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KURRI FFAG simulation update

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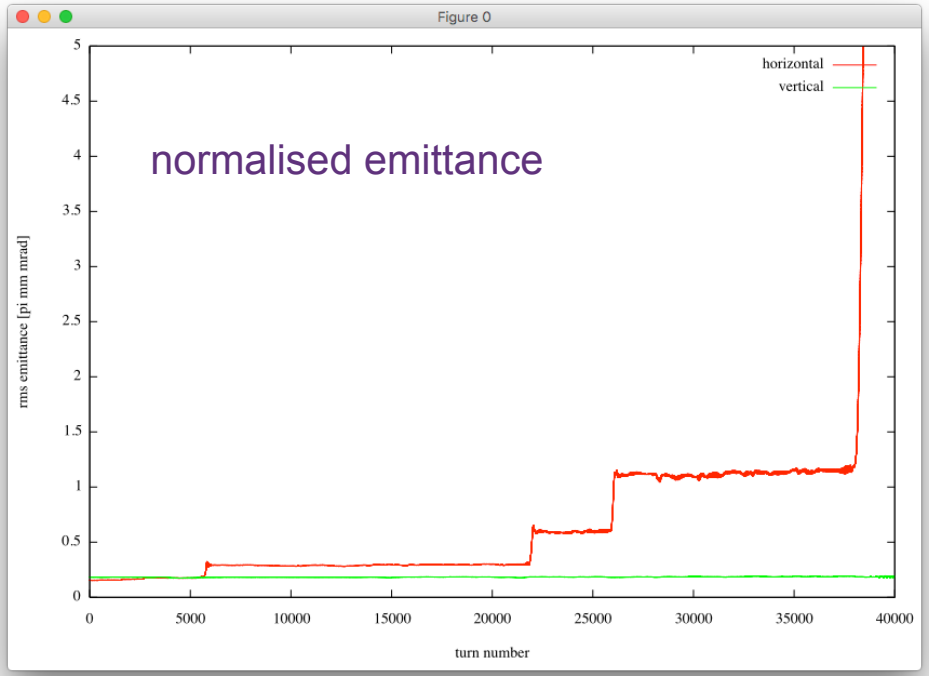
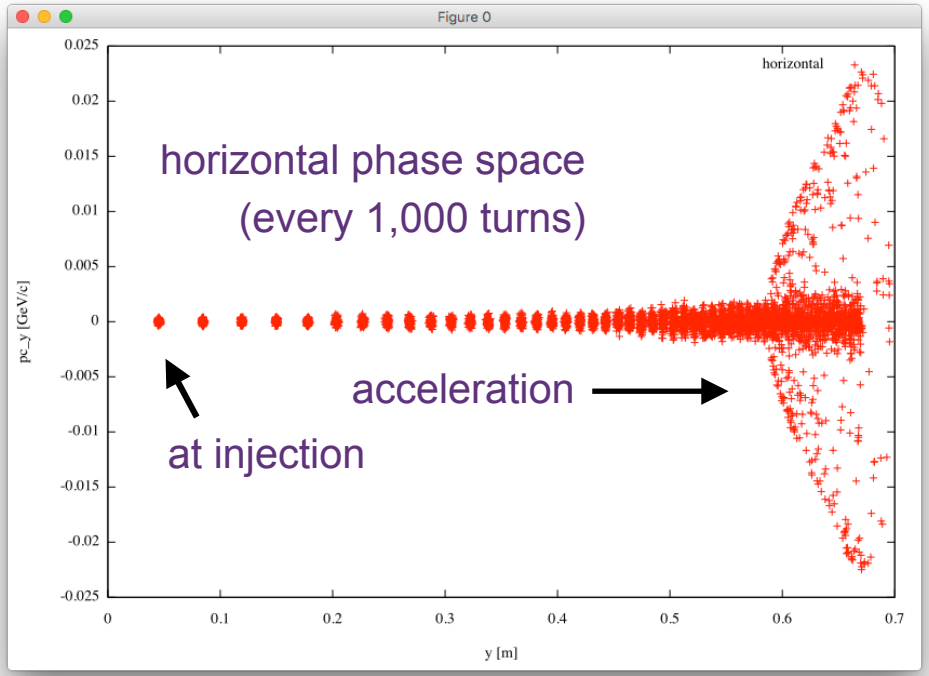
Emittance evolution

Zgoubi and Scode show similar emittance jump at some turns (energy).

No space charge. No error in the lattice.

No jump in vertical plane.

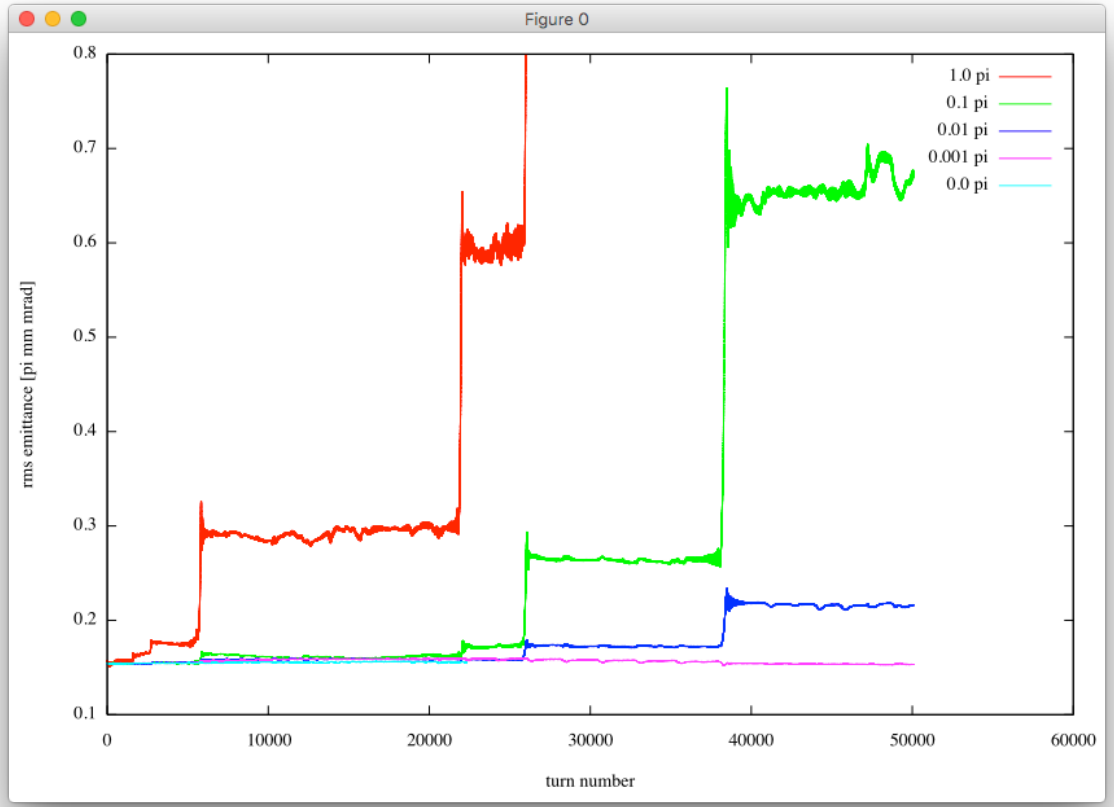




Kinetic energy [MeV]
= 11.0 + 0.002 x (turn number)

Parameter dependence
vertical emittance

When vertical emittance is reduced (1 pi to 0 pi), the jump disappears.



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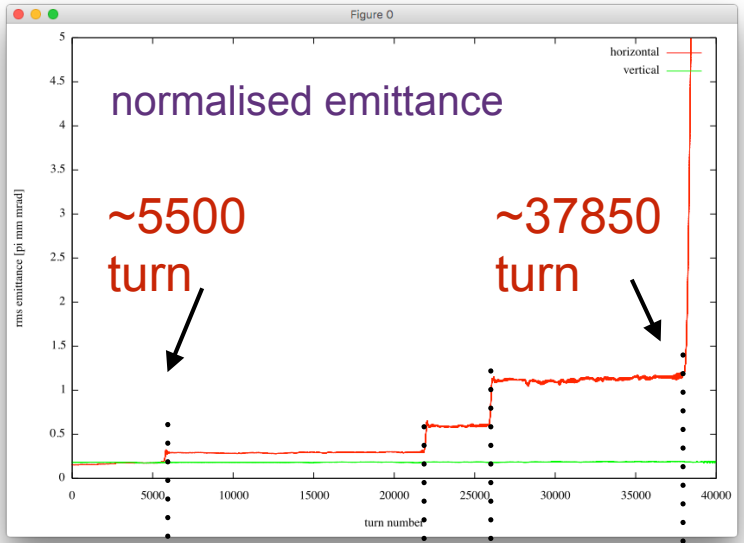
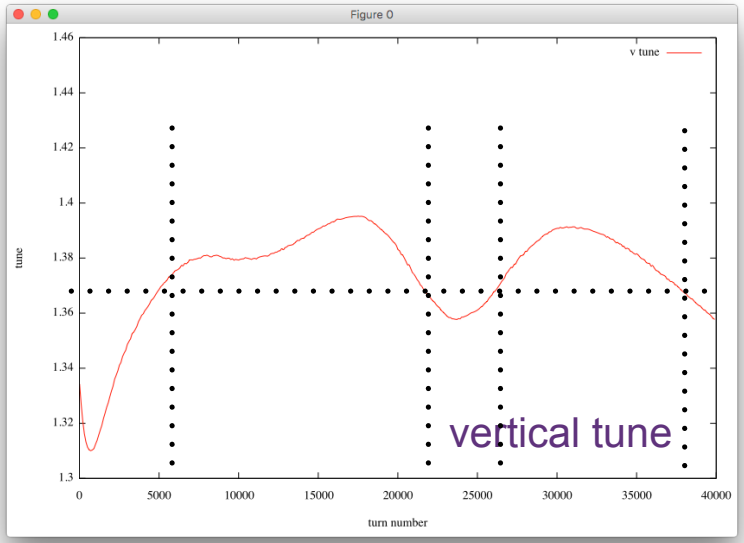
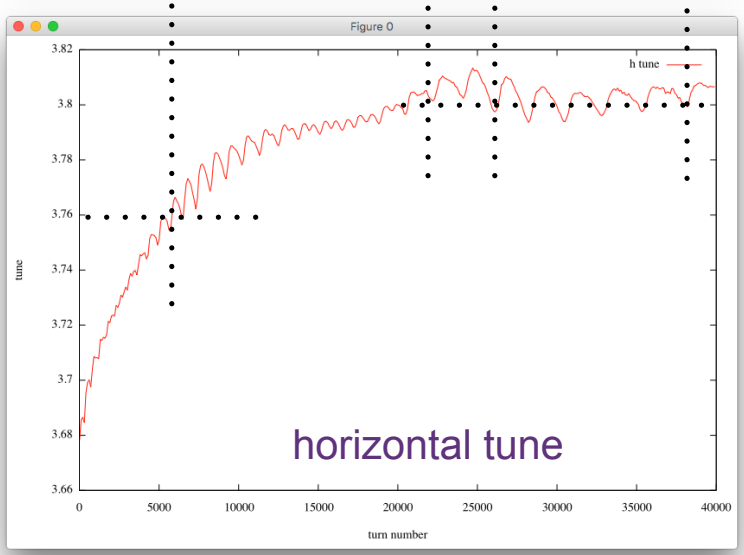
Tune evolution

Except the first jump, it happens at around Qh=3.8







In fact, Qv~1.37 when jump appears.

~~Qh+6Qv=12 7th order coupling~~

Since the order of vertical is ~~much higher than horizontal,~~ there is no jump in vertical?

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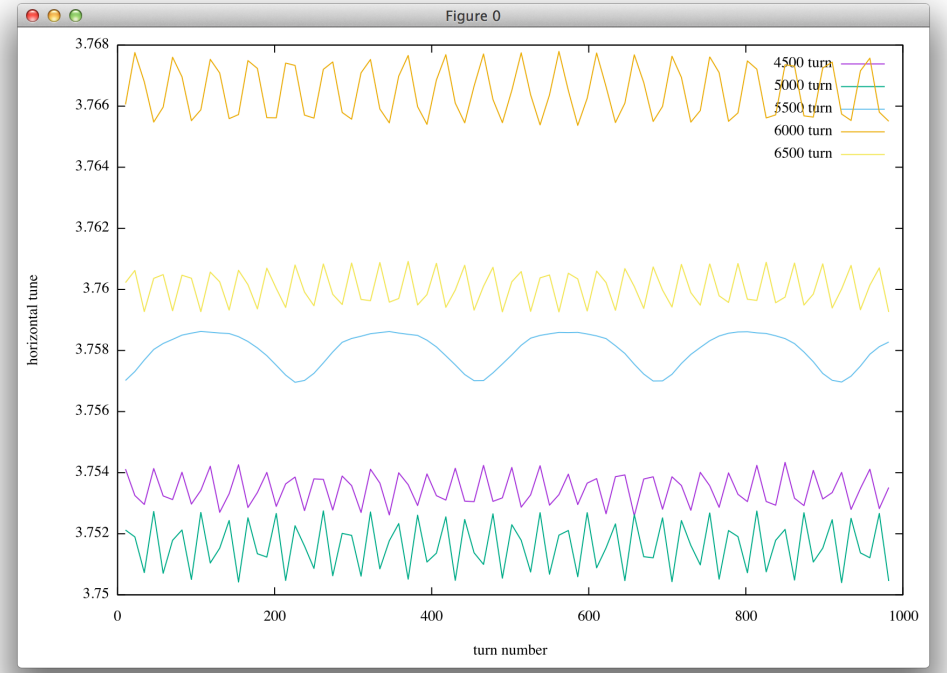
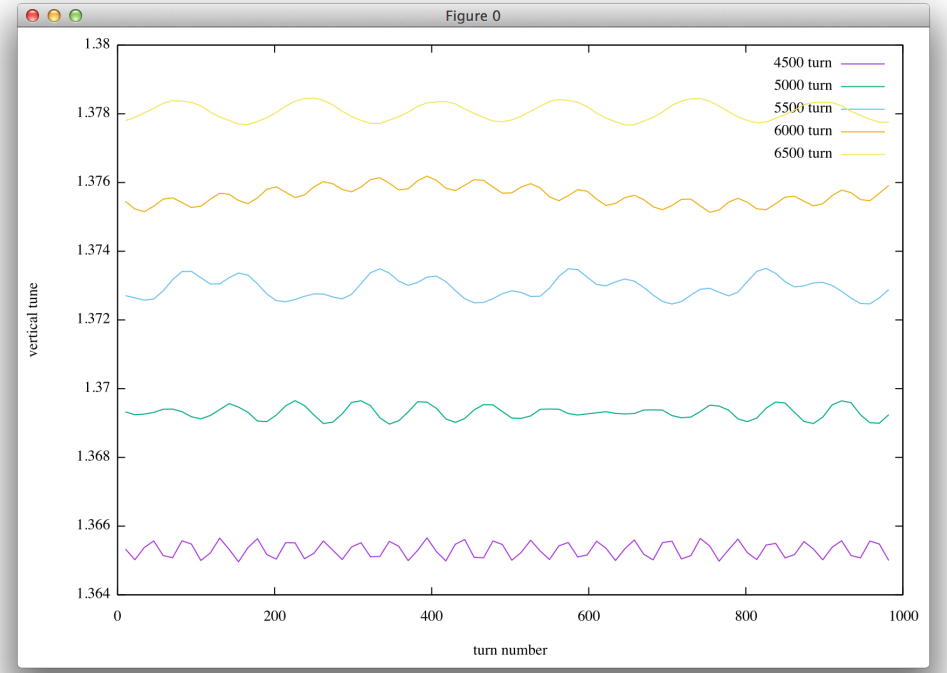
Tune at ~5500 turn



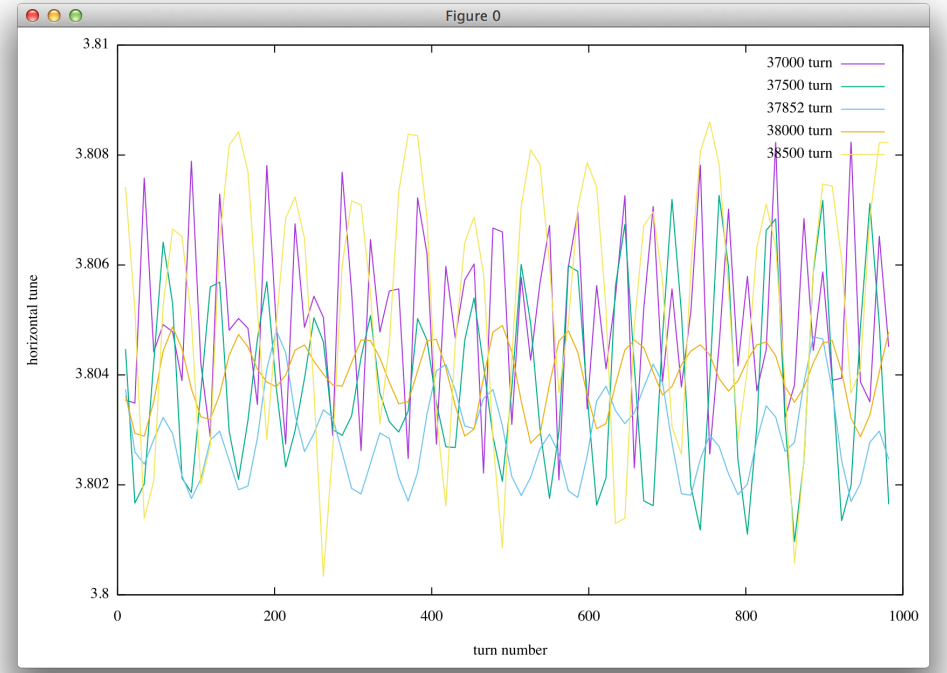


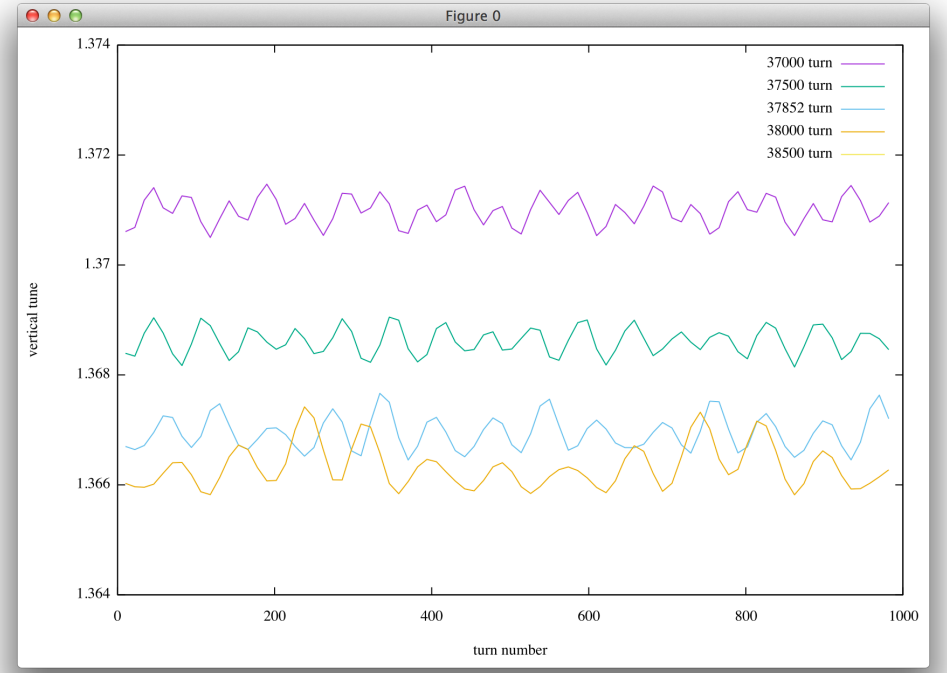
Qh=3.758

Qv=1.373

6Qh + Qv = 23.921

Tune at ~37850 turn



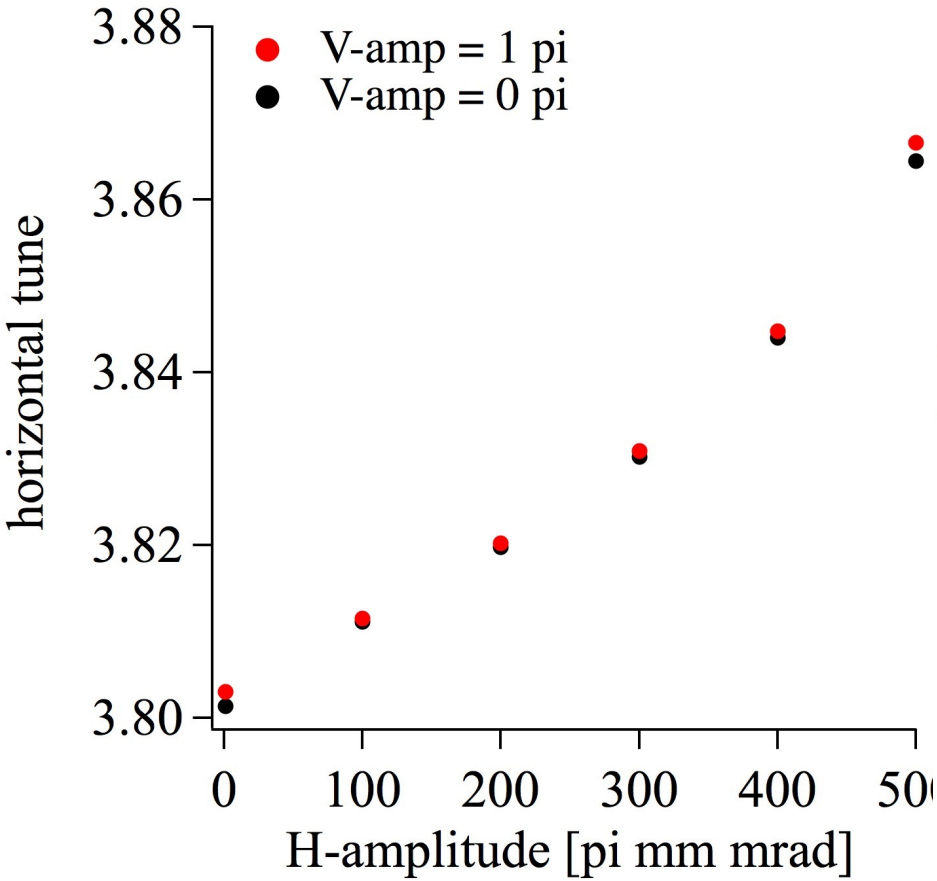


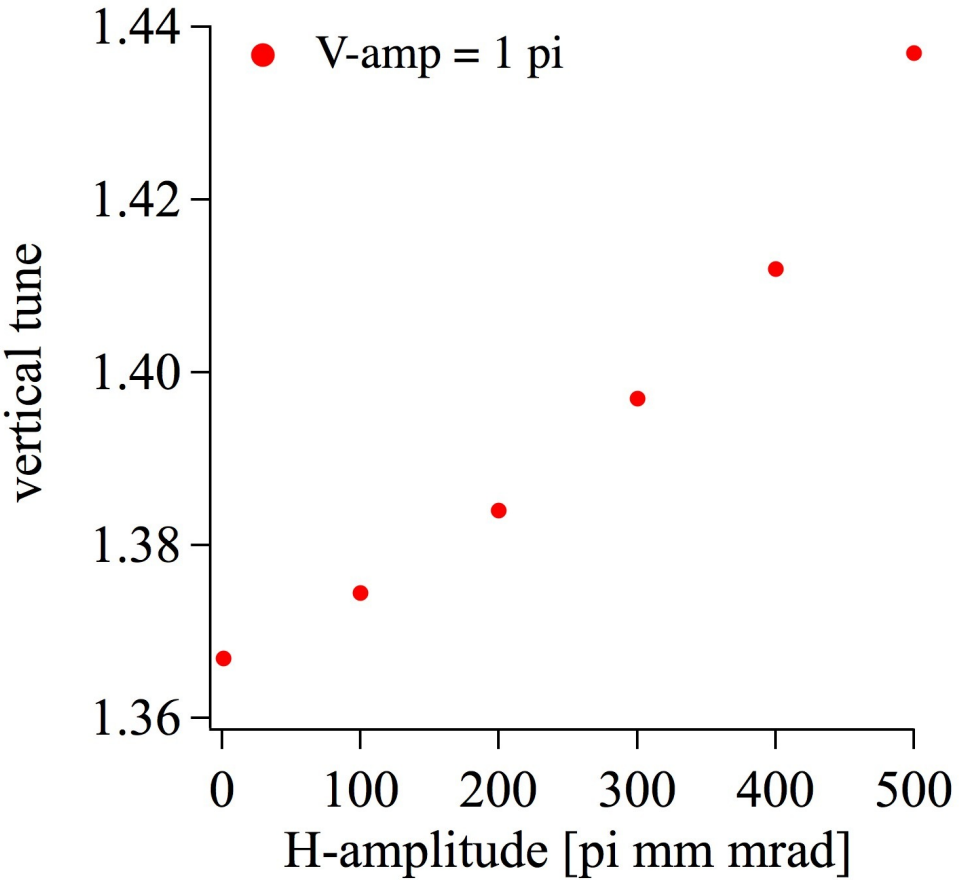
Qh=3.803

Qv=1.367

6Qh + Qv = 24.185

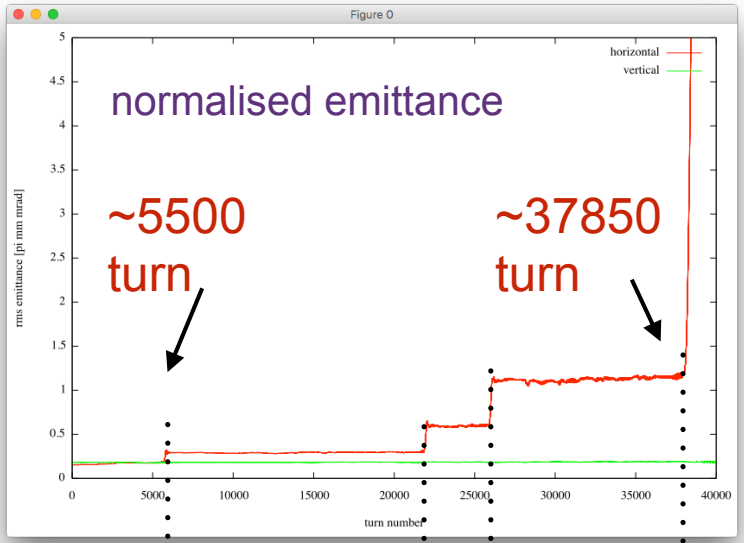
Amplitude dependent tune

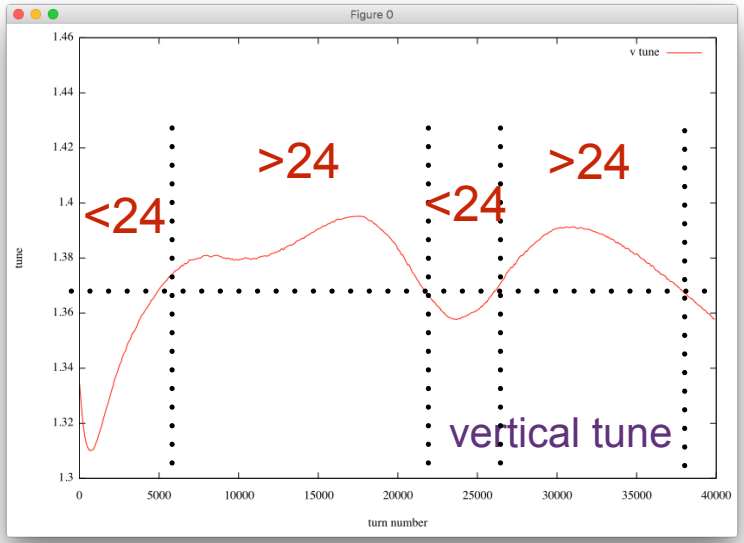


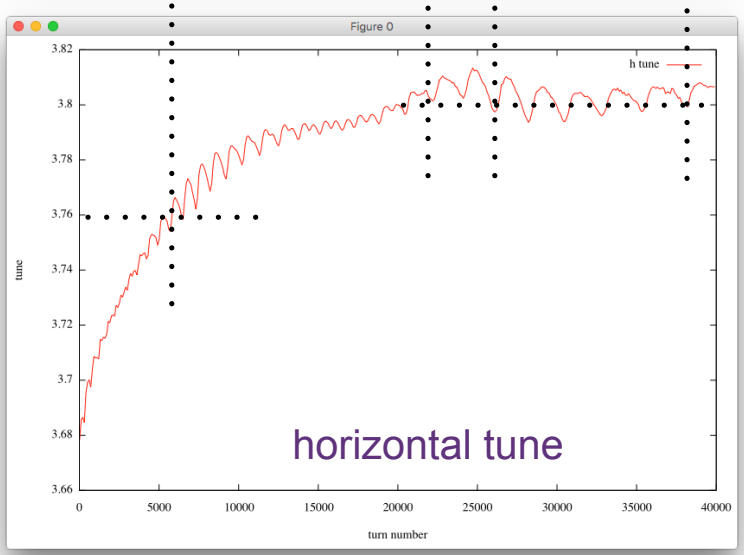


Amplitude dependent tune shift is negligible.

Tune evolution







6Qh+Qv=2*12 7th order coupling

Much higher order in horizontal plane is consistent with much higher increase of horizontal emittance.

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Remark

- Still it is mystery that no indication of emittance growth in vertical direction.
  - Does it depend on the crossing angle?

- Trapping at the end of a cycle can be understood by amplitude dependent tune shift.
  - Fixed point moves out to maintain the resonance condition.

- Another explanation is syncho-beta resonance which occurs only in horizontal direction.