第７回 リニアコライダー加速器レビュー委員会

Friday 07 February 2014 from **08:00** to **18:00** (Asia/Tokyo)
at ４号館 セミナーホール

Description 主催／共催：先端加速器推進部・LC計画推進室／加速器研究施設
趣旨：TDRの完成、LC技術開発の現状を踏まえ、LC準備段階における、KEK／国内における技術開発、展望を評価する。
評価委員：生出（委員長）、小林、新竹、古屋、内藤、小磯、羽島

Friday 07 February 2014

09:30 - 09:40	委員打合せ
09:40 - 10:10	加速器ビームオプティクス・ダイナミクス [久保浄] *30'* Material: **Slides**
10:10 - 10:40	超伝導空洞・企業との協力による開発 [山本康史] *30'* Material: **Slides**
10:40 - 11:10	超伝導空洞・KEK でのIn-House開発 [佐伯学行] *30'* Material: **Slides**
11:10 - 11:40	クライオモジュール・クライオジェニクス [仲井浩孝] *30'* Material: **Slides**
11:40 - 12:10	高周波技術 [松本利広] *30'* Material: **Slides**
12:10 - 13:10	昼休み
13:10 - 13:40	STF-II (ERL-SCRF 技術開発連携含む) [加古永治] *30'* Material: **Slides**
13:40 - 14:10	STF-COI 設備開発、及びSTF 総合的展望 [早野仁司] *30'* Material: **Slides**
14:10 - 14:40	ATF II [奥木敏行] *30'* Material: **Slides**
14:40 - 15:00	休憩
15:00 - 15:20	ATF総合的展望 [照沼信浩] *20'* Material: **Slides**
15:20 - 15:50	陽電子源 [大森恒彦] *30'* Material: **Slides**
15:50 - 16:20	施設設計 (土木・建築・設備) [宮原正信] *30'* Material: **Slides**
16:20 - 17:00	委員議論，答申作成 *40'*
17:00 - 17:30	答申 *30'*

Preliminary review results for ATF (memo)

(1)The two Goals are appropriate, however it is unclear what have been achieved during yearly operations. Milestones should be clearly specified and regularly monitored.

(2) The IPBSM laser system is observed to be very unstable, e.g. fringe scans. Dedicated person(s) must be needed in order to understand the performance in details and to operate it stably.

(3) Many young researchers have been trained at ATF. It is a very important role of ATF. So, this educational responsibility should be maintained in addition to individual R&Ds.

Experimental validation of a novel compact focusing scheme for future energy-frontier linear lepton colliders
by G. R. White, R. Ainsworth, T. Akagi, et al.
Phys. Rev. Lett. 112, 034802, published 24 January 2014

Goals at this meeting

First goal of achievement of 37nm vertical beam size, we would like to focus on two major issues of the wakefield and vertical emittance growth keeping in mind that there are other issues such as multipole fields in the quadrupole magnets, electron/laser beam jitters etc. .

The primary goals are identification of sources for the wakefieds and emittance growth and establishment of the mitigations. (1/23-25, 2013)

Setup of milestones such as ;

37nm@low intensity, wakefield-free, 37nm@high intensity

Second goal of nanometer stabilization at IP :

Setup of milestones such as ;

nm-resolution, jitter measurements and IP feedback

Wakefield **Beam intensity 0.1 to 1 x 10^{10}**	Small emittance at DR ~4pm Emittance growth at EXT	**Small beam size** **σ^*_y<70nm (design 37nm)** **wrt ILC chromaticity correction**
Wakefield free steering -algorithm for ATF2 beam line - beam study Alignment of CBPMs at large beta function regions <100um CBPMs to stripline BPMs at large beta function regions Reduction of steps in the beampipes Exchange of SD4FF due to short circuit in one of 6 coils (done) - large skew sextupoles - large intensity dependence - measurement of beam size of < 70nm - new sextupole magnets	Vacuum pressure <10^{-7} Pa - scrubbing with 50 to 100mA 3D emittance measurements by new DR-LW - the cavity (done) - laser system (this weekend) - commissioning Beam position at MB2X (MB1X) - calibration (done w/ Yves's reconstructed orbits) Alignment of KEX1, BH3X - estimation by simulation with V offset, tilt (2 weeks) - re-alignment of them	If there is no wakefield issue at the low intensity : (1) β^*_y=0.1mm, 1×10^9/bunch and δ=0.05% : $\xi^*_y\delta$=1/2 of ILC σ^*_y=45nm@ ε_y=20pm σ^*_y=55nm@ ε_y=30pm (2) β^*_y=0.05mm, 1×10^9/bunch and δ=0.05% : $\xi^*_y\delta$=1 of ILC σ^*_y=32nm@ ε_y=20pm σ^*_y=39nm@ ε_y=30pm
larger effect to the beam size ?	Is the growth ∝ ε_y ?	No problem at low intensity?

Session Organization

17th Mtg.	12th Feb., 2014 Wednesday	13th Feb., 2014 Thursday	14th Feb., 2014 Friday
9:30 12:30	**Introduction** greeting, goal at this meeting **Alignment&LINAC, DR** alignments, hardware improvements at LINAC and DR **Instrumentation** IPBSM, IPBPM system	**The first goal** how to reach 37nm milestones, i.e. detailed procedure in next runs preparation for the ultra-low beta optics study (25nm)	**Wakefield and emittance issues** simulation and measurement of wakefield effects, emittance growth, mitigation plan **Plan for future studies** Milestones, i.e. next 6 months and next 2 years
14:00 16:10 17:30(Fri)	**Beam studies** DR jitters Halo measurements Extraction line Final ficus line	**17th TB/SGC Meeting** Opening and status reports of ATF2 status/plan, FONT, LW-OTR, KEK/LAL Cavity Compton status/plan, GM feedback, and 5 proposals of (1) halo collimation, (2) two octupoles&hybrid QD0, (3) new OTR/ODR beam size monitor, (4)wakefield free steering,(5) PoP experiment on beam loading at LINAC	**The 2nd goal** Status and future plans of IPBPM, IP chamber and the mover, FONT for IP feedback and discussion of collaboration and milestones 18:30 - Banquet@Sasano-ya

IPBSM Reminders from previous studies

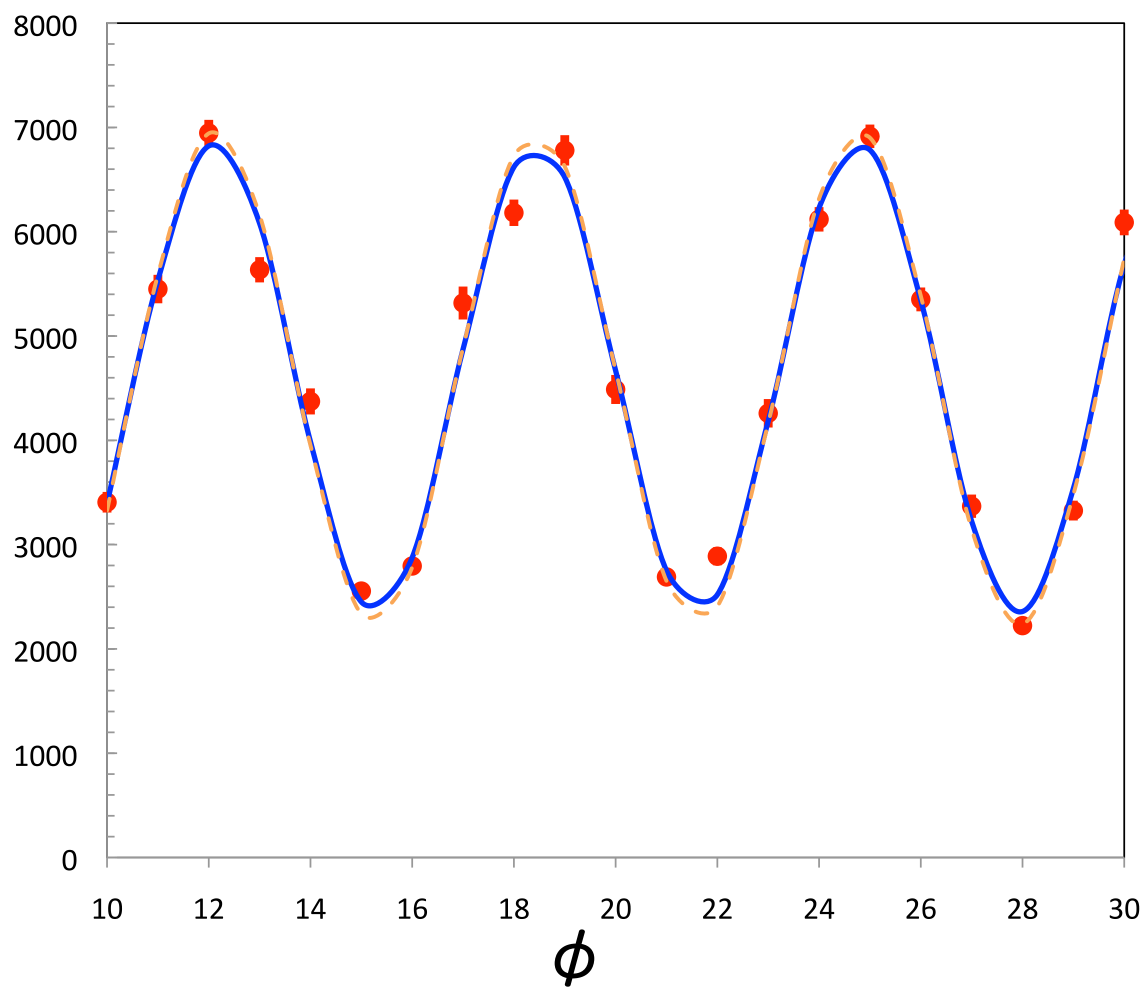
Fringe scan results at 30 degree mode

Nave=99, 130519_233909

M=0.52±0.01 by MIN-MAX (dotted line)

M=0.49±0.01 by the fringe pattern fit

error bars show rms/√98



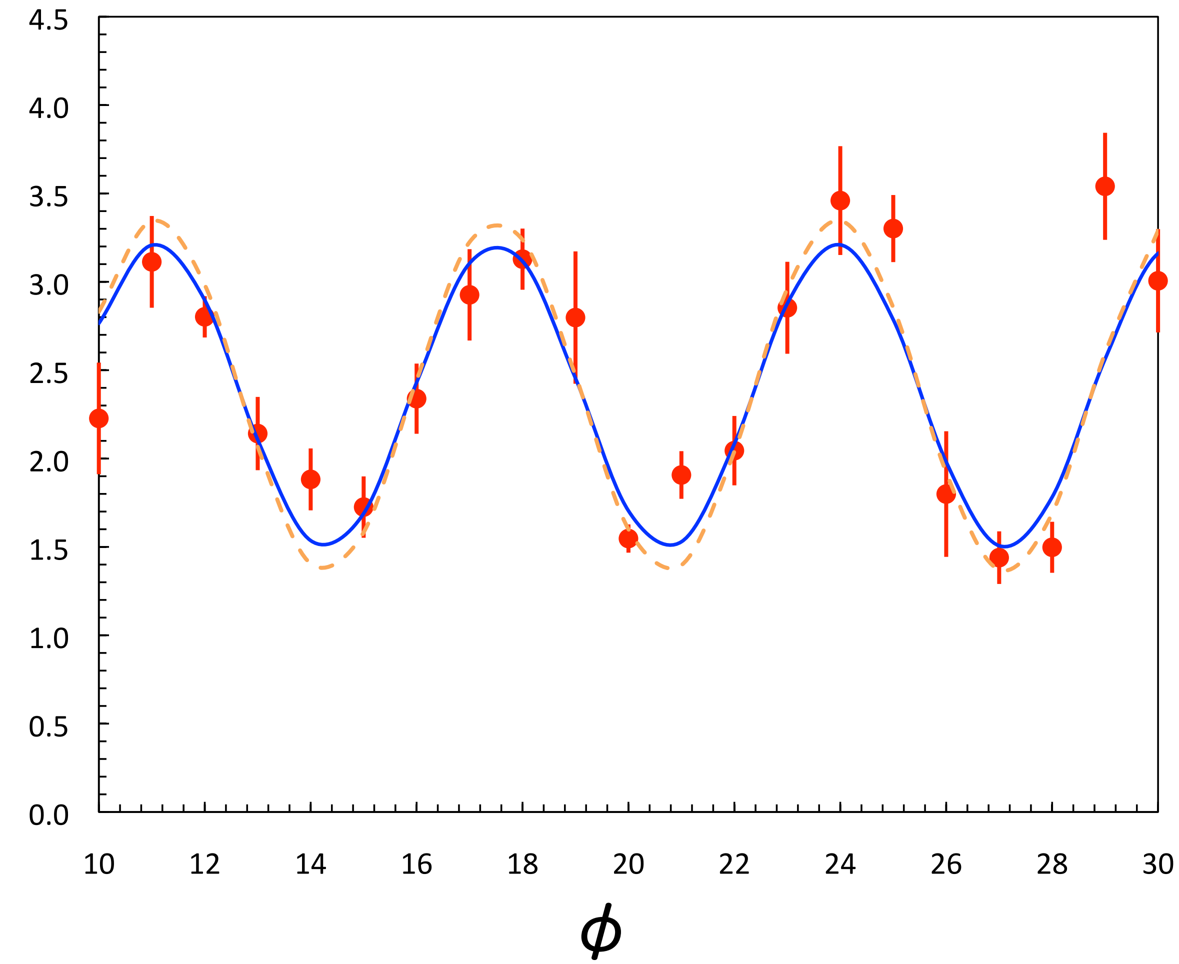
Fringe scan results at 174 degree mode

Nave=10, 130520_222330

M=0.42±0.06 by MIN-MAX (dotted line)

M=0.36±0.04 by the fringe pattern fit

error bars show rms / √9



$$f = N_0(1 + M\cos(C_{phi} \cdot \phi - \phi_0))$$

30 degree mode:

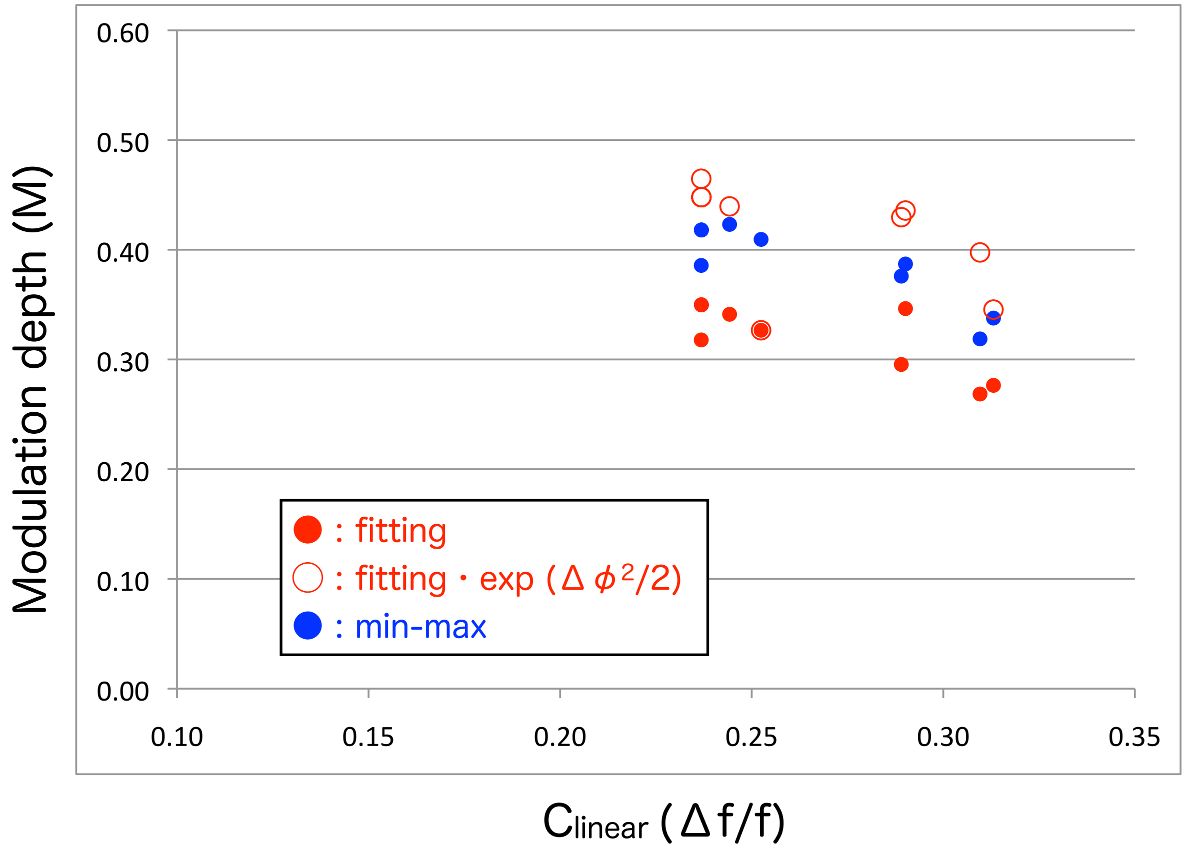
N_0 = 4598.66
M = 0.488736966 (σ_y = 175nm)
phi_0 = 12.09731397
C_{phi} = 0.996017034
χ^2 = 98.1
reduced χ^2= 5.45

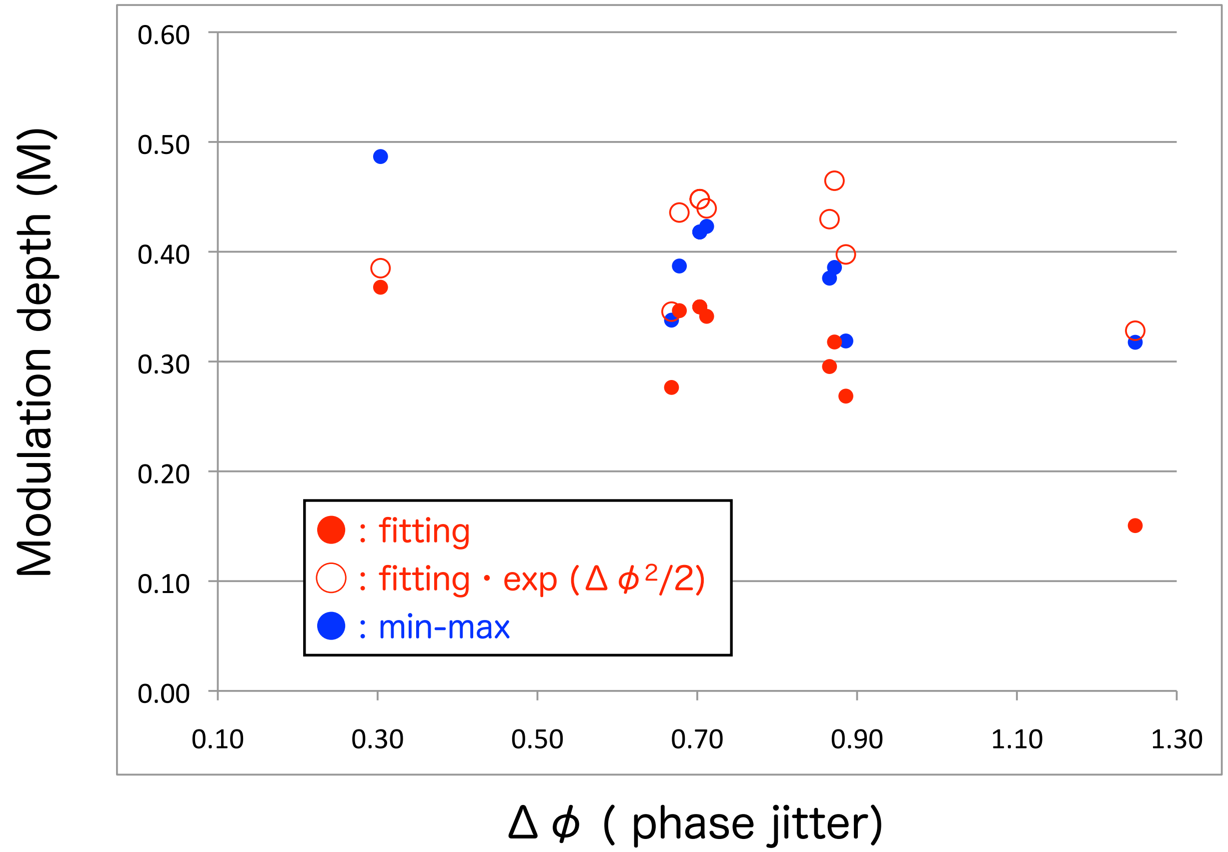
174 degree mode:

N_0 = 2354.033506
M = 0.363681862 (σ_y = 60.4nm)
phi_0 = 10.86035195
C_{phi}= 0.978788759
χ^2 = 44.0
reduced χ^2= 2.45

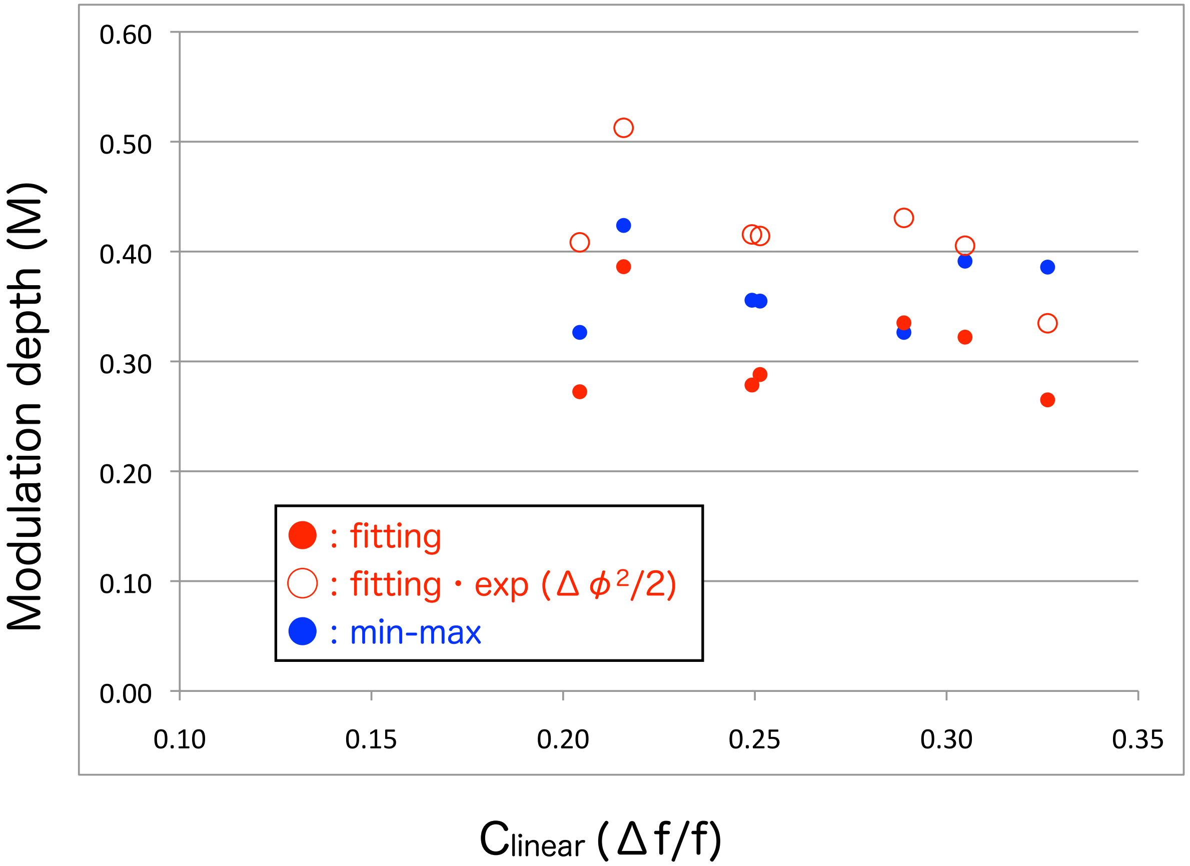
Free parameters in the jitter analysis = C_{linear}, C_{stat} (Δf_{stat}), $\Delta\phi$

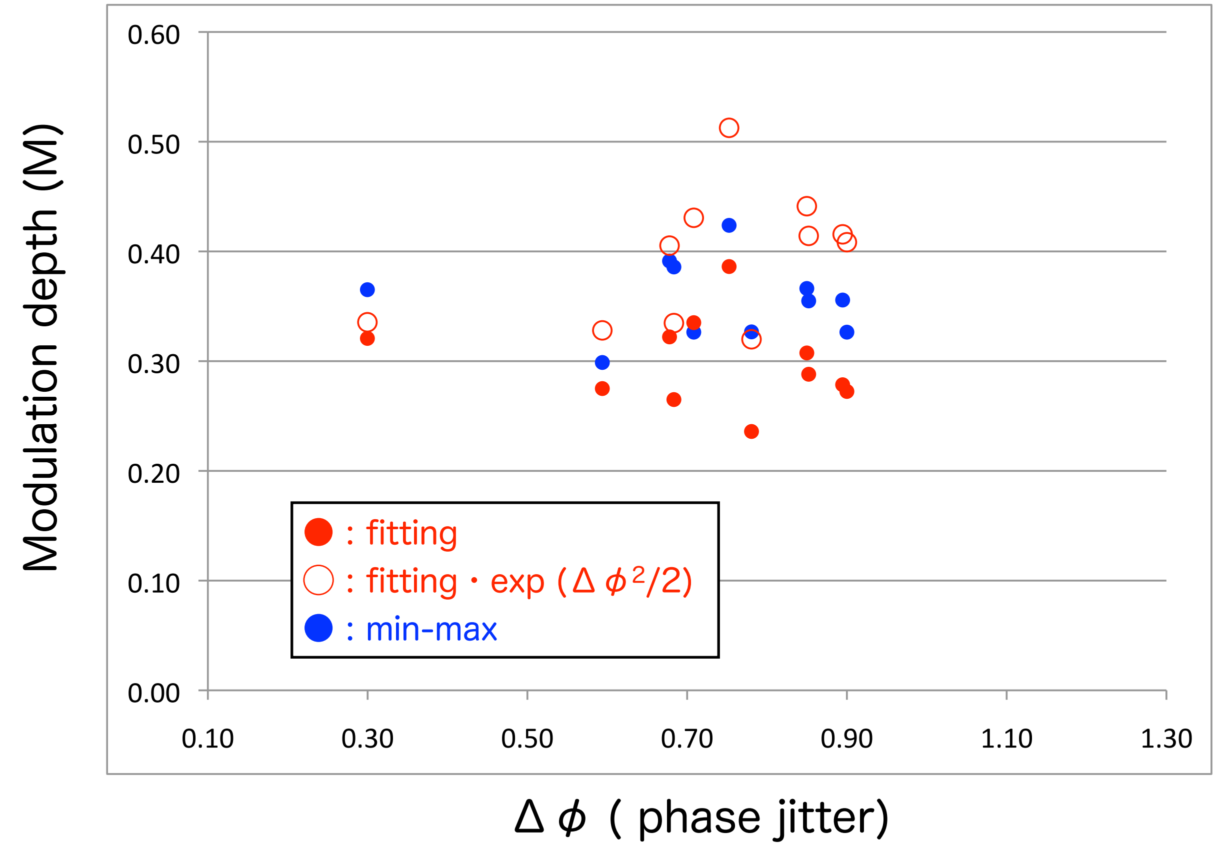
10 Consecutive Fringe scan results on 14 March 2013 : 174 degree mode and < ICT>= 0.58 x 10^9/bunch



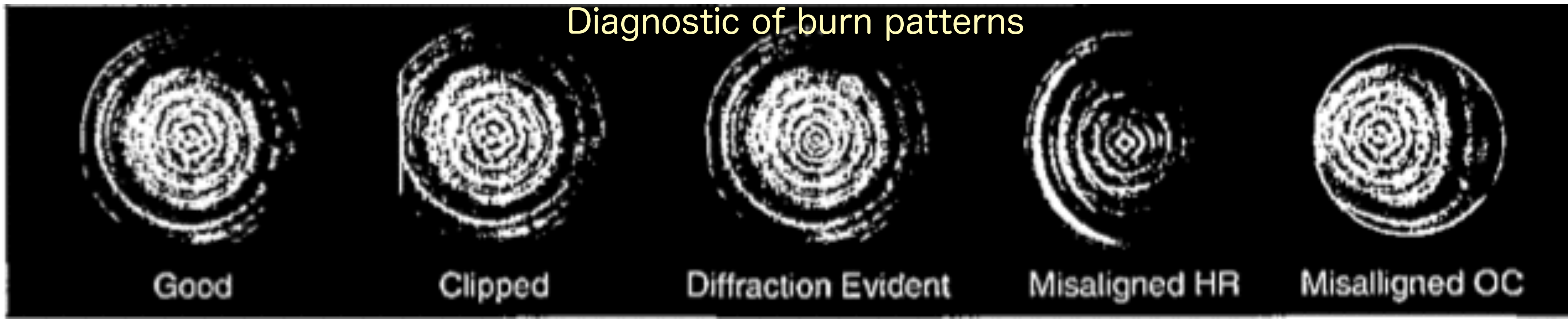


10 Consecutive Fringe scan results on 8 March 2013 : 174 degree mode and < ICT>= 0.68 x 10^9/bunch





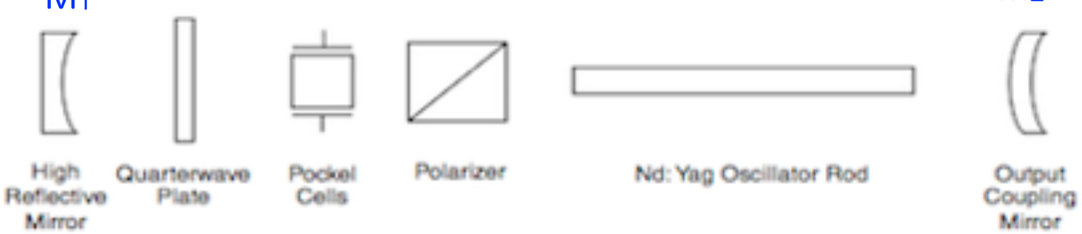
Laser system of IPBSM



Oscillator (laser resonator, cavity)

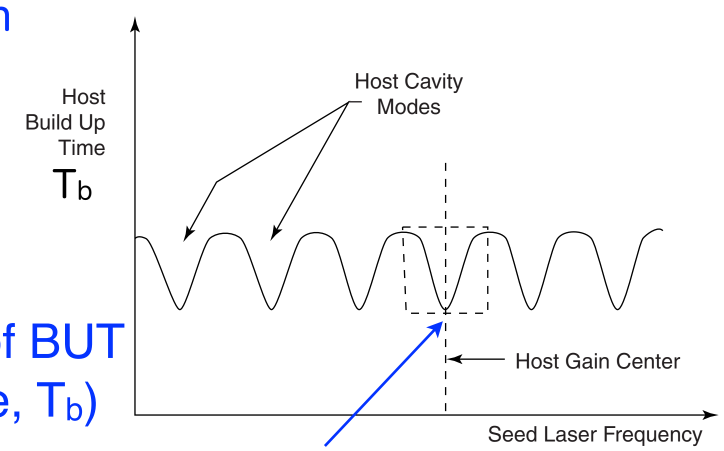
rear mirror M_1

M_2

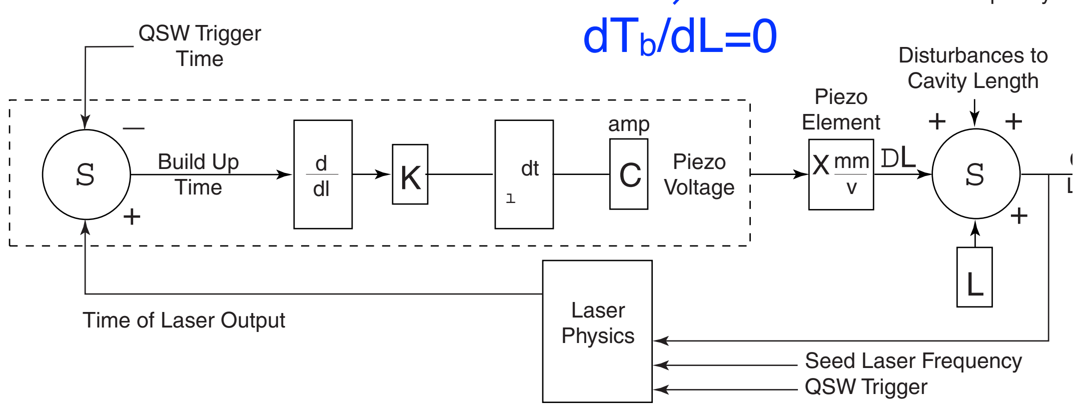


Q-Switch

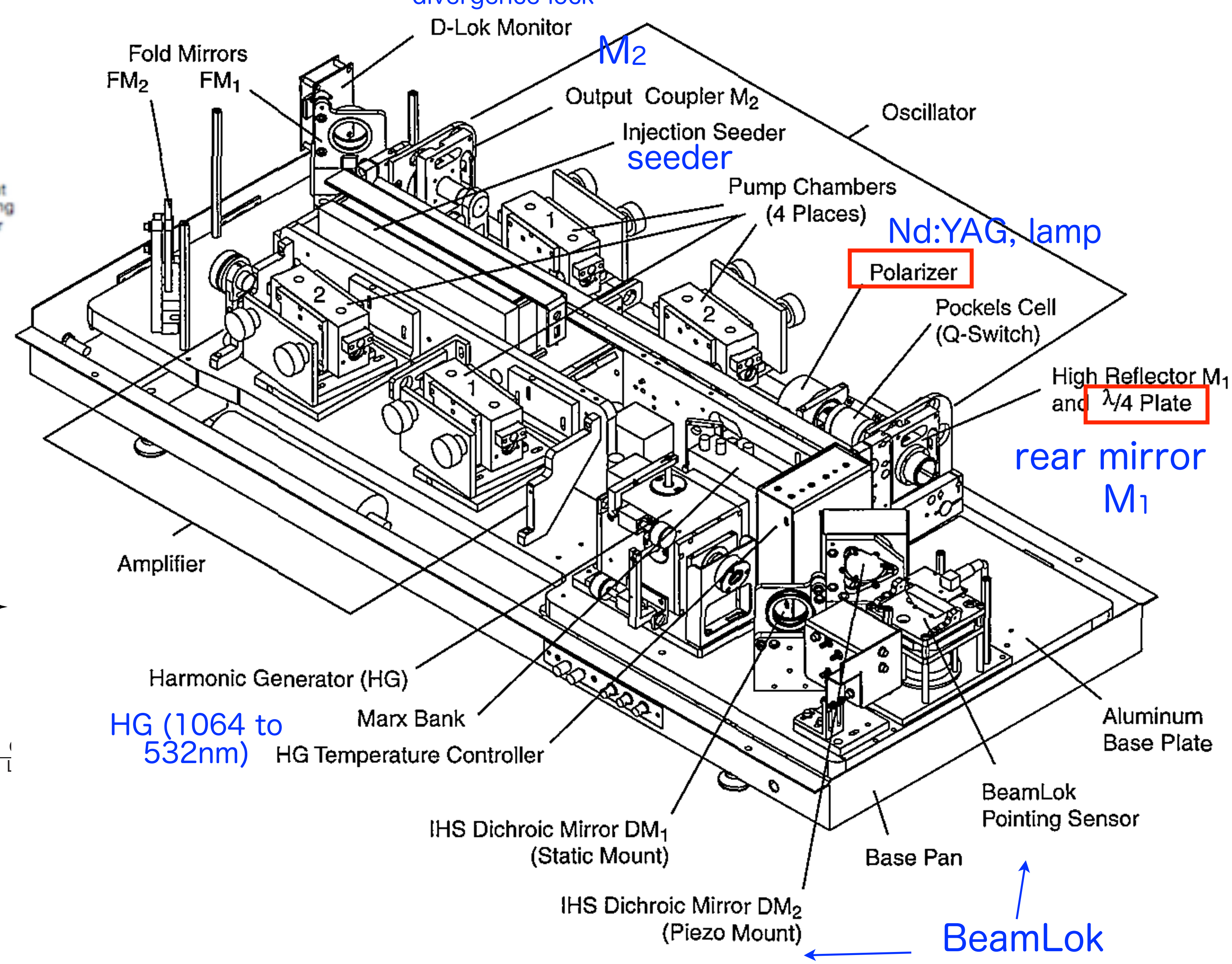
Seeding
minimization of BUT
(Build Up Time, T_b)



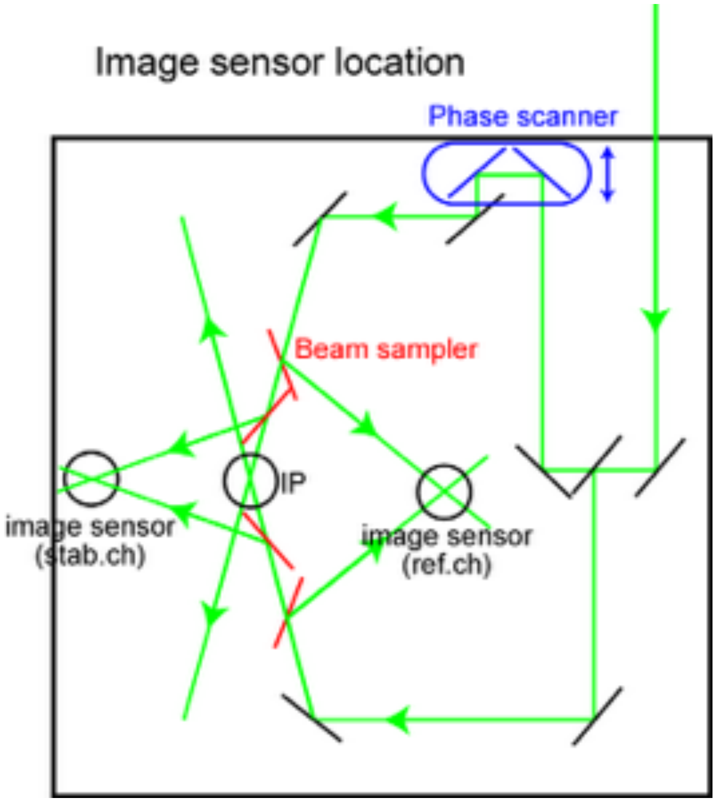
$dT_b/dL=0$



re 3-5: Frequency Control Loop Block Diagram



Suehara's doctor thesis



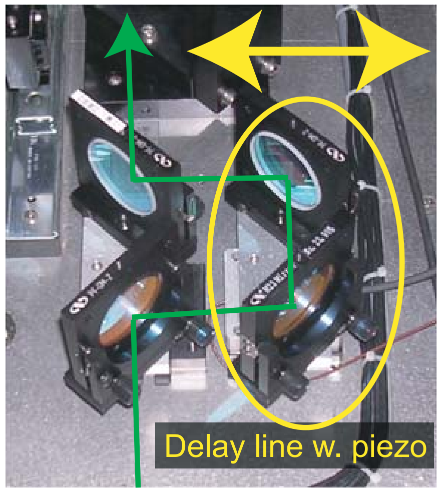
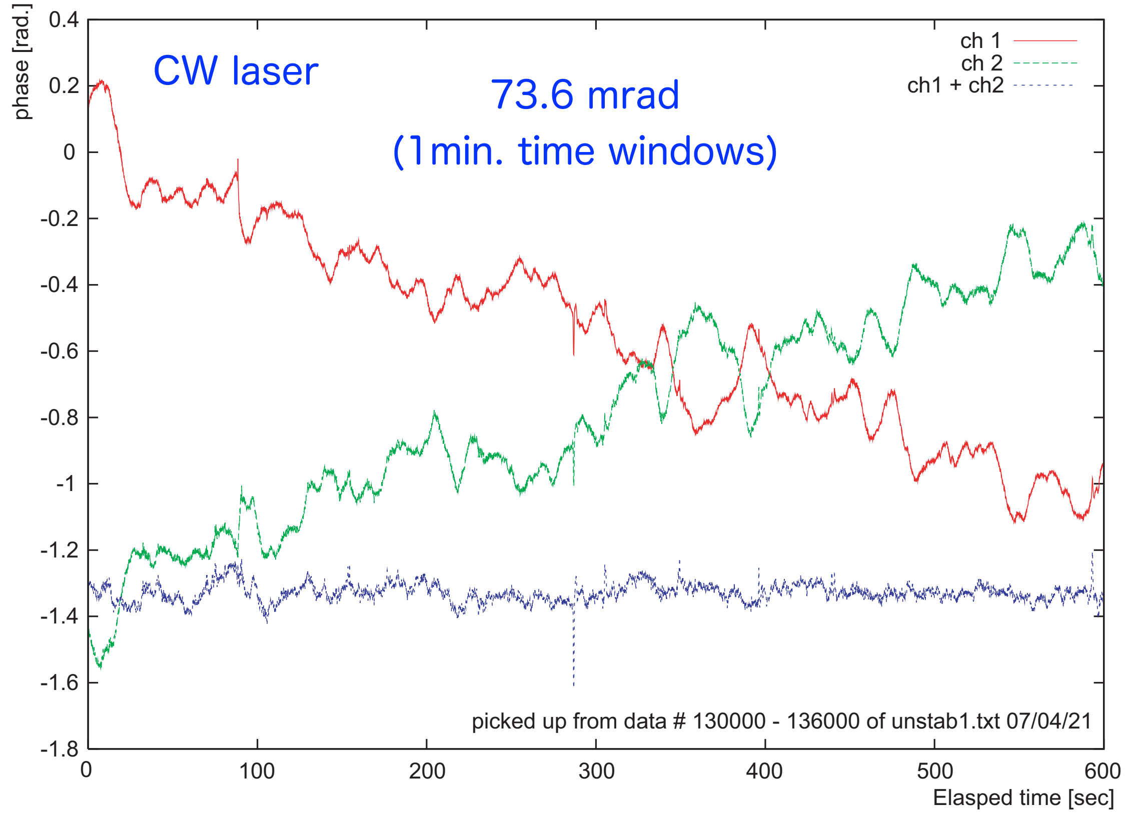


Figure 5.14: A schematic figure of the variable optical delay line (left) and a picture of its test setup (right). The test setup uses mirrors instead of prisms.



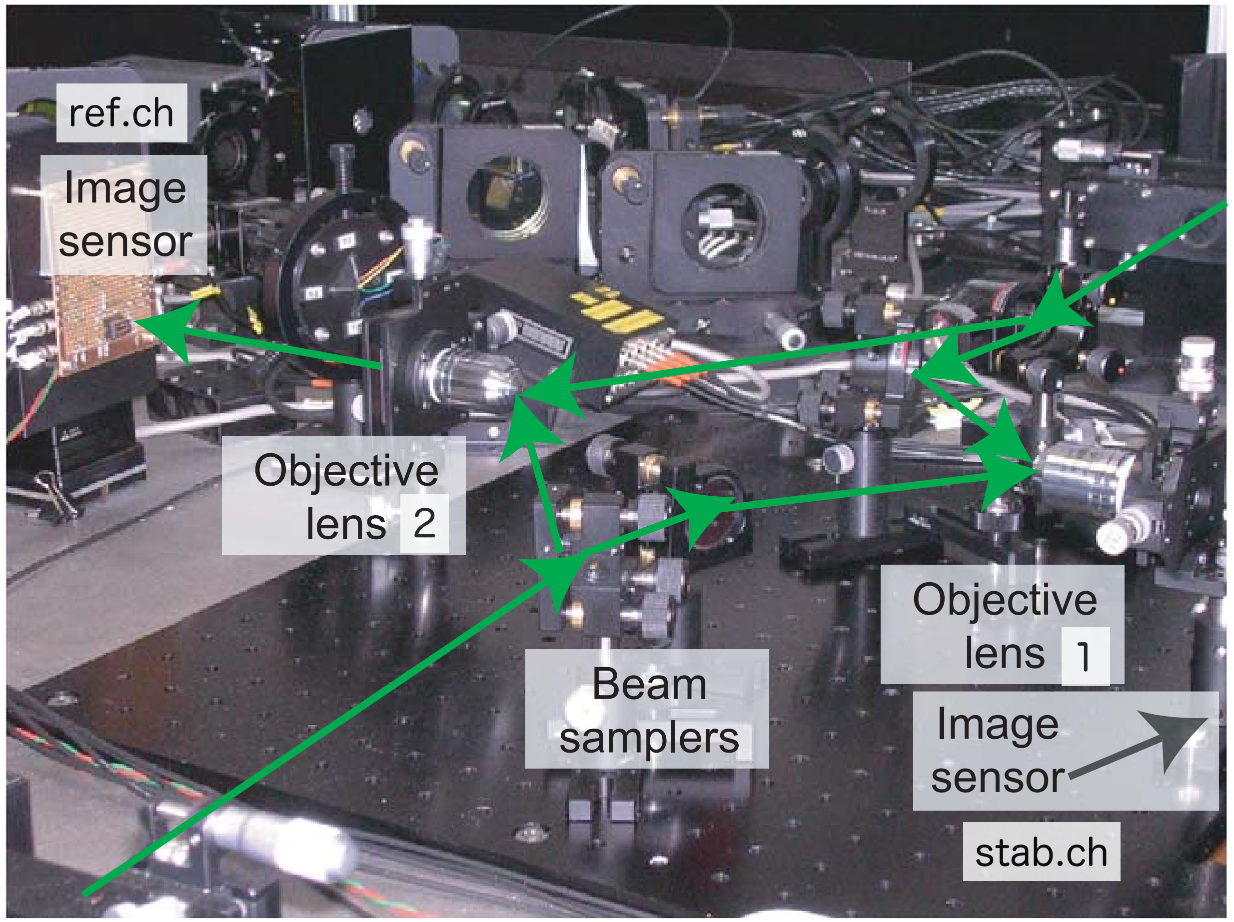
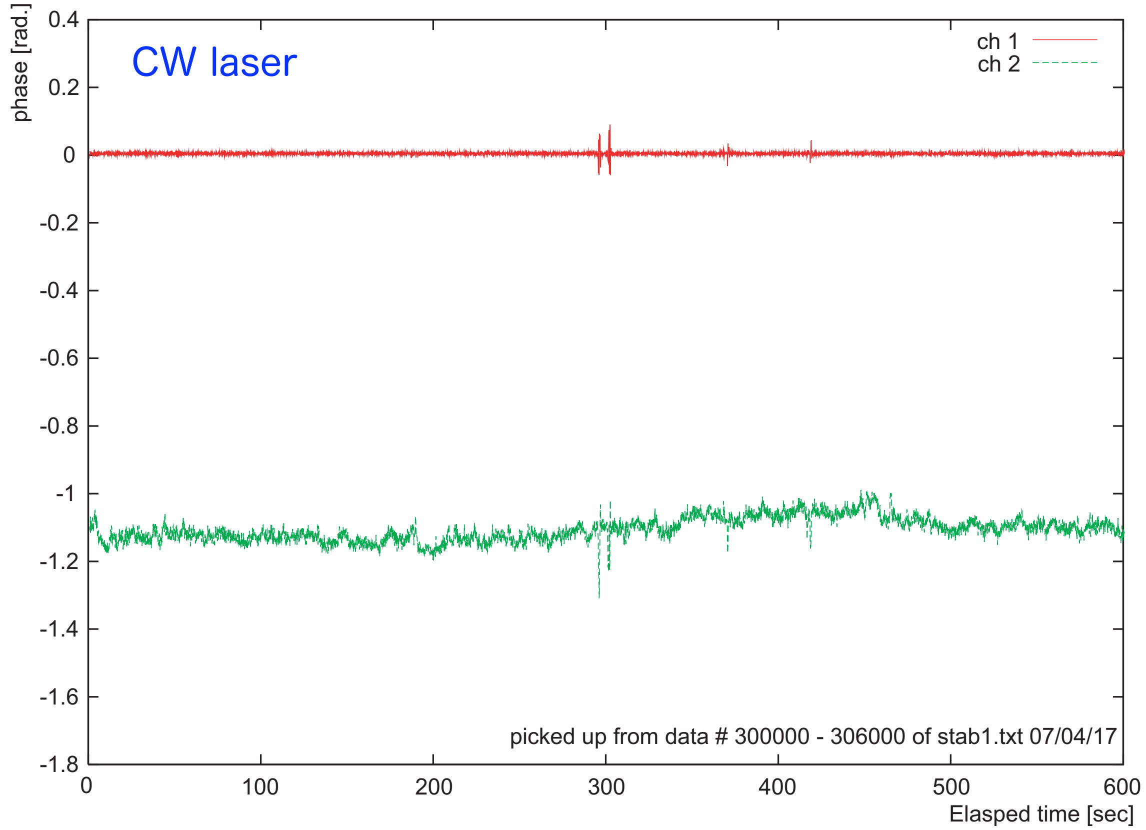


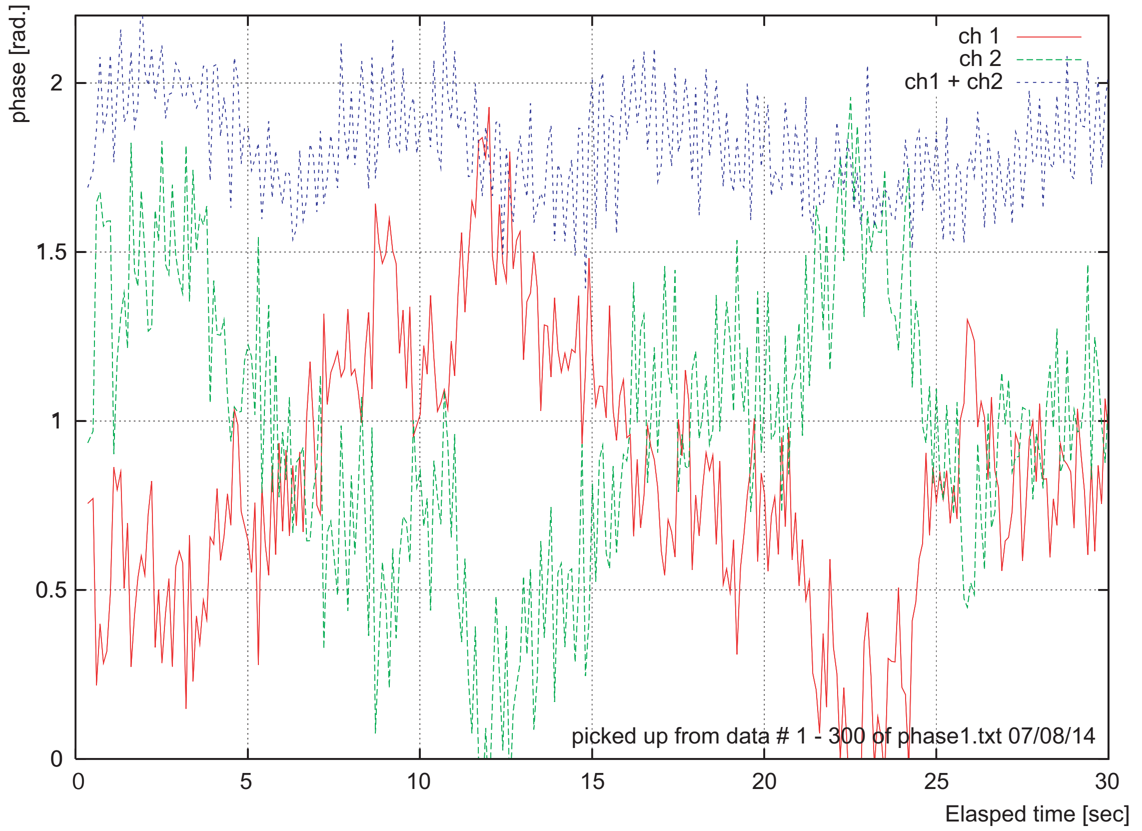
Figure 5.16: A picture of the test setup of the phase monitoring.

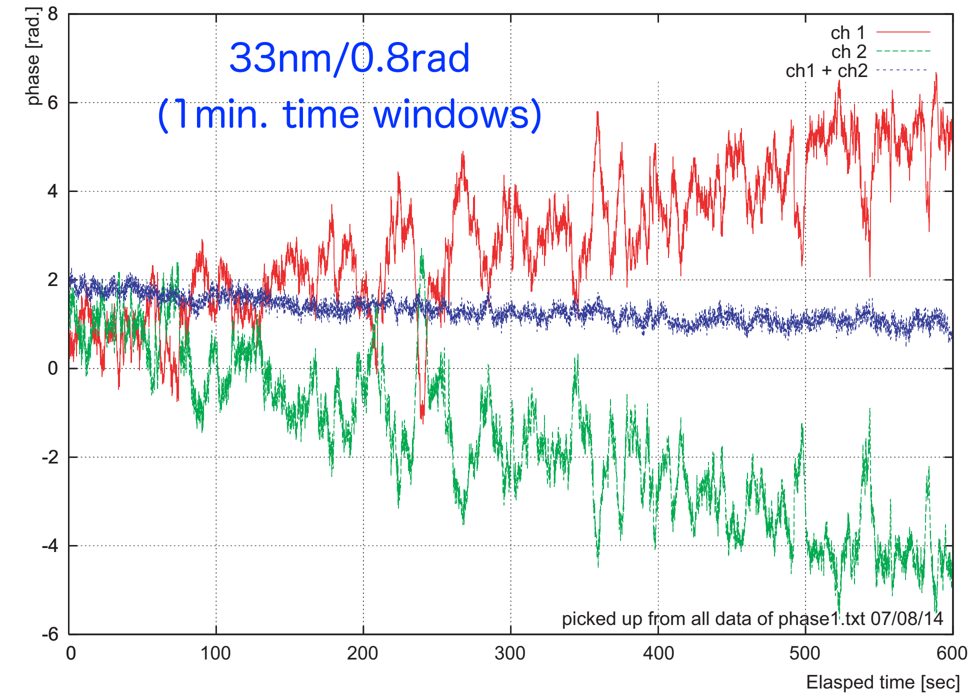
Stabilized 27.5 mrad (1min. time windows)



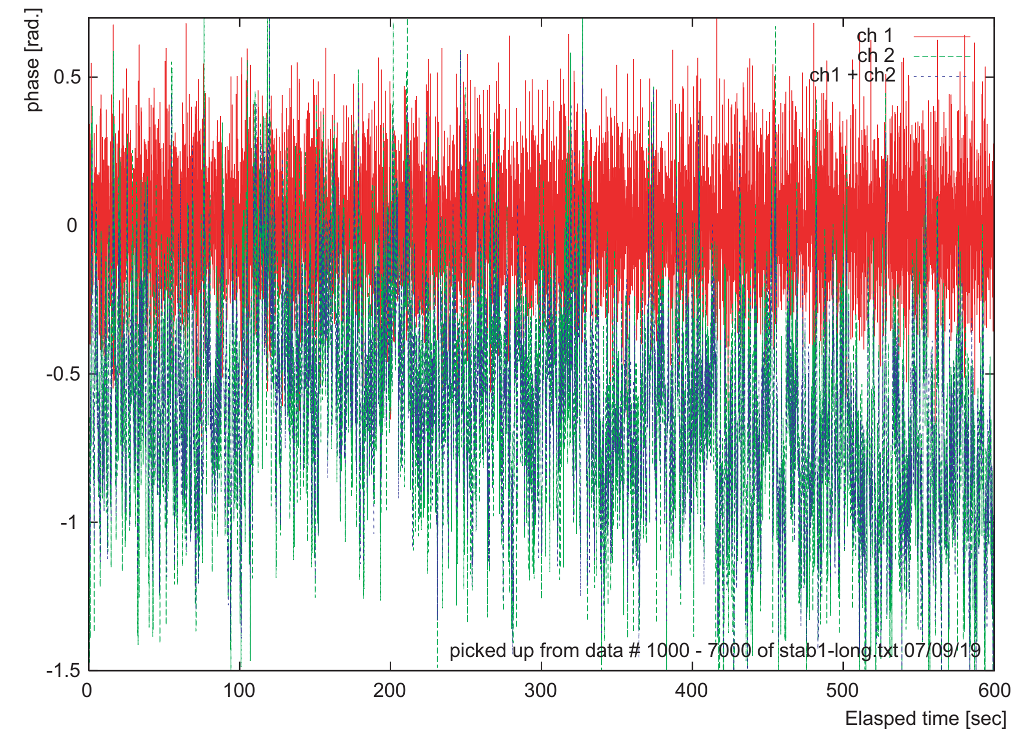
Pulse laser (angular jitter = 18.2 urad)

33nm/0.8rad (1min. time windows)

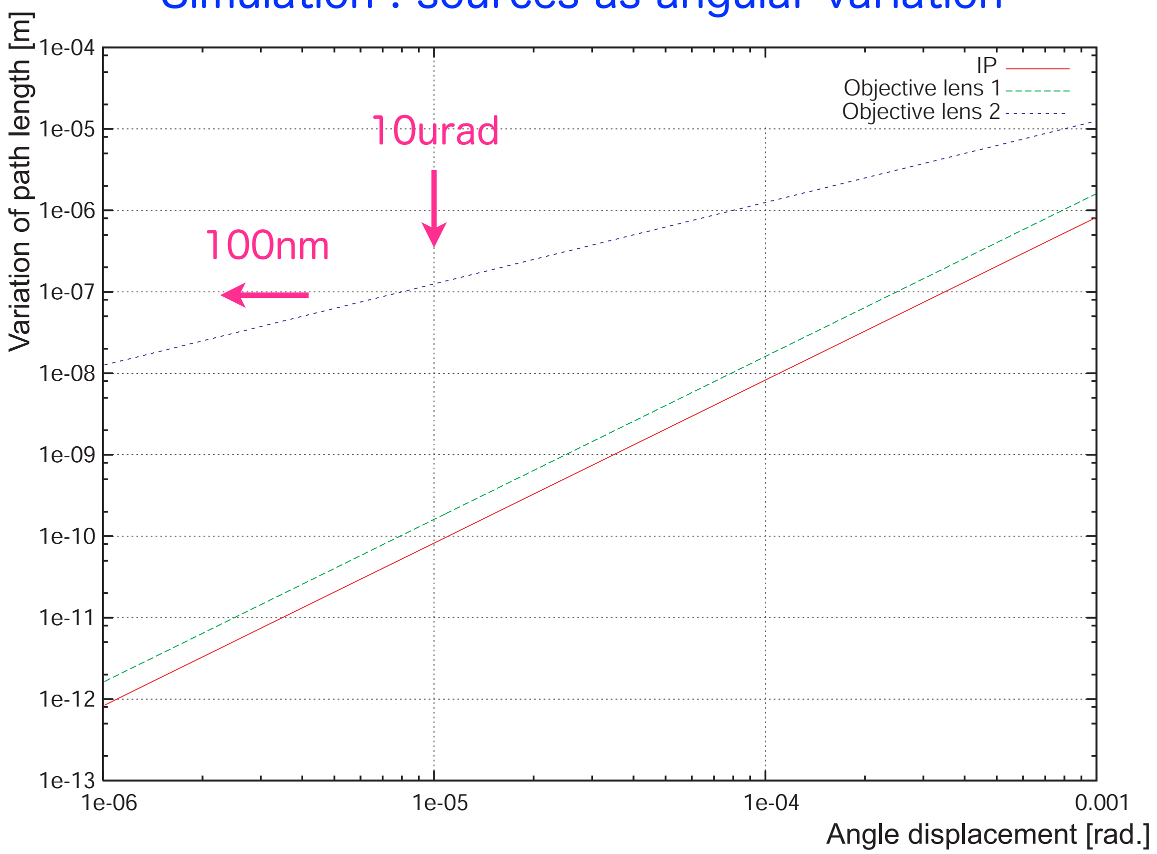




Stabilized 10nm/0.239rad (1min. time windows)



Simulation : sources as angular variation



The obtained RMS stability of 1 minute windows for the pulsed laser is,

- Stabilized Ch.2: 239 mrad., 10nm
- Unstabilized Ch.2: 800 mrad., 33nm
- Unstabilized Ch.1 + Ch.2: 162 mrad.

from Yamanaka's Master thesis

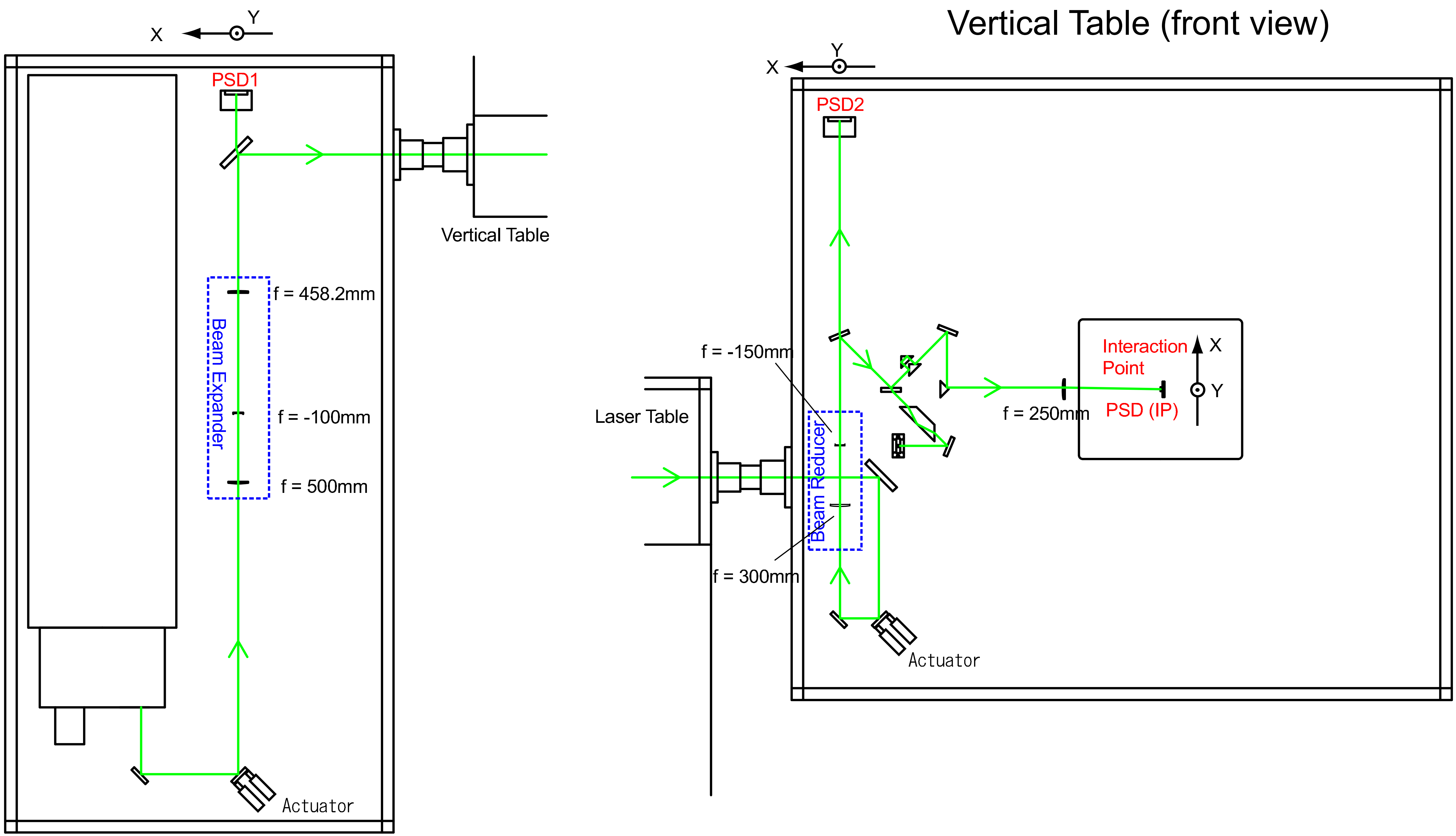


図 4.12: レーザー光位置安定度測定時の光学系配置

from Yamanaka's Master thesis

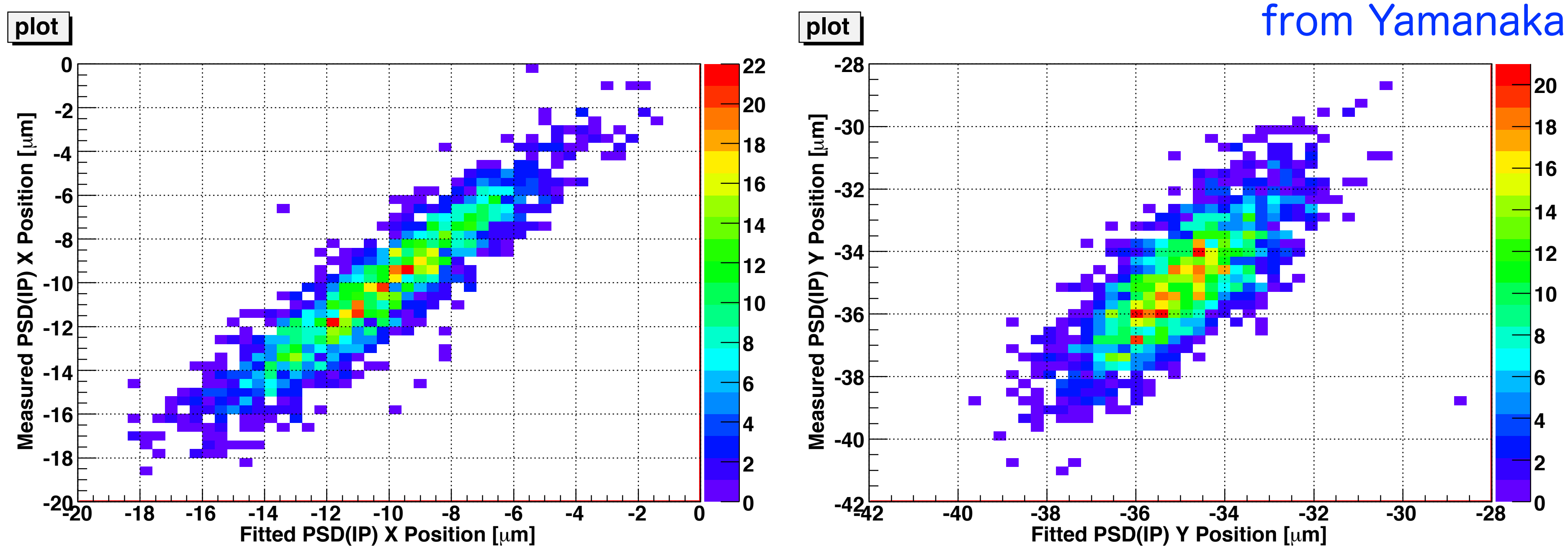


図 4.17: 衝突点におけるレーザー光位置のフィッティング値と測定値。左図は PSD(IP)X 軸方向 (鉛直方向)、右図は PSD(IP)Y 軸方向 (ビーム軸方向)。縦軸が測定値で横軸が PSD1、PSD2 からのフィッティング値を表す。比例関係からのずれが測定誤差に相当する。

Fitting equations :

$$X_{\mathrm{IP}} = p_0 + p_1 Y_1 + p_2 X_2 \qquad (4.6)$$

$$Y_{\mathrm{IP}} = q_0 + q_1 X_1 + q_2 Y_2 \qquad (4.7)$$

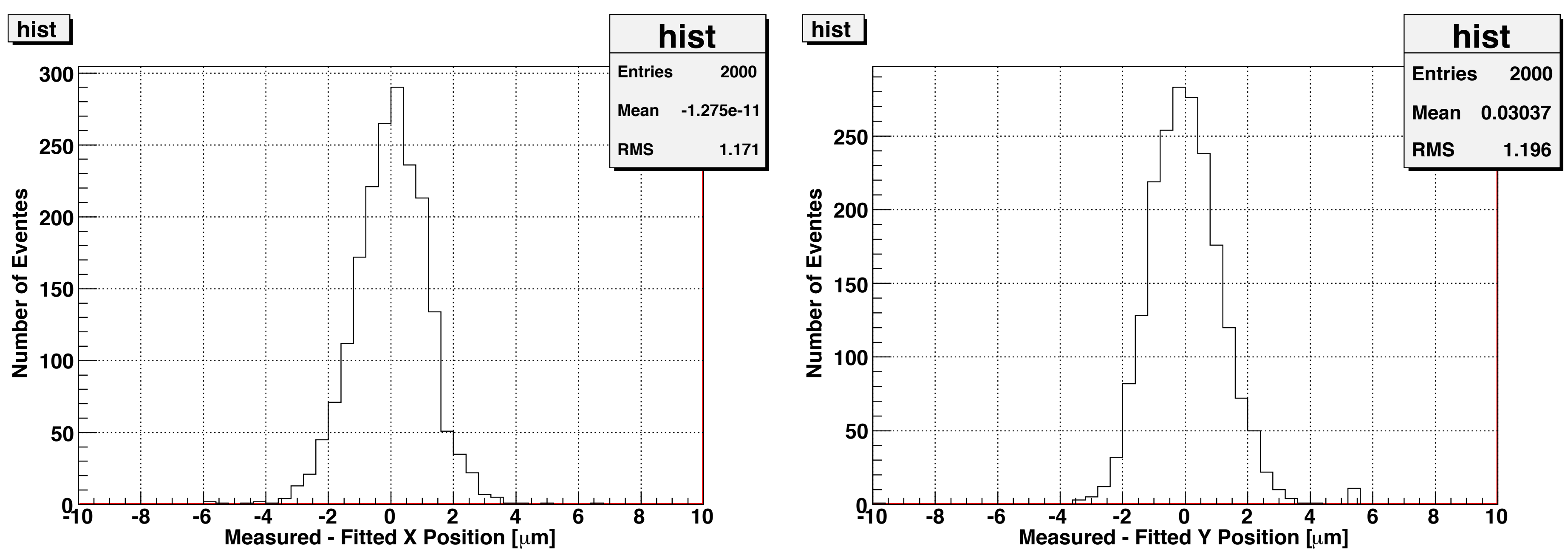


図 4.18: 衝突点におけるレーザー光位置のフィッティング値と測定値の差のヒストグラム。PSD(IP)X 軸方向 (左)、PSD(IP)Y 軸方向 (右)。ヒストグラムの幅が測定値とフィッティング値のずれを表し、両軸とも 1.2 μm 程度である。