In Silico Magnetgenesis: from astrophysics to the lab

Understanding the origin of magnetic fields in astrophysical unmagnetized plasmas is a problem of great interest, which has attracted considerable effort during the past years [1]. Various mechanisms leading to the field generation have been identified, but a clear comprehension of the process is still missing. Analytical and numerical works have suggested that the Biermann battery [2] and the Weibel/Current Filamentation instability [3, 4] are able to produce seed magnetic fields.

Nowadays, the availability of multi-terawatt lasers with intensity higher than 10^{19} W/cm^2 and ultra-relativistic high-density particle beams allows probing these scenarios in the laboratory through properly scaled experiments. In this way, fine experimental diagnostics can grant access to a new series of unprecedented information on the magnetic field dynamics [5, 6].

During this talk, I will review how strong magnetic fields can be generated under realistic experimental conditions using intense laser pulses [7, 8]. Leveraging realistic kinetic simulations, novel experimental setups will be illustrated. It will be thus shown how fields similar to the one present in astrophysical contexts can be produced and explored in the laboratory.

References

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