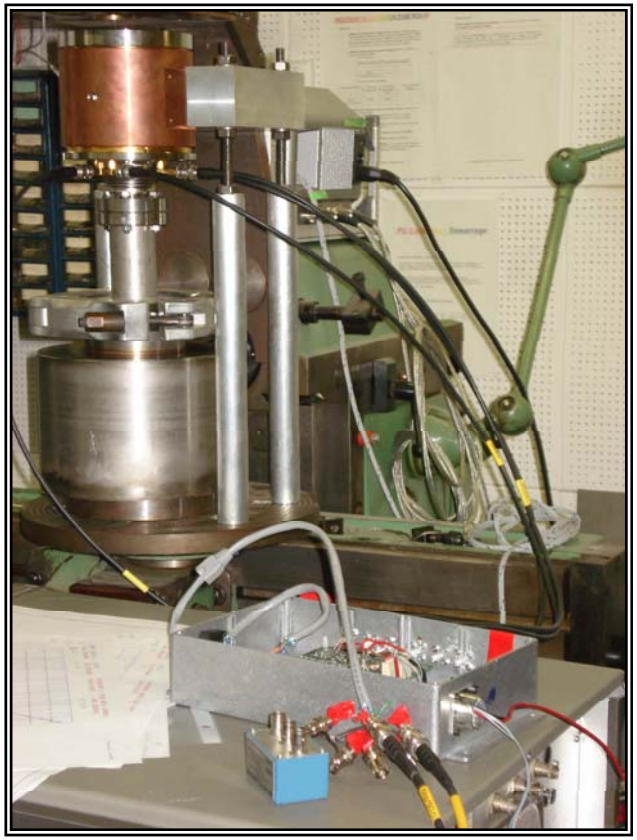
BPM (Valencia)

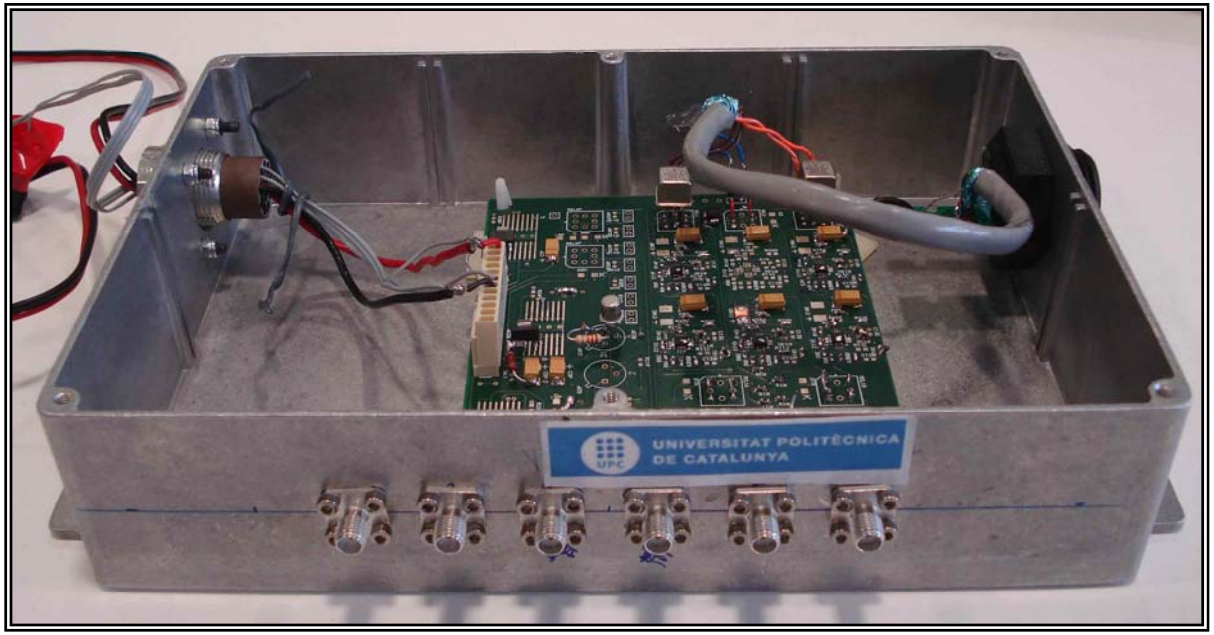


Two prototypes currently assembled in Valencia

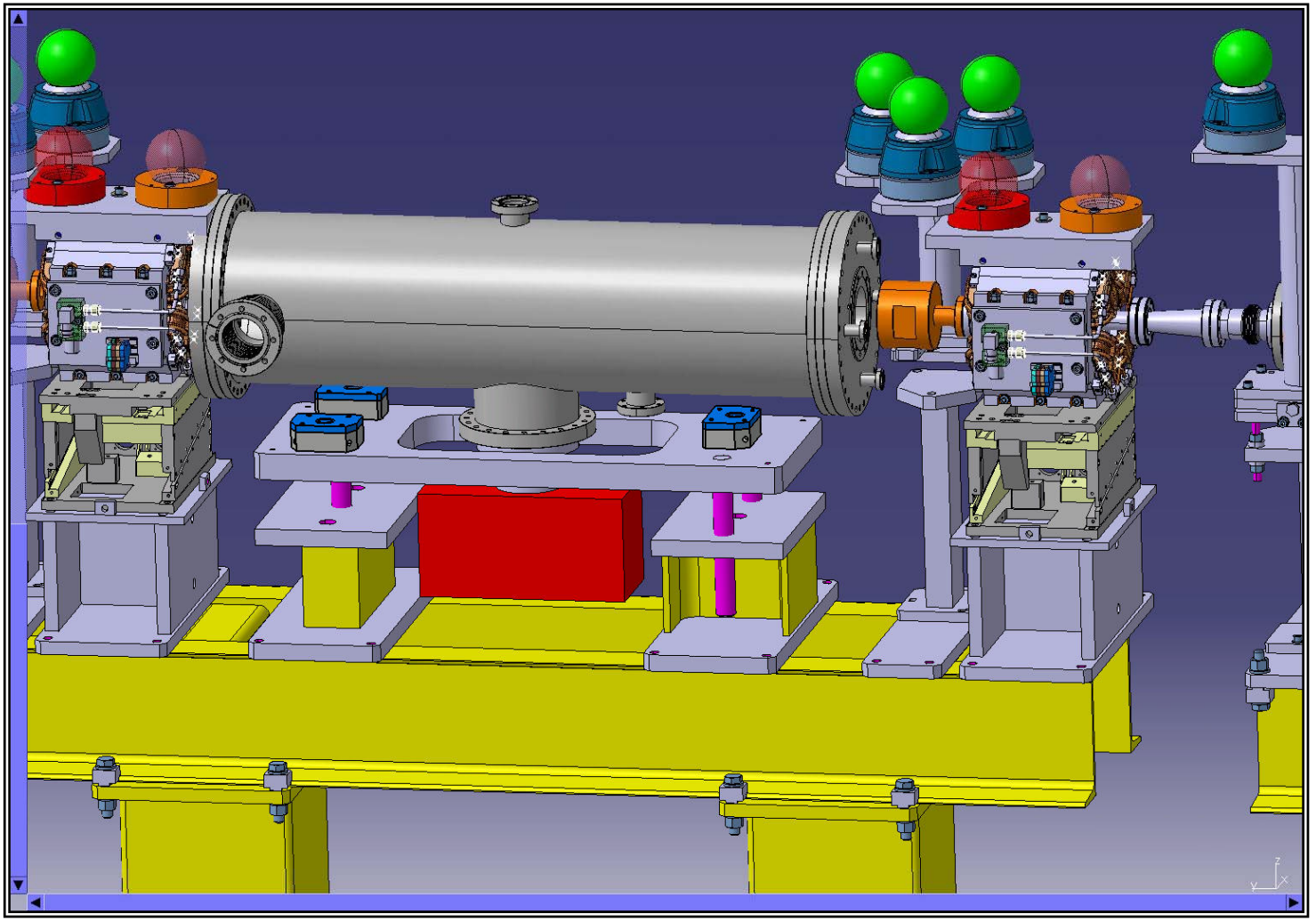
BPM-analog electronics (Barcelona)

Prototype tested successfully at CERN in December,
final fine tuning under way before installation





Module integration



Installation

Started, first girder mounted in CLEX

Currently planned to be finished in March 2008

What do we want to demonstrate

- Power production: Energy balance, rf-pulse stability
- Efficiency: Low loss beam transport
- Stability: Emittance growth ?
- Bench mark simulations: Energy spread, phase space, beam parameters
- Alignment, initial and beam based, test procedures
- Test of PETS technology
- HOM damping of PETS

Tentative TBL-Schedule

	2008												2009
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dez	Jan
Task													
Diagnostic Beam line installation													
Module Design													
Construction of prototype PETS tank													
Prototype module installation													
Ptrotype module testing													
Series production													
Installation of more modules													
Commissioning													
Complete installation													
Commissioning													

											2010						
Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dez	Jan	Feb	Mar	Apr	May	Jun	Jul

Conclusions

- Need to test prototypes first, before further decisions can be made
- Have to rely on PETS design
- If the prototypes are successful we can start the series (collaborators and budget ?)
- Schedule is probably not realistic
- Need to incorporate temporary diagnostics before the end of the line
- Ongoing work on what we can learn from TBL for CLIC
- TBL is not CLIC !
- Need to work on the future of TBL and CTF3 now ?

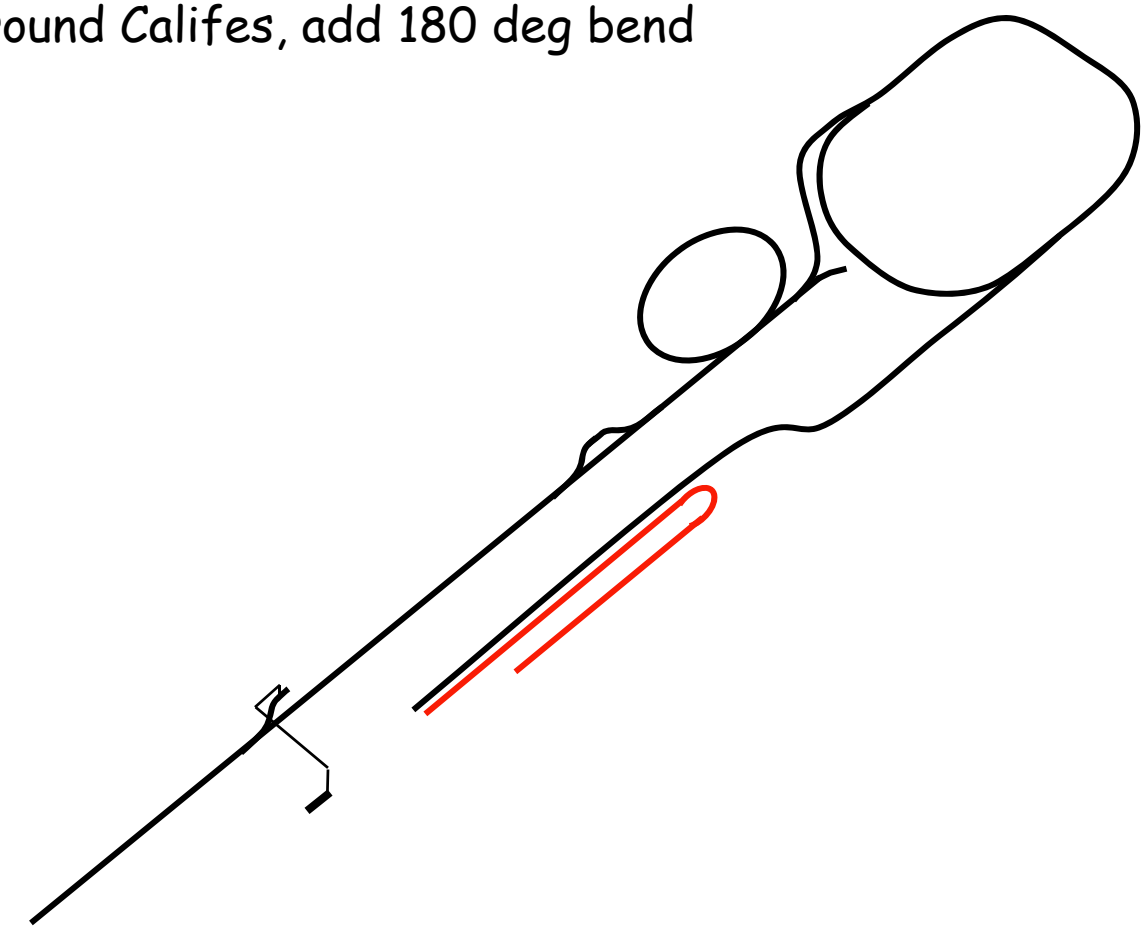
TBL long term idea's

- ACE recommended upgrading TBL to an 800 MeV two beam test accelerator (16*2=32 acc structures with a total length of 8 m = 800 MeV)
- Upgrade probe beam for full beam loading and pulse length
- Upgrade CTF3 to full CLIC pulse length, better emittance and higher energy
- Wakefield kick measurement option ?
  (photo injector with two bunches adjustable in distance
  in either probe or drive beam)
- More CLIC-like modules
- Alignment test facility
- Resistive wall and Fast Beam-Ion Instability tests (beam line only)

'CTF3 upgrade'

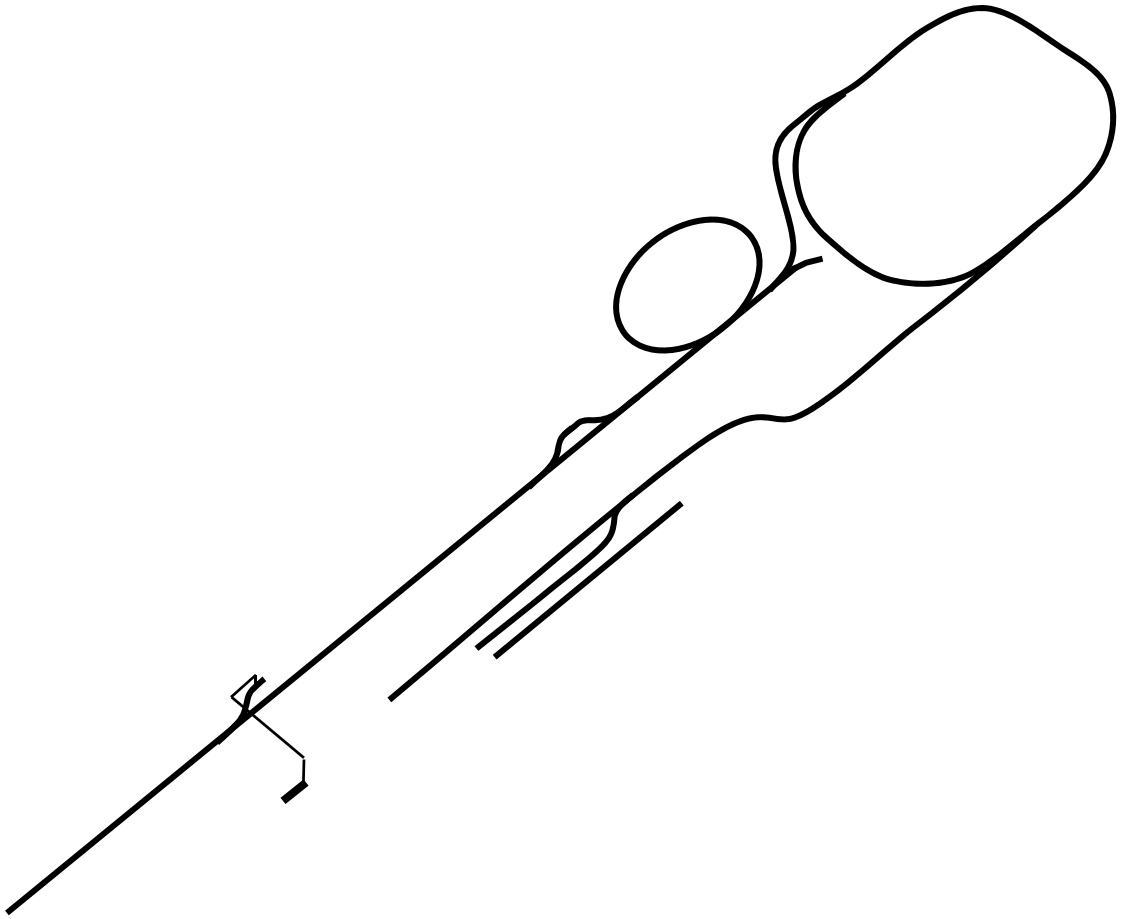
Scenario A:

Turn around Califes, add 180 deg bend



The end, reserve slides following

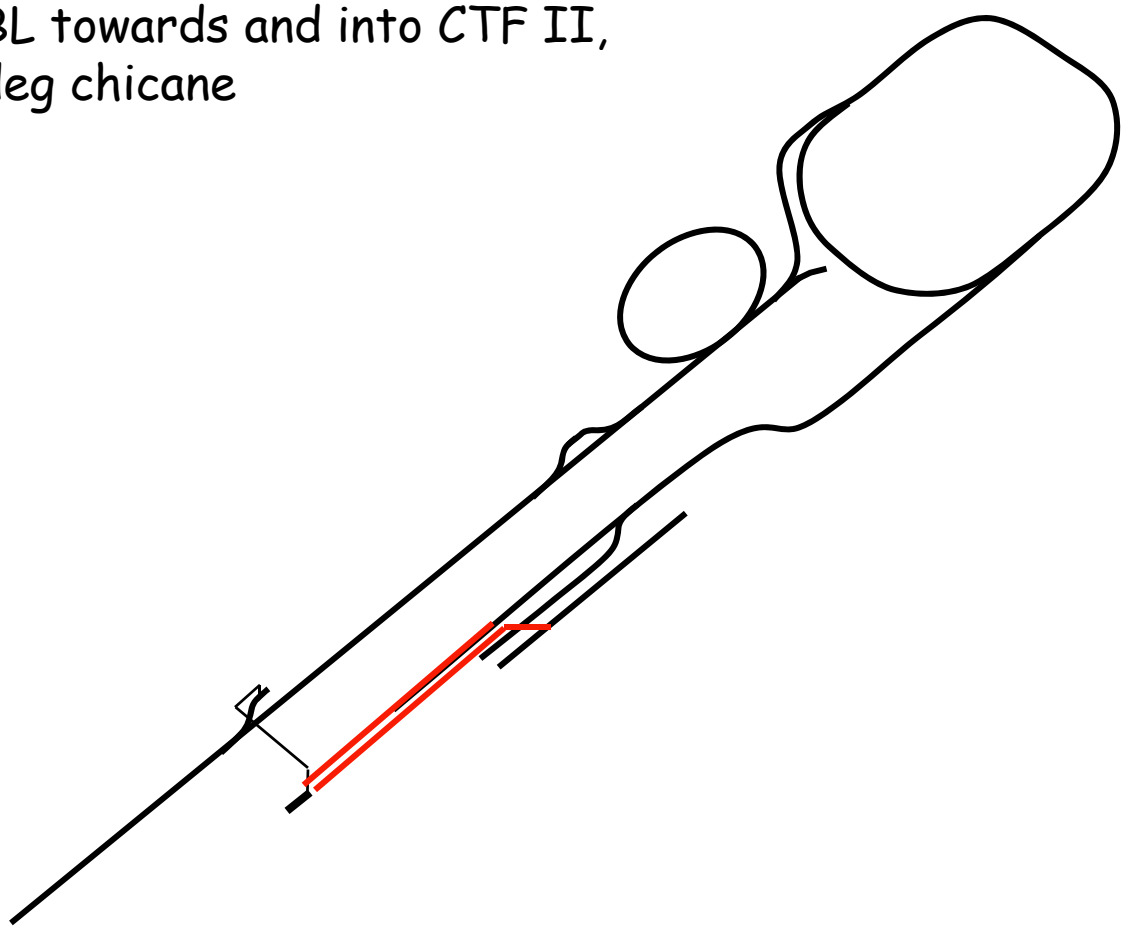
TBL long term idea's



'CTF3 upgrade'

Scenario B:

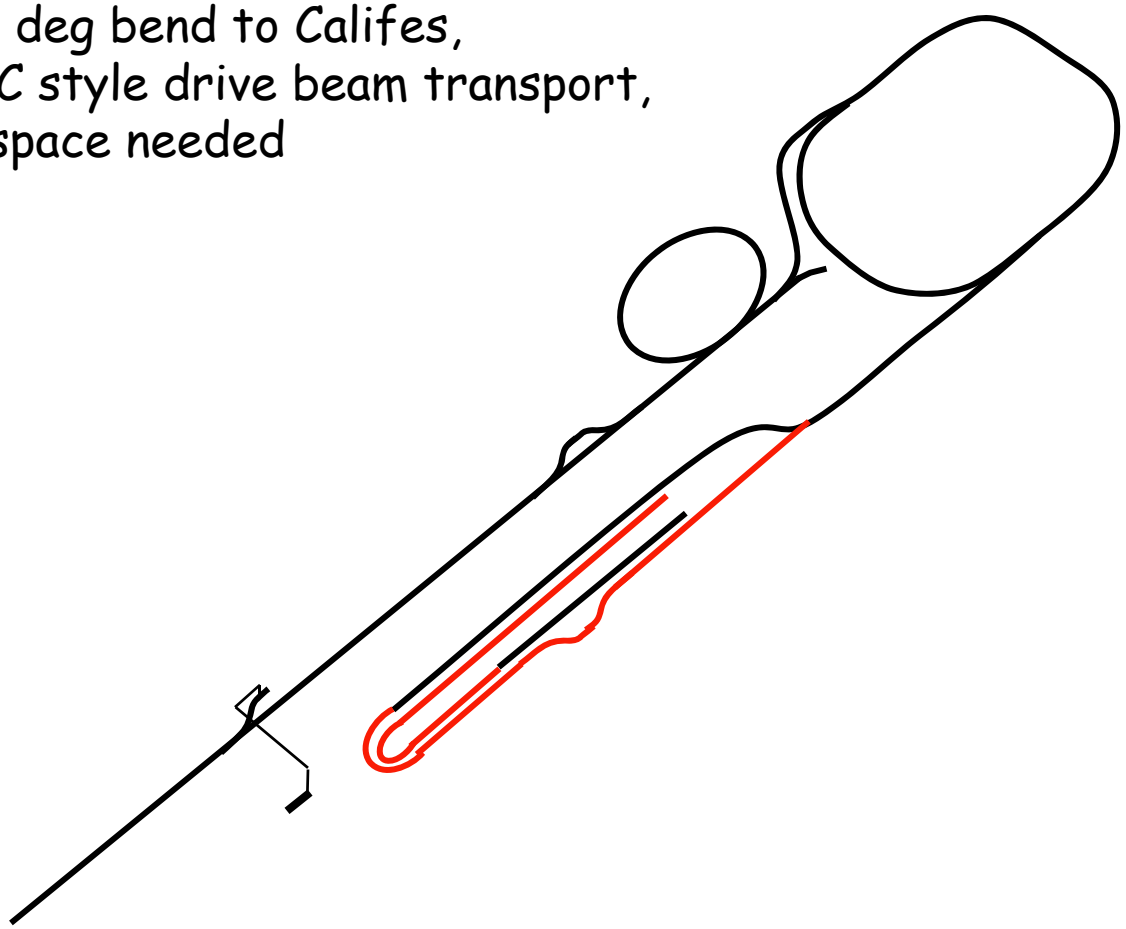
Move TBL towards and into CTF II,
add 10 deg chicane



'CTF4'

Scenario C:

Add 180 deg bend to Califes,
new CLIC style drive beam transport,
CTF II space needed



Module integration