Recent Results of ATF2

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ALCPG11, 19 -23 March 2011, Eugene, USA

ATF / ATF2 Schematic Layout



2010 Autumn/Winter Run

| 7 2010 8 2010 | 9 2010 10 2010 | 11 2010 | 12 2010 |
|---|---|-----------------------------------|-----------------------------|
| Su Mo Tu We Th Fr Sa Su Mo Tu We Th Fr Sa | Su Mo Tu We Th Fr Sa Su Mo Tu We Th Fr Sa | Su Mo Tu We Th Fr Sa | Su Mo Tu We Th Fr Sa |
| 1 2 3 1 2 3 4 5 6 7 | 1234 12 | 1 2 3 4 5 6 | 1 2 3 4 |
| 4 5 6 7 8 9 10 8 9 10 11 12 13 14 | 5 6 7 8 9 10 11 3 4 5 6 7 8 9 | 7 8 9 10 11 12 13 | 5 6 7 8 9 10 11 |
| 11 12 13 14 15 16 17 15 16 17 18 19 20 21 | 12 13 14 15 16 17 18 10 11 12 13 14 15 16 | 14 <mark>15 16 17 18 19</mark> 20 | 12 13 14 15 16 17 18 |
| 18 19 20 21 22 23 24 22 23 24 25 26 27 28 | 19 20 21 22 23 24 25 17 18 19 20 21 22 23 | 21 22 23 24 25 26 27 | 19 20 21 22 23 24 25 |
| 25 26 27 28 29 30 31 29 30 31 | 26 27 28 29 30 24 25 26 27 28 29 30 | 28 29 30 | 26 27 28 29 30 31 |
| | 31 | | |

Beam operation: 7 weeks

- Fast kicker mode ... 2 weeks
- ATF2 continuous run ... 1 week 13 17 December 2010

ATF2 BPM layout



C-Band BPMs



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Orbit Monitor at IP

• IP BPM installed : September, 2010



Full BPM system

| 000 | | X /atf/control/epics/ | atf2/cbpm//edm/summ | nary.edl |
|---|-----------------------------|--------------------------------|------------------------|---|
| Diagnostics HW ch | eck SIS Config T/LO/Cal RF | Debug Correlatio | dip amp dip pha | X pos Y pos Status mcal EXIT |
| Mode Bear | m Cal Sim | History | r his dip amp | dip pha Putse 0 CASR bomCasr 20101201 161852 dat |
| Expert Save/re | store DAQ Config SBand RF A | nalysis waveform | IS all r WIS all X WIS | CASR Tone CASR Beam bpmCasr_20101117_023437.dat |
| Cal OD10X Cal | stat action | cal stat | action | cal stat action |
| al OF11X cal | good Tune Cal Log | 15 GMT2FF cal good | Tune MCal Log | Grane al good tune weat cog |
| cal | good Tune Cal Log | GM11FF cal good | Tune MCal Log | GF3FF cal good Tune MCal Log |
| cal | good Tune Cal Log | 17 GD10BFF cal good | Tune MCal Log | REF4 nocal good Tune Log |
| as ablex cal | good Tune Cal Log | REF2 nocal good | Tune Log | 32 GD2BFF cal good Tune MCal Log |
| GF17X cal | good Tune Cal Log | 14 GD10AFF cal good | Tune MCal Log | 33 GD2AFF cal good Tune MCal Log |
| REF1 hocal | good Tune Log | 19 GF9BFF cal good | Tune MCal Log | REF5 nocal good Tune Log |
| CDIODE | | 20 SF6FF cal good | Tune MCal Log | SDIODE |
| es GD18X cal | good Tune Cal Log | 21 GF9AFF cal good | Tune MCal Log | SPHASE |
| of GF19X nocal | good Tune Cal Log | 22 GD8FF cal good cal good | Tune MCal Log | 34 SF1FF cal good Tune MCal Log |
| 07 GD20X cal | good Tune Cal Log | 23 GF7FF cal good cal good | Tune MCal Log | 35 GF1FF cal good Tune MCal Log |
| GF21X cal | good Tune Cal Log | 24 QD6FF cal good | Tune MCal Log | SDOFF cal good Tune MCal Log |
| PBPM notune | good Tune Cal Log | 25 GF5BFF cal good cal good | Tune MCal Log | 37 GD0FF Cal good Tune MCal Log |
| 10 GM16FF cal | good Tune Cal Log | SF5FF cal good | Tune MCal Log | 38 PREIP Tune Cal |
| 11 GM15FF cal | good Tune MCal Log | 27 GFSAFF Cal good | Tune MCal Log | 39 IP1 Tune Cal |
| 12 GM14FF cal | good Tune MCal Log | REF3 nocal good | Tune Log | IP2 |
| 13 FB2FF cal | good good Tune MCal Log | 28 GD4BFF cal good | Tune MCal Log | M-PIP al good Tune Cal Log |
| 14 GM13FF cal | good Tune MCal Log | 29 SD4FF cal good | Tune MCal Log | ALL Tune Cal Log |
| 8000 6000 4000 2000 -2000 -2000 -2000 -4000 -6000 | | | 20 25 | Log TILT Titt monitor LogKNU Fast Kicket IPBPM |

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IP calibration 20110202

Boogert/Lyapin/Kim/Cullinan

presented at ALCPG11, 22 March 2-11



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Jitter Analysis



Dispersion Correction (December 7, 2010)

Before Correction

After Correction



Beam must be centered in QF1X/QF6X/QS1X/QS2X

| Vertical EXT Emittance Measurements |
|-------------------------------------|
|-------------------------------------|

| Date | N _{wire} | Emit (nm) | BMAG | Date | N _{wire} | Emit (pm) | BMAG | | |
|--------------|-------------------|-------------------|-----------------|--------------|--------------------------|----------------|-----------------|--|--|
| Dec 14 2010 | 4 | 1.784 ± 0.130 | 1.10 ± 0.04 | Dec 14 2010 | 5 | 27.6 ± 1.8 | 1.09 ± 0.04 | | |
| Dec 9 2010 | 4 | 1.686 ± 0.102 | 1.08 ± 0.05 | Dec 9 2010 | 4 | 29.3 ± 3.1 | 1.05 ± 0.02 | | |
| Nov 2010 (?) | EXT | kicker controller | replaced | Nov 2010 (?) | EXT I | er replaced | | | |
| May 18 2010 | 4 | 1.905 ± 0.078 | 1.08 ± 0.03 | May 18 2010 | 5 | 11.7 ± 2.3 | 1.43 ± 0.25 | | |
| Apr 21 2010 | 4 | 1.212 ± 0.065 | 1.26 ± 0.03 | Apr 21 2010 | 5 | 15.4 ± 2.0 | 1.78 ± 0.17 | | |
| Mar 17 2010 | BS | 3X rolled ~4 mra | d (CCW) | Mar 17 2010 | BS3X rolled ~4 mrad (CC\ | | | | |
| Feb 25 2010 | 4 | 1.868 ± 0.336 | 1.15 ± 0.12 | Feb 25 2010 | 5 | 22.08 ±0.9 | 1.19 ± 0.03 | | |
| | | | | Feb 25 2010 | 5 | 38.33 ± 1.1 | 1.10 ± 0.02 | | |
| Feb 17 2010 | 4 | negative | | Feb 17 2010 | 5 | 22.6 ± 1.4 | 1.15 ± 0.04 | | |
| Feb 3 2010 | 4 | 1.626 ± 0.095 | 1.10 ± 0.06 | Feb 3 2010 | 5 | 16.1 ± 0.7 | 1.06 ± 0.03 | | |
| Jan 28 2010 | | | | Jan 28 2010 | 5 | 31.6 ± 1.2 | 1.03 ± 0.01 | | |

11th ATF2 Project Meeting, January 13 2011

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Multi-OTR system



Cont. Tuning Week Summary

| Monday | •DR setup + tune (ε_y = 14pm) •mOTR setup, tuning (ε_y<34 pm EXT, 27pm MW) •EXT Emit meas + cor •EXT Disp meas + cor |
|-----------|---|
| Tuesday | IP C wire measurements Sext BBA BPM checks + diagnostics IP σ_y < 2um |
| Wednesday | •IPBSM 2 degree mode •Start $\sigma_{y=}$ 1.8 um • <x'y> scan, σ_{y} = 1.3um •IPBSM 6 degree mode •σ_{y} = 1.0 um •<x'y> scan, σ_{y} = 804 +/- 133 nm •Waist_y scan, σ_{y} = 720 +/- 53 nm</x'y></x'y> |
| Thursday | •IPBSM tune, $\sigma_y = 612 + /-103 \text{ nm}$ •+ 4 hours, $\sigma_y = 482,394,594,498 = 492 + /-82 \text{ nm}$ • <xy> scan $\sigma_y = 327,401,375 = 368 + /-38 \text{ nm}$</xy> |

Results of the continuous run in December, 2010



Interference scan plot for one of the smallest beam sizes measured at 5.96 degree on Dec 16, 2010.

 $\sigma_y^* = 280 \pm 90 \text{ nm}$ M_{meas} = 0.918 ~ 0.984

> $\beta_x = 10$ mm $\beta_y = 0.1$ mm



Figure 10-1 : Performance of beam size tuning at IP. The experimental data in December 2010 are plotted together with the expectations ones. First data shows the initial beam size before any correction with the beam size measurement by the IPBSM, and <x'y>, α 'y, <xy>, η 'y, T322 and T326 are tuning knobs of horizontal angle, the vertical waist, coupling, vertical dispersion, second order aberrations of horizontal angle (T322) and dispersion (T326), respectively.

A Skew Sextupole magnet was installed at upstream of QF5B in January, 2011. power supply : ±20A (w/o cooling)

| 1 | 2011 | | | | | 2 | 20: | 11 | | | | | 3 | 20 | 11 | | | | | 4 | 20 | 11 | | | | | 5 | 20 | 11 | | | | | 6 | 201 | .1 | | |
|----------|-------|----|----|----|-----|-----|-----|----|----|----|-----|----------|-----|-----|-------|----|----|----|----|----|----|----|----|----|----|-----|----|----|----|----|----|----|------------|----|-----|------|-----|----|
| Su Mo Tu | We Th | Fr | Sa | Su | Мо | Tu | We | Th | Fr | Sa | Su | Мо | Tu | We | e Th | Fr | Sa | Su | Мо | Tu | We | Th | Fr | Sa | Su | Мо | Tu | We | Th | Fr | Sa | Su | Мо | Tu | We | Th | Fr | Sa |
| | | | 1 | | | 1 | 2 | 3 | 4 | 5 | | | 1 | 2 | 5 | - | 5 | | | | | | 1 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | 1 | 2 | 3 | 4 |
| 2 3 4 | 56 | 7 | 8 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 6 | 7 | 0 | ÷ | 10 | 1 | 12 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 5 | 6 | 7 | 8 | 9 1 | 10 | 11 |
| 9 10 11 | 1213 | 14 | 15 | 13 | 14 | 15 | | 17 | 20 | 19 | 13 | <u> </u> | 4 6 | 4.4 | . 4 7 | 40 | 19 | 10 | 11 | 12 | 15 | 14 | 25 | 16 | 15 | 1.6 | 17 | 18 | 19 | 20 | 21 | 12 | 13 | 14 | 15 | 16 1 | 1.7 | 18 |
| 161718 | 19 20 | 21 | 22 | 20 | - | 2.2 | - | 24 | 25 | 26 | 20 | 21 | 22 | 23 | 1 24 | 25 | 26 | 17 | 13 | 19 | 00 | 21 | 22 | 23 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 19 | 20 | 21 | 22 | 23 2 | 24 | 25 |
| 23 24 25 | 26 27 | 28 | 20 | 27 | 2.9 | | | | | | 27 | 28 | 20 | 30 | 131 | | | 24 | 25 | 26 | 27 | 28 | 20 | 30 | 20 | 30 | 31 | | | | | 26 | 27 | 28 | 20 | 30 | | |
| 20 24 20 | 2021 | 20 | 27 | ~/ | | | | | | | - ' | 40 | 23 | | | | | 24 | 20 | 20 | | 20 | 27 | 50 | 23 | 20 | 31 | | | | | 20 | ~ / | 20 | | 90 | | |
| 30 31 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

First priority is ATF2-37 nm until the end of March. ... 7 weeks

However;

- 16 Feb. fire at the modulator #0 at the ATF-LINAC
- 10 Mar. resume the ATF operation and ATF2 beam tuning
- 11 Mar. Great Eastern Japan Earthquake (M9.0)



IPBSM

Signal & BG levels : May and Dec 2010

| | Optics | Signal [GeV] | BG [GeV] | Beam Current [10 ⁹ e⁻] |
|--------------|---------------------|--------------|----------|--------------------------------------|
| May, 2010 | Beta x 10 optics | 150 | 15 | ~ 4 |
| Dec, 2010 | nominal | 15* - 60 | 100 | ~ 3 |

* After problem of unfocused laser, especially at 30 deg.

IPBSM : reducer scan at 30 degree mode, 2 February 2011

after optical alignment in the reducer by alignment laser



IPBSM : reducer scan at 30 degree mode, 2 February 2011



note: σ varied from 43 to 15μ m as the reducer from 3.5 to 6mm

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Figure 10-2 : Two students (University of Tokyo) were adjusting the laser optics system at the black optical table of the IPBSM for the ATF2 beam tuning run in March 2011, where the final focus quadrupole magnet (QF1) is also seen in red color at the upstream.

Estimation of multipole components in the QEA magnets for the re-matched optics by Edu M. Lacoma

with powering a skew sextupole



 $\gamma \epsilon_x [\mu m]$

Dispersion without the DR RF ramp from the SVD analysis



Energy spread from the SVD analysis



by Y. Renier

It is the parameter reconstruction function of time during a dispersion measurement. It is just to show the reconstruction works well as the steps in delta_f ramp are clearly visible (5 steps of 1kHz, from -2kHz to +2kHz).

As expected, for large parameter variation the error bars are larger,

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Response by a steering magnet from the SVD analysis

by Y. Renier



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Jitters at the IEX from the SVD analysis

by Y. Renier

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Check List made at the 11th ATF2 project meeting, SLAC, 1/13-14, 2011

(1) 2 movers for matching quads, x/y movement seems to be largely coupled (2) no BBA of SF1/SD0 for 12A limit (cooling) (3) EXT : DR orbit around the extraction (3 septum's) (4) Dispersion measurement by BPMs without the DR-RF ramp (5) IPBSM : focussing of laser beams at 30 degree mode (lower beam at 8 deg.) (6) BG of IPBSM as a function of beta* x : Is it main dependence? (7) Simulation of FFS with all higher multipole components corrected (KEK)