Status and Prospects of the EXTRACTION beam line

Edu Marin on behalf of ATF2 Tuning team

17th ATF2 Project Meeting

February 12th, 2014

Outline

1 Tuning Extraction Line
- Dispersion
- Coupling
- Matching

2 Observed Issues
- KICKER
- OTRs

3 Final Focus
- FF Matching
- β^* Measurement

4 Summary

Tuning Extraction Line
○○○○○

Observed Issues
○○○○○○○

Final Focus
○○

Summary

Tuning Extraction Line

EXT Tuning Procedure

Tuning procedure of the Extraction Line
- Dispersion Correction
  - Try to reduce η to the lowest value as possible (<5mm)
- Coupling Correction
- β-Matching

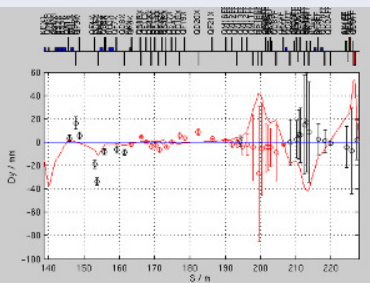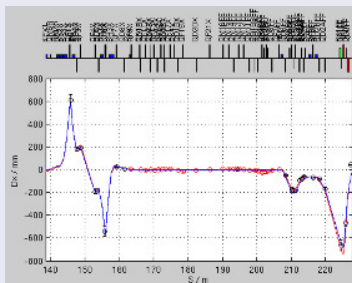The procedure is iterated until convergence is achieved

Bmag=1.0 ϵ_y=12 pm**

Dispersion

Dispersion correction

$\sum$-Knob

Dispersion corrected by means of the sum knob (Strength of QSs are varied the same amount)

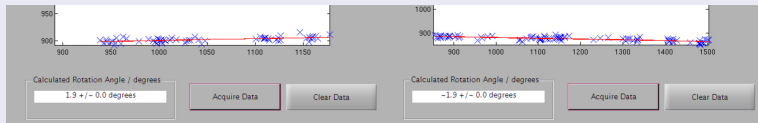*Measurement taken during owl shift January 21st*

Coupling Correction

OTRs cables

We have replaced the OTR cables the by a better shielded cables ($\downarrow$ background and better triggering).
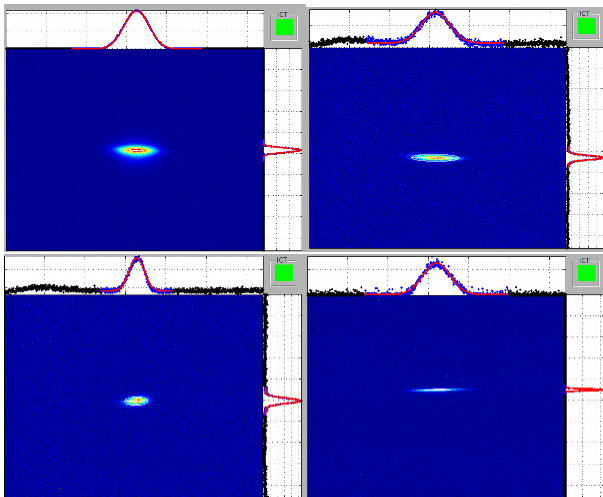
Camera Tilt Calibration

Since coupling corrected is based on zeroing the tilt at the OTR cameras, we must correct for tilted cameras.
OTR0X and OTR2X a significant tilt was observed:

After manually correcting for the measured tilt, all cameras are align within <0.2 deg
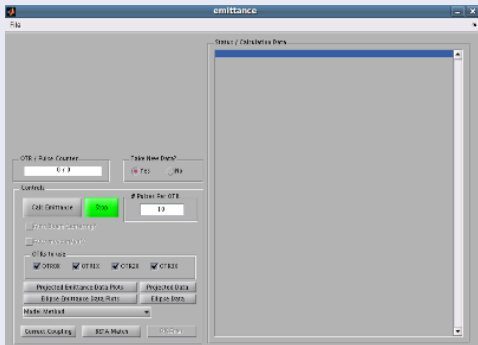
Coupling Correction

Notice lower intensity in OTR3X...

Emittance Panel

Beta Matching

We used EXT line quadrupoles from QF1X to QD10X to match:

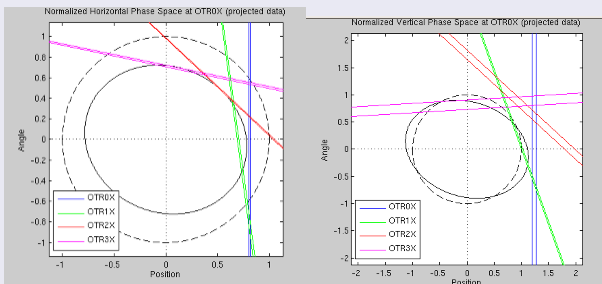- Twiss parameters **(Bmag=1.0)**

- Dispersion

↑

Emittance Calculation

Final Emittance

Example of measurement on January 22nd.
After applying the tuning procedure, we obtained:

ϵ_x=**1.1nm (Bmag=1.00)** ϵ_y=**12pm (Bmag=1.0)**

Tuning Extraction Line
○○○○○

Observed Issues
○○○○○○○

Final Focus
○○

Summary

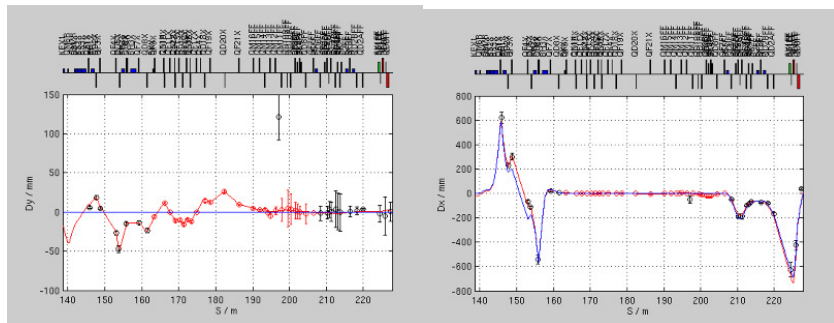# Observed Issues

Dispersion correction

Could not correct $\eta < 10$mm at the OTRs by scanning the sum knob, orbit bumps at kicker or BS3...
Measurement taken during swing shift January 28th

ϵ_x=1.6 nm (Bmag=1.02) ; ϵ_y=23 pm (Bmag=1.06)

Incoming dispersion from DR has changed.

Tuning Extraction Line
○○○○○

Observed Issues
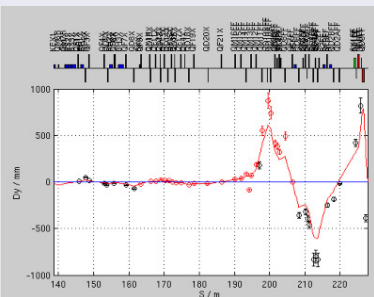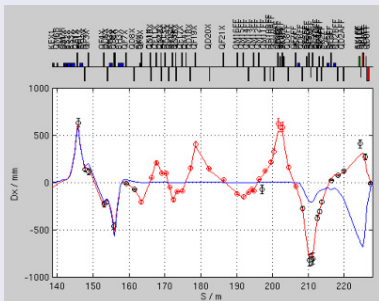○●○○○○○

Final Focus
○○

Summary

KICKER

Dispersion without correction

Incoming Dispersion from DR

Dispersion at the extraction line with QSs and [QF1X:QF10X] at the nominal values

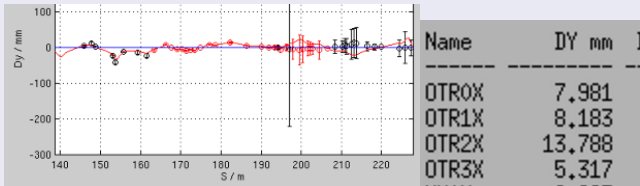*Measurement taken during swing shift January 28th*

After correcting DR dispersion

After changing the DR (x,y)-orbit around kicker by local bumps
which features lower dispersion but larger emittance.
We had a better correction of dispersion at the EXT line.
Measurement taken during day shift January 29th

ϵ_x=1.4nm (Bmag=1.00) ; ϵ_y=15pm (Bmag=1.1)
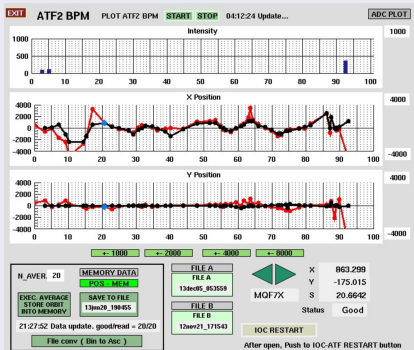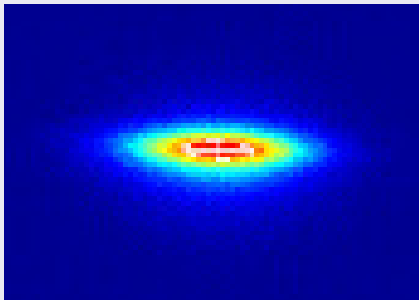
Timing Dependence

Orbit Variation

Kicker timing is changed for switching between 1/2-Train.
Initial orbit cannot be recovered with the initial timing.
Different timing kicker is set to bring back the orbit.

OTR0X Intensity

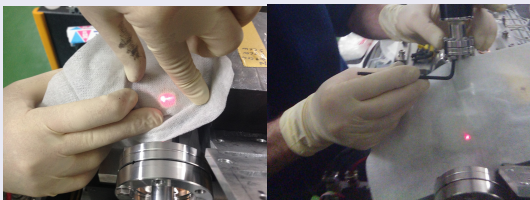OTR0X has a larger signal to noise ratio compare to others

Gaussian fit is very sensitive to the S/N ratio cut

OTR3X Intensity

OTR3X has always show a lower signal to noise ratio.
Tried solutions: Background subtraction, optics re-alignment,
swap optics, replace cameras...

We found on last day run that target was not well align with the
OTR window.
It has been realigned, to be confirmed in next run...

Intrinsic Emittance

Measurement to evaluate the intrinsic emittance.

- we scanned all 4 skew quadrupoles QK1X, QK2X, QK3X and QK4X at a time over their power supply ranges.
- At each current value, dispersion and projected emittance were measured.
- Preliminary analysis of the data done by Mark Woodley are unclear.

Developing an algorithm to digitally determine σ_{13} and conduct a 4-D parameter fit.

Tuning Extraction Line
○○○○○

Observed Issues
○○○○○○○

Final Focus
○○

Summary

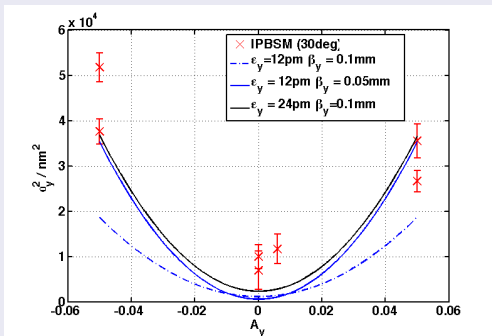# Final Focus

FF Matching

Matching Goals

We tested a script meant to match the IP Twiss parameters given: Twiss parameters measured at OTR0X or at IP. The code optimizes QD18X, QF19X, QD20X, QF21X and the 6-matching quadrupoles of the FF to constraint:

- $\beta_{x,y}^*$=4 cm, 0.1 mm
- $\alpha_{x,y}^*$=0, 0
- α_y^{MFB2FF}=0
- α_x^{MFB1FF}=0

- $\Delta\phi_x^{MFB1-IP}$=n$\frac{\pi}{2}$
- $\Delta\phi_y^{MFB2-IP}$=n$\frac{\pi}{2}$
- $\Delta\phi_x^{ZH1FF-IP}$=n$\frac{\pi}{2}$
- $\Delta\phi_y^{ZV1FF-IP}$=n$\frac{\pi}{2}$

The algorithm has been tested→jitter reduction at MFB2FF from 12μm to 3μm.
Unfortunately we could not measured the IP Twiss functions

IP Twiss measurement

Estimation of β_y^* by α_y knob scan

Two different combinations of β_y^*-ϵ_y explain the measurement:
β_y^*=0.1mm, ϵ_y=24pm or β_y^*=0.05mm, ϵ_y=12pm

Tuning Extraction Line
○○○○○

Observed Issues
○○○○○○○

Final Focus
○○

Summary

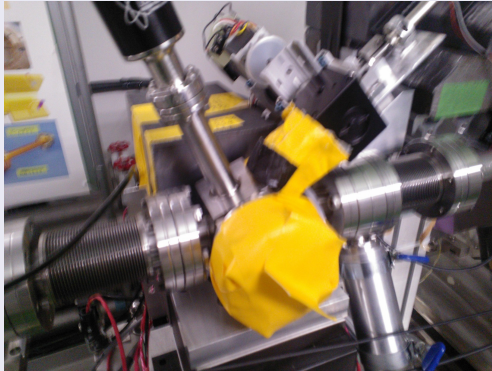# Summary

Summary and Outlook

Summary

- New algorithm to beta match the Twiss parameters out of DR
- All the necessary tools for dispersion, coupling correction and matching the extraction line are in good shape.
- Intensity issues observed at OTR0X and OTR3X have been addressed

Outlook
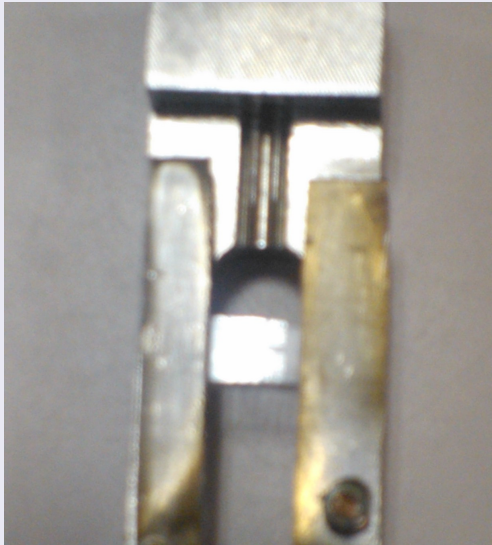
- Design a new holder that integrates the target and calibration device
- Evaluate intrinsic emittance
- Match the FF

Tuning Extraction Line
○○○○○

Observed Issues
○○○○○○○

Final Focus
○○

Summary

Thank you for your attention!!

Tuning Extraction Line
○○○○○

Observed Issues
○○○○○○○

Final Focus
○○

Summary

Back Up Slides

Tuning Extraction Line
○○○○○

Observed Issues
○○○○○○○

Final Focus
○○

Summary

Back Up Slides

Tuning Extraction Line
○○○○○

Observed Issues
○○○○○○○

Final Focus
○○

Summary

Back Up Slides

Tuning Extraction Line
ooooo

Observed Issues
ooooooo

Final Focus
oo

Summary

Back Up Slides