Cavity Compton

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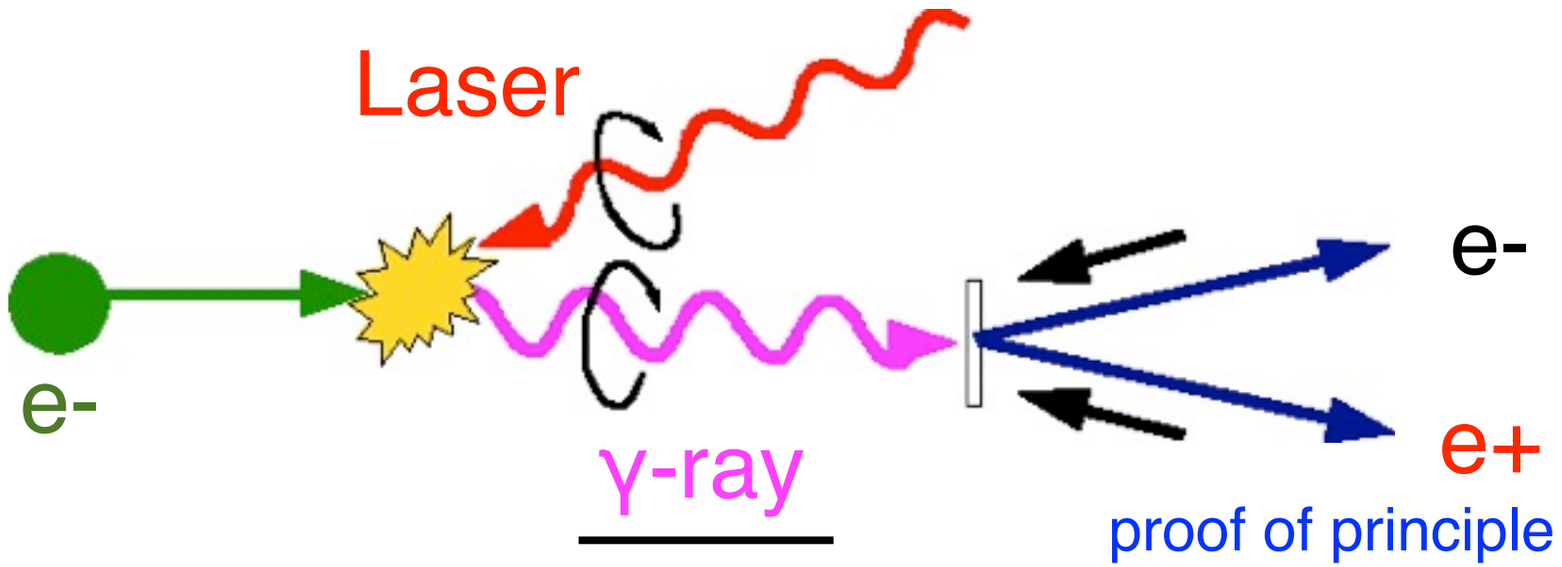
14th ATF TB/SGC Meeting
27 June 2012

Hiroshima-KEK-Waseda-Seikei Collaboration
Special Thanks to French Compton team

Introduction

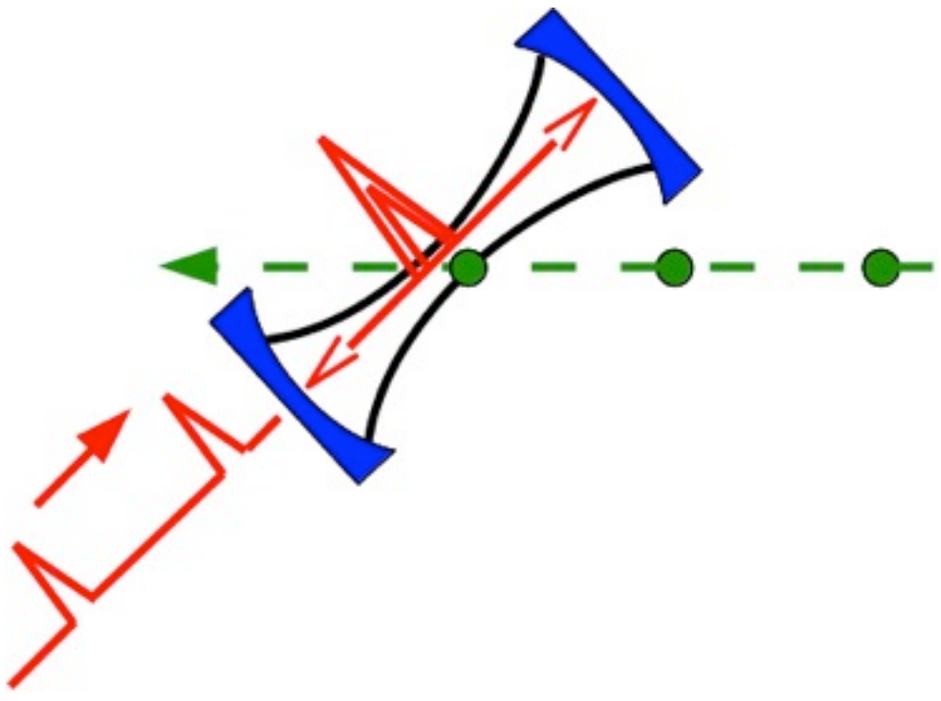
Polarized e+ by laser Compton scheme



proof of principle experiment

M. Fukuda et al., Physical Review Letters 91, 164801(2003)

T. Omori et al., Physical Review Letters 96, 114801(2006)



Increase laser power
for high intense gamma-rays
with an optical cavity

Nov. 2011

Installation of 3D 4-mirror cavity into DR

Dec. 2011

Compton signal observed with 4-mirror cavity

Mar. 2012

Multi-bunch gamma-rays measurement

May 2012

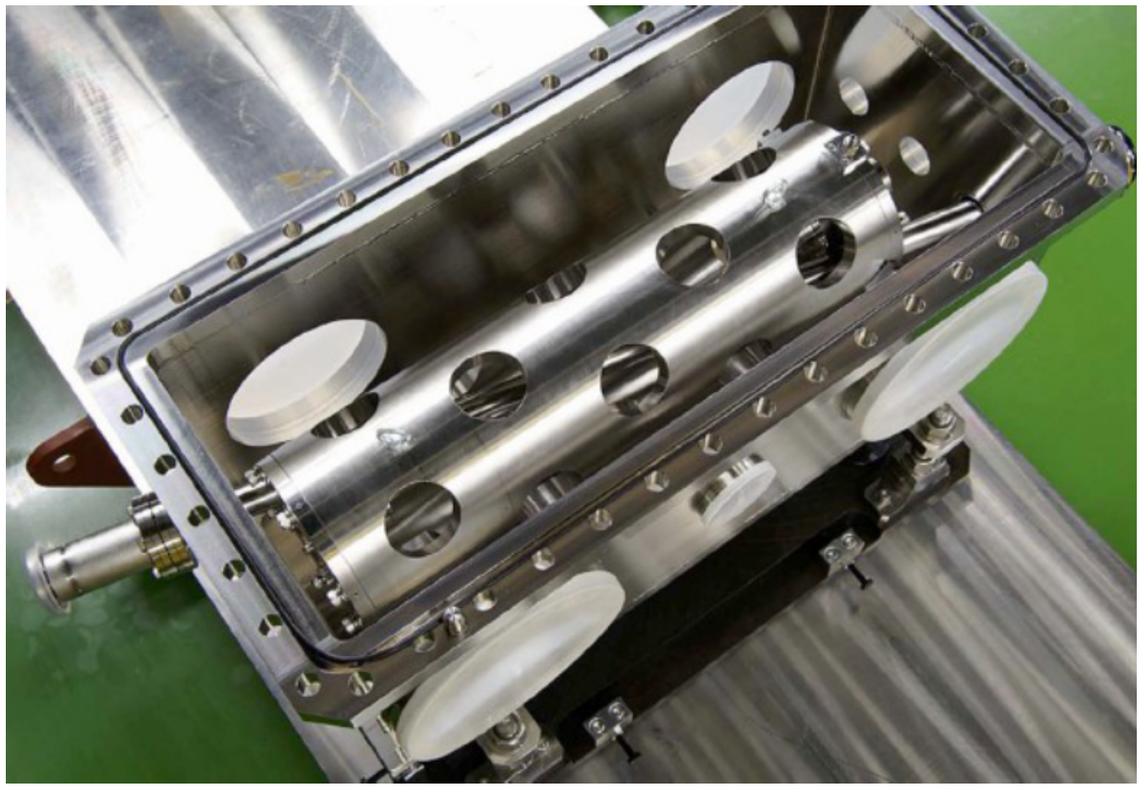
Modification laser path to the cavity

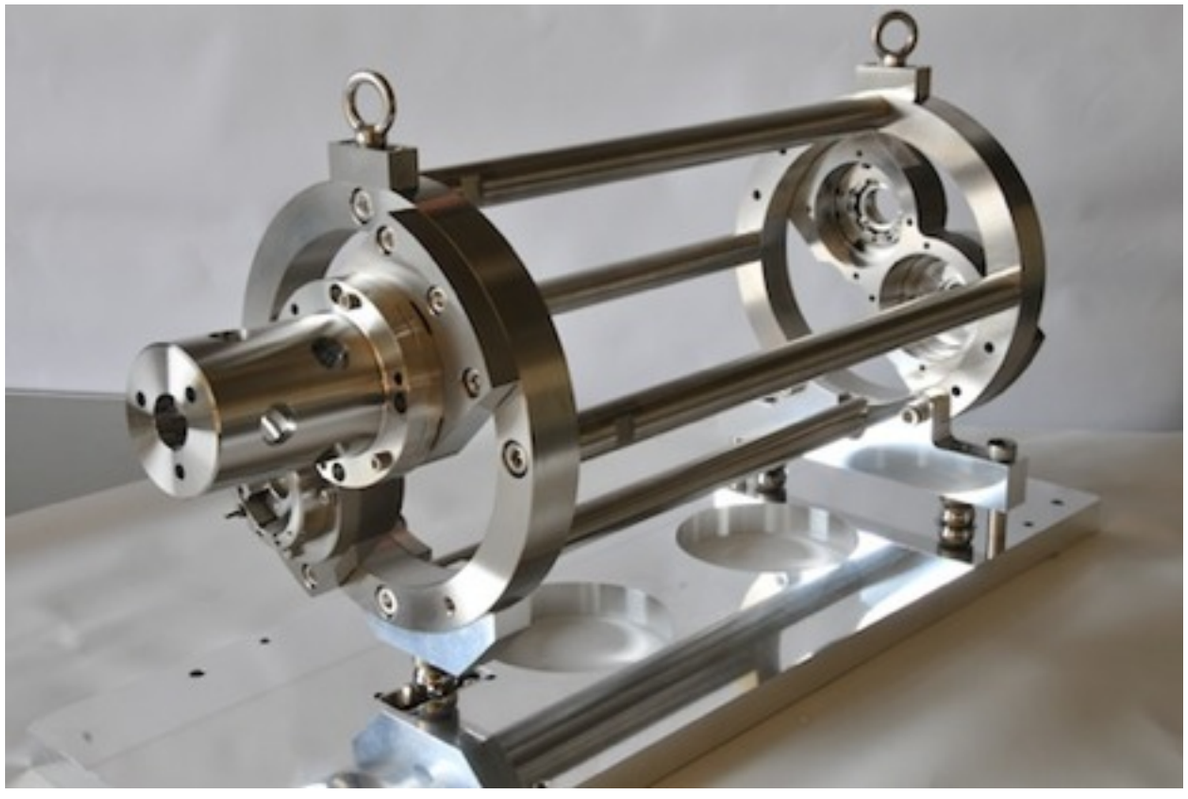
700W --> 1.6kW

June 2012

~100photons/train observed

2-mirror cavity -> 4-mirror cavity (2011)





σ ~ 30μm

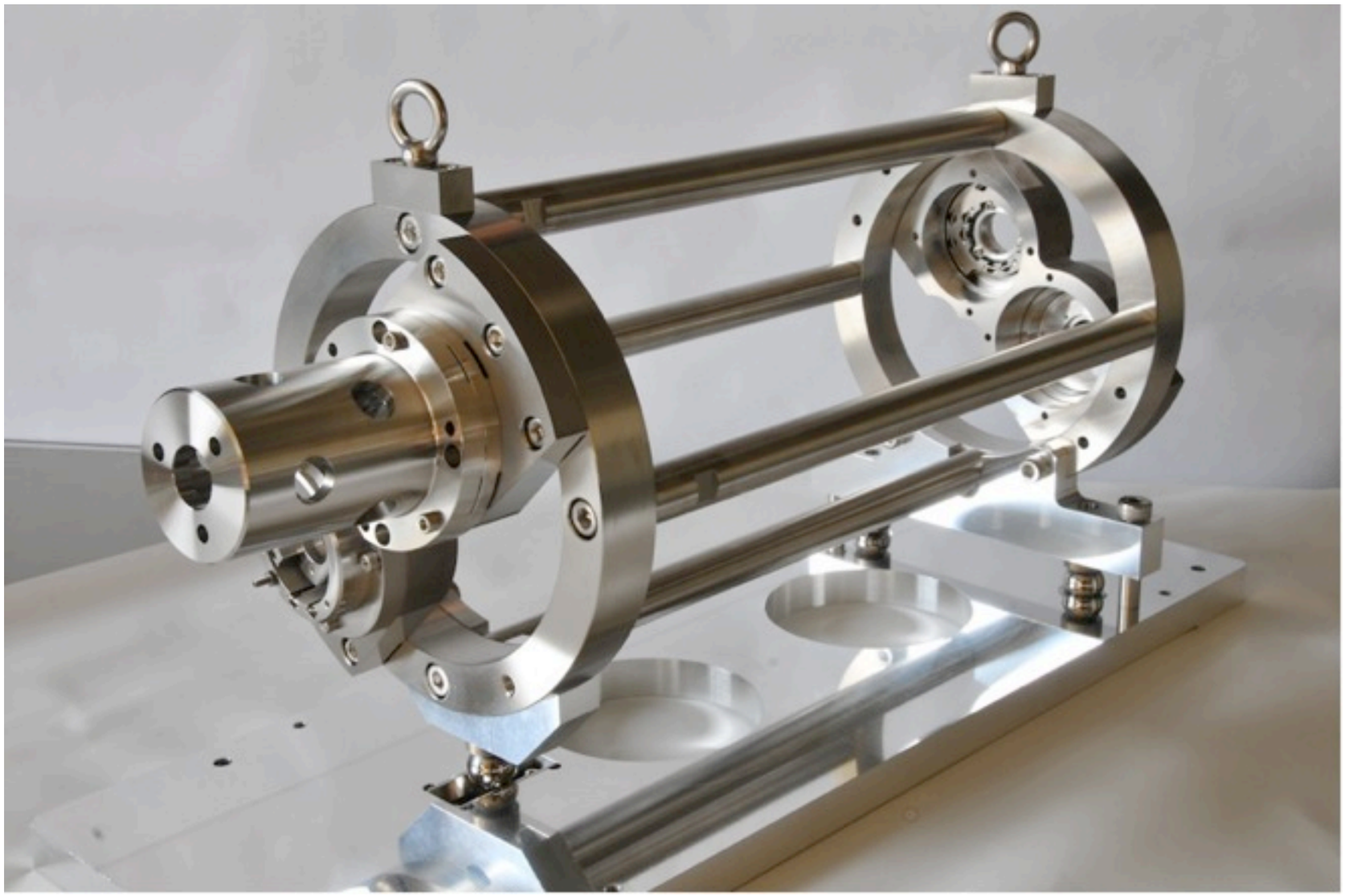
Finesse ~ 2000

σ ~ 15μm(design)

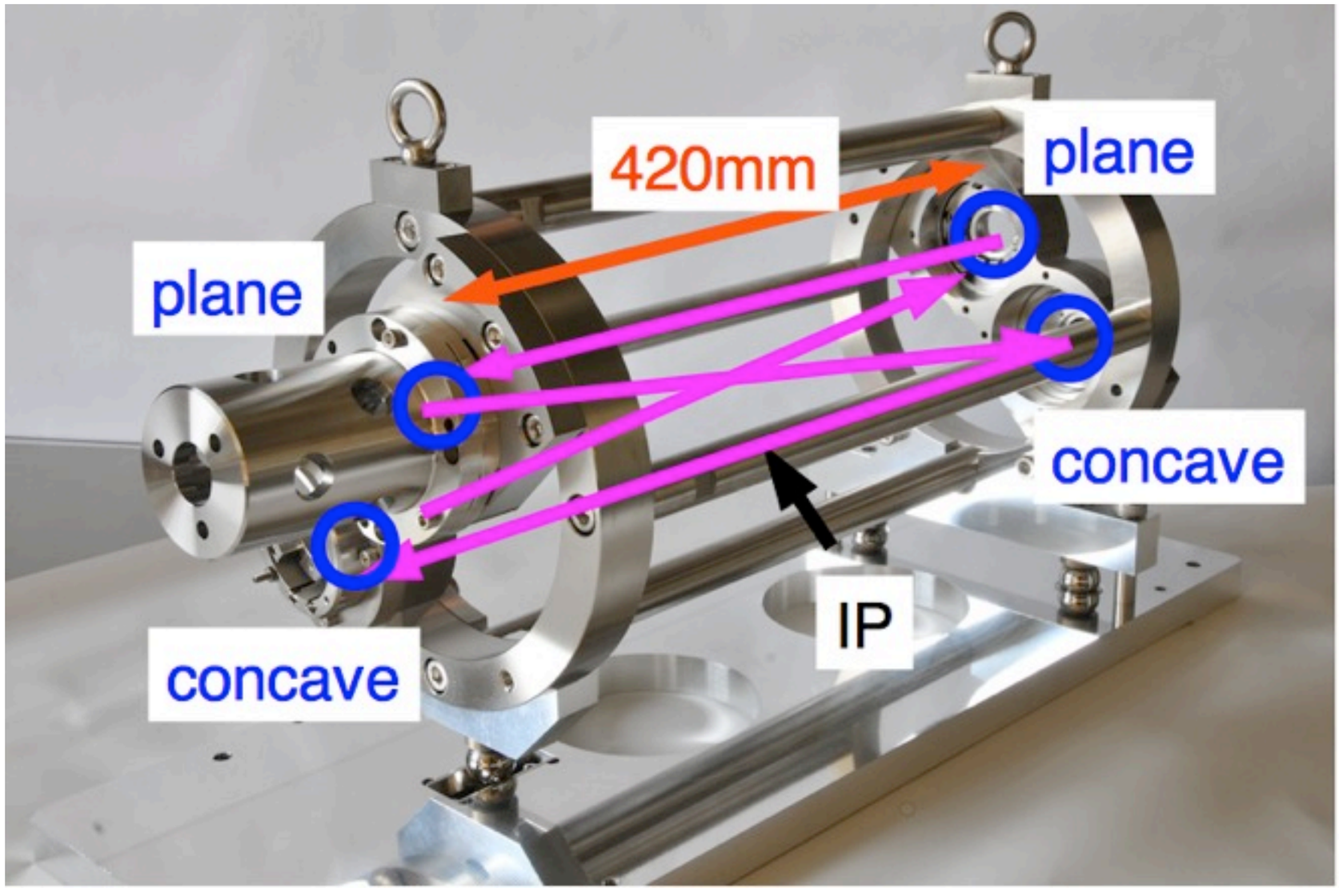
Finesse ~ 5000

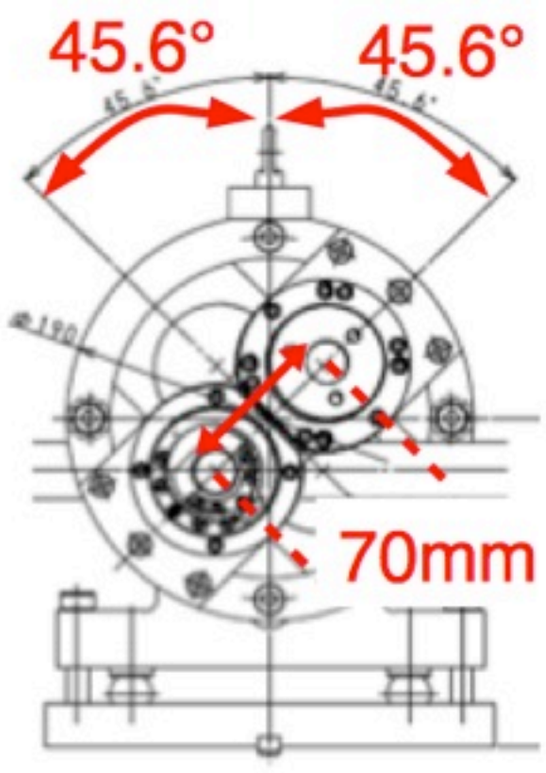
4-mirror cavity is stable for small spot size

3D 4-mirror cavity

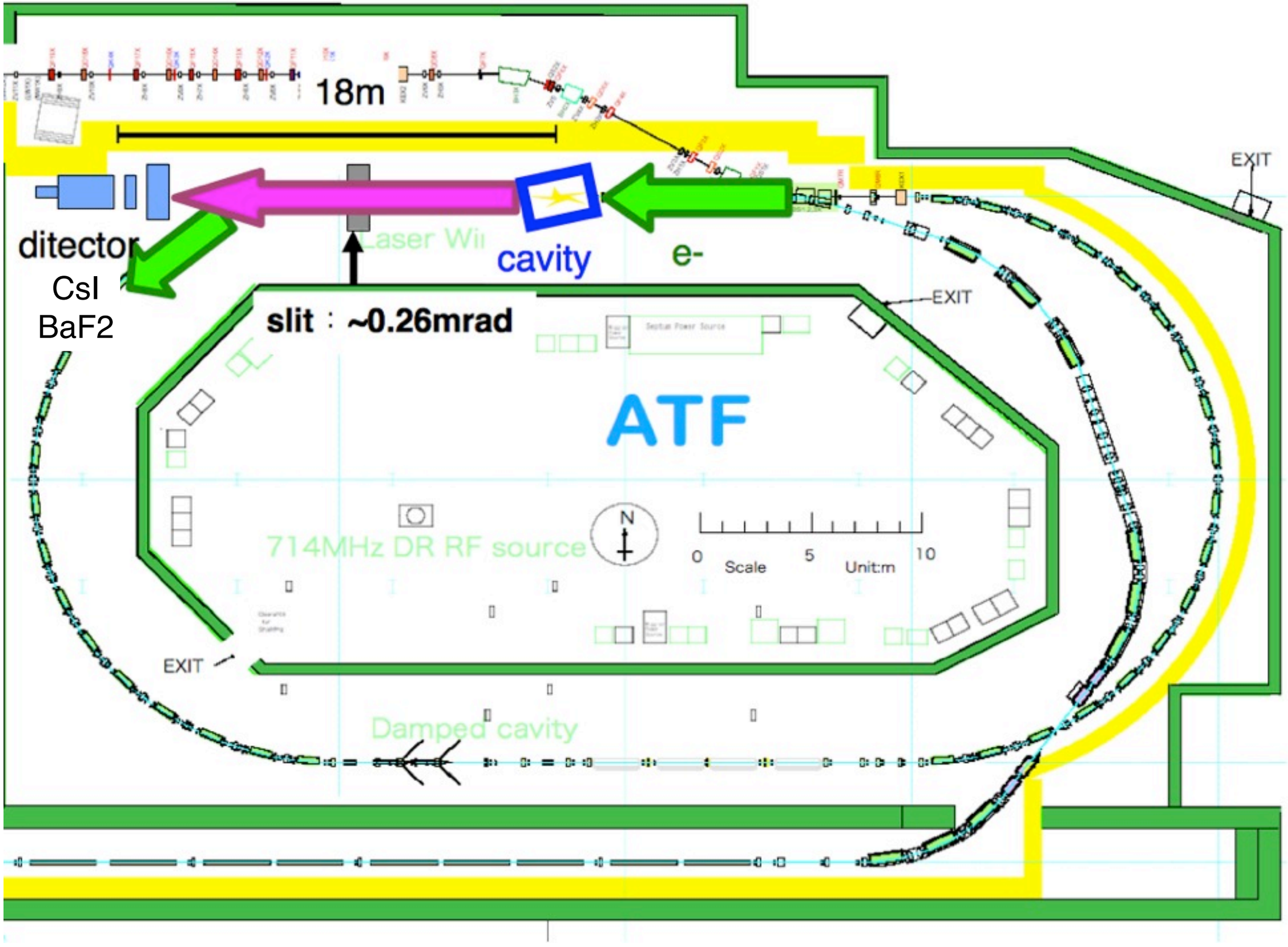


3D 4-mirror cavity



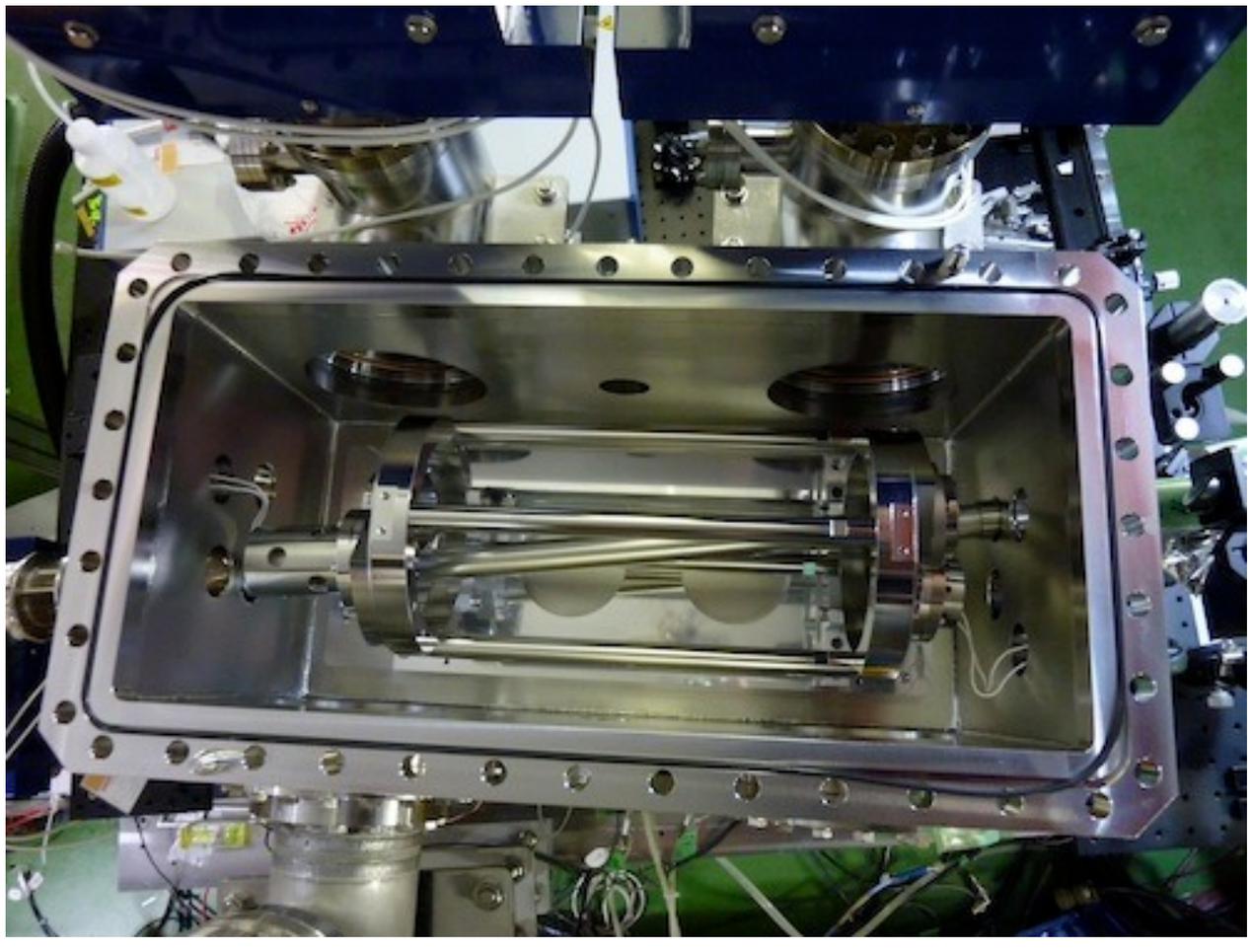


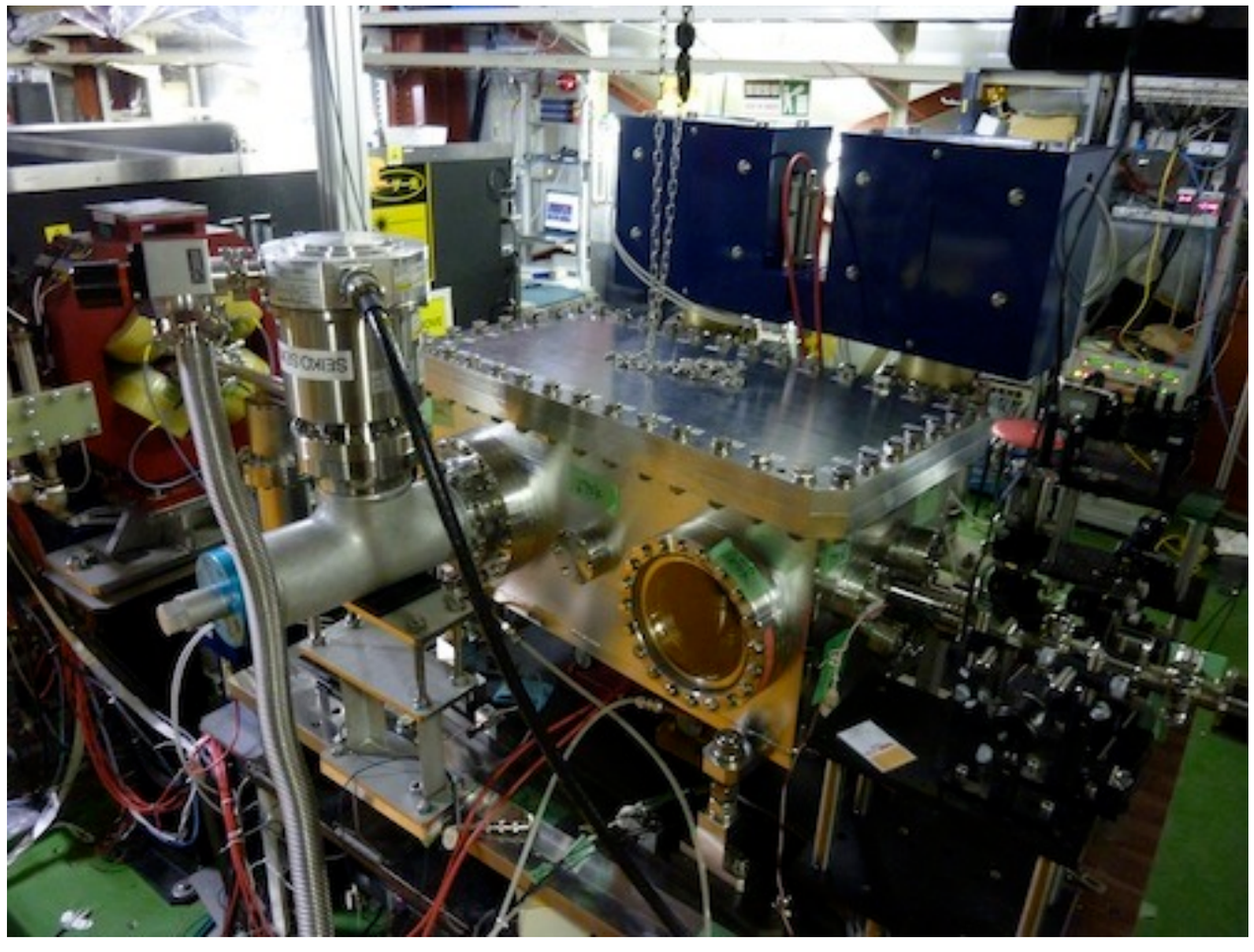
Total cavity length 1680mm → 178.5MHz


18m
ditector
CsI
BaF2
Laser Wi
cavity
e-
EXIT
EXIT
slit : ~0.26mrad
ATF
714MHz DR RF source
N
0
Scale
5
Unit:m
10
EXIT
Damped cavity

Installation of the 4-mirror cavity into DR (November 2011)

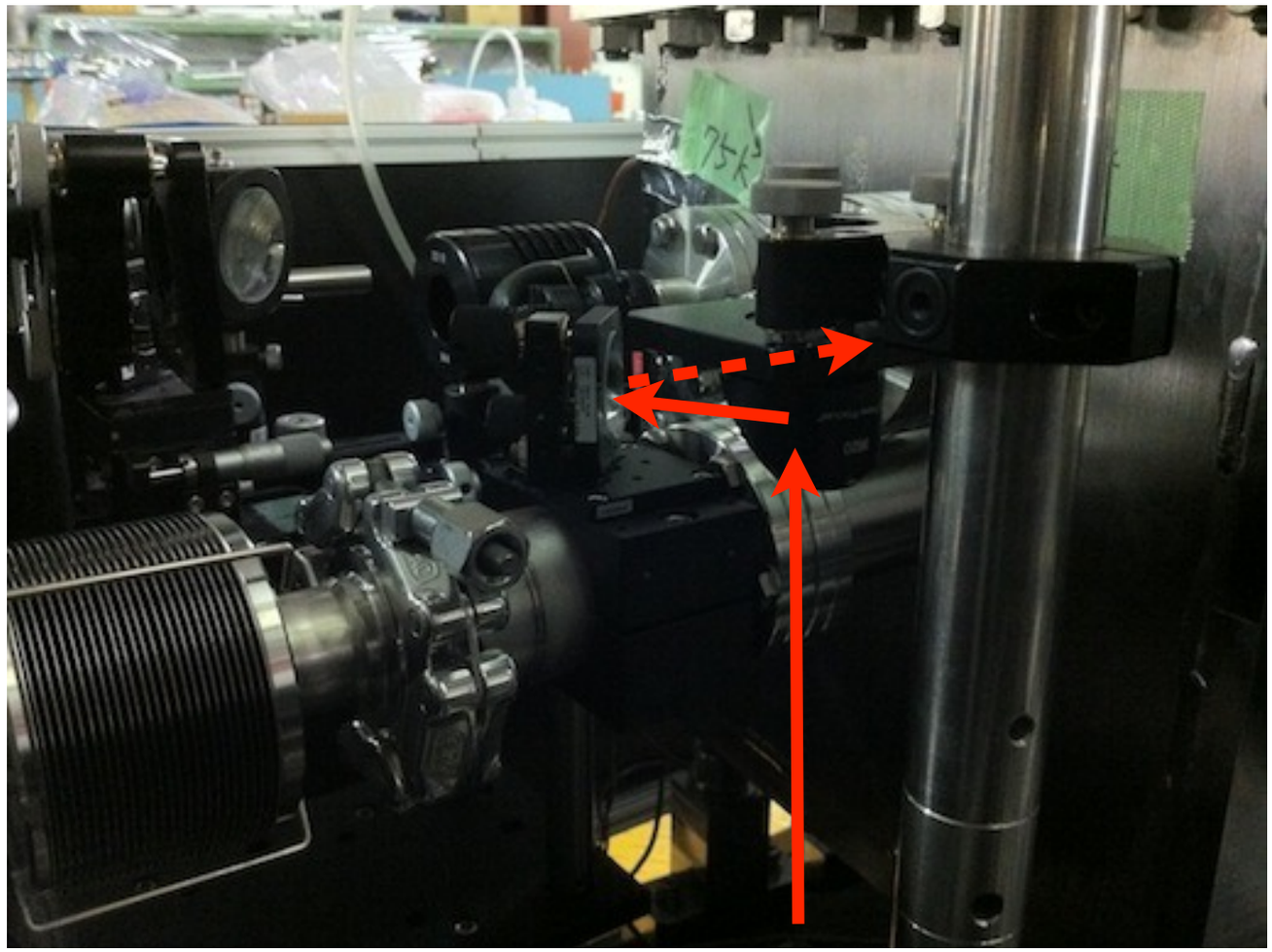
3D 4-mirror cavity and vacuum chamber





Modification of laser path (May 2012)

- Replaced the injection mirror holder
- Realigned the laser path

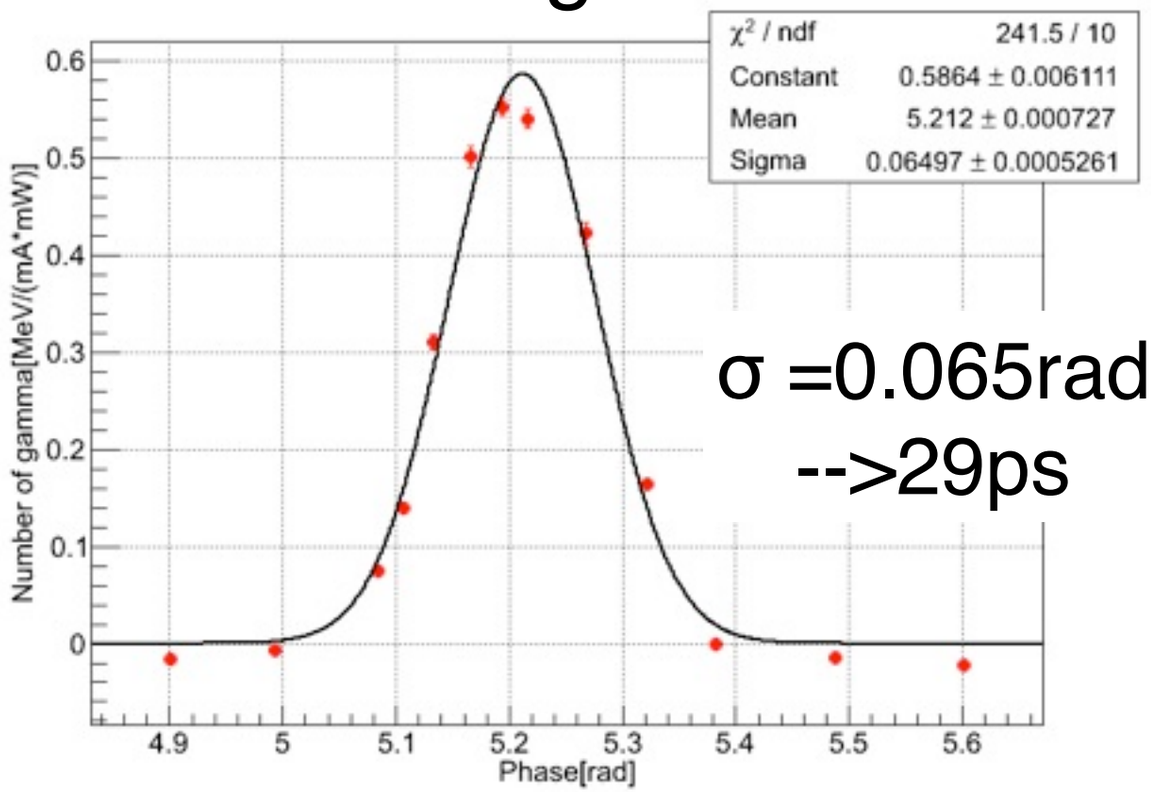


stored laser power improved

700W --> 1.6kW

Now 2.5kW can be stored in the optical cavity.

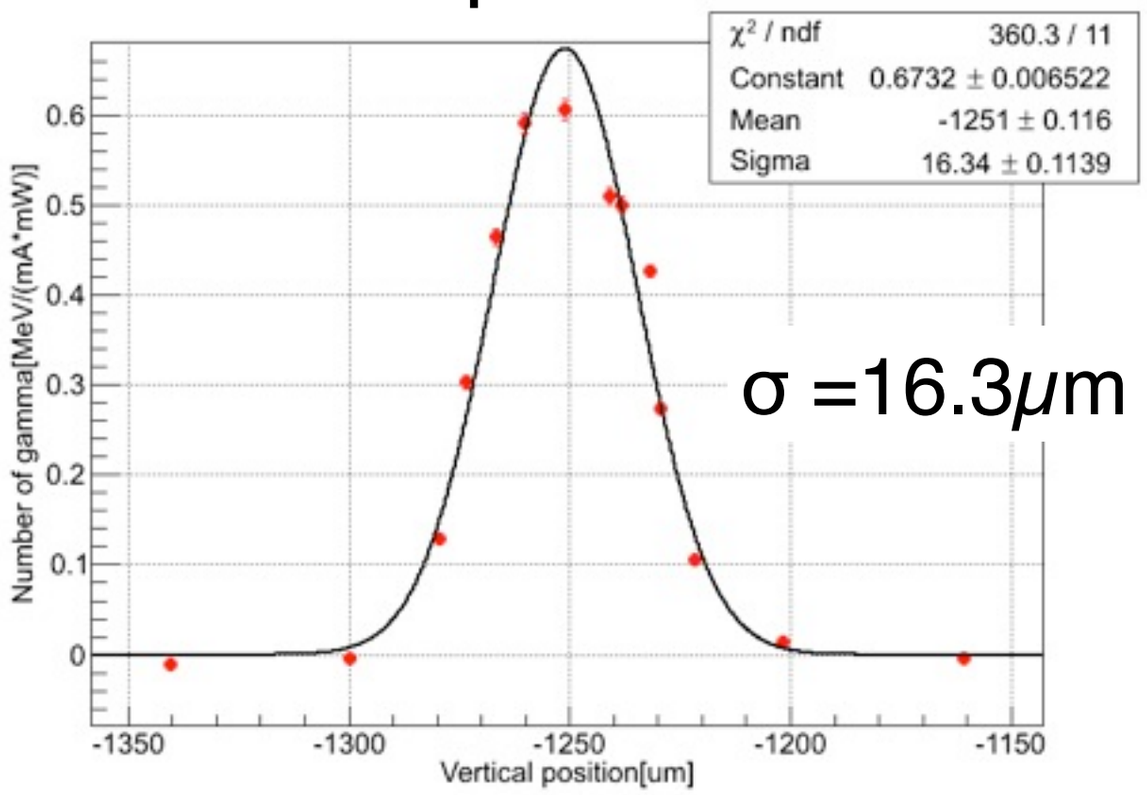
Timing scan



σ =0.065rad
-->29ps

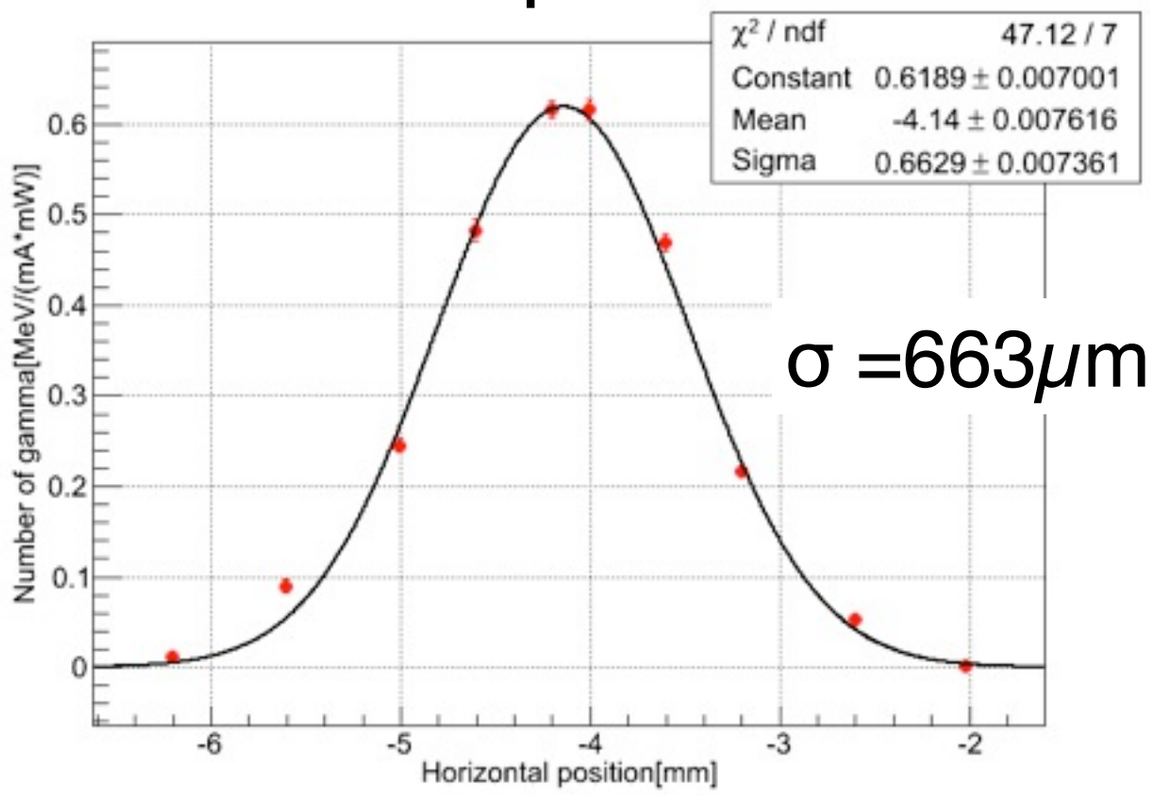
Optimization of laser timing laser position (13 June 2012)

Vertical position scan



σ =16.3μm

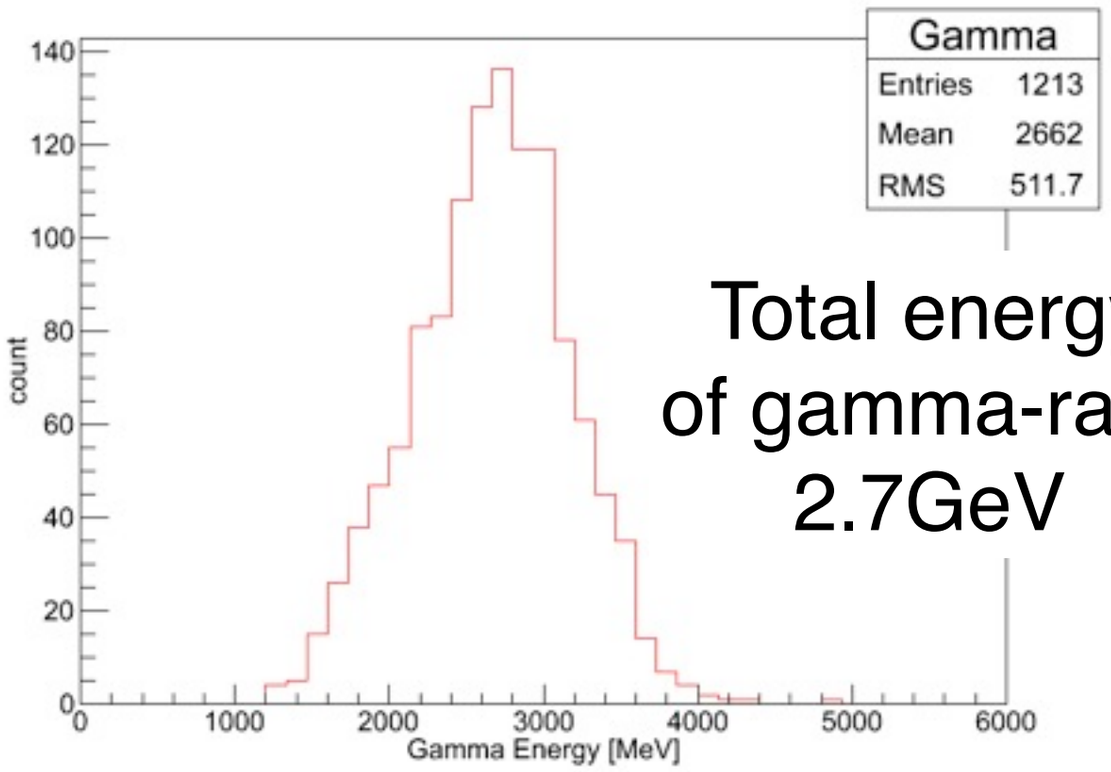
Horizontal position scan



σ =663μm

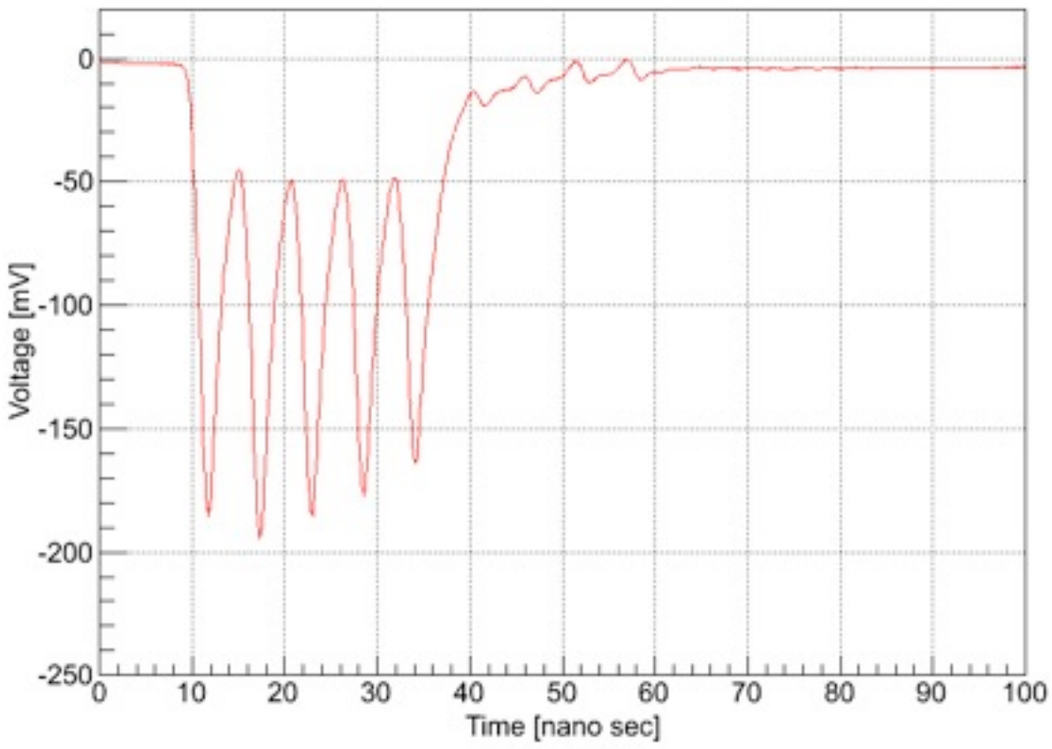
Result (6 June 2012)

Energy distribution of Compton gamma
(5 bunches operation)

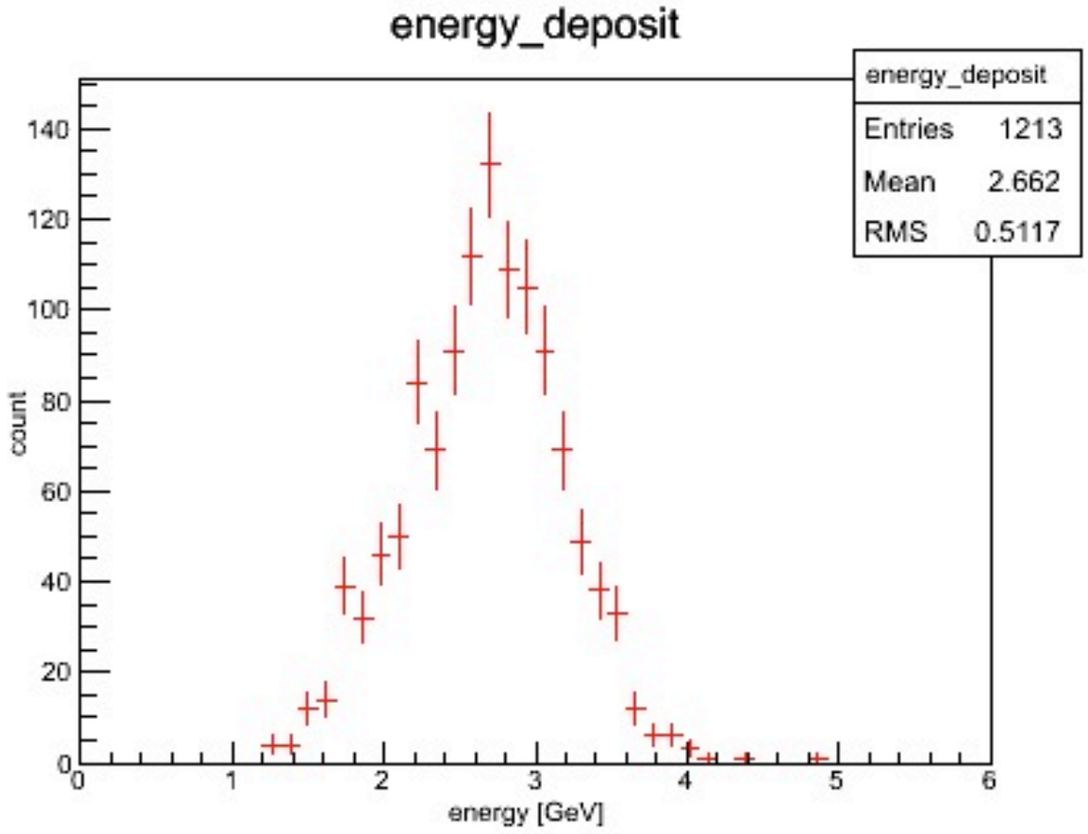


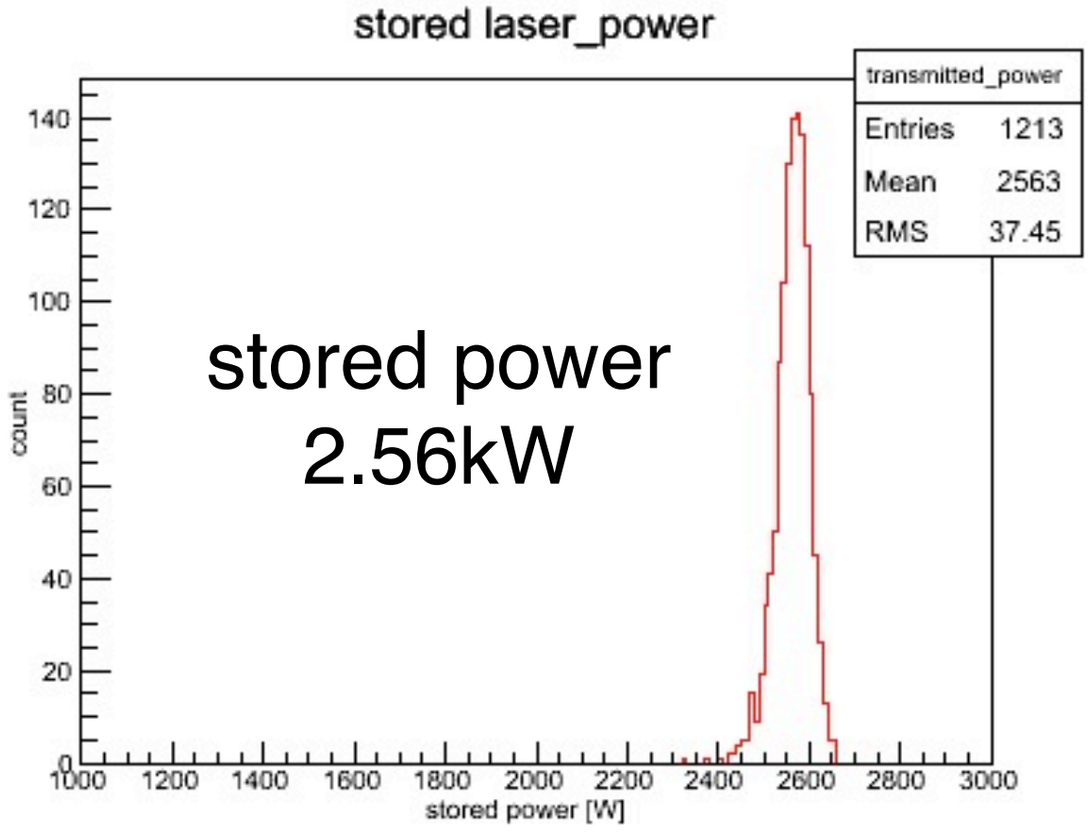
Total energy
of gamma-rays
2.7GeV

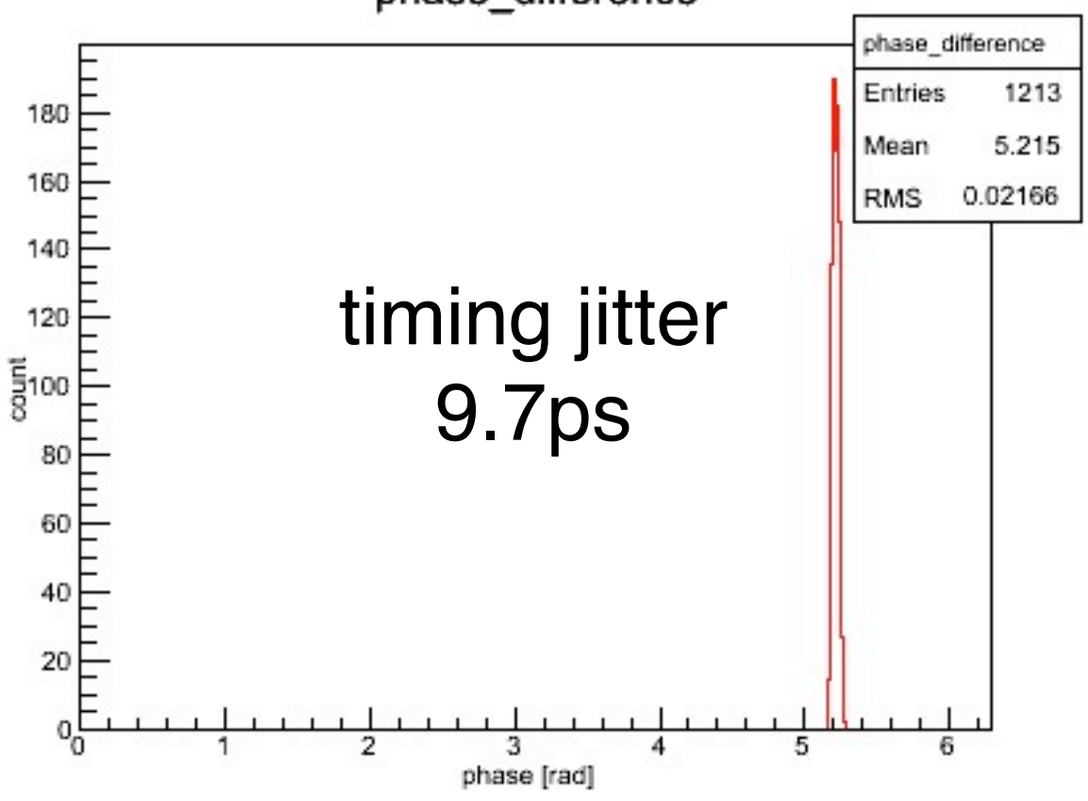
Waveform data of Compton signal

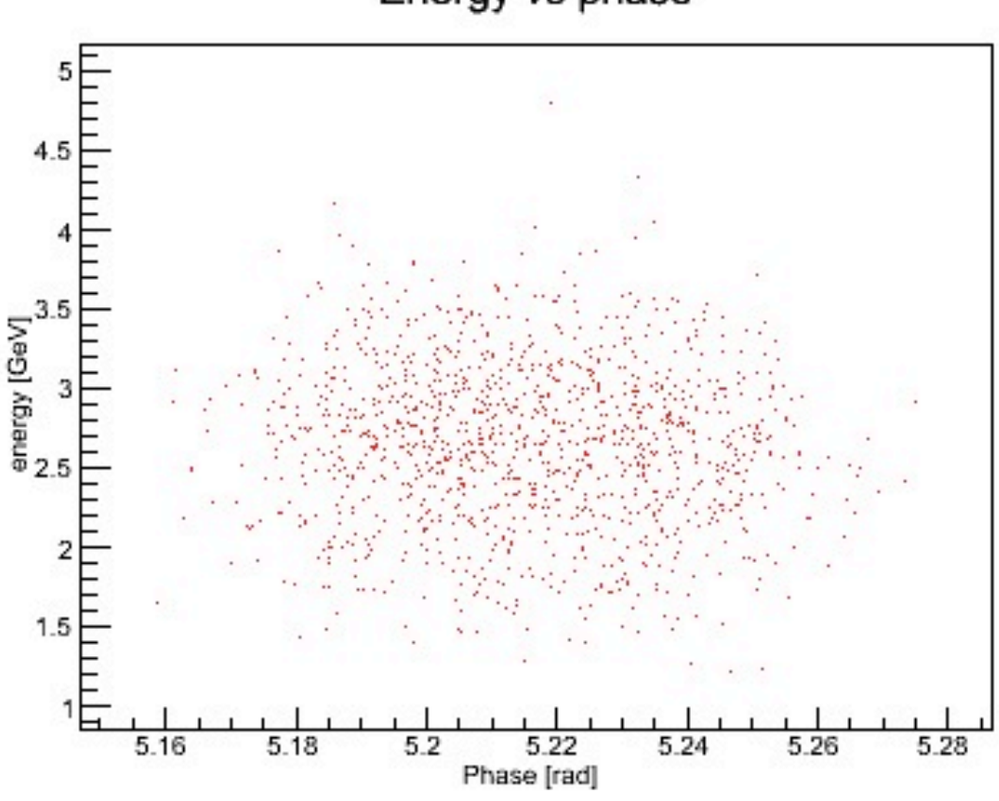


~100 photons/train
observed !


energy_deposit
energy_deposit
Entries 1213
Mean 2.662
RMS 0.5117
count
energy [GeV]


stored laser_power
transmitted_power
Entries 1213
Mean 2563
RMS 37.45
stored power
2.56kW
count
stored power [W]


phase_difference
phase_difference
Entries 1213
Mean 5.215
RMS 0.02166
timing jitter
9.7ps
count
phase [rad]


Energy vs phase
energy [GeV]
Phase [rad]

Near future plan

- Try to higher finesse (in this summer)
  - 5000 --> more than 28000 (R >99.996%)
- Digital feedback system