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Non-perturbative QFT for the calculation of collider processes embedded in the intense electromagnetic fields at the Interaction Point

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A non-perturbative QFT - the Furry picture - which treats the interaction of particles with each other perturbatively and with intense electromagnetic fields exactly, is already used routinely in the calculation of the beamstrahlung and coherent pair production. The current implementation of the theory for existing calculations requires the approximation of ultra-relativistic, co-linear initial and final states and takes into account the field of only one of the intense charge bunches colliding at the IP. In this talk will be presented theoretical developments to make existing calculations more exact by obtaining solutions of the minimally coupled Dirac equation in two external, constant crossed fields for general kinematics. These solutions are applied to the beamstrahlung and the more exact transition probability is compared numerically to the standard one. The next generation of colliders will involve such intense electromagnetic fields that these exact solutions must be applied to all collider processes so as to obtain corrected cross-sections. Such a program of work is outlined and the application to general second order processes is described in detail.

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