High energy attosecond pulse interaction with matter and application to proton–Boron fusion

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For several decades, the interest of the scientific community in aneutronic fusion reactions such as proton–Boron fusion has grown because of potential applications in different fields. Recently, many scientific teams in the world have worked experimentally on the possibility to trigger proton–Boron fusion using intense lasers demonstrating an important renewal of interest of this field [1]. It is now possible to generate ultra–short high intensity laser pulses at high repetition rate [2, 3]. These pulses also have unique properties that can be leveraged to produce proton–Boron fusion reactions. In this work, we investigate the interaction of a high energy attosecond pulse with a solid proton–Boron target and the associated ion acceleration supported by numerical simulations. We demonstrate the efficiency of single–cycle attosecond pulses in comparison to multi–cycle attosecond pulses in ion acceleration and magnetic field generation. Using these results we also propose a path to proton–Boron fusion using high energy attosecond pulses [4].

References

[1] Giuffrida L., Belloni F., Margarone D., Petringa G., Milluzzo G., Scuderi V., Velyhan A. A., Rosinski M., Picciotto A., Kucharik M., Dostal J., Dudzak R., Krasa J., Istokskaia V., Catalano R., Tuisco S., Verona C., Jungwirth K., Bellutti P., Korn G. and Cirrone G. A. P., Phys. Rev. E **101**, 013204 (2020)

[2] Vincenti H. Phys. Rev. Lett. **123**, 105001 (2019)

[3] Wheeler J. A., Mourou G. & Tajima T., Rev. Accel. Sci. and Tech. **10**, 227 (2019)

[4] X. Ribeyre, R. Capdessus, J. Wheeler, E. d'Humières and G. Mourou , Submitted to Science Rep. (2022)