Reduced Model Bunch Dynamics - Part I

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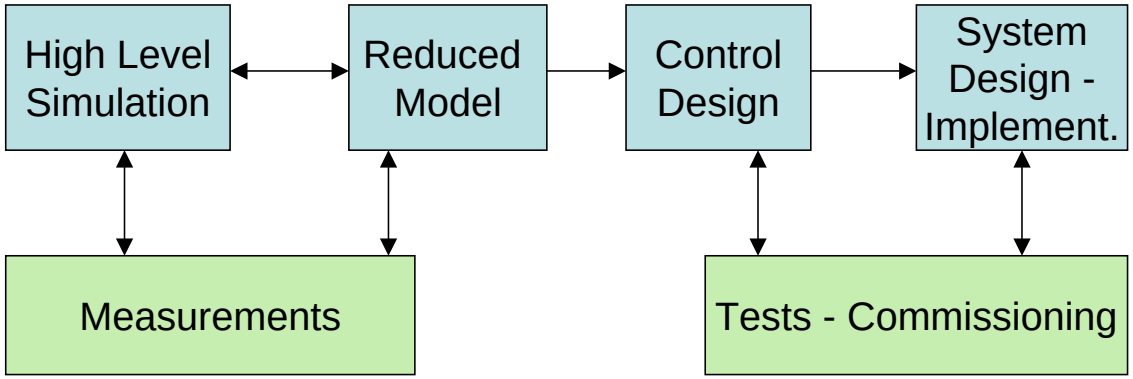
SLAC - LBNL

Introduction

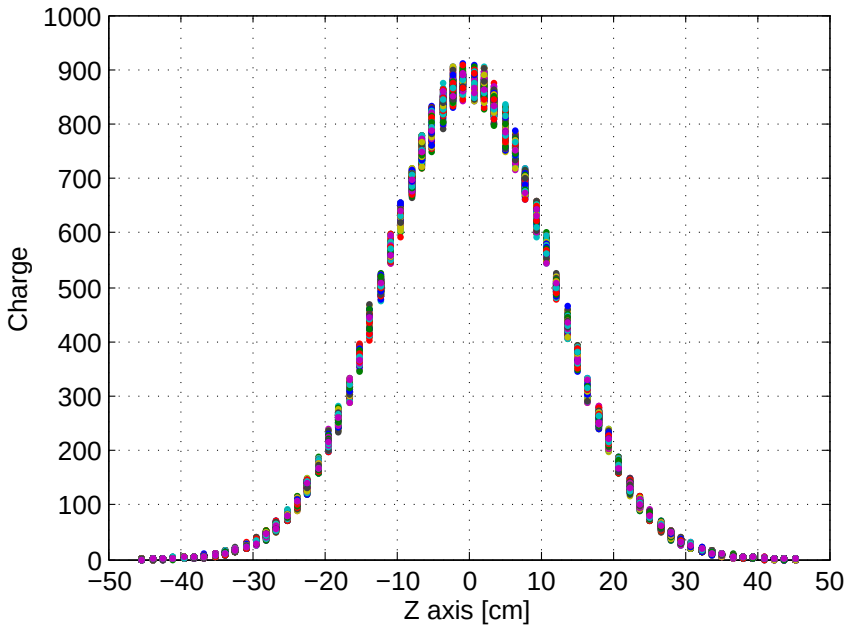
E-cloud mitigation using feedback

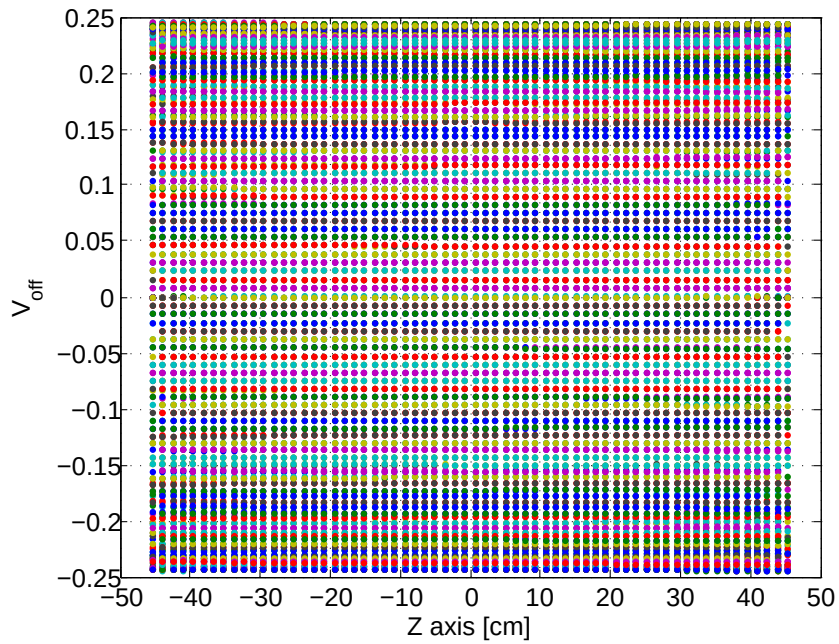


- The process to design a feedback system to mitigate e-cloud effects starts with simulations at the particle dynamics level, define appropriated reduced models and control strategies, ending with the implementation of the system.
- Beam measurements of the phenomena are important to validate the simulation and models. Test of partial hardware is important before final commissioning.

Intrinsic Bunch Dynamics - No e-clouds

Data extracted from simulation - Particle Dynamics

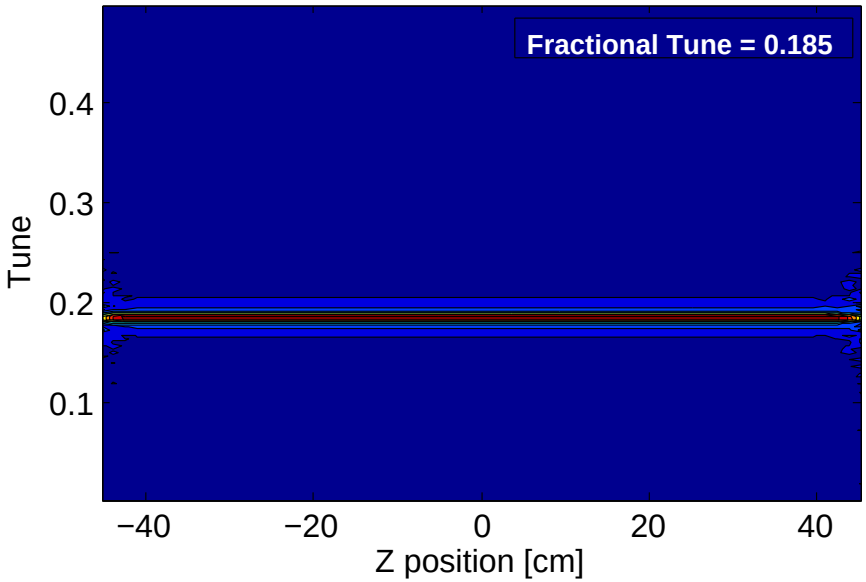


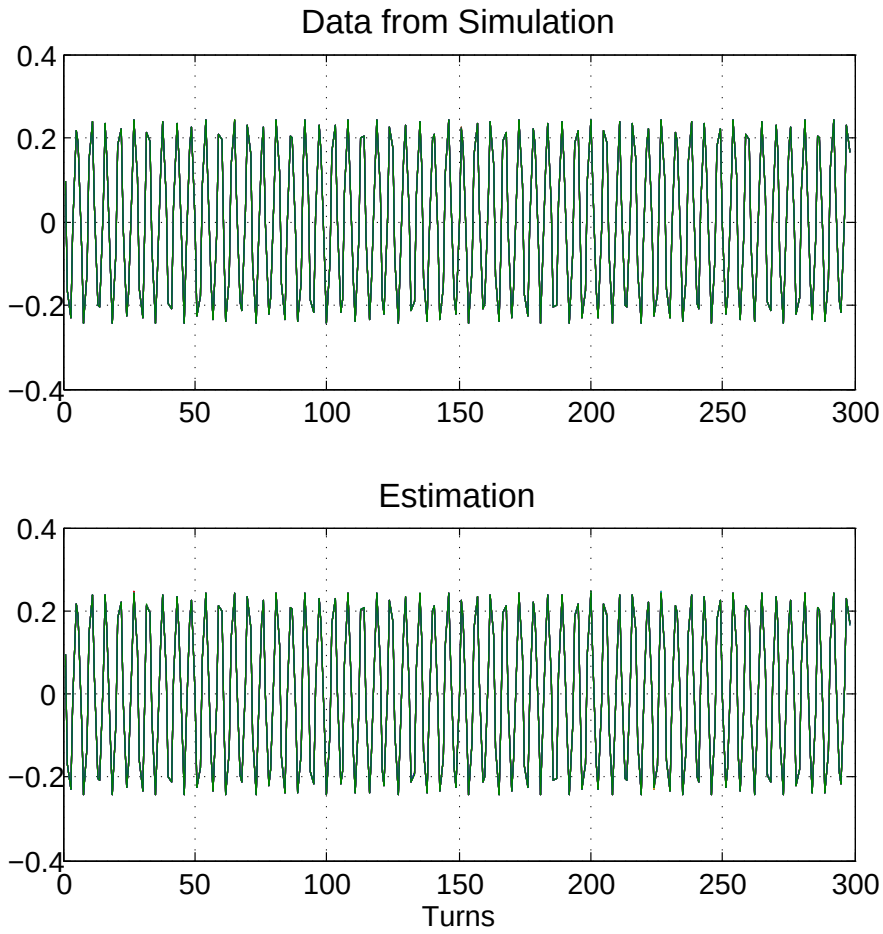


- The bunch is divided in 64 slides, the charge and vertical position of the centroid per slide is used to calculate the reduced model and define the control strategy.

Intrinsic Bunch Dynamics - No e-clouds

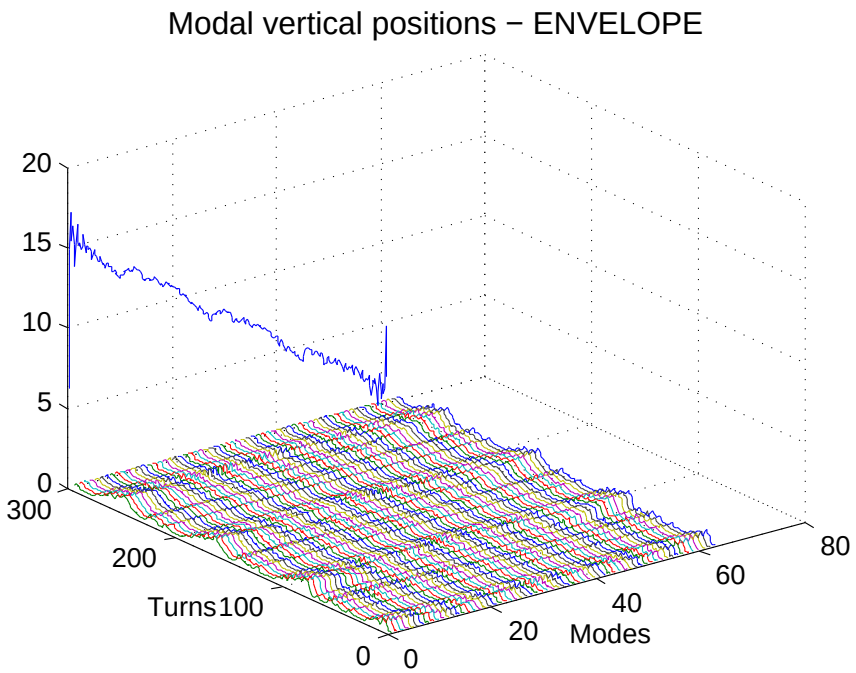
Tune - Reduced Model





Intrinsic Bunch Dynamics - No e-clouds

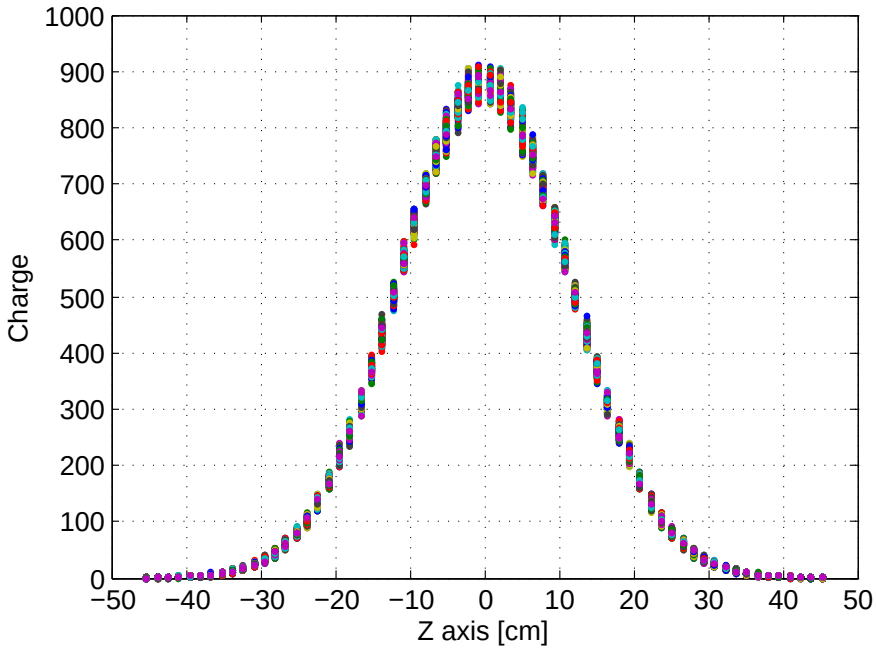
time domain, envelope modal evolution

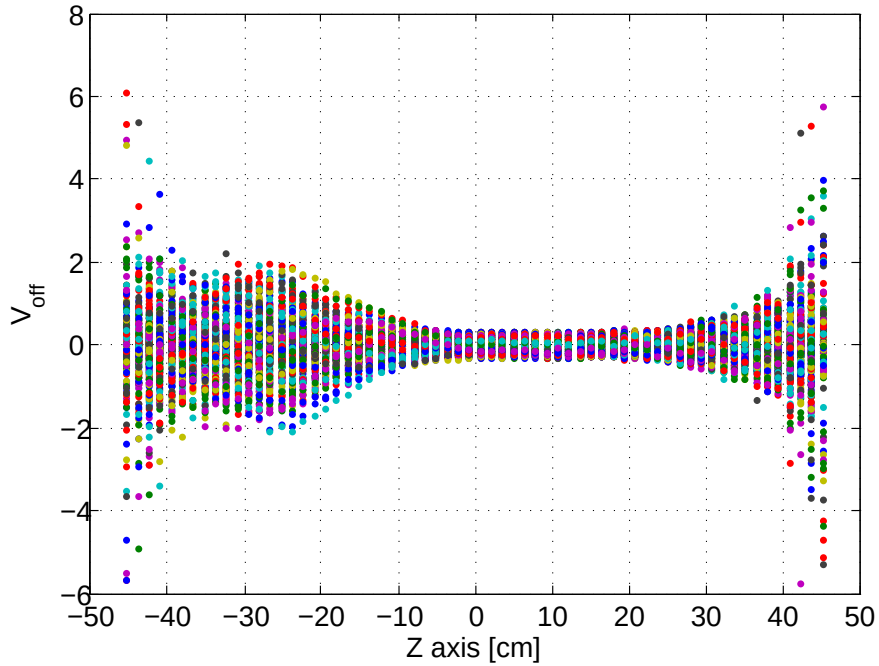


- The bunch is modeled by a single oscillator (Mode 0, centroid).
- This case is important to set the reference to understand the impact of the e-clouds on the intrinsic bunch dynamics.

Intrinsic Bunch Dynamics - E-Clouds

Data extracted from simulation - Particle Dynamics

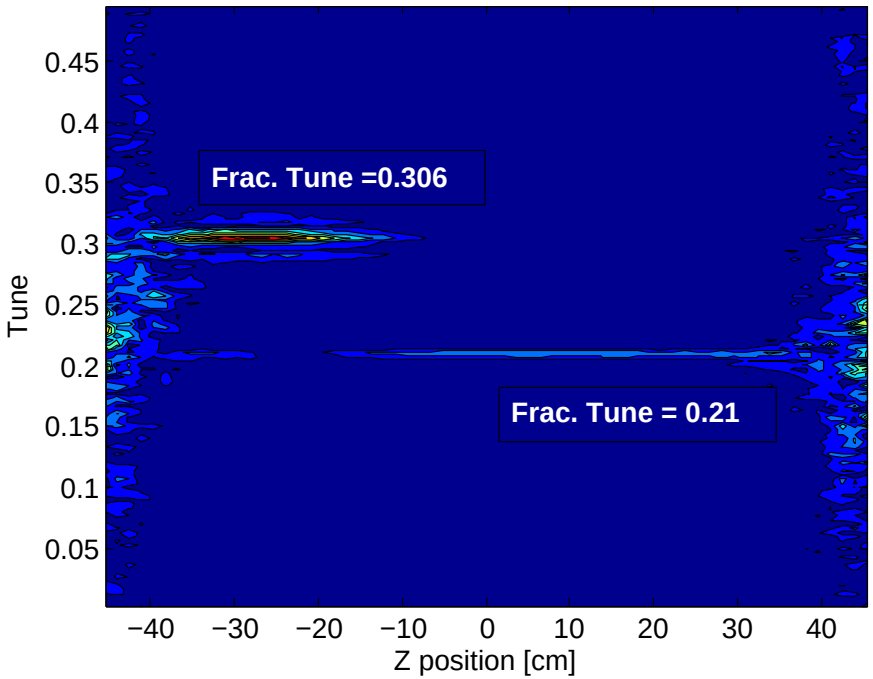


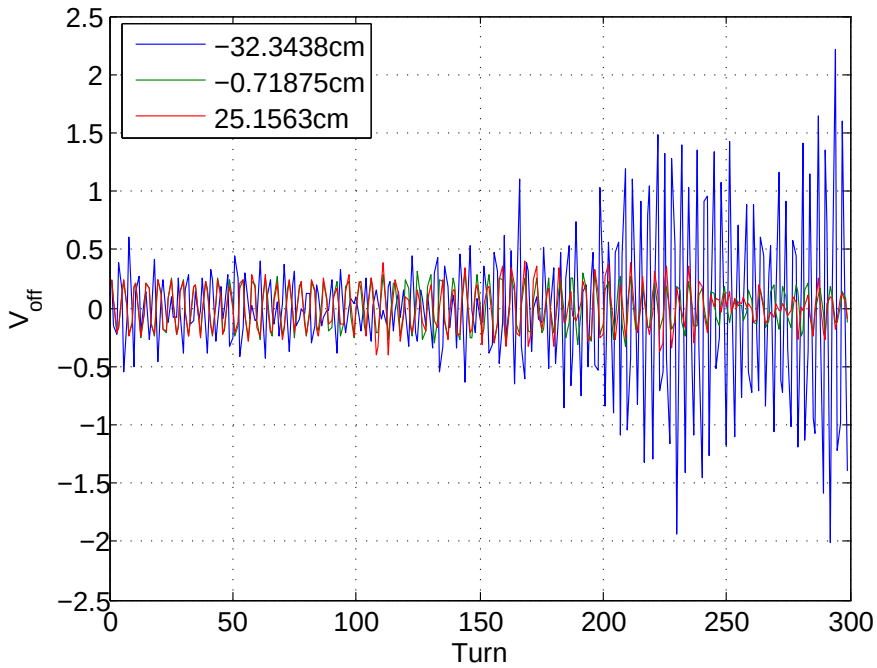


- There are vertical oscillations at the bunch front (Z positive) and bunch tail (Z negative).

Intrinsic Bunch Dynamics - E-Clouds

Tune - time domain, bunch evolutions

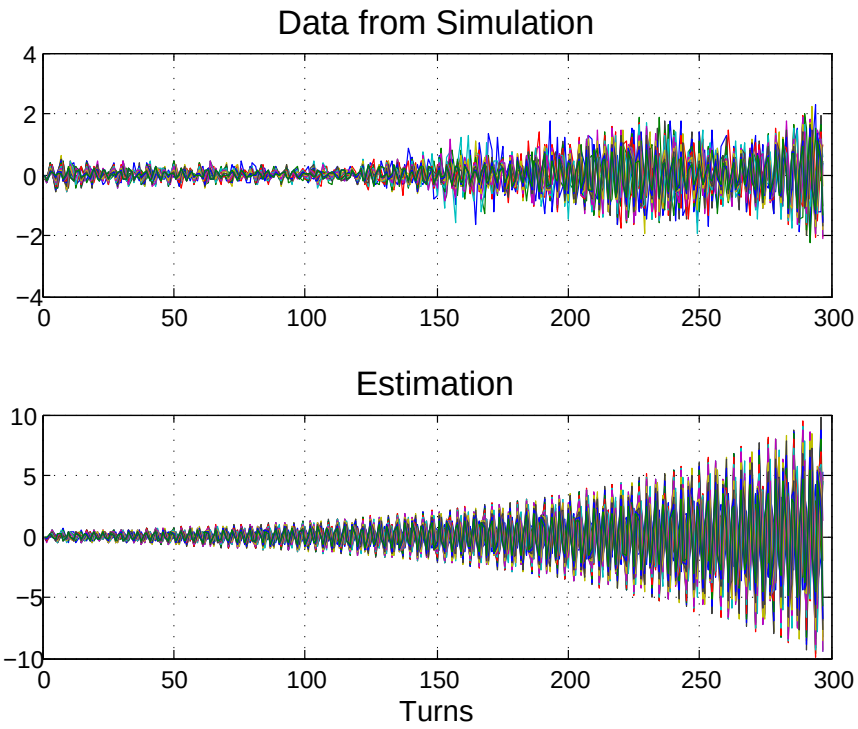




- The bunch tail exibits growing oscillations.

Intrinsic Bunch Dynamics - E-Clouds

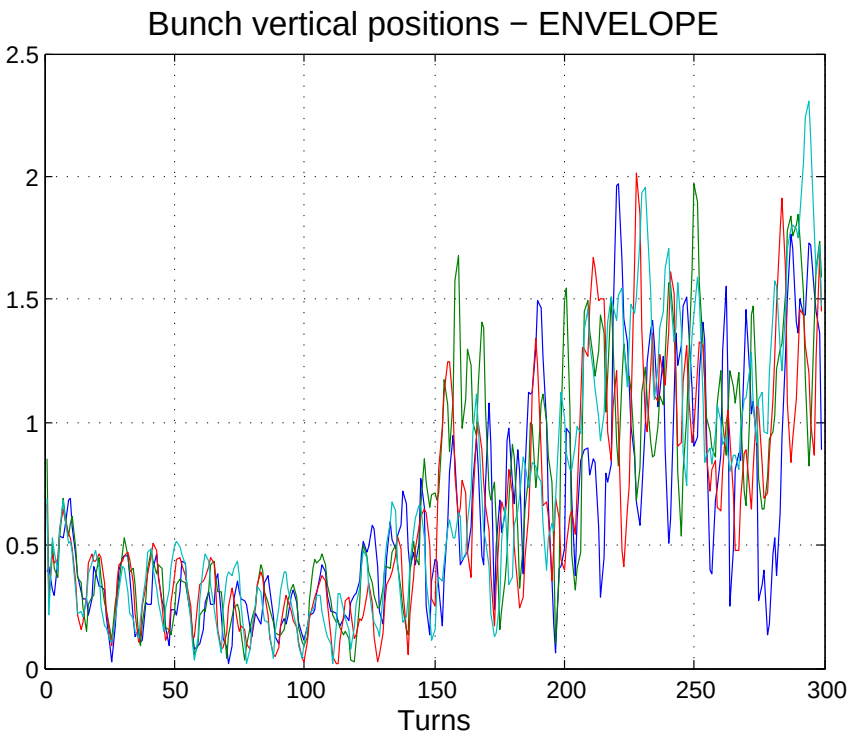
time domain - Bunch tail



- Data and estimation are not coincidents.
- The estimated model identifies only a single unstable mode at the correct frequency. We have not conclusions about the growth rates. Needs more work.

Intrinsic Bunch Dynamics - E-Clouds

time domain, 'slice' envelope evolution



- Observing the time evolution of several 'slices' on the bunch tail, there is not a defined growing rate.
- We need to define the appropriated coupling among 'slices' to define the modal growth rate.