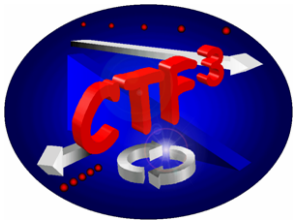
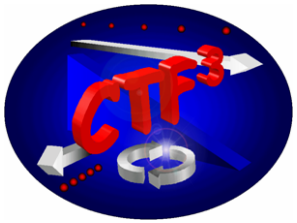


Power and pulse length possibilities in CTF3

G.Geschonke

Base line design of CTF3



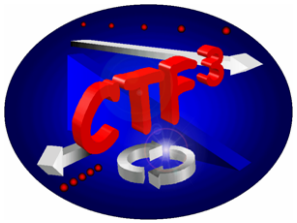
1) demonstrate 30 GHz RF power source for CLIC

design parameters 30 GHz and 140 ns RF pulse length
other frequencies than 30 GHz ?
different pulse length ?

2) Power source for 30 GHz tests

a) PETS line
b) 2-beam test stand

Other frequencies after CR



PETS line:

- Virtually all harmonics of 3 GHz would be accessible
- Current limited to a maximum of 5 A (~ 200 ns pulse length)

after Combiner Ring

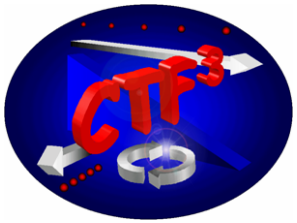
- Using the nominal combination factor (5), the basic bunch frequency is 15 GHz
- Accessible frequencies: 15 GHz , 30 GHz & 45 GHz
- Current limited to 35 A (140 ns pulse length)

- Different combination factors can in principle be used (from 2 to 5 ?):

• CF = 2	ν_0 = 6 GHz	6, 12, 18, 24, 30, 36 …	14 A
• CF = 3	ν_0 = 9 GHz	9, 18, 27, 36 …	21 A
• CF = 4	ν_0 = 12 GHz	12, 24, 36 …	28 A
• CF = 5	ν_0 = 15 GHz	15, 30, 45 …	35 A

Roberto Corsini

Other frequencies after CR

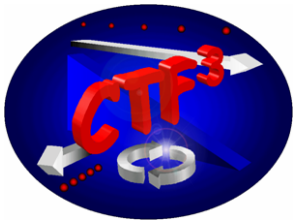


- In order to cover a range from 2 to 5 in CF, both path length and frequency must be changed – Example:

FX =	$\delta f(FX)$ =	$\delta C_{CR}(FX)$	$\delta L_{DL}(FX)$
2	-238	-10	3.3
3	0	0	0
4	119	5	-1.7
5	190	8	-2.7
	kHz	mm	

N.B.: Nominal ring length set around CF = 3

Other pulse lengths after CR



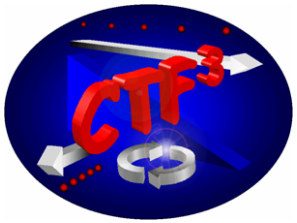
Pulse length:

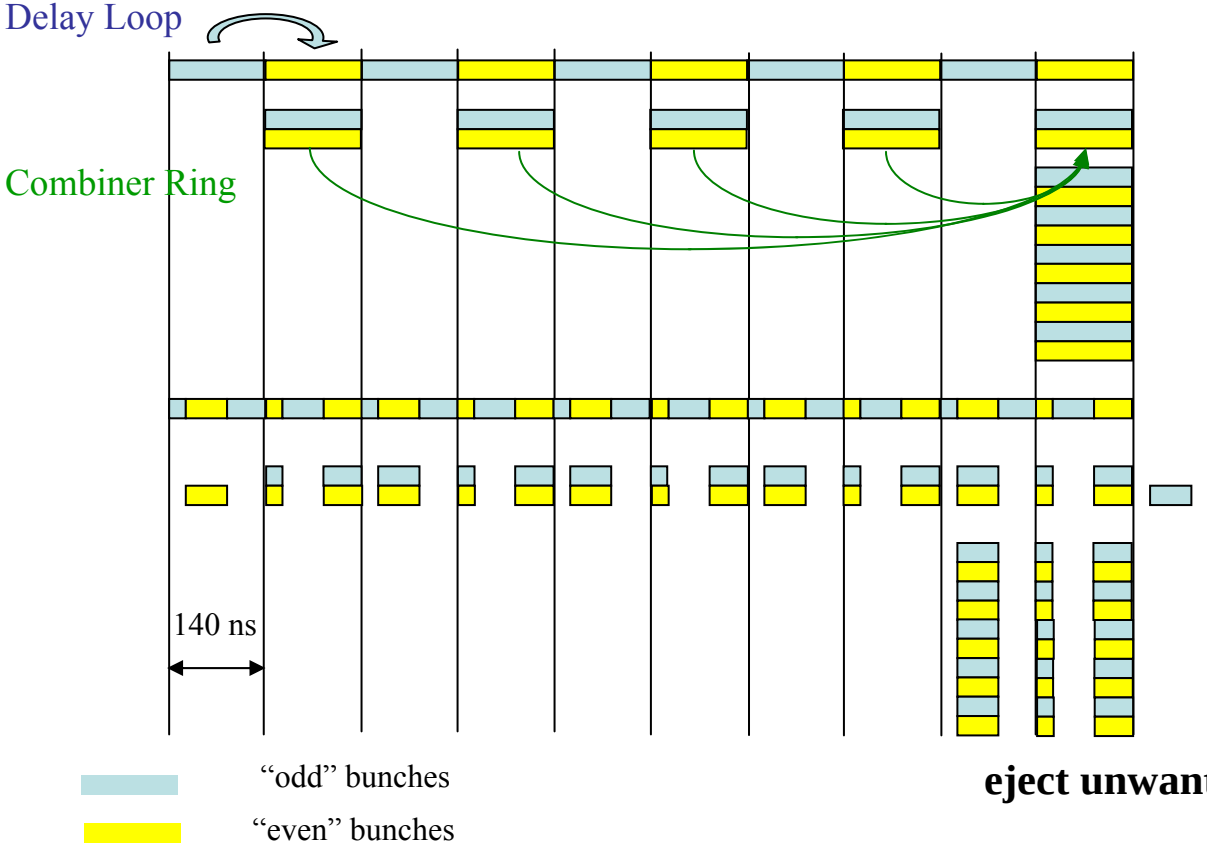
140 ns given by SHB phase switching
Delay Loop length = 140 ns

eject bunches with kicker after Combiner Ring.

15 GHz rep. rate => 67 ps
kicker rise time 20 ns
3 ns development for ILC

Other pulse lengths after CR





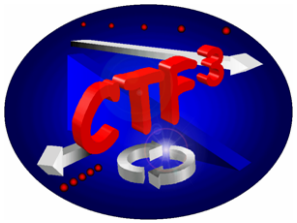
nominal scheme:
SHB bunch phase switch
every 140 ns

2 additional phase switches
within 140 ns

eject unwanted bunches with kicker

any pulse length possible,
however switching transient ~ 5 ns

Power after CR



35 A beam available at pulse length adjustable

CTF3 vs. CLIC		
Current, A	35	176
σ, mm	0.4	0.4
Energy, GeV	0.15	2.37
Power, MW	25.4	642
Frequency, GHz	15.	15.

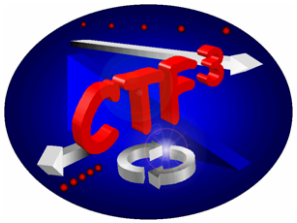
The full power will be generated by CLIC PETS from CTF3 drive beam if extra 430 MW will be used to "prime" it. This could be done using few special booster structures in parallel, so that each of them produces moderate peak power. It is advisable not to exceed the electric surface field level in booster structure compared to that in CLIC PETS. Assuming 90% power transfer efficiency, booster should produce 480 MW.

remark on time scale:

tests can be done as soon as CR is commissioned
➔ 2007

OK for PETS tests with primer

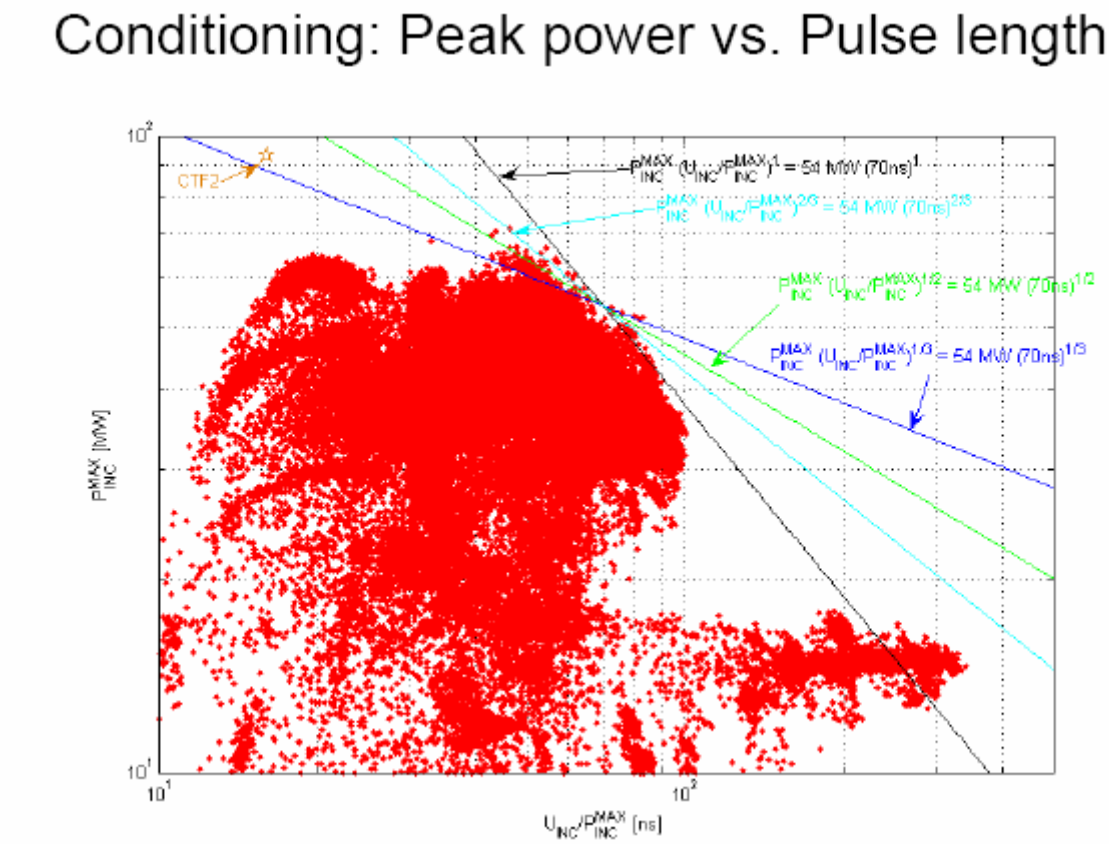
PETS line



Frequency:
any multiple of 3 GHz

operation in power mode:
higher beam current 3.5 A ➔ 5 A,
higher RF power in structures (reminder: outside their specs)
typically: 50 – 70 MW instead of 35 MW
at shorter pulse length 200 ns instead of 1.5 µs

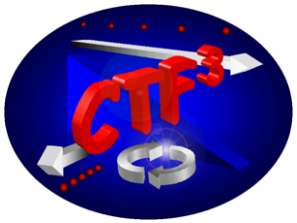
30 GHz data



70 MW, 50 ns
52 MW, 70 ns

Alberto Rodriguez

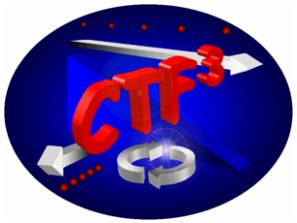
Power production with PETS



S. Doebert

Expected	Achieved
(P_{out} (MW) = 4.762 I^2 (A) *F^2)	
3.5 A: 58 MW	30 MW ,90 %Trans
4.5 A: 96 MW	77 MW
5A: 119 MW	100 MW, 80 % Trans
95-100% Transmission	

now - future



	PETS out	pulse length	DUT
	MW	ns	MW
Hans 2004 coll meeting	74	80	54
		140	40
Steffen 2005	100	70	60
	25	300	15
Alberto's plot		50	70
		70	52
		100	45
Roberto	90	70	70

take: 60 MW @ 70 ns
power loss PETS – DUT: 30 %

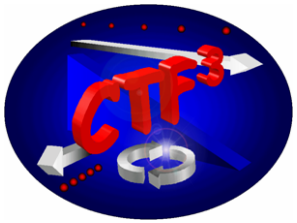
if we need 100 MW in DUT at 70 ns:
reduce losses in RF power line (different waveguides) +10% ➔ 80 % transfer
increase beam current from 5 ➔ 6 A : + 30 % Lower energy ?

➔ 85 MW in DUT

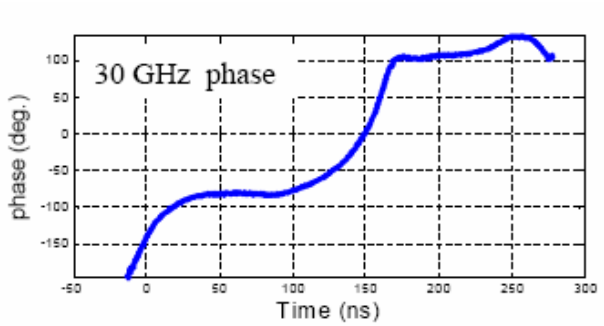
about 20 % missing.

New PETS structure ?

RF pulse compression



1. bunch phase switch by 18 degrees



(Hans Braun 2004 coll meeting)

Works in principle. If this can be further improved, the PETS line together with a 30 GHz pulse compressor could provide 30 GHz power of ≈300 MW, covering all the needs for the 30 GHz accelerating structure development programme !

has not been followed up in 2005

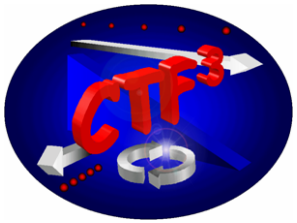
2. active switched pulse compressor

still in laboratory stage.
does it work ?
reliability, rep rate,

3. passive pulse compressor

has not been done in 2005.
potential:

RF Pulse compression



to reach 100 MW @ 70 ns in DUT:

not switched: factor 2

400 ns @ 60 MW from PETS
possible ?

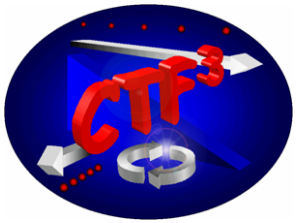
switched: factor 4

a) slow switch
750 ns @ 30 MW
possible ?

b) fast switch
360 ns @ 30 MW

Conclusion : Can we base our test programme on RF pulse compression ?
my personal opinion: No, at least not in the moment

Conclusion



continue business as usual:
up to 70 ns, 60-70 MW into DUT
pulse length limited by PETS / RF transmission line

PETS damaged ?
waveguides damaged ?

upgrade:
with planned upgrades we can probably achieve 85 MW @ 70 ns
for more new PETS necessary

SOS scheme:
pulse compression works, long RF pulse necessary (360 - 750 ns, 30 - 60 MW from PETS)

100 MW probably achievable in routine operation.
Consequence for CLIC structure parameters ?