An X-band e+e-/$\gamma\gamma$ Higgs factory at KEK

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R. Belusevic: KEK Preprint 2008-33, ArXiv:0810.3187v2

Main characteristics of the proposed facility:

1. Based on CLIC-type cavities and the existing RF technology (XL4 klystrons, ScandiNova modulators, SLED II system)

2. A two-beam scheme could be implemented at a later stage as a test facility for CLIC

3. An optical FEL would be used to produce high-energy photon beams for a $\gamma\gamma$ collider

4. In the first stage of operation ($e^+e^- \rightarrow Z, WW$ and $\gamma\gamma \rightarrow H$) the proposed facility could be built within the KEK site

Main characteristics of the proposed facility:

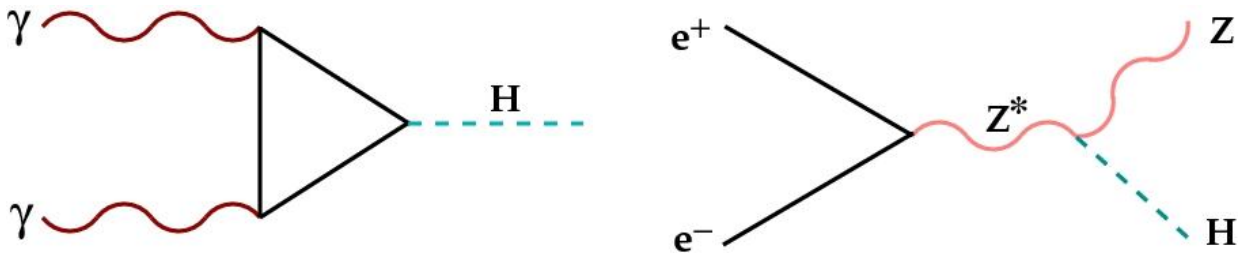
5 If the initial operational mode is with photon beams, then there is no need for an e+ source and a positron DR

6 With a crossing angle of ~25 mrad for both e+e- and $\gamma\gamma$ beams, only a single beam dump line would be required

7 For some processes, the required CM energy is considerably lower at the proposed facility than at an e+e- or pp collider

8 The rich set of final states in e+e- and $\gamma\gamma$ collisions is essential for measuring all the properties of the Higgs boson

Higgs production in e+e- and $\gamma\gamma$ collisions



The following Higgs properties can be measured in these processes:

M_H, spin, CP	M_H, spin, CP
CP violation	H-Z coupling
$\Gamma_{\gamma\gamma}Br(W^*W)$	Γ_{tot}
$\Gamma_{\gamma\gamma}Br(bb)$, …	$Br(W^*W)$, $Br(bb)$, …

Combining the two sets of measurements yields $\Gamma_{\gamma\gamma}$, which is a unique measure of physics beyond the Standard Model.

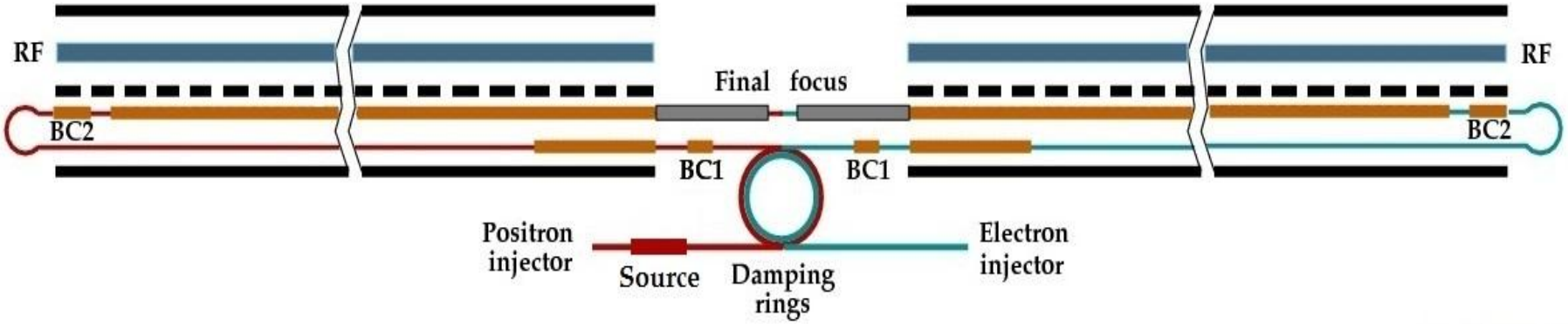
Higgs self-coupling in e+e- and $\gamma\gamma$ collisions

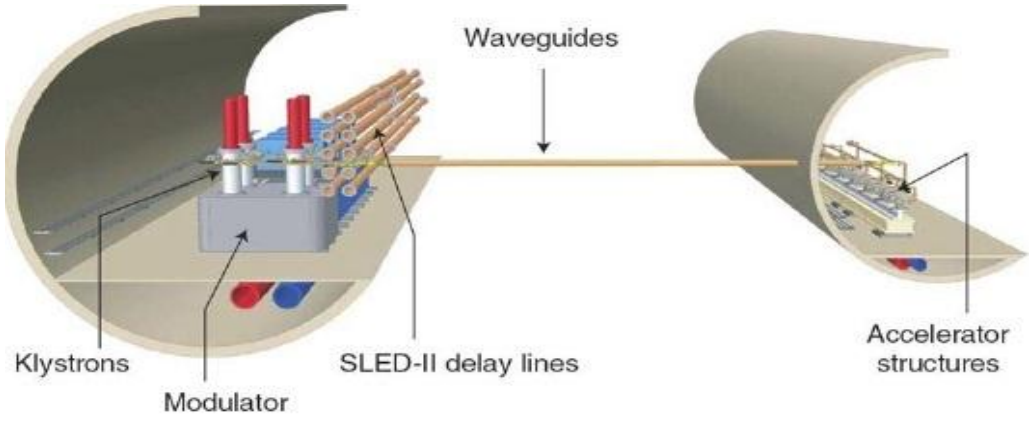
The trilinear Higgs self-coupling can be measured in the process $\gamma\gamma \rightarrow HH$ just above the kinematic threshold of $2M_H$ ($E_{ee} \sim 340$ GeV), and at $E_{ee} \sim 500$ GeV in the process $e^+e^- \leftrightarrow ZHH$.

Sensitivity to the trilinear Higgs self-coupling is expected to be similar in e+e- and $\gamma\gamma$ collisions. Detailed MC simulations are currently carried out at Hiroshima University and KEK (K. Fujii et al.).

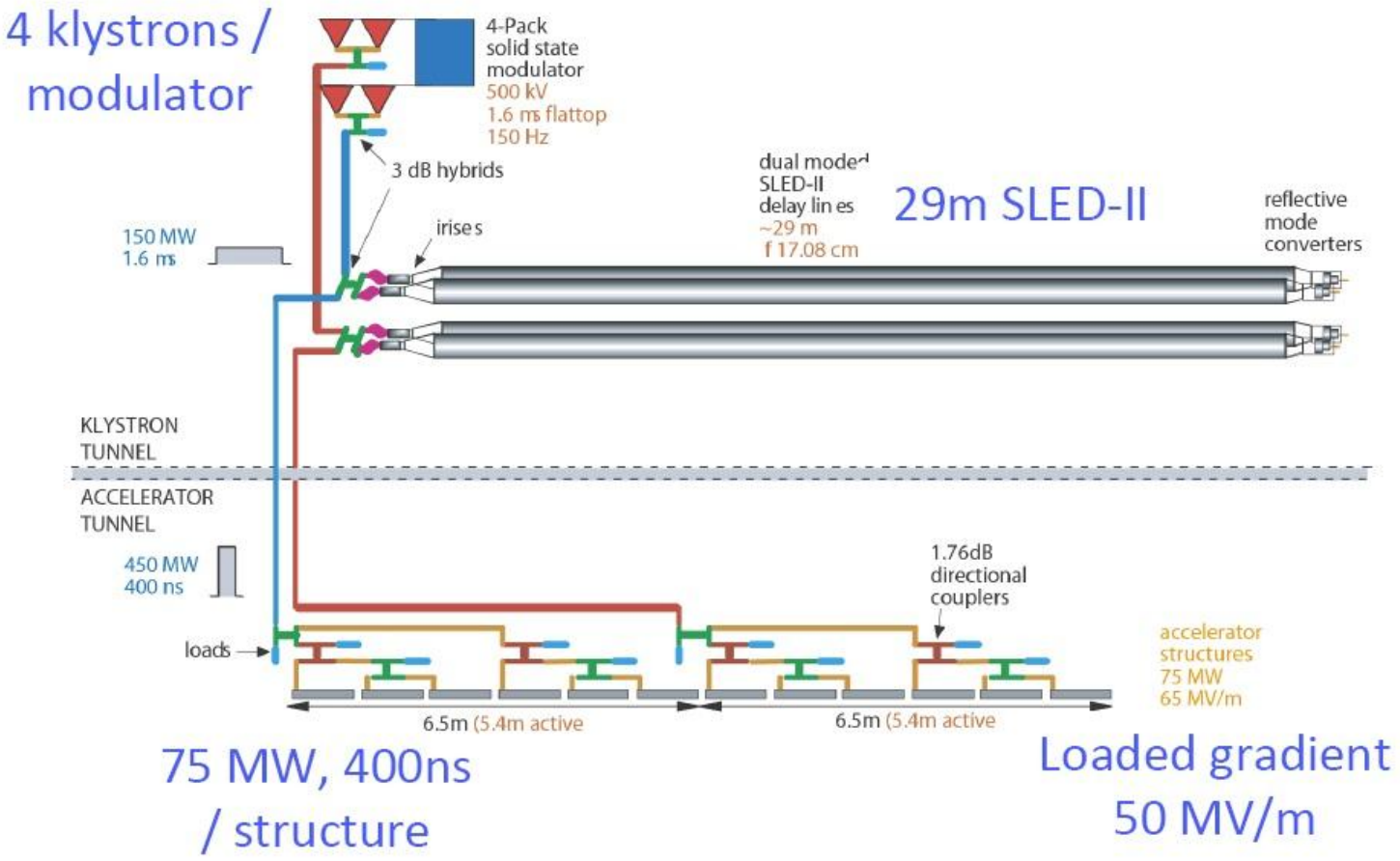
R. Belusevic & G. Jikia: Phys. Rev. D **70,** 073017-1 (2004)

Schematic layout of the collider





GLC RF configuration



GLC Project, KEK Report 2003-7

Rough design parameters (1)

T. Higo

	GLC	CLIC500	CLIC	Stage 1
Total CM energy (GeV)	500	500	3000	250
Loaded accelerator gradient (MV/m)	50	80	100	85
Effective gradient (MV/m)	44			70
Linac length (km)	14.5			3.6
Klystron peak power (MW)	75			40
Klystron pulse length (μs)	1.6			1.0
Pulse compression ratio	4			4
Power / structure	75			52
RF pulse length	400			250
Beam current	0.86	2.2	1.2	1.2

Rough design parameters (2)

T. Higo

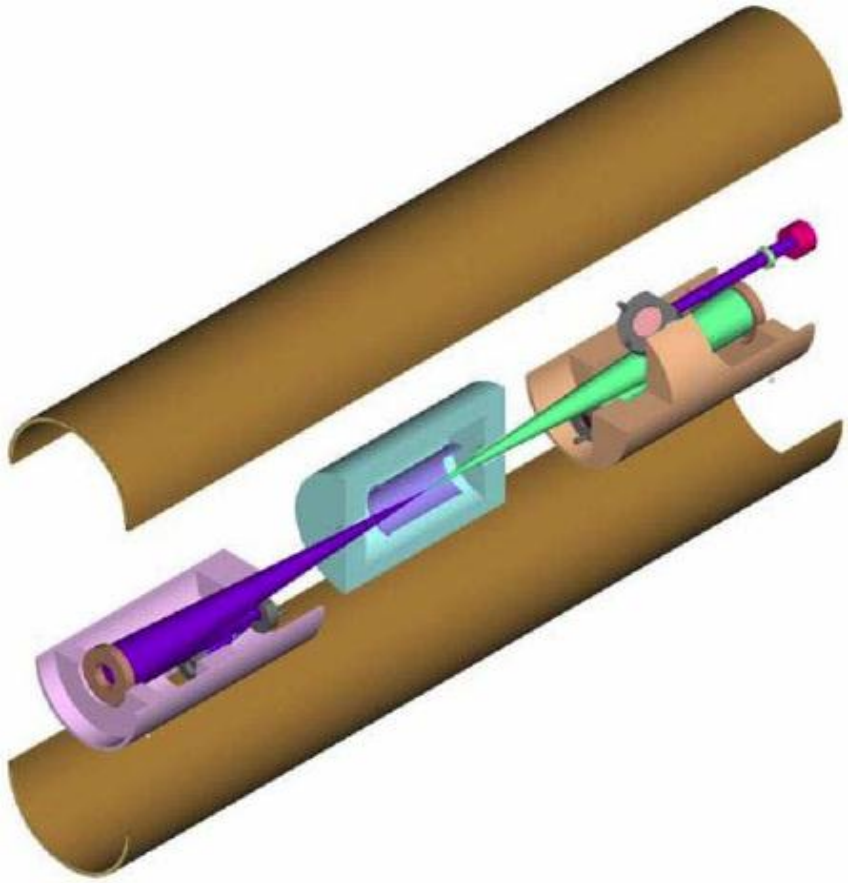
	GLC	CLIC500	CLIC	Present
Number of particles in a bunch 10^{10}	0.75	0.68	0.37	
Bunch spacing (ns)	1.4	0.5	0.5	
Number of bunches / train	192	354	392	
Bunch train length (ns)	267	177	196	
.....				
Wall plug power (MW)	233			
Peak luminosity (10^{34})	2.5			
Cost				

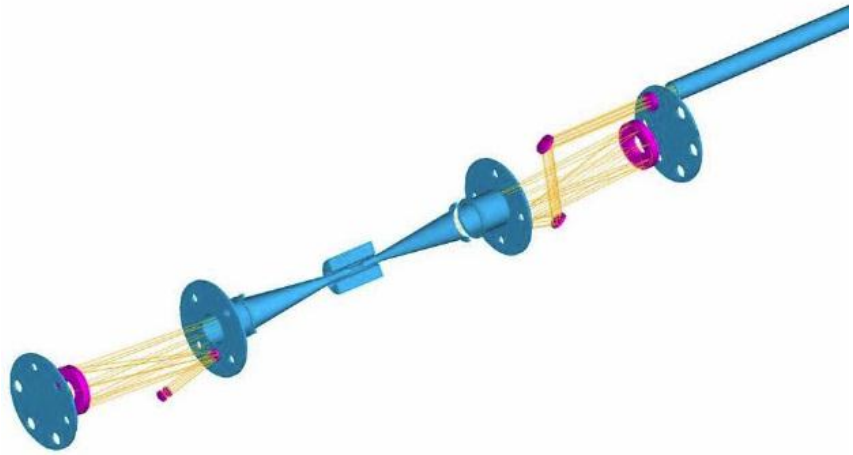
Rough design parameters (3)

T. Higo

	GLC	CLIC500	CLIC	Present
Modulator				
Klystron				XL4/PPM
Pulse compression				SLED II
Power delivery				Low loss WG
Acc. structure length (m)	0.6		0.25	0.25
Phase advance / cell	$5\pi/6$	$5\pi/6$	$2\pi/3$	$2\pi/3$
Structure filling time (ns)	120	50	67	67
Beam hole aperture 2a (mm)	0.21-0.15	<0.145>	<0.11>	<0.11>
Vg/c (%)	5.1 – 1.1	1.9 – 1.1	1.7 – 0.8	1.7 – 0.8

Optics assembly at the $\gamma\gamma$ interaction region





Elements of the assembly were designed and prototyped at LLNL

Concluding remarks:

The proposed facility would be a highly versatile Higgs factory.

The total length of the two linacs would be only about 3.6 km at $E_{ee} \sim 250$ GeV.

If a two-beam scheme is implemented (even partially) at a later stage, the proposed X-band machine could serve as a genuine test facility for CLIC.