

Model error of EGUN-EHDT-DUMP

H. W. Koay

TRIUMF

Abstract: This work reports the quadrupole scan performed from EHAT:Q3 to EHDT:Q2 to investigate the source of discrepancy with the calculated tune for egun-ehdt-dump.

1 Introduction

The simulation of beam envelope from E-GUN to EHD:DUMP was compared with the actual values extracted from the view screens along the beamline. A significant discrepancy at the high energy section (especially at the last viewscreen) is observed. Aiming to troubleshoot the difference, we did a quadrupole-scan at the last four quadrupoles. The measurement shown was taken on 23-06-2023.

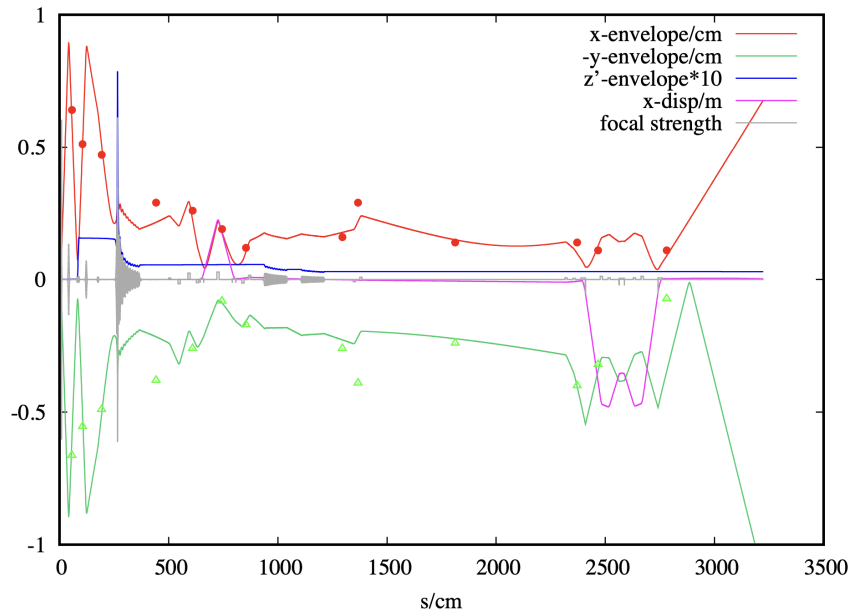


Figure 1: The comparison of the theoretical beam envelope with the actual values captured from view screens from the E-GUN to EHD:DUMP. The last point in the high energy section shows a significant mismatch in Y.

2 Quadrupole scan

2.1 EHAT:Q3

The operational tune as shown in Appendix A was loaded. Any quads in between EHAT:Q3 and EHAT:VS4 were turned off. The viewscreen image was taken, followed by a background shot when EHAT:Q3 was changed sequentially around the minima of σ_x or σ_y (visual guess). The results were then analyzed and shown in Fig. 2. Detail of the raw images can be found in [1].

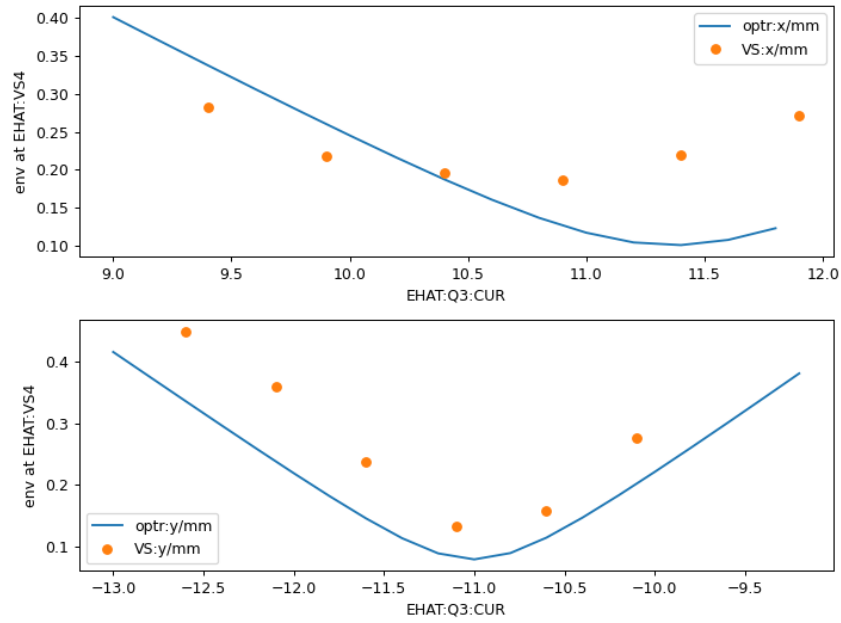


Figure 2: The comparison of the theoretical beam envelope with the actual 2σ captured from EHAT:VS4 when EHAT:Q3 was changed.

2.2 EHAT:Q4

Similarly, the operational tune was loaded. Any quads in between EHAT:Q4 and EHDT:VS0 were turned off. The viewscreen image was taken, followed by a background shot when EHAT:Q3 was changed sequentially around the minima of σ_x or σ_y (visual guess). The results were then analyzed and shown in Fig. 3. Detail of the raw images can be found in [2].

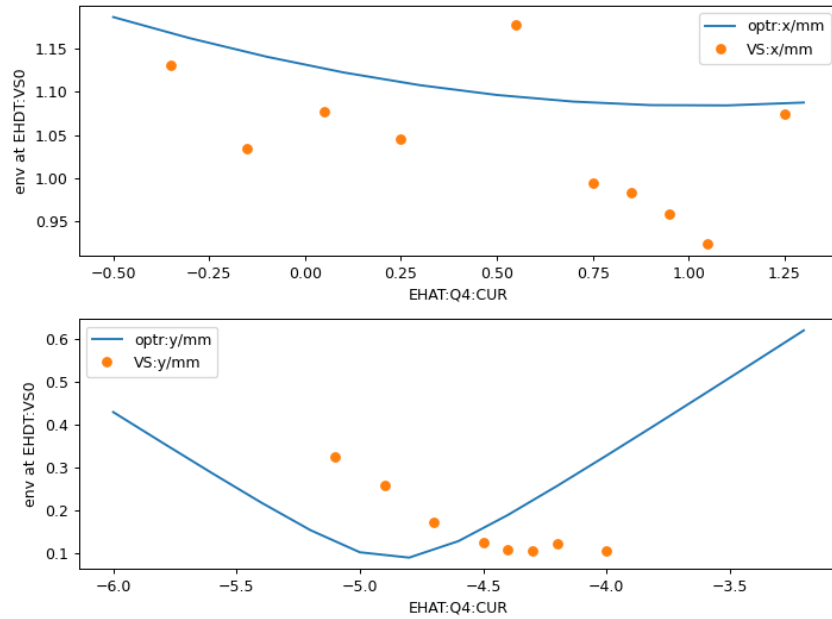


Figure 3: The comparison of the theoretical beam envelope with the actual 2σ captured from EHAT:VS4 when EHAT:Q4 was changed. Note that the poor match in X is reasonable due to the significant dispersion at the viewscreen position.

2.3 EHDT:Q1 & EHDT:Q4

Similarly, the operational tune was loaded. Any quads in between EHDT:Q1 and EHDT:VS4 were turned off. The viewscreen image was taken, followed by a background shot when EHDT:Q1 was changed sequentially around the minima of σ_x or σ_y (visual guess). The results were then analyzed and shown in Fig. 4. Note also EHDT:Q1 and Q4 were governed by the same power supply. Changing the coil current of EHDT:Q1 will also change EHDT:Q4 by the same amount. Detail of the raw images can be found in [3].

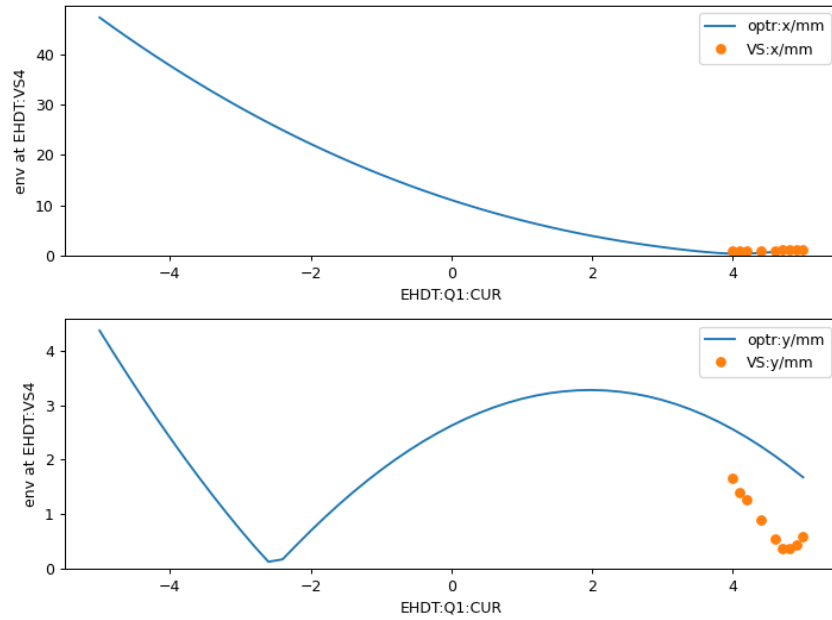


Figure 4: The comparison of the theoretical beam envelope with the actual values captured from EHDT:VS0 when EHDT:Q1 and EHDT:Q4 were changed. The calculated Y envelope has a significant discrepancy from the measurement.

2.4 EHDT:Q2 & EHDT:Q3

Similarly, the operational tune was loaded. Any quads in between EHDT:Q2 and EHDT:VS4 were turned off. EHDT:Q1 was also turned off. The viewscreen image was taken, followed by a background shot when EHDT:Q2 was changed sequentially around the minima of σ_x or σ_y (visual guess). The results were then analyzed and shown in Fig. 5. Note also EHDT:Q2 and Q3 were governed by the same power supply. Changing the coil current of EHDT:Q2 will also change EHDT:Q3 by the same amount. Detail of the raw images can be found in [4].

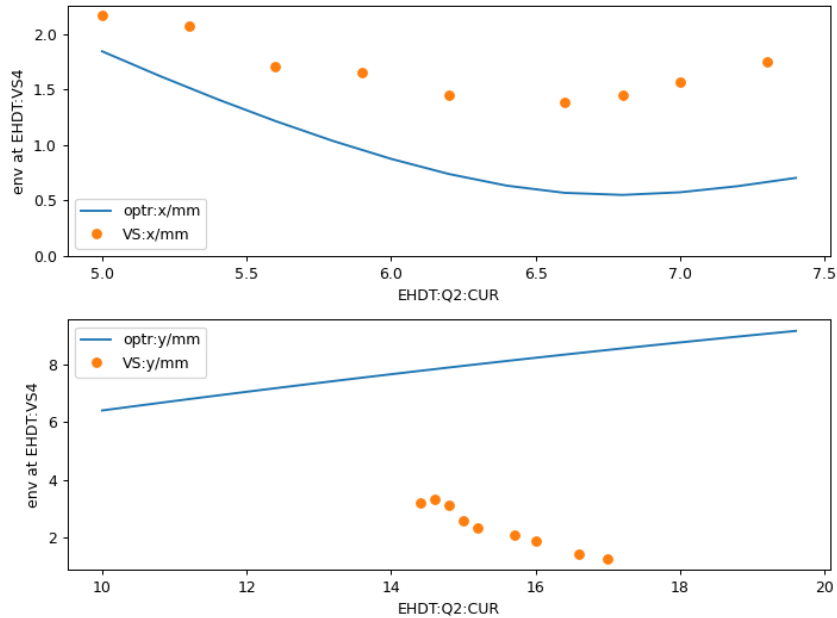


Figure 5: The comparison of the theoretical beam envelope with the actual values captured from EHDT:VS4 when EHDT:Q2 and EHDT:Q3 were changed. Similar to EHDT:Q1, the calculated Y envelope has a significant discrepancy from the measurement.

3 Summary

The scan of EHAT:Q3 shows a small shift in X, but a better match in Y. The shift in Y seems to be carried over to EHAT:Q4 where the shift in Y becomes more prominent. X is a total mess for this quad scan due to the significant dispersion that deteriorates the beam quality at the viewscreen. EHDT:Q1 (Q4) and EGDT:Q2 (Q3) show very poor match in Y, but a reasonable match in X. The ultimate reason of this mismatch remains unresolved.

References

- [1] H. W. Koay (2023). [\[link\]](https://triumffoffice365-my.sharepoint.com/:f:/g/personal/hkoay_triumf_ca/EpMxDEXNSjNLuLltMaVrPVUBzcc7rvy0Z7jVg8Z5Le6G_g?e=IBLHdm).
URL https://triumffoffice365-my.sharepoint.com/:f:/g/personal/hkoay_triumf_ca/EpMxDEXNSjNLuLltMaVrPVUBzcc7rvy0Z7jVg8Z5Le6G_g?e=IBLHdm
- [2] H. W. Koay (2023). [\[link\]](https://triumffoffice365-my.sharepoint.com/:f:/g/personal/hkoay_triumf_ca/EqpDn15-GlZLrst2GpdbID8BjNrbsRL9tD14q7y372K10g?e=rmdKbM).
URL https://triumffoffice365-my.sharepoint.com/:f:/g/personal/hkoay_triumf_ca/EqpDn15-GlZLrst2GpdbID8BjNrbsRL9tD14q7y372K10g?e=rmdKbM
- [3] H. W. Koay (2023). [\[link\]](https://triumffoffice365-my.sharepoint.com/:f:/g/personal/hkoay_triumf_ca/Eiwn68SJT2NPt2qaSltcAjYBEQJ_bMzwZdeaow-6cnabg?e=v5ht6n).
URL https://triumffoffice365-my.sharepoint.com/:f:/g/personal/hkoay_triumf_ca/Eiwn68SJT2NPt2qaSltcAjYBEQJ_bMzwZdeaow-6cnabg?e=v5ht6n
- [4] H. W. Koay (2023). [\[link\]](https://triumffoffice365-my.sharepoint.com/:f:/g/personal/hkoay_triumf_ca/EqVG30U44thHtv0H_mXt9dIB5jv0rD02J1haUXQSSLJ6Vg?e=hh1Rx1).
URL https://triumffoffice365-my.sharepoint.com/:f:/g/personal/hkoay_triumf_ca/EqVG30U44thHtv0H_mXt9dIB5jv0rD02J1haUXQSSLJ6Vg?e=hh1Rx1

A TRANSOPTR input

The following TRANSOPTR input was used as the base tune for the quad scans performed in this work:

```

2e-05 0.0 0.0 0.510999 -1.0 5.4e-13
-1 5 0.01 0.0001
0 0.0 1.0 0.0
0.382 0.988 0.382 0.988 0.014 1.0
1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
2
1 2 -0.792 3 4 -0.792
31
3e+05 0.0 3.5e+05 0 ! EGUN:BIAS:VOL V1 V
2.91 -5.0 5.0 0 ! EGUN:SOL1:CUR B1 A
0.01687 0.0 0.05 0 ! ELRF:VVM:BUNCH:BVOL RFA1 V
2.65 -5.0 5.0 0 ! ELBT:SOL1:CUR B2 A
1.0 -5.0 5.0 0 ! ELBT:SOL2:CUR B3 A
0.1933 0.0 1.0 0 ! ELRF:VVM:EINJ:BVOL RFA2 V
-175.7 -180.0 180.0 0 ! ELRF:VVM:EINJ:PHASE RFP1 deg
-80.98 -180.0 180.0 0 ! ELRF:VVM:BUNCH:PHASE RFP2 deg
0 -5.0 5.0 0 ! EMBT:Q1:CUR QM1 A
0.5 -5.0 5.0 0 ! EMBT:Q2:CUR QM2 A
-1.3 -5.0 5.0 0 ! EMBT:Q3:CUR QM3 A
2.0 -5.0 5.0 0 ! EMBT:Q4:CUR QM4 A
-1.0 -5.0 5.0 0 ! EMBT:Q5:CUR QM5 A
2.38 -5.0 5.0 0 ! EMBT:Q5B:CUR QM6 A
-1.1 -5.0 5.0 0 ! EMBT:Q6:CUR QM7 A
1.3 -5.0 5.0 0 ! EMBT:Q7:CUR QM8 A
9.5 0.0 30.0 0 ! EACA:CAV1:AMP RFA3 MV
-10.19 -180.0 180.0 0 ! EACA:CAV1:PHASE RFP3 deg
9.5 0.0 30.0 0 ! EACA:CAV2:AMP RFA4 MV
-147.6 -180.0 180.0 0 ! EACA:CAV2:PHASE RFP4 deg
0.0 -5.0 5.0 0 ! EABT:Q1:CUR QM9 A
-2.0 -5.0 5.0 0 ! EABT:Q2:CUR QM10 A
2.1 -5.0 5.0 0 ! EABT:Q3:CUR QM11 A
0.0 -20.0 20.0 0 ! EHAT:Q1:CUR QM12 A
0.0 -20.0 20.0 0 ! EHAT:Q2:CUR QM13 A
3.2 -50.0 50.0 0 ! EHAT:Q3:CUR QM14 A
2.4 -50.0 50.0 0 ! EHAT:Q4:CUR QM15 A
2.93 -5.0 5.0 0 ! EHDT:Q1:CUR QM16 A

```


3.29 -39.0 39.0 0 ! EHDT:Q2:CUR QM17 A
0.0 -43.0 43.0 0 ! EHDT:Q5:CUR QM18 A
0.0 0.0 43.0 0 ! EHDT:Q6:CUR QM19 A
0.001 20
10 0.0 0.95 20