For considerations on limit of vertical dispersion and coupling corrections in ATF EXT

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From Okugi's report in Project meeting

Simulations

- When the dispersion sources are only in the extraction line, we can correct the vertical dispersion with single sum-knob.
- When the coupling sources are only in the extraction line, we can correct the coupling with the present QKs.

Experiment (May 14)

- The measured dispersion cannot be corrected with only sum-knobs. It means the incoming vertical dispersion is large and the phase of incoming dispersion is not on phase to sum-knob.
- In order to correct the dispersion with QSs, we must apply large opposite fields to QSs, and it make large betatron coupling.
- In order to correct the coupling, generated by the QSs the maximum field of QK1X was too weak

Calculations here

Correction of η_y and η_y' at the EXT entrance (IEX).

- Vertical dispersion correction using QS1X and QS2X + Coupling correction using QK1~4X
- Vertical dispersion correction using QS1X, QS2X and orbit bump + Coupling correction using QK1~4X

Check strength limit of skew quads

Calculation procedure -1 (using SAD optics calculations)

- Set η_y and η_y' at the EXT entrance (IEX).
- Correct dispersion (Make downstream η_y and η_y' zero.)
  - Find set of strengths of QS1X and QS2X
- Correct coupling
  - Find set of strengths of QK1~4X
- Look if strengths of QSs and QKs exceed limits. (In SAD, halves of them)
  - QS1X, QS2X: SK1<0.025
  - QK1X, QK4X: SK1<0.1
  - QK2X, QK3X: SK1<0.025
- Plot set of (η_y, η_y') for
  - Both QS and QK within limits
  - QS within limits and QK out of limits
  - QS out of limits and QK within limits: None

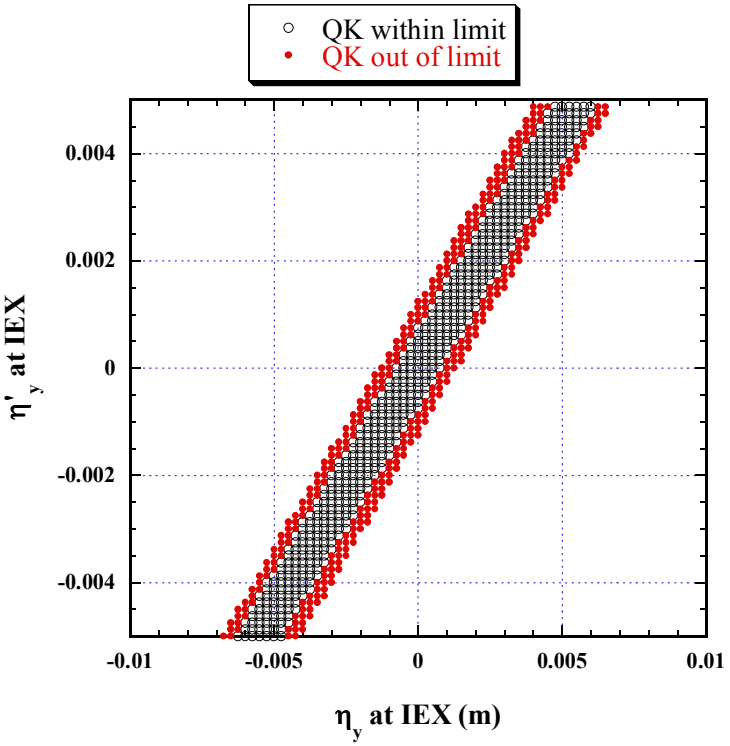
Calculation procedure -2 (using SAD optics calculations)

- Set η_y and η_y' at the EXT entrance.
- Correct dispersion (Make downstream η_y and η_y' zero.)
  - Find set of strengths of QS1X and QS2X
  - Find set amplitude of closed orbit bump using ZV5~7X.
  - Limit the bump hight 6mm at peak.
  - Keep constraint of "sum-knob". SK1(QS1X)=SK1(QS2X) if possible.
    - Fit independently, if not.
- Correct coupling
  - Find set of strengths of QK1~4X
- Look if strengths of QSs and QKs exceed limits.
  - Maximum orbit change limit +- 6 mm
  - QS1X, QS2X: SK1 limit +-0.025
  - QK1X, QK4X: SK1 limit +-0.1
  - QK2X, QK3X: SK1 limit +-0.025
- Plot set of (η_y, η_y') for
  - Both QS and QK within limits
  - QS within limits and QK out of limits
  - QS out of limits and QK within limits: None

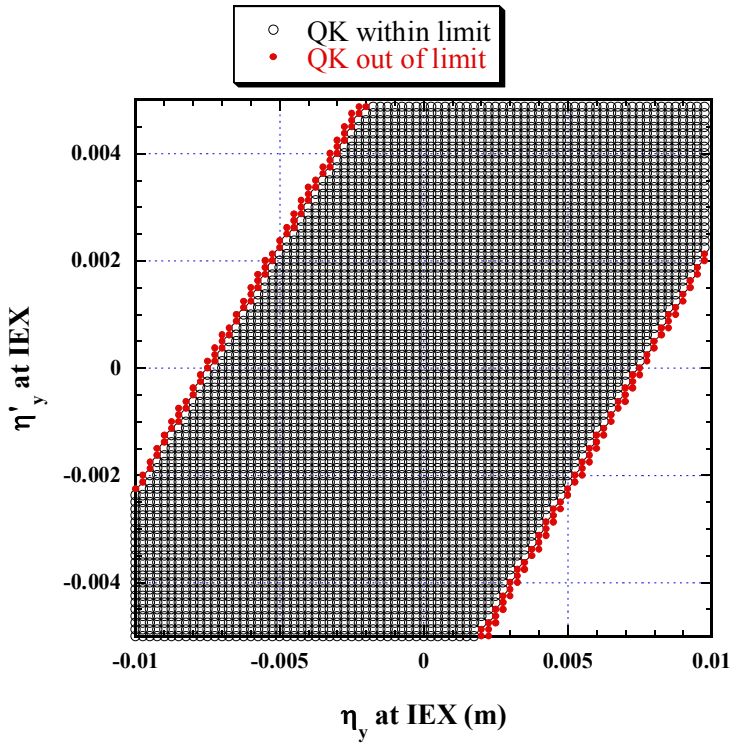
Results

Black: Dispersion and coupling can be corrected within strength limit.
Red: Dispersion can but coupling cannot be corrected within strength limit.
No mark: Dispersion cannot be corrected within strength limit.

1, Dispersion correction using QS1X and QS2X



2, Dispersion correction using Orbit bump (ZV5,6,7X)) and QS1X and QS2X



SUMMARY

- Using QS1X and QS2X, only a thin strip in (η_y, η_y') space (at EXT entrance) can be corrected.
  - This is because the phase advance between QS1X and QS2X is close to pi. Can we find better locations?
- Using closed orbit bump (by ZV5,6,7X), the correctable region becomes larger.
- There are regions where coupling cannot be corrected by QKs, near the borders of the dispersion correctable region. (But not very large.)
  - Increasing QK1X strength limit will make correctable region only slightly larger.

Note:

- Only dispersion from DR is considered
- No coupling sources except corrector skew quads are considered
- No errors in EXT line included.