Residual Ions Dynamics in ThomX Electron Storage Ring

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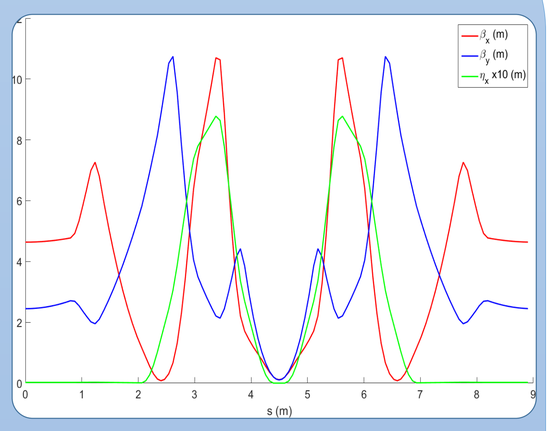
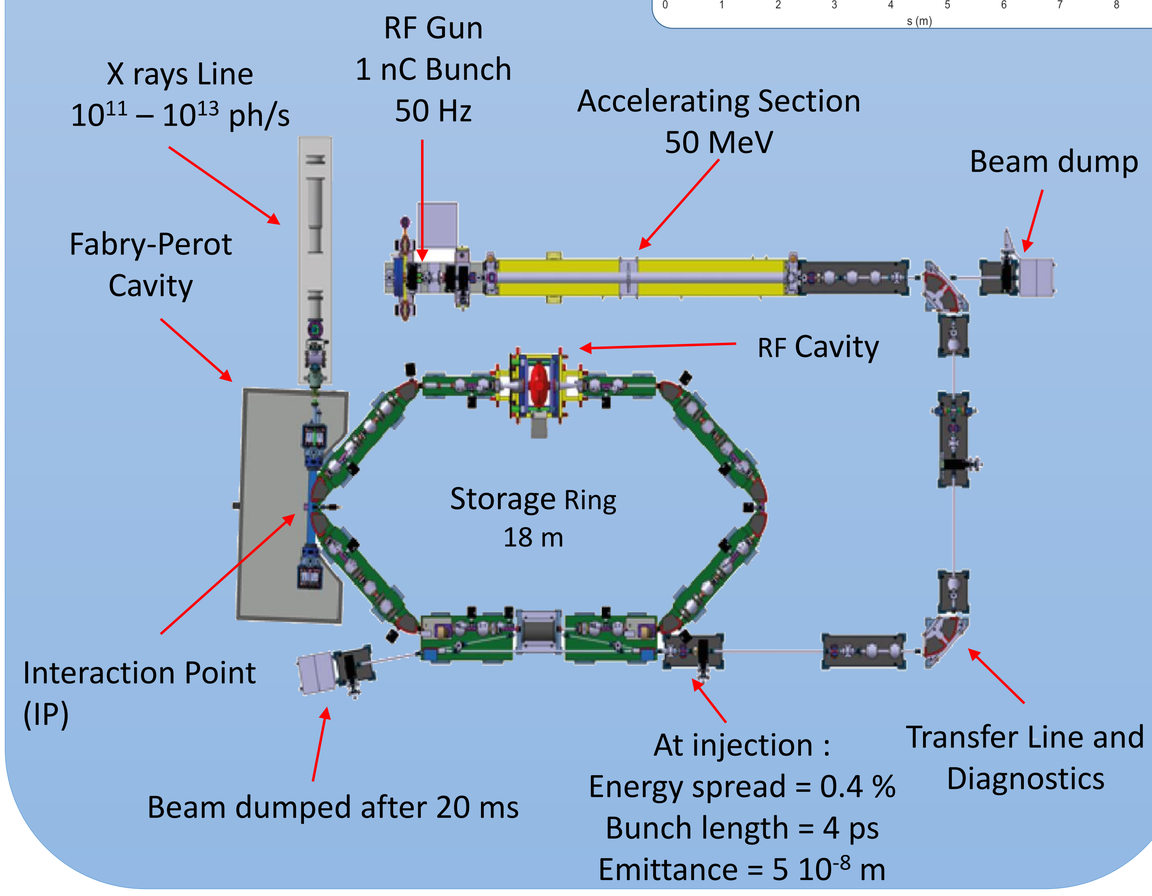
Abstract: Ions produced from residual gas in the storage ring can induce several instabilities. Complete studies of the beam-ion interaction has been undertaken. It shows that there are preferential ion accumulation points depending on the storage ring lattice. This poster details the ions longitudinal and transverse dynamics in ThomX storage ring.

ThomX

- ThomX is a compact Light Source based on Compton Backscattering
- Production goal of 10^{13} ph/s in the hard X rays range (50 to 90 KeV)
- Damping time >> storage time





Beam-Ion Model

- Model based on beam-beam interaction under the "strong-weak" approximation
- The transverse ion kicks Δv_x and Δv_y are given by the Bassetti-Erskine formula[1]:

$$i\Delta v_x + \Delta v_y = -\frac{NK\sqrt{\pi}}{\sqrt{2(\sigma_x^2-\sigma_y^2)}}\left(w\left[\frac{x+iy}{\sqrt{2(\sigma_x^2-\sigma_y^2)}}\right]-\exp\left[-\left(\frac{x^2}{2\sigma_x^2}+\frac{y^2}{2\sigma_y^2}\right)^2\right]w\left[\frac{x\frac{\sigma_y}{\sigma_x}+iy\frac{\sigma_x}{\sigma_y}}{\sqrt{2(\sigma_x^2-\sigma_y^2)}}\right]\right)$$

- The longitudinale ion kick is given by Sagan formula[2]:

$$\Delta v_s = [-\alpha_x\epsilon_x + \eta\eta'\sigma_\epsilon^2]\frac{\partial\Delta v_x}{\partial x} - \alpha_y\epsilon_y\frac{\partial\Delta v_y}{\partial y}$$

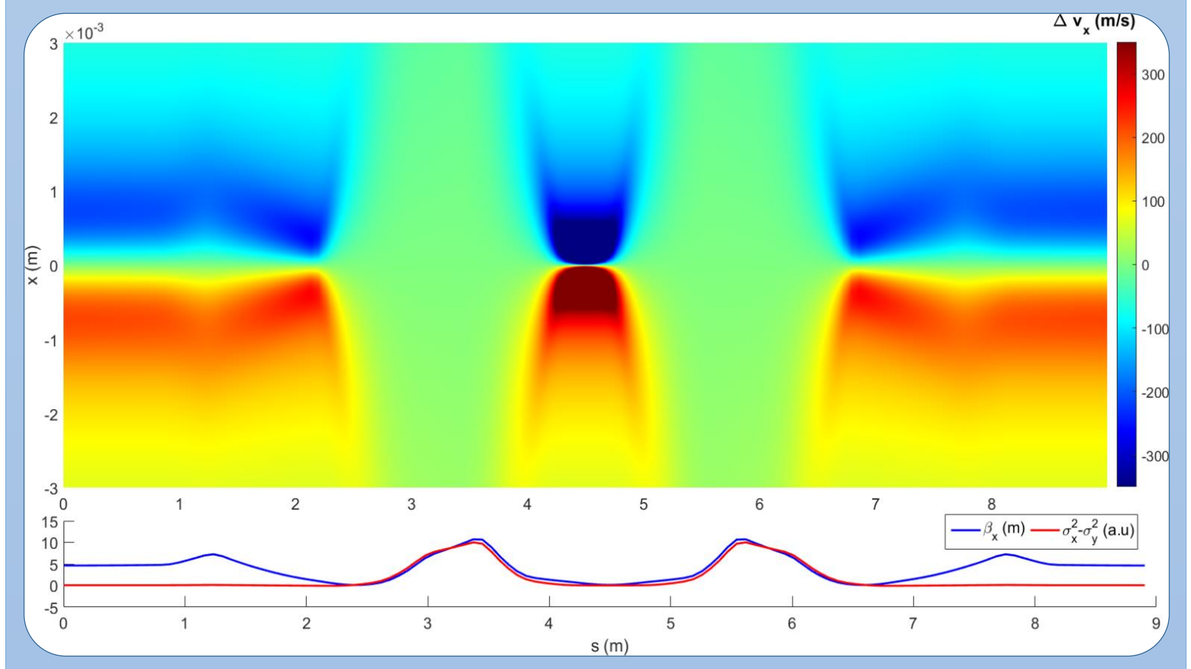
- The Twiss parameters and the lattice design completely determine the ions motion in the accelerator

References

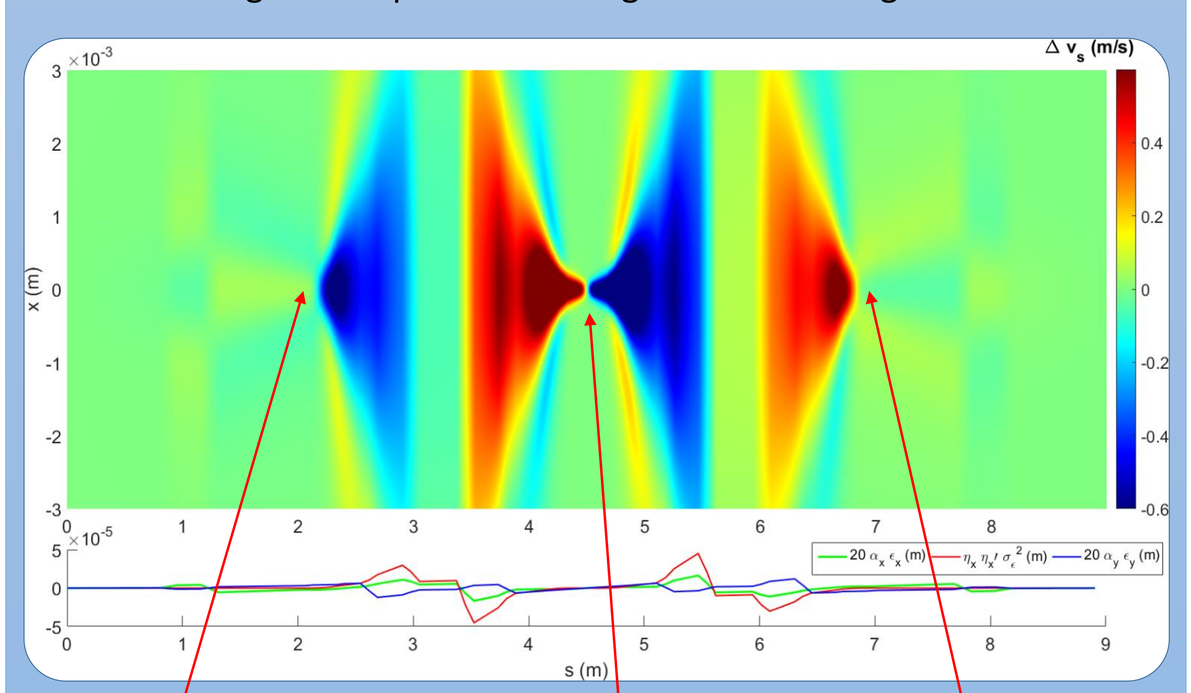
- [1] - M. Bassetti, and G. Erskine, CERN-ISR-TH/80-06 (1970)
- [2] - D. Sagan "Some aspects of the longitudinal motion of ions in electron storage rings."Nucl. Instr. Meth., vol. A307, pp.171-178, 1991.
- [3] – ThomX TDR

Beam-Ion Kicks

- Color map of the horizontal kick Δv_x vs horizontal position x and longitudinal position s along half ThomX ring:



- Color map of the longitudinal kick Δv_s vs horizontal position x and longitudinal position s along half ThomX ring:



Expulsion zone with weak trapping

Accumulation point at the IP

Expulsion zone with weak trapping

Simulations

- Longitudinal distribution of 20 000 CO^+ ions after 30 000 turns in ThomX storage ring: