

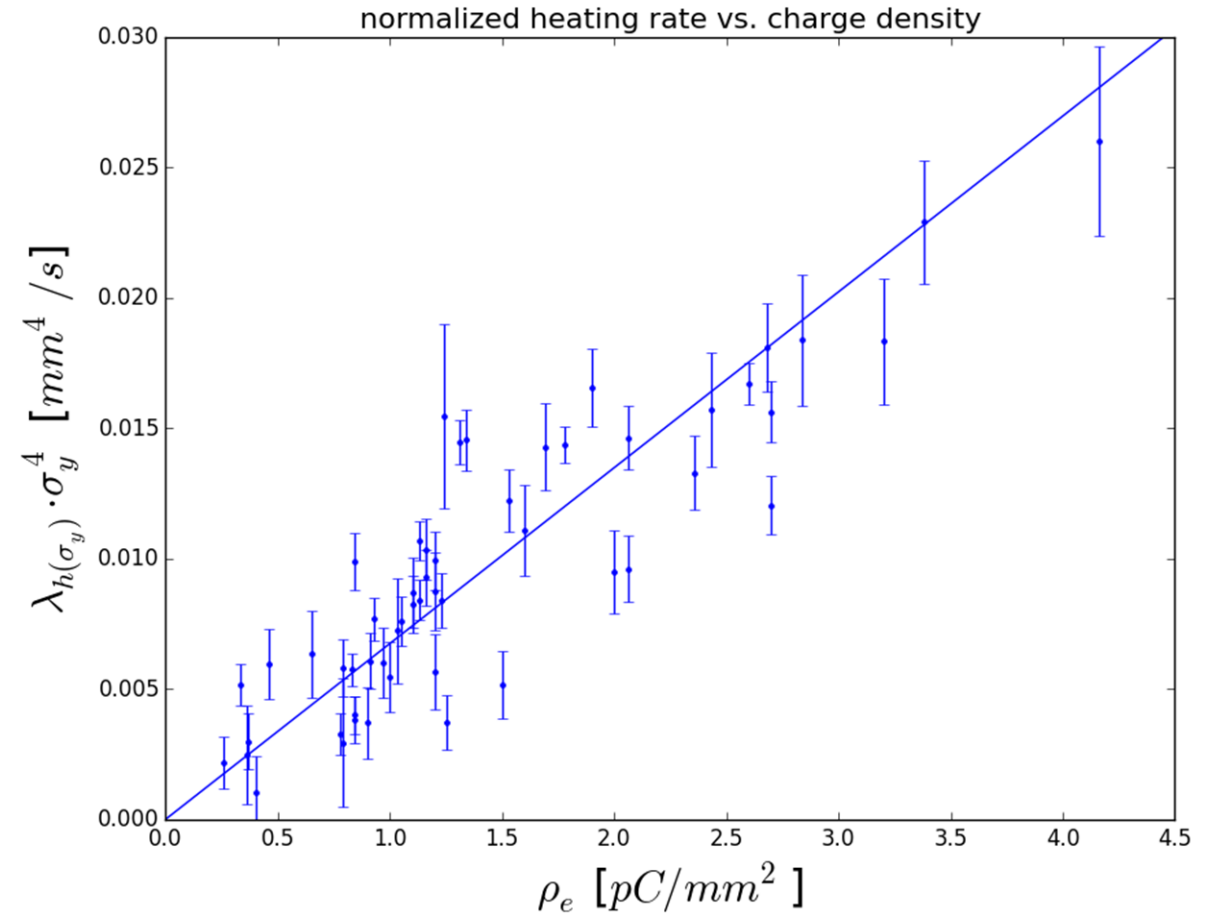
Electron-ion heating studies

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Main results from 2021

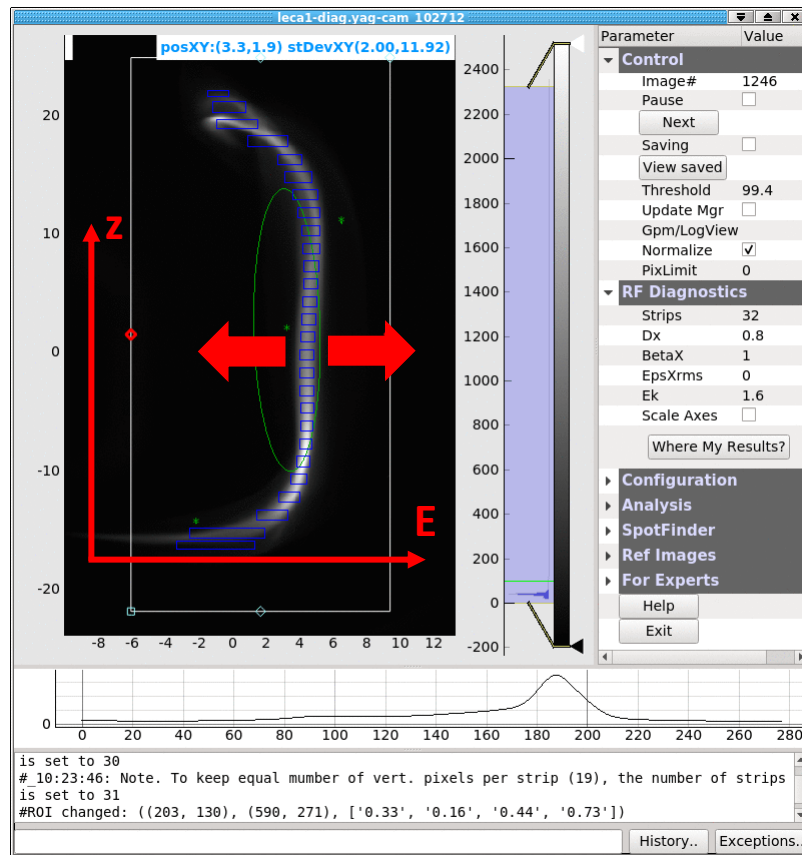
- We call additional emittance growth of ions with electron cooling “turned off” the “electron-ion heating”
- During the Run 2021 we performed dedicated measurements of this effect (at $\gamma = 4.1$ and $\nu = 0.13$)
- **The dependence of the heating rate on the average effective density (ρ_e) of the e-beam in the cooling section is linear**
- These data contradict a traditional explanation of the heating: space charge kicks randomized by some mechanism, for example, by the IBS “pulling” the ions through the synchro-betatron resonances



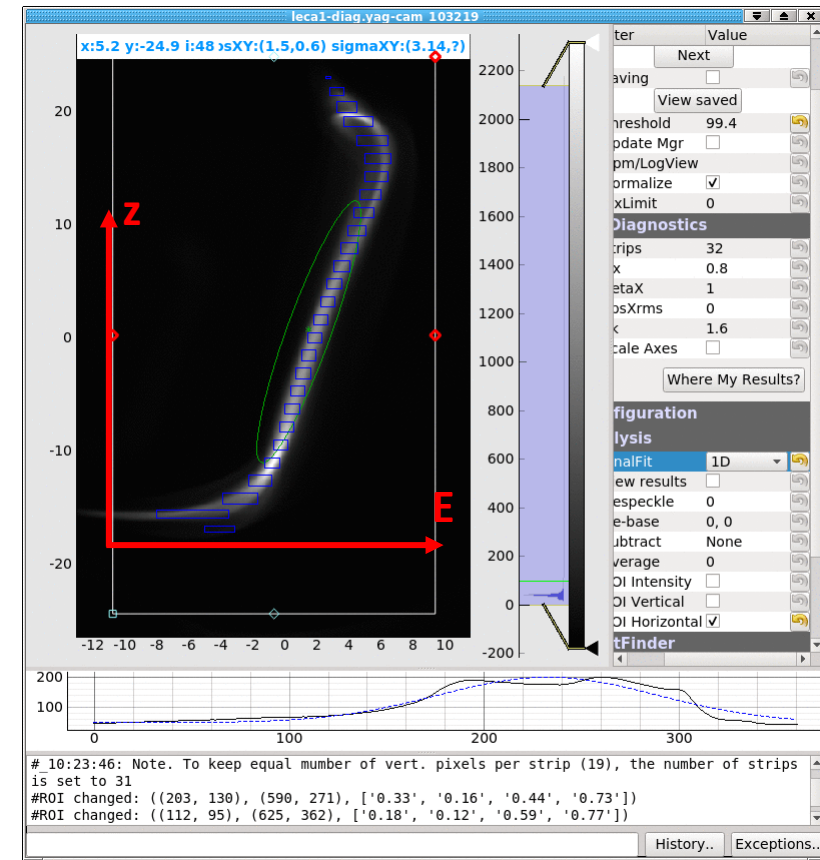
Studies objective

- We wanted to test a theory that the heating is a result of the energy offset leading to creation of the longitudinal attractor and the coupling of the transverse & the longitudinal phase spaces via the ions D' in the cooling section. This would explain the linear rate-density dependence.
- To test this idea, we need to compare the heating due to the E-offset to the heating in the presence of the E-chirp.

offset

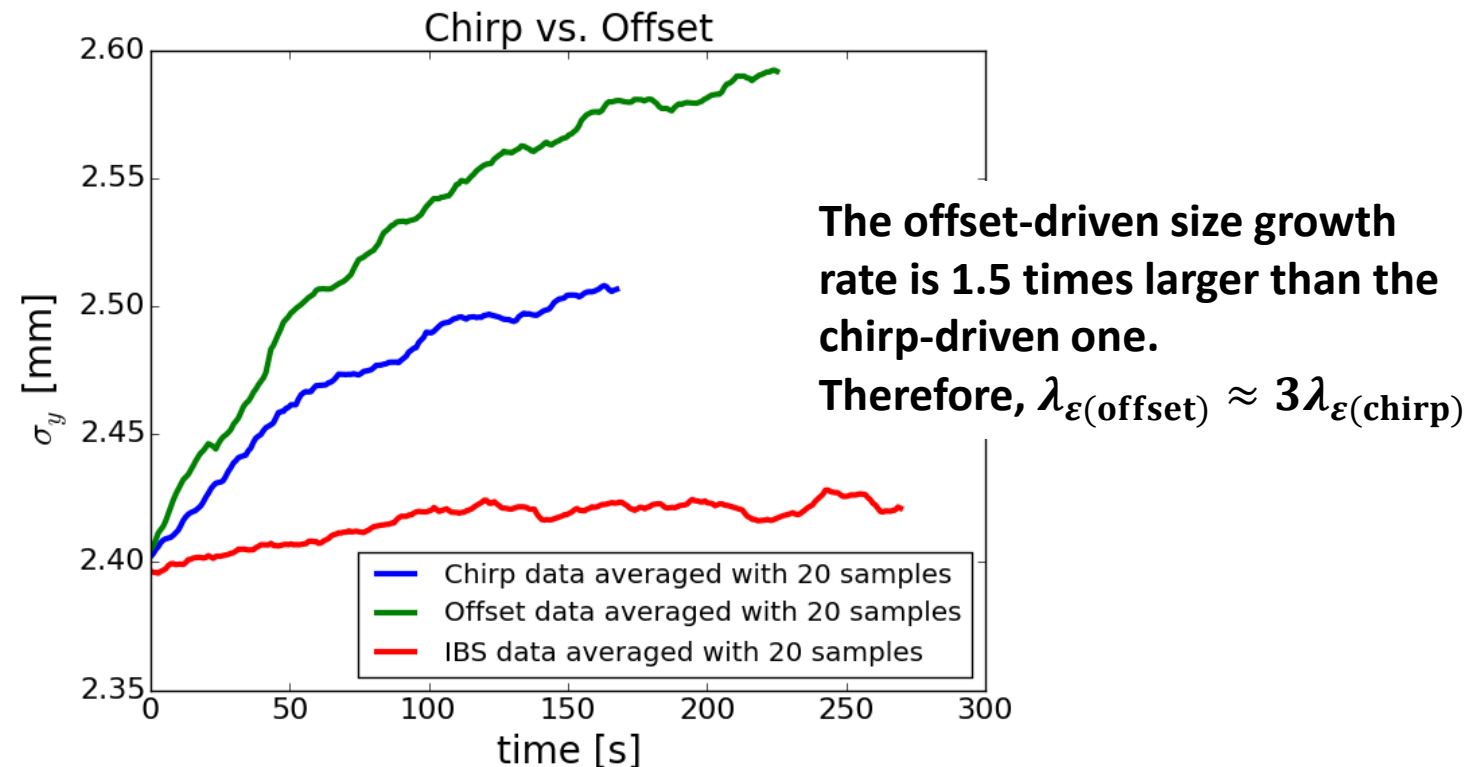
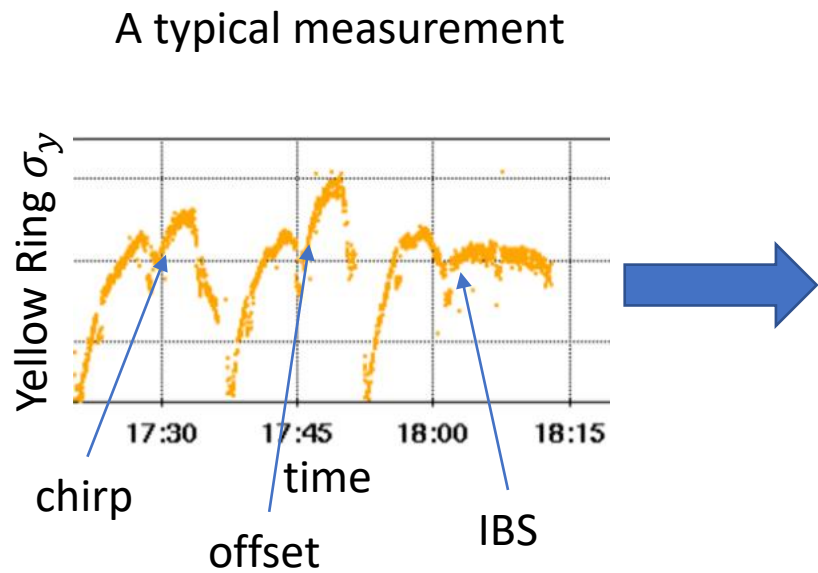


chirp



Measurements

- We need three measurements to test the theory: a heating due to an offset, a heating due to a chirp, the IBS-driven size growth.
- Without the 9 MHz RF the lifetime at $\gamma = 4.1$ is poor even for the low intensity ion bunches.
- It turned out that the best way to do the measurements is to precool the ions to the same conditions (size, length, intensity) and then “switch off” the cooling and measure the heating rate.



Conclusions

The “pseudo heating” - the extra emittance growth created by the energy offset of the electron beam seems to be a non-negligible part of the heating we observed last year, but it doesn't explain the whole picture.