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Overview of Advanced Compton Sources

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Three physical regimes of Compton Sources based on back-scattering of high power lasers by relativistic high brightness electron beams will be discussed. Electron recoil is the key quantity: X-ray Thomson sources are characterized by negligible recoil and can be described classically as synchrotron radiation sources. Compton sources for nuclear photonics are characterized by a small electron recoil. However, their spectral properties are not significantly affected, so that a classical description is still accurate, as far as the recoil red-shift is taken into account as an average spectrum shift. Gamma-gamma colliders operate in the third regime, where Klein-Nishina formalism must be applied to describe the decrease of total cross section. The electron beam is weakly perturbed in the Thomson regime, where energy loss is comparable to beam energy spread. There is instead a significant distortion of the beam phase space in the intermediate regime of Gamma-ray Compton sources: the electron energy distribution goes through a transitory production of fringes, but eventually can be described by a Chapman-Kolmogorov master-equation, bringing to complete diffusion. Different technologies applied in new generation Compton sources, aiming at producing photon beams with very high brilliance, will be summarized.

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