Effects of the Compton collisions on the electron beam and possible diagnostics

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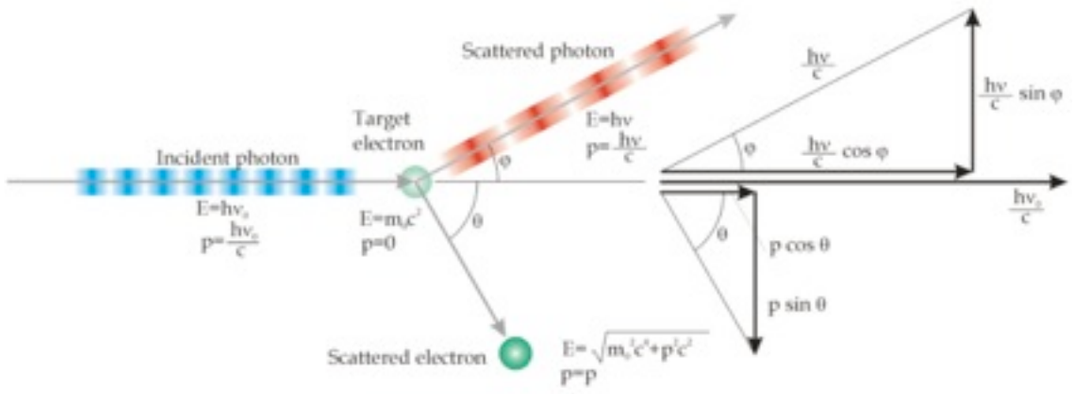
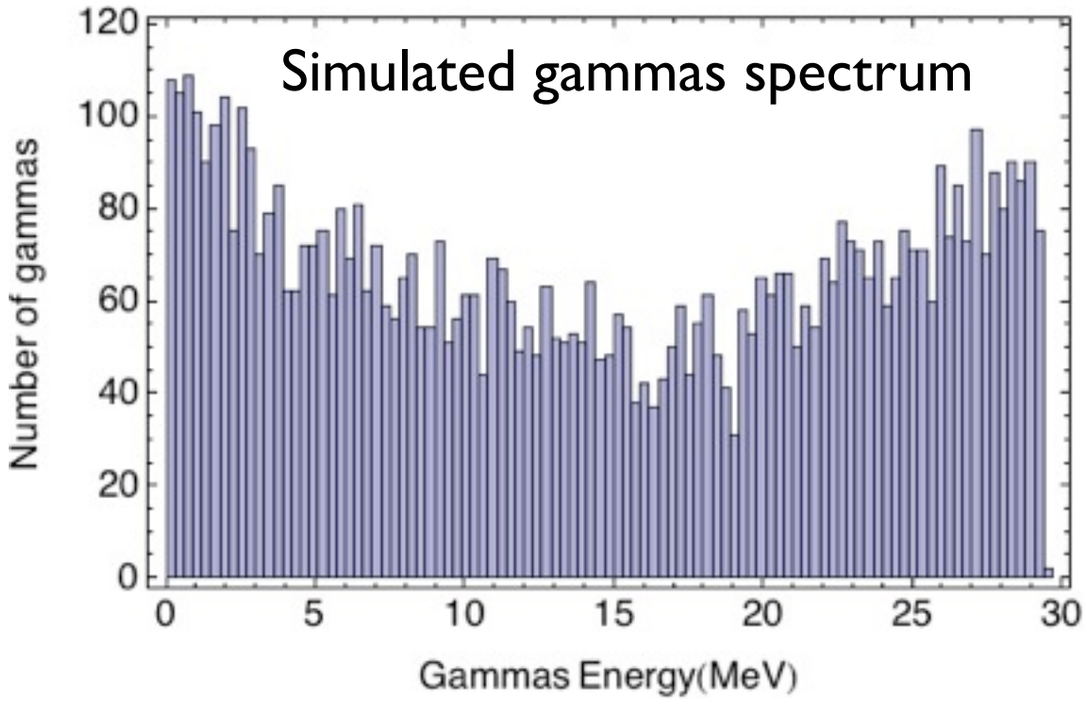
Compton Scattering. Gammas production.



During Compton scattering , the electrons transfer part of their kinetic energy to low energy photons.



Electrons Energy	1.28 GeV
Electrons population	1e10 e/bunch
Electrons bunch length	25 ps
Bunch spacing	5.6 ns
Rotation frequency	2.165 MHz
Photons energy	1.2 eV
LASER pulse length	20 ps
LASER frequency	178.5 MHz
Gammas Energy (max)	29 MeV
Gammas Energy (mean)	14 MeV
Gammas Energy (diaph)	24 MeV
Opening angle, $1/\gamma$	0.39 mrad

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Electron dynamics after Compton scattering

• In an accelerator, the voltage of the RF cavities defines RF buckets. (in ATF Damping Ring there are 165 buckets)

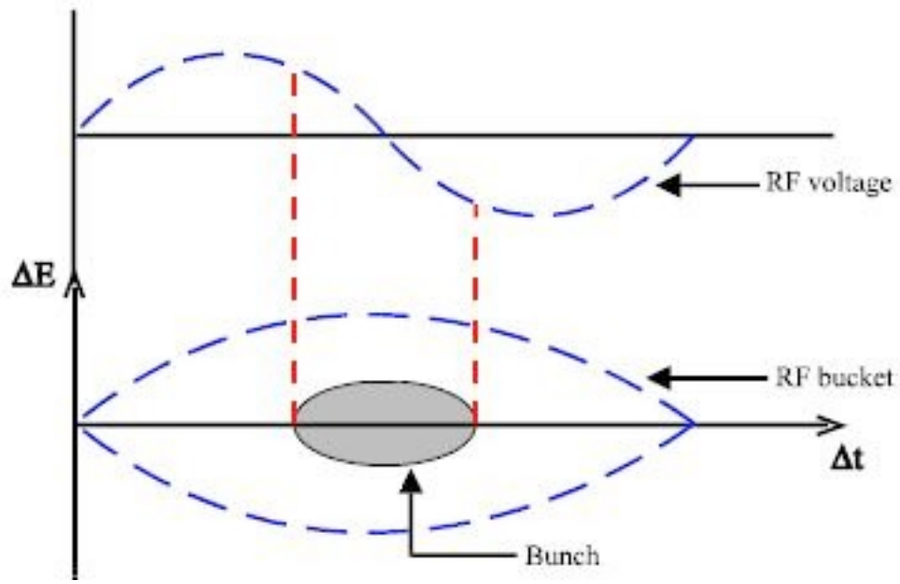
• Within each bucket there is an area of stability (bunch).

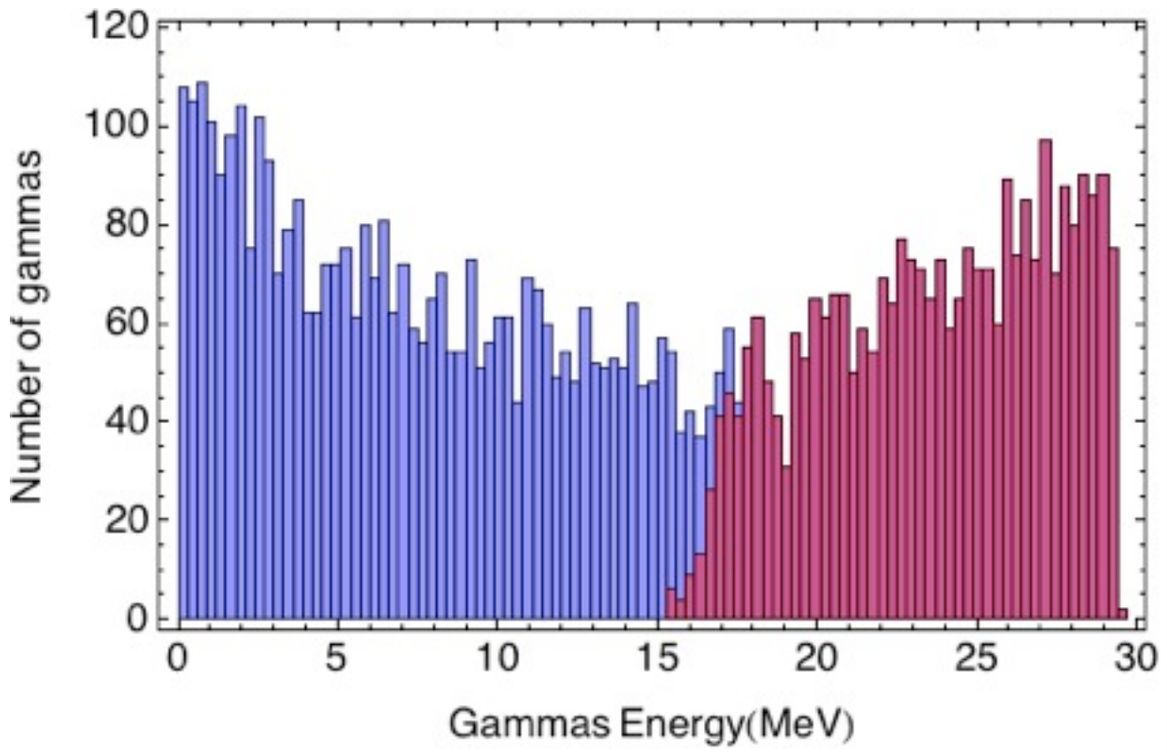
• During the normal operation, particles remain within that area.

• A small perturbation (such as low energy CS) will displace the electrons inside the area of stability.

• Whereas a larger perturbations (such as high energy CS) will kick the electrons out the area of stability.

• Electrons outside the bucket may get lost, e.g. by hitting a collimator.





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Consequences of Compton scattering

- The Compton Scattering of LASER photons off the electron beam leads to the increase of the electrons energy spread.

- The electrons beam life time decreases.

- The transverse emittance of the electrons is changed.

- The electron beam size increases transversely and longitudinally (bunch length).

Possible diagnostics

Electron bunch charge/lifetime - Wall Current Monitor (WCM), Integrating Current Transformer (ICT), Beam-Position Monitor (BPM)

Electrons positions - BPM

Emittance - QUAD scan

Electron beam size - Synchrotron radiation

Electron bunch length - Streak camera

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Outlook

- When there is enough LASER power, Compton scattering affects the beam

- This changes the properties of the beam

- There are several diagnostics available that would allow us to monitor these effects.

- We hope to look at this in February...