CLIC overview

R. Tomás for the CLIC/CTF3 collaboration

- May 8^{th}, 2009

Goal of the CLIC study

Centre of mass energy	3	TeV
Luminosity (in 1% energy)	2×10^{34}	$\mathrm{cm}^{-2}\mathrm{s}^{-1}$

With current parameters:

Number of $e^{\pm}$ per bunch	3.7×10^{9}	
Bunch separation	0.5	ns
Main linac RF frequency	12	GHz
Number of bunches per train	312	
Repetition frequency	50	Hz
Proposed site length	48.3	km
AC to beam power efficiency	6.8	%
$\gamma\epsilon_x/\gamma\epsilon_y$	660/20	nm

The CTF3 – CLIC world wide collaboration

TH3GBI01 FR1RAC04

Ankara University (Turkey)
BINP (Russia)
CERN
CIEMAT (Spain)
Cockcroft Institute (UK)
Gazi Universities (Turkey)
IRFU/Saclay (France)

Helsinki Institute of Physics (Finland)
IAP (Russia)
IAP NASU (Ukraine)
Instituto de Fisica Corpuscular (Spain)
INFN / LNF (Italy)
J.Adams Institute, (UK)

JINR (Russia)
JLAB (USA)
KEK (Japan)
LAL/Orsay (France)
LAPP/ESIA (France)
NCP (Pakistan)
North-West. Univ. Illinois (USA)

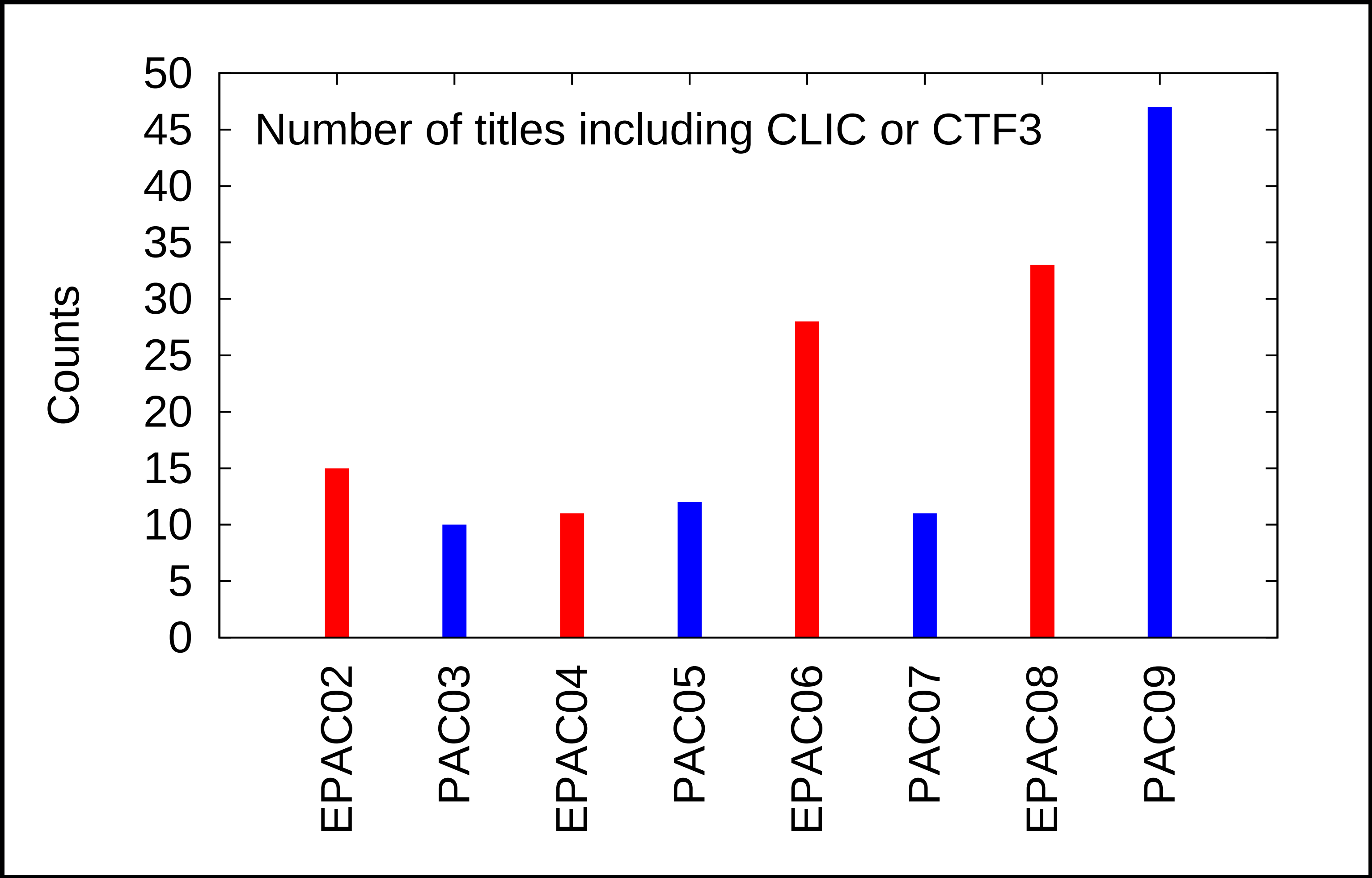
Oslo University (Norway)
PSI (Switzerland),
Polytech. University of Catalonia (Spai
RRCAT-Indore (India)
Royal Holloway, Univ. London, (UK)
SLAC (USA)
Uppsala University (Sweden)

CLIC/ILC collaboration

Friendly rivalry **Nature 456,422, 27 Nov. 08**

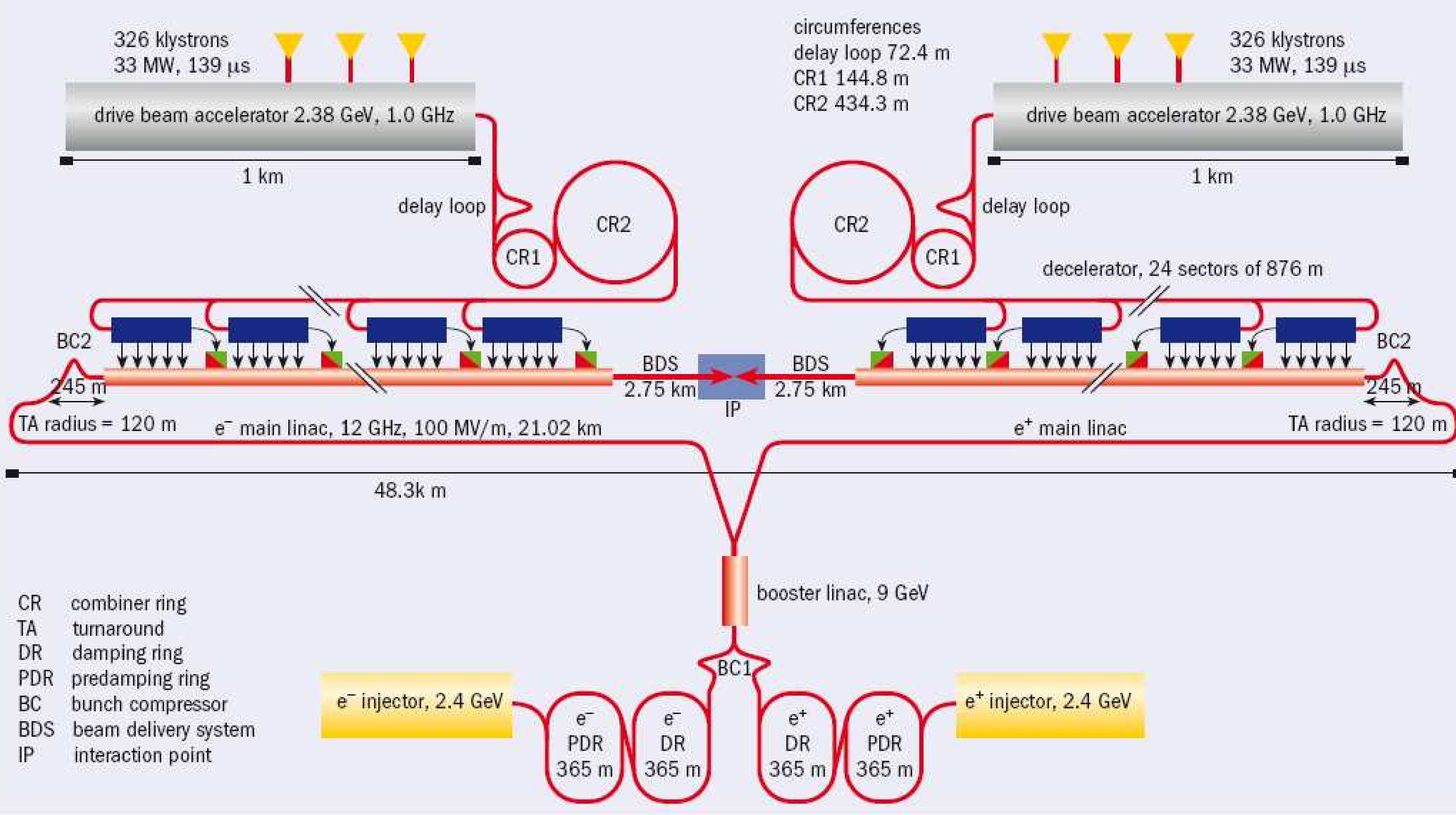
“The spirit of collaboration in the race to define the LHC’s successor sets an example for large projects. The future for high-energy physics is decidedly mixed...”

and in fact...



Number of titles including CLIC or CTF3
Counts
0
5
10
15
20
25
30
35
40
45
50
EPAC02
PAC03
EPAC04
PAC05
EPAC06
PAC07
EPAC08
PAC09

CLIC complex layout - Two beam accel.

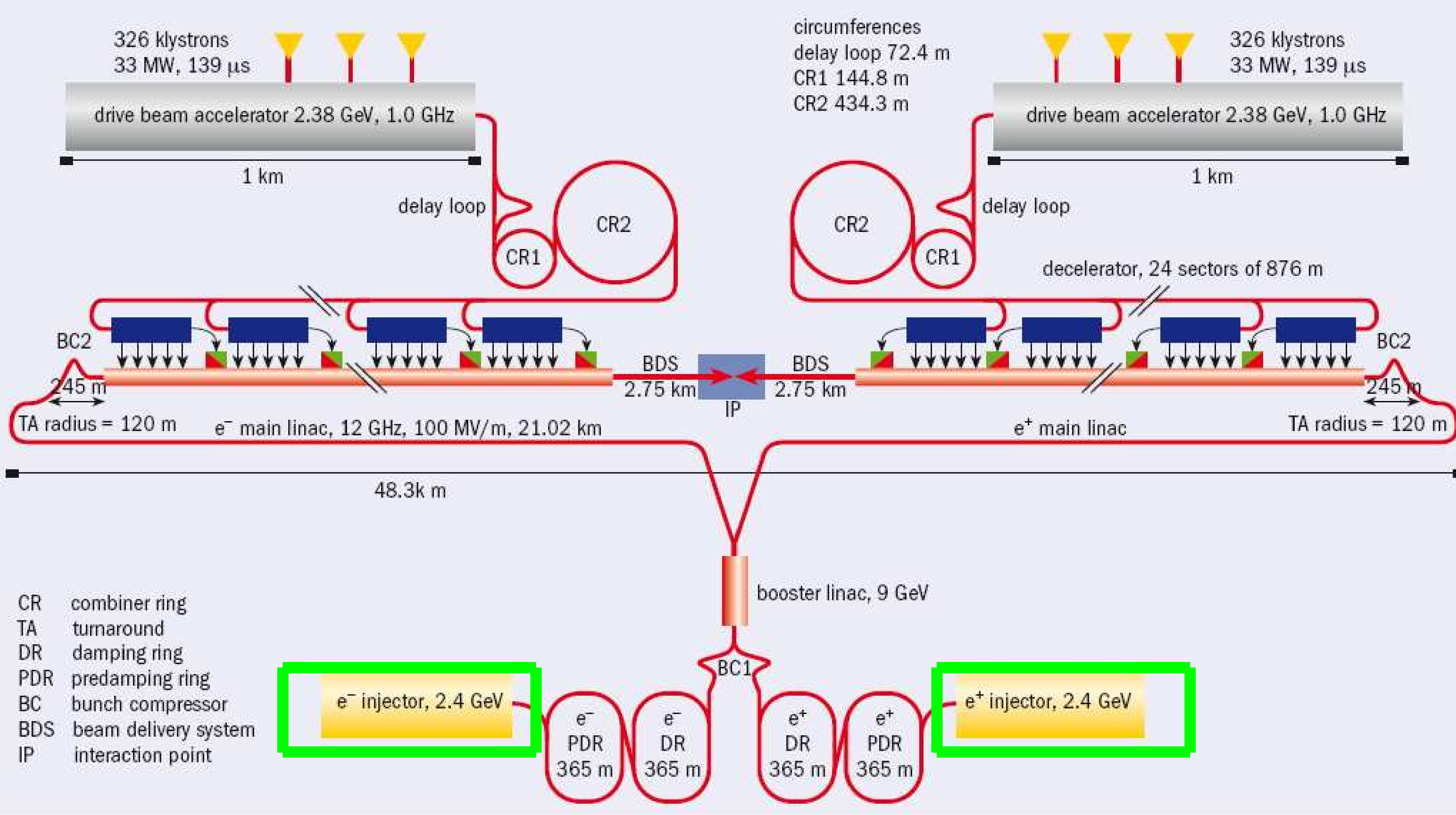


Conceptual Design Report - end 2010

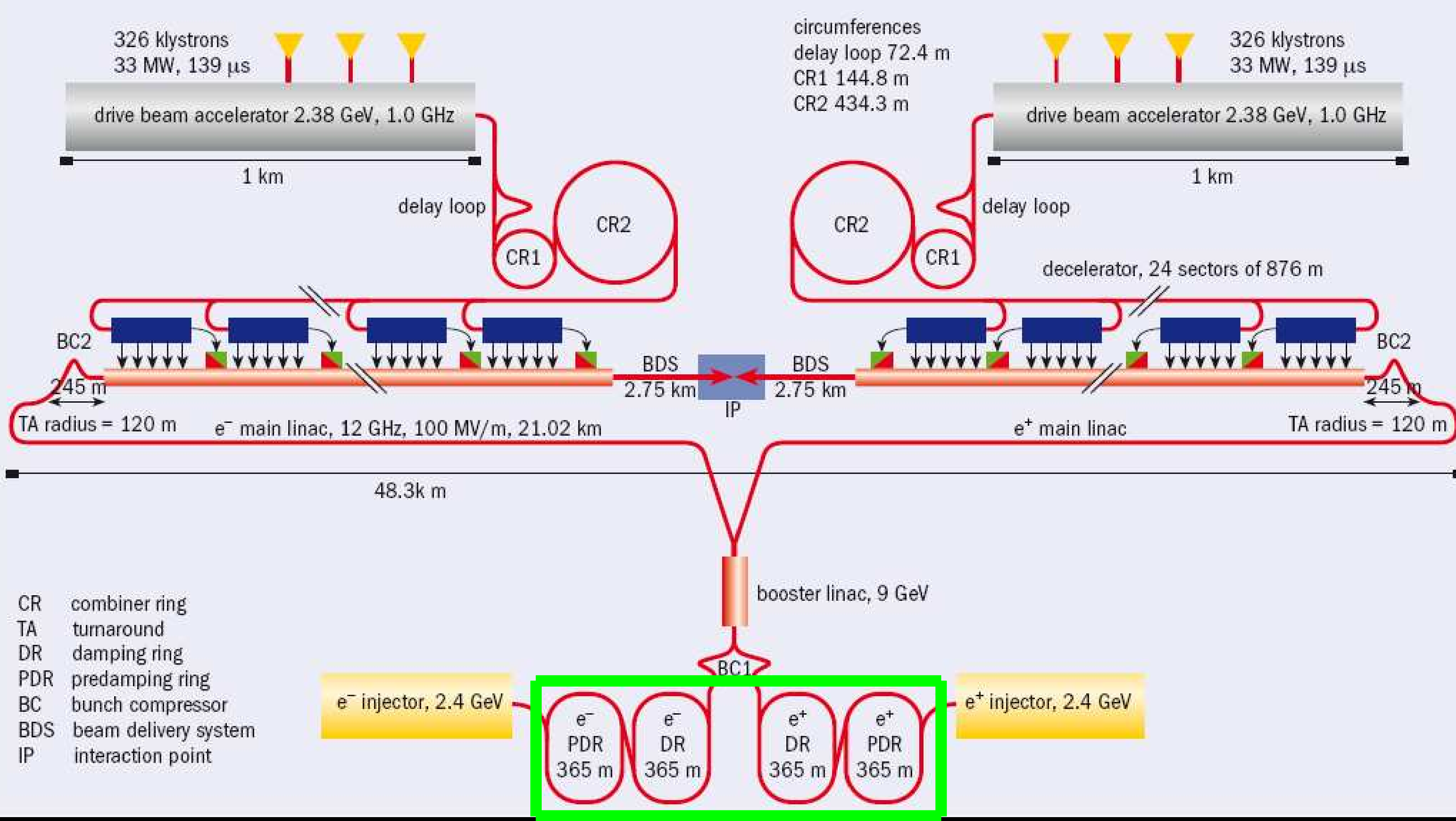
The CLIC CDR should address the critical points:

- Accelerating structures at 100 MV/m.
- Power Extraction and Transfer Structures (PETS).
- Generation of the 100 A drive beam with 12 GHz bunch frequency,
- meeting the phase, energy and intensity stability tolerances.
- Main beam low emittances.
- Stabilization of main quads. to 1nm and FD quads to 0.15nm (freqs $>$4 Hz).
- Machine protection.

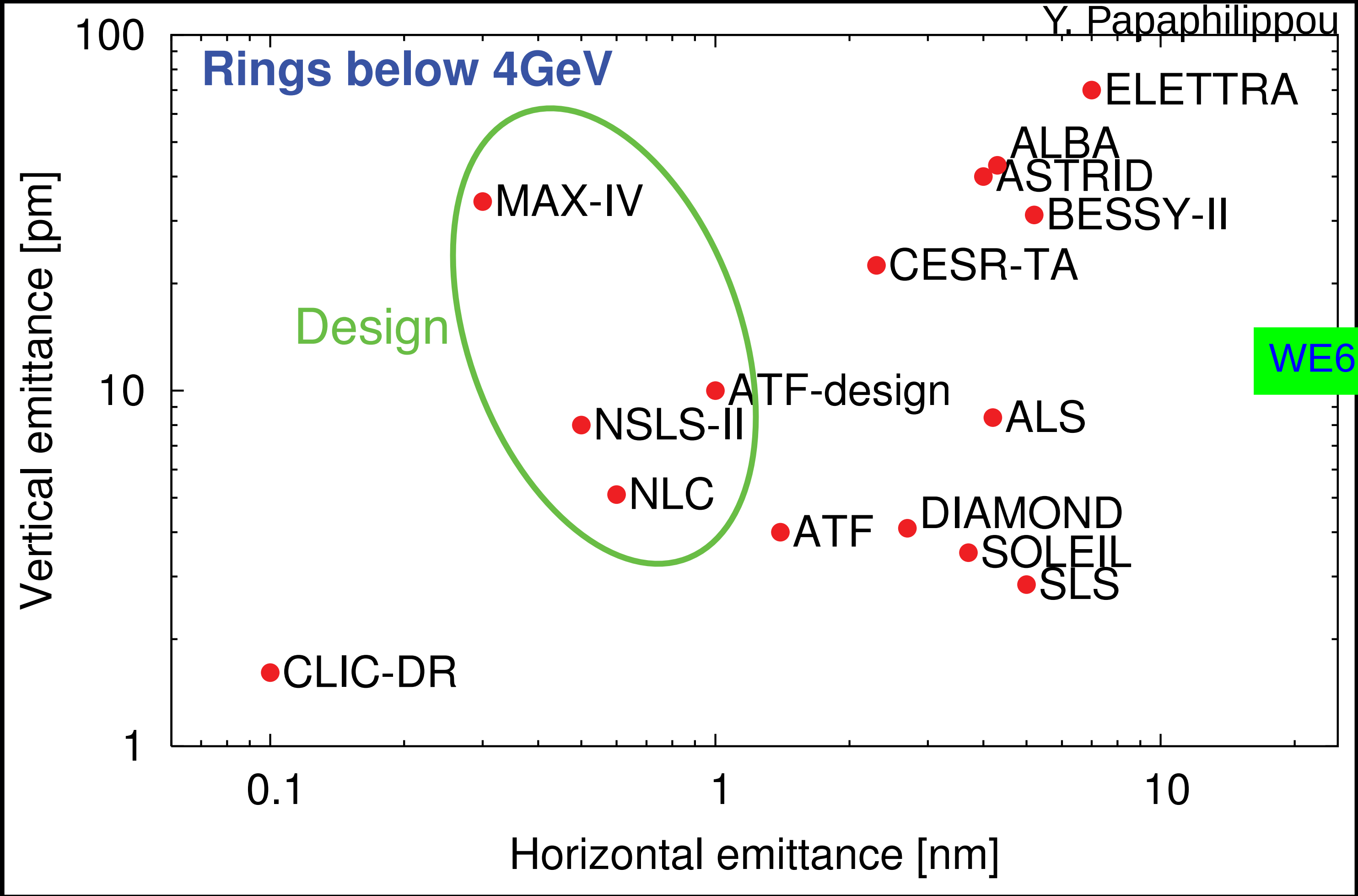
Injector complex WE6RFP065 MO6RFP064



Damping Rings



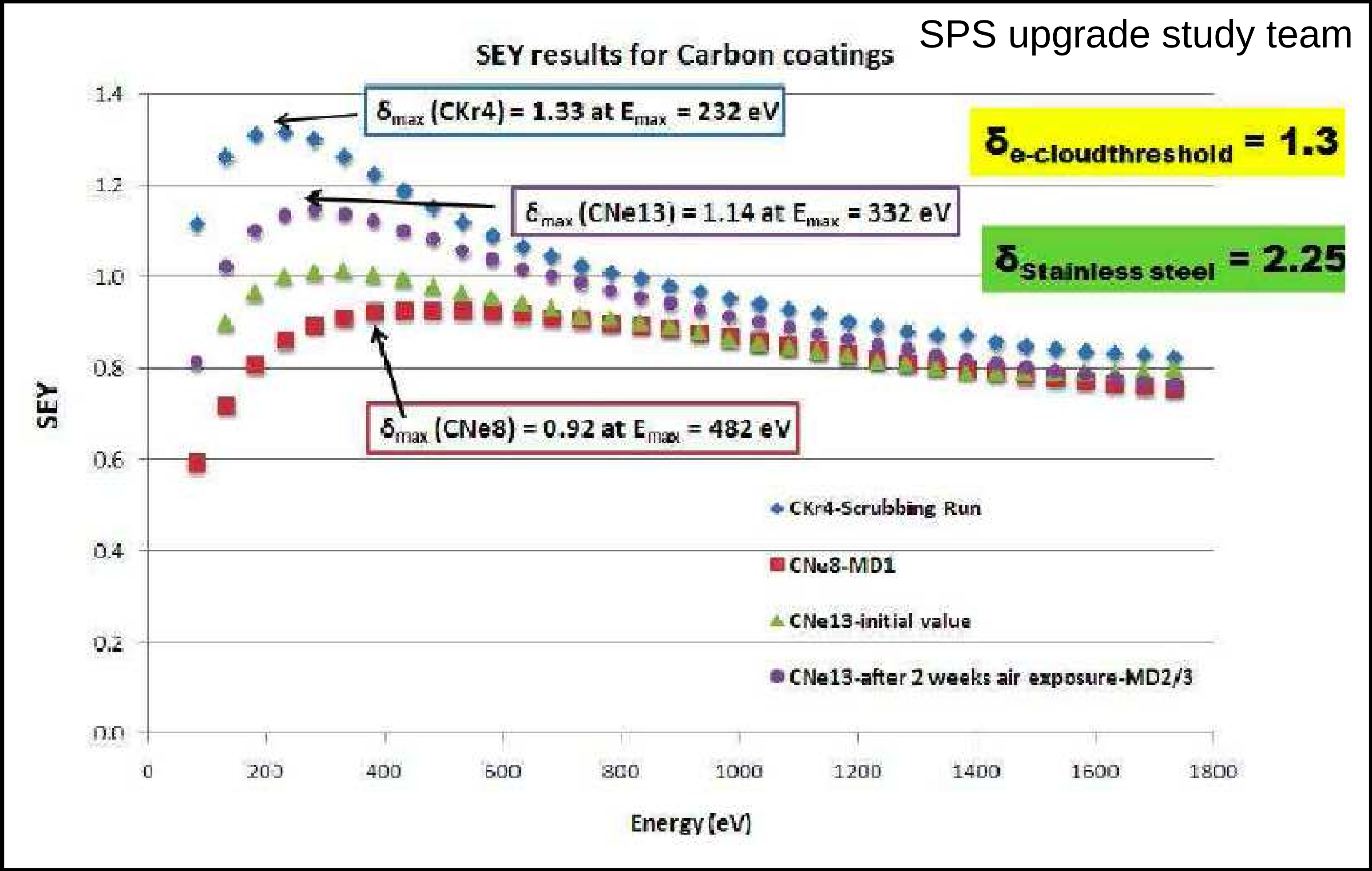
The emittance challenge



WE6PFP10[5-7]

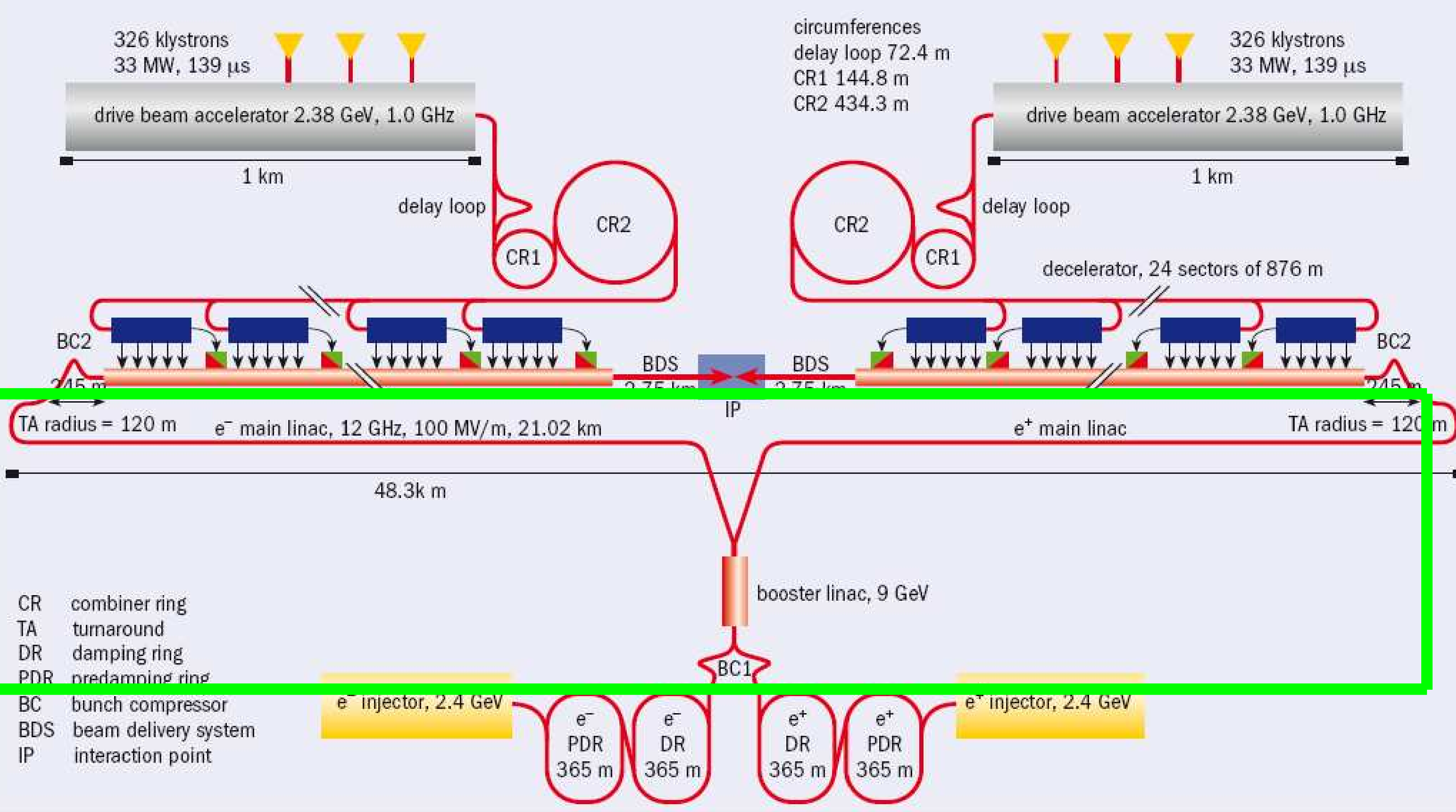
with severe collective effects: intra-beam scattering, fast-ion instability and e-cloud.

e-cloud mitigation



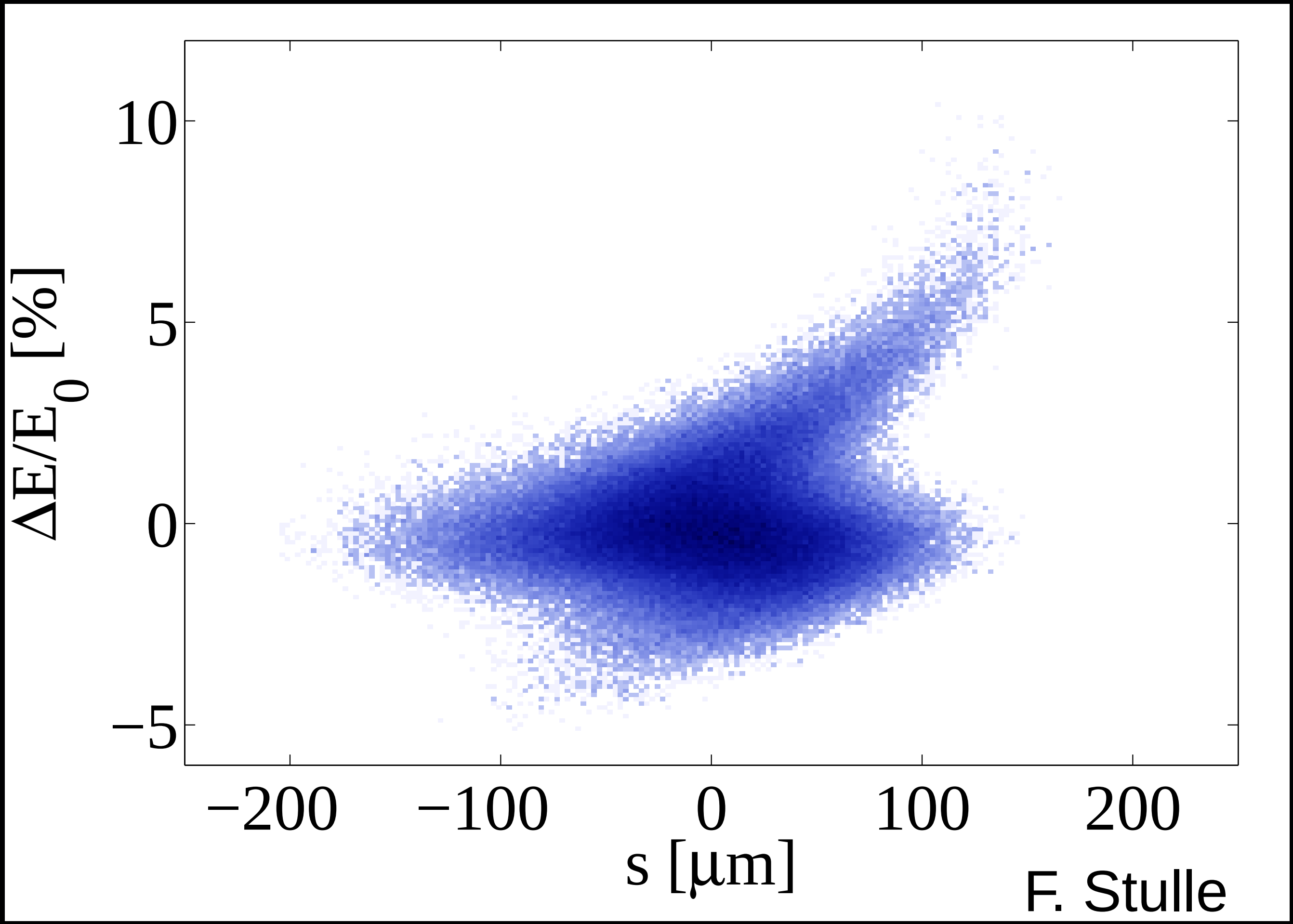
Carbon coating with SEY$<$1 developed in CERN being tested in SPS and CESR-TA (summer 09).

RTML



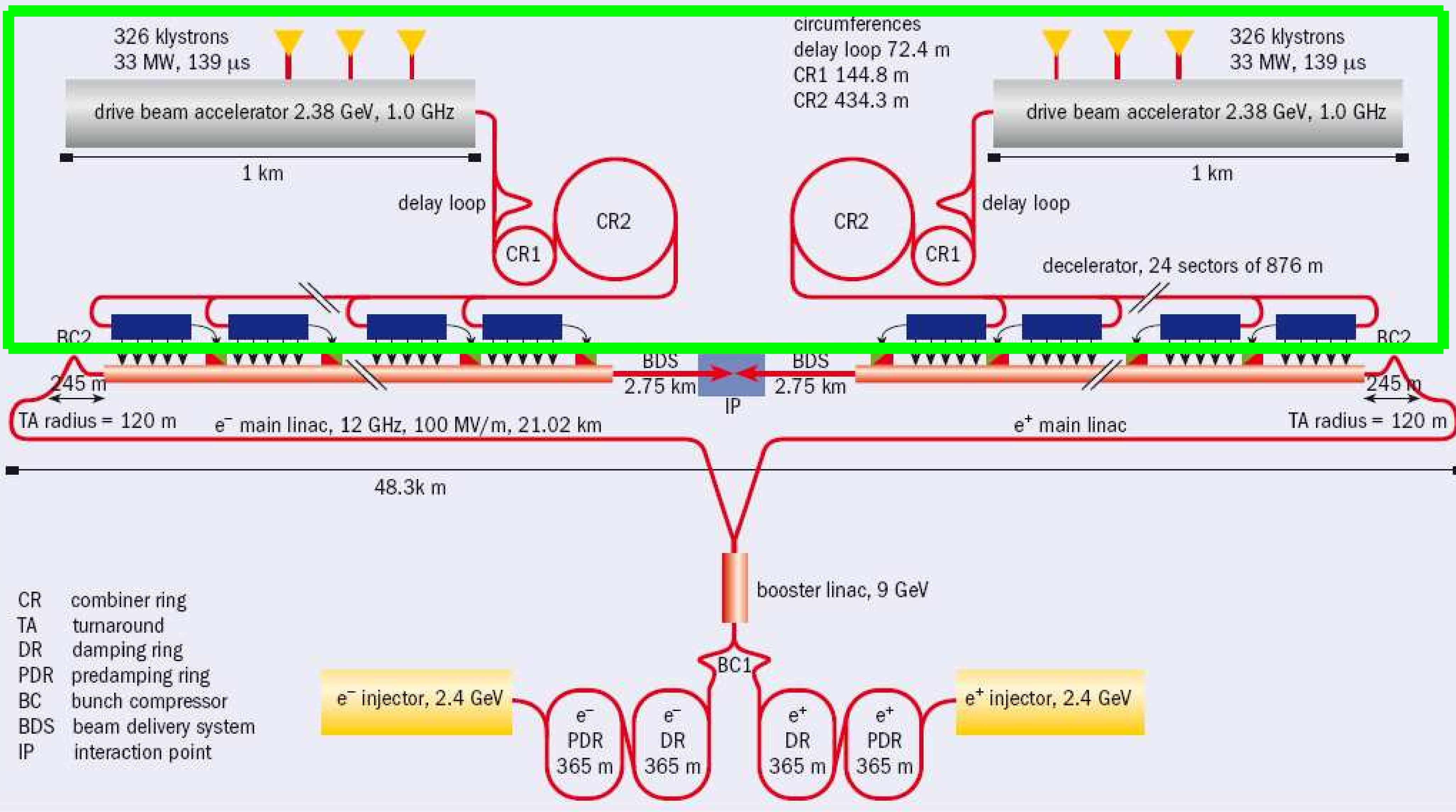
326 klystrons
33 MW, 139 μs
drive beam accelerator 2.38 GeV, 1.0 GHz
1 km
circumferences
delay loop 72.4 m
CR1 144.8 m
CR2 434.3 m
326 klystrons
33 MW, 139 μs
drive beam accelerator 2.38 GeV, 1.0 GHz
1 km
delay loop
CR2
CR1
delay loop
CR2
CR1
decelerator, 24 sectors of 876 m
BC2
BDS
BDS
BC2
IP
TA radius = 120 m
e⁻ main linac, 12 GHz, 100 MV/m, 21.02 km
e⁺ main linac
48.3k m
booster linac, 9 GeV
BC1
CR combiner ring
TA turnaround
DR damping ring
BC bunch compressor
BDS beam delivery system
IP interaction point
e⁻ injector, 2.4 GeV
e⁻ PDR 365 m
e⁻ DR 365 m
e⁺ DR 365 m
e⁺ PDR 365 m
e⁺ injector, 2.4 GeV

RTML - 1st tracking studies

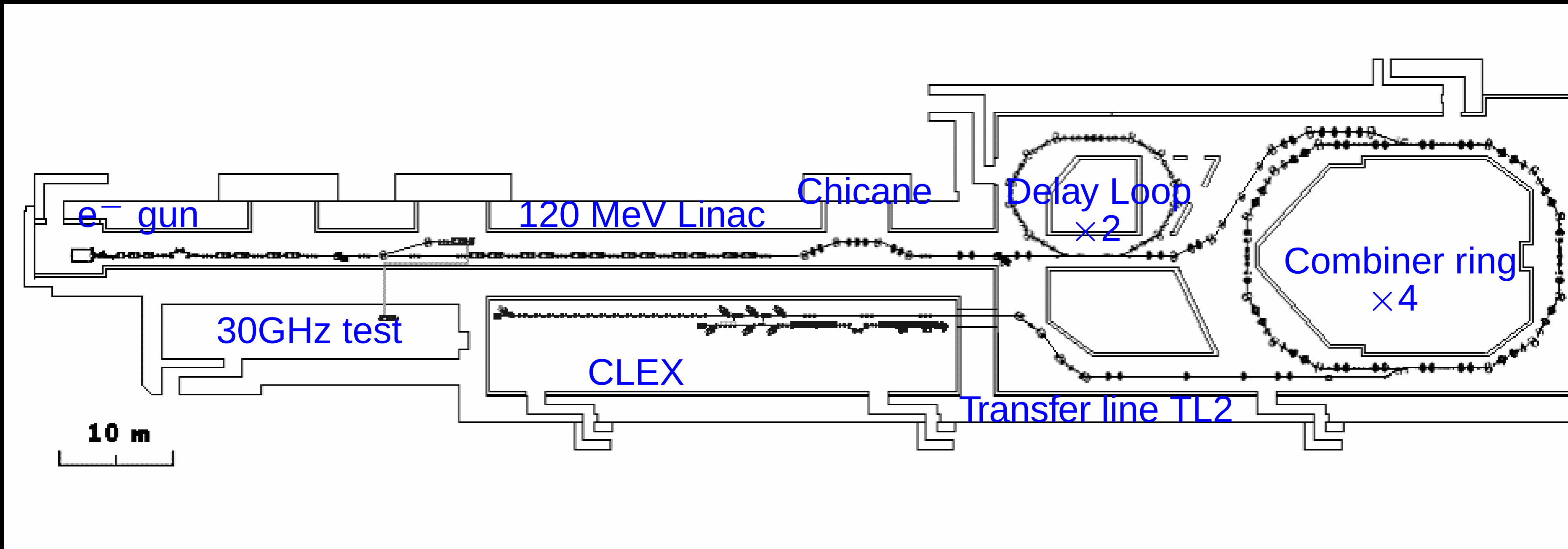


Negligible longitudinal phase space deformation in the RTML at 8 GeV. TH6PFP047

Drive beam complex

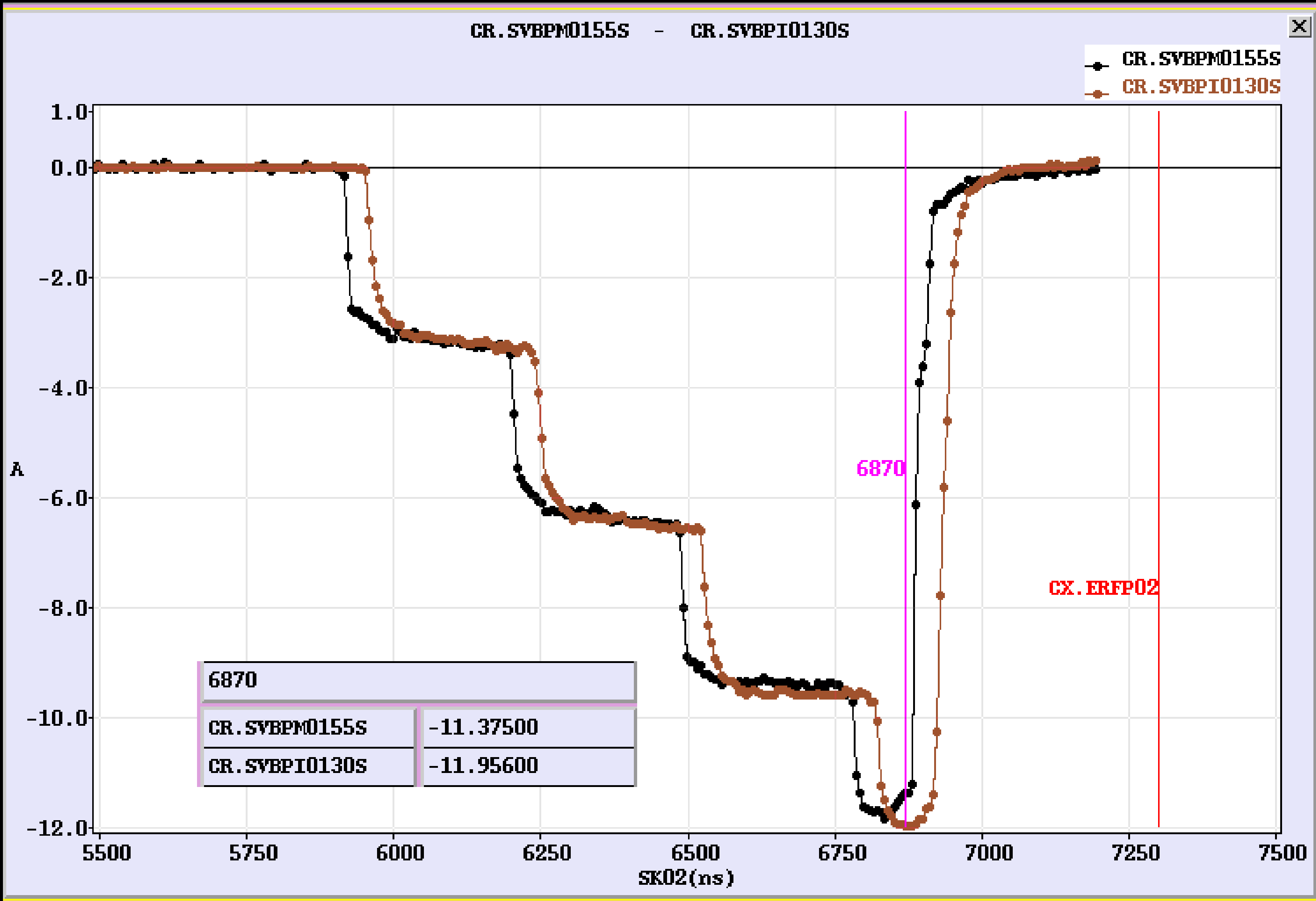


CLIC Test Facility 3

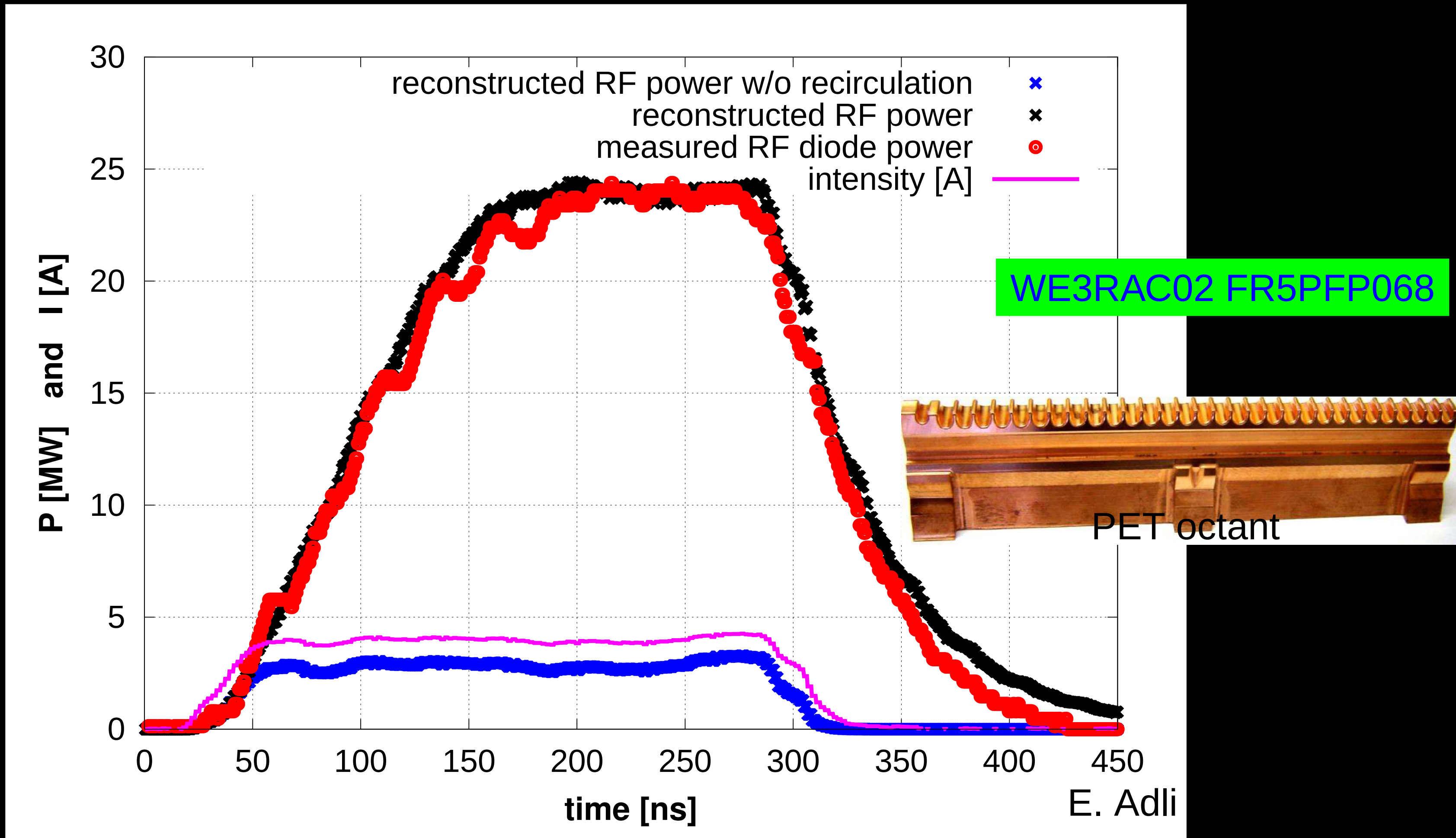


CLEX is where the high intensity beam (drive beam) transfers its energy to the main beam.

CTF3 - $\times$4 combination in CR!



CTF3 - Power extraction & recirculation!



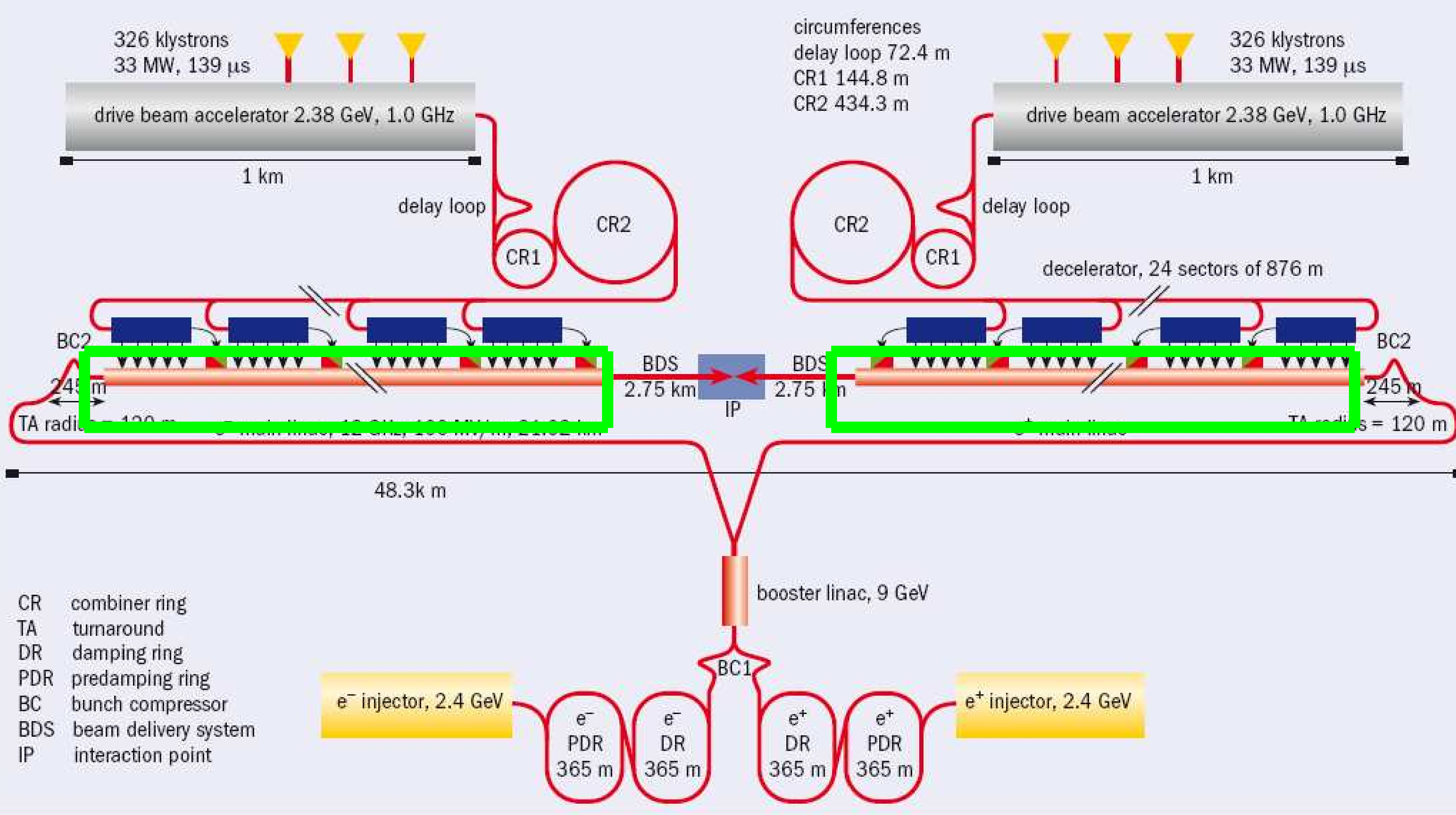
WE3RAC02 FR5PFP068

Power extraction demonstrated @ 3 A. Enhancement by power recirculation in the PETS.

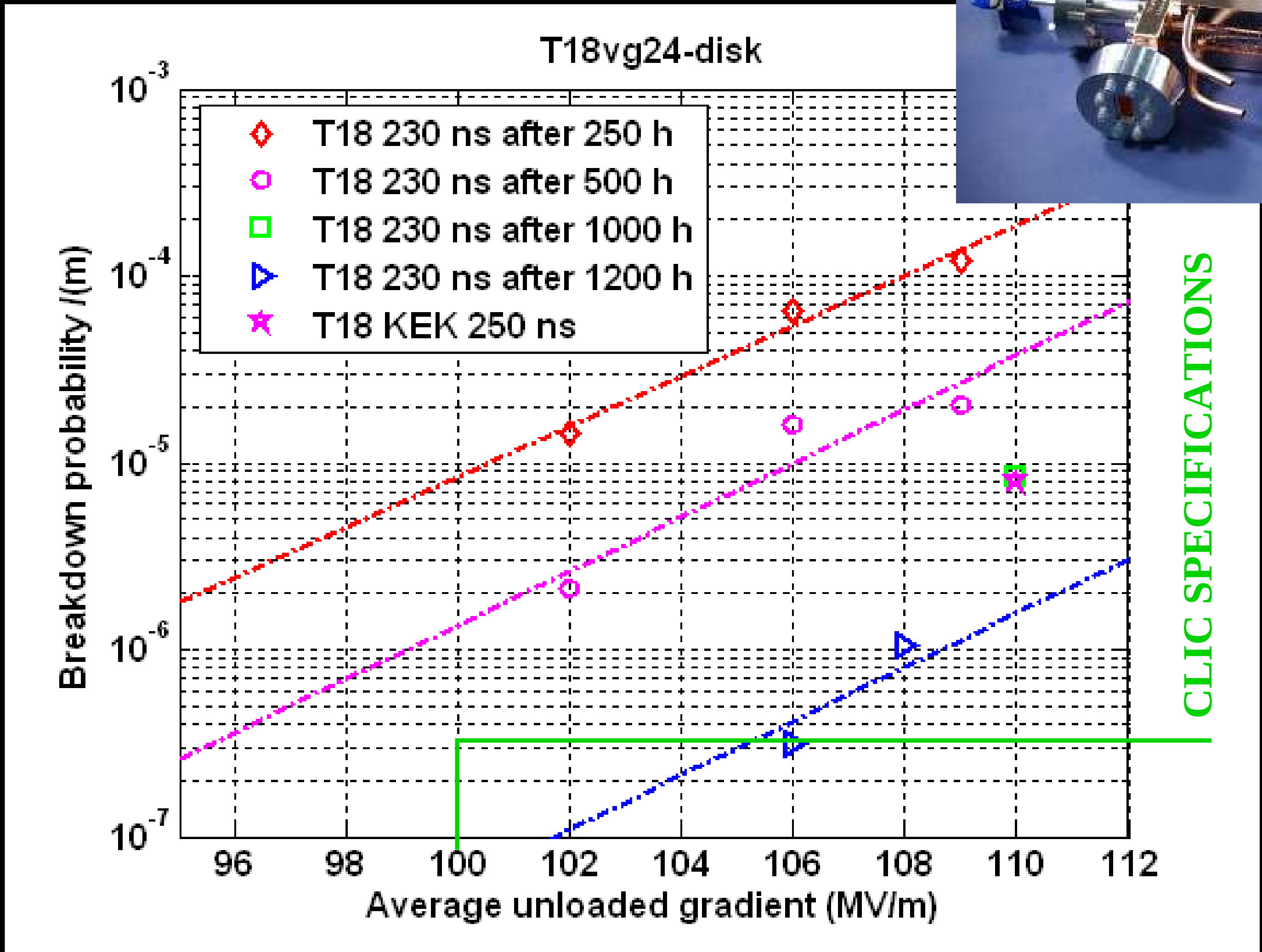
CTF3 - Next steps

- 28 A by recombination in delay loop and CR
- two beam acceleration (PETS + 12 GHz structures)
- Stability of decelarated beam
- PETS on-off
- RF feedback R&D

LINAC TH6PFP04[5-6] FR5RFP05[3,5]



Accelerating cavity tests

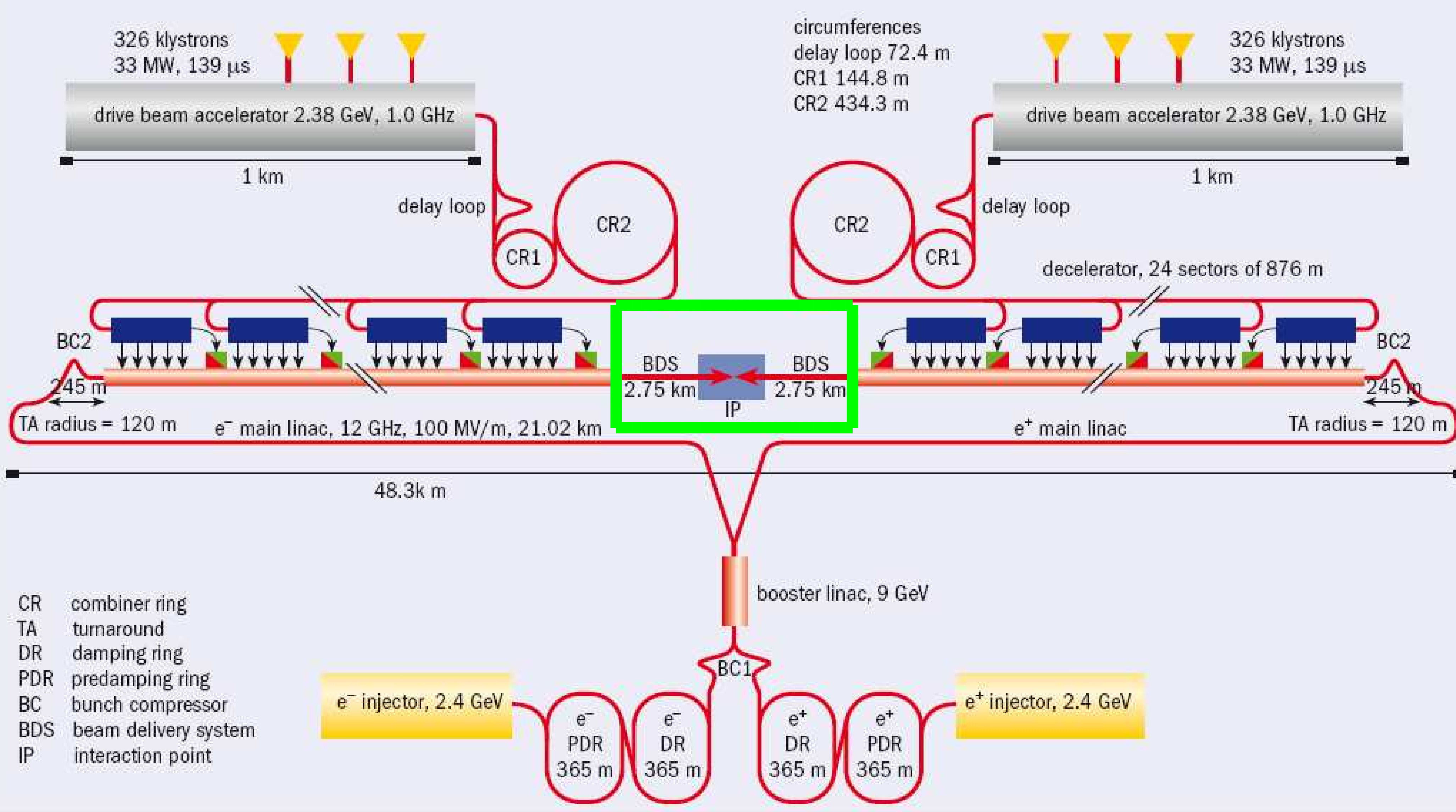


CERN design
KEK manufacturing
SLAC assembly &
RF testing

WE5PFP018

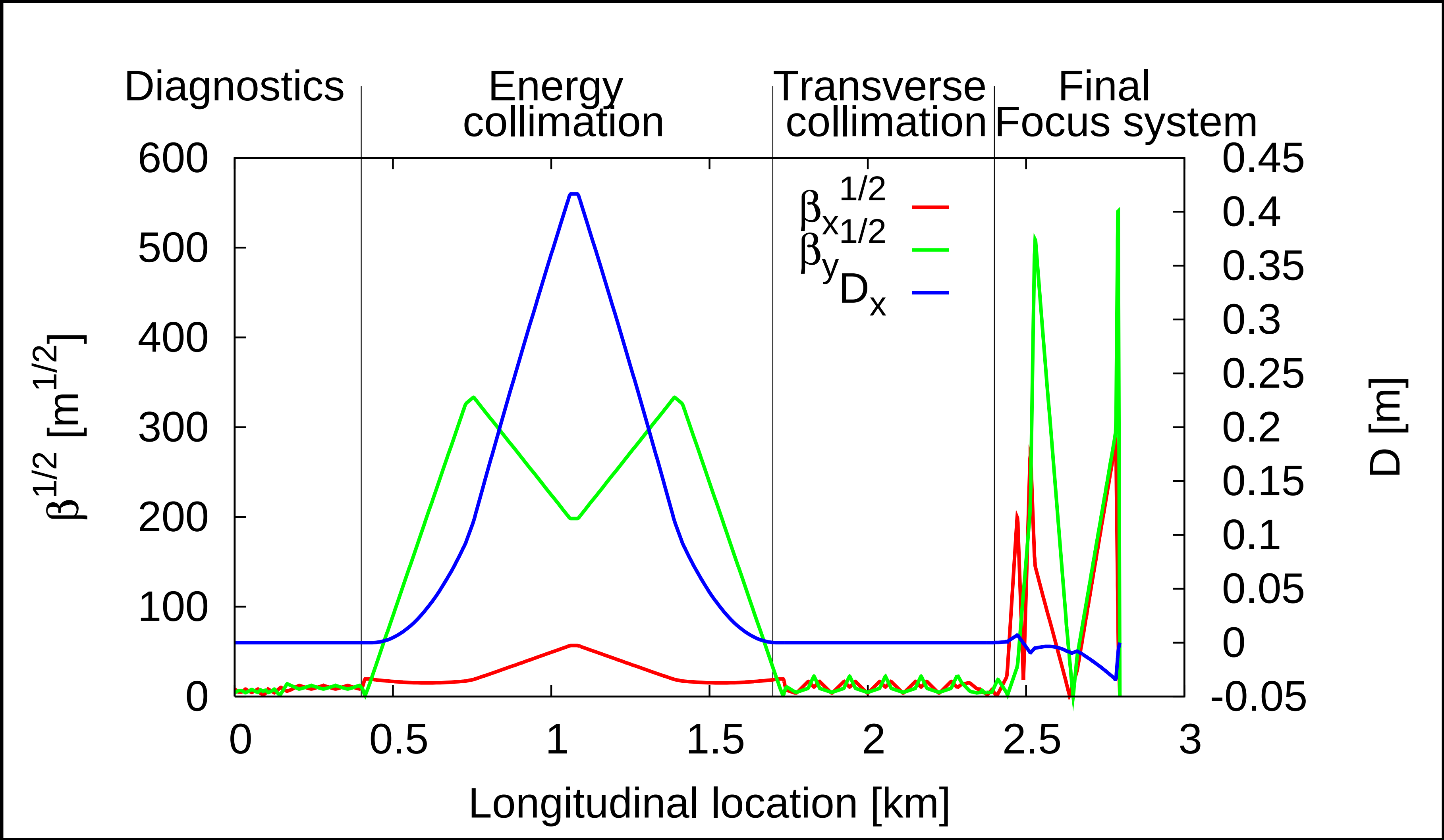
Demonstration of CLIC specifications with a CLIC-like structure without damping.

Beam Delivery System



BDS subsystems

WE6PFP023 WE6RFP026 WE6RFP035 TH6PFP074



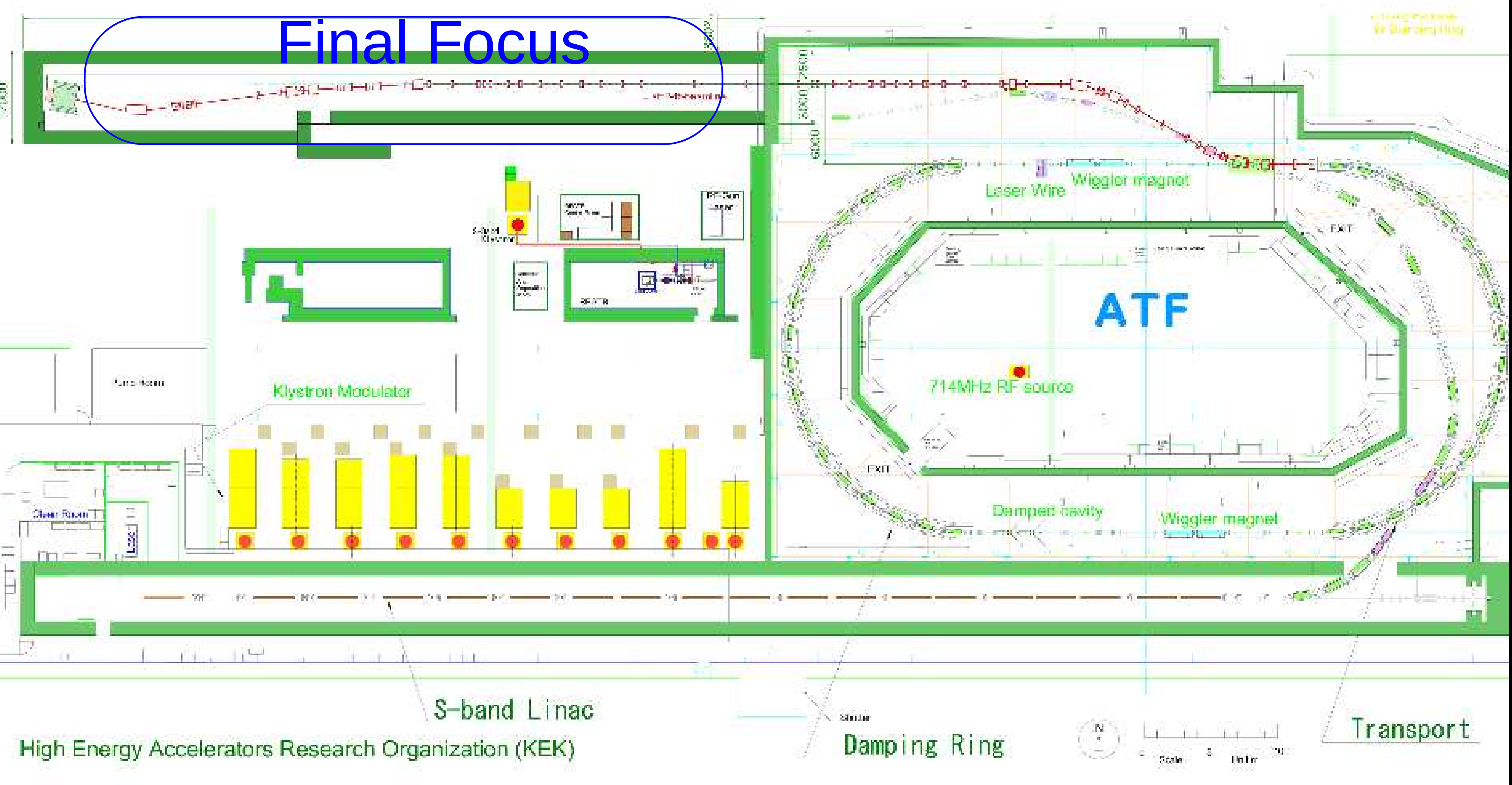
Vertical IP beam sizes and chromaticities

Project	Status	σ_y^* [nm]	ξ_y
FFTB	Measured	70	17000
ATF2	Commissioning	37	19000
ILC	Design	6	15000
ILC low power†	Proposed	4	30000
CLIC	Design	1	63000

† WE6PFP082

CLIC, again, the most challenging.

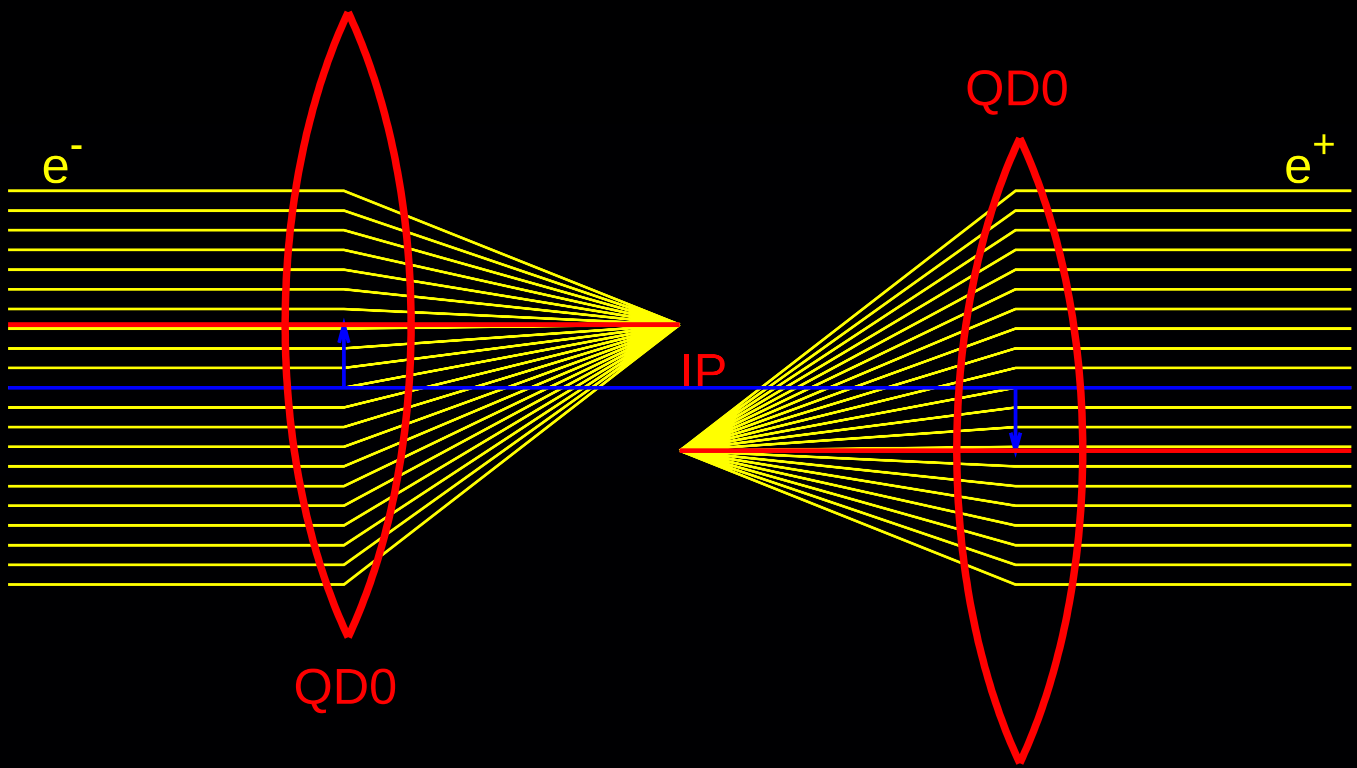
ATF2 layout FR1RAI03 FR5PFP021



ATF2 ultra-low β proposal WE6PFP024

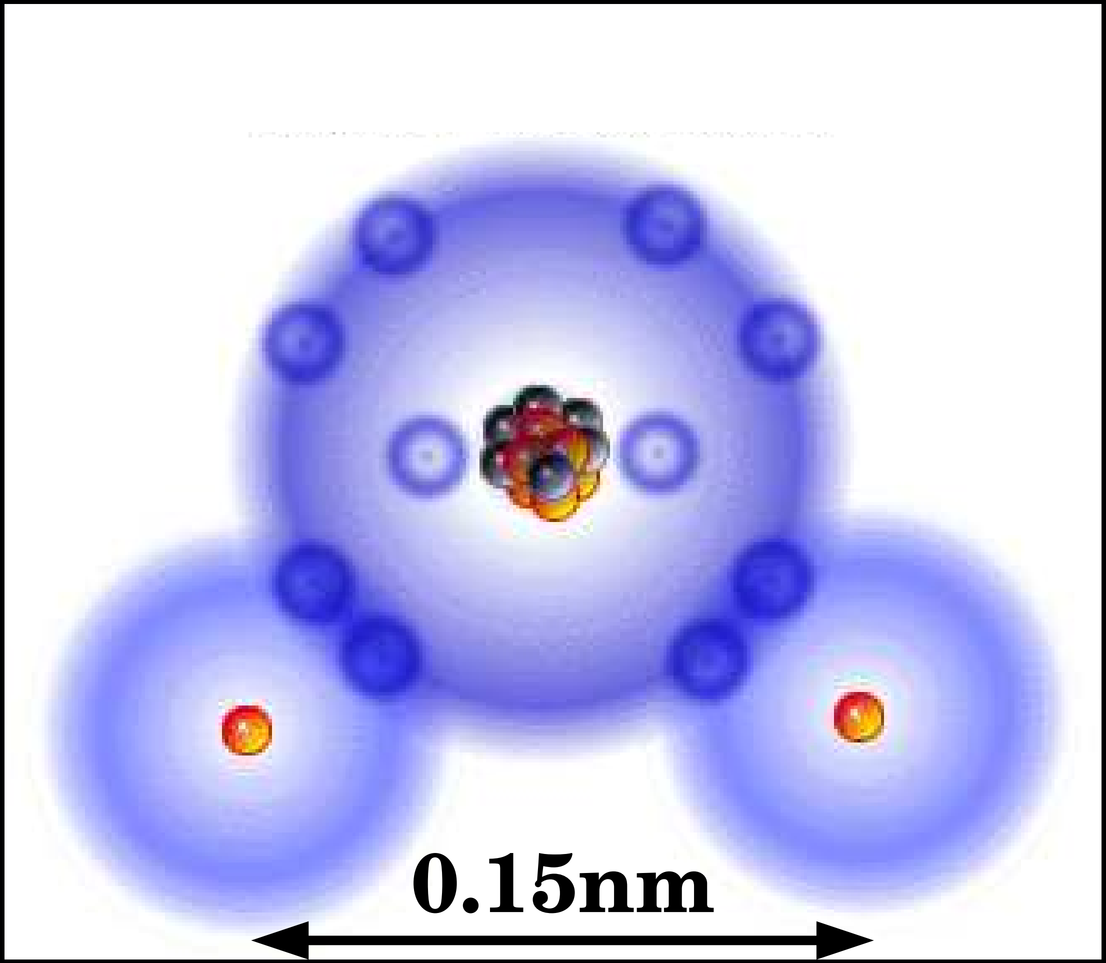
- In CARE/ELAN-2008-002 a squeeze of the ATF2 IP β-functions by a factor of 4 was proposed to prove CLIC chromaticity,
- $\sigma_y \approx$20 nm, $\xi_y \approx$76000.
- Beneficial for the ILC project, more in particular for the ILC low power option.
- The future superconducting FD for ATF2 should extend the ultra-low β R&D. MO6PFP044

CLIC QD0 stabilization TH5RFP086 TH5RFP081

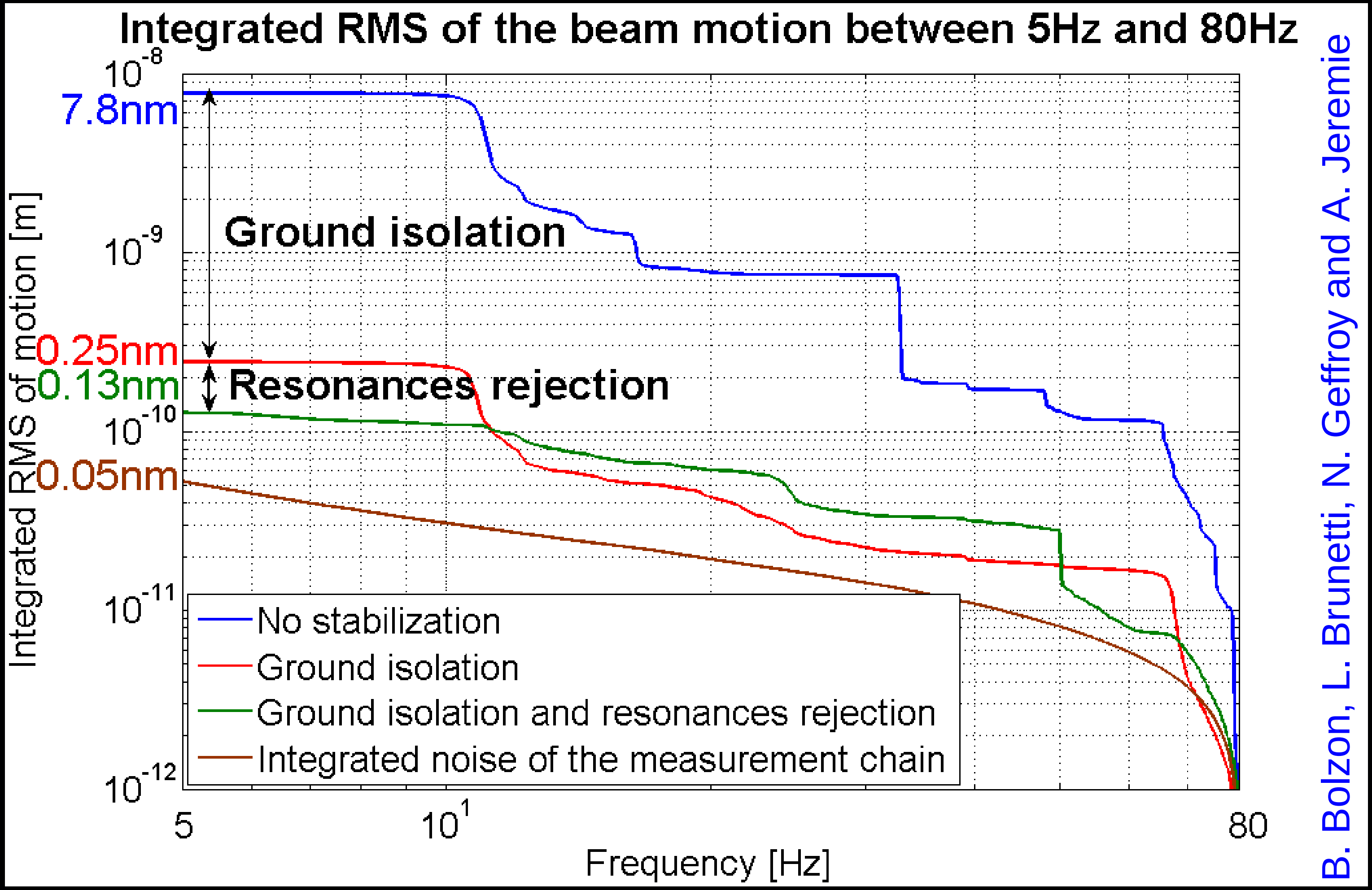


QD0 has to be stabilized to 0.15 nm for frequencies above 4 Hz.

0.15 nm, small as a H_2O molecule!

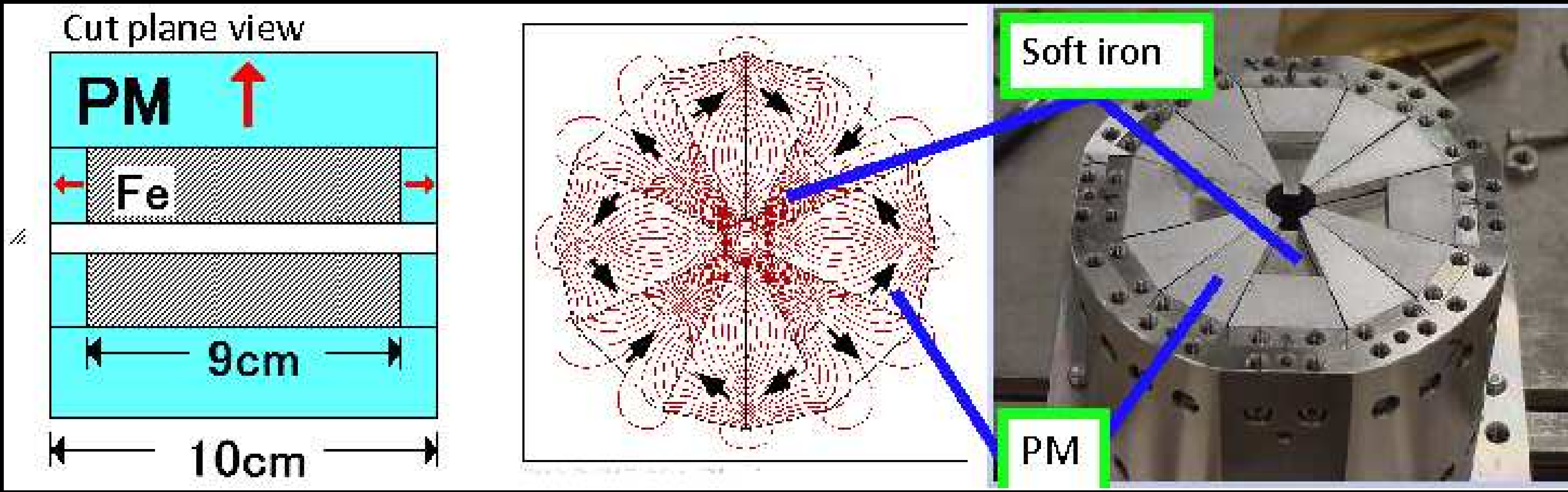


Active stabilization studies



0.13 nm reached in laboratory, the challenge remains to prove 0.15 nm within the detector.

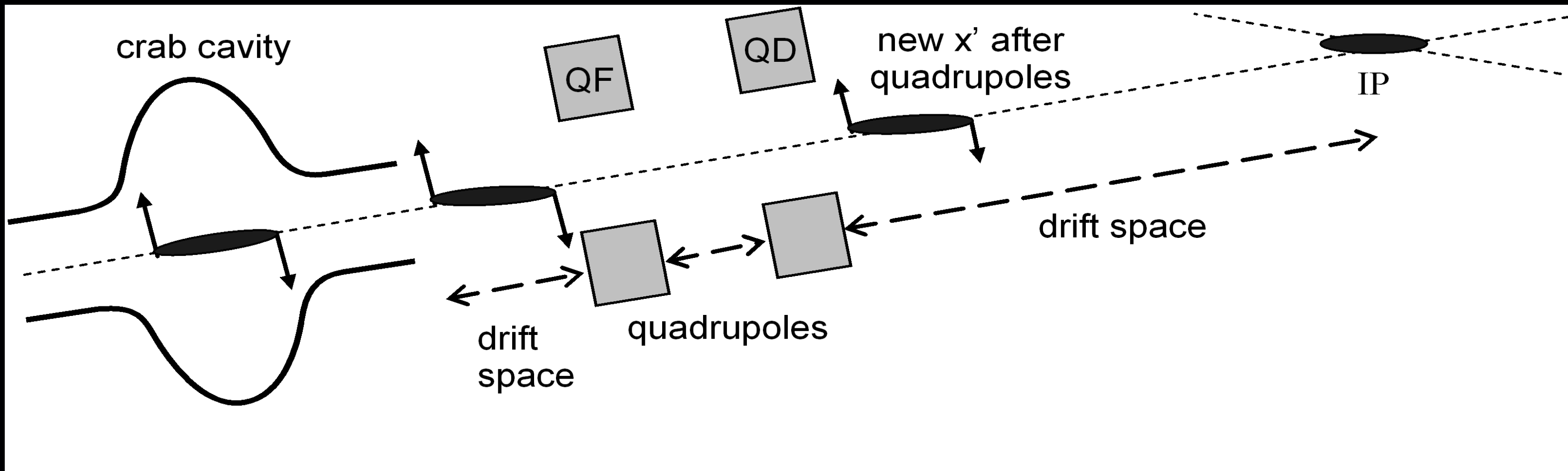
A possible concept for the CLIC QD0



T. Mihara, Y.Iwashita, M. Kumada and C.M. Spencer

(Superconducting QD0 is not excluded but subnanometer stabilization of coil adds a challenge)

Crab Cavity TU5PFP006



A. Dexter

Frequency can be 4 GHz or 12 GHz, biggest challenge is phase stability of 0.008° and 0.025°, respectively.

CLIC schedule

- 2010: CDR.
- 2015: TDR, technical designs and final cost.
- 2016: project aproval?
- 2023: 500 GeV CLIC first beam.
- 2026: 3 TeV CLIC first beam.

Summary

- Excellent progress towards the CLIC CDR,
- but lots of work still to be done.
- Challenging work and tight schedule!

Thanks to the outstanding contributions from the growing international collaborations!:

Helsinki Inst. of Phys., IRFU, LAL, LURE, LAPP, LAS, RRCAT, Indore, LNF, KEK, Oslo Univ., NCP, BINP, IAP, JINR, CIEMAT, UPC, IFIC, Uppsala Univ., Svedberg Lab, PSI, Ankara Univ., Gazi Univ., IAP, NASU, J. Adams Institute, Royal Holloway, Univ. of London, Cockcroft Institute, Univ. of Oxford, Northwestern univ. Illinois, SLAC, JLAB, ANL, BNL and NSC/KIPT-Kharkov.

See you in CLIC09 workshop,

October @ CERN.