Enhancement of Chirality Production from the Vacuum by Time-Dependent Electromagnetic Fields

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Nonzero chirality (*i.e.*, difference between the number of right- and left-handed electrons) can be produced from the vacuum by a strong electromagnetic field as a consequence of chiral anomaly. For massless electrons, the chirality production is very well understood, and the amount of chirality produced can be obtained exactly by the Adler-Bell-Jackiw anomaly relation. The understanding is incomplete when electrons are massive: There is no general formula for the amount of chirality produced, except for the limit of a constant electromagnetic field. In the constant electromagnetic-field limit, the chirality production is suppressed exponentially by the electron mass and therefore, it is commonly understood that the chirality production is difficult to be observed with laboratory experiments.

In this talk, I show that the amount of chirality produced can be enhanced significantly, *i.e.*, becomes free from the exponential suppression if electromagnetic fields are time-dependent. In particular, I consider two mechanisms to enhance the chirality production: (i) the dynamically assisted Schwinger mechanism [1,2] and (ii) (a periodic) high-frequency electric field [3] based on the perturbation theory in the Furry picture and the Floquet expansion, respectively.

References

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[2] H Taya, arXiv:2003.08948 (2020)

[3] K Fukushima, Y Hidaka, T Shimazaki and H Taya, in preparation