Matching laser frequency to electron energy for a Thomson source

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A Thomson source generates high energy radiation by colliding a laser pulse with an electron beam. This process can be described fully by classical electrodynamics [1]. The bandwidth of the emitted radiation depends, amongst others, by the energy spread of the electrons. When the energy spread is correlated a chirp can be introduced on the laser pulse such that the frequency of the laser is matched to the energy of an electron. Two different geometries have been investigated: an energy spread along propagation and in the transverse direction. For both geometries the bandwidth of the emitted radiation can be reduced to that of the case of a monochromatic electron beam.

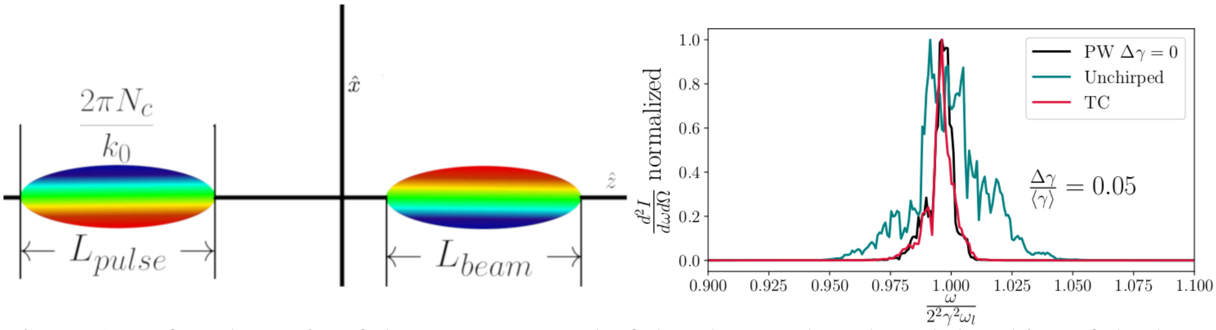

Figure 1: Left: schematic of the energy spread of the electron bunch and the chirp of the laser pulse in the transverse direction. Right: Spectrum on axis obtained from laser parameters $a_0 = 0.1$, $L_{pulse} = 150\mu$m, $W_0 = 30^{-4}$ cm, and electron parameters $\gamma = 10^3$, $\frac{\Delta\gamma}{\gamma} = 0.05$

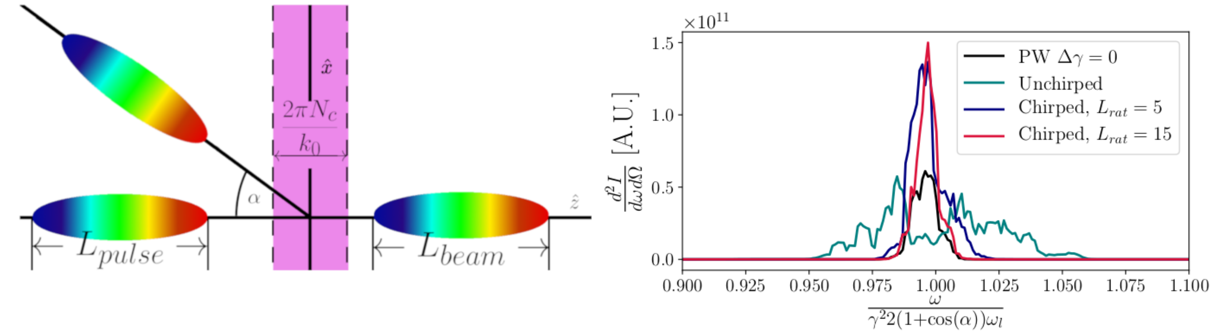

Figure 2: Left: schematic of the energy spread of the electron bunch and the chirp of the laser pulse in the longitudinal direction. Right: Spectrum on axis obtained from laser parameters $a_0 = 0.1$, $L_{pulse} = 150\mu$m, $W_0 = 30^{-4}$ cm, and electron parameters $\gamma = 10^3$, $\frac{\Delta\gamma}{\gamma} = 0.05$.

References

[1] A. I. Nikishov and V. I. Ritus, Sov. Phys. JETP, **19**, 529-541 (1964)