Optimization of gamma photons collision setups for two photon Breit-Wheeler pair production in the laboratory

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Linear Breit-Wheeler pair creation is the lowest threshold process in photon-photon interaction, controlling the energy release in Gamma Ray Bursts and Active Galactic Nuclei, but it has never been directly observed in the laboratory. We have recently proposed a new experimental setup based on the collision of MeV photon sources produced by high intensity lasers [1]. Using numerical simulations, we have therefore optimized the generation of collimated gamma beams with high energy conversion efficiency using high intensity lasers and innovative targets. The results of this optimization campaign will be detailed.

When two of these gamma beams collide at particular angles, our analytical calculations demonstrate a pair beaming effect easing their detection in the laboratory [2]. This effect has been confirmed in photon collision simulations using a recently developed innovative algorithm [3] that allows us to propose robust experimental designs on facilities like APOLLON, PETAL and ELI-NP. Moreover, we have studied the effect of the differential Breit-Wheeler cross section on this pair beaming. This effect changes the angular and energy distribution of the produced pairs in the laboratory frame.

An alternative scheme using Bremsstrahlung radiation produced by next generation high repetition rate laser systems at lower intensities is also being explored and we will present the results of first optimization campaigns in this regime.

This research was supported by the French National Research Agency under Grant ANR-17-CE30-0033-01, and the US Air Force project AFOSR No. FA9550-17-1-0382

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