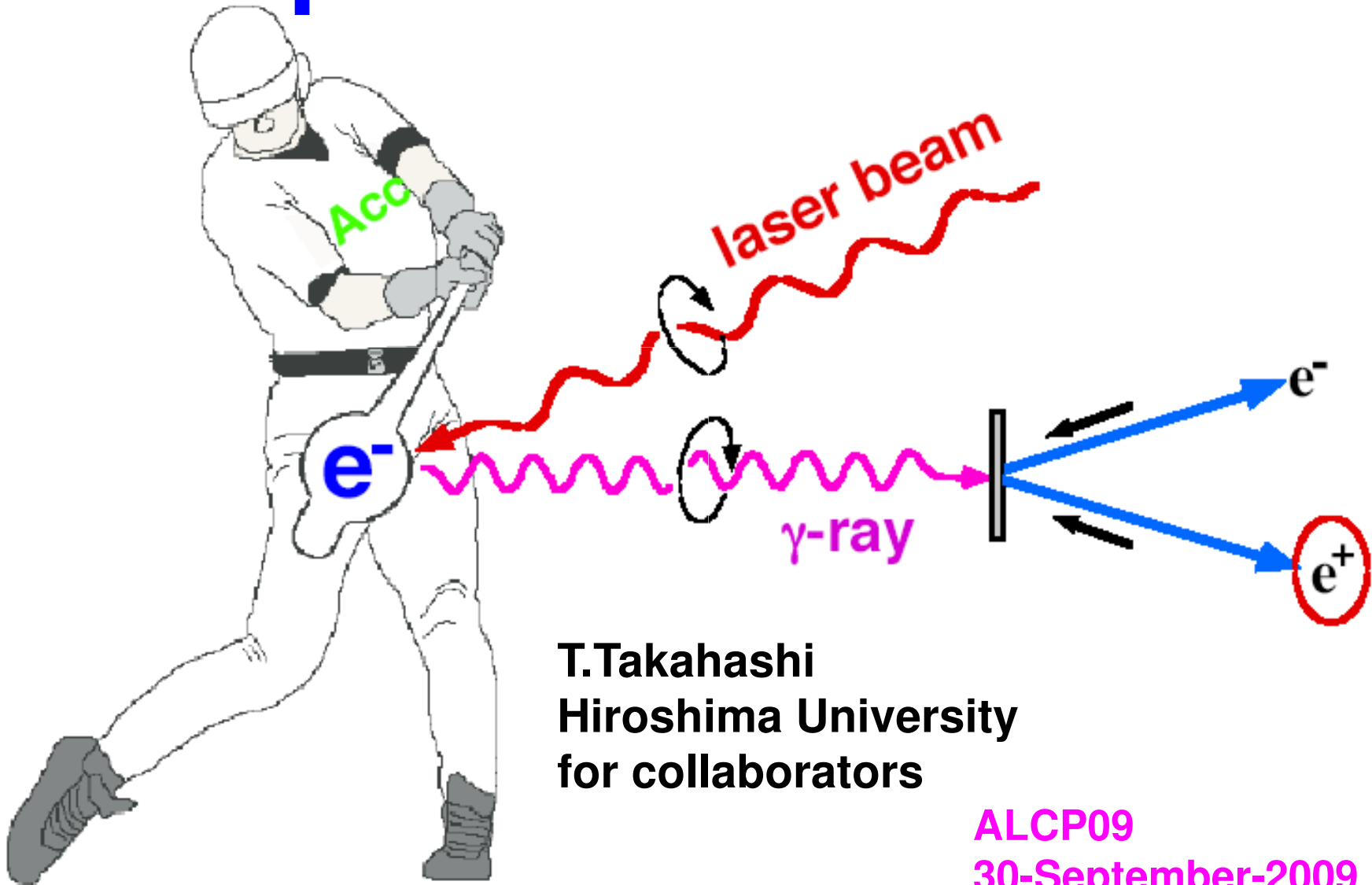


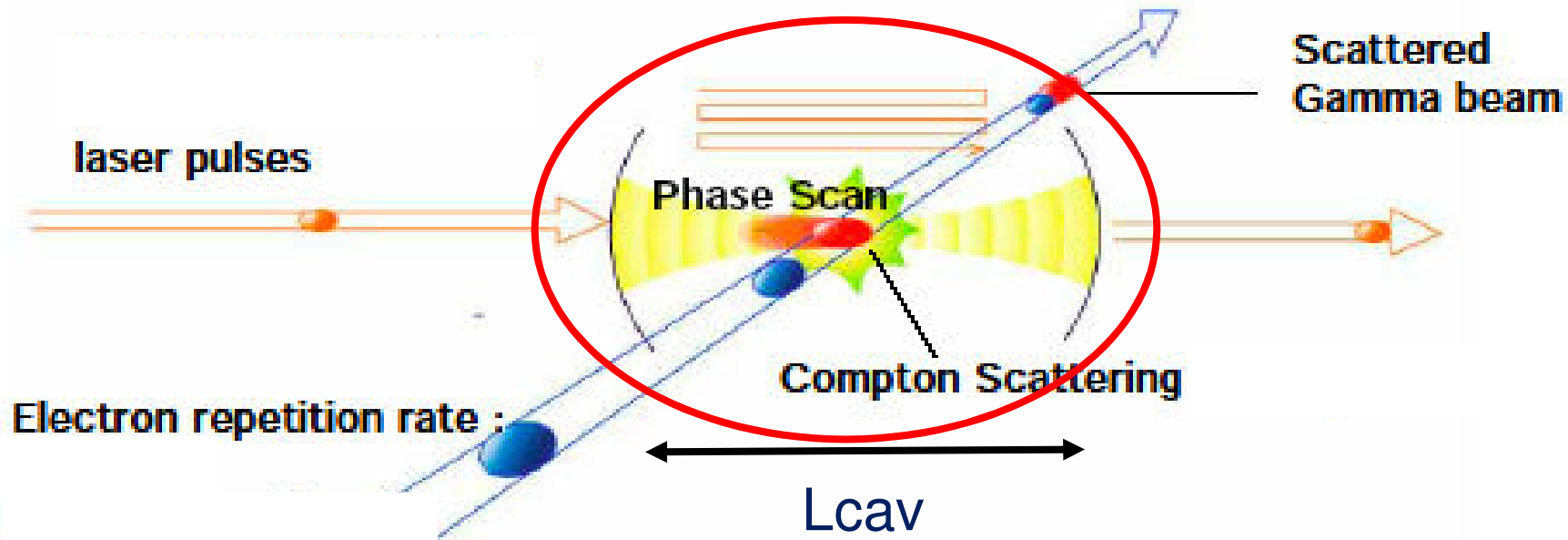
Compton Experiment at the ATF Update since TILC09



T.Takahashi
Hiroshima University
for collaborators

ALCP09
30-September-2009

Optical Cavity for Laser-Compton



Higher laser power

$L_{cav} = n \lambda/2$, $\Delta L < nm$ laser for pulse stacking

->more enhancement the more precision

Laser should be focused for high power density

Efficient laser-Compton scattering

$\Delta T < ps$

Accommodate laser cavity in the accelerator

Two Prototype Cavities

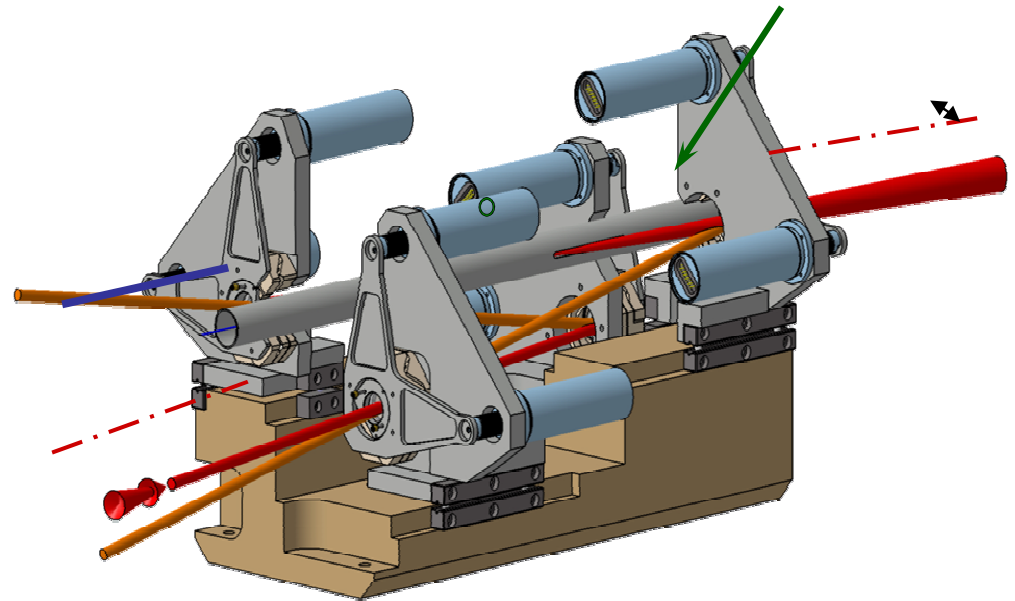
2-mirror cavity (Hiroshima / Weseda /
Kyoto / IHEP / KEK)



moderate enhancement
moderate spot size
simple control

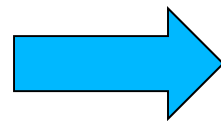
demonstration of γ ray gen.
accum. exp. w/ cavity and acc.

4-mirror cavities w/LAL



high enhancement
small spot size
complicated control

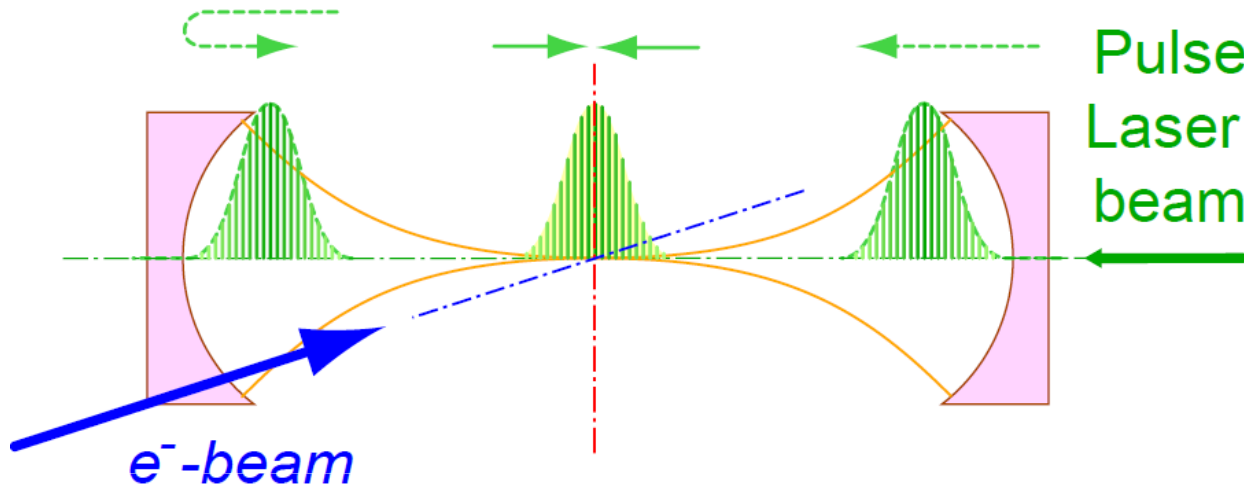
intense γ ray generation



2 MIRROR CAVITY STATUS

Experimental R/D in ATF

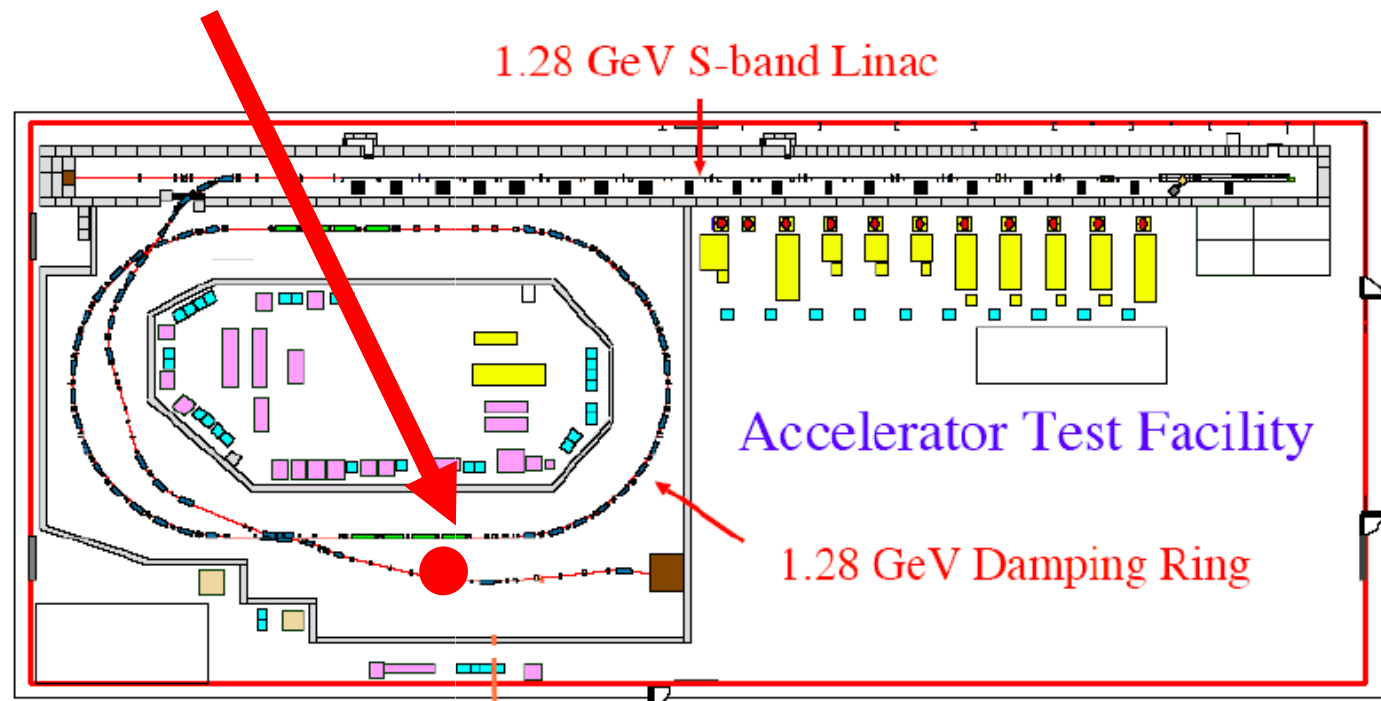
Hiroshima-Waseda-Kyoto-IHEP-KEK



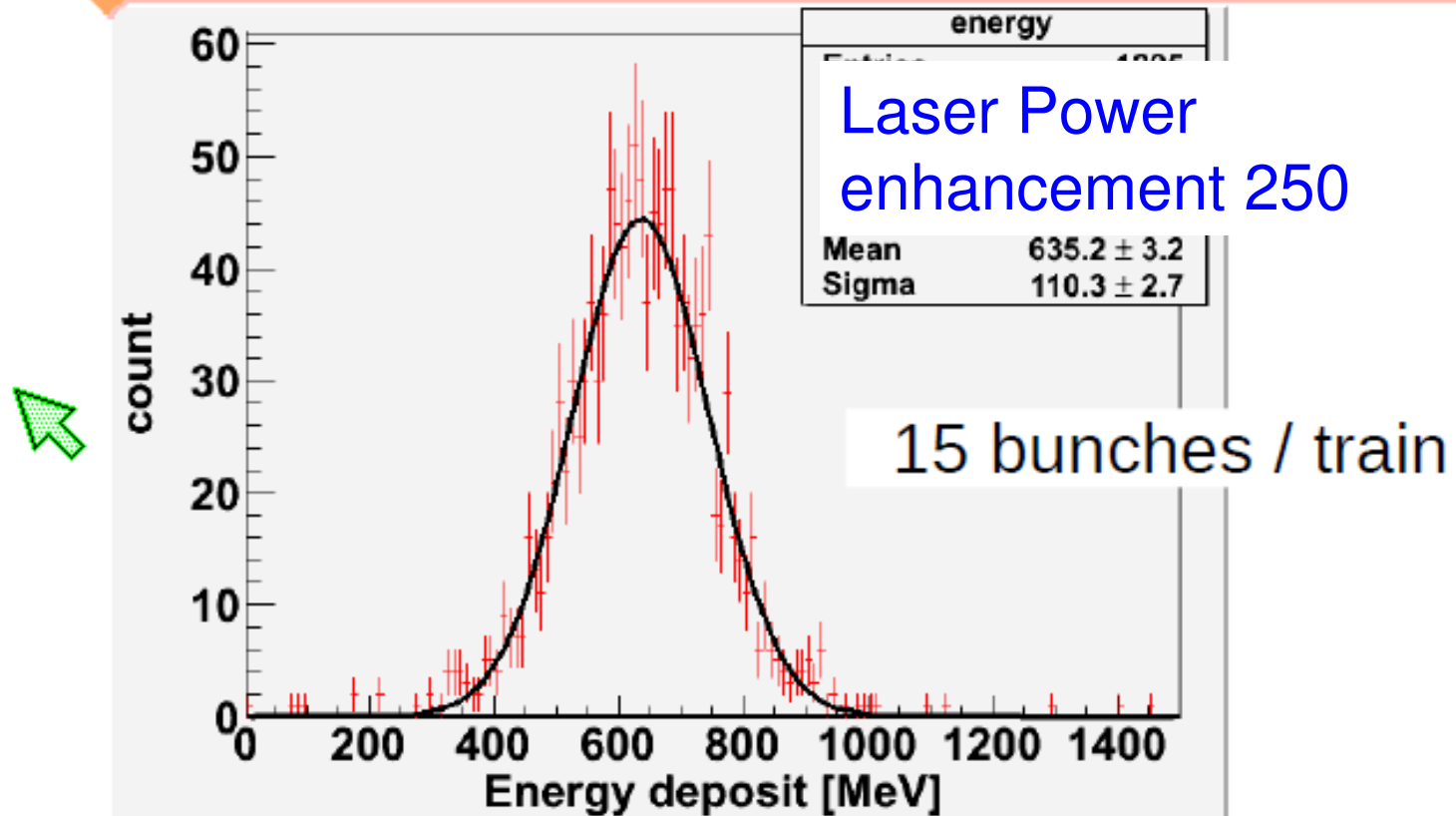
Make a fist prototype 2-mirror cavity

$$L_{\text{cav}} = 420 \text{ mm}$$


Put it in ATF ring



Result



We detected 27 gamma-rays / bunch train.
generation 60 gamma-rays / train to all angle.

 $60 \times 2.16 \text{ MHz} \sim 1.2 \times 10^8$ [gamma / second]
Revolution

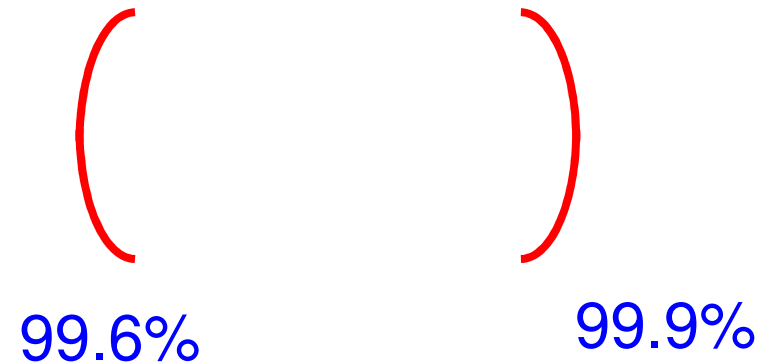
AFTER TILC09

- ▶ One of the Mirror was replaced with the higher reflectivity one

- 99.6% -> 99.9%

- power enhancement

- 250 -> ~750



- more precise controll required (~0.1nm)

- ▶ Status of the cavity w/ new mirror

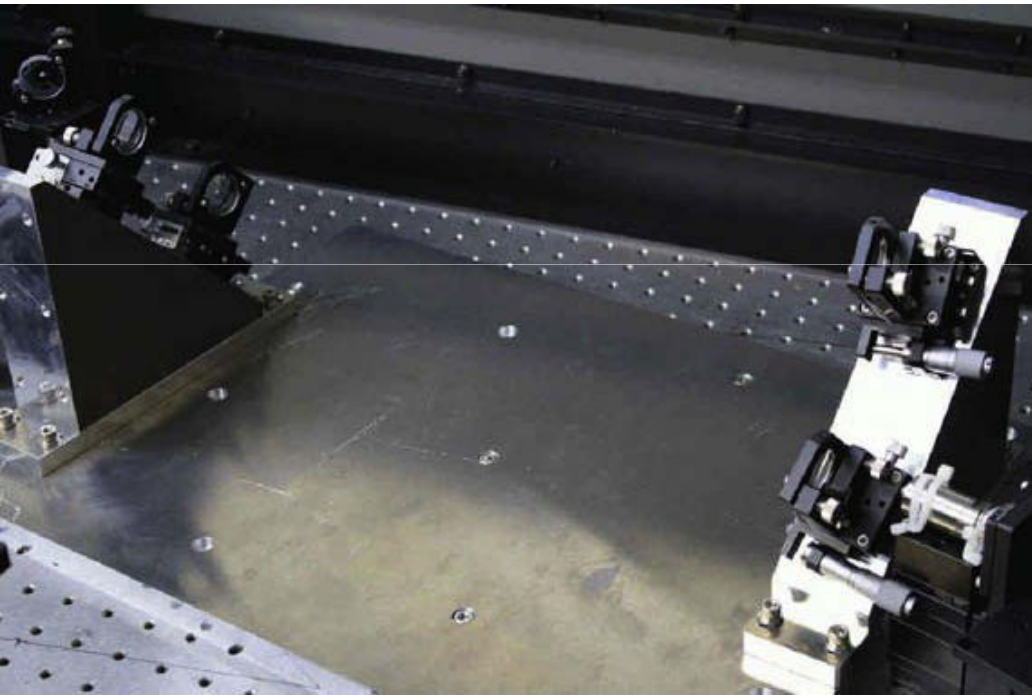
- Finess ~2000 with feedback on before vacuum on

- now in preparation for beam

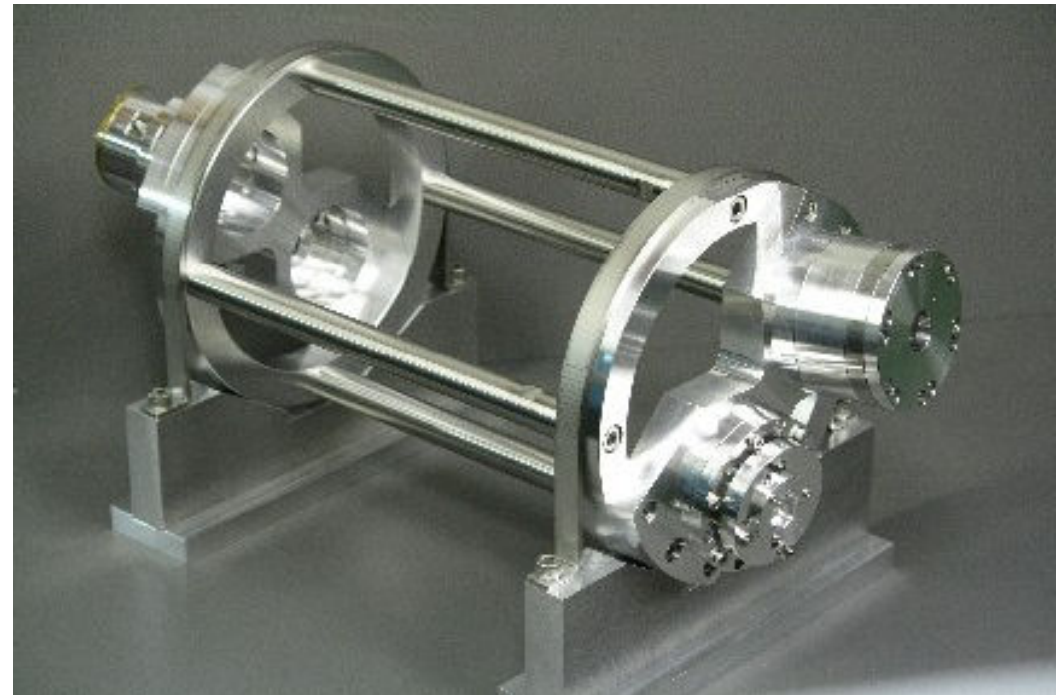
- hope to get 3 times more photons by the end of the year

4 MIRROR CAVITY STATUS

March 2009

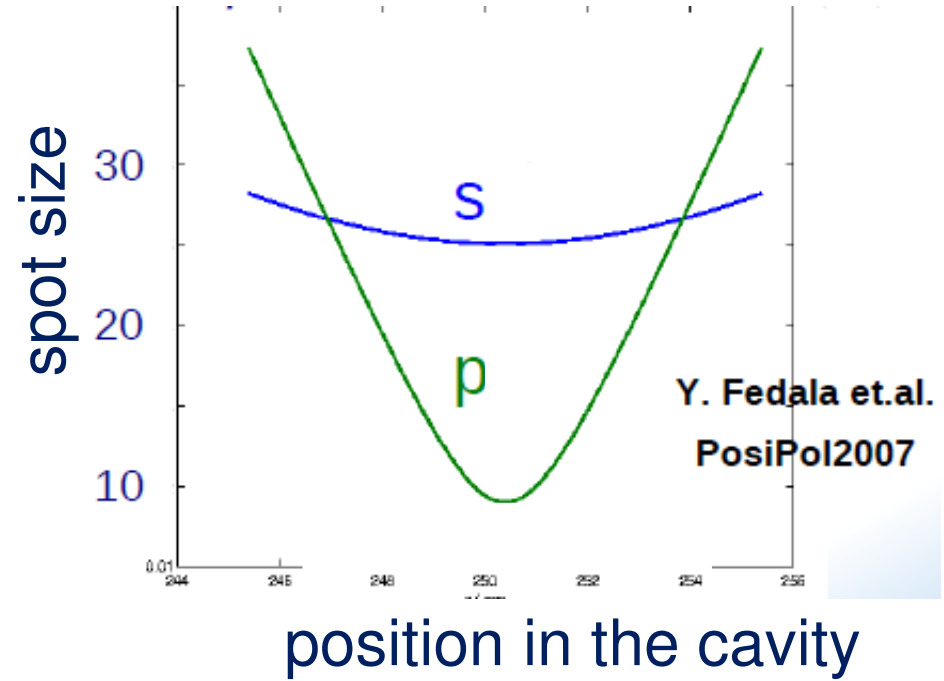


August 2009



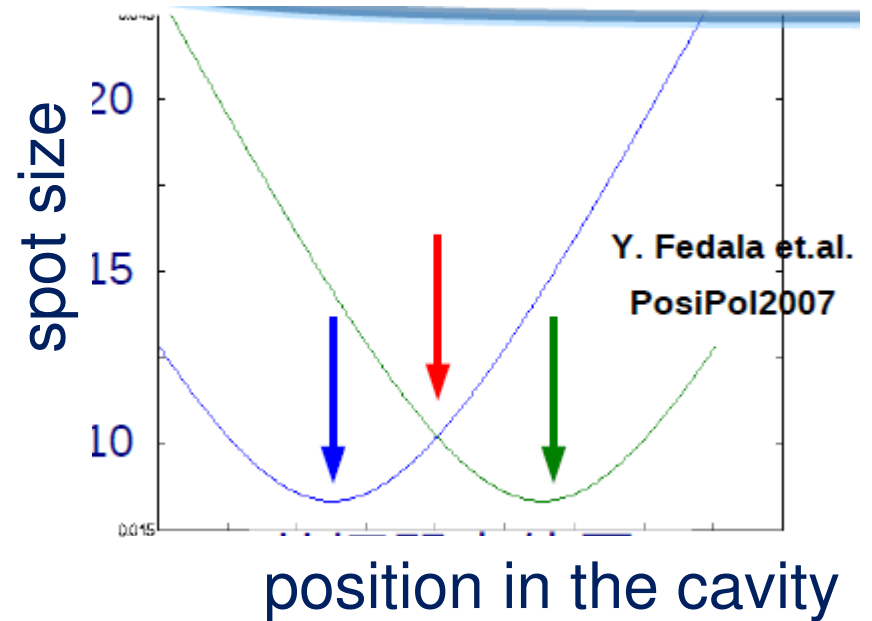
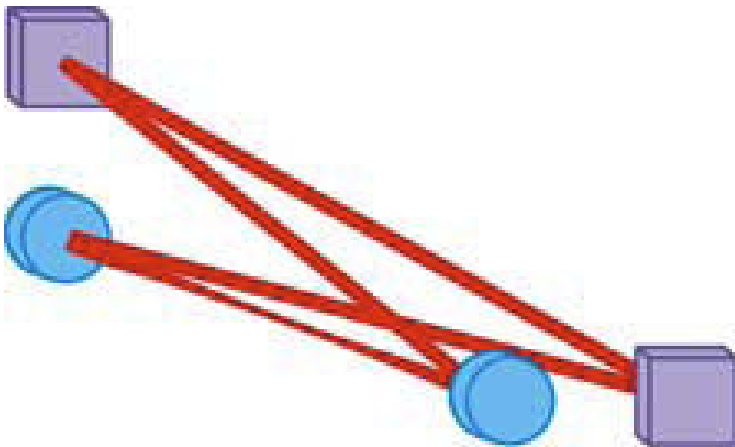
2D configuration

2D 4mirror cavity has astigmatism.

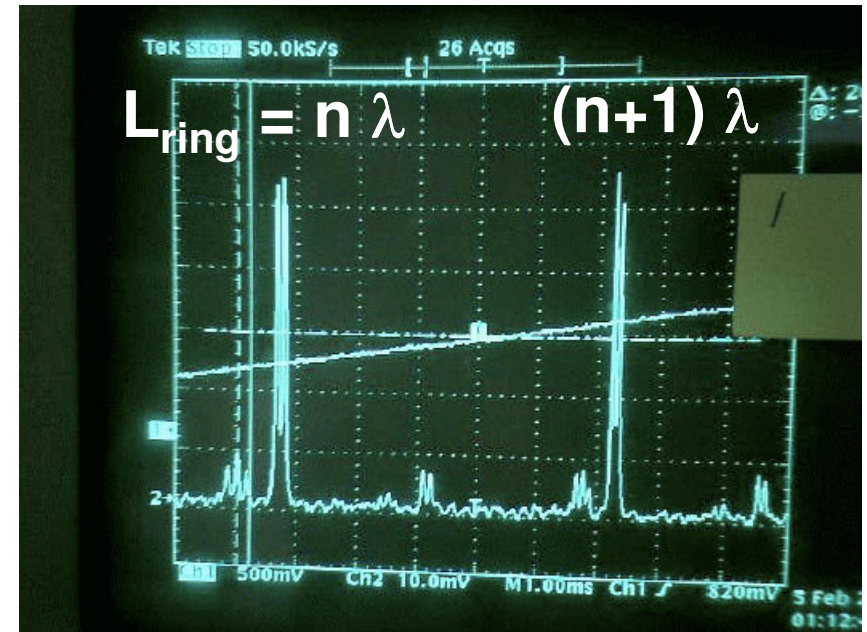
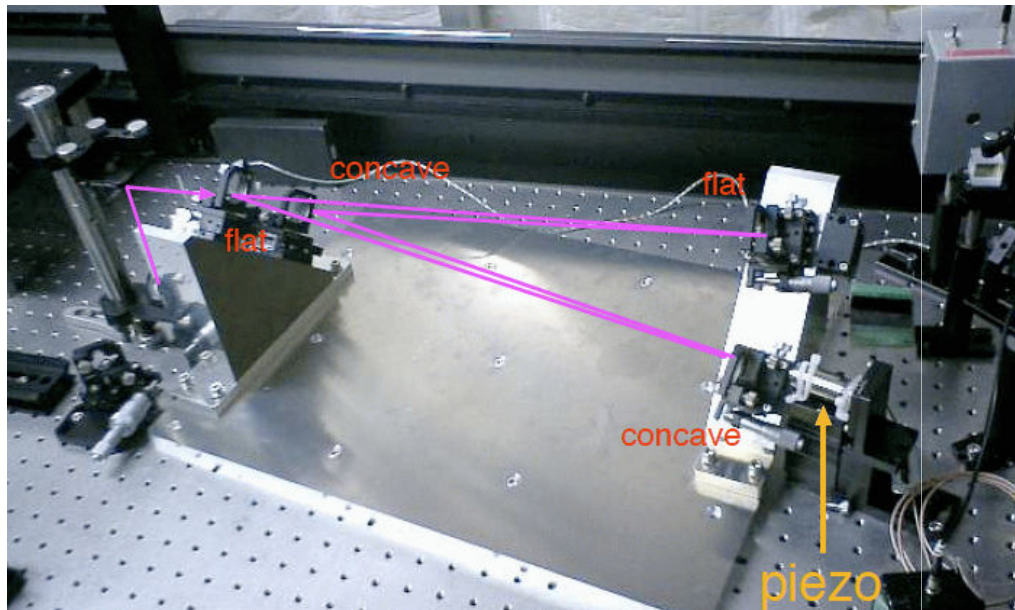
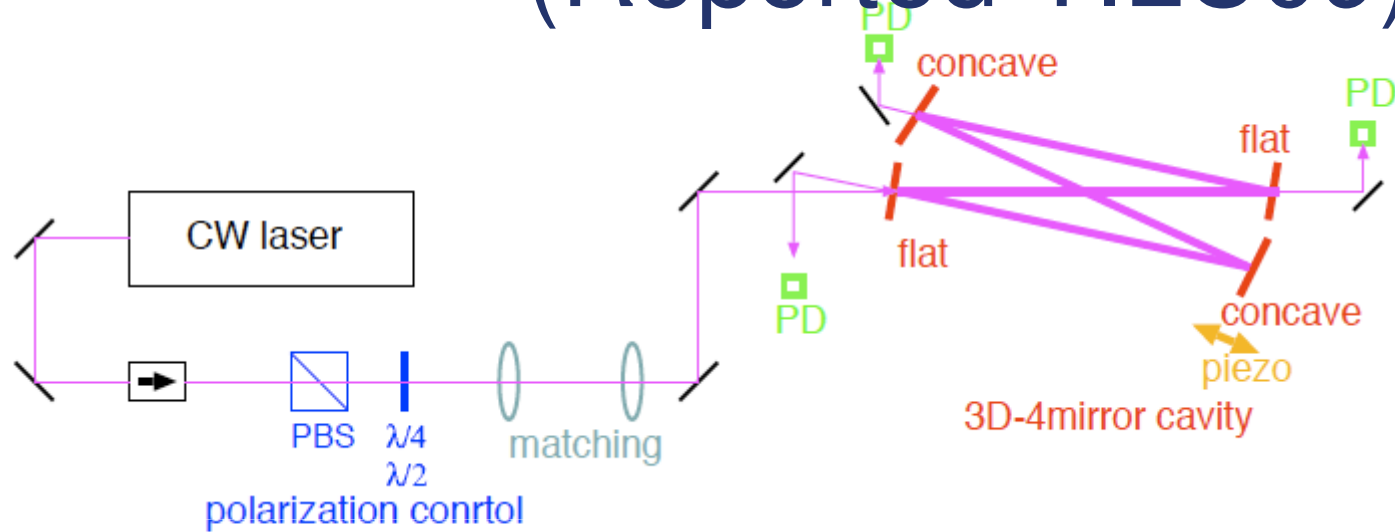


3D configuration

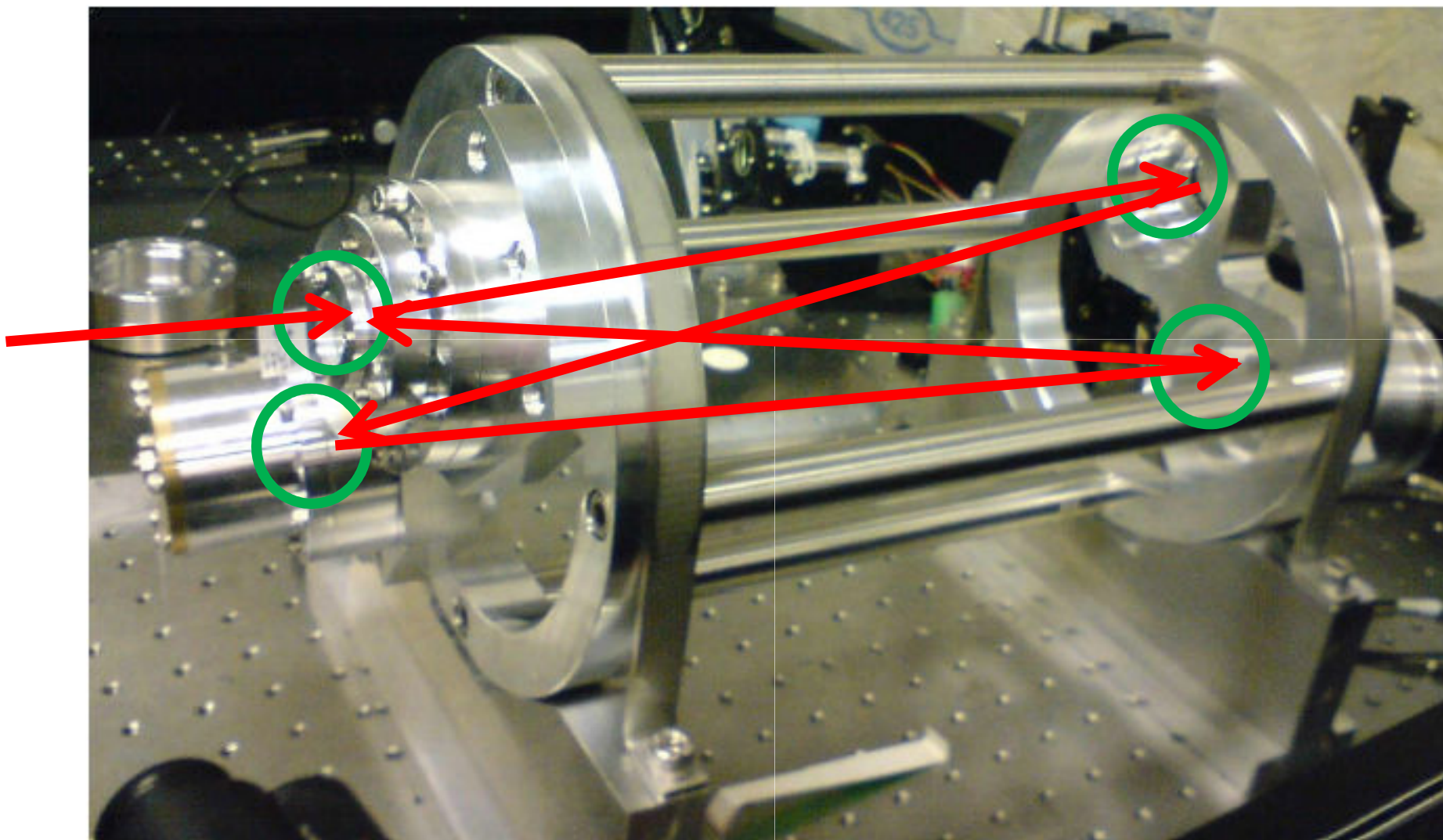
go to 3D config. to avoid astigmatism



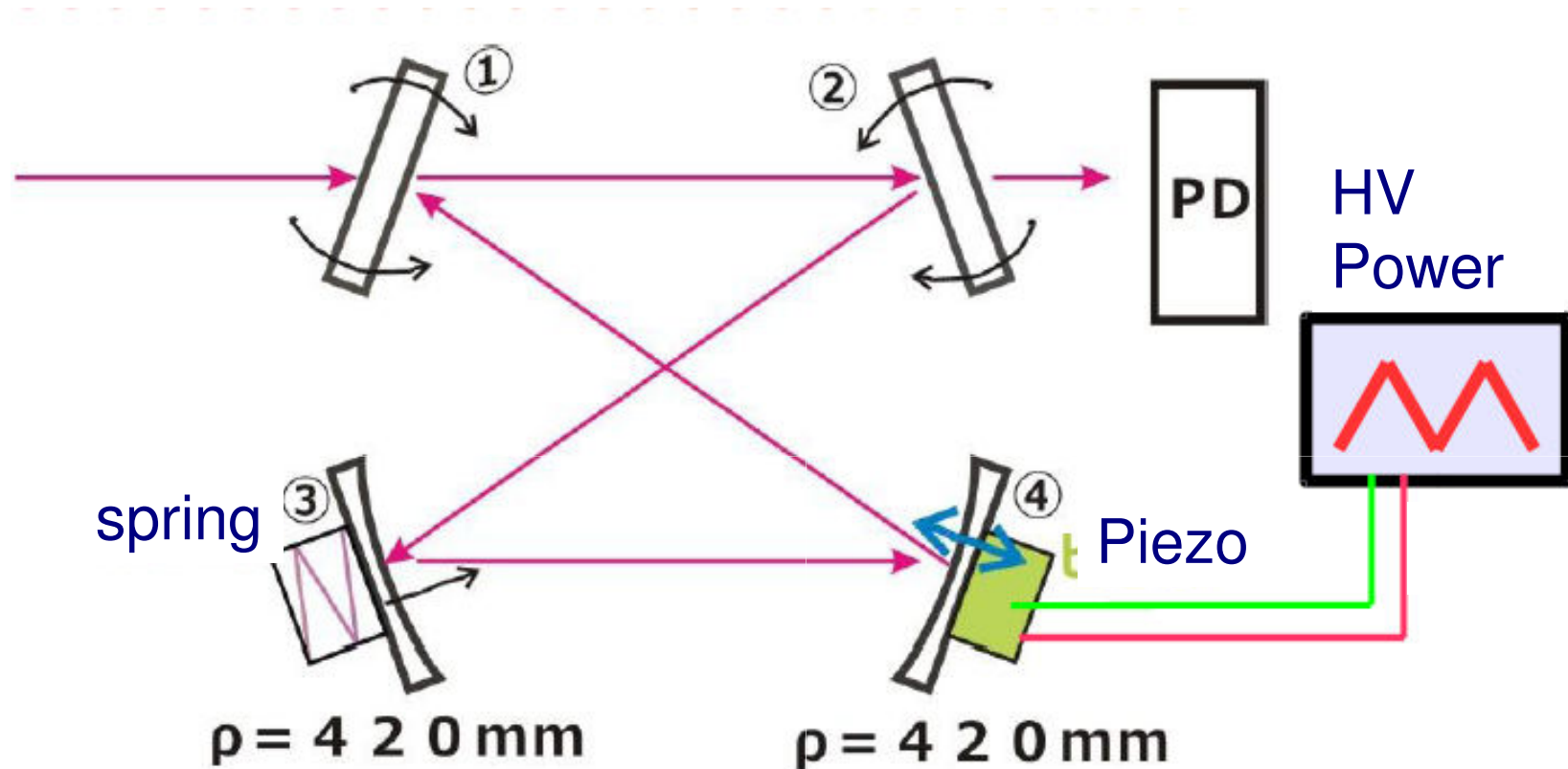
R&D of 4 mirrors cavity started at KEK (Reported TILC09)



prototype 4 mirror cavity Constructed

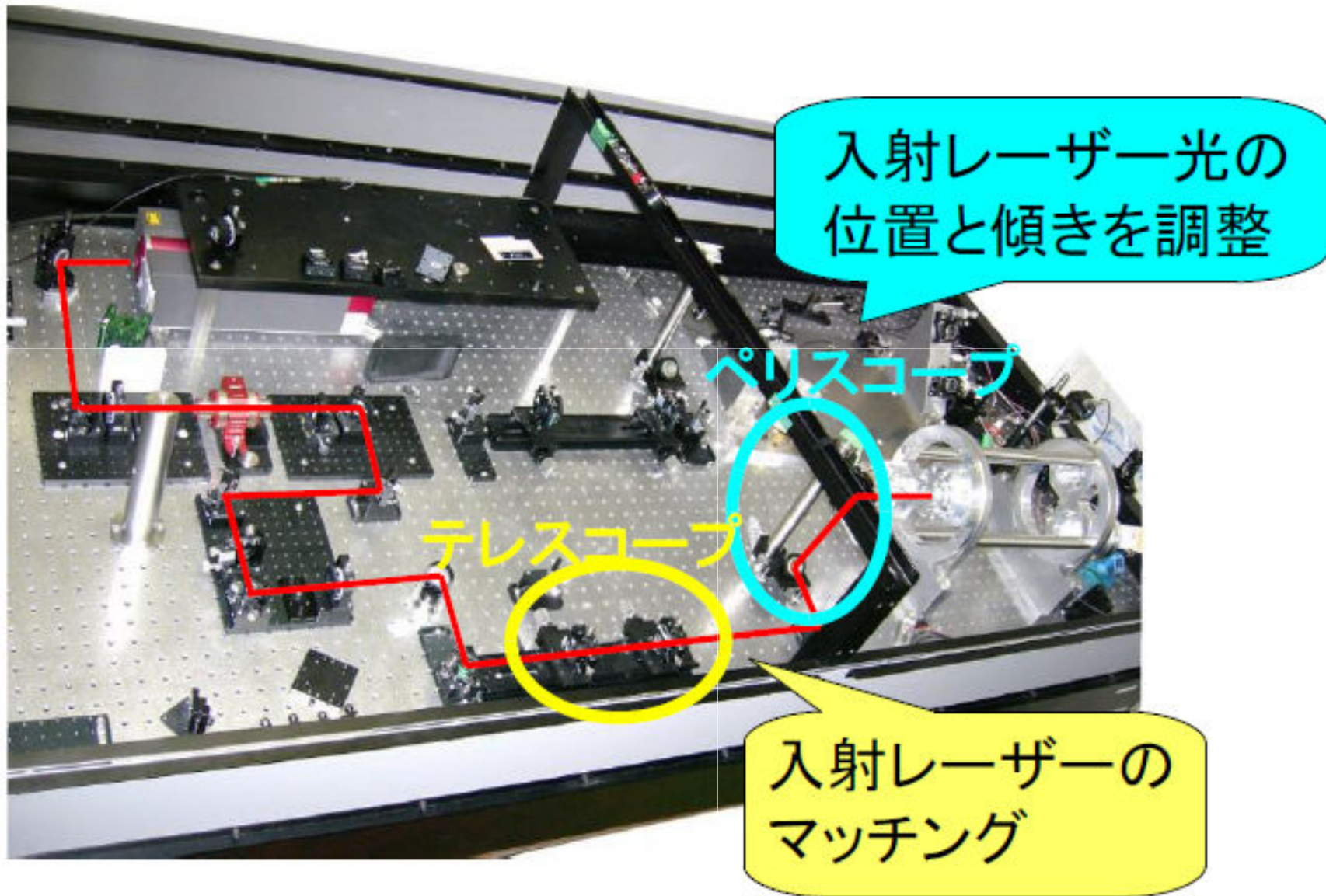


tuning mechanism

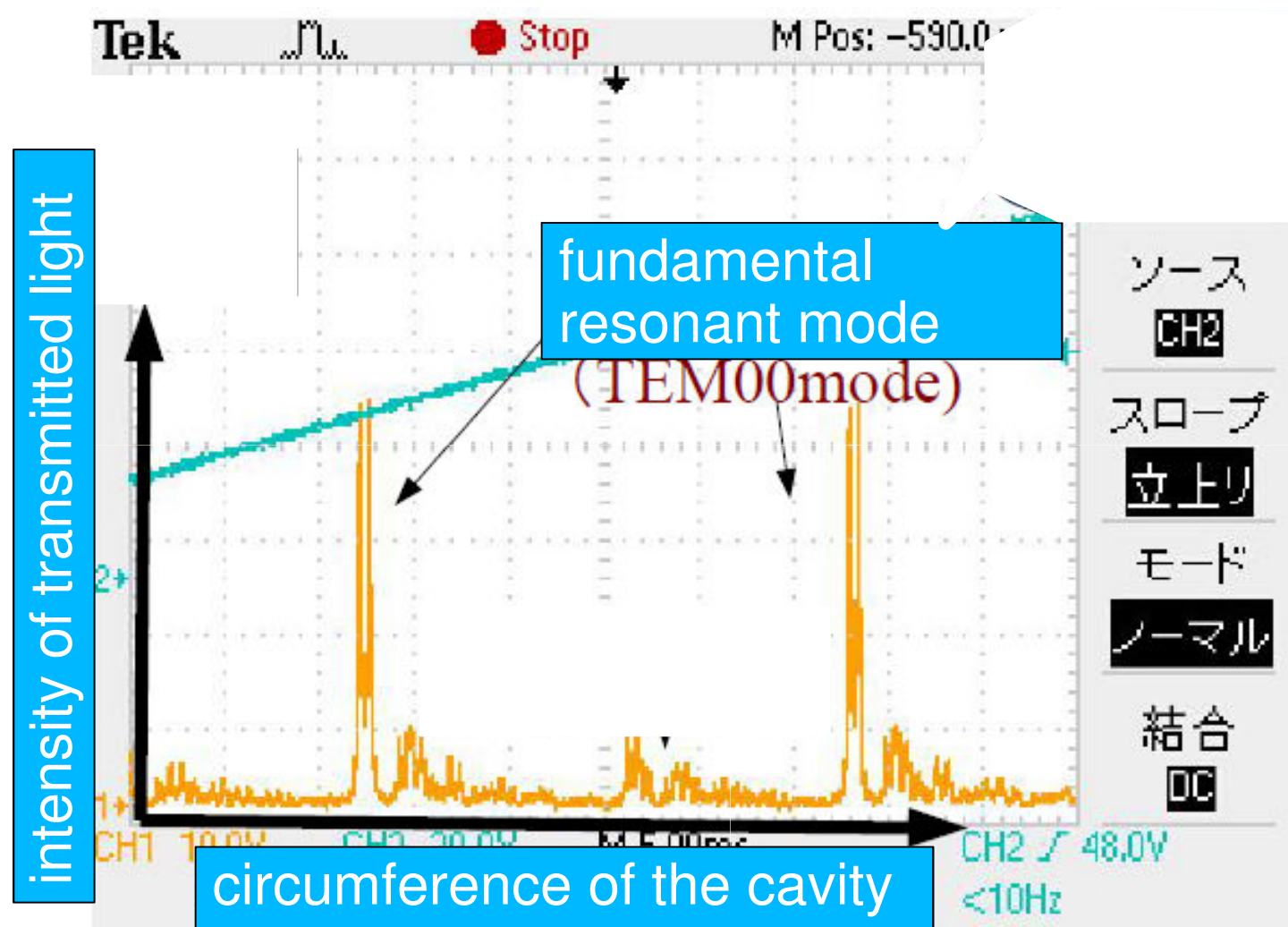


Objective: to establish method of:
mirror alignment, control cavity length
→ feed back to the beam compatible cavity

Prototype cavity on the optical table

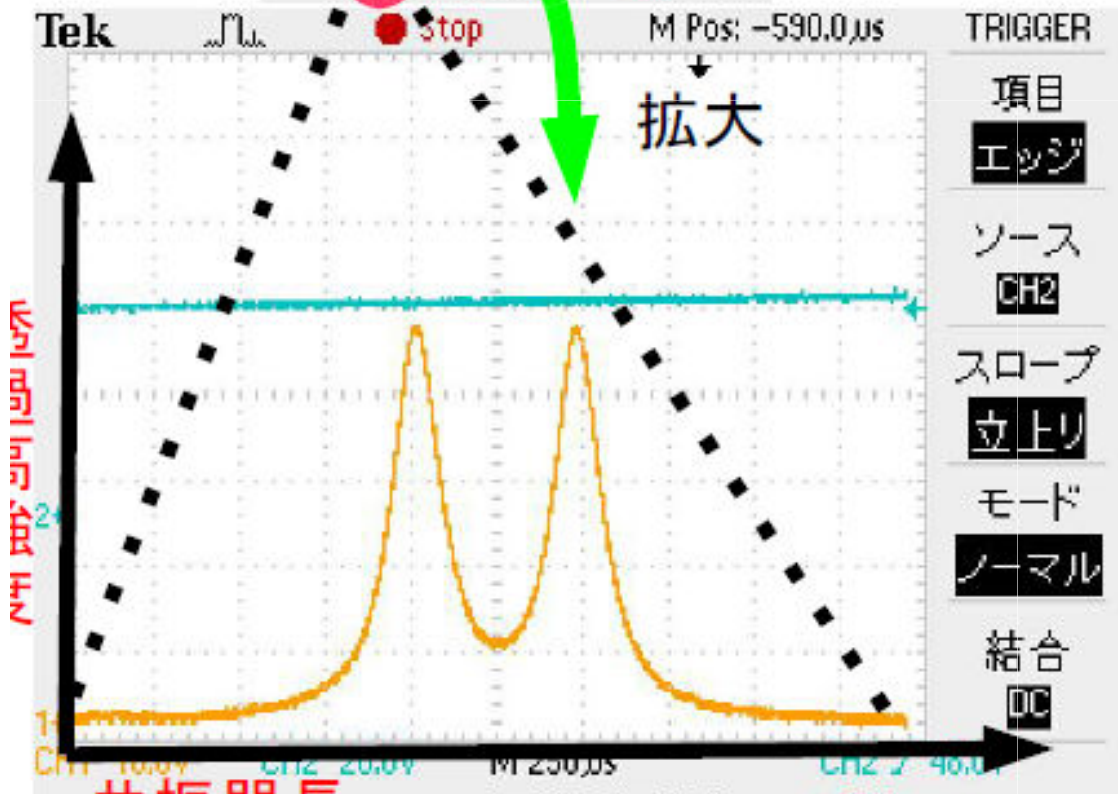
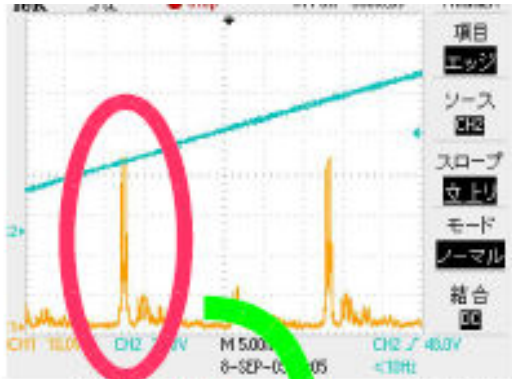


status of initial tests



resonance of the cavity with injecting laser observed

two peaks



- two separated resonant peaks

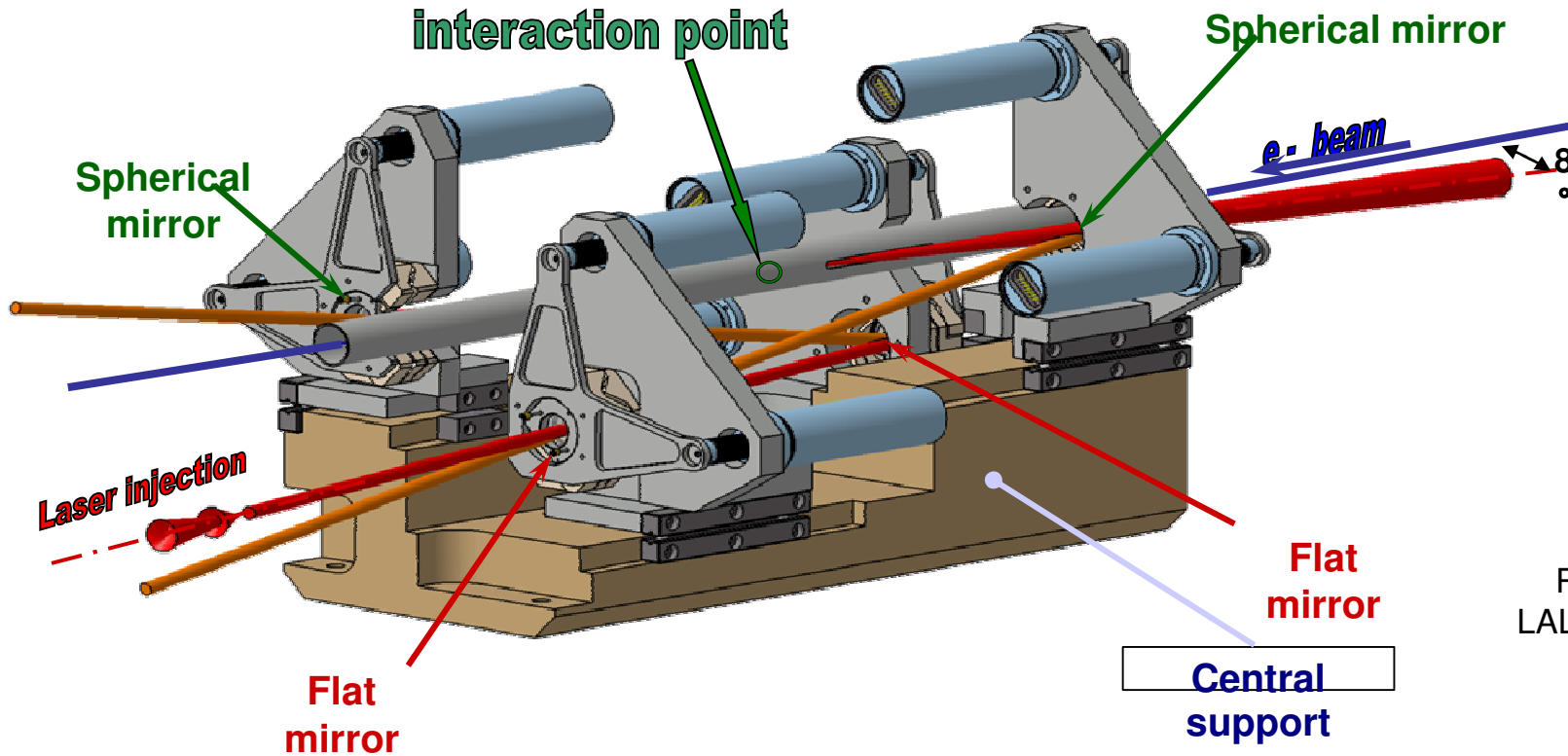
each corresponds to left or right handed polarization

- 3D cavity only resonates with circular polarization due to geometric phase

Useful to:

- generate circularly pol. γ s
- fast switching

Staus of the LAL cavity



R. Cizeron
LAL 30/01/2008

French colleagues visited KEK in July.
discussed detail of the installation procedure
setting up at the ATF beam line

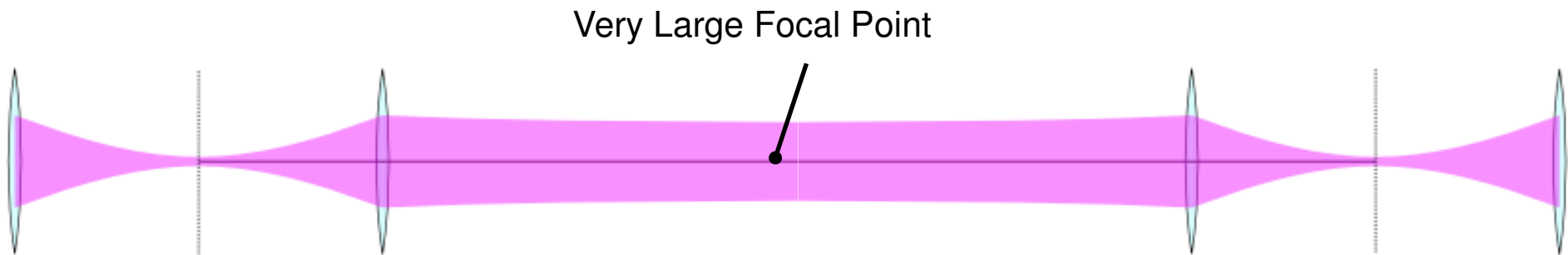
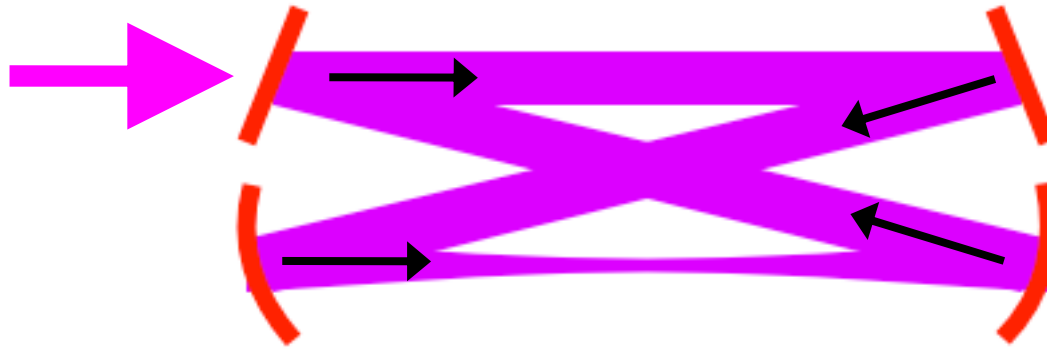


working to install the cavity in summer 2010

Summary

- ▶ 2 mirror cavity to demonstrate photon generation and to accumulate experience w/ beams
 - **At the TILC09**
 - enhancement of 250, 27 gammas / crossing
 - **high reflection mirror (99.6% -> 99.9%)**
 - beam with enhancement ~750 to 1000 this year
- ▶ 4 mirror ring cavity for higher enhancement and small spot size
 - **at the TILC09**
 - basic test on optical table
 - **first prototype at KEK and being tested**
 - **installation of LAL cavity being ready**

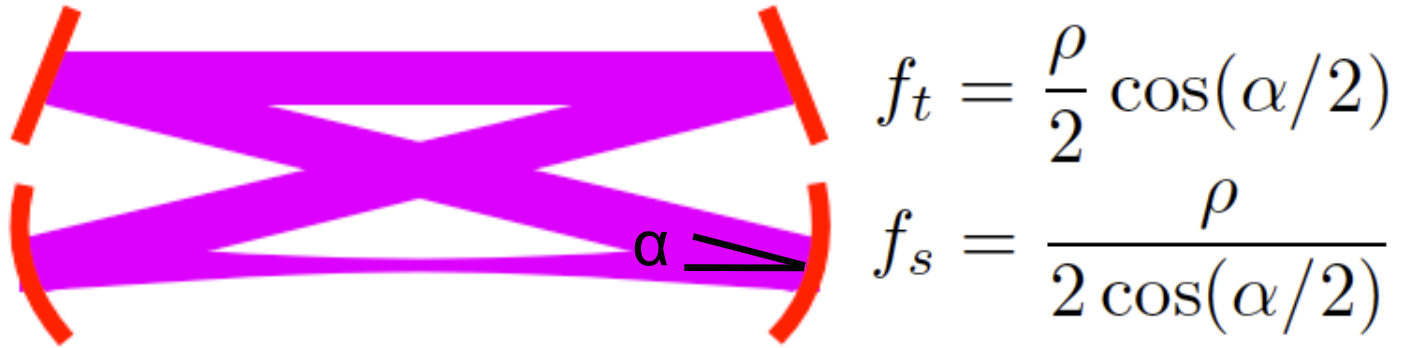
4-mirror ring cavity



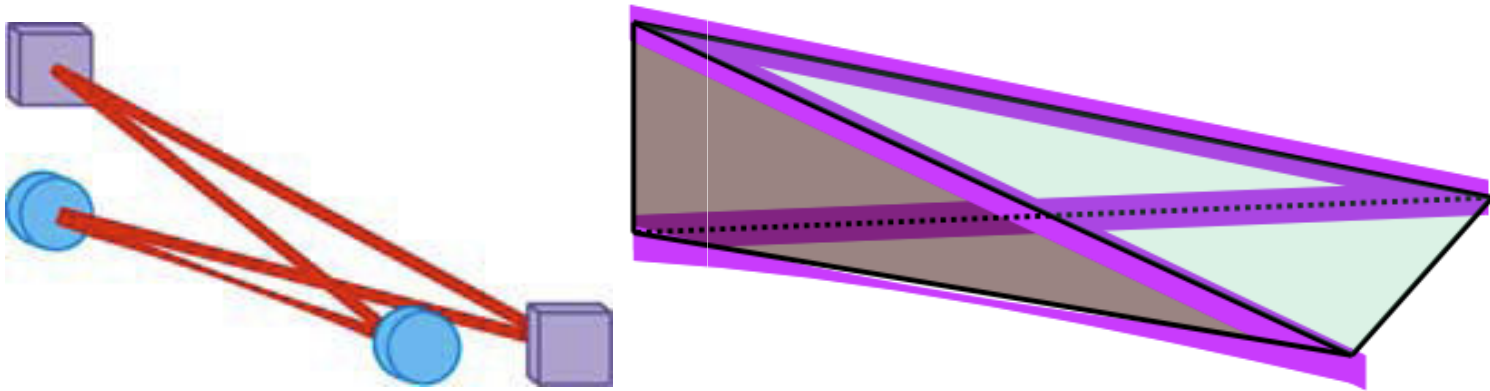
Equivalent Optics of the 4-mirror Cavity

tolerance : 4-mirror = 100 x 2-mirror

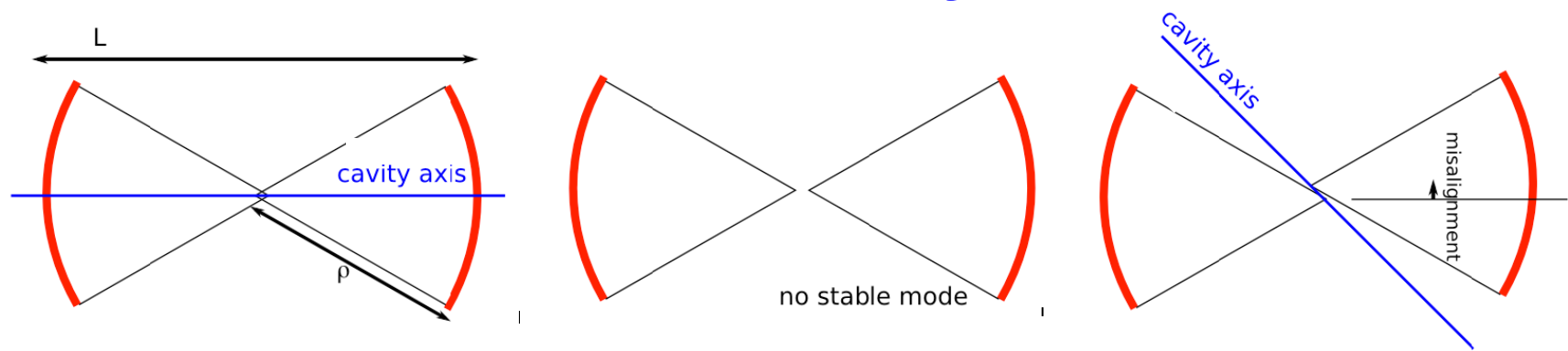
2D configuration



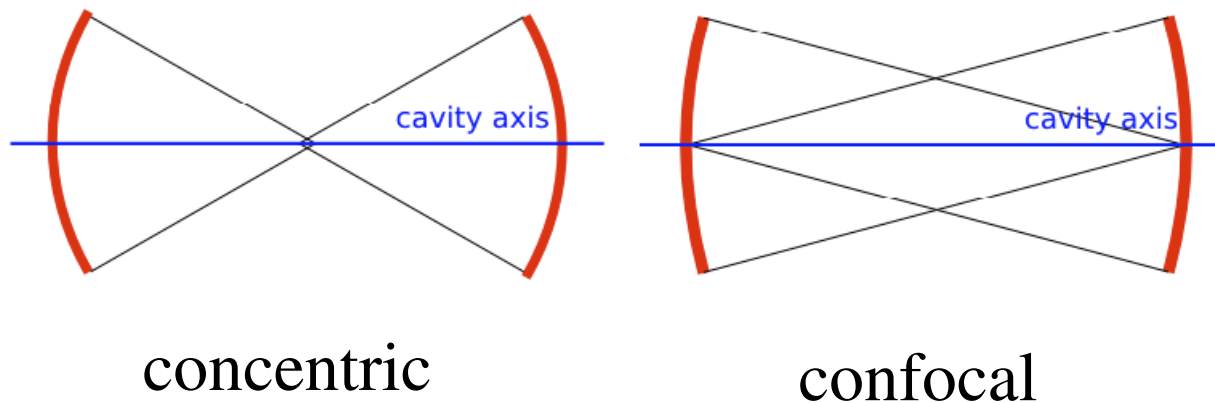
3D configuration



Tolerance of 2-mirror cavity

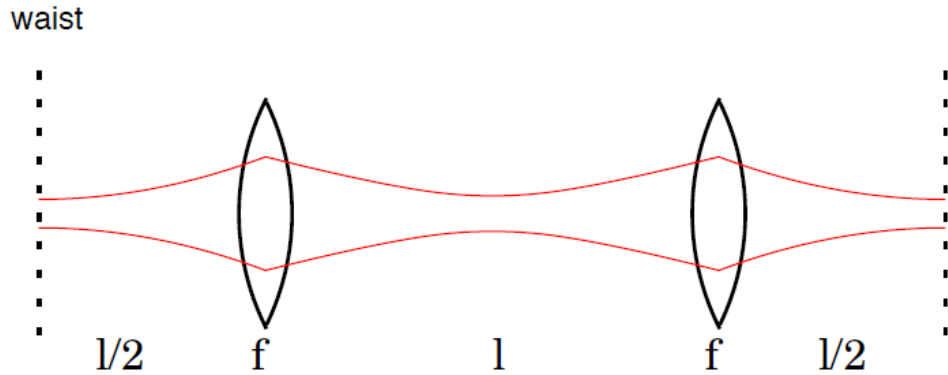
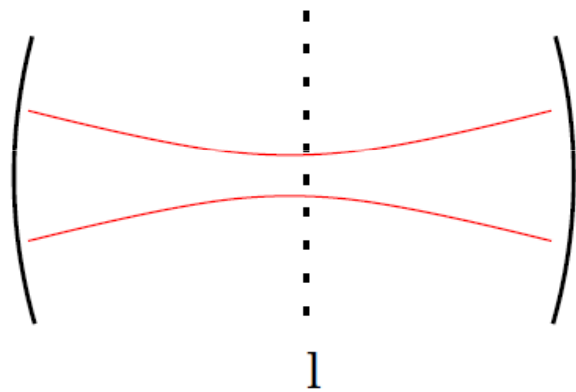
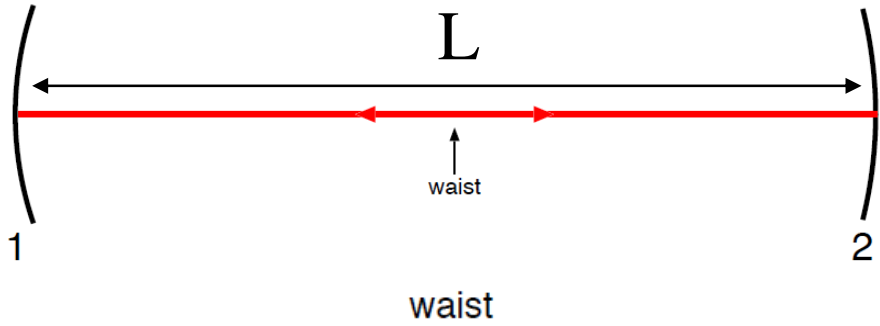


Concentric Configuration and Confocal Configuration



2-mirror cavity

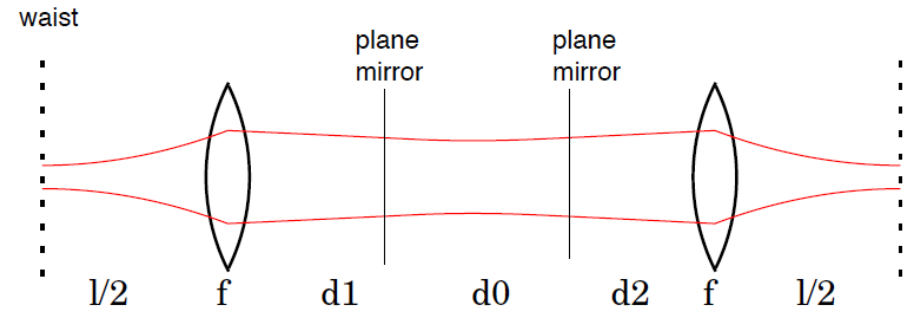
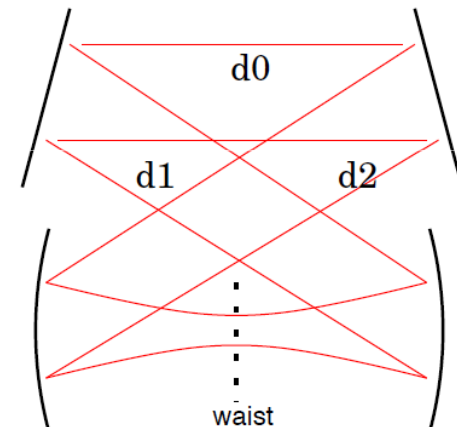
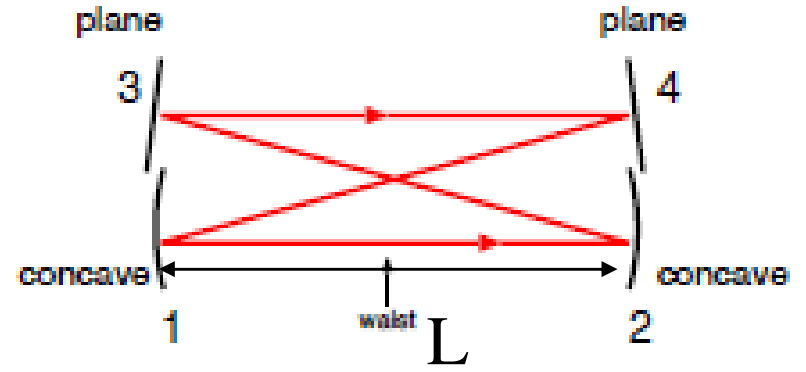
$$R_1=R_2=L/2$$



concentric

4-mirror cavity

$$R_1=R_2=L$$



confocal

data summary

bunch /train	current [mA]	Stacked Laser power[W]	γ s/train	expectation	normarized γ s/A/W
1	2.2	437 ± 2	5.4 ± 0.3	4.9 ± 0.3	5.6 ± 0.3
5	4.7	432 ± 2	10.6 ± 0.1	10.5 ± 0.5	5.3 ± 0.1
10	8.5	470 ± 2	19.0 ± 0.1	21 ± 1	4.8 ± 0.1
15	11	498 ± 2	26.9 ± 0.1	29 ± 1	4.8 ± 0.1

Normalized γ yield seems to decrease as # bunches/train goes up

 Bunch (size, timing) fluctuation in the ATF suspected