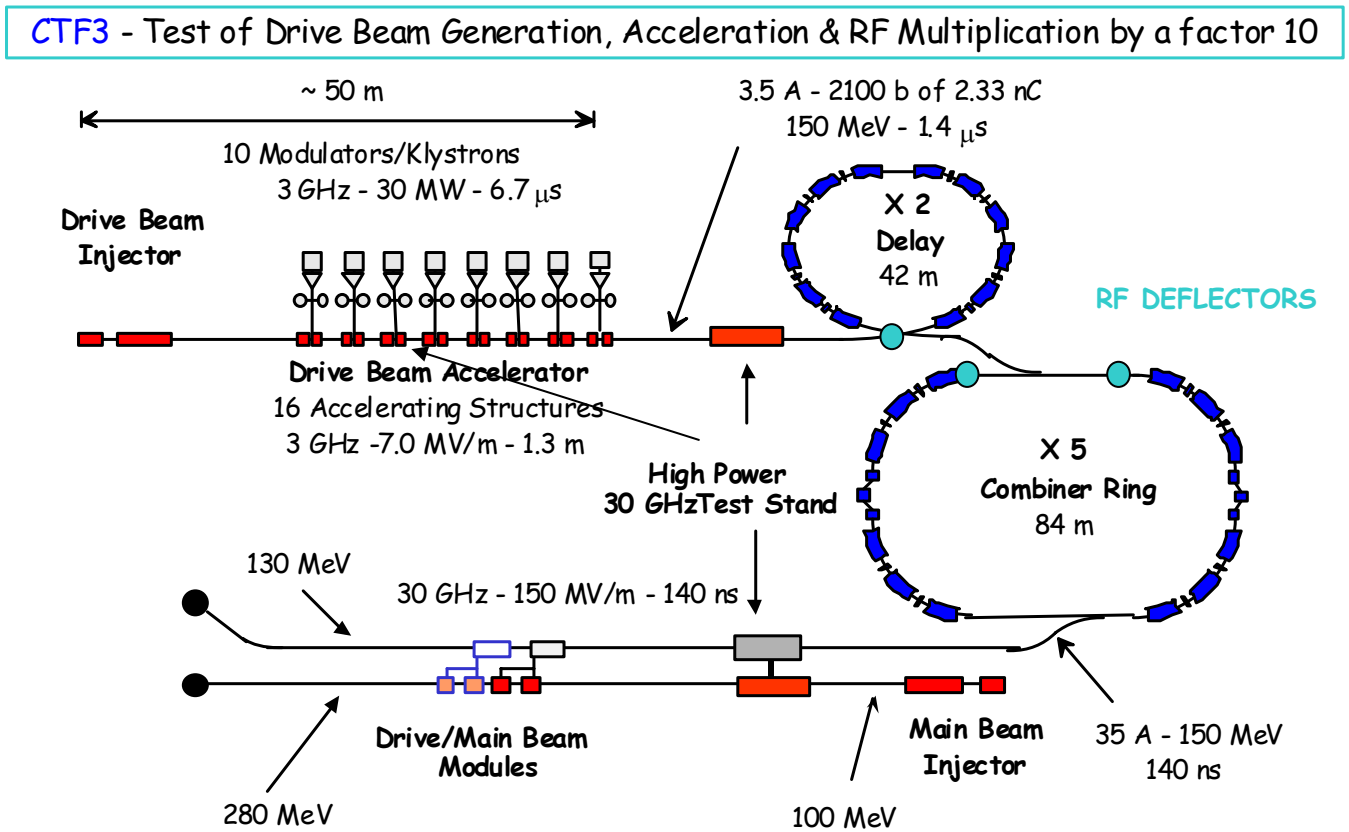
Status of CTF3

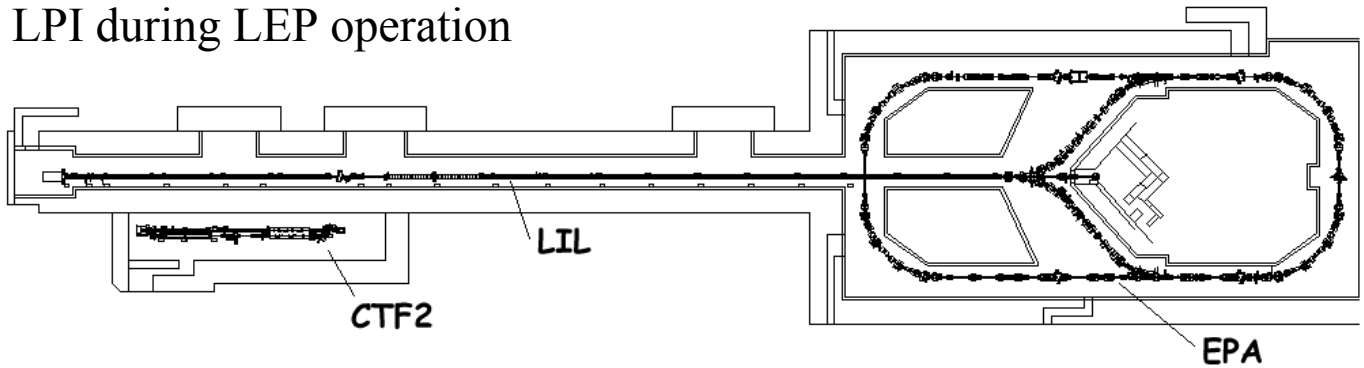
G.Geschonke
CERN, AB

CTF3 layout

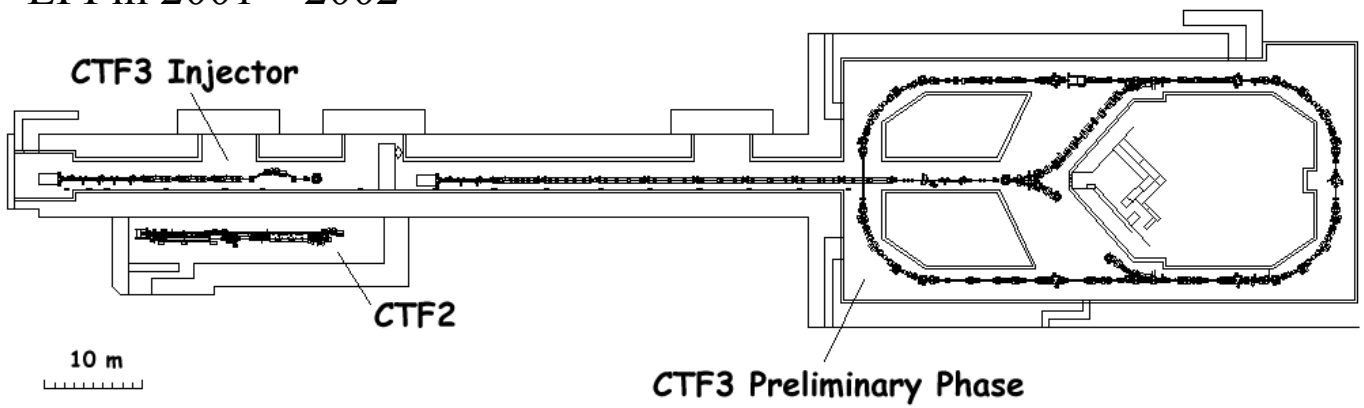

CTF3 - Test of Drive Beam Generation, Acceleration & RF Multiplication by a factor 10
~ 50 m
10 Modulators/Klystrons
3 GHz - 30 MW - 6.7 μs
3.5 A - 2100 b of 2.33 nC
150 MeV - 1.4 μs
Drive Beam
Injector
X 2
Delay
42 m
RF DEFLECTORS
Drive Beam Accelerator
16 Accelerating Structures
3 GHz -7.0 MV/m - 1.3 m
High Power
30 GHzTest Stand
X 5
Combiner Ring
84 m
130 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

Recent Results – Preliminary phase

LPI during LEP operation

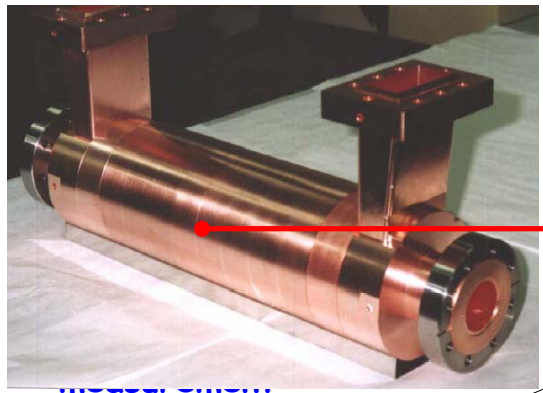


LPI in 2001 – 2002

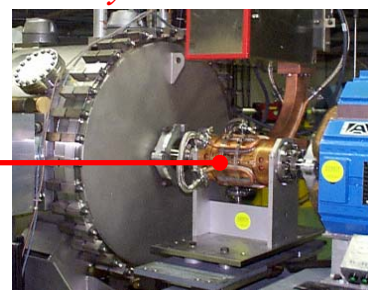


Recent results – Preliminary phase

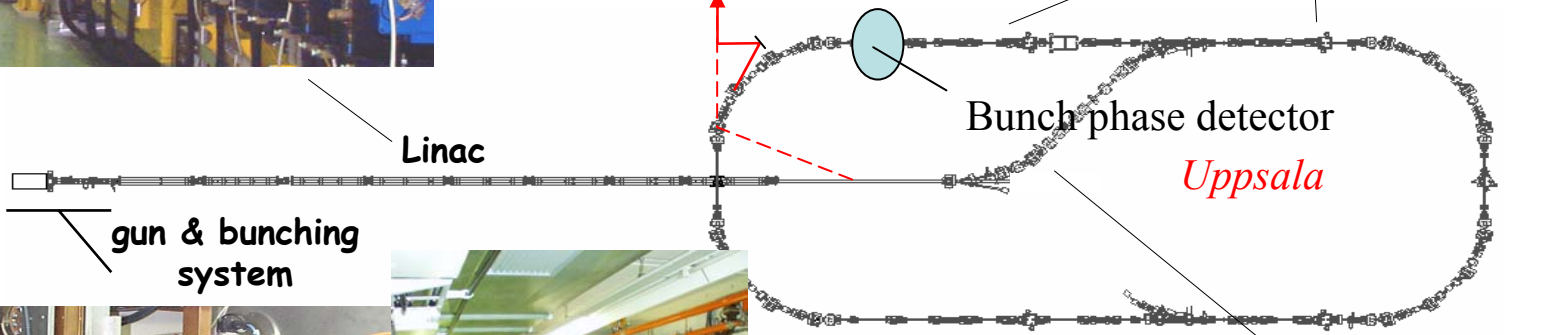
Modifications to the LEP pre-injector complex



Provided by INFN



RF deflectors



Provided by LAL

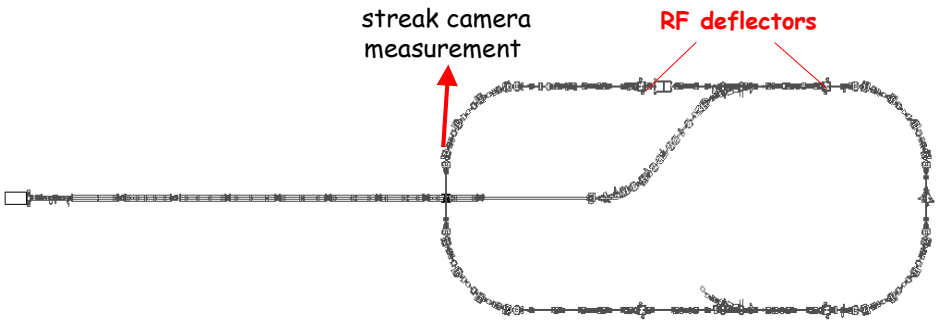
Collaborations for preliminary phase

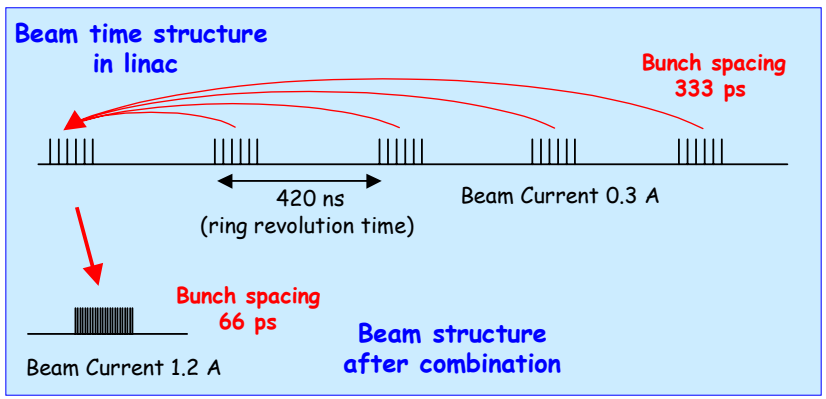
- LAL:
  - New thermionic gun
- INFN:
  - RF deflectors
  - Participation in operation
- Uppsala:
  - Bunch phase monitor,
  - Operations support
- University Lausanne:
  - PhD student

Recent results – Preliminary phase

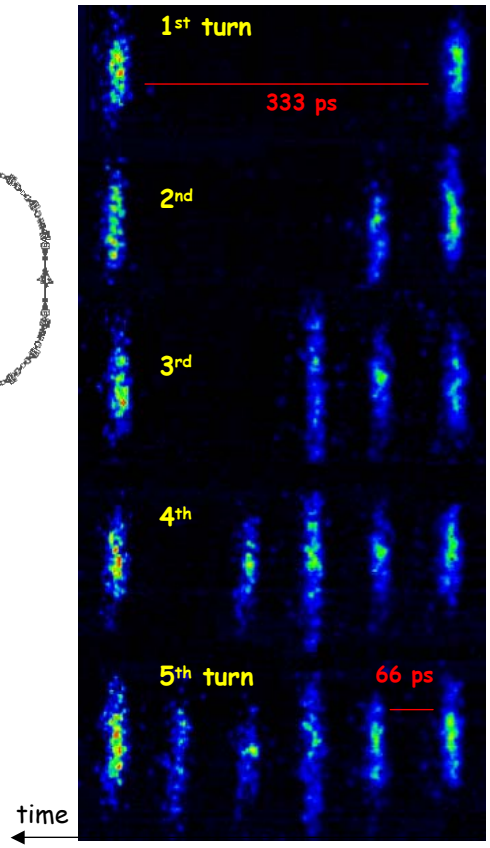
CTF3 - PRELIMINARY PHASE

low-charge demonstration of electron pulse combination and bunch frequency multiplication by up to factor 5

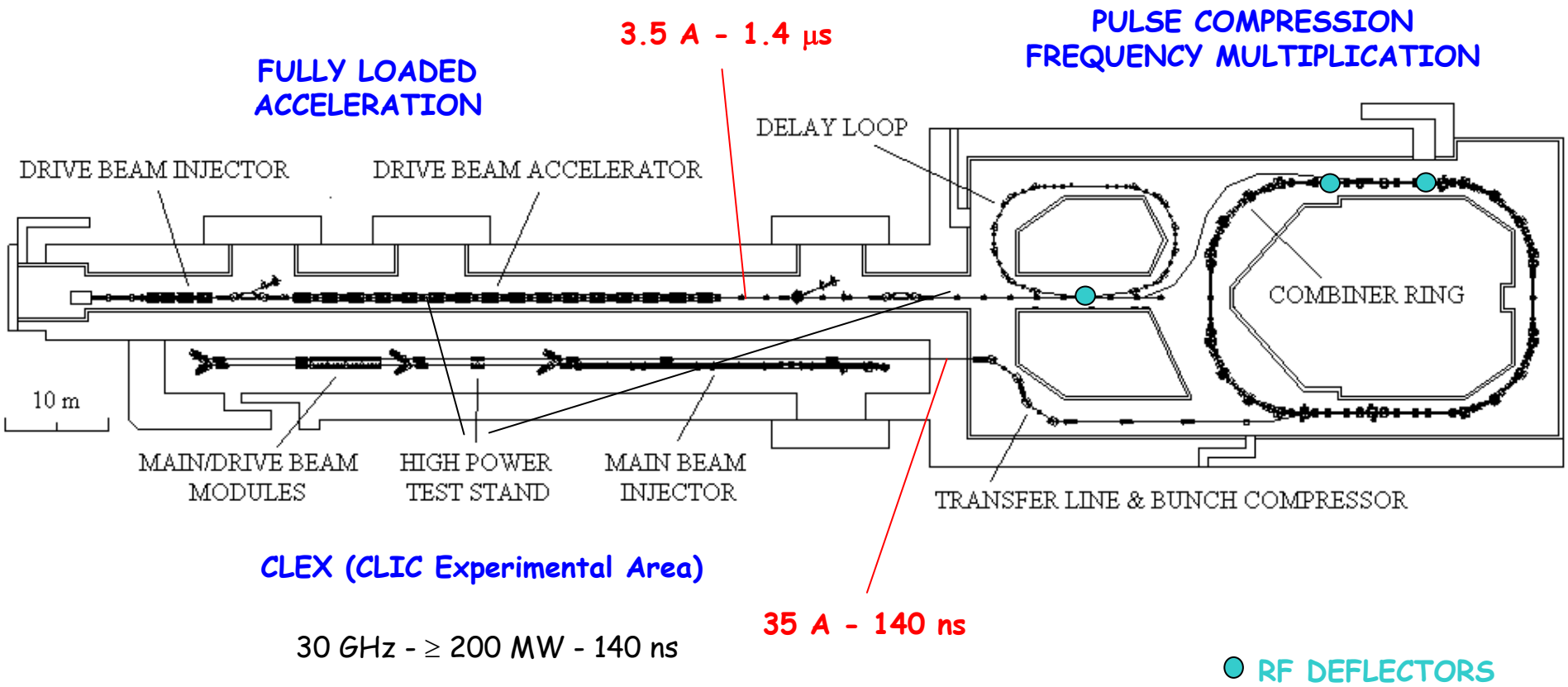




Streak camera image of
beam time structure evolution

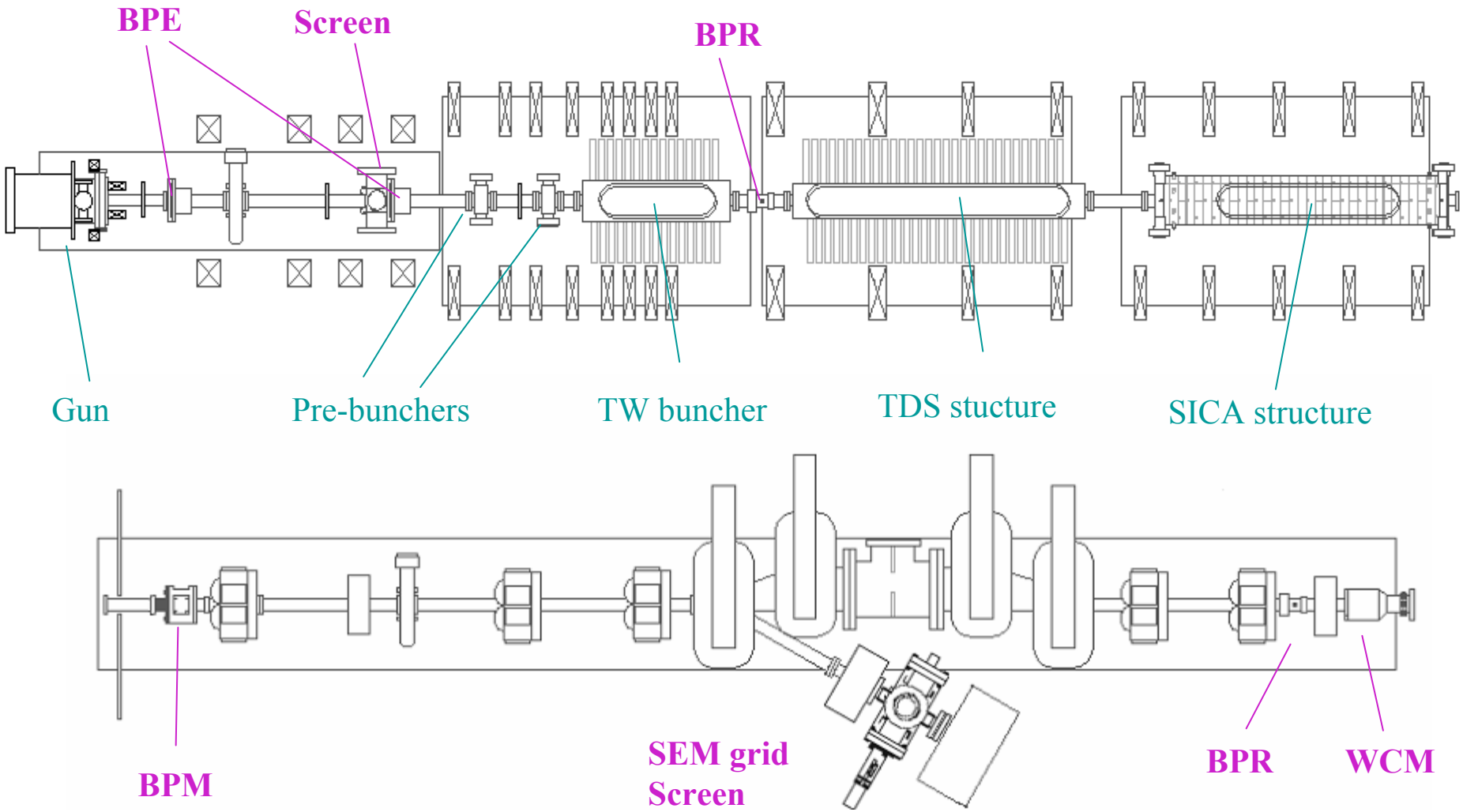


CTF3 Nominal phase

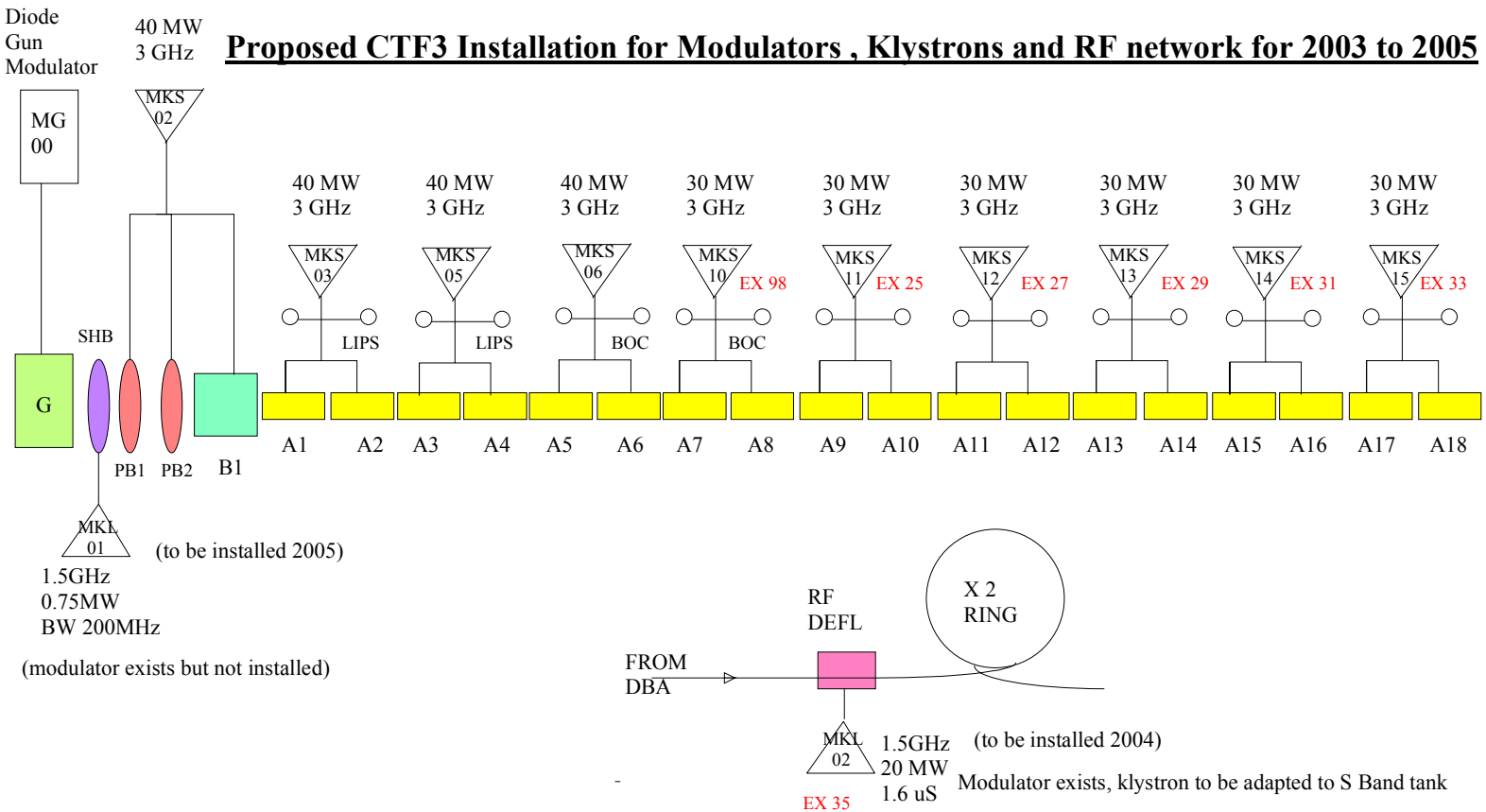


Injector

Already commissioned



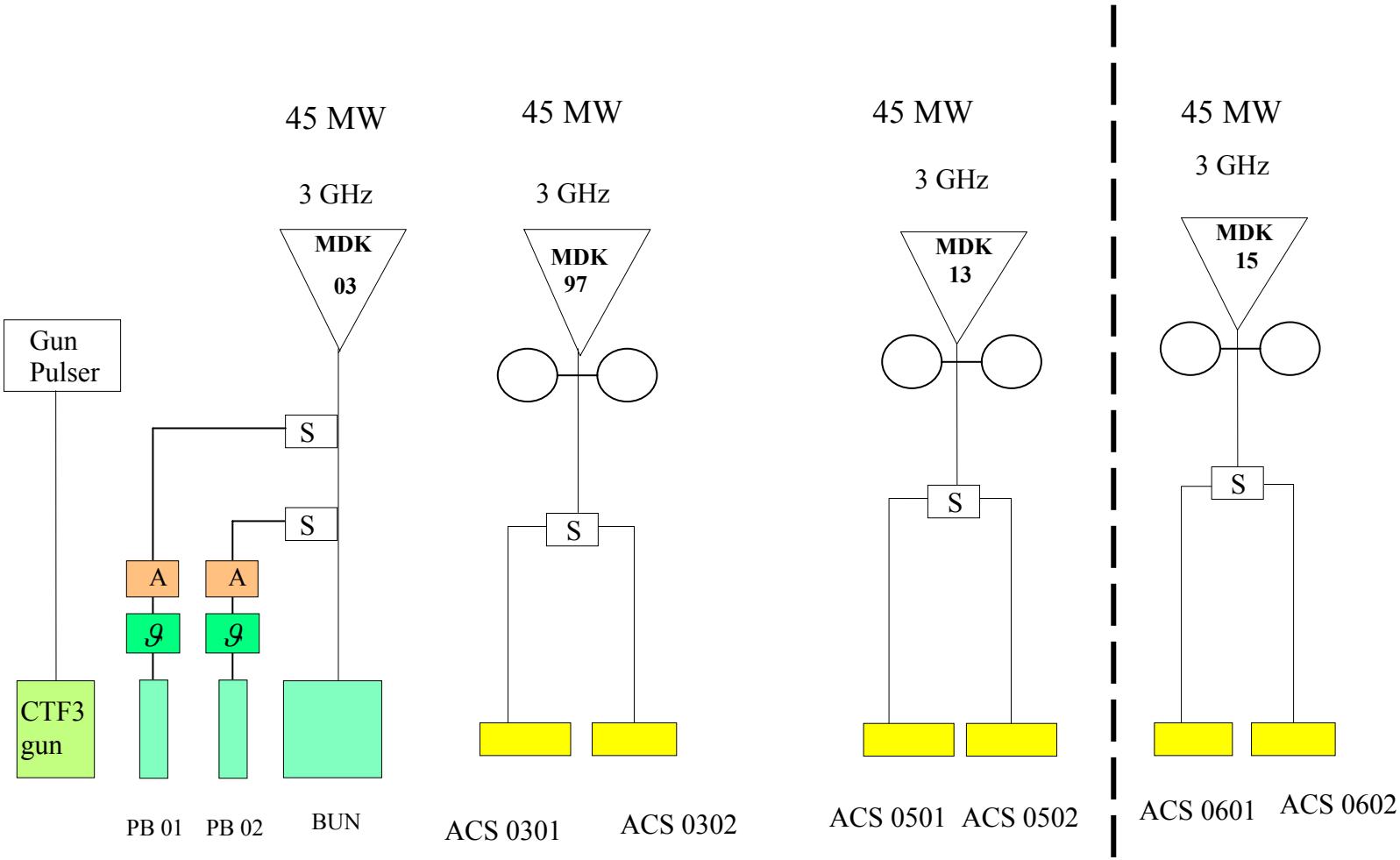
Nominal phase RF power plant



N.B. This Installation scenario assumes that we do not build a reserve modulator for testing purposes and that all tests on faulty equipment will be done in shutdown or to the detriment of available machine time

G. McMonagle AB/RF 07/08/03

RF power plant in 2003



PB = Pre-Buncher

ACS = Accelerating structure

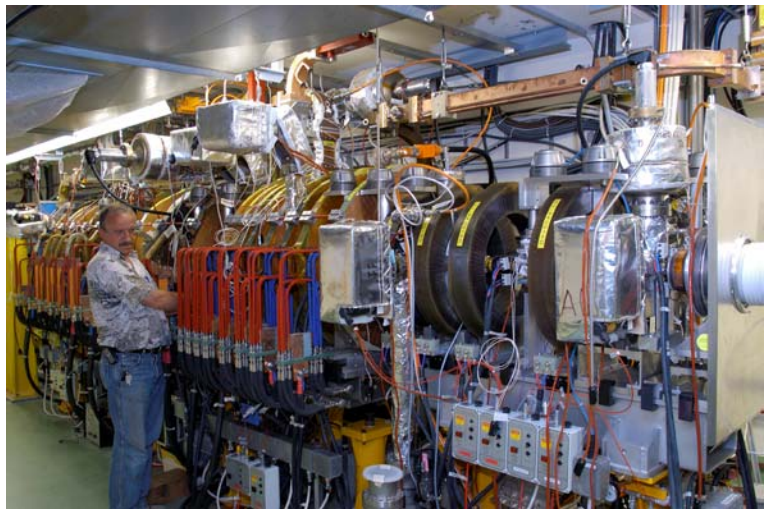
BUN = Buncher

S = Power Splitter

Pulse compressor

Installation

Thermionic gun

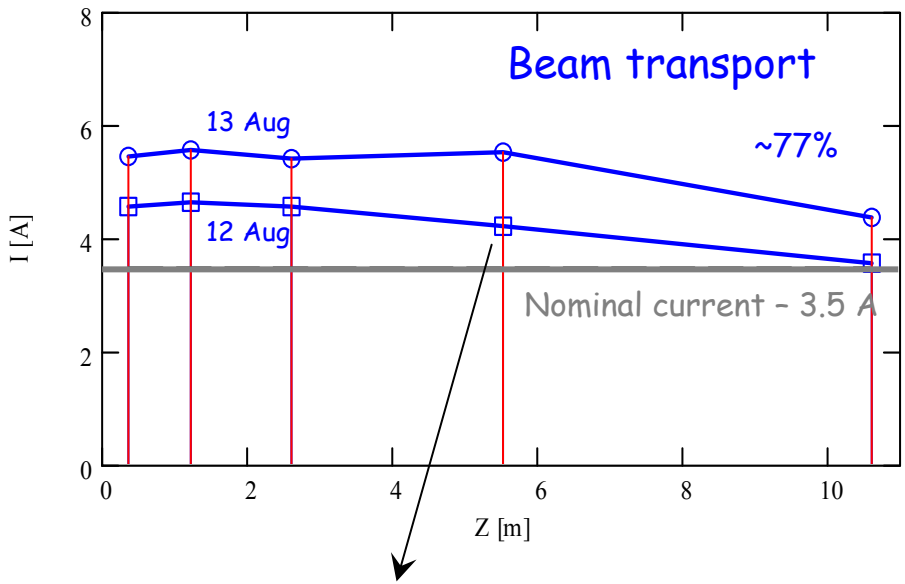


Injector solenoid

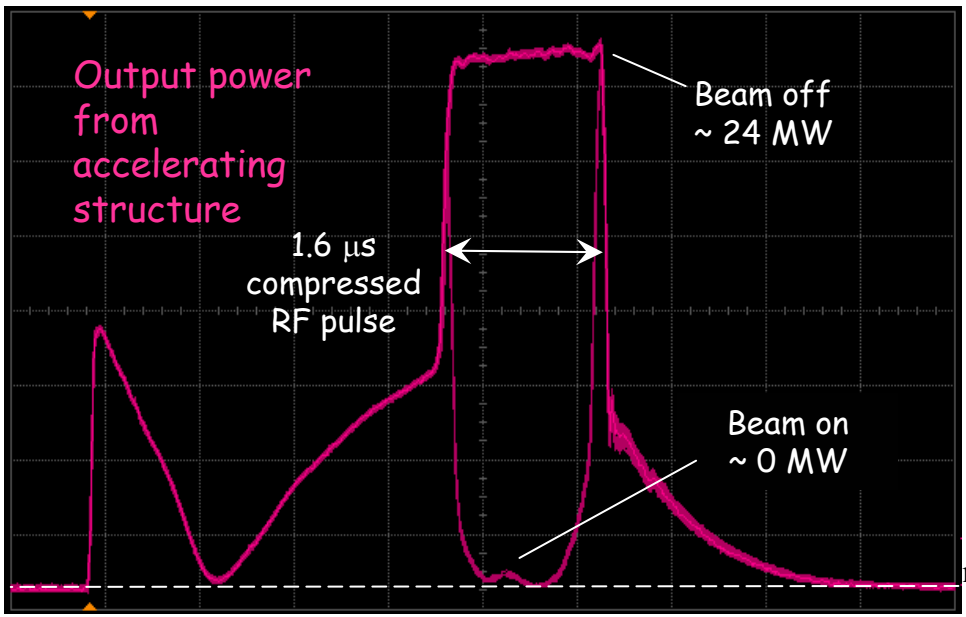
Magnetic chicane

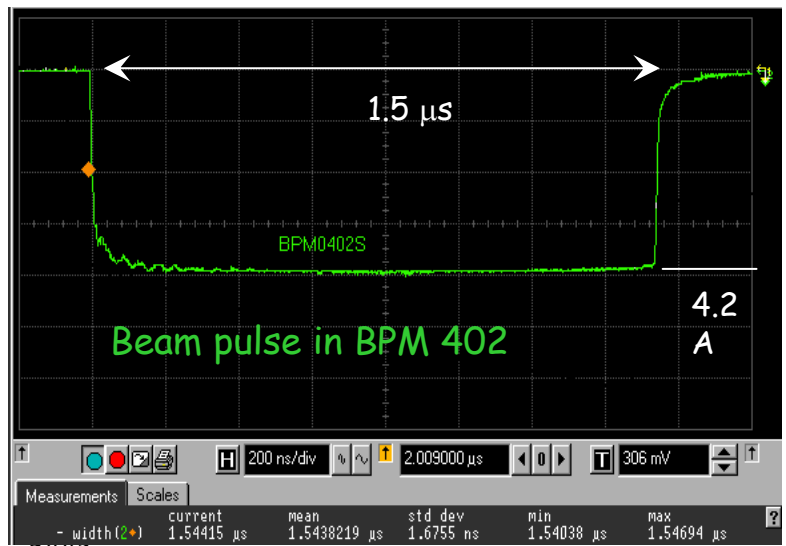
Commissioning results

	Nominal	Achieved
I	3.5 A	4.5 A
τ_p	1.5 μs	1.5 μs
E	20 MeV	20 MeV
$\varepsilon_{n,rms}$	100 π mm mrad	60-90 π mm mrad
$\tau_{bunch,rms}$	5 ps	< 6.5 ps



First demonstration of full beam loading

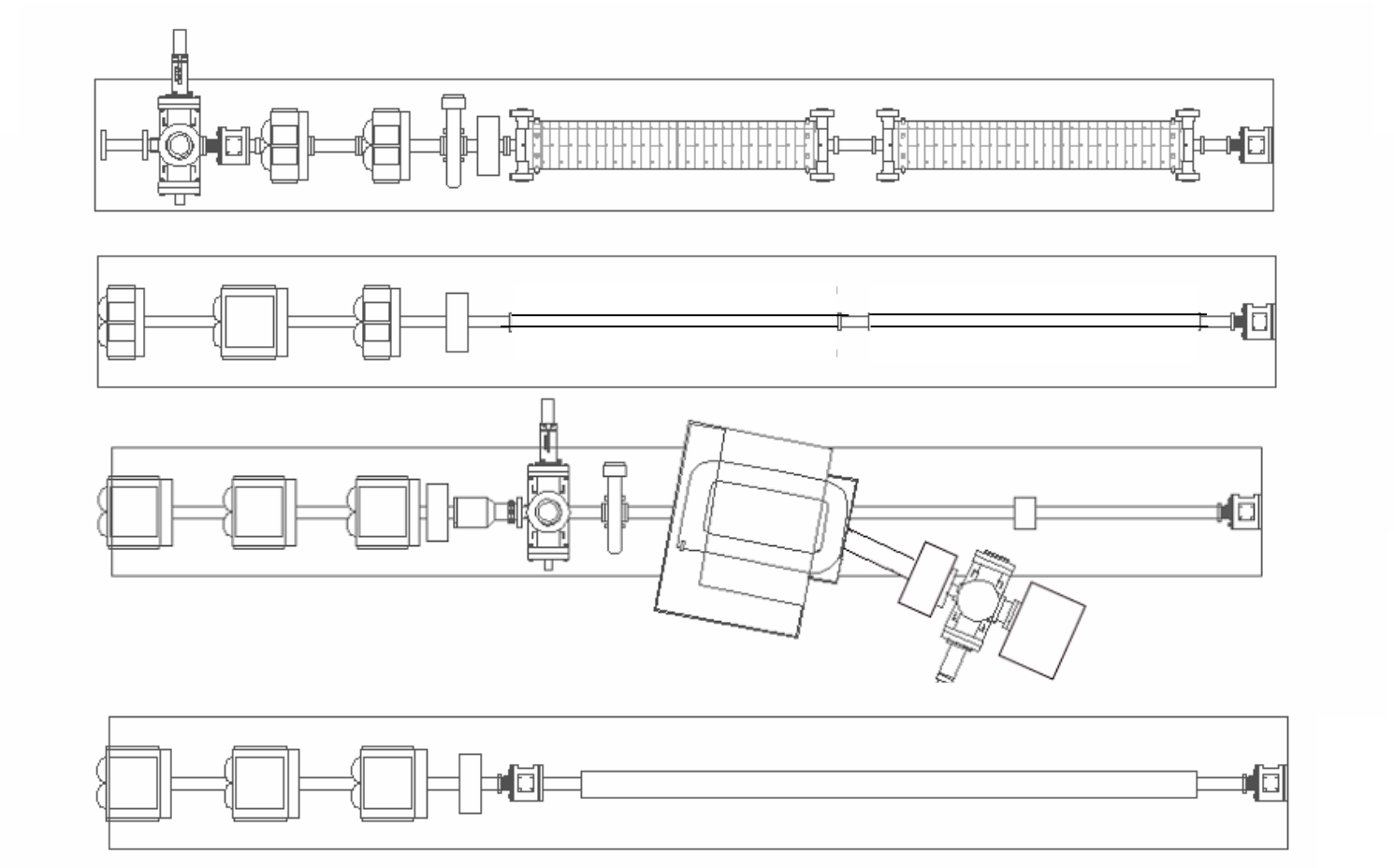




meeting 2003

New installation

To be commissioned now



CTF3 Objectives

From the outset:

a) Demonstrate the CLIC RF power source

b) 30 GHz RF power source for CLIC equipment

PETS, Accelerating structures ….

In addition (TRC):

Answer R1 and R2 priorities

Do as much as possible bench-mark testing relevant for CLIC

CTF3 Objectives

CLIC LIST OF CRUCIAL CLIC-TECHNOLOGY-RELATED FEASIBILITY ITEMS

- **Test of damped accelerating structure at design gradient and pulse length (TRC R1)**

  required: CTF3 linac, delay loop and intermediate high gradient test stand after the delay loop.

- **Validation of drive beam generation scheme (TRC R1)**

  required: linac, delay loop, combiner ring and bunch compressor

- **Design and test of damped ON/OFF power extraction structure (TRC R1)**

  A new design of power extraction structure with an ON/OFF capability exists but requires about one year of further study before the fabrication of prototype

  required: linac, delay loop Combiner ring, bunch compressor and end-of-line high-gradient test stand

CTF3 Objectives

- **Validation of stability and losses of drive beam decelerator, and design of machine protection system (TRC R2) - bench-marking**

  required: CTF3 Experimental Area (CLEX) with the 35 A beam.

- **Test of relevant linac sub-unit with beam (TRC R2)**

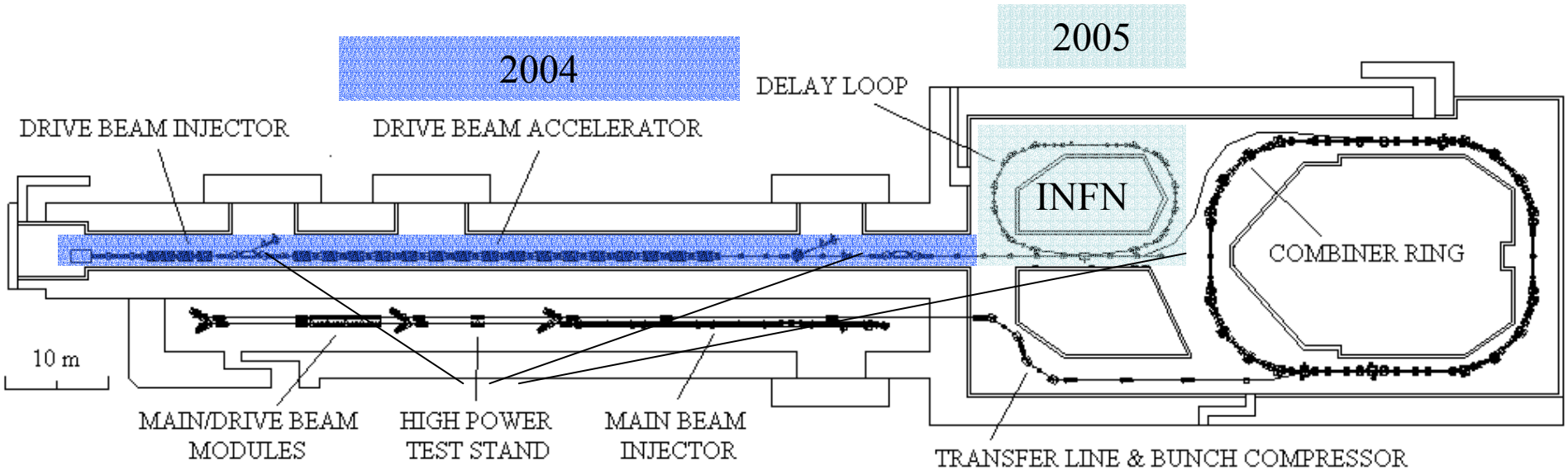
  required: CLEX and a short section of linac to produce the main beam.

- **Any other accelerator physics issues**

From I.Wilson

CTF3 programme

Damped accelerating structure (R1)



CLEX

2006 **(2009, unfunded !)**

2007 **(2012, unfunded !)**

Drive beam generation scheme (R1)
ON/OFF PETS (R1)

Stability bench marking (R2)
CLIC sub-unit (R2)

CTF3 Objectives - conclusion

installations needed to test the **TRC R1-feasibility** items could be completed by **2009**, and tests completed by **2010**

extra funding for the combiner ring early enough (2004):
installation could be completed by **2006**,
R1-feasibility tests could be completed by **2007**

---

installations needed for the **R2-feasibility** items could be completed by **2012**,
R2 tests could be completed by **2013**.

extra funding for CLEX early enough (2005):
installations to achieve these R2 milestones would be ready by **2008**,
R2-tests could be completed by **2009**.

SUMMARY: **R1: 2010 (no extra funds) or 2007**
R2: 2013 (no extra funds) or 2010

Injector issues – bunch phase coding

Base line design: Thermionic injector
with sub-harmonic bunchers
design exists
buncher cavities
1.5 GHz wide band 700 kW klystron
feasibility study done,
order postponed for financial reasons

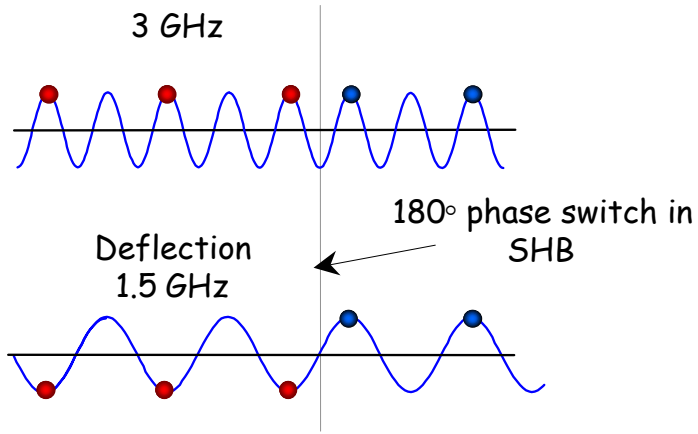


Photo Injector: bunch phase coding done by laser timing
High Power laser
development work already done by RAL, promising test done with diode pumped laser
Photo Cathode
feasibility demonstrated
RF gun
to be designed

Injector issues

Bid to EU FP 6 programme for Photo injector:
- funded up to 90 % !
- available end 2006

➔ Delay Loop (2005) can not be commissioned until 2007

Additional funds made available for klystron by CERN DG
- **tendering under way, plan to order end 2003**

In parallel alternative study of sub-harmonic bunching system:
- tw bunchers,
- lower cost RF power sources (tw tubes ?)

********** **Decision before end 2003** **********

Collaboration

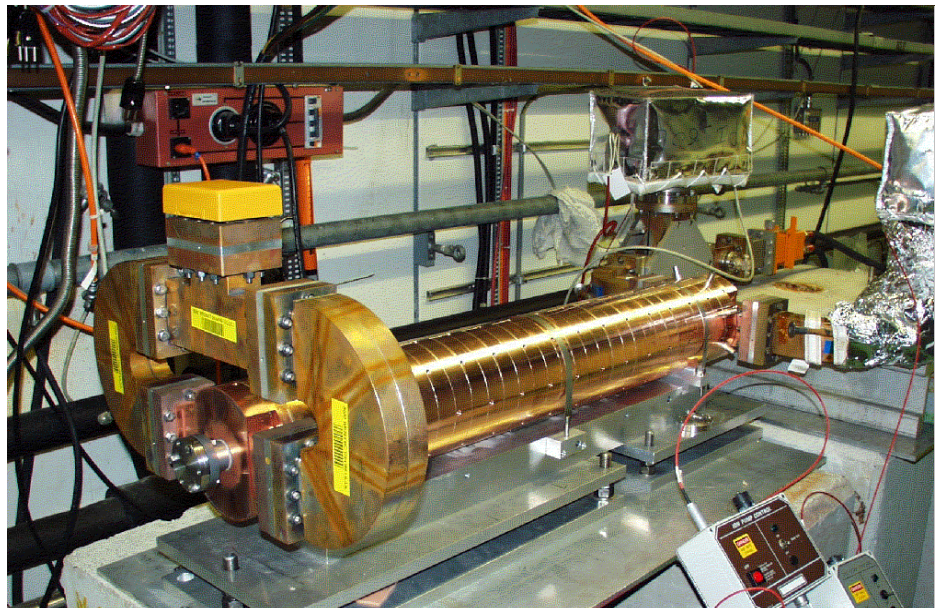
- INFN:
  Full responsibility of Delay Loop, Design of Combiner Ring, participation in operation
- RAL
  Laser Development for Photo Injector
- LAL
  Gun for Preliminary Phase, Gun and pre-bunchers for Nominal Phase incl HV deck, RF gun for Photo injector
- Uppsala University
  Bunch phase monitor
  Operations support
- SLAC
  Thermionic gun assembly, injector layout, participation in commissioning
- NW University Illinois
  Financial participation in accelerating structures, Beam loss monitoring system
- Finnish Industry
  One post for CLIC / CTF3
- Many CERN groups

Equipment status

- Major orders:
  - Accelerating structures (SICA) for linac being manufactured
  - Quadrupoles for linac ordered
  - 1.5 GHz high power klystron for DL deflector ordered
  - DL hardware, corrector magnets ➔ A.Ghigo
- Beam diagnostics equipment for linac
  - Equipment is developed, production ongoing
  - Beam loss machine protection system under development
  - Digital data acquisition cards ordered
- RF low level system
  - Equipment being developed / manufactured
  - 3 GHz amplifiers – in house ?
  - Phase programming for RF pulse compression developed, solution found
- RF high power
  - All 3 GHz klystrons available
  - 5 new BOC cavities being manufactured
  - High power RF absorbers under development at CERN
- Beam loss detection system
  - New collaboration with NW University Illinois

Some hardware

BOC prototype

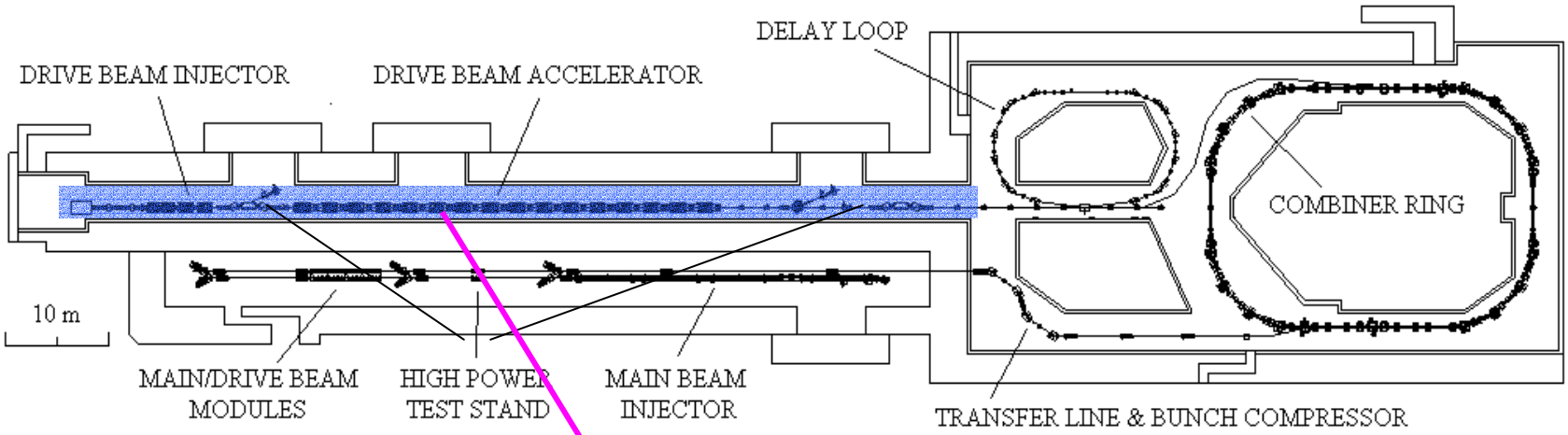


Accelering structure
Industrial prototype

Additional resources

- Bid made to PPARC for missing Combiner Ring equipment
- CLEX ??
- New collaboration partners ??

What comes next ?



Known so far:

2003 / 2004 :	install and test 30 GHz power test station install+commission full linac and chicane
2004/2005:	install Delay loop sub-harmonic bunching system
2006/2007:	Install +commission photo injector