Contribution ID: **6** Type: **not specified**

Electron-positron pairs beaming in the Breit-Wheeler process

Wednesday 30 November 2016 16:20 (20 minutes)

Direct production of electron-position pairs in photon collisions is one of the basic processes in the Universe. The electron-positron production $\gamma + \gamma$ to $e^+ + e^-$ (linear Breit-Wheeler process) is the lowest threshold process in photon-photon interaction, controlling the energy release in Gamma Ray Bursts, Active Galactic Nuclei, black holes and other explosive phenomena [1]. It is also responsible for the TeV cutoff in the photon energy spectrum of extra-galactic sources. The linear Breit-Wheeler process has never been clearly observed in laboratory with important probability of matter creation [2].

Thanks to the recent progress in high-power laser sources it will be possible to create compact sources of intense γ-ray beams (few MeV) and to use them in new experiments allowing to observe and study the BW process in laboratory [3]. In this presentation, based on the kinematics of two photon collisions, we study the $e^+ - e^-$ beam properties. In particular, we demonstrate a possibility for beaming of $e^+ - e^-$ pairs in one particular direction, which may strongly facilitate the observation of the BW process [4]. We show that the pair beaming effect depends on the angle between photon beams and the energy of each beam. Moreover, the numerical simulations with the photon collision code TriLens [5] are in good agreement with the analytical model. Simulation results obtained with TriLens using optimized gamma beams to prepare experiments on future ultra-high intensities lasers like Apollon will be presented. With higher photon beam energies (>100 MeV) the beaming effect can be observed also for muon-pairs creation.

We acknowledge the financial support from the French National Research Agency (ANR) in the frame of "The Investments for the Future" Programme IdEx Bordeaux - LAPHIA (ANR-10-IDEX-03-02) - Project TULIMA. This work is partly supported by the Aquitaine Regional Council (project ARIEL).

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Session Classification: Basic Science

Track Classification: Basic Science