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Luminosity effects of heavy tailed beams with transverse x-y correlation

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The luminosity of particle colliders depends, among other parameters, on the transverse profiles of the colliding beams. At the LHC at CERN, heavy-tailed transverse beam distributions are often observed, and the luminosity is modeled with the assumption that the x-y planes are independent in each beam. Analytical calculations show that the solution of inverting 1D heavy-tailed beam profiles to transverse 4D phase-space distributions is not unique. For the same transverse profile, the distributions can be dependent or independent in the transverse planes in absence of machine coupling. In this work, the effect of transverse x-y dependence of the 4D phase space distribution on the luminosity of a particle collider is evaluated for heavy-tailed q-Gaussian beams.

Footnotes

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