ATS MD

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04.09.17

Testing the telescopic optics with negative octupole current

- Squeezing beta from 100 to 35 cm at const crossing angle
- Using the negative octupole polarity
- Need to ensure stability
- \+ Larger betas in the arcs
  - Larger oct spread
- – Parasitic long range beam-beam interaction fights against the octupole tune spread

Simulation procedure

MADX to track

- 4D (on-momentum)
- Full lattice with sext and oct
- Thin elements

PySSD to compute stab diags

- Assuming the modes uncoupled
- Tune shifts small

$$\left(\int \frac{J_x \partial f / \partial J_x}{Q_c - mQ_s - Q_x(J_x, J_y) + io} dJ_x dJ_y \right)^{-1}$$

Parameters

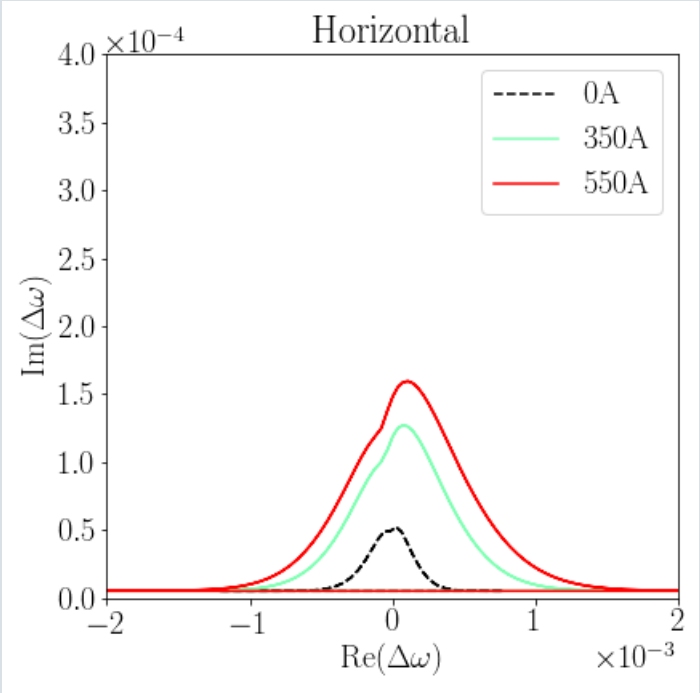
- ε_n = 2.0 – **2.5** μm
- $N_b = 1.2 \times 10^{11}$
- Gaussian distribution
- Separation:

$$\theta_{cr} = \frac{\rho}{2\sqrt{\frac{\beta_{IP}\gamma}{\varepsilon_n}}}$$

Goal: To a SD greater or equal the nominal one

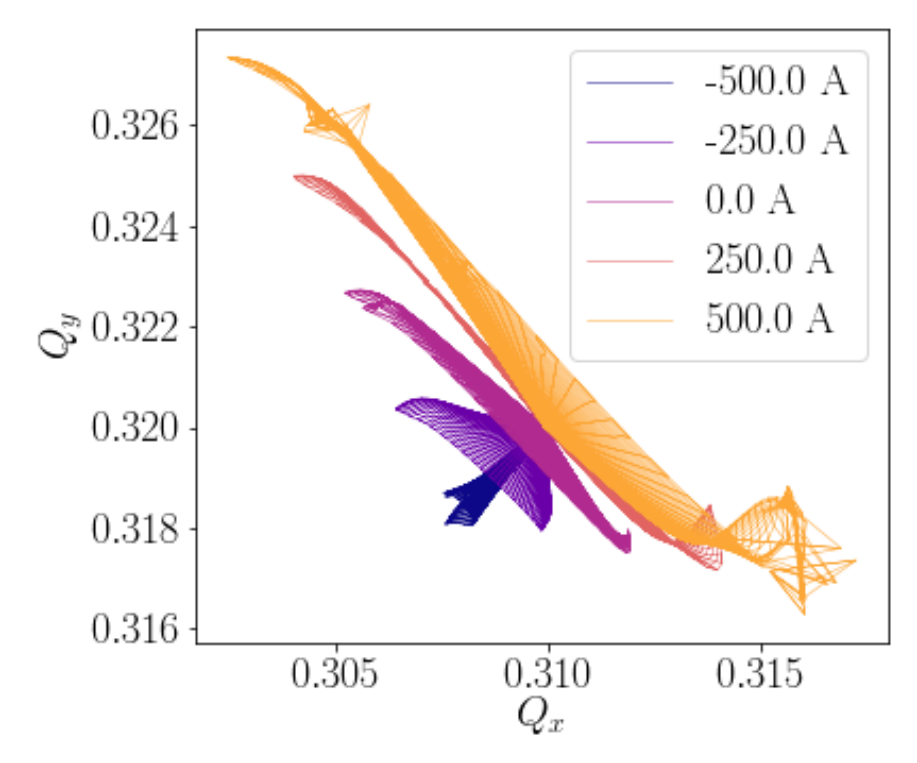
+ octupole current, 150 μrad crossing angle, 2.5 μm emittance

Observation: need 340 A to stabilize B1H

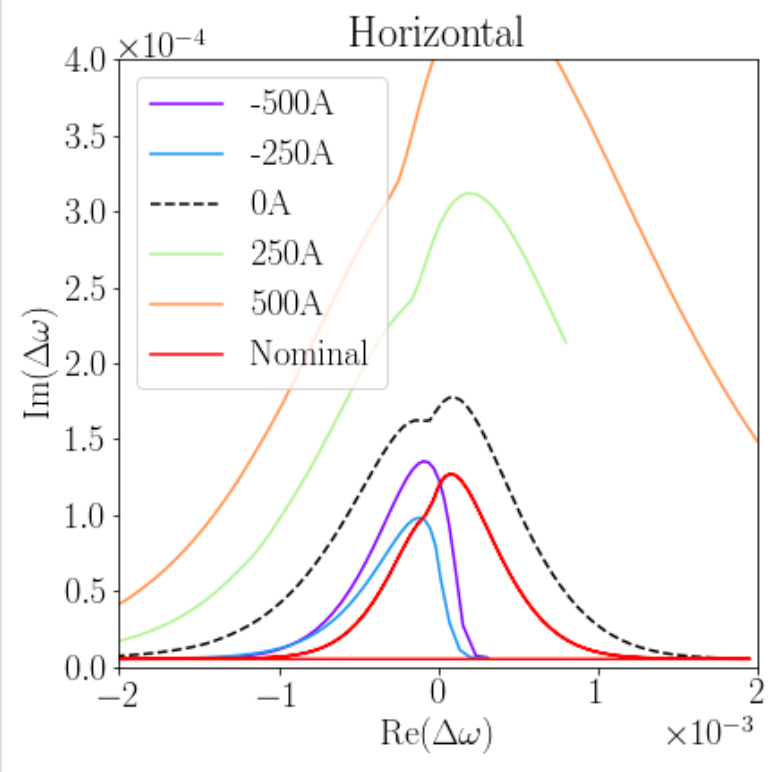


Proposed 150 μm rad crossing angle (separation of 9 σ at β* = 35 cm) might be close to the limit

Tune footprints distorted by the LR

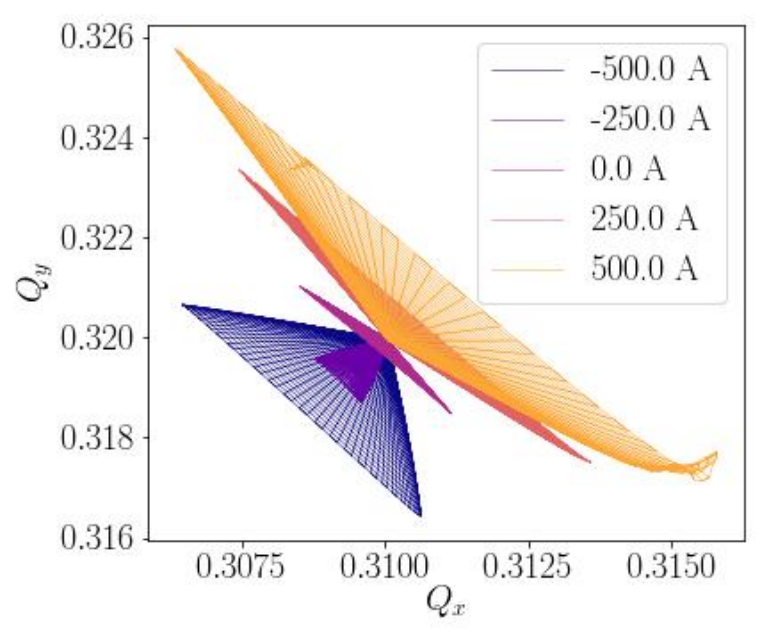


May need -500 A

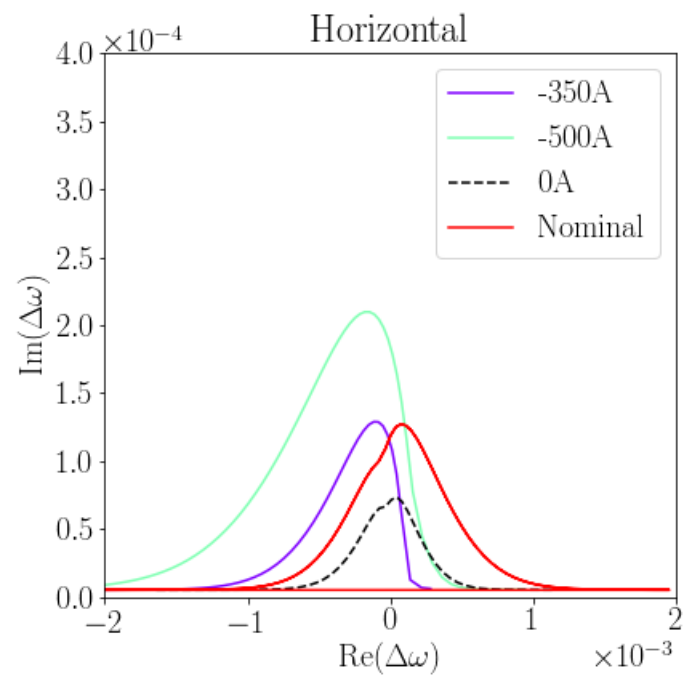


Increasing the separation to 12 σ (190 μrad) helps

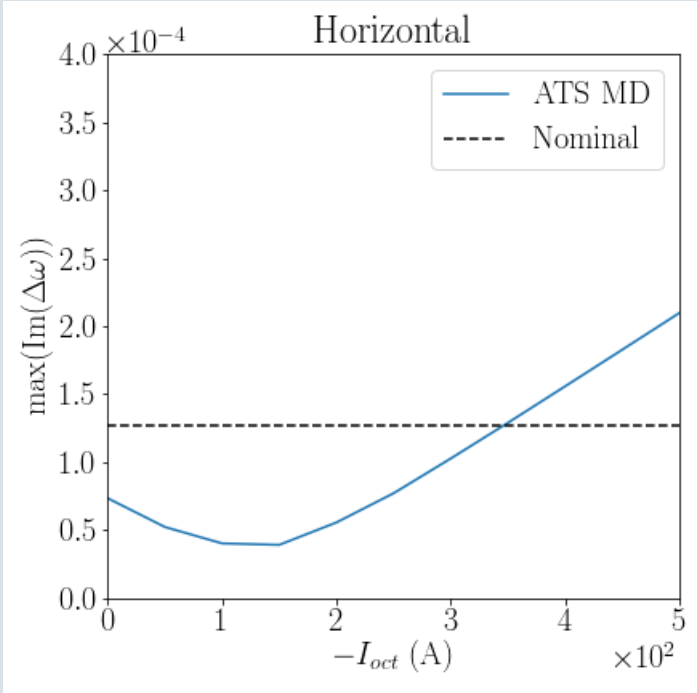
Smaller effect of LR beam-beam force on the octupole tune footprint



At -350 A one achieves the SD close to the nominal

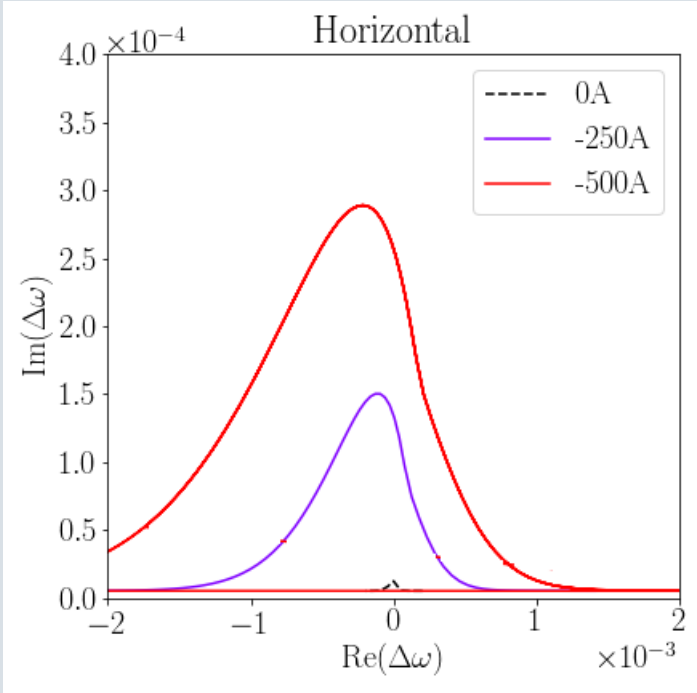


The (negative) octupole current should be 350 A or higher



ε_n = 2.5 μm
β^* = **35 cm**
Θ_{cr} = 190 μrad
ρ = 12 σ
N_b = 1.2x10^{11}

In the absence of LR (large β*) we should be stable



ε_n = 2.5 μm
β* = **100 cm**
Θ_{cr} = 190 μrad
ρ = 20 σ
N_b = 1.2x10^{11}

Conclusion

The proposed crossing angle of **150 μrad** seems challenging

- At β* of 35 cm the parasitic LR interaction distorts the octupole tune spread significantly
- The SD shape is affected
- Need **500 A** to be close to the nominal case with the positive polarity

Propose increasing the crossing angle to **190 μrad**

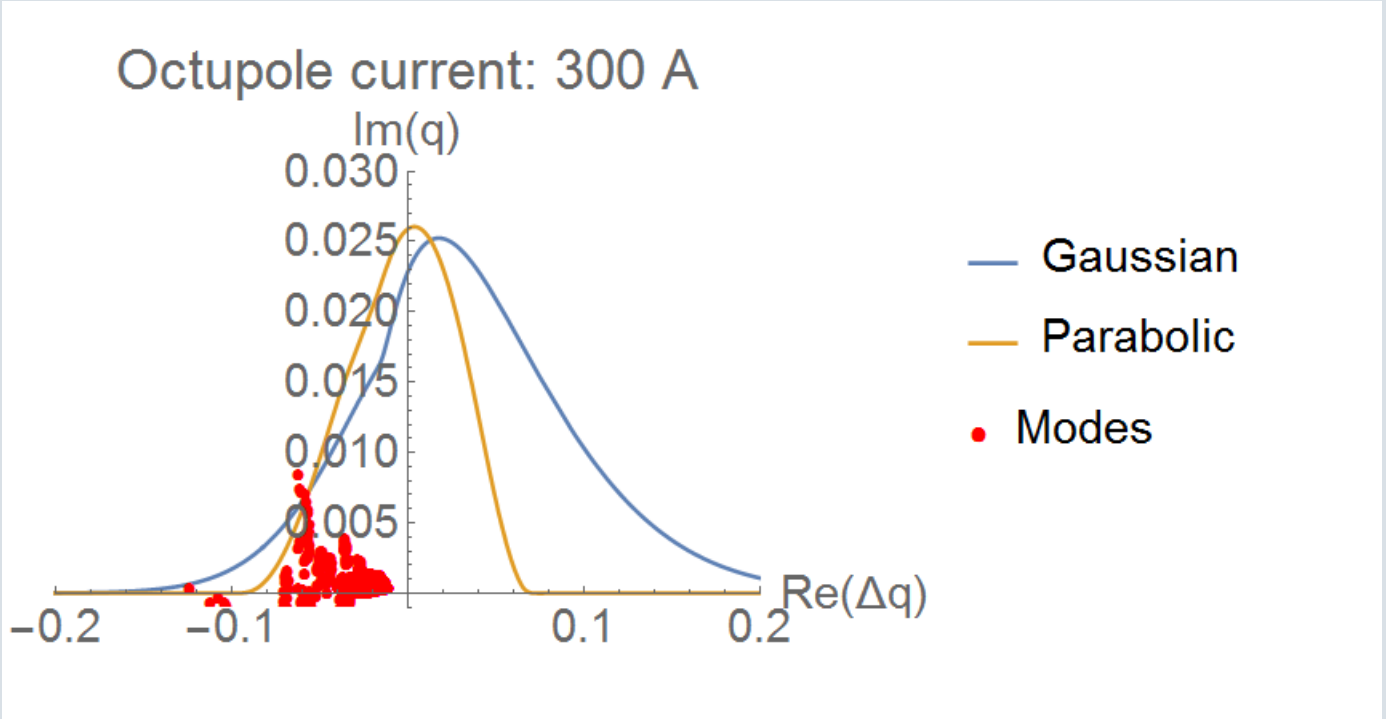
- The octupole current shall be higher than **350 A**

Another option could be to increase β in the arc

Back-up slides

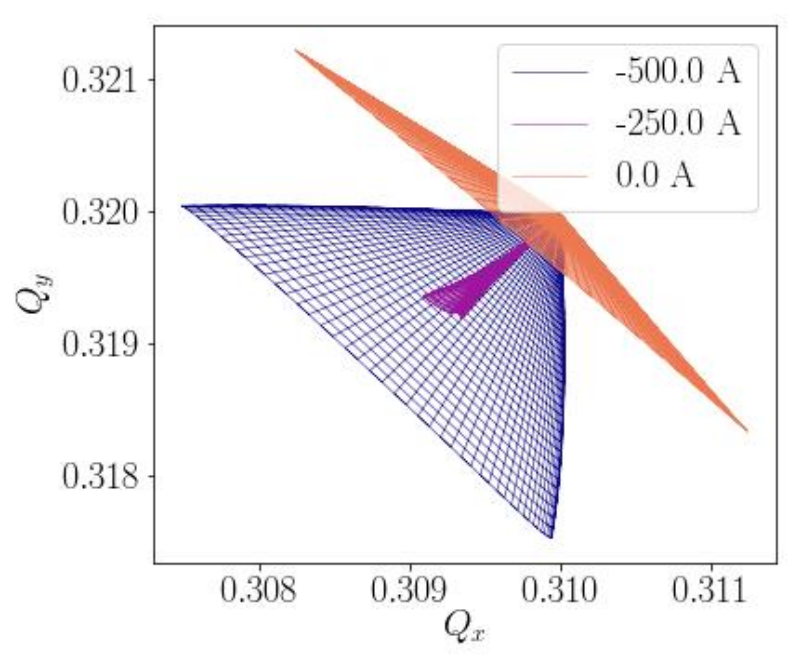
Most unstable modes have negative tune shift

Most critical modes for the RW-driven head-tail instability calculated for the TCSPM MD

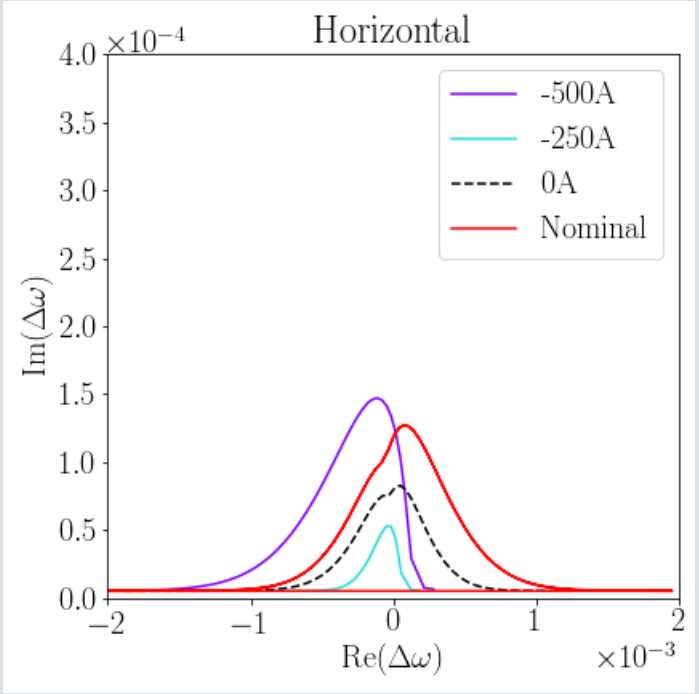


Having a smaller emittance requires a larger octupole current

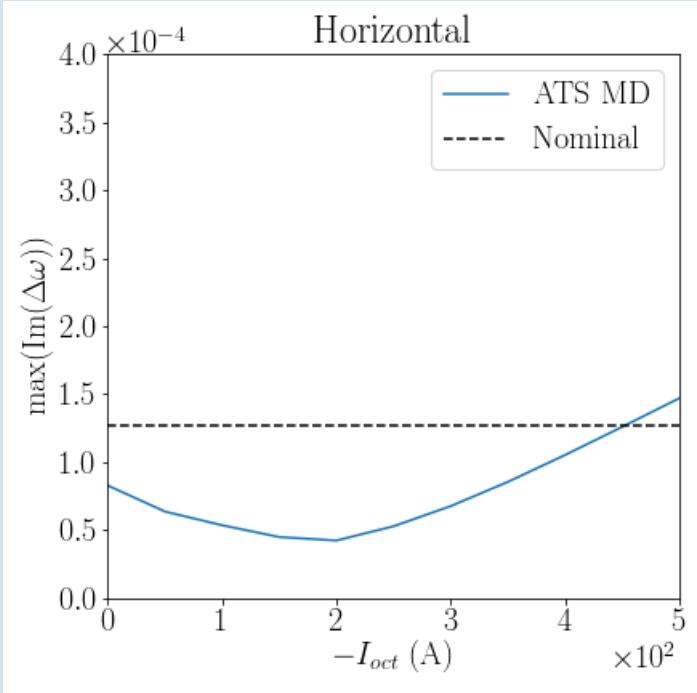
Tune footprint more distorted at low negative currents



Need the current close to max



The (negative) octupole current should be close to 500 A



ε_n = 2.0 μm
β^* = **35 cm**
Θ_{cr} = 190 μrad
ρ = 12 σ
N_b = 1.2x10^{11}