Progress on Final Focus designs for different L^*

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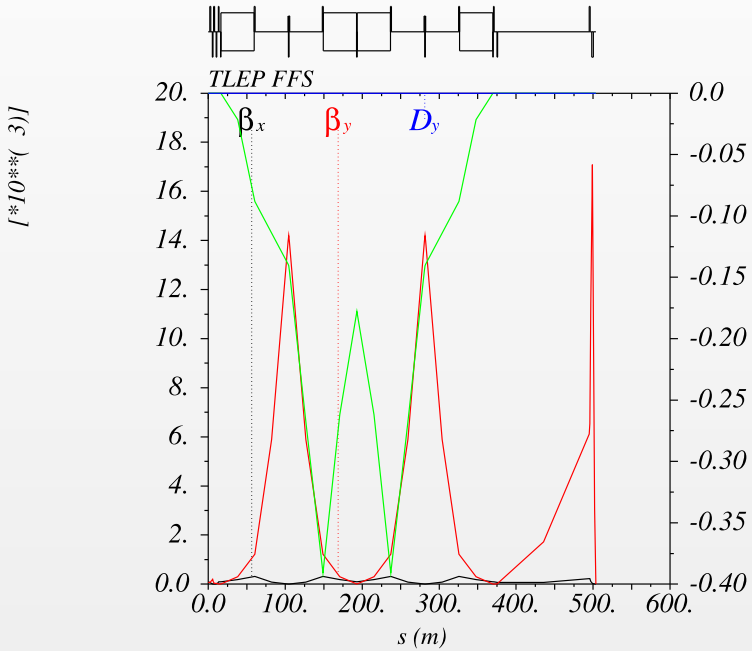
Parameters

Parameter	[**Units**]	TLEP t A	TLEP t B
Beam energy E_{beam}	[GeV]	175	175
Circumeference f_{rep}	[km]	100	100
Bunch population N_e	$[10^{11}]$	0.88	7.0
Number of bunches n_b		160	20
Bunch length σ_z	[mm]	0.77	1.95
IP beam size σ_x^*/σ_y^*	[μm]	45/0.045	126/0.126
Emittance (IP) ϵ_x/ϵ_y	[nm]	2.0/0.002	16.0/0.016
Beta functions (IP) β_x^*/β_y^*	[m]	1.0/0.001	1.0/0.001
Luminosity $\mathcal{L}_{\mathrm{T}}$	$[10^{34}\mathrm{cm}^{-2}s^{-1}]$	1.32	1.04

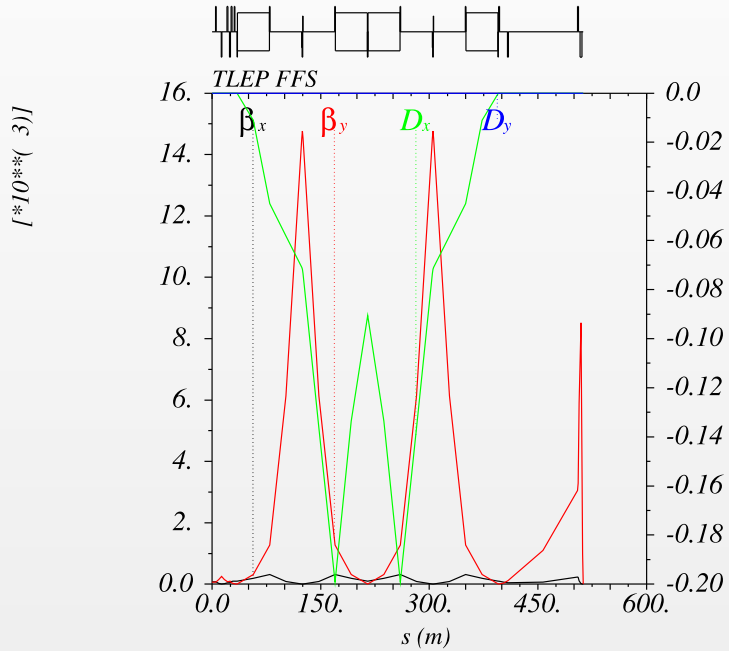
- We mainly focus on TLEP t A (Small emittance).

Final Focus Optics

$L^* = 3.5$ m

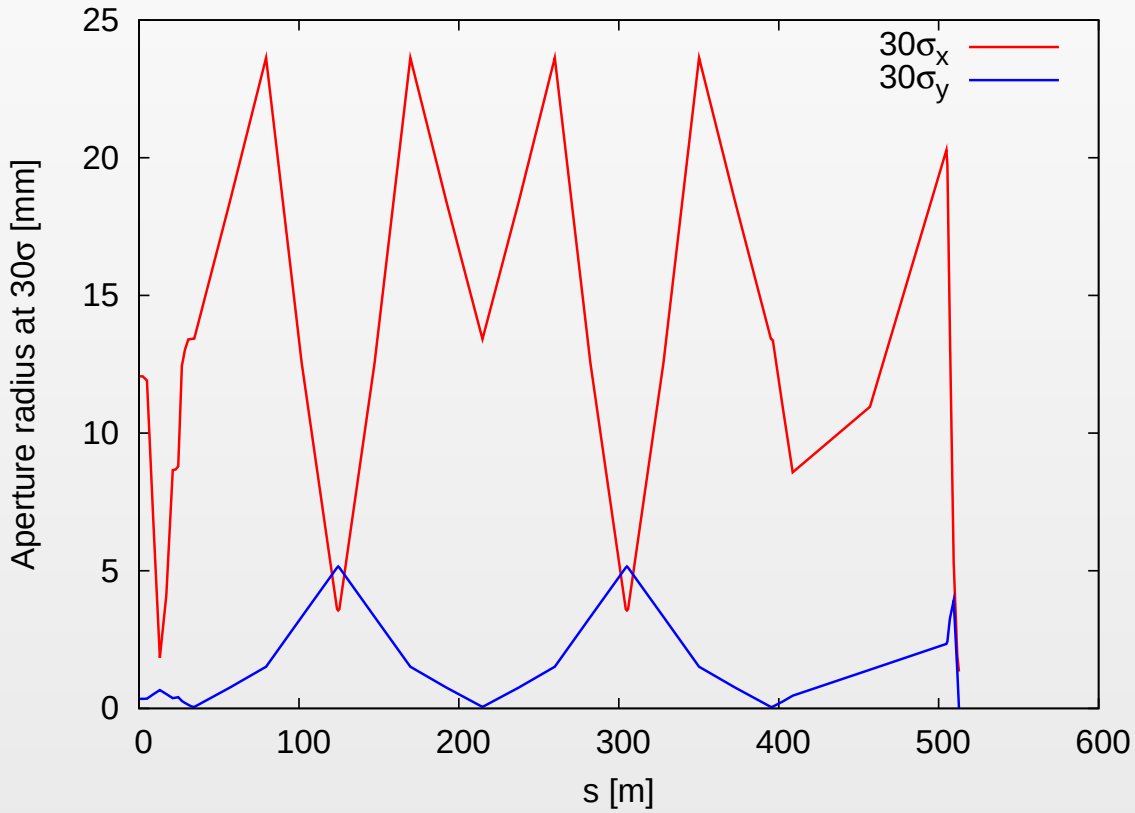


$L^* = 2.0$ m



L^* [m]	Magnet	L [m]	k [m^{-2}]	G [T/m]	Ap. rad. ($15\sigma_x$) [mm]	B ($15\sigma_x$) [T]
3.5	QD0	2.02	-0.195	113.6	3.4	0.4
3.5	QF1	1.15	0.195	113.6	9.8	1.11
2.0	QD0	2.66	-0.195	113.6	2.6	0.3
2.0	QF1	1.16	0.195	113.6	9.8	1.11

Apertures $L^\star = 2.0$ m, TLEP A



Nonlinear optimization

MAPCLASS Beam sizes $L^* = 3.5$ m

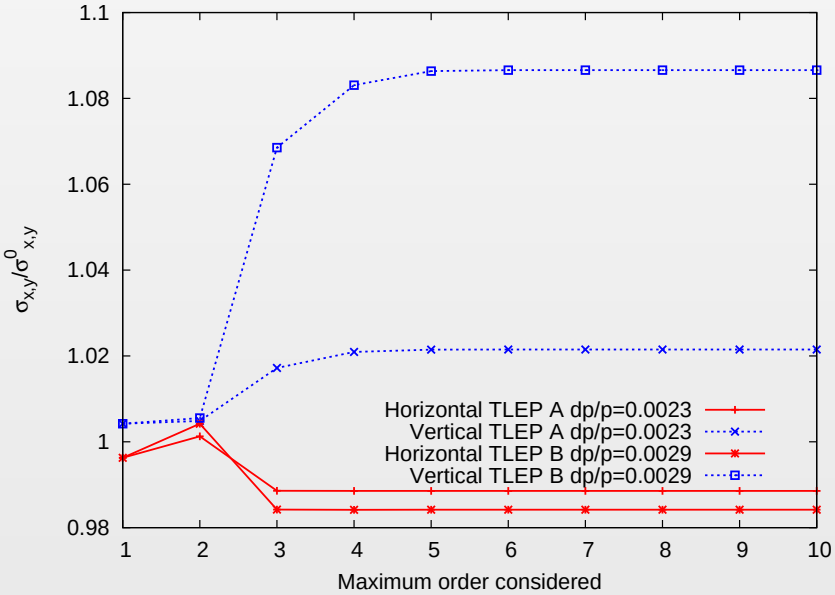
$$\sigma_x^*(A) = 44.21\,\mu\text{m},\ \sigma_y^*(A) = 45.71\text{nm}$$

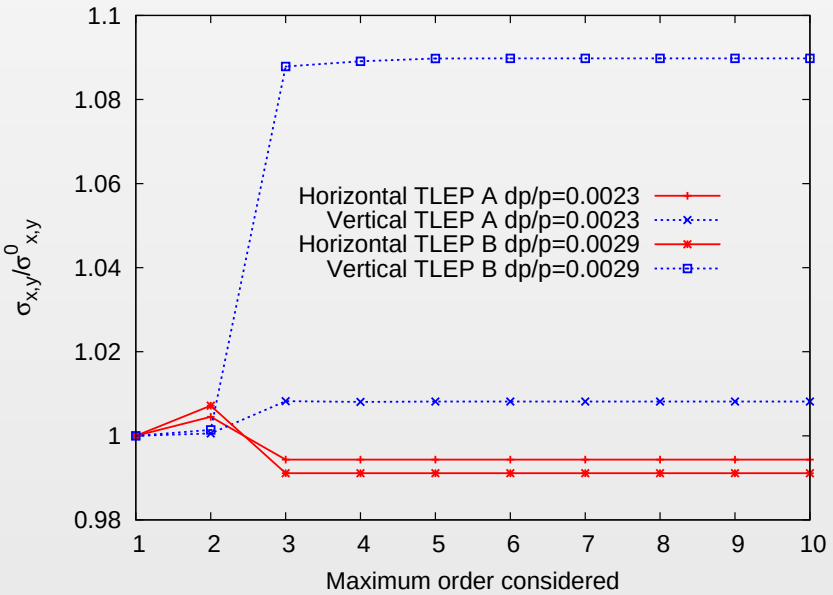
$$\sigma_x^*(B) = 124.49\,\mu\text{m},\ \sigma_y^*(B) = 137.48\text{nm}$$

MAPCLASS Beam sizes $L^* = 2.0$ m

$$\sigma_x^*(A) = 44.47\,\mu\text{m},\ \sigma_y^*(A) = 45.09\text{nm}$$

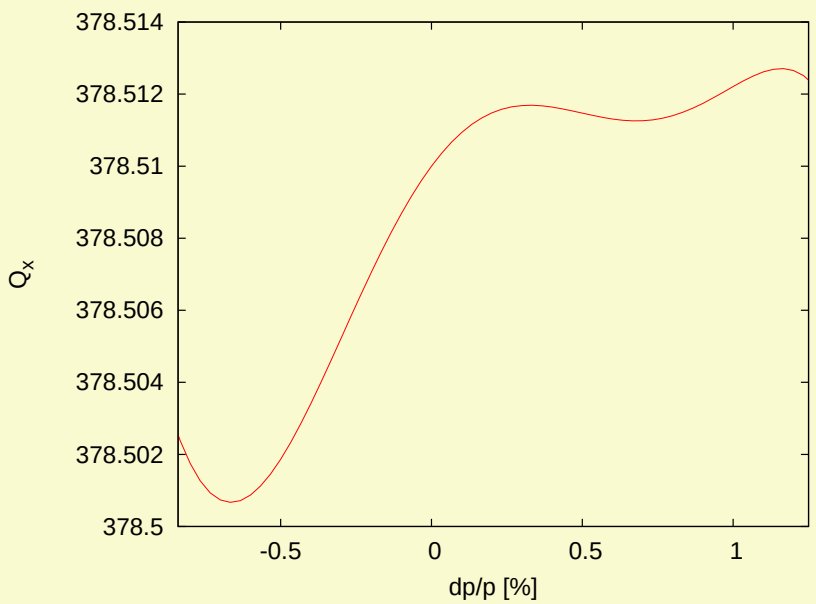
$$\sigma_x^*(B) = 125.37\,\mu\text{m},\ \sigma_y^*(B) = 137.42\text{nm}$$



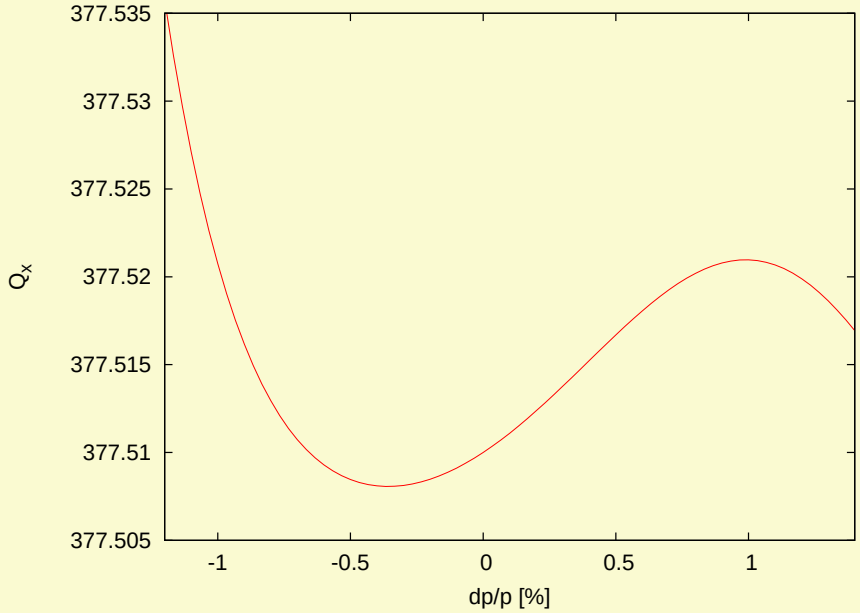


Stability: Tunes. Horizontal plane

$L^* = 3.5$ m, $Q_x = 377.51$



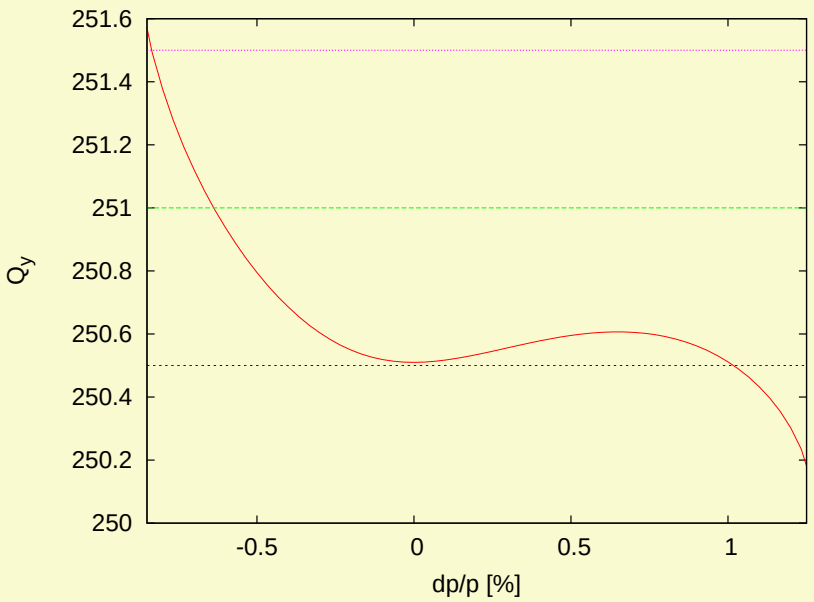
$L^* = 2.0$ m, $Q_x = 378.51$



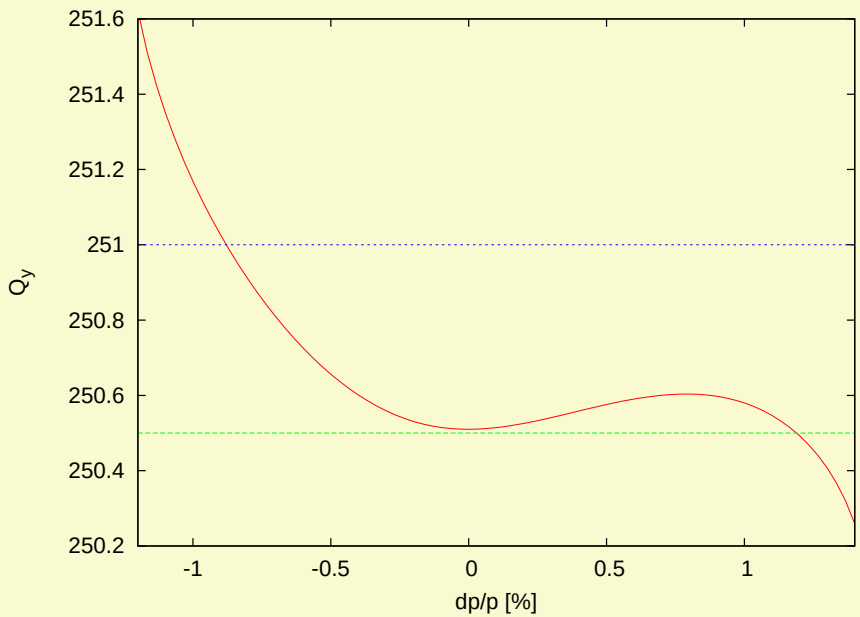
- For $L^* = 3.5$ m horizontal tune seems more stable than for $L^* = 5.0$ m.
- Compared to the vertical plane it does not imposes a big contraint.

Stability: Tunes. Vertical plane

$L^* = 3.5$ m, $Q_y = 250.51$



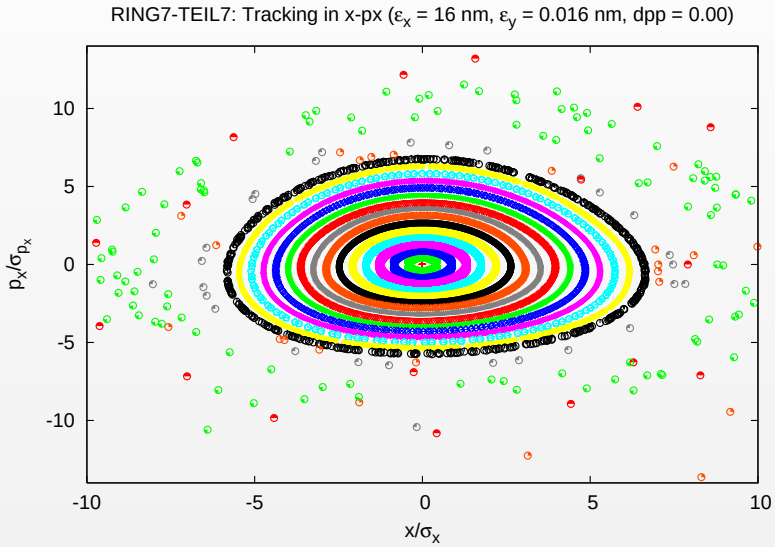
$L^* = 2.0$ m, $Q_y = 250.51$

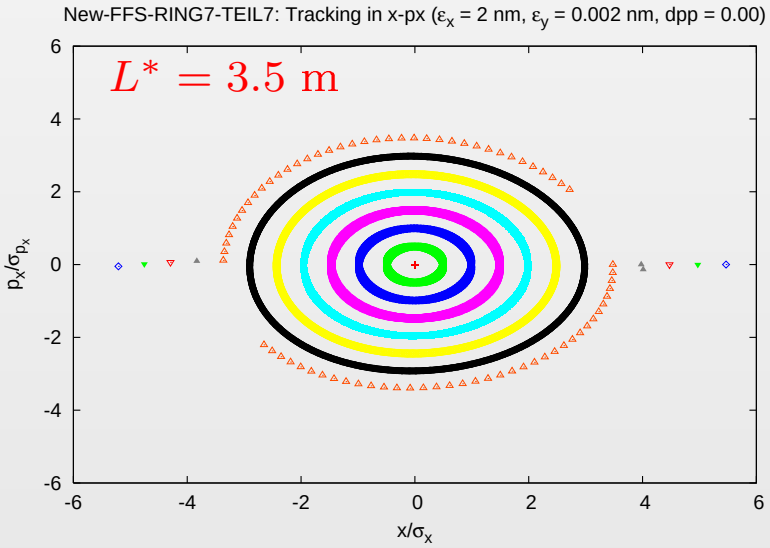


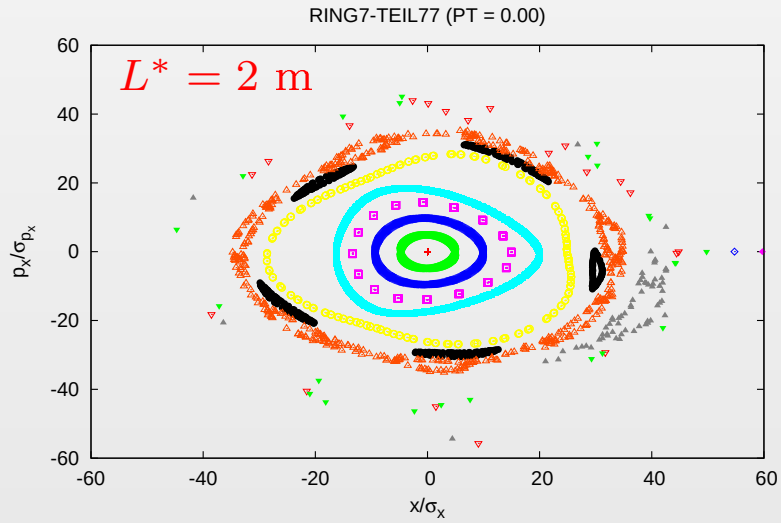
- Stability does not improve considerably when L^* is reduced.
- A maximum of $\pm 1\%$ momentum acceptance seems possible with a bit more time.
- Perhaps negative values of dp/p are more relevant when we take into account beamstrahlung.

Horizontal phase space. n momentum $dp/p = 0.0$. tlep A

Without low-β

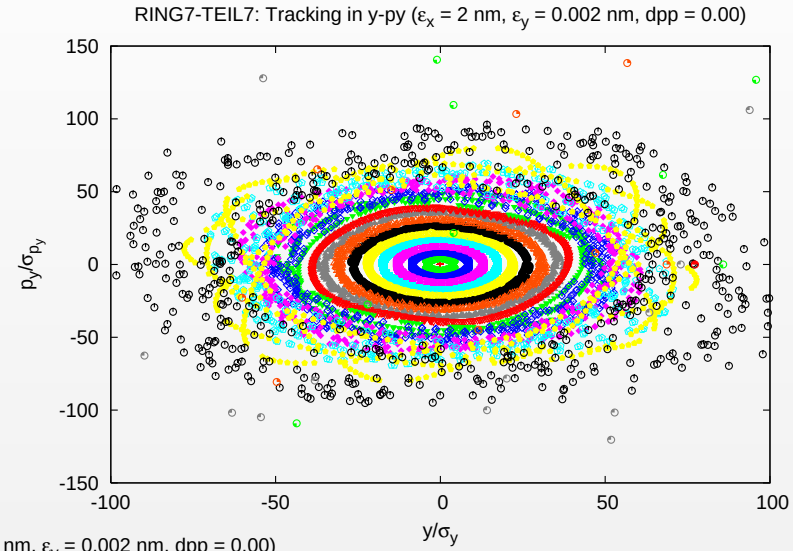


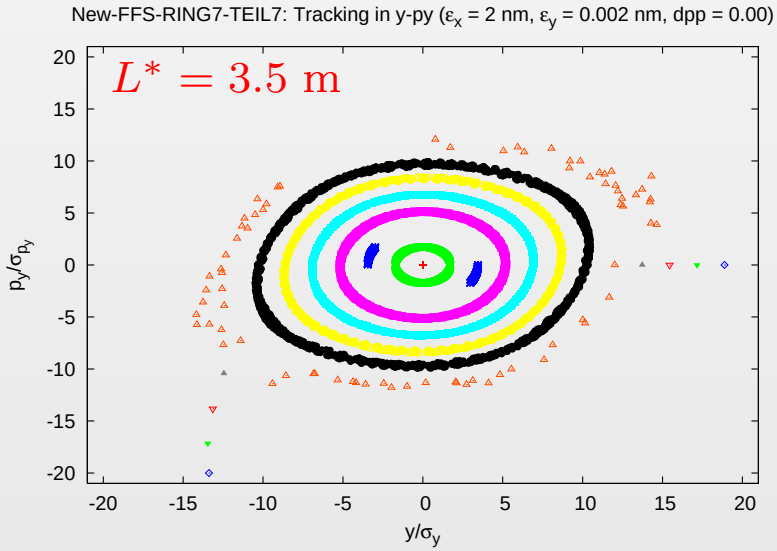


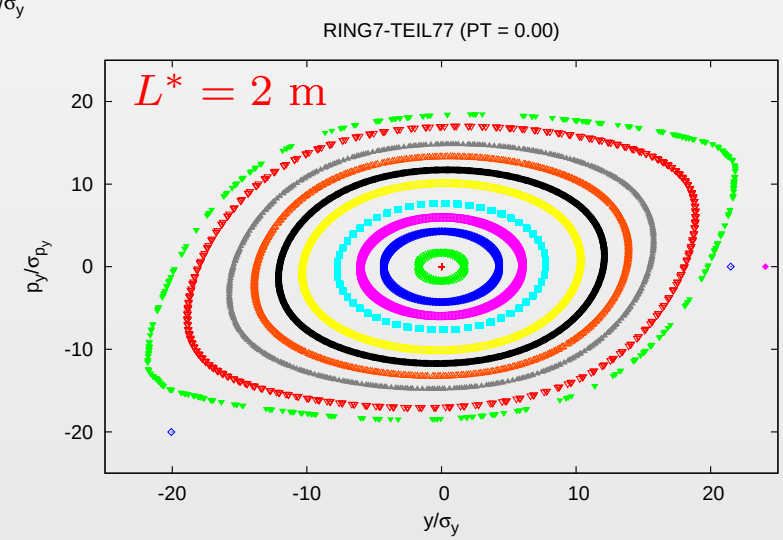


Vertical phase space. On momentum $dp/p = 0.0$. tlep A

Without low-β

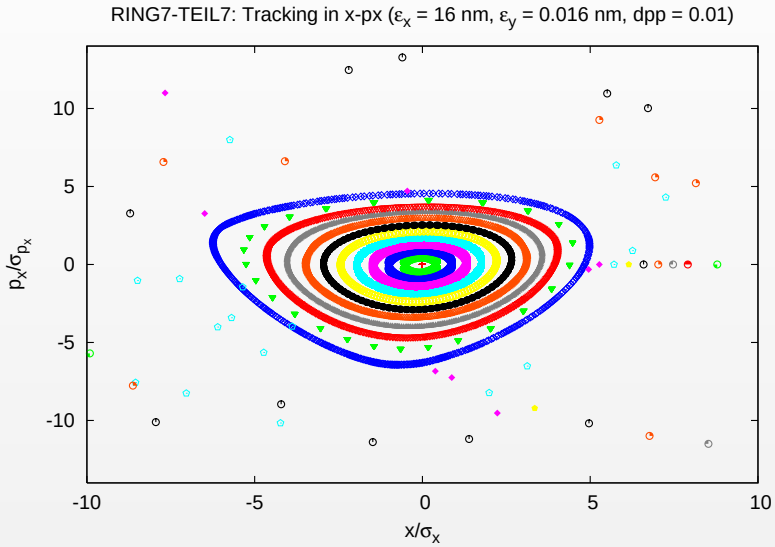


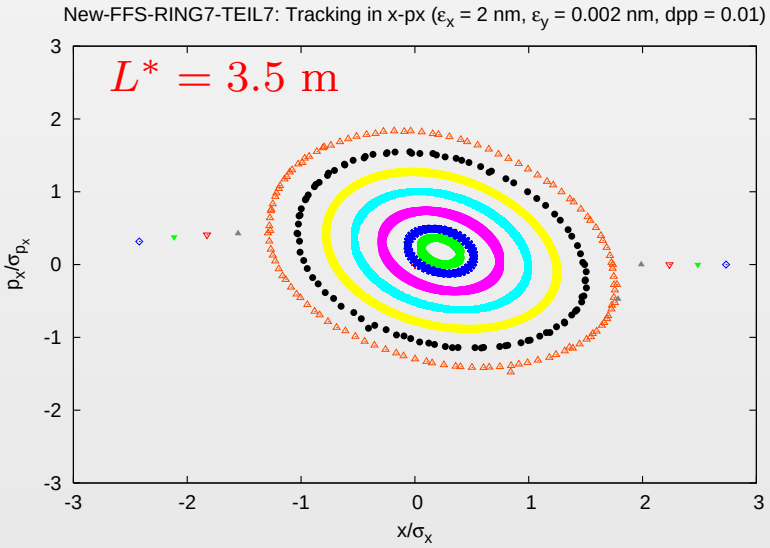


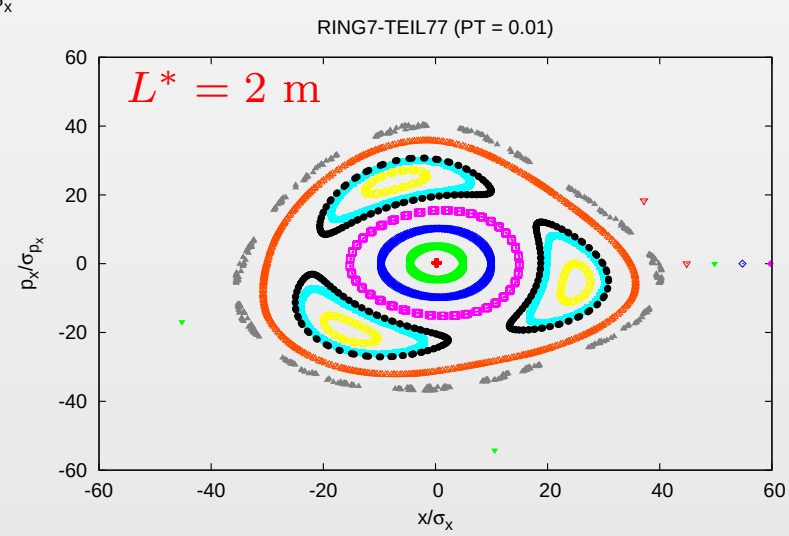


Horizontal phase space. Off momentum $dp/p = 1\%$. tlep A

Without low-β

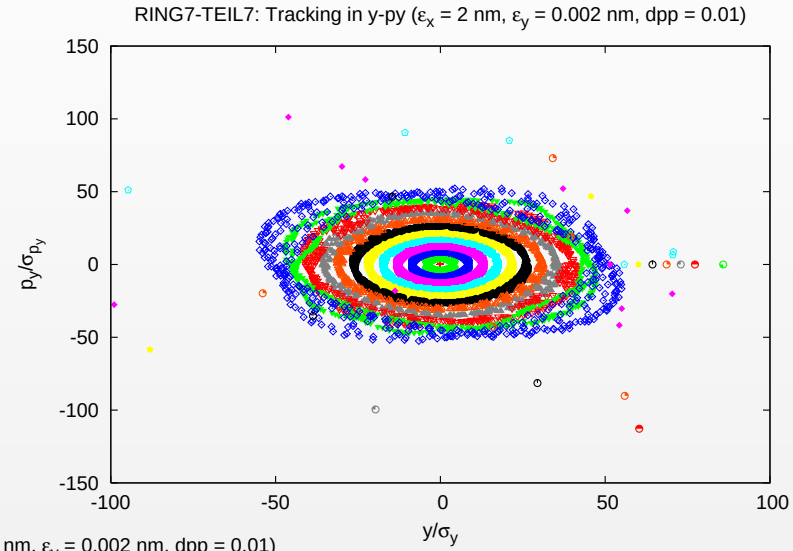


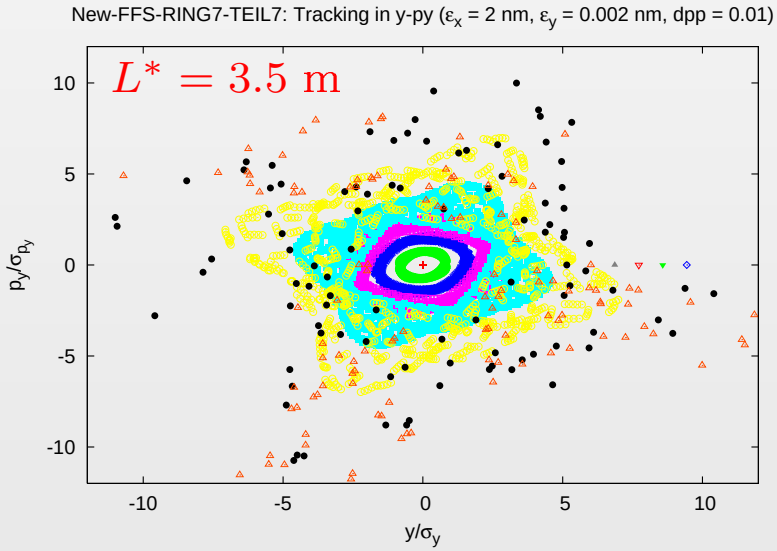


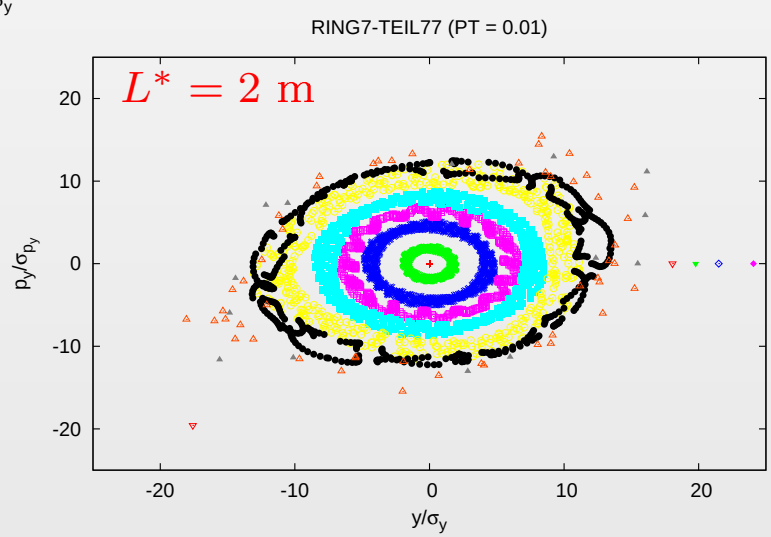


Vertical phase space. Off momentum $dp/p = 1\%$. tlep A

Without low-β







Conclusions and future prospects

- After L^* reduction from 3.5 to 2.0 m a gain in dynamic aperture has been observed but not a real gain in momentum acceptance.
- Momentum accpetance of $\sim \pm 1\%$.
- It seems that small momentum accpetance is not only determined by L^* and other sources. It needs to be understood.
- Reoptimization in detail of the Final Focus System is being considered.