Update on LHC e-cloud instability studies

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Outline

- Follow-up from the EC meeting (30.09.2016)
  - Popcorn instabilities update
  - Coherent tune shift at injection and flat-top

Pop-corn instabilities update

- To check the potential role played by the EC on the pop-corn instabilities mechanism
  - long simulation runs are carried out→ more than 10k turns to have more realistic simulations
  - the impact of the beam intensity on the instability threshold has been investigated and the results compared with the estimation from the buildup simulations

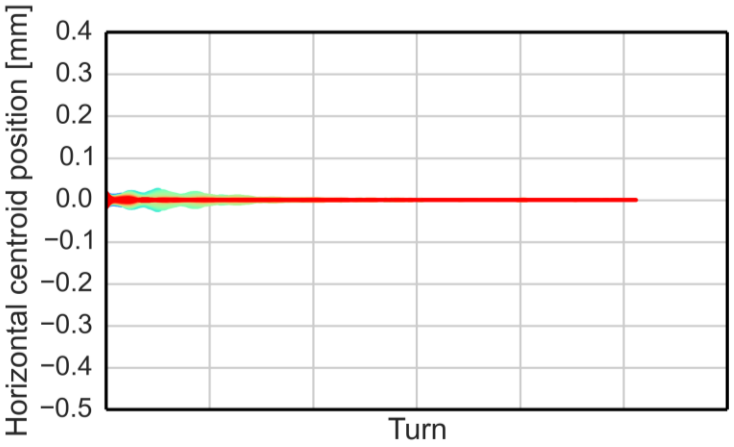
Simulations setup:

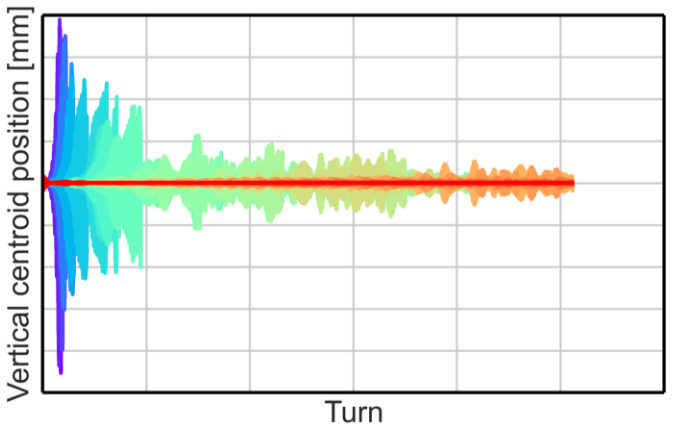
- Beam intensity 1.0e11 and 0.7e11 ppb
- 1ns bunch length
- 3um transverse emittance
- Ecloud in dipoles (uniform density scan)
- Ecloud in quadruopoles (simulation from buildup → SEY 1.30)
- Octupoles set to -2.5
- Chromaticity 15/15
- Transverse damper (100 turns damping time)
- 10000 turns simulated

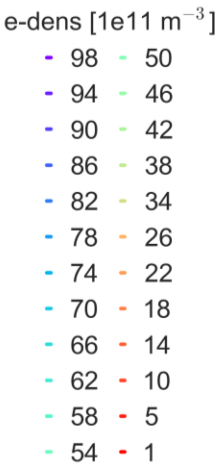
Pop-corn instabilities update

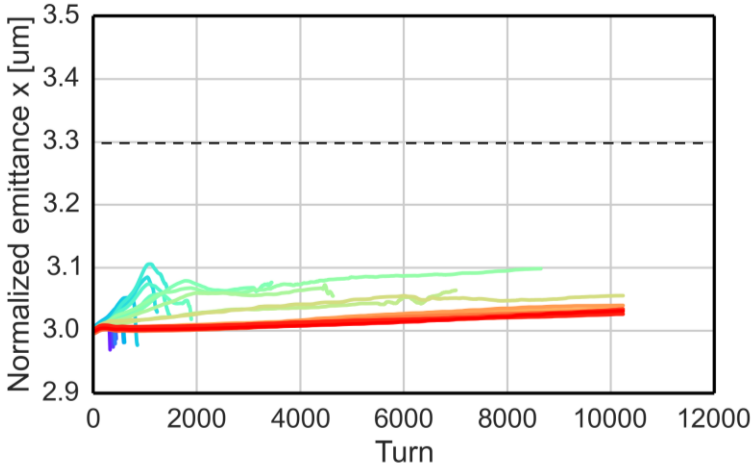
EC dipoles	EC quadruoles	Chromaticity	Oct	Damper	Turns
Density scan	SEY 1.30	20/20	-2.5	100 turns	10k

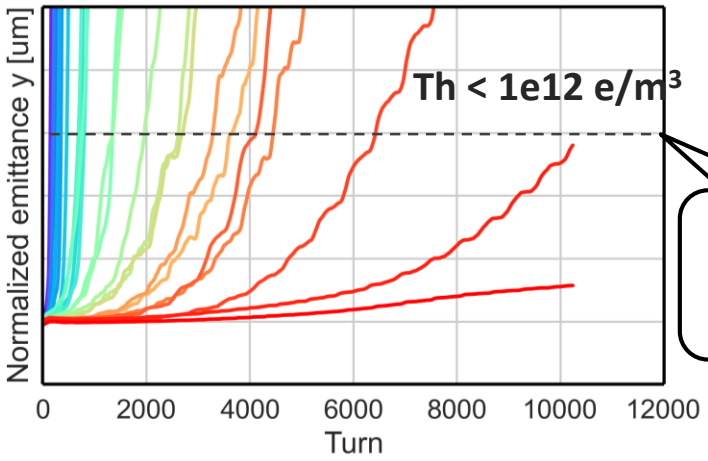
Beam intensity 1e11 ppb









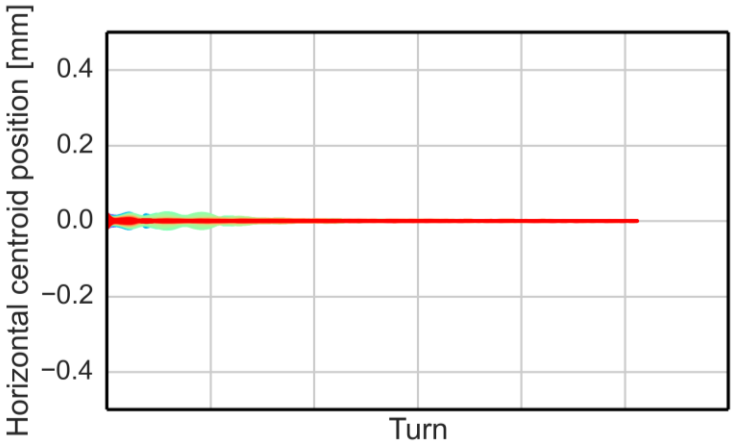


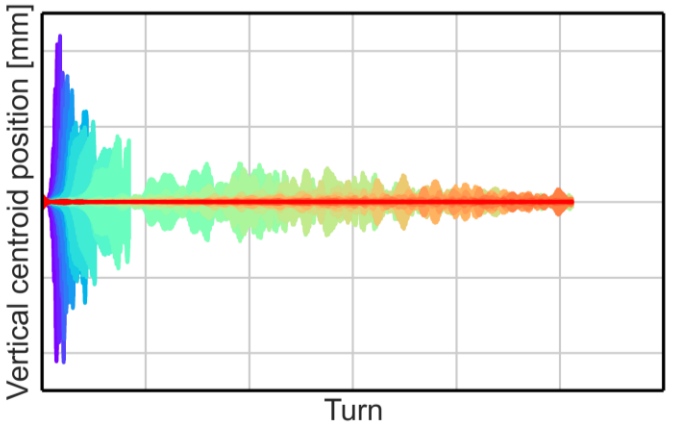
10% vertical emittance growth

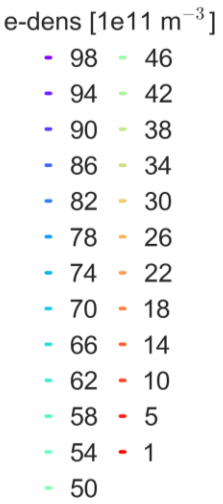
Pop-corn instabilities update

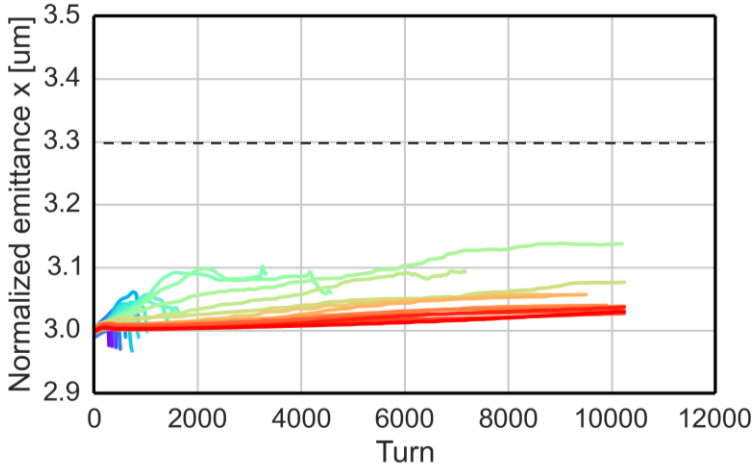
EC dipoles	EC quadruoles	Chromaticity	Oct	Damper	Turns
Density scan	SEY 1.30	20/20	-2.5	100 turns	10k

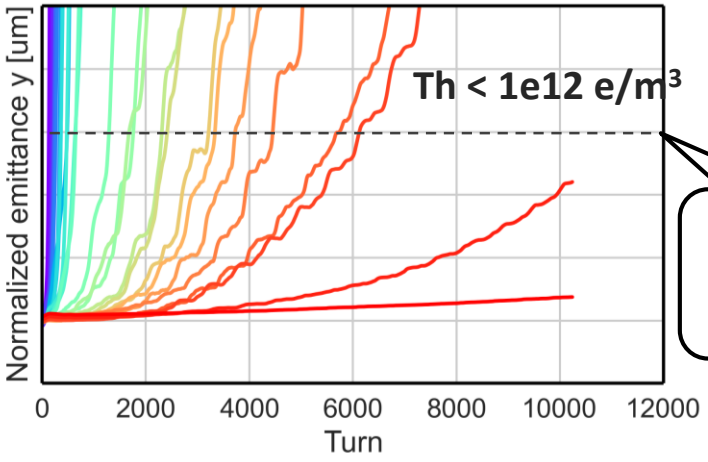
Beam intensity 0.7e11 ppb







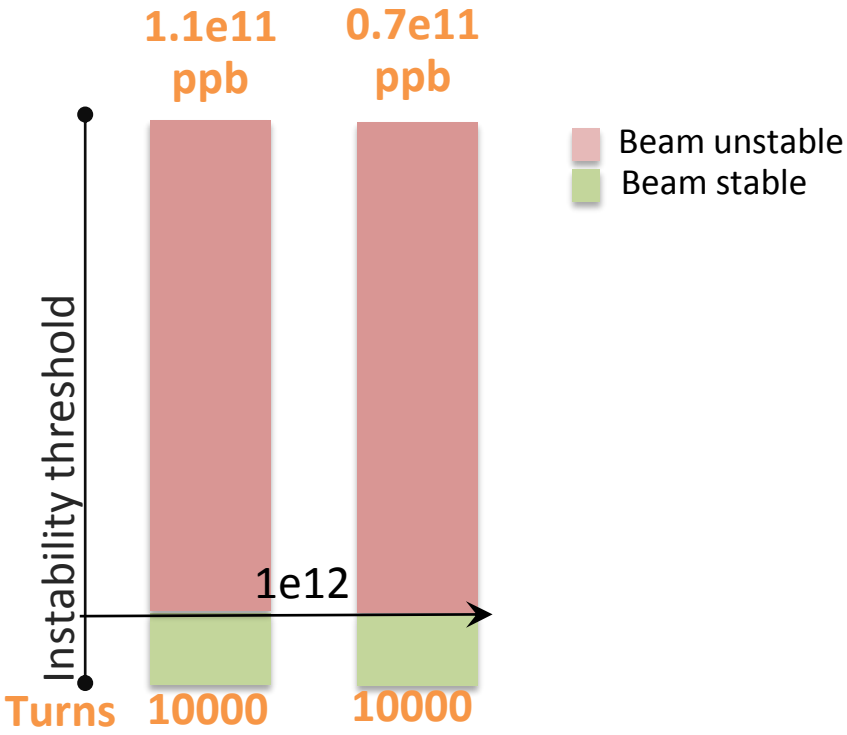


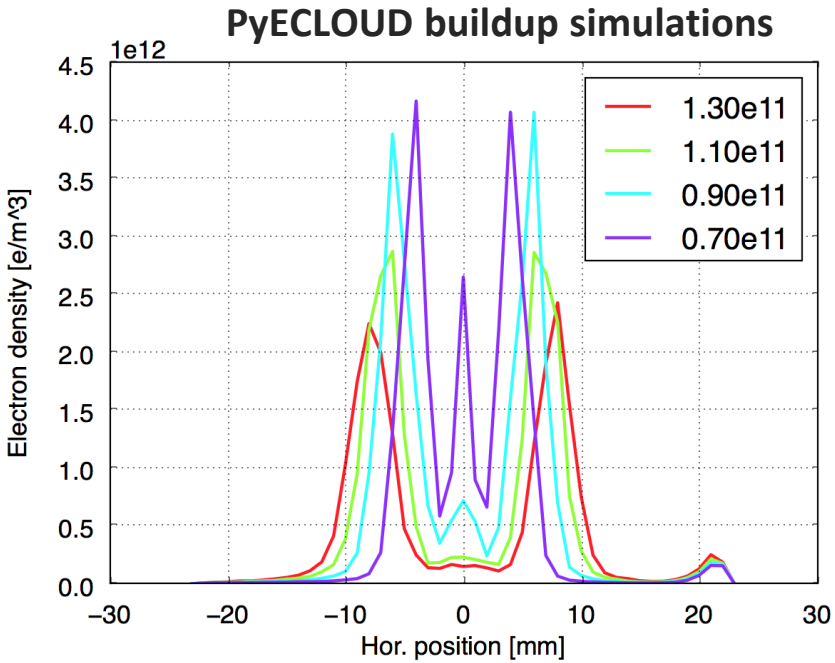


10% vertical emittance growth

Pop-corn instabilities update

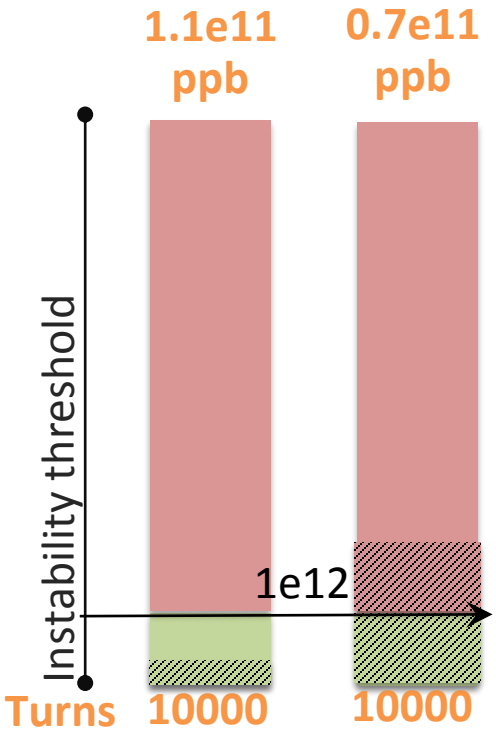
- From the buildup simulations: when the beam intesity decreases the e- central density increases

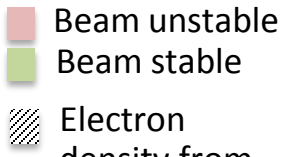


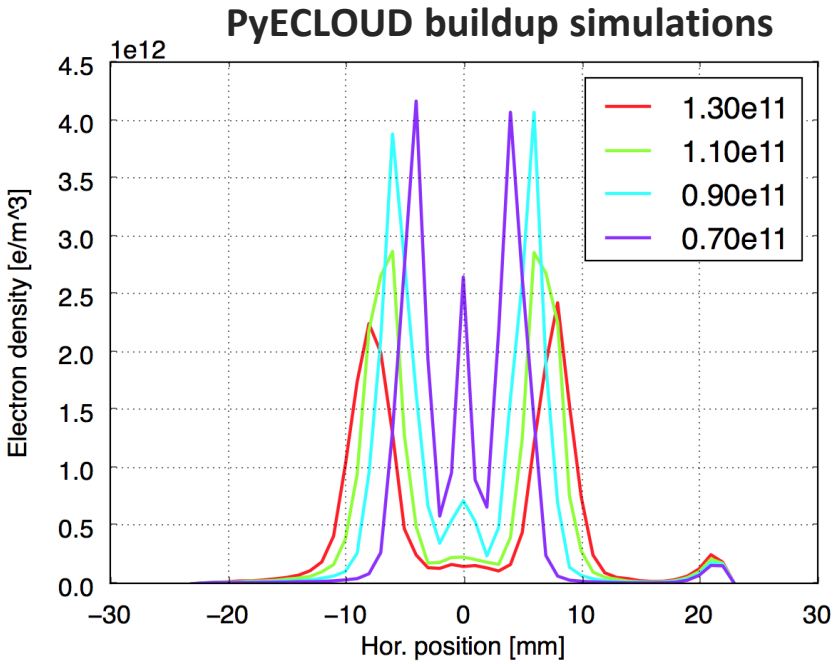


Pop-corn instabilities update

- From the buildup simulations: when the beam intesity decreases the e- central density increases
- Beam intensity of 1.1e11 ppb
  - the ecloud density estimated from the buildup is lower than the instability threshold → **the beam is stable**
- Beam intensity of 0.7e11 ppb
  - the ecloud density estimated from the buildup is higher than the instability threshold → **the beam is unstable**







Coherent tune shift

Simulating coherent tune shift at injection:

- Intensity: 1.1e11 ppb
- Emittance: 2.5 um
- Bunch lenght: 1.25 ns
- EC in dipoles: uniform electron density scan between 1e11-3.2e11
- EC in quadrupoles: simulation from buildup → SEY 1.30

Simulating coherent tune shift at high energy :

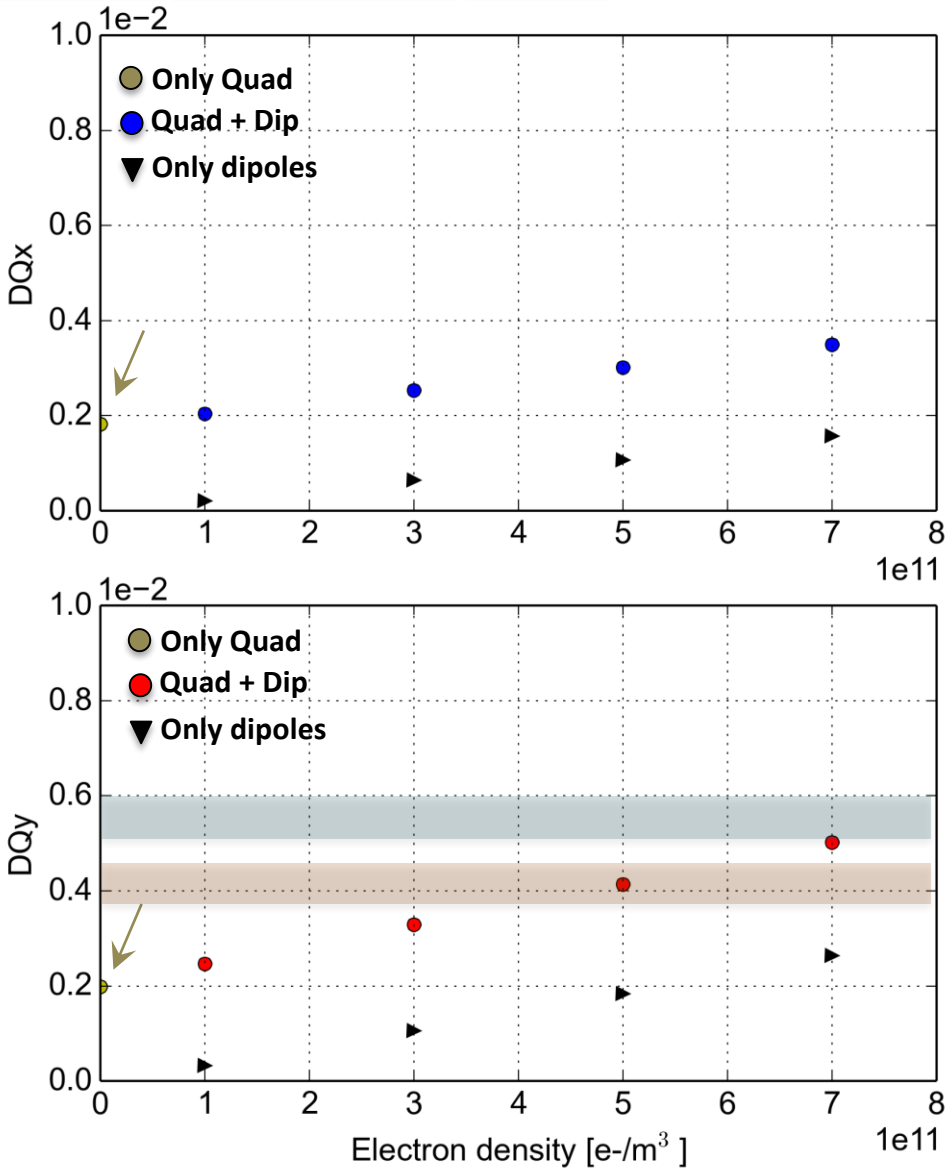
- Intensity: 1.0e11 ppb
- Emittance: 3.0 um
- Bunch lenght: 1. ns
- EC in dipoles: uniform electron density scan between 1e11-1°13
- EC in quadrupoles: simulation from buildup → SEY 1.30

→ The tune shift has been computed using **PySUSSIX**

Coherent tune shift at injection

EC dipoles	EC quadruoles	Chromaticity	Oct
Density scan	SEY 1.30	✗	✗

- The tune analysis has been done over 100 turns using SUSSIX
- For electon density larger than 8e11 the bunch is unstable



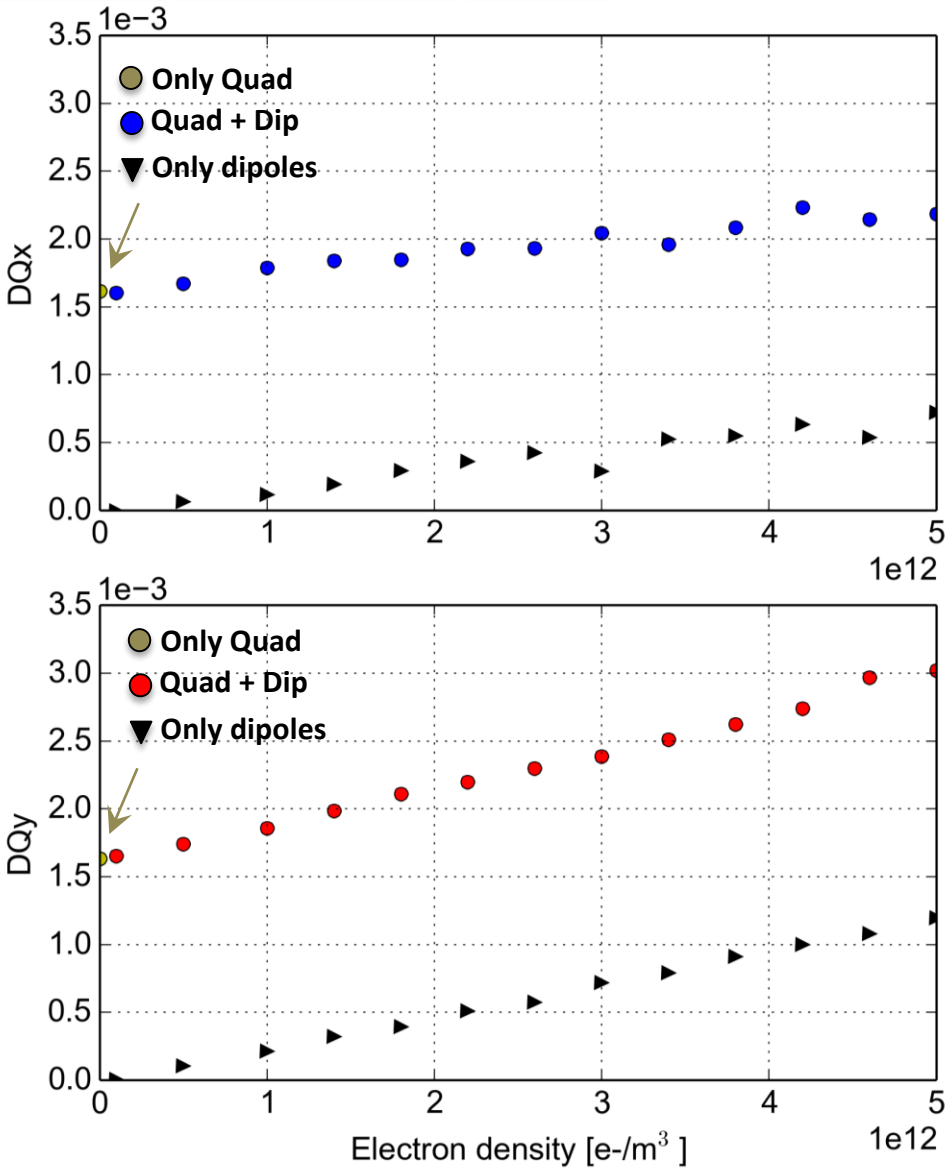
From Lee 's measuraments (slides):

- BEAM 1: Tune shift for batch 2 in 144b injection is 5.0e-3 to 6.0e-3
- BEAM2: Tune shift for batch 2 and 3 in 216b injection is 3.9e-3 to 4.4e-3

Coherent tune shift at high energy

EC dipoles	EC quadruoles	Chromaticity	Oct
Density scan	SEY 1.30	✗	✗

- The tune analysis has been done over 150 turns using SUSSIX
- For electron density larger than 5e12 the bunch is unstable



Thanks for your attention!