Simulation of Emittance Growth due to the AC Dipole

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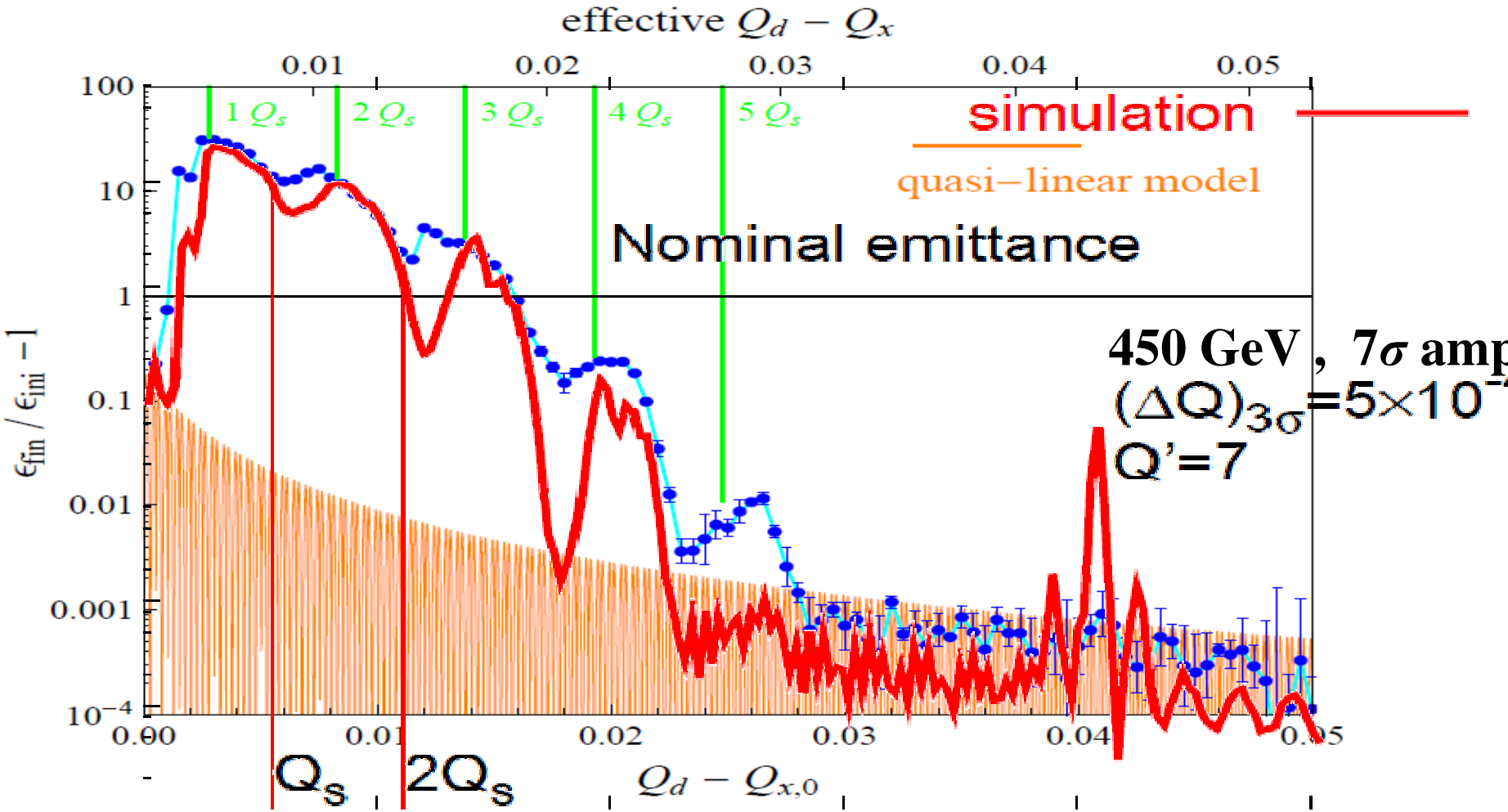
LHC AC Dipole Meeting

October 30th, 2009

- Outline -

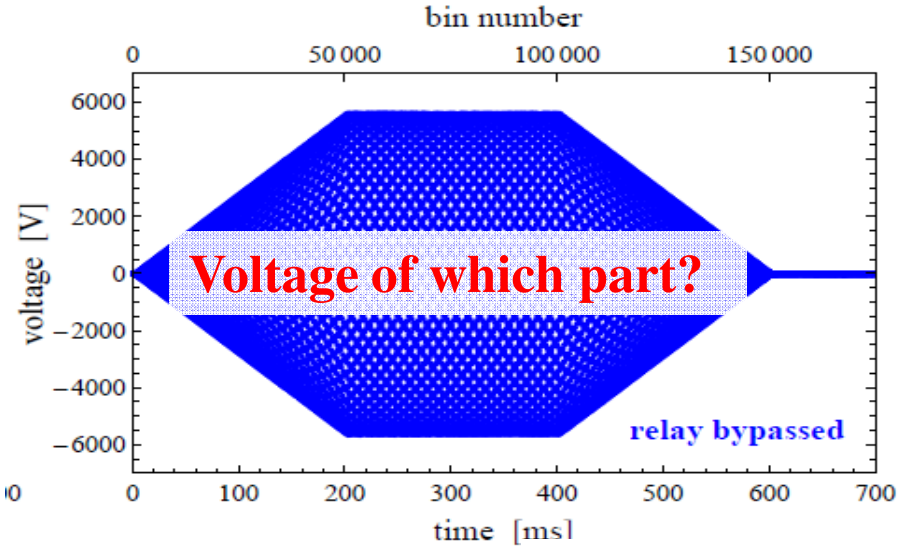
- Double check the previous results (EPAC08 & etc)
- (Measurement of LHC AC Dipole)
- Consider noise effect
- Advice Welcome for Simulation and Noise!

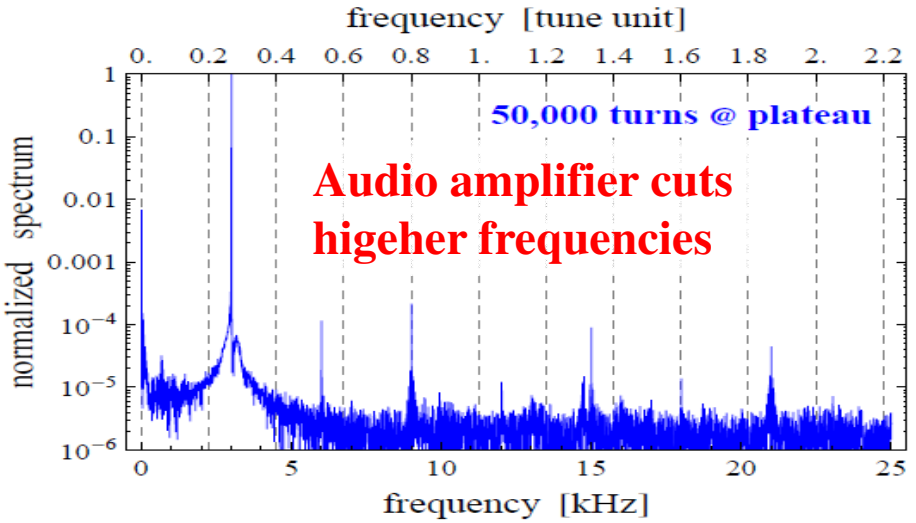
Emittance Growth Simulation for the AC Dipole



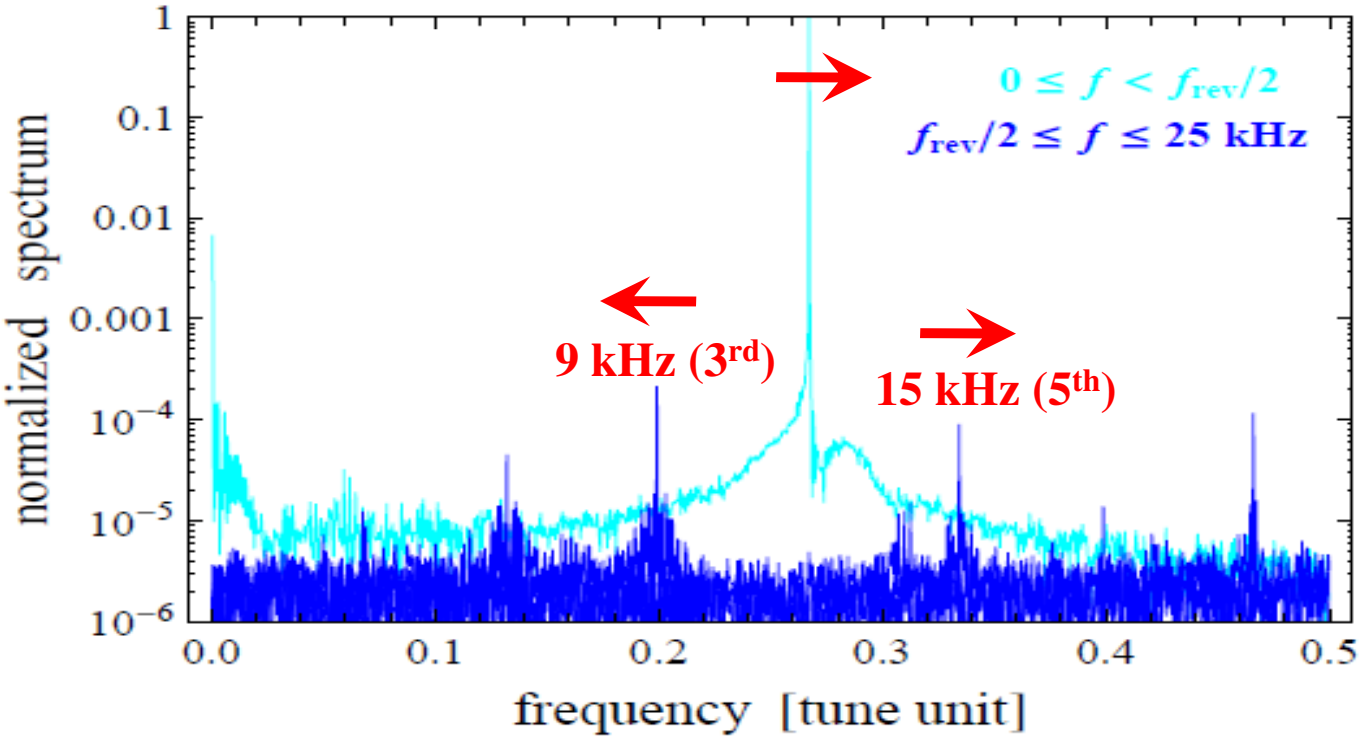
- 1D single turn map at the AC dipole's location
- Including linear chrom and detuning, implementing noise
- Must be the "right" side
- Side bands visible but may be shifted

Measurement of the LHC AC Dipole

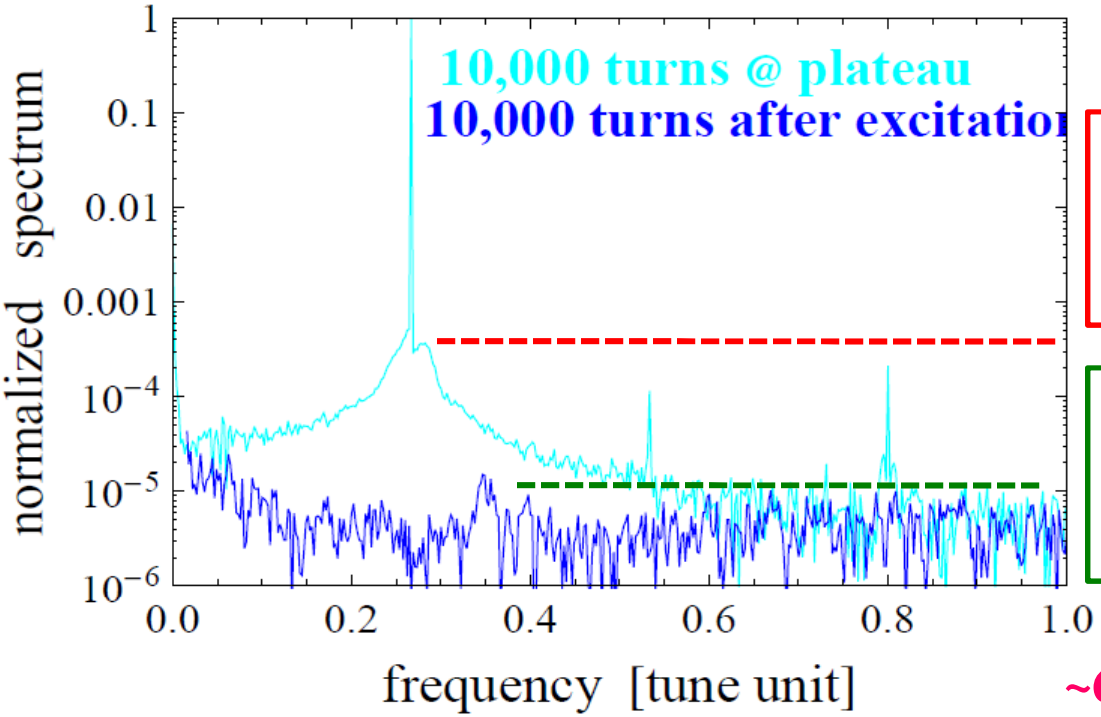




May wanna pay attention to the 15 kHz side band when lowering the main peak.



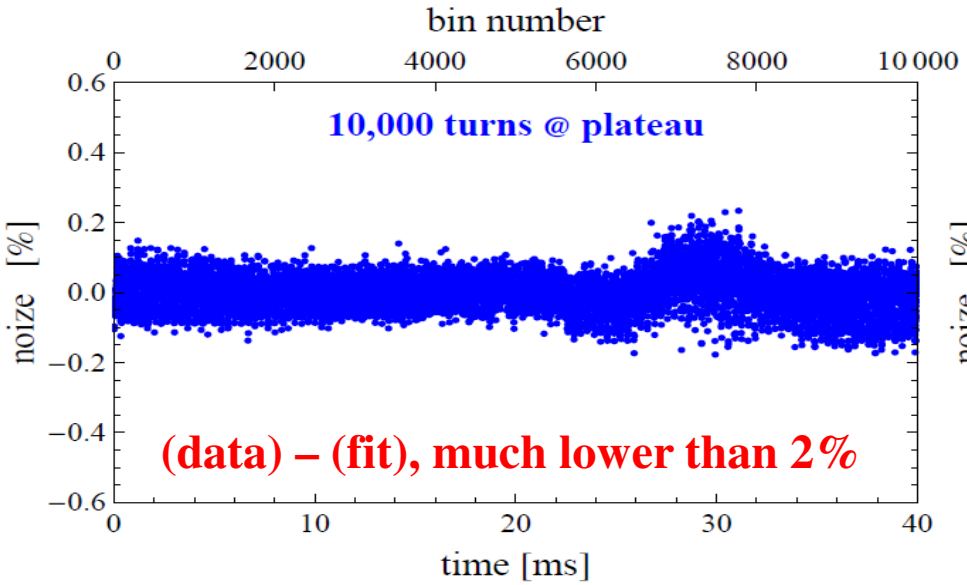
Noise of the LHC AC Dipole

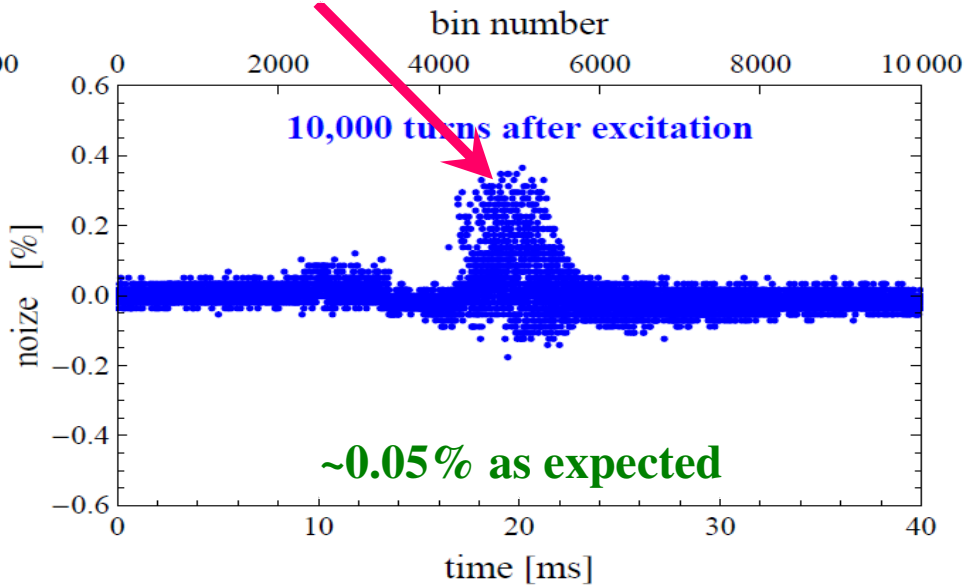


~4 10^{-4} for 10,000 data points
↔ σ_V / V_{max} ~ 2% white noise in time domain

~1 10^{-5} for 10,000 data points
↔ σ_V / V_{max} ~ 0.05% white noise in time domain

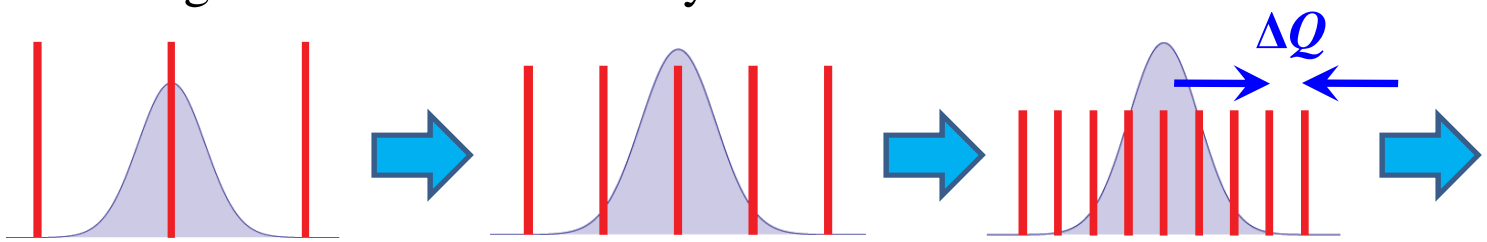
~60 ms period (~15 Hz?)



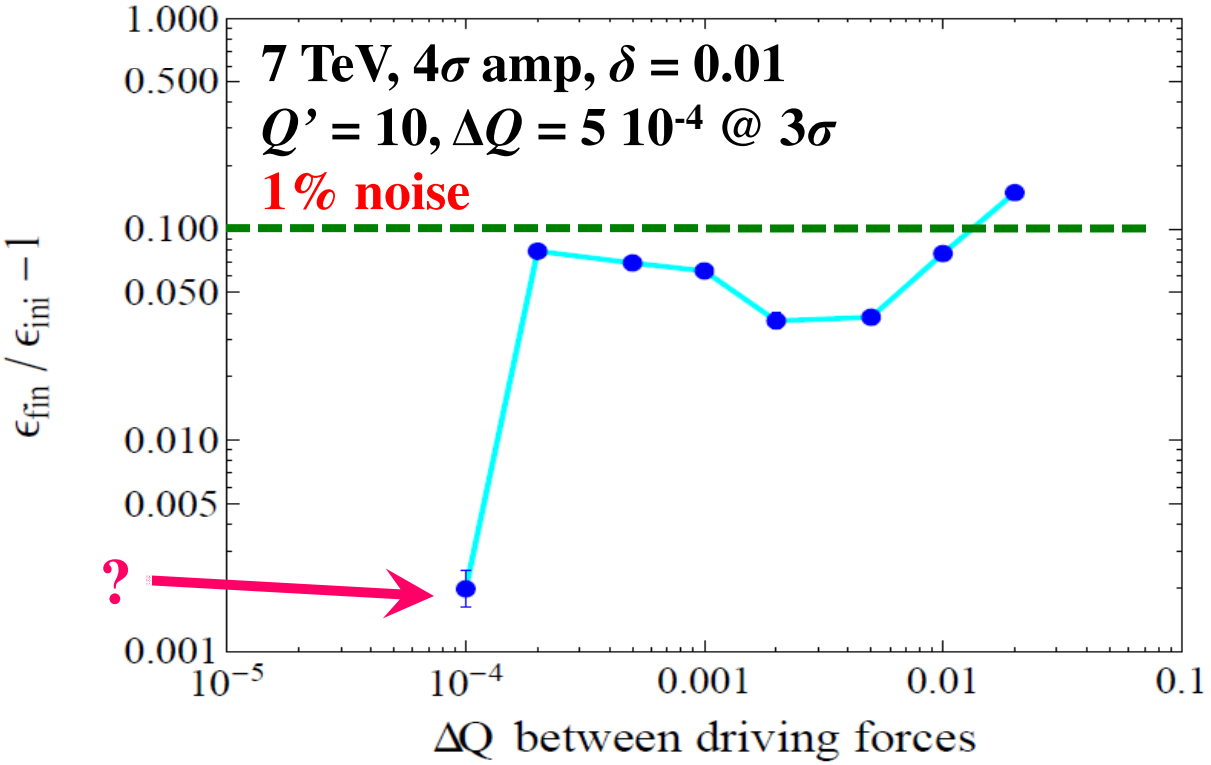


How to Simulate Noise?

- White noise in time domain is trivial (but noise is high near the main peak).
- Simulating as resonant forces may not be trivial…



Good enough? **Or, we must do this until converge?**

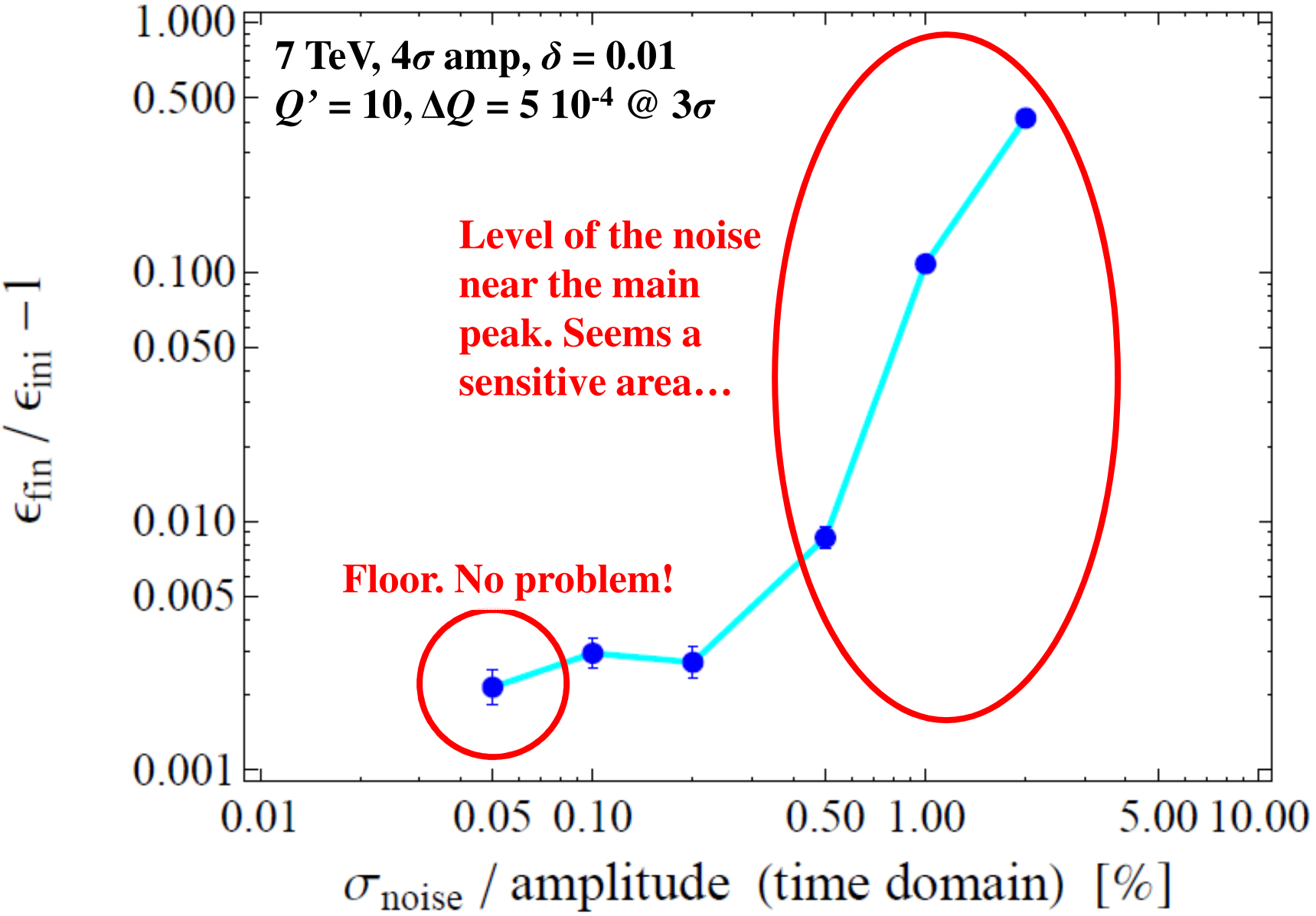


~10% predicted from the white noise model

For this specific case:

- **ΔQ = 0.01 ~ 0.001 seems to be good enough**
- **Not far the white noise model**

Noise vs. Emittance Growth (White Noise)

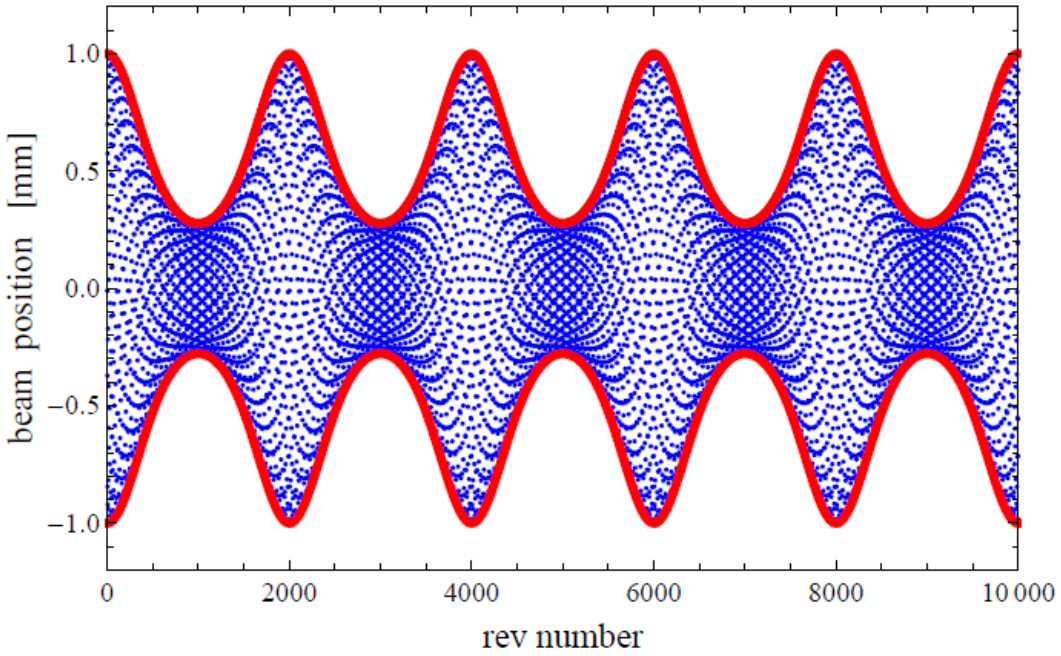


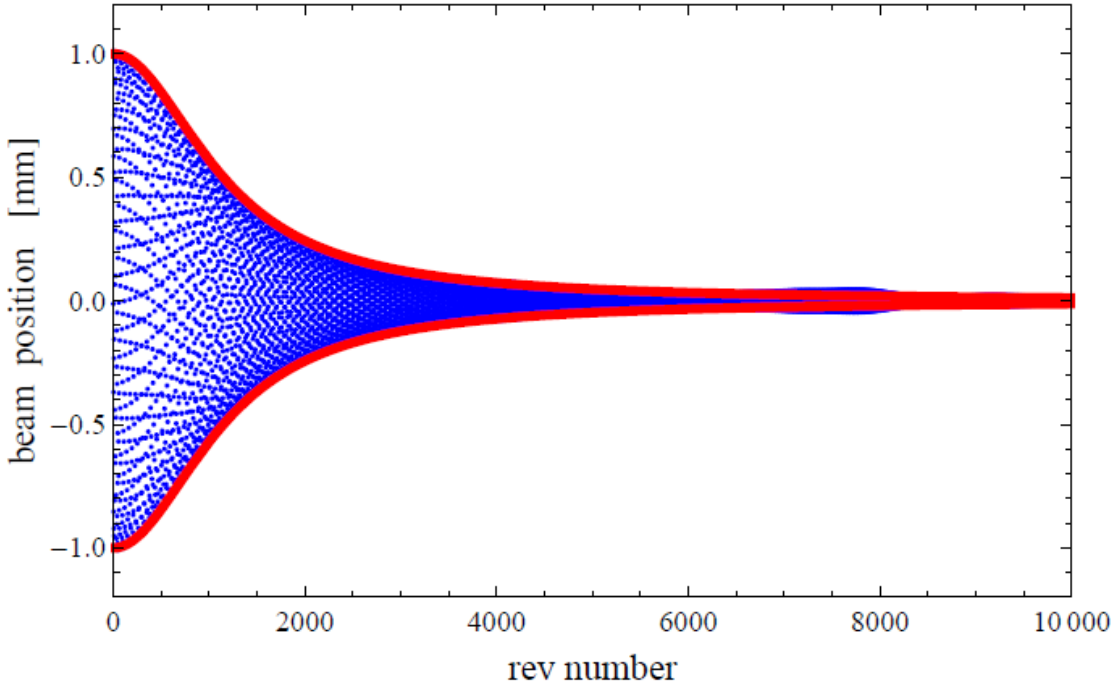
Conclusions

- A simple simulation to estimate the emittance growth due to the AC dipole, including noise, has been developed.
- As estimated before, noise floor is no problem but the noise level near the main peak could cause 10% level emittance growth in a standard condition.
- Two models of noise seems to be close (at least for the order estimation).
- More parameters scan.

Backup Slides

Check Chrom & Detuning in the Code





Data points compared to the decoherence formula (red).