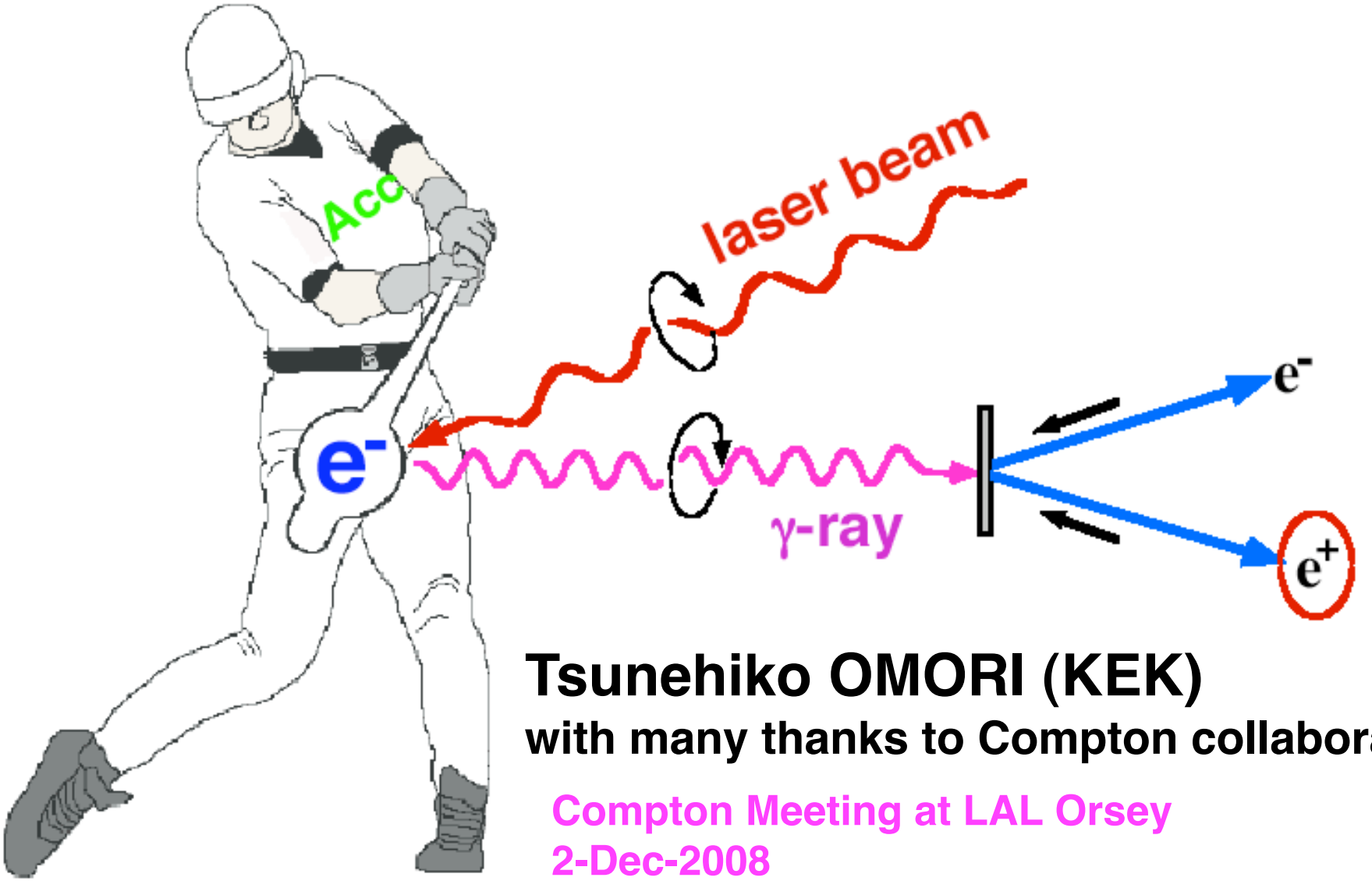
Compton Experiment at ATF



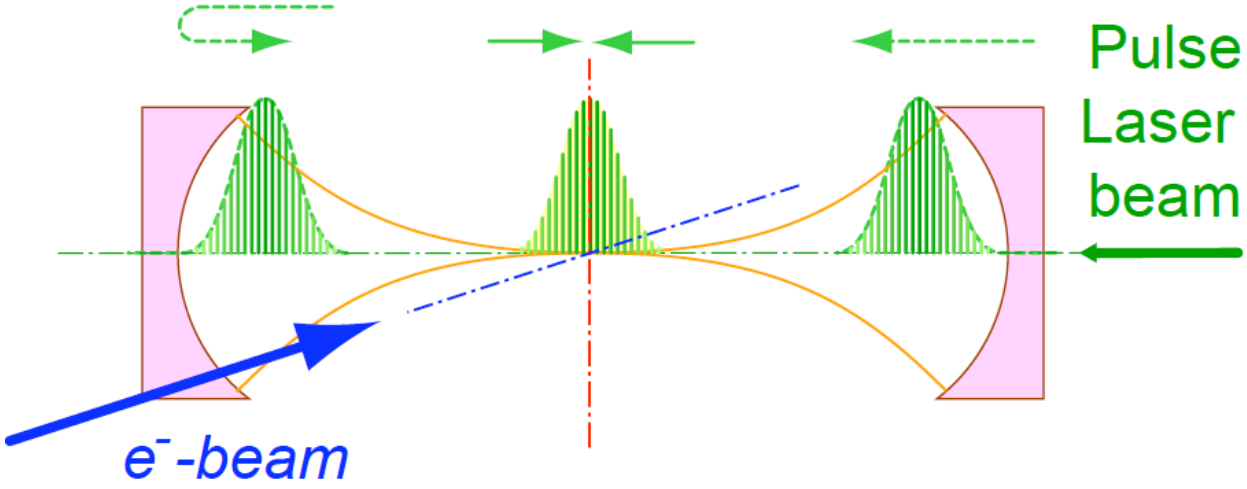
Tsunehiko OMORI (KEK)

with many thanks to Compton collaborators

Compton Meeting at LAL Orsey
2-Dec-2008

Experimental R/D in ATF

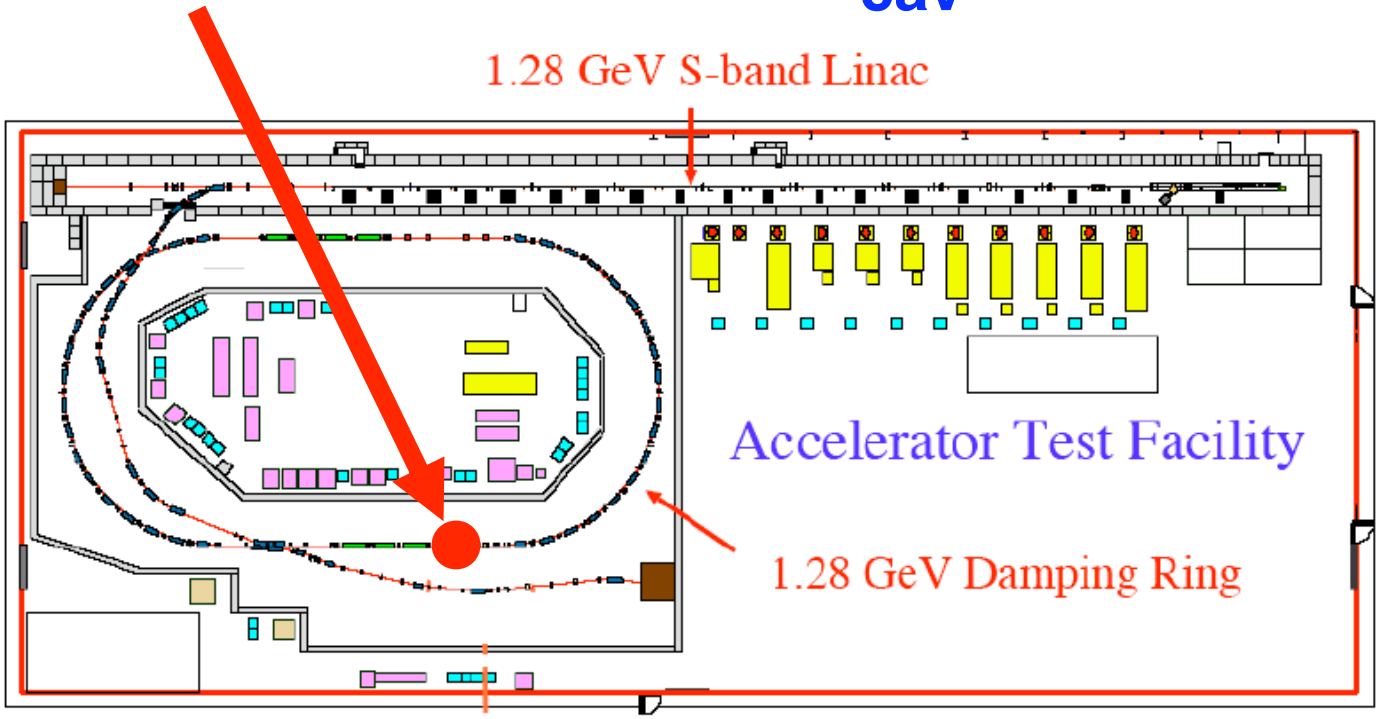
Hiroshima-Waseda-Kyoto-IHEP-KEK



Make a fist prototype 2-mirror cavity

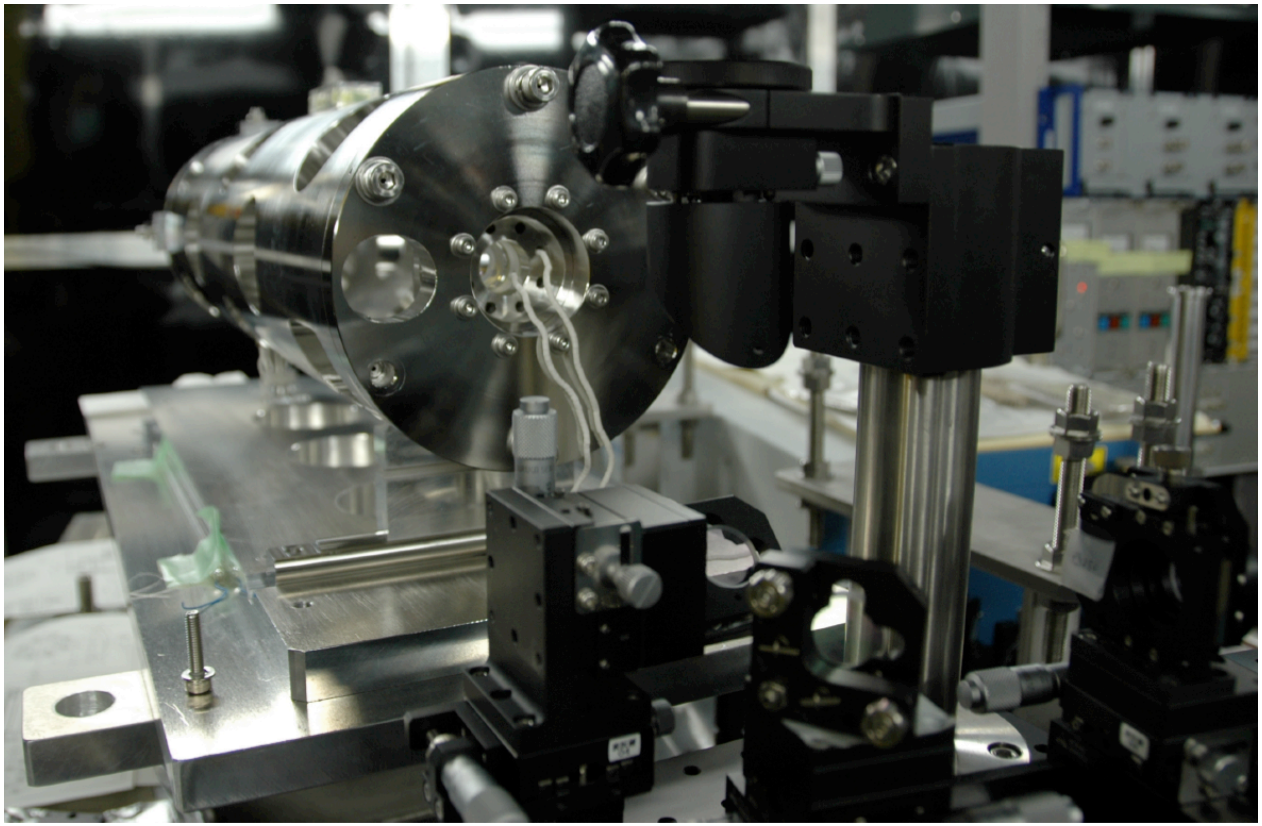
L_{cav} = 420 mm

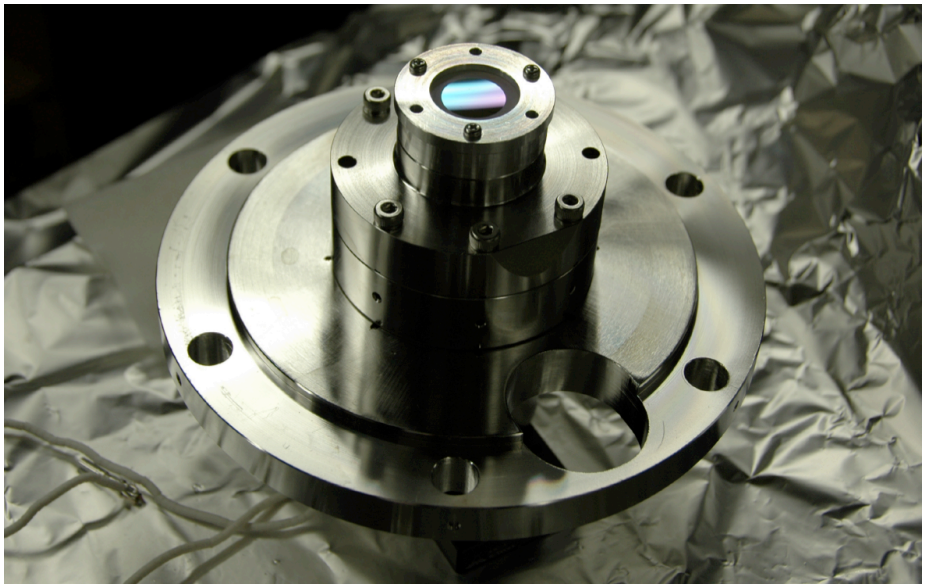
Put it in ATF ring



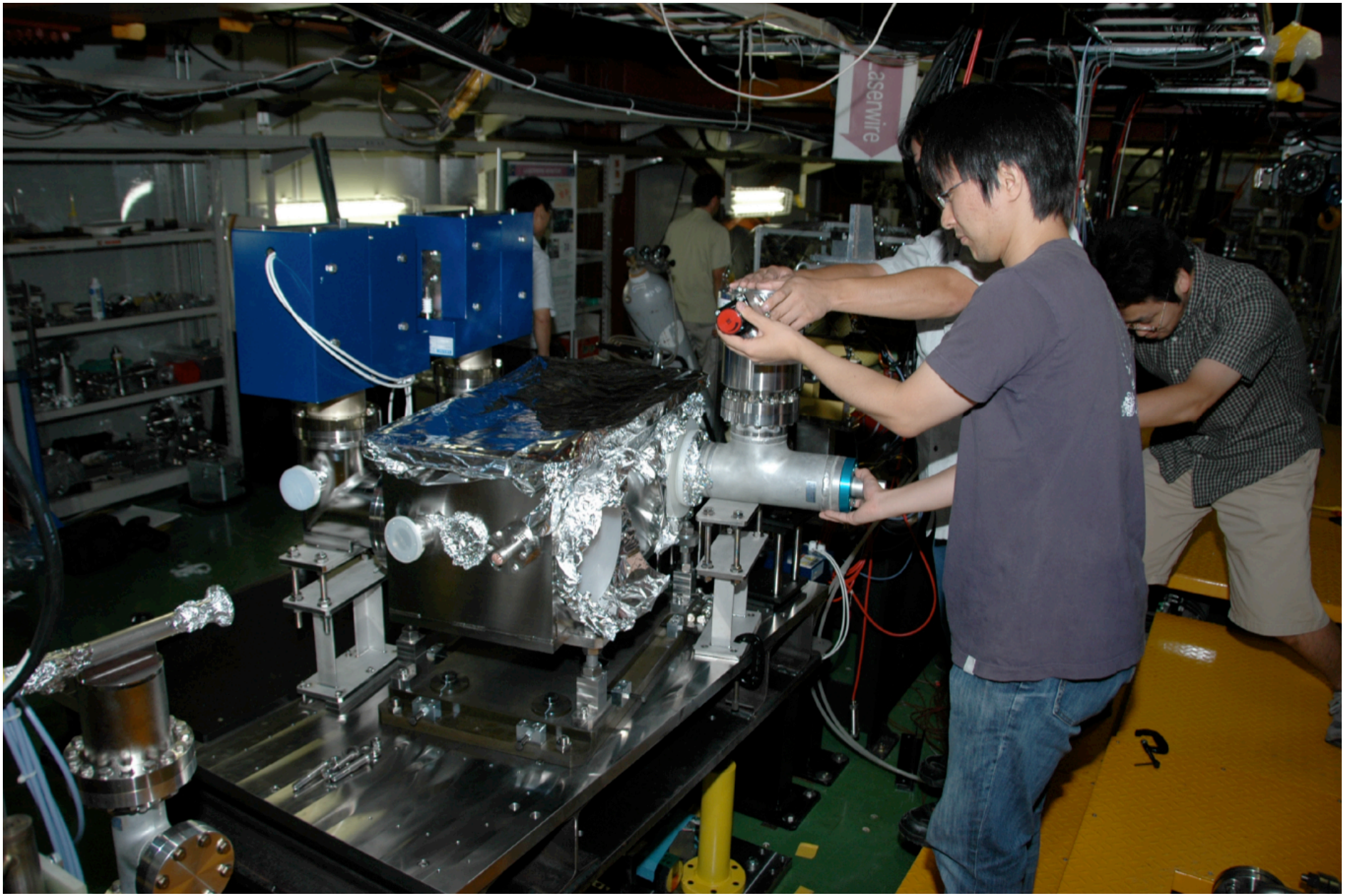
Laser Stacking Optical Cavity in Vacuum Chamber

Summer 2007: Assembling the Optical Cavity





October 2007: Install the 2-mirror cavity into ATF-DR



Before Summer

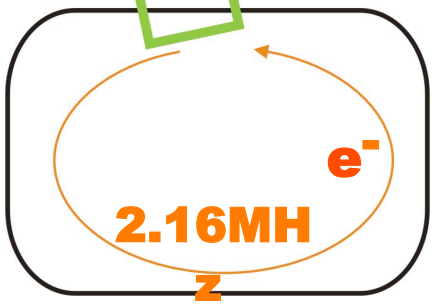
DAQ Schematic

T-light
(Cavity information)

Electron beam
signal(2.16MHz)

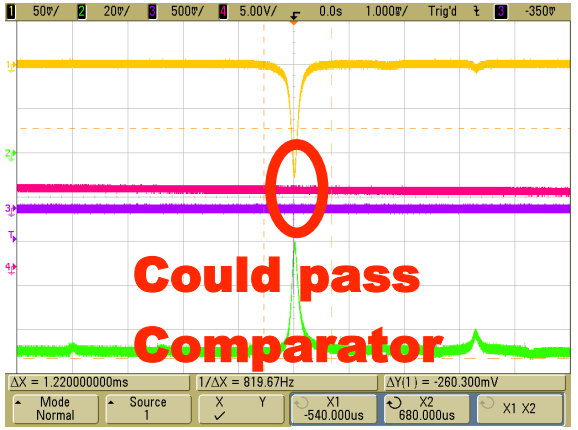
PD

cavity



T = 463ns

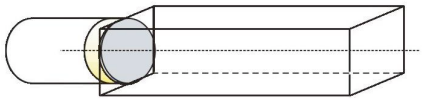
Comparator



Coincidence

Gate
generator

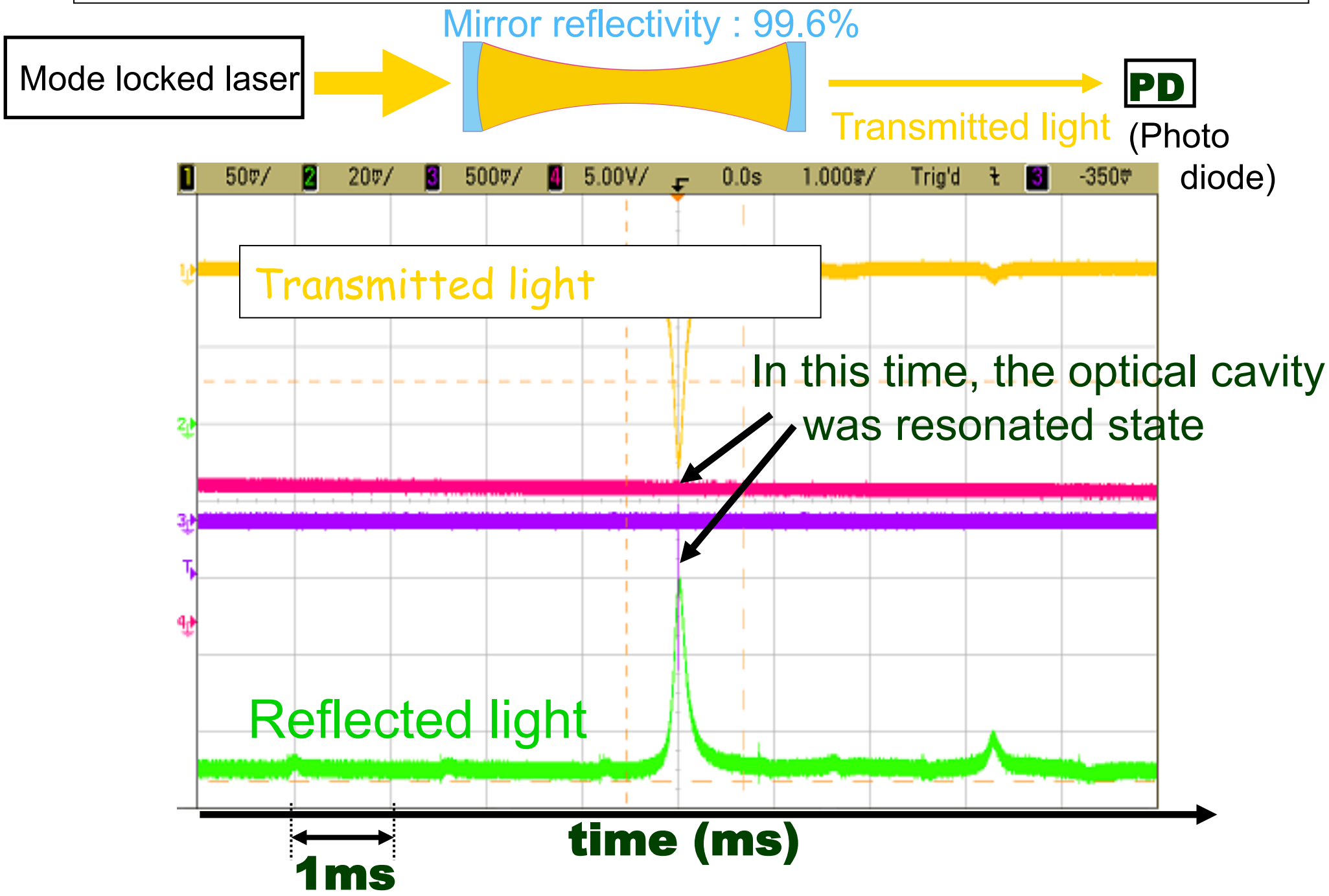
Gate was opened
for 100ns.



Continued to change the length of the external cavity.

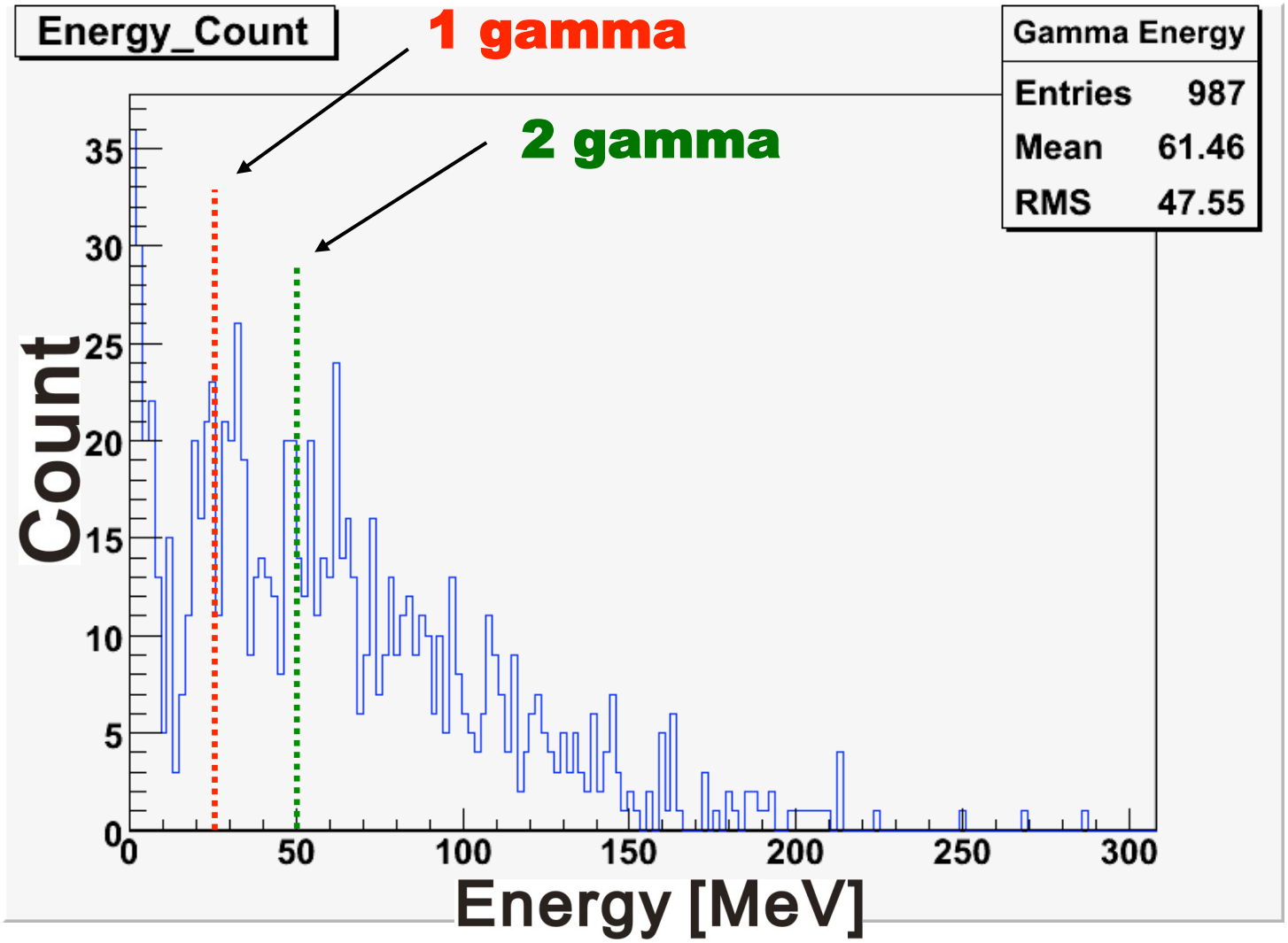
Only picked up the data when the cavity was resonated.

The appearance of light resonance signal



Continued to change the length of the external cavity.

Gamma Energy distribution 2



This graph shows the appearance of gamma energy distribution.

one of gamma had 16~28 MeV energy.

The number of gamma

date	bunch	the number of electron	transmitted power	stack power estimate	γ
		1/pulse (included in one train)	W	W	
2008/4/22	20	2.6E+10 (in 20 bunches)	1.55	388	3.1
2008/5/27	1	7.2E+9 (in 1 bunch)	1.09	272	3.27

Mirror reflectivity : 99.6% ⟶ stack power = $\frac{\text{transmitted power}}{1 - 0.996}$

bunch distance : 2.8 ns

We estimated the number of gamma to use a simulation software “CAIN”.

20 bunches : experiment γ~3.1 simulated by CAIN γ ~ 20

1 bunch : experiment γ~3.3 simulated by CAIN γ ~ 4.5

In the case of 1 bunch, the number of gamma seems to consist comparing our experiment data with estimate by CAIN.

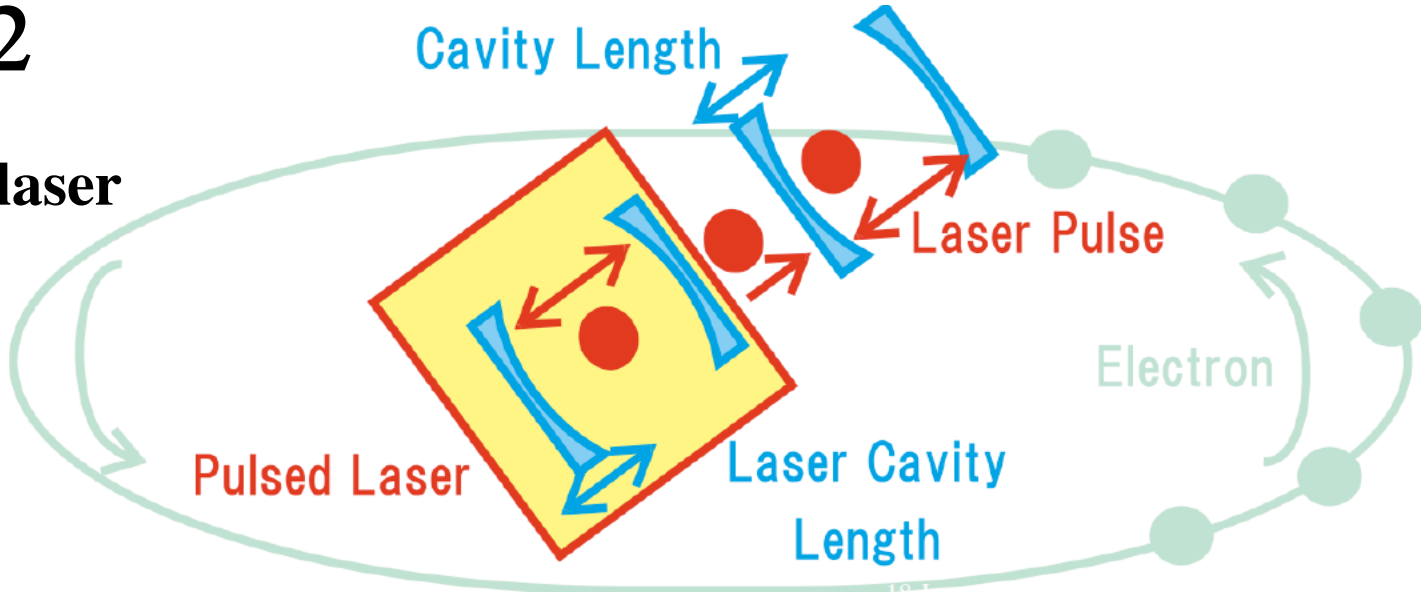
However, the data of 20bunches were inconsistent.The reason of this,there was a possibility that not every electron bunches were collided.

Present Status

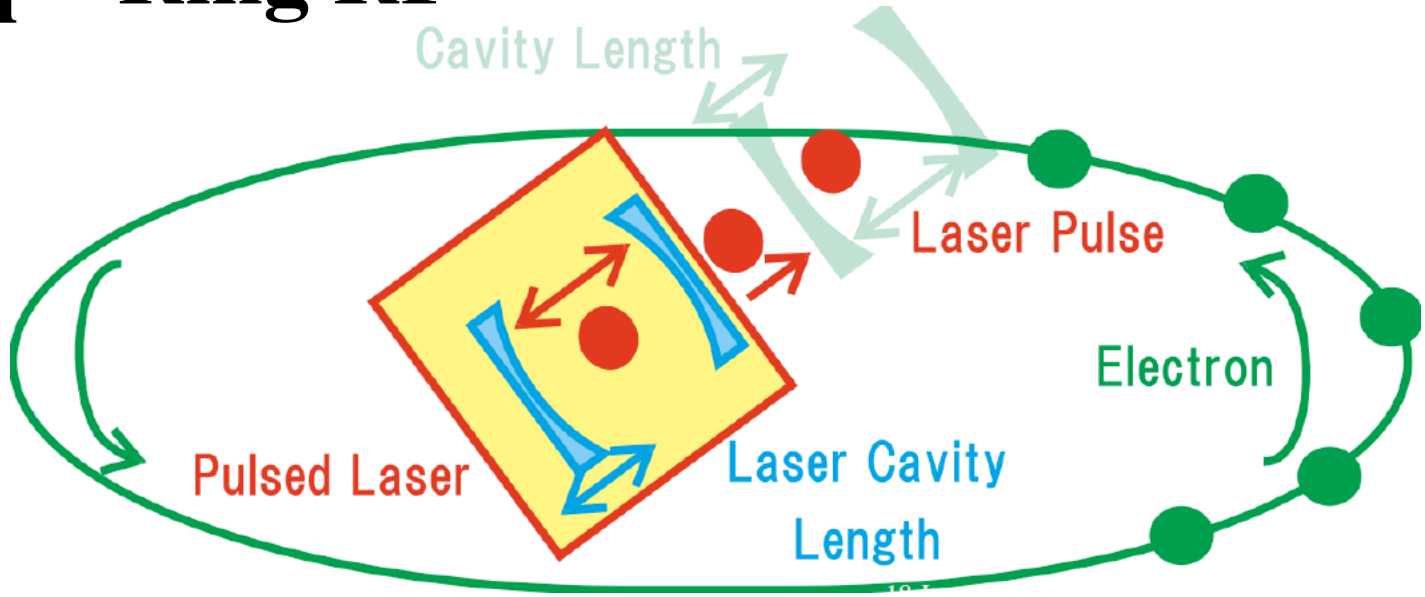
Feedback to Achieve 3 Conditions

$L_{cav} = n \lambda/2$

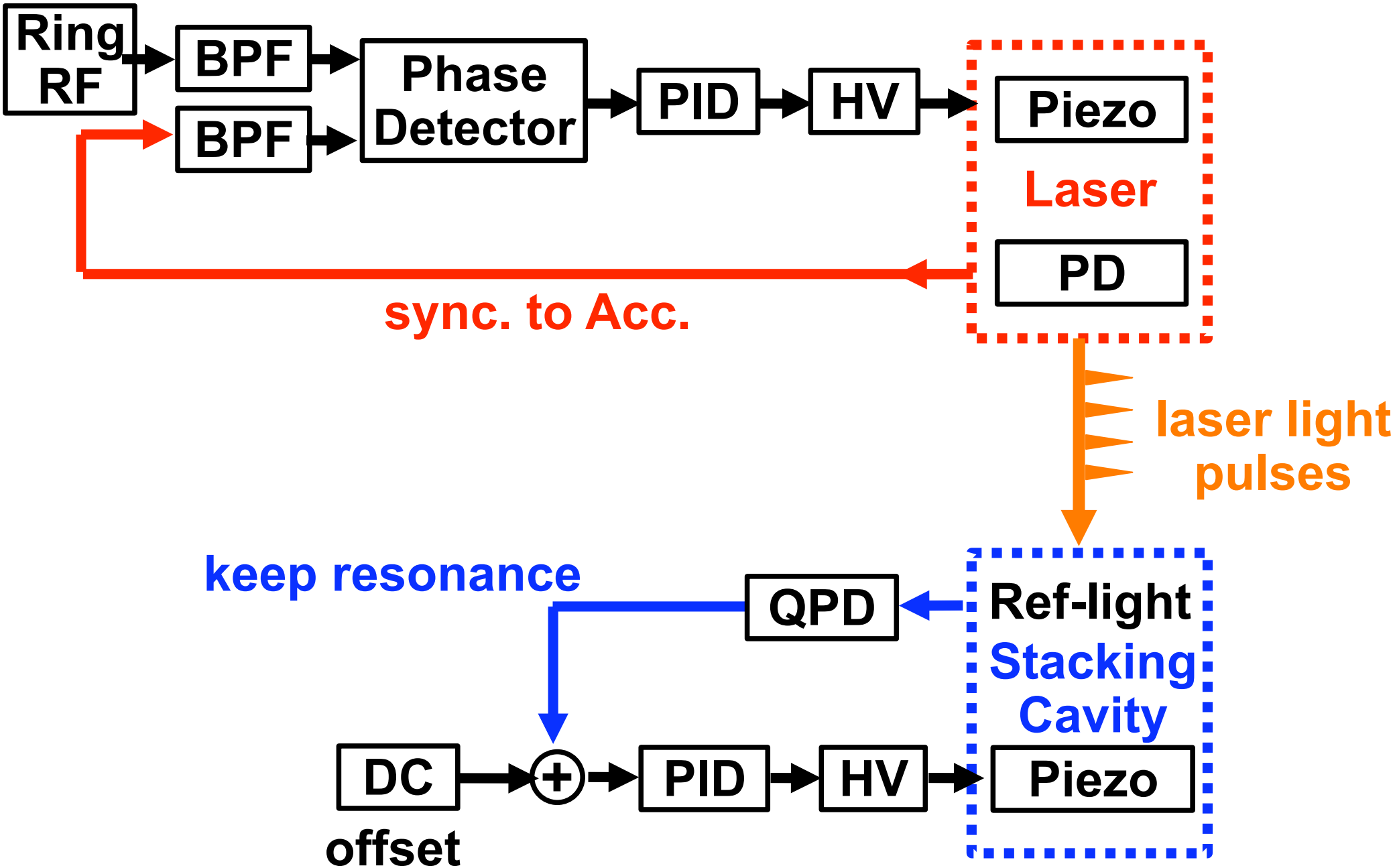
$L_{cav} = m L_{laser}$



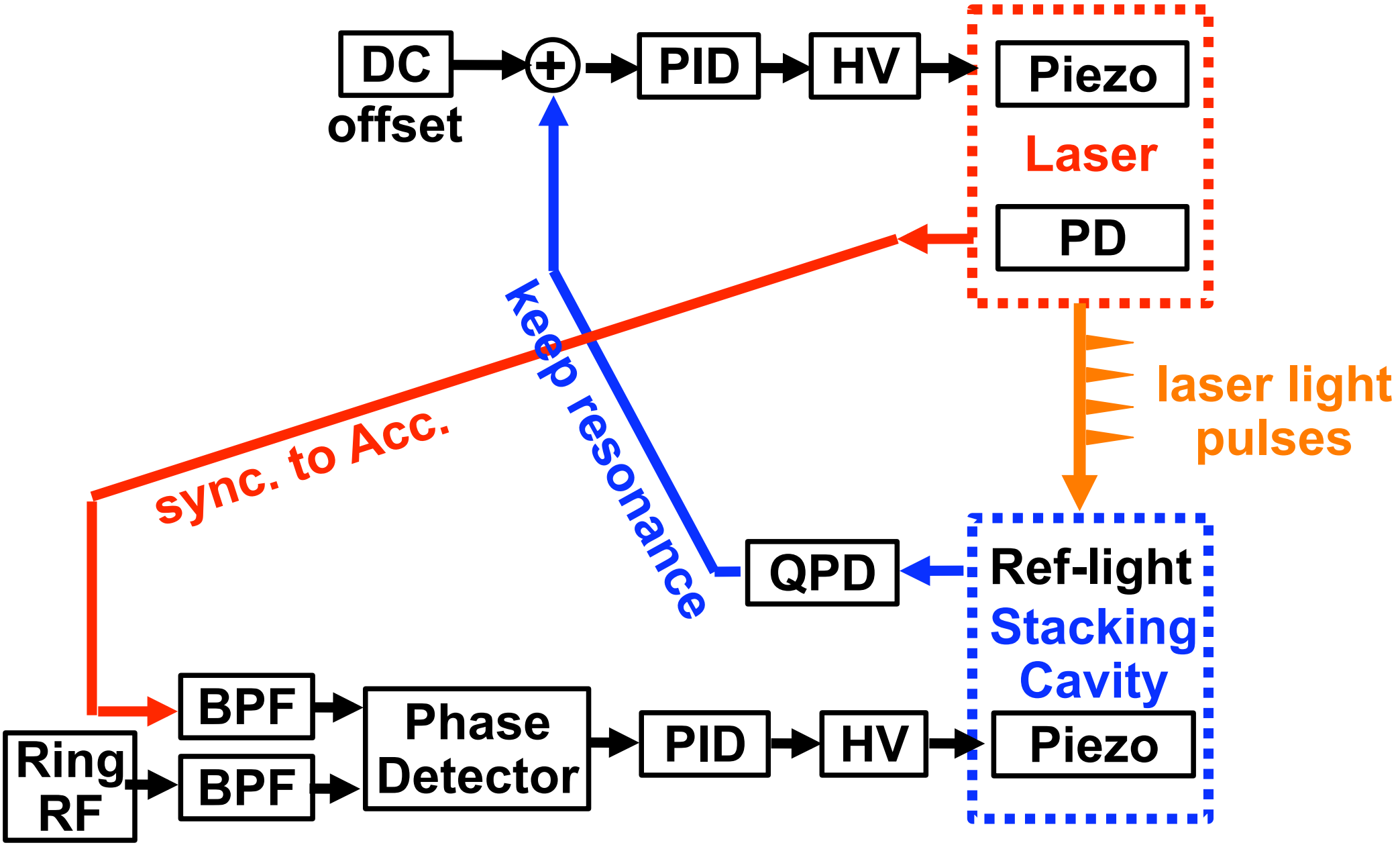
Laser freq = Ring RF



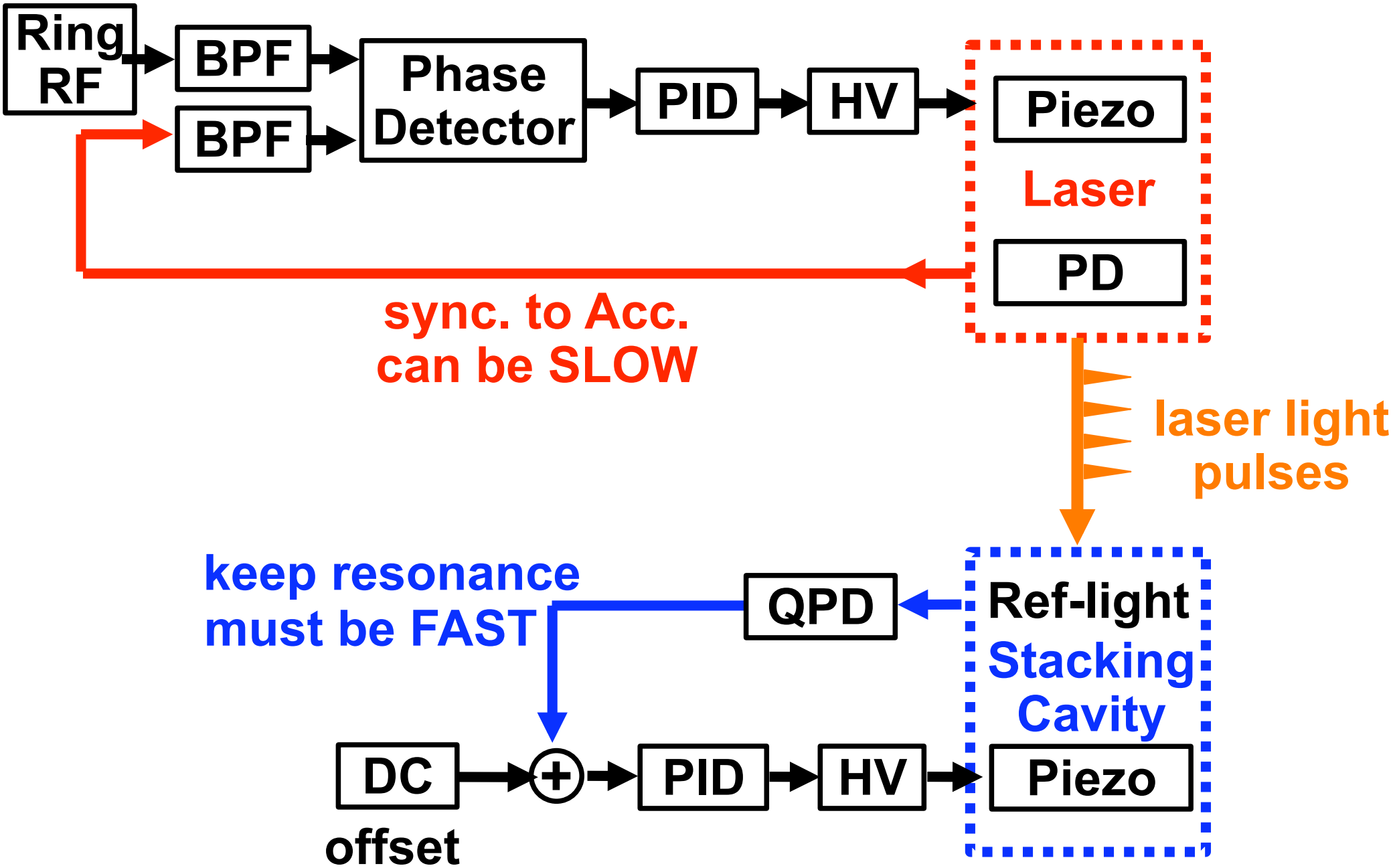
Normal Solution



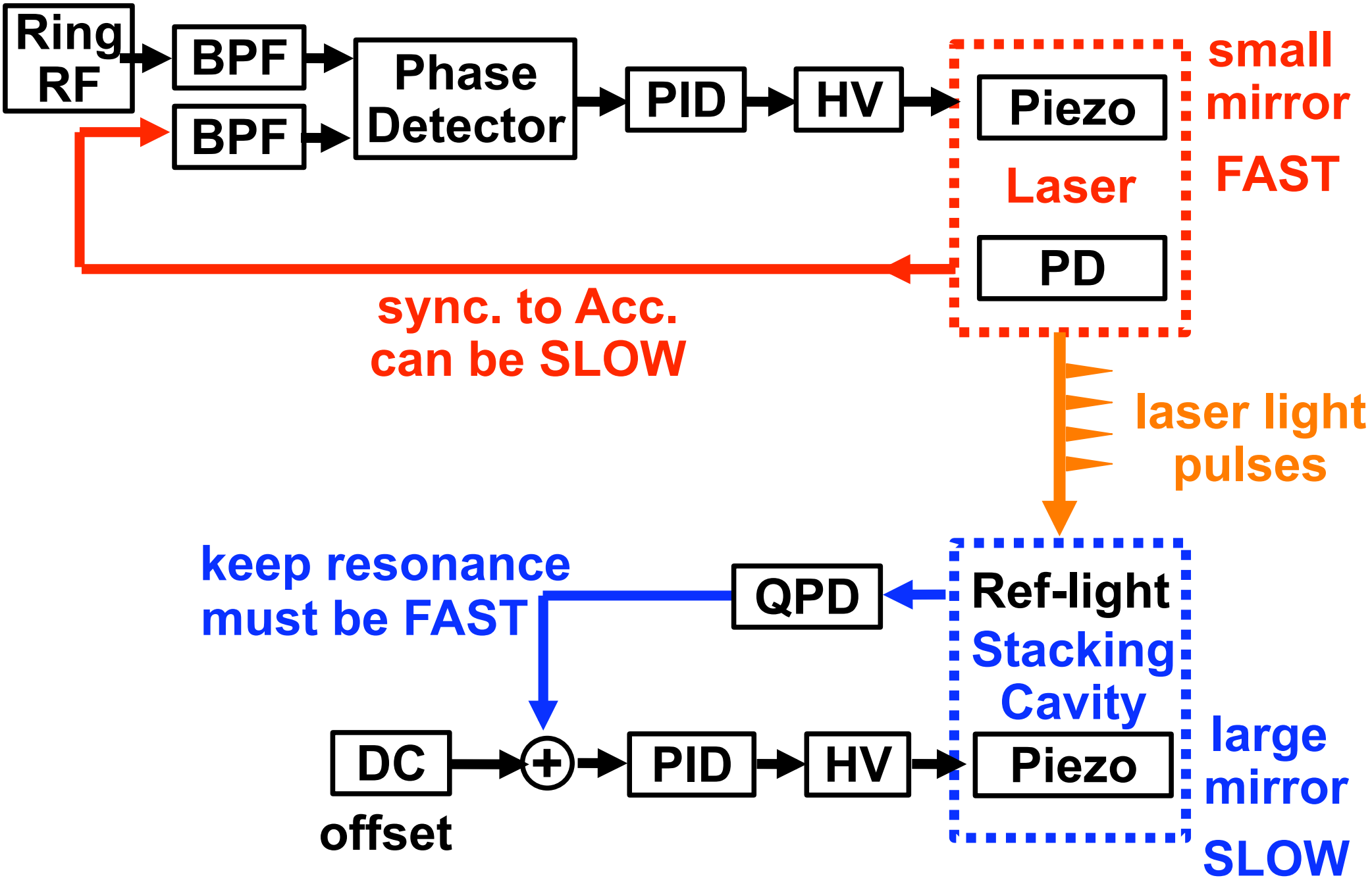
Cross-feedback Solution (Sakaue)



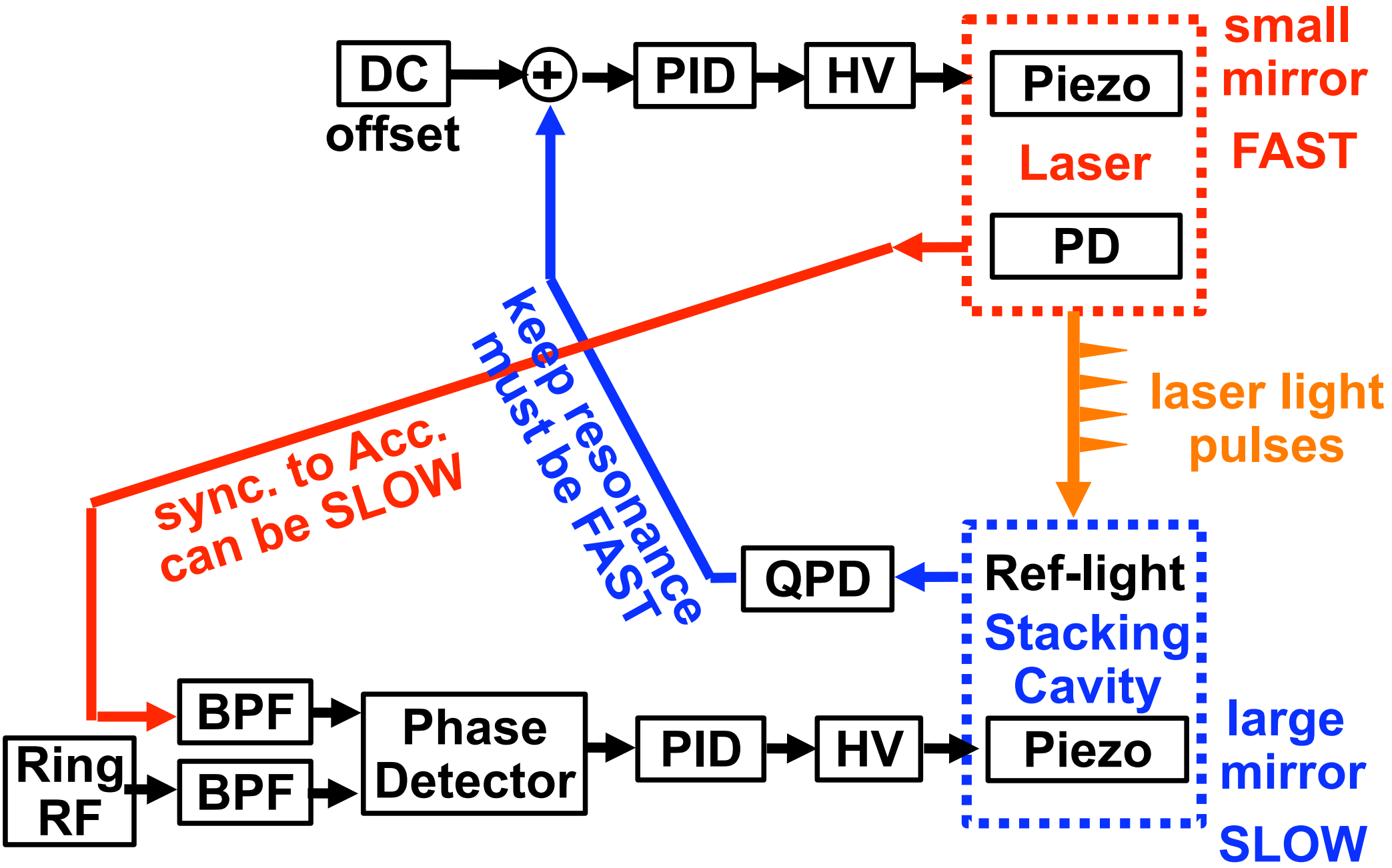
Normal Solution



Normal Solution

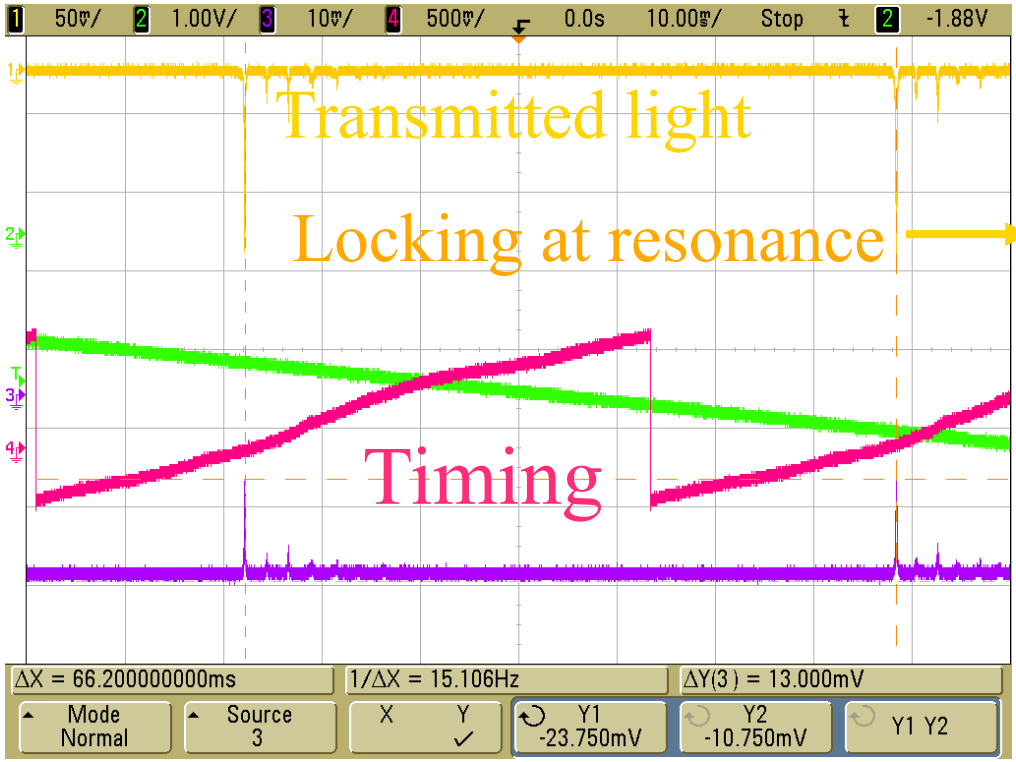


Cross-feedback Solution (Sakaue)



Optical cavity condition

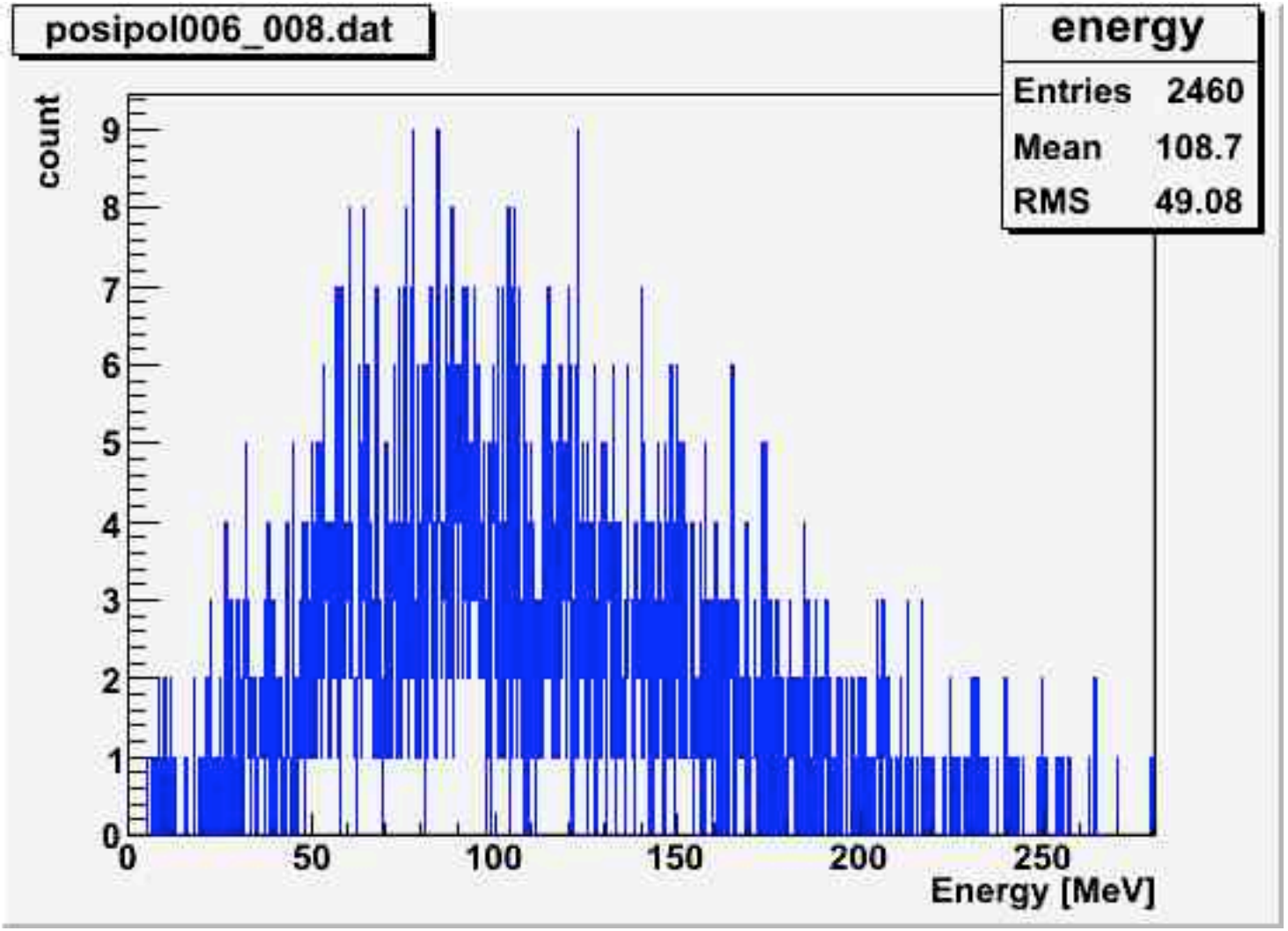
In summer time, we succeeded to keep condition of optical cavity timing lock and locking at resonance point.



Last week beam time, Optical cavity was to keep condition timing lock and locking at resonance point.

Energy Distribution

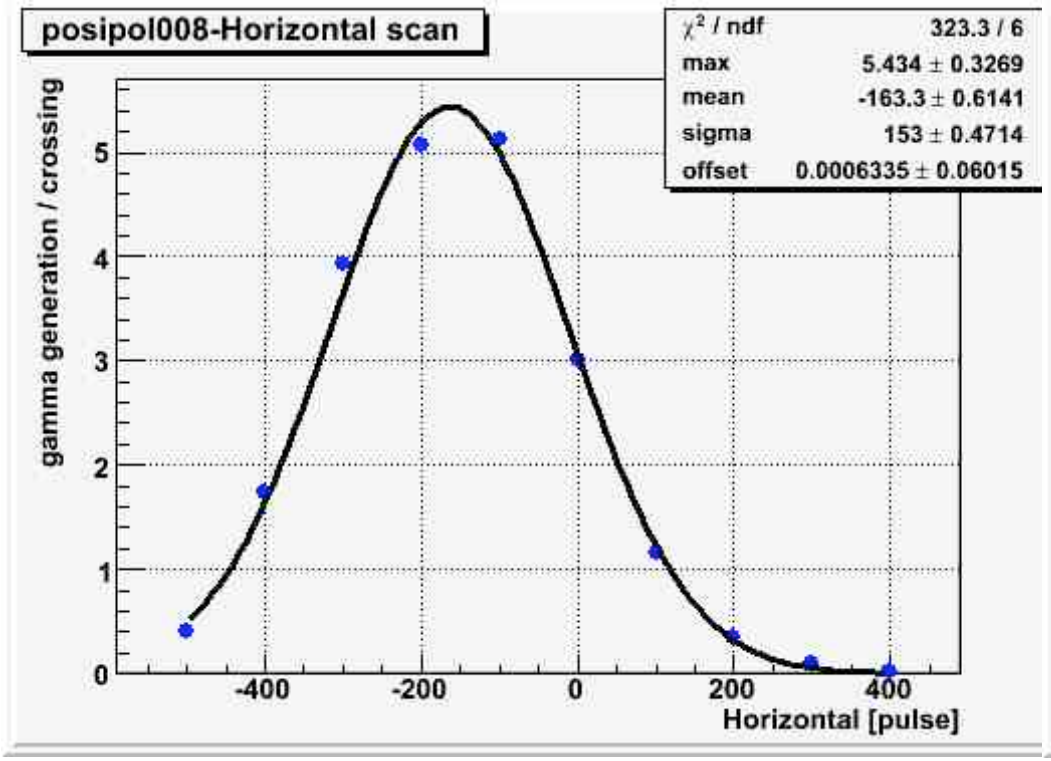
single-bunch operation



Best collision point data in 1 bunch and 2 bunches

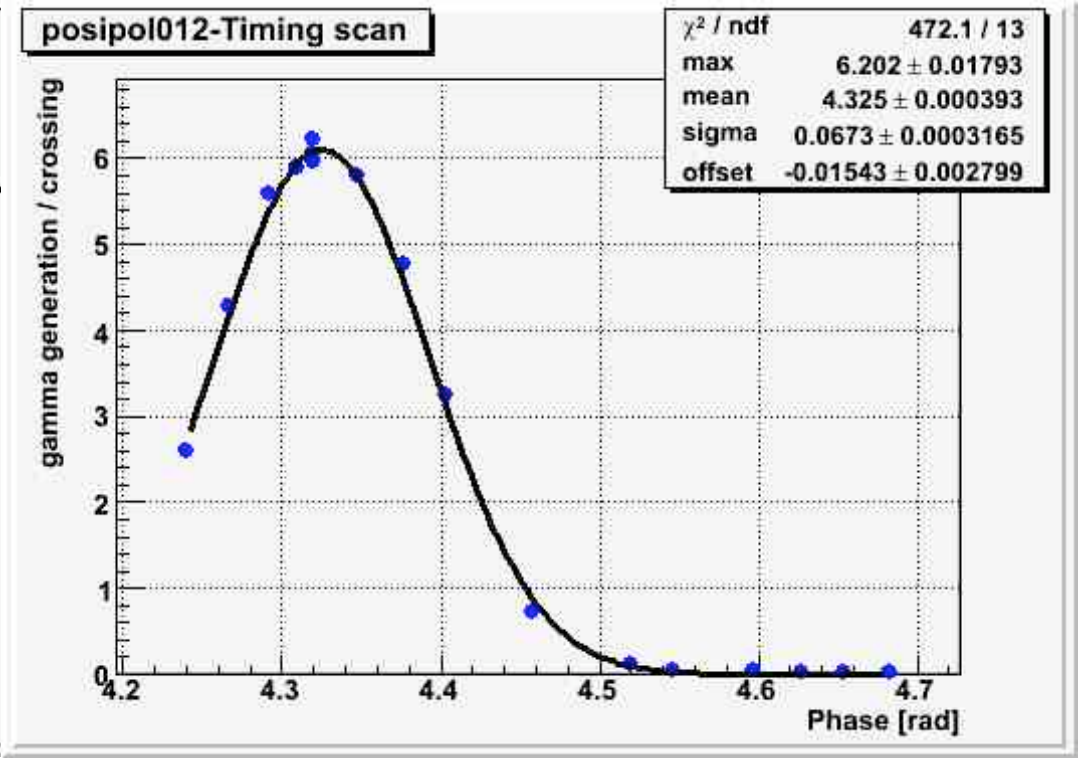
1 bunch

Scanning to Horizontal position



2 bunches

Scanning to Timing



After that, we tried to take 3 bunches data.

However, gamma detector was broken.

↓

Now, gamma detector is recovered.

date	run #	electron	the number of electron	stack power estimate	γ
	posipol	bunch(es)	1/pulse	by trans [W]	1/crossing
2008 11/20	8-005	1	7.20E+09	413	5.1
2008 11/20	12-012	2	1.24E+10	291	6.2

The number of γ : 6.2 × 2.16×10E+6 [1/second]

Simulated by Cain 1bunch γ : 5.7 2 bunches :6.7

Rough consistency check

γ ÷ the number of electron ÷ stack power

1 bunch 1.715×10E+8

2 bunches 1.718·10E+8

1 bunch data and 2 bunches data seem to consistent

This week
We try 10-bunch and 20-bunch operation

Summary

Summary

1. Success : Resonance Feedback + Phase Lock on Acc RF
   - Before Summer
     - No feedback
       - Trigger : Acc + Transmitted Light
   - Present
     - Normal Feedback ---> Cross-feedback
     - Resonance Feedback + Phase Lock on ACC RF
       - Trigger : Acc

2. Collision Experiment on going
   - 5 gamma / crossing (single-bunch op.)
   - 6 gamma / crossing (two-bunch op.)
     - Consistent: Experiment <--> CAIN simulation
     - Consistent: single-bunch <--> two-bunch

This week : collision in 10-bunch and 20-bunch op.