Collimation Studies for Touschek and ion scattering

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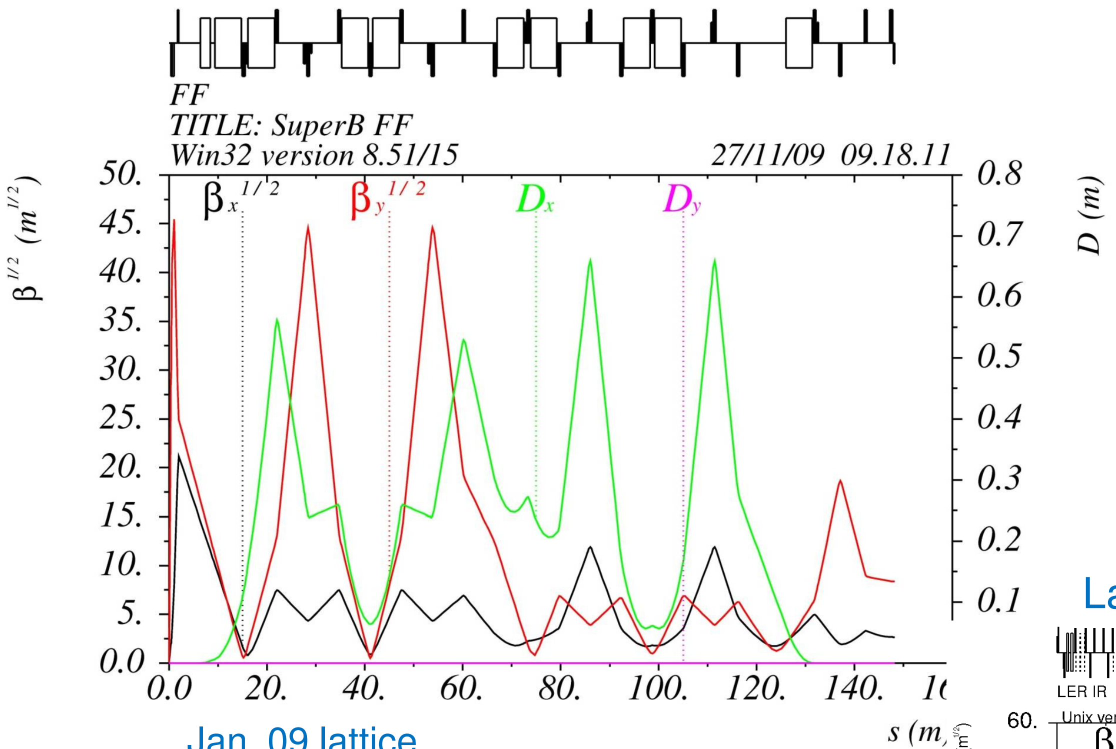
Introduction

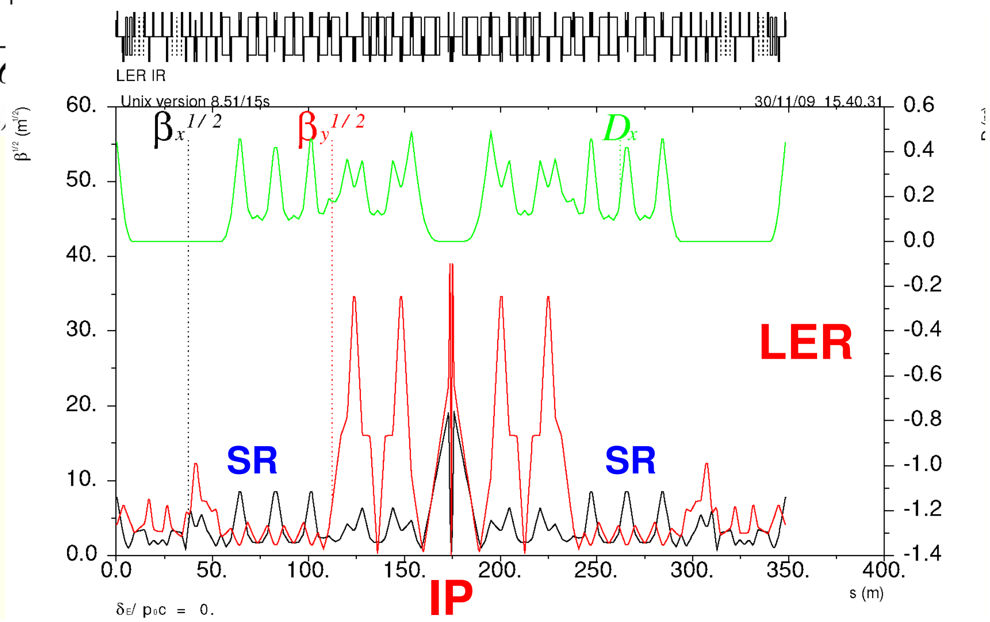
- **Background rates** from Touschek (and beam-gas scattering- but especially for Touschek) **strongly depend on lattice**, particularly on **off-momentum Dynamic Aperture**.
- Lattice has been improving, evolving fast. Yet **the latest lattice version needs to be updated** as long as FF octupoles and sextupoles are concerned**, to have a large off-momentum dynamic aperture**.
- Moreover, Touschek primaries for GEANT4 background simulations in the detectors have been calculated and need to be analized.
- For these reasons, in the meanwhile Pantaleo proposed to study an efficient collimation system in the final focus, as its lattice design in more or less stable now.

Final Focus used for collimation studies

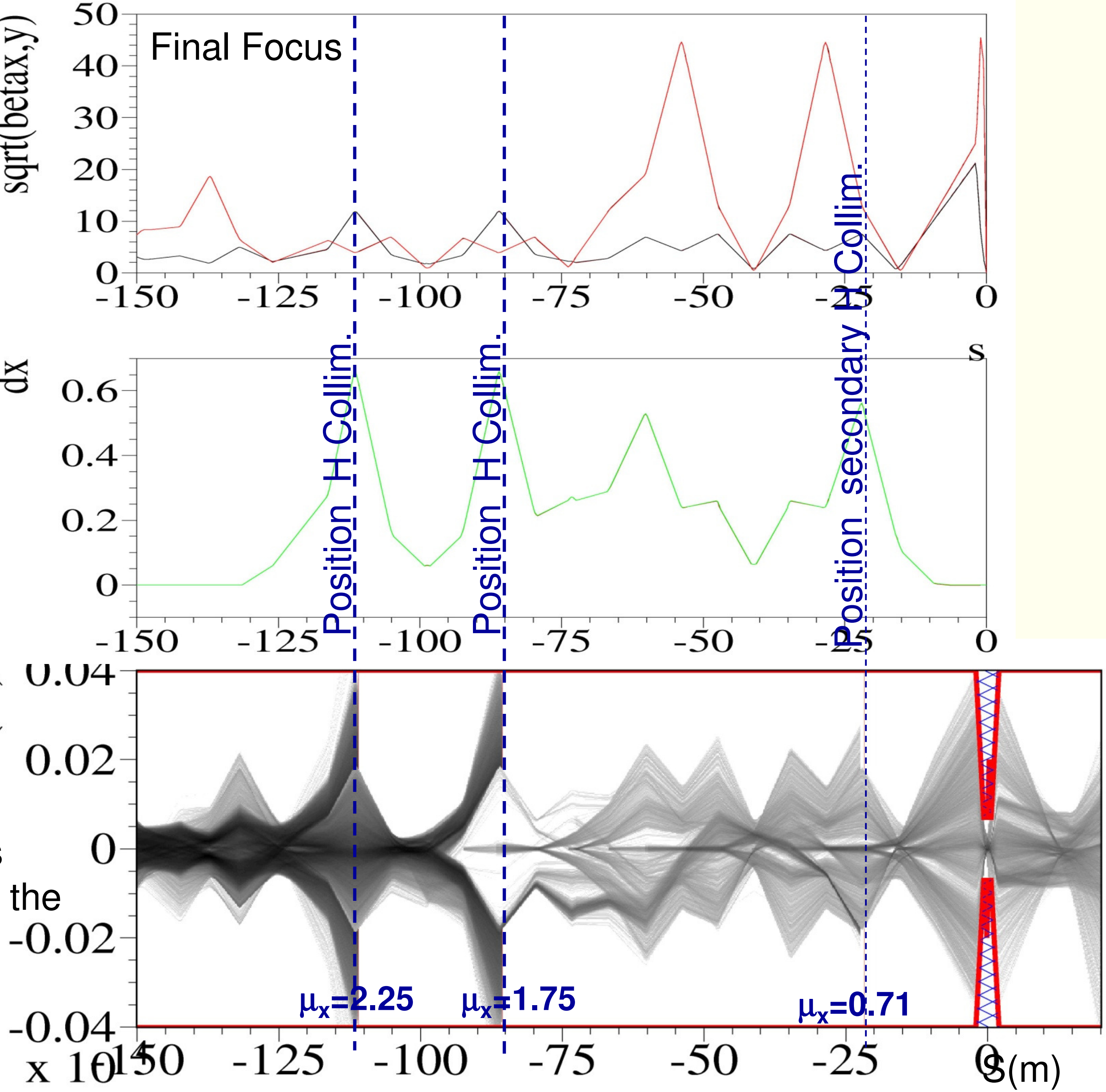


Jan. 09 lattice

Latest version: Yuri Nosochokov, 1 Dec. 09



collimators at **n·π/2** upstream the IP to intercept particles that would be lost at IP



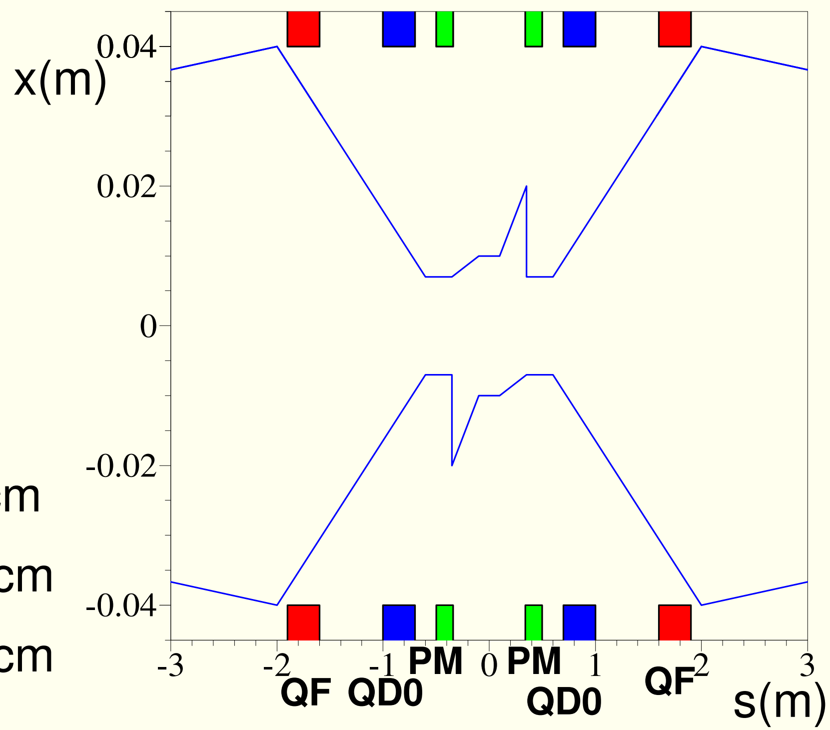
Trajectories of Touschek particles scattered all along the ring and tracked through the FF

Horizontal Collimators upstream the IR

Horiz. Collimator jaw insertion = 0.45* phys. aperture(QF1) =

$$0.9 * \sqrt{\beta_x(\text{collim})/\beta_x(\text{QF1})}$$

Idea is simple:
collimate upstream the IR rescaling the σx and intercepting the particles that would be lost at the QF1



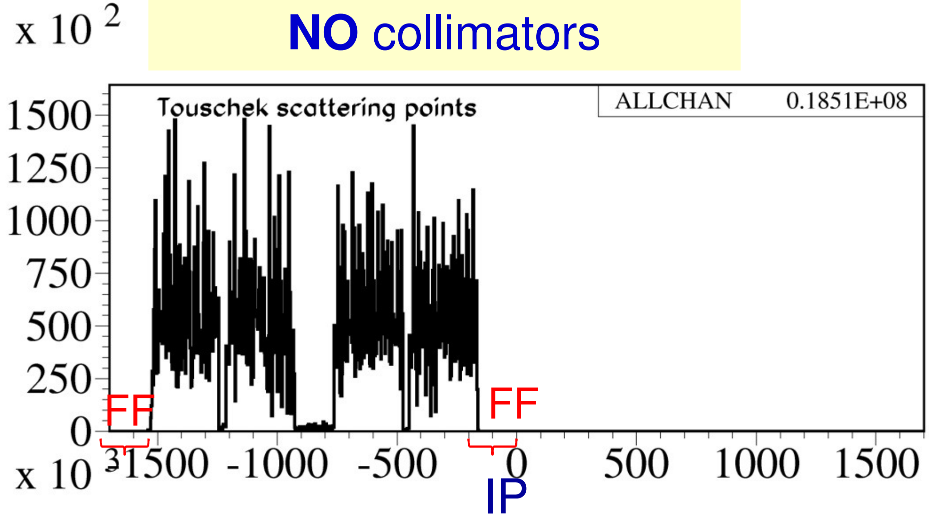
aperture(QF1) is 4 cm

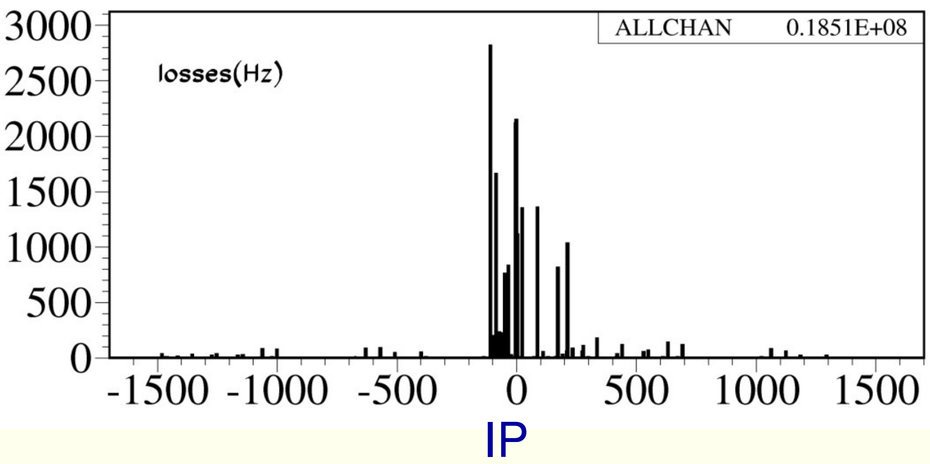
for primary horizontal collimators = 18 cm

for secondary horizontal collimators = 12 cm

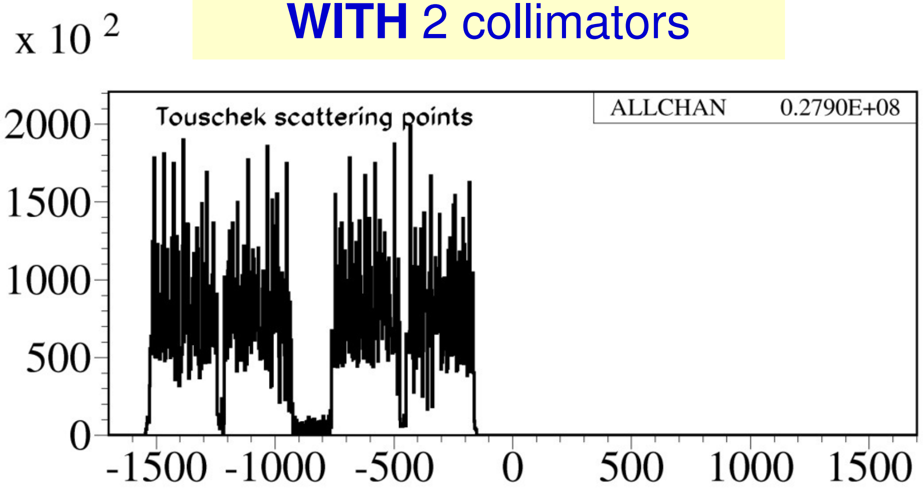
Touschek scattering all along ring BUT FF

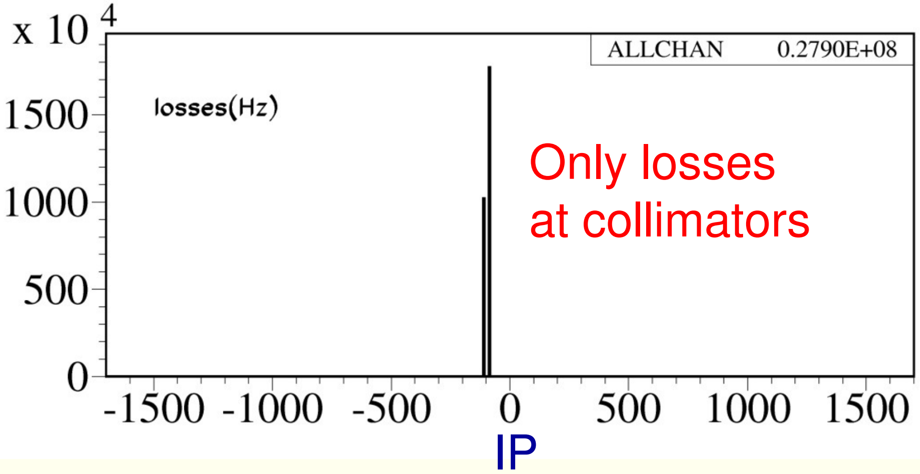
NO collimators





WITH 2 collimators

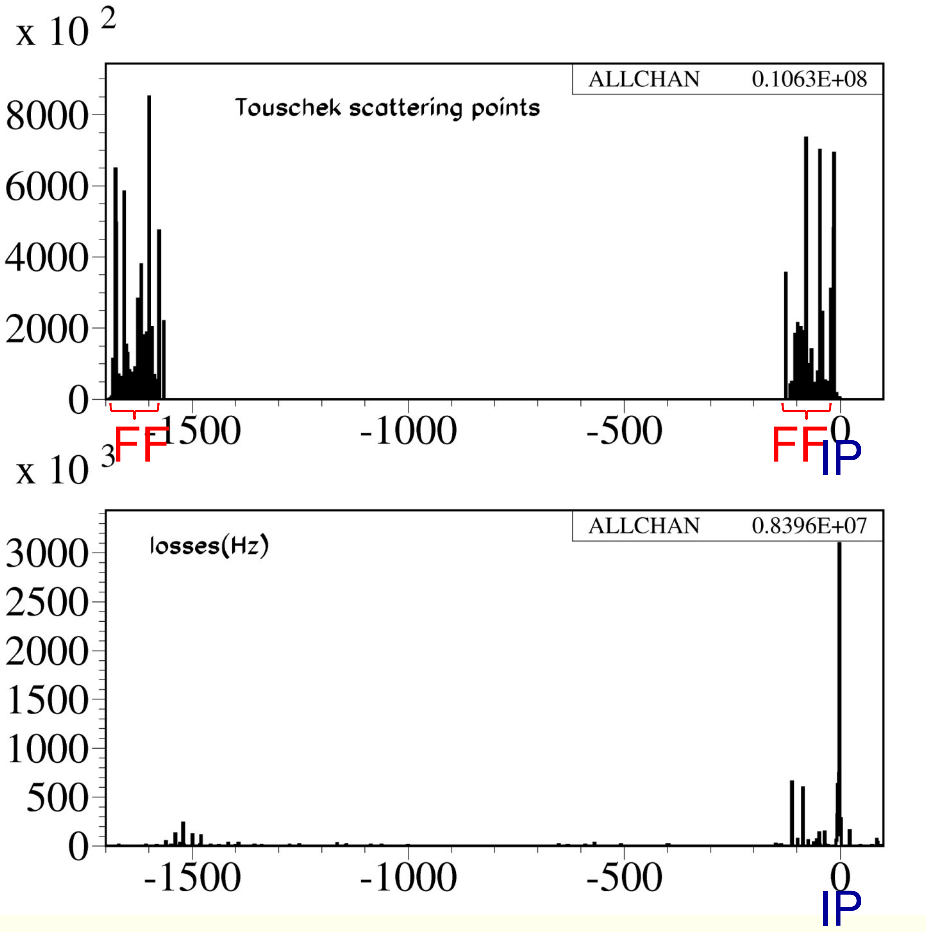




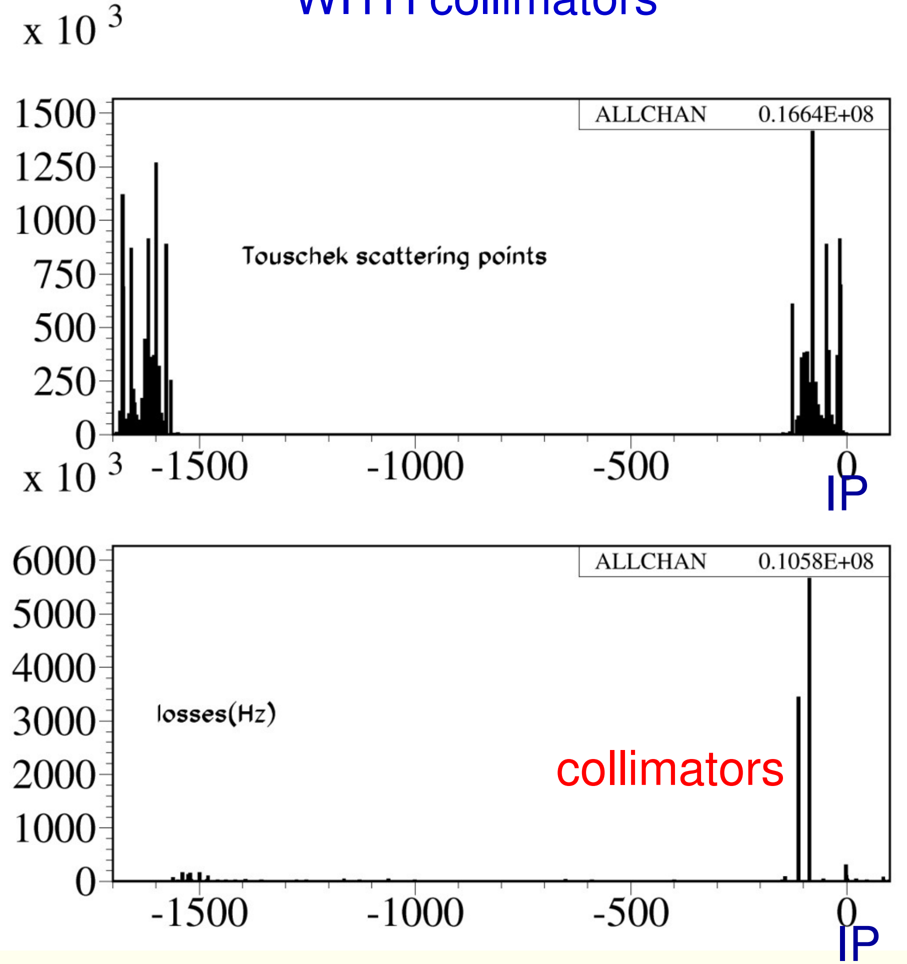
For Touschek scattering
all along ring excluding final focus
the two H. collimators are 100% efficient

Touschek scattering only in the Final Focus

NO collimators



WITH collimators

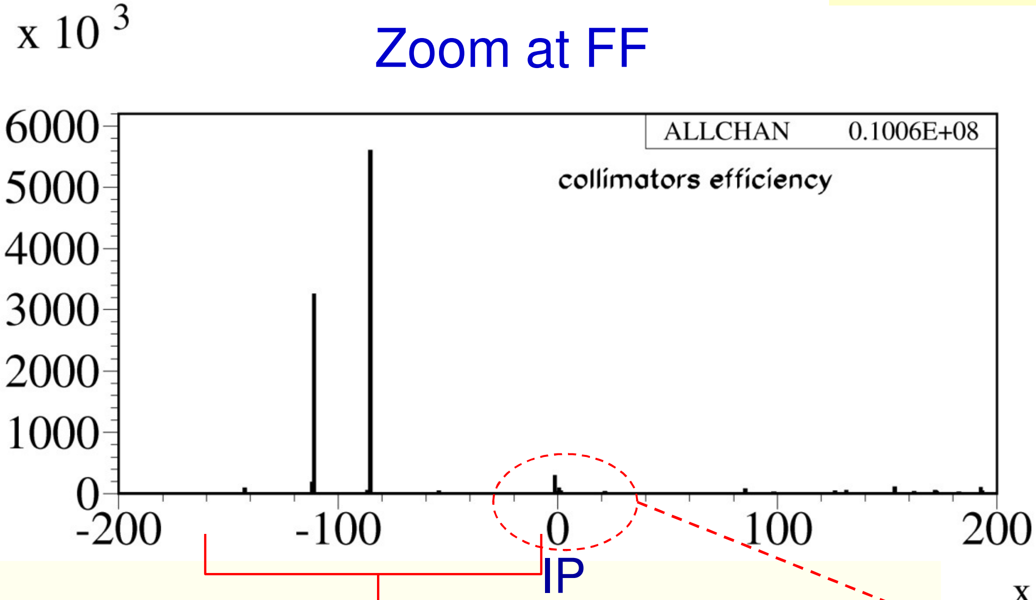


Touschek scattered in the final focus are lost immediately

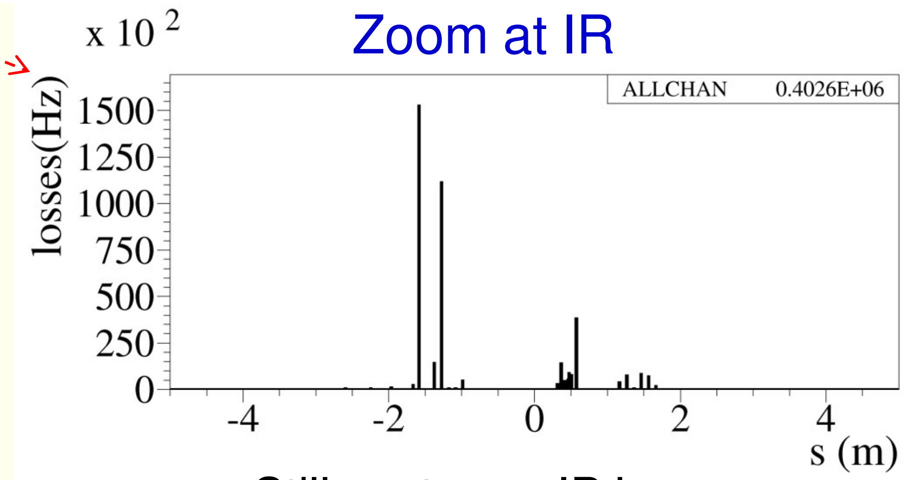
The two collimators intercept many of these particles

Touschek scattering only in the Final Focus: zoom

Only 2 primary collimators in



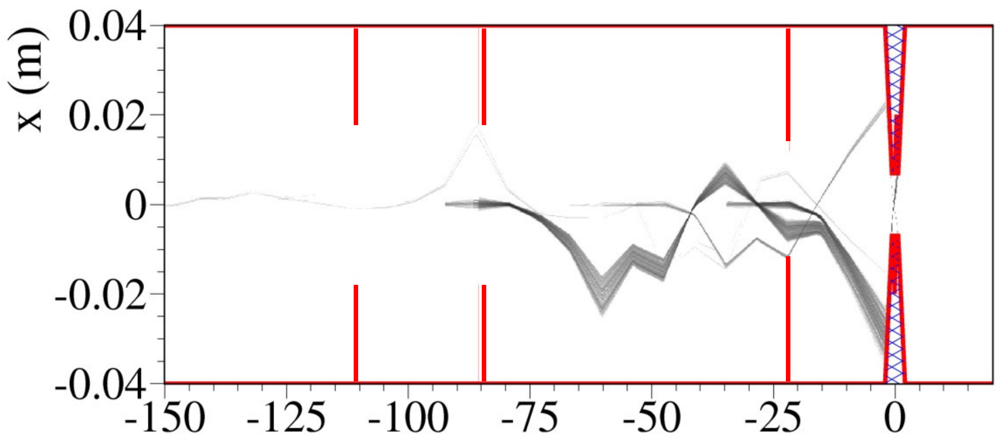
The two collimators intercept many of the particles scattered at the FF, but a few are still lost at the IR



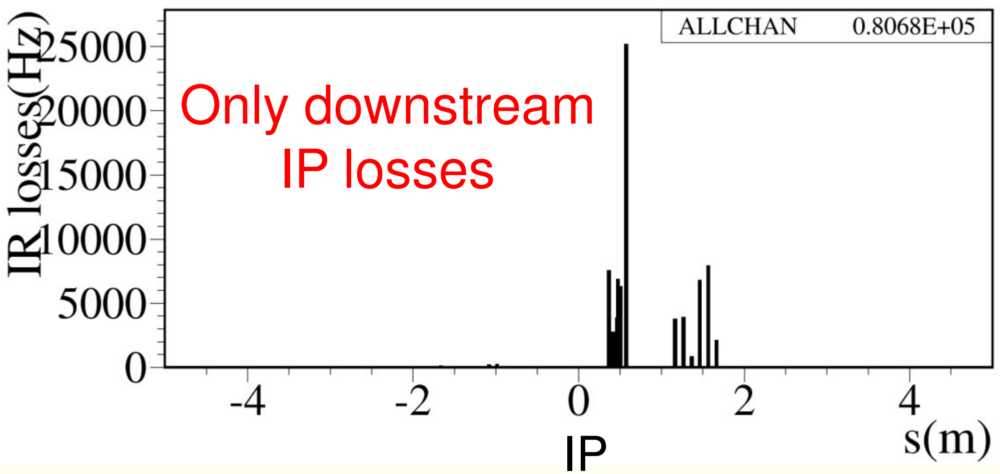
Still upstream IP losses

Zoom in the IR for Touschek particles generated in the FF

2 primary Collimators + secondary Collimator



Trajectories of the Touschek scattered particles in the FF and not intercepted by the 3 collimators and eventually lost at IR

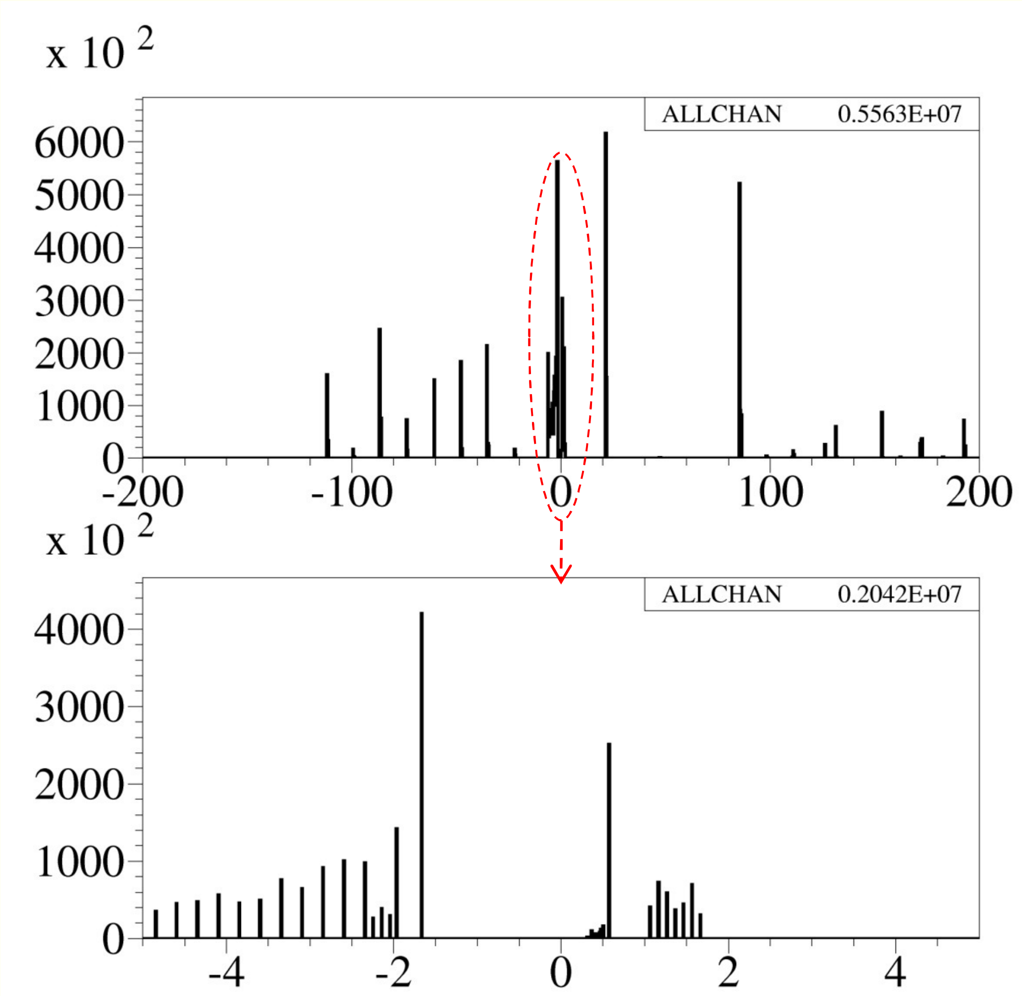


These 3 hor. Collimators cut IR losses by a factor 25

(Lifetime is reduced by a factor 1.8 still acceptable but of course a trade-off has to be found)

Zoom in the IR
for Touschek particles generated in the FF

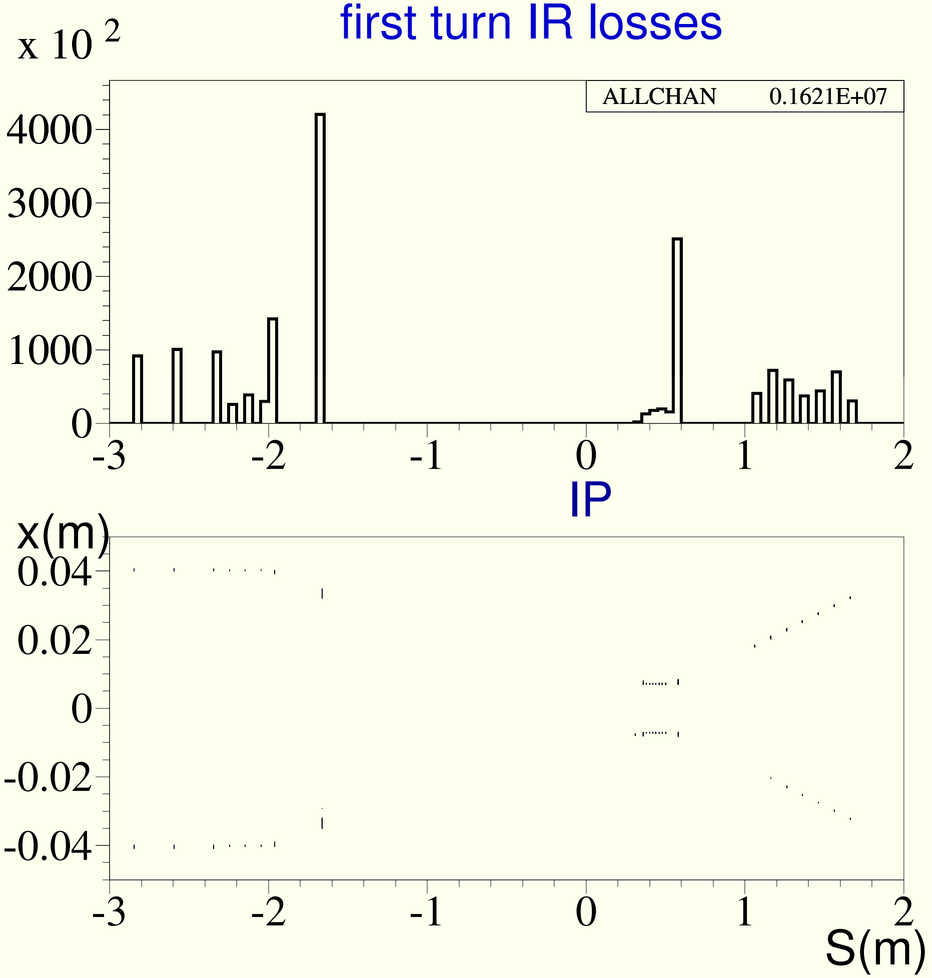
NO collimators



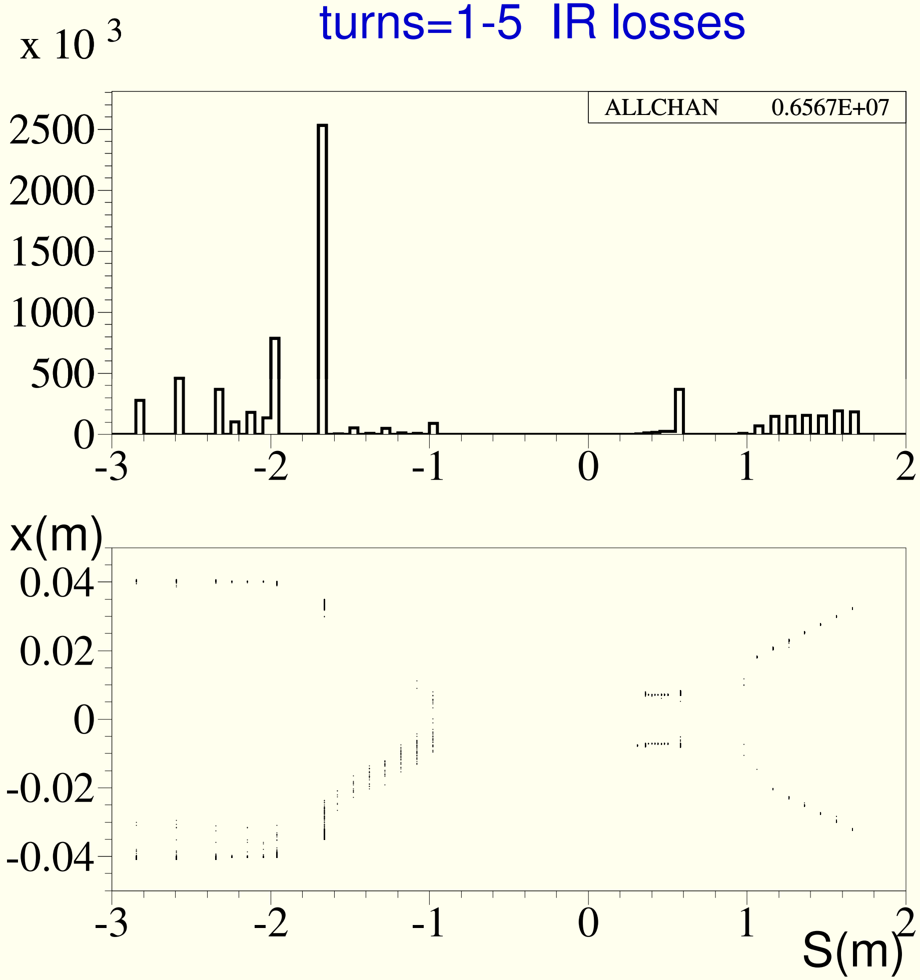
Zoom in the IR
for Touschek particles generated in the FF

NO collimators

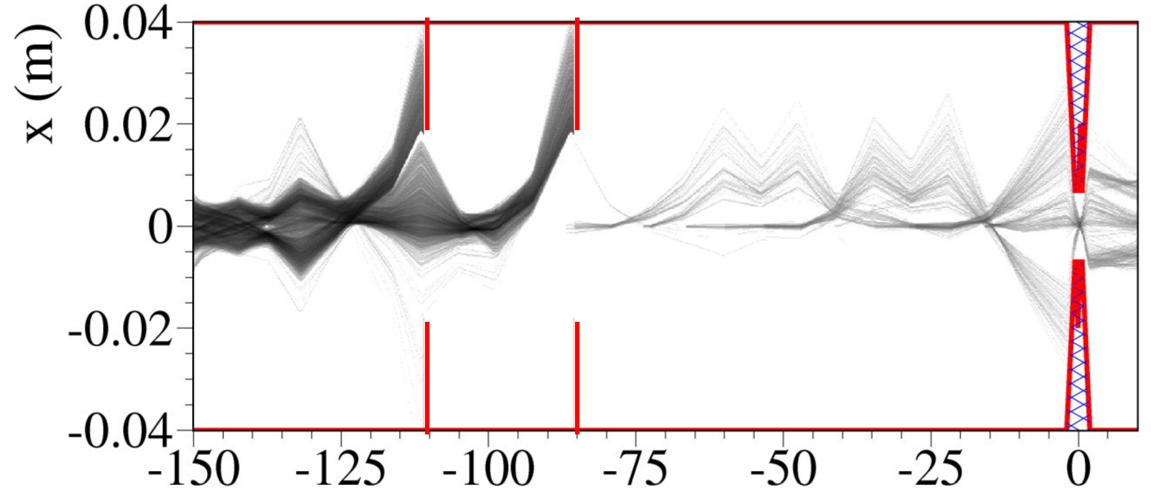
first turn IR losses



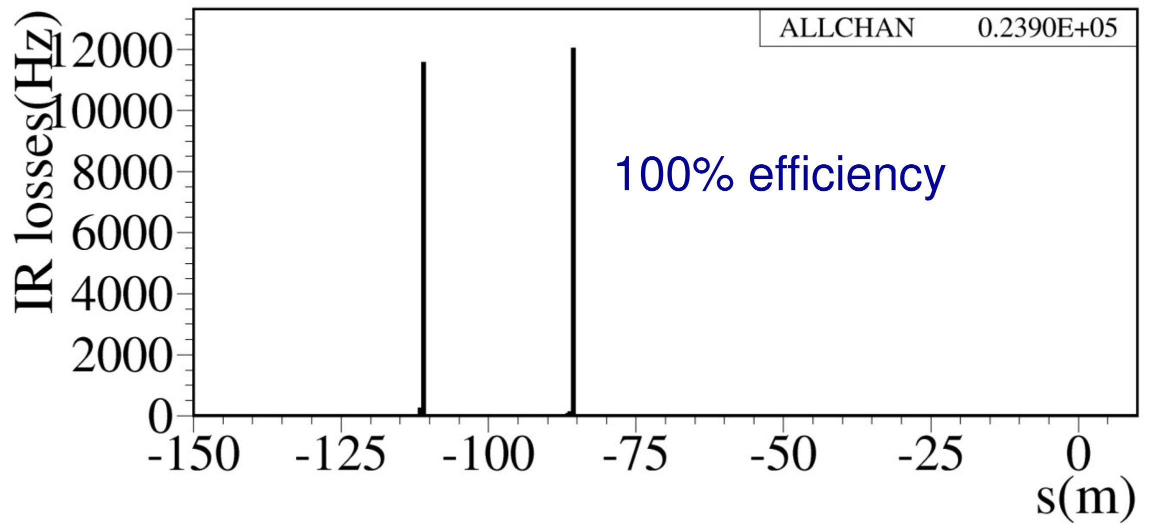
turns=1-5 IR losses



Inelastic Beam-gas scattering

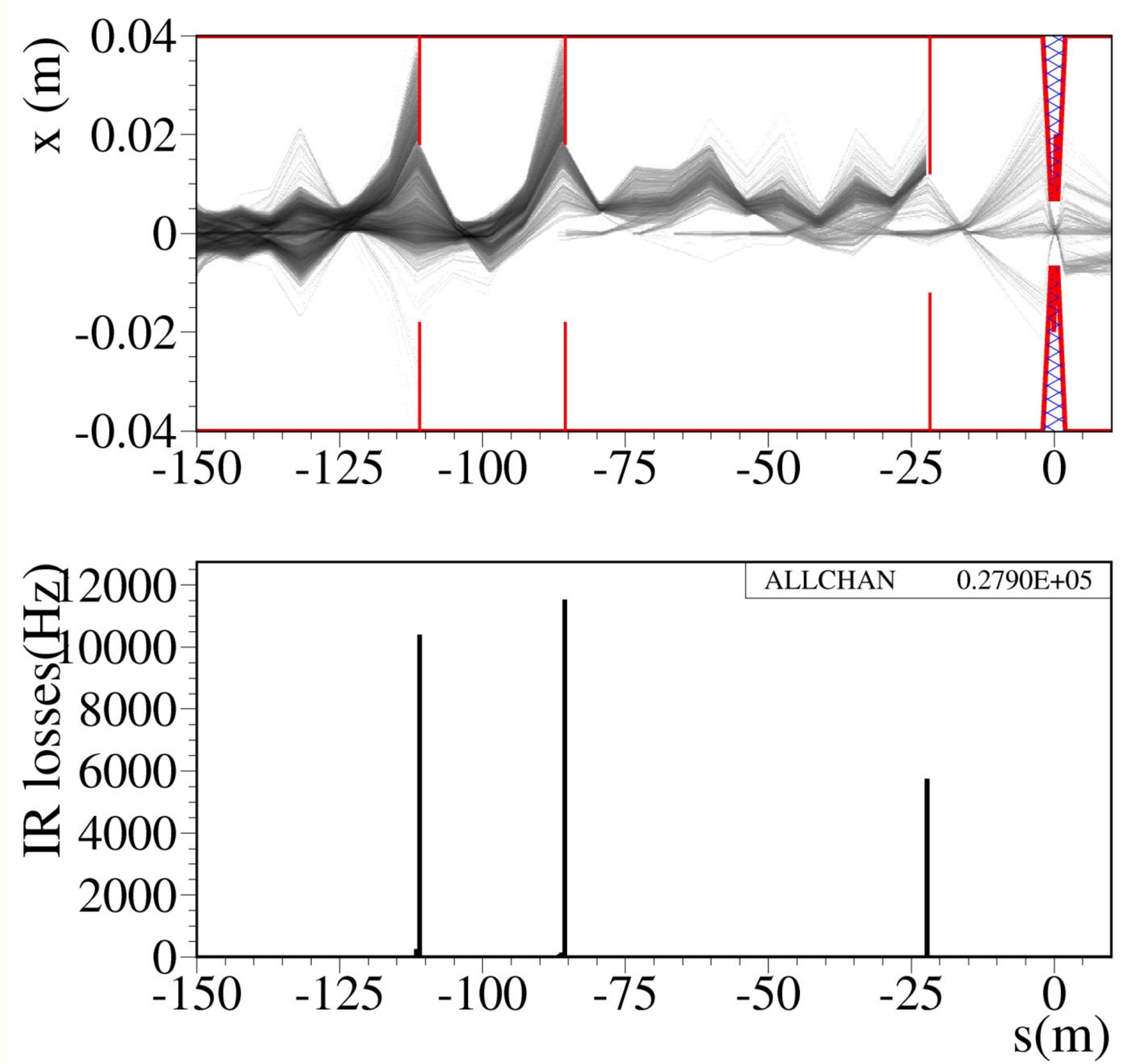


Trajectories of scattered particles in the FF, with the **two primary Hor. collimators** inserted



the **two H collimators** inserted are very efficient in intercepting particles scattered out of the FF.
The particles scattered in the FF do not get lost in the IR

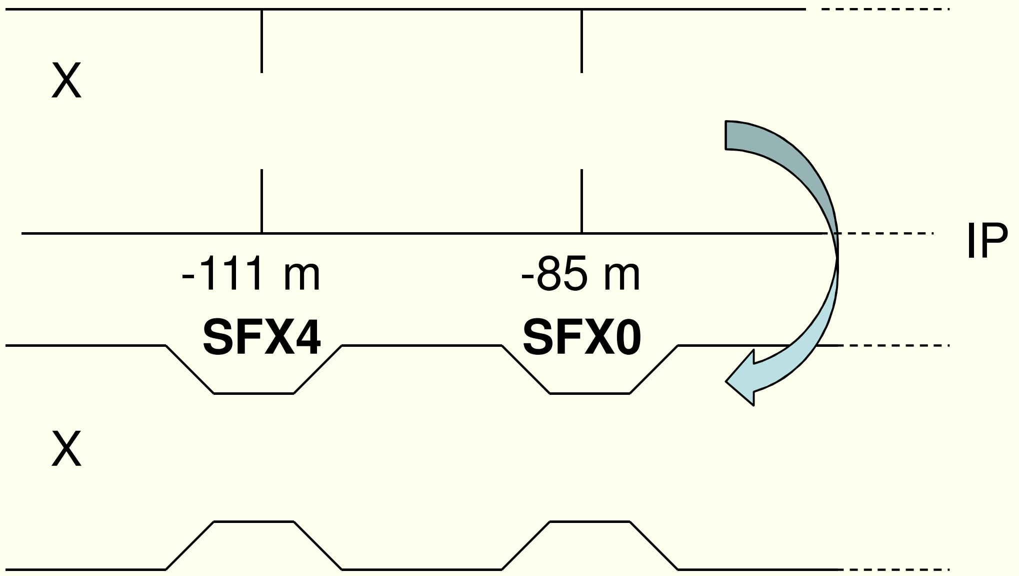
Inelastic Beam-gas scattering



Trajectories of scattered particles in the FF, with the **2 primary collimators + secondary one** inserted

Conclusions

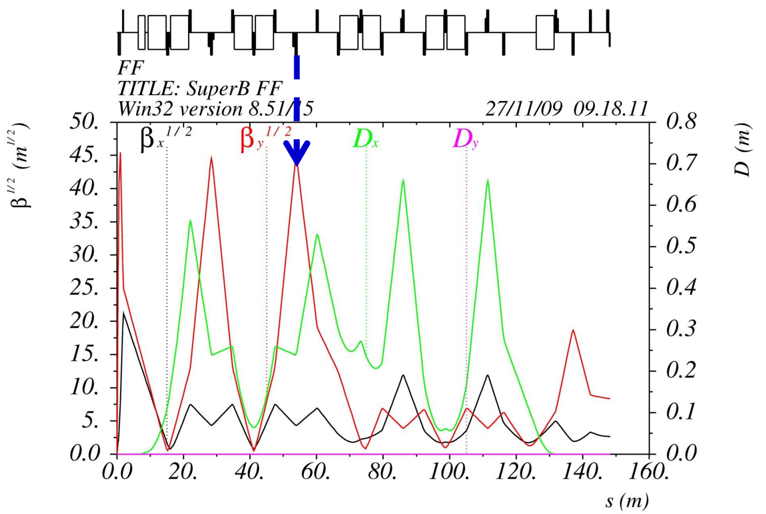
- The proposed **horizontal collimation system** results **very efficient** from simulations.
- Straightforwardly, **we propose to model the beam pipe at the longitudinal positions where the horizontal collimators should be placed** (two hor. Sextupoles) with a horiz. physical aperture corresponding to the one needed for the jaws to efficiently intercept the scattered particles that would be lost at the QF1.



To do list

Check on simulations that this principle works also in vertical plane

- Same principle is proposed for the collimation of elastic beam-gas scattered particles, with a **Vertical collimator** upstream the IR in the FF



Vert. Collimator jaw insertion = $0.9 * \sqrt{\beta_y(\text{collim})/\beta_y(\text{QD0})}$

- It will be straightforward to propose a vertical beam pipe at the longitudinal position where the vertical Collimator should be placed (V. Sextup.) modeled by the same aperture needed to collimate particles that would be lost at the QD0