SYNERGIA Simulations of the Space-Charge Compensation with Electron Lenses

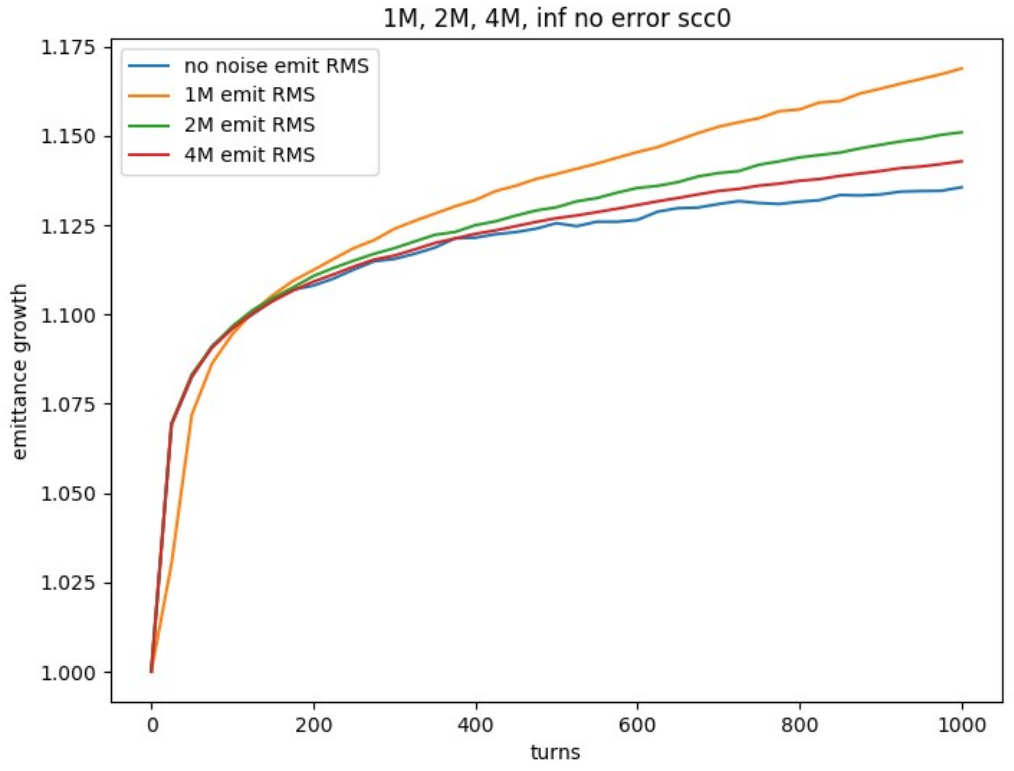
by Eric STERN

As of Oct 24, 2018

- presented to and discussed with Yu.Alexahin, A.Burov, V.Shiltsev

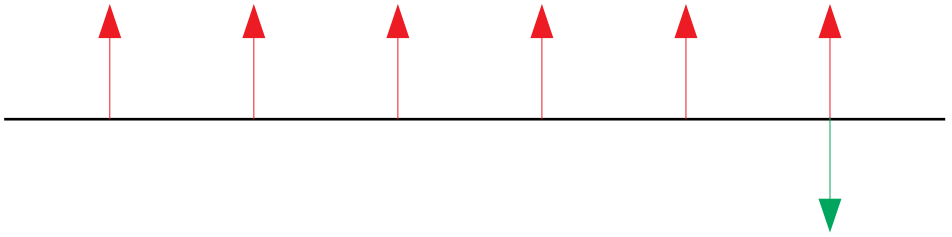
also, at the end - some analysis by all

Scale of noise in emittance growth



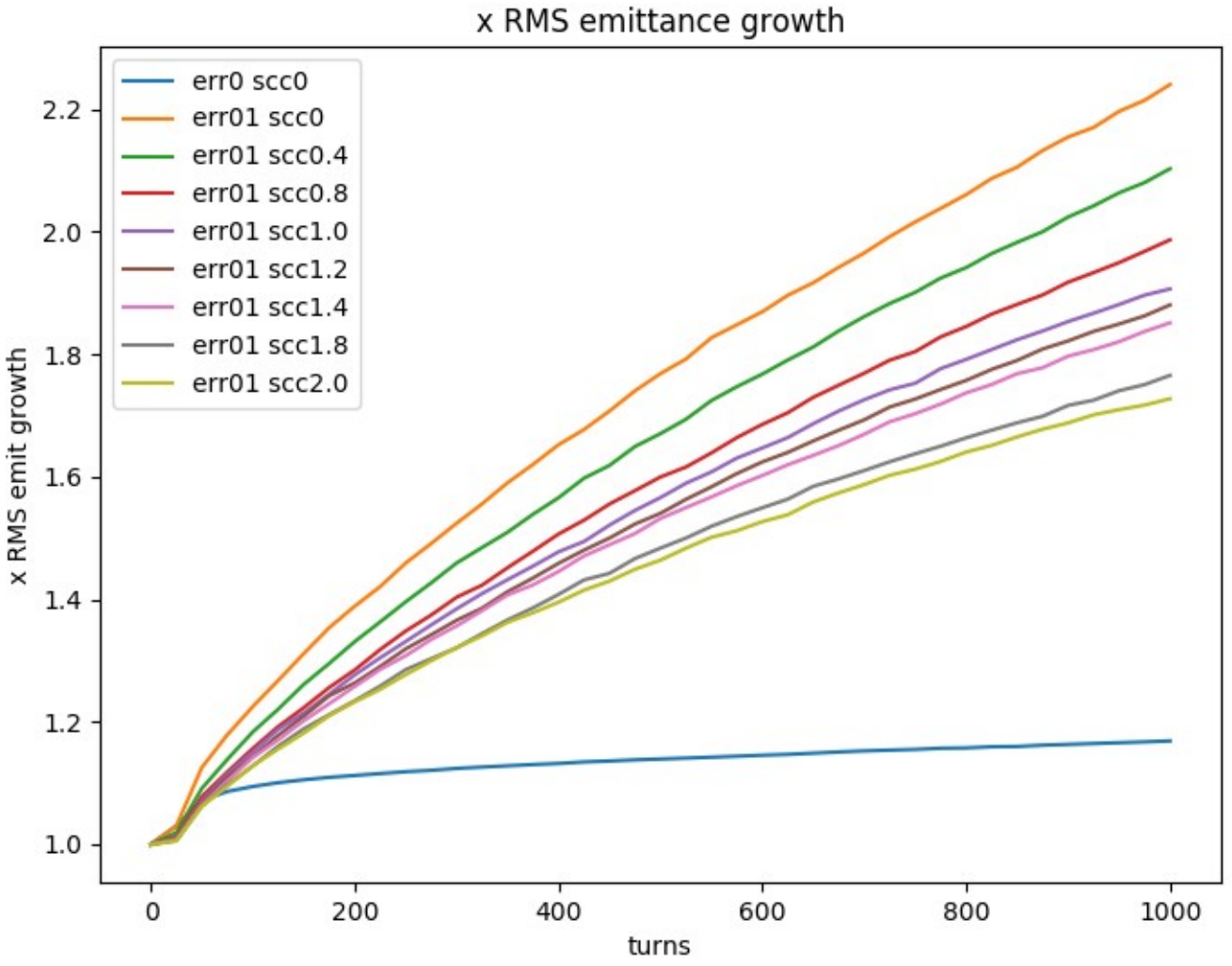
Following Jim's calculation of fitting emittance growth as quadratic function of (1/N) and extrapolating N→ infinity.

Activate Maxwell’s daemon SC compensation



Shown is SCC = 1

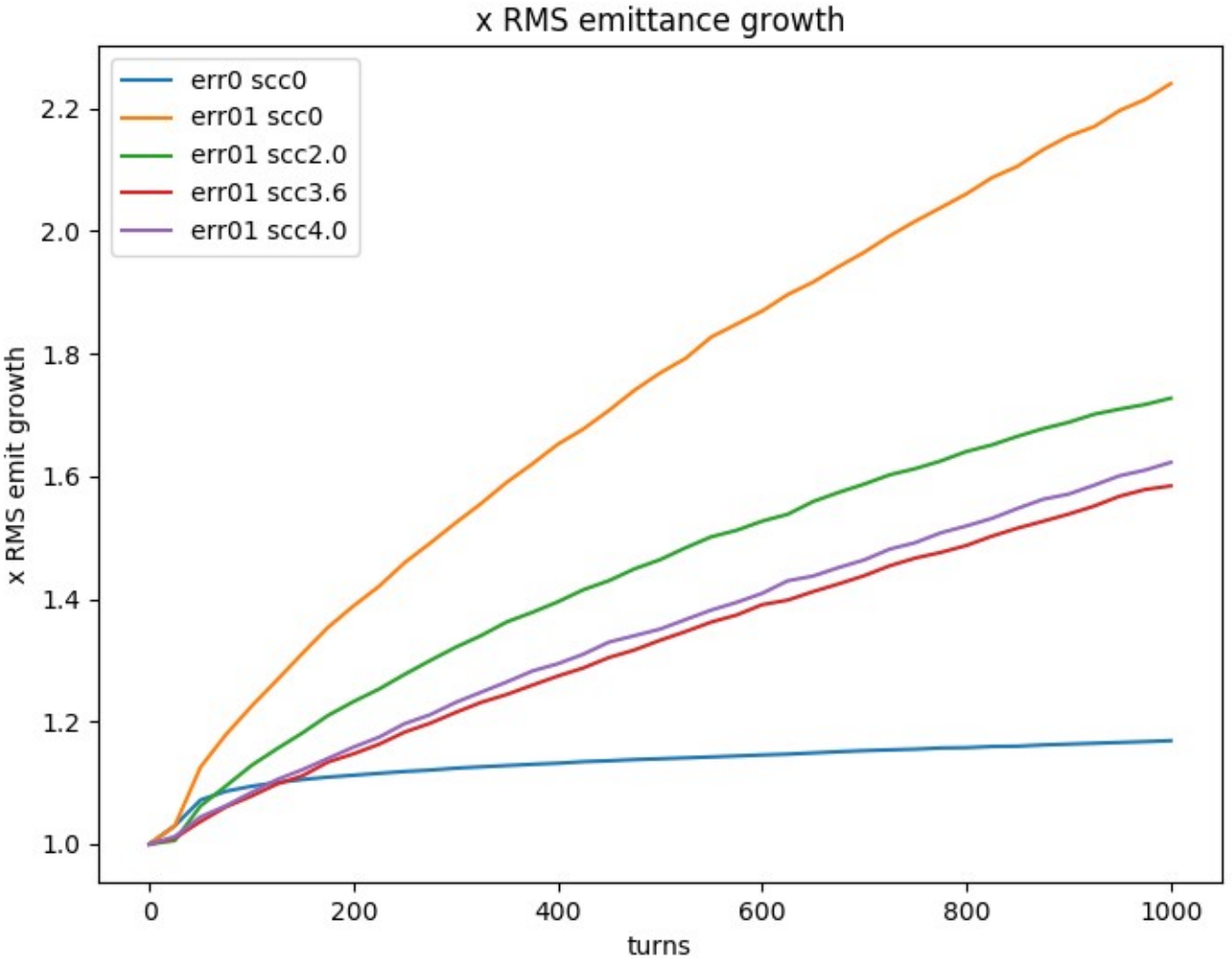
Compensation applied at 1/6 SC kicks



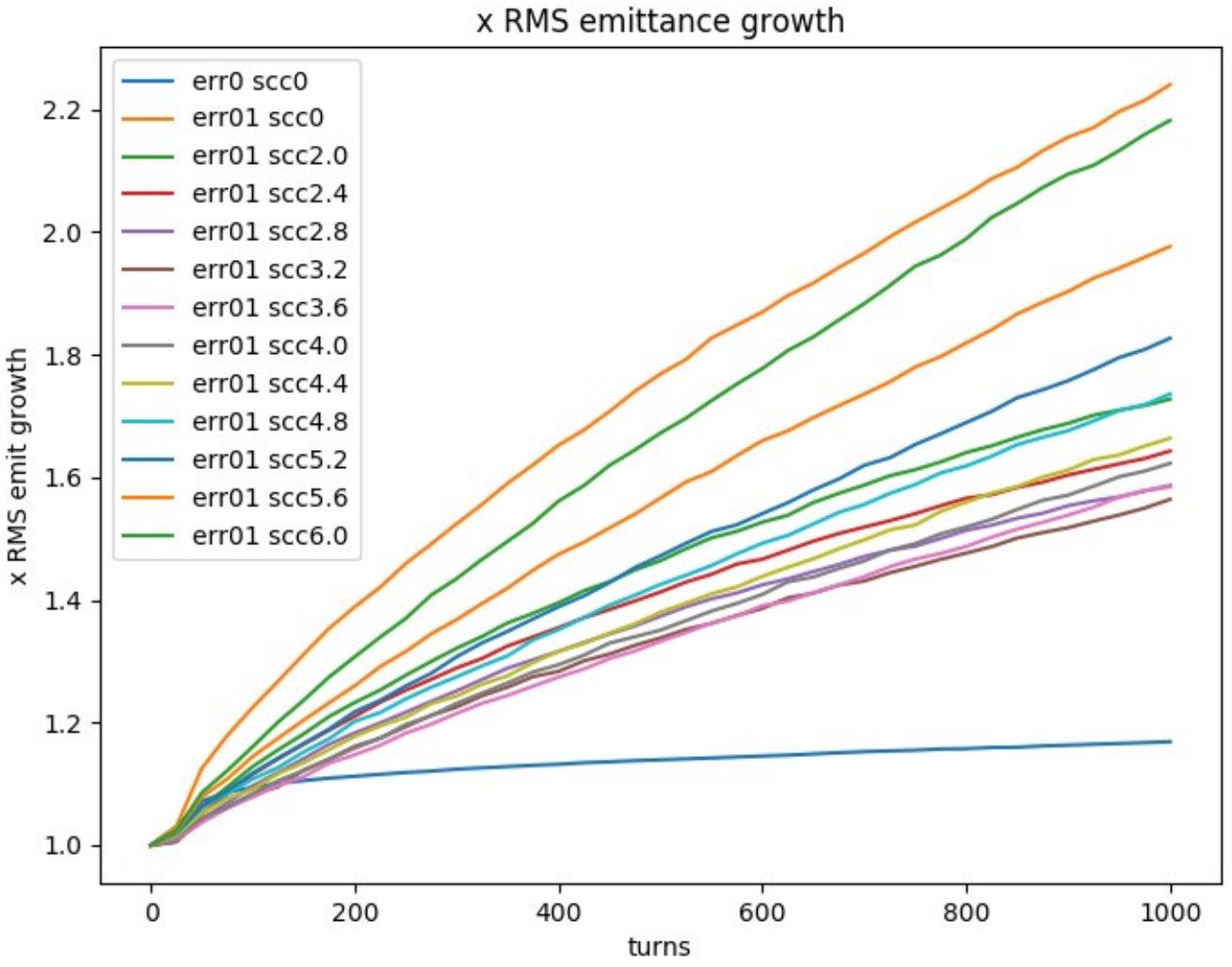
Not corrected for statistical noise

Unfortunately, ran with only 100K particles

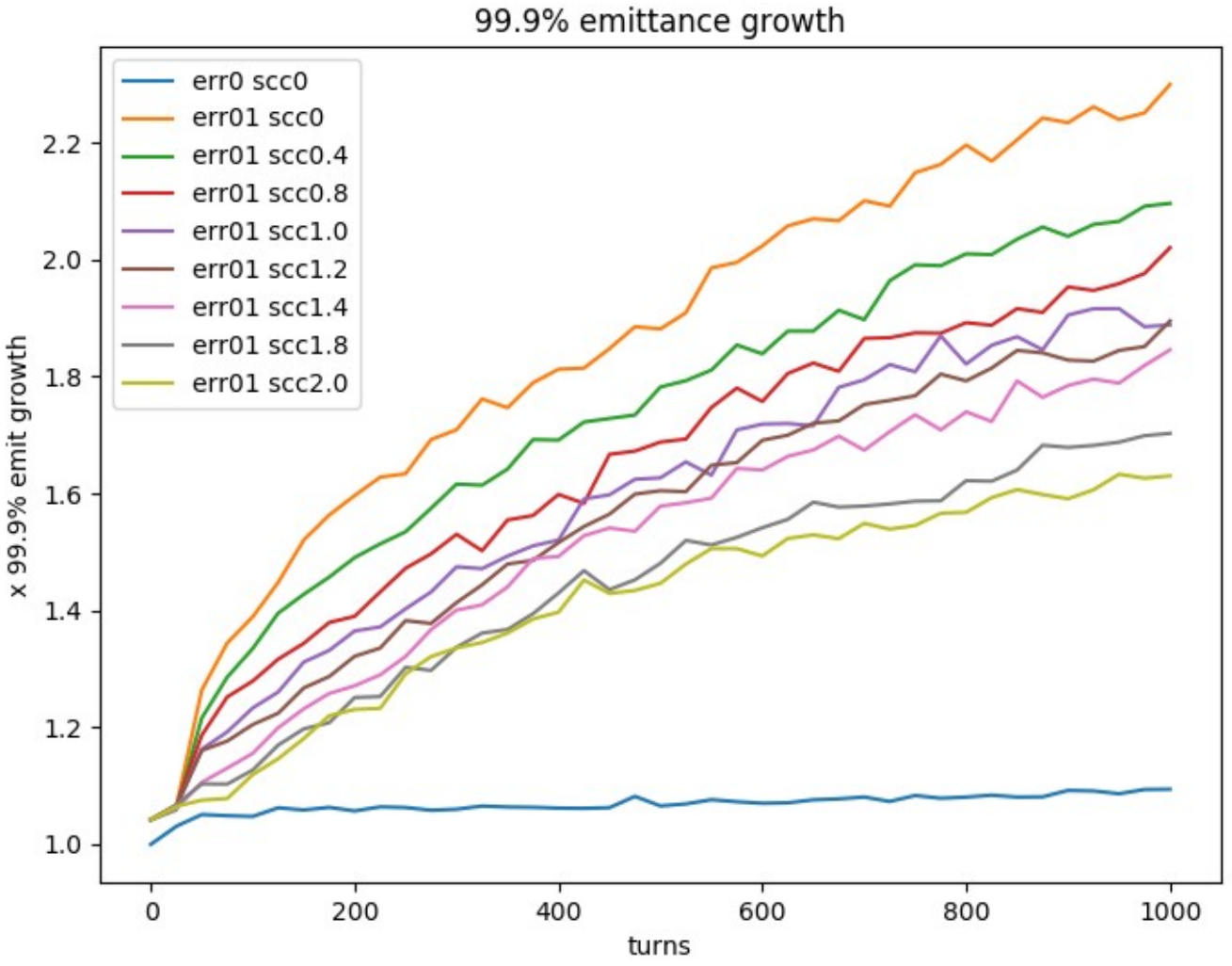
+1% error with compensation factor up to 2

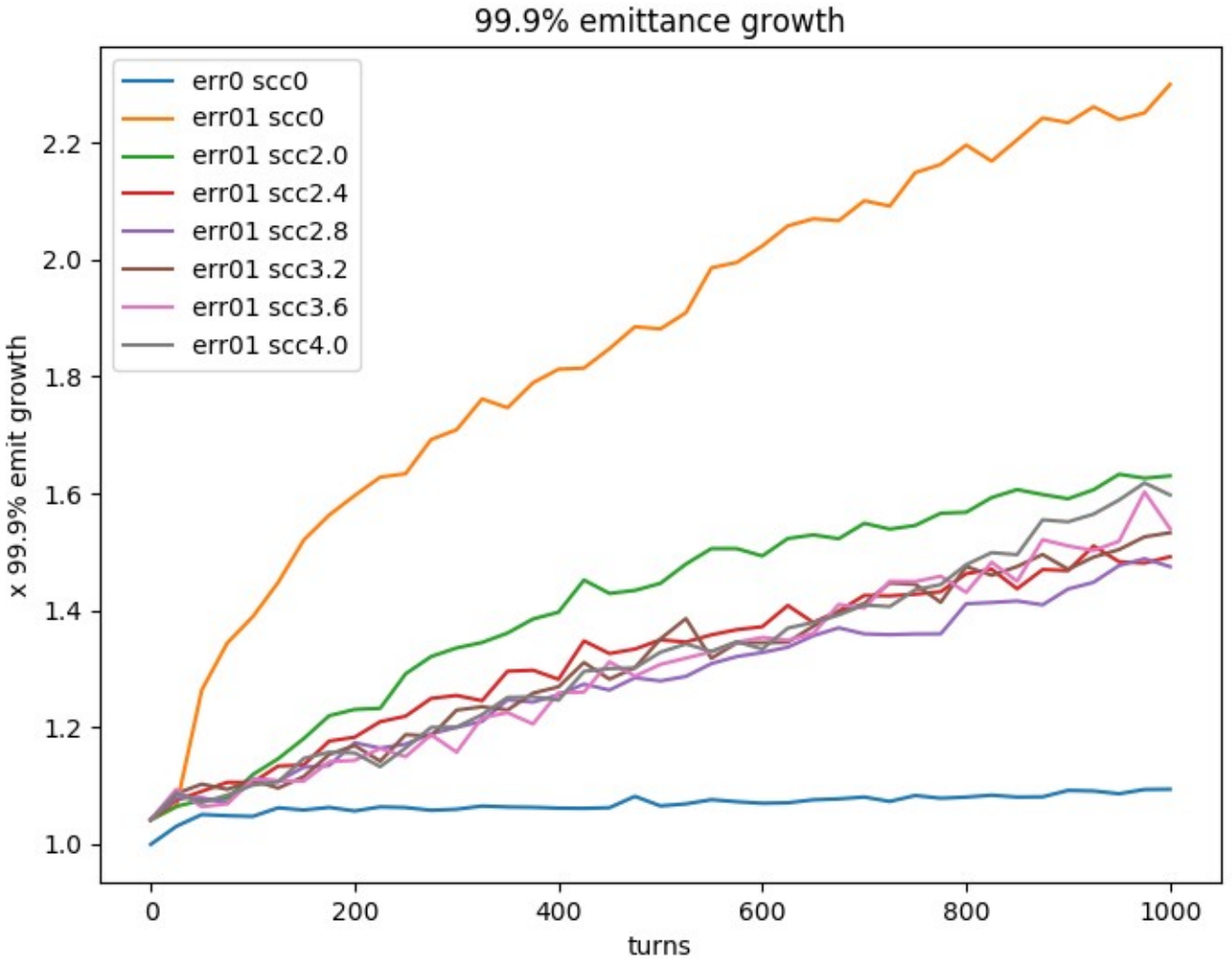


No improvement above compensation of 3.6

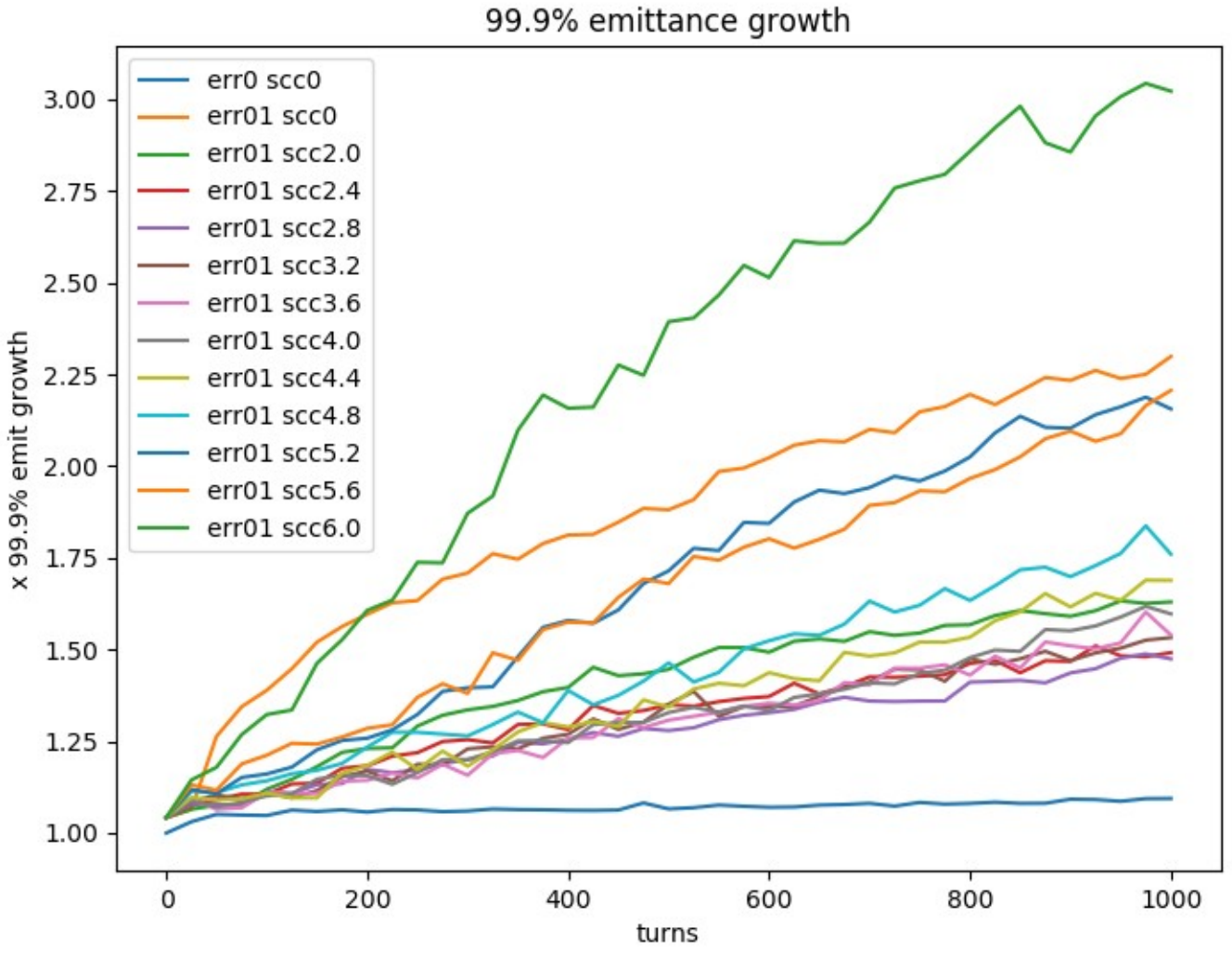


Really, it doesn't get better after 3.2 or 3.6

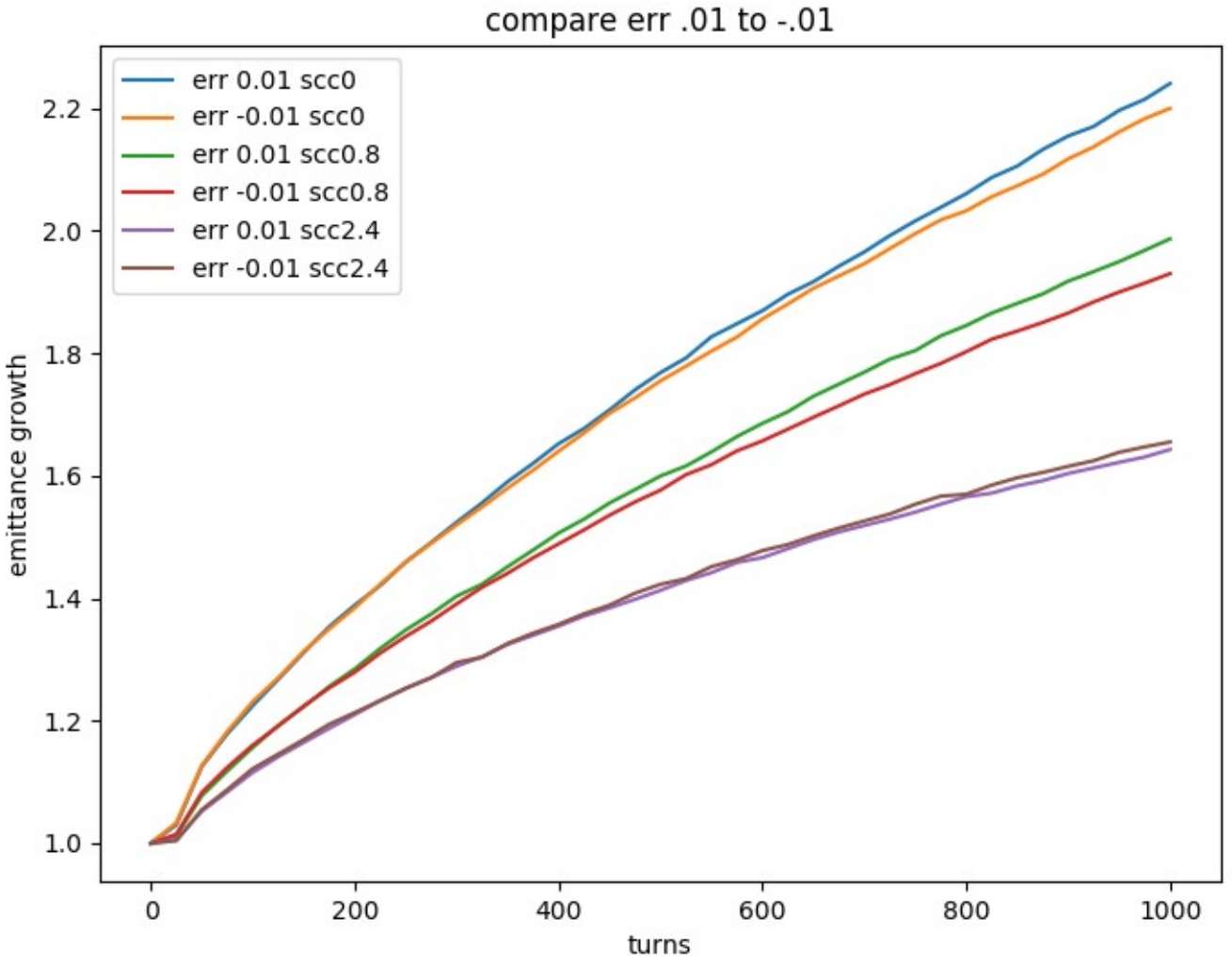

99.9% emittance growth
err0 scc0
err01 scc0
err01 scc0.4
err01 scc0.8
err01 scc1.0
err01 scc1.2
err01 scc1.4
err01 scc1.8
err01 scc2.0
x 99.9% emit growth
turns
1.0
1.2
1.4
1.6
1.8
2.0
2.2
0
200
400
600
800
1000



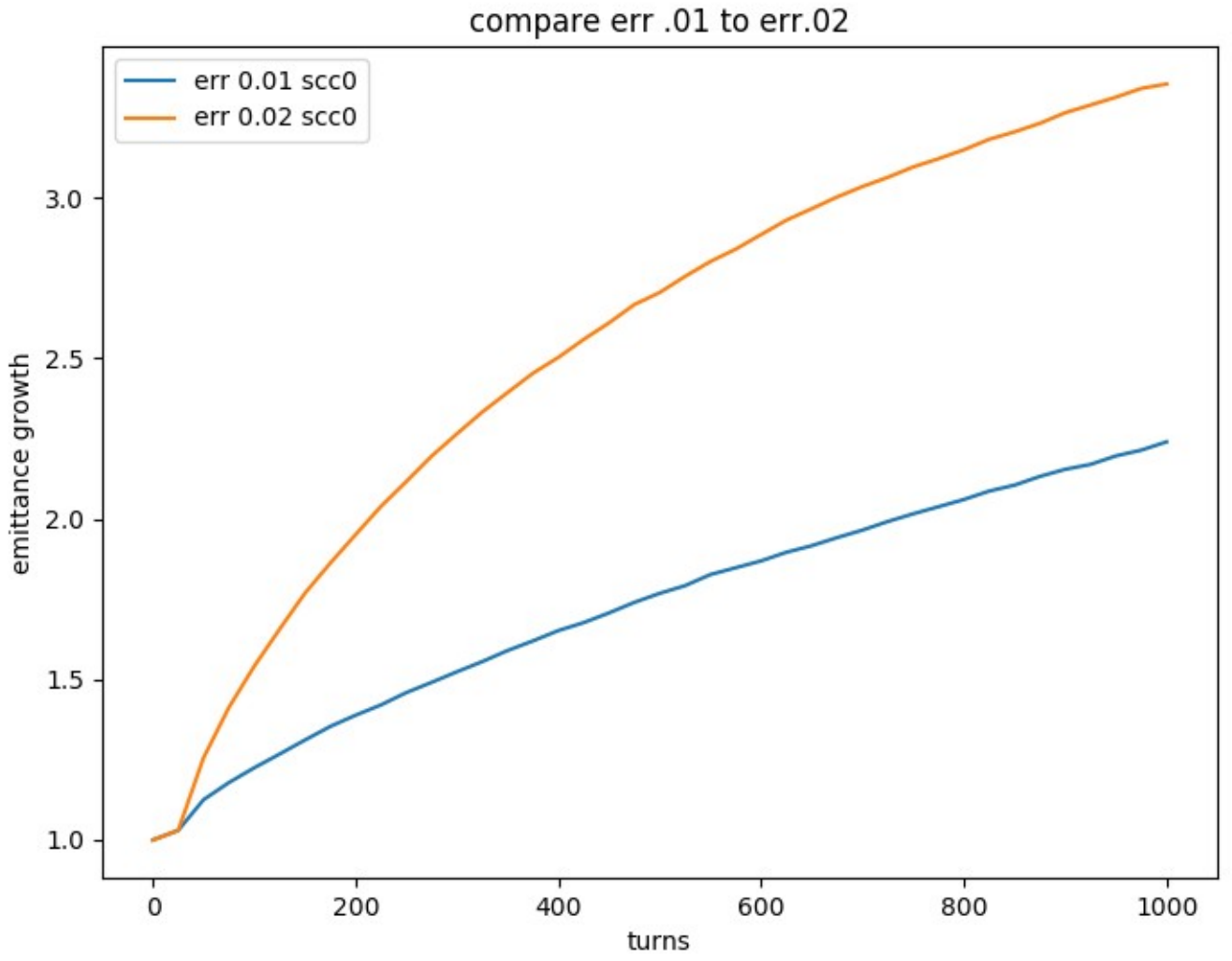
99.9% emittance shows improvement up to about 3.2

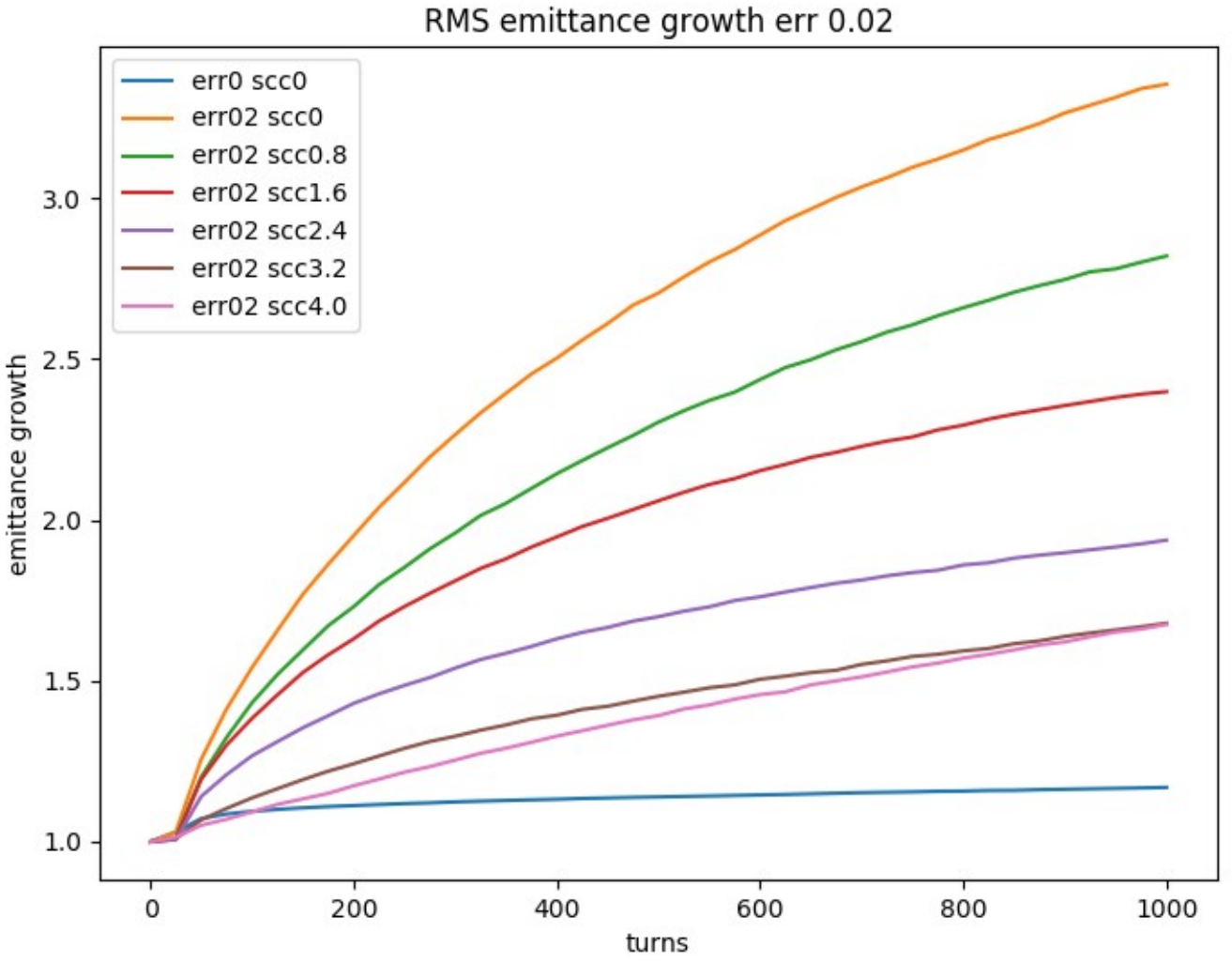


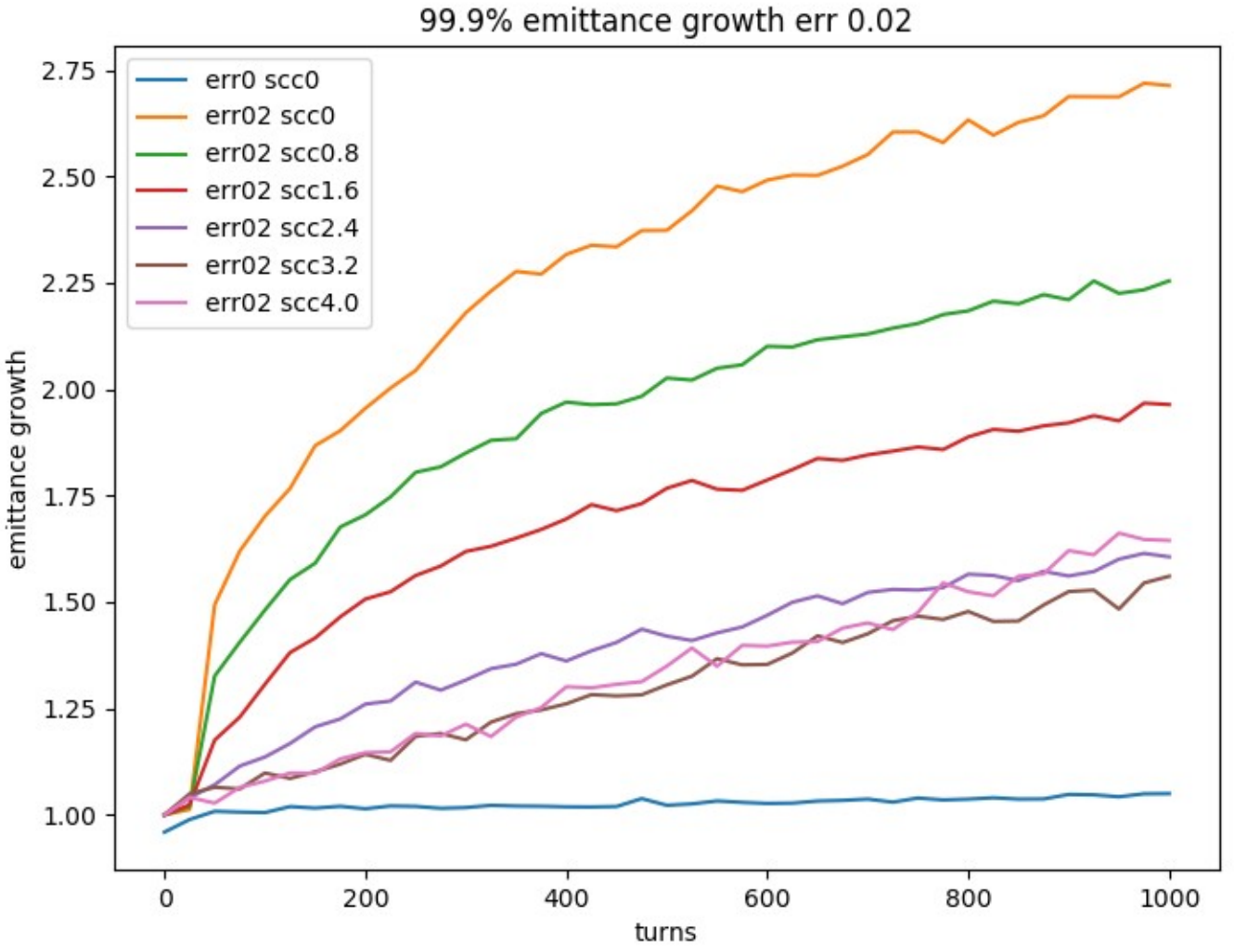
Really, you don't want to go above 2.8 or 3.2. Going to 6 is especially disastrous.



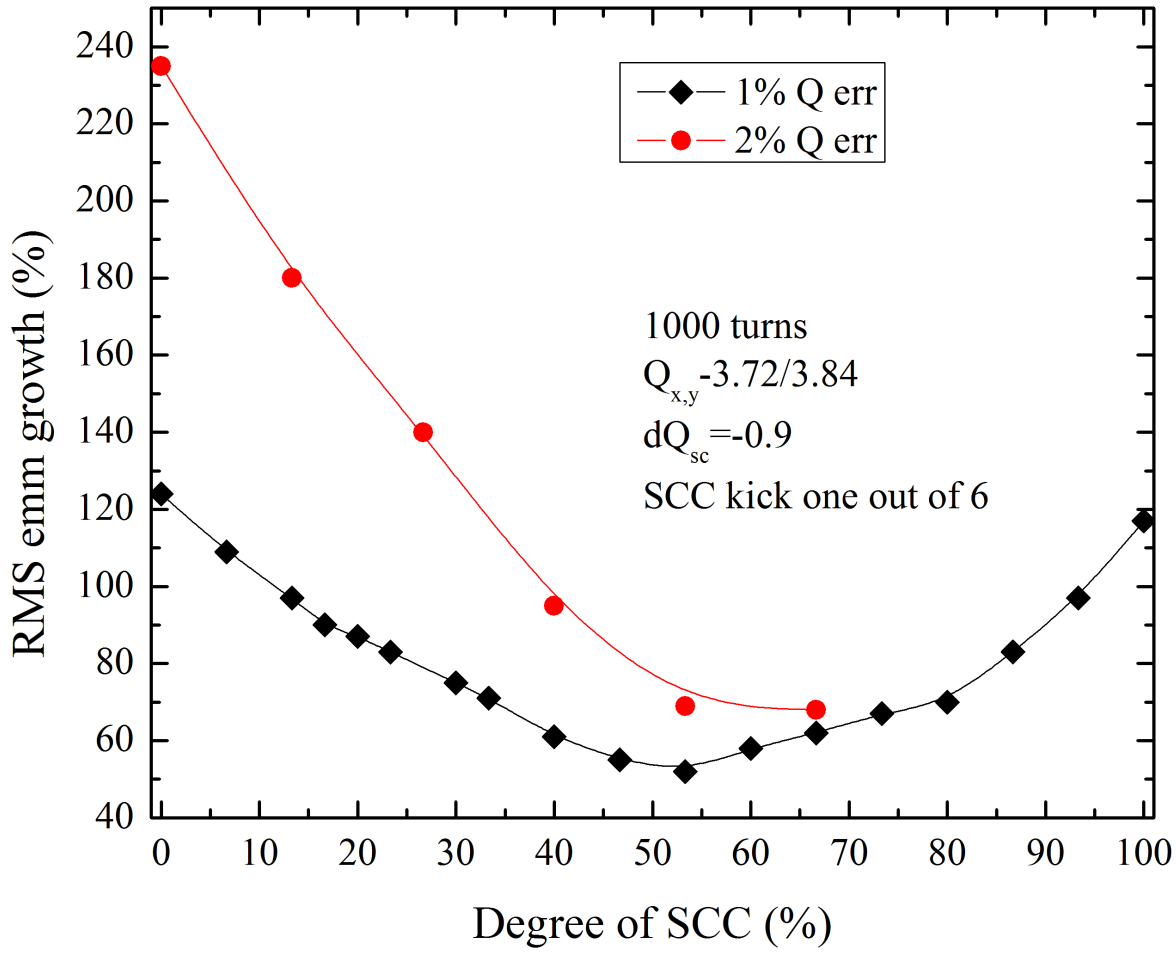
Error of +.01 and -.01 give roughly same emittance growths at sample compensation factors. Tune adjusted to be the same each time. (3.72, 3.84)


compare err .01 to err.02
err 0.01 scc0
err 0.02 scc0
emittance growth
turns
1.0
1.5
2.0
2.5
3.0
0
200
400
600
800
1000

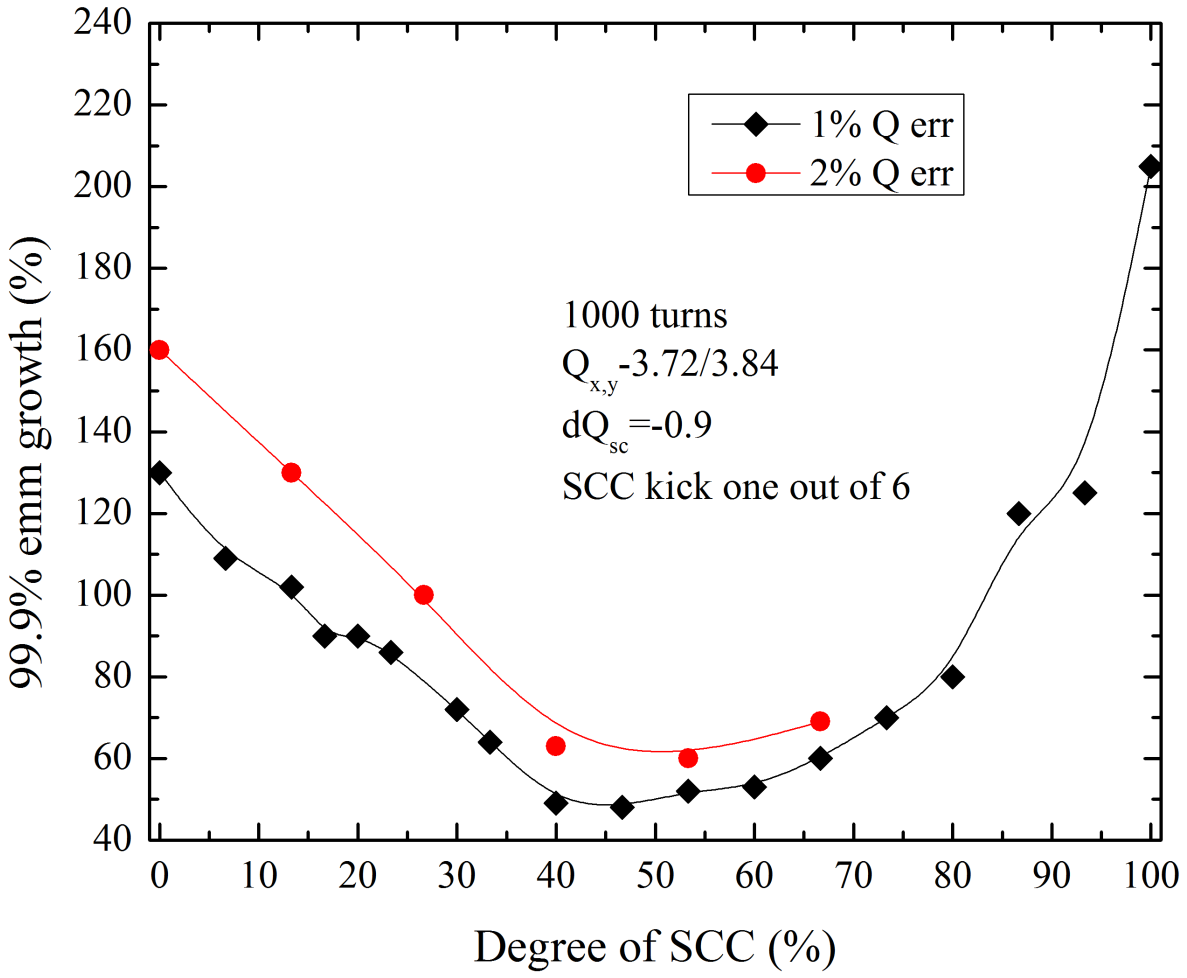

RMS emittance growth err 0.02
err0 scc0
err02 scc0
err02 scc0.8
err02 scc1.6
err02 scc2.4
err02 scc3.2
err02 scc4.0
emittance growth
1.0
1.5
2.0
2.5
3.0
0
200
400
600
800
1000
turns


99.9% emittance growth err 0.02
err0 scc0
err02 scc0
err02 scc0.8
err02 scc1.6
err02 scc2.4
err02 scc3.2
err02 scc4.0
emittance growth
turns
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0
200
400
600
800
1000

RMS emittance vs e-lens SCC: 1% and 2% quad errors



99.9% emittance vs e-lens SCC: 1% and 2% quad errors



Yuri’s calculation: beta-beat in Eric’s lattice with 1% Q-error