Non-equilibrium atmospheric pressure discharges provide an attractive area of industrial interest, largely due to their relative ease of operation and usefulness in fields such as surface treatment of plastics, medical surfaces or even tissue. In recent years there has therefore been a mounting interest in characterising these types of discharges numerically through simulation, as well as through experiment. However due to the computational intensity and complex physics of atmospheric pressure discharges most of the simulation work has been done using the fluid approximation, as opposed to the directly kinetic treatment of the Particle-In-Cell/Monte Carlo collisions approach. As a result of these simplifications, the quantitative validity of these simulations has been previously questioned in the literature.

In our work we utilise the performance improvements facilitated by the highly parallel nature of the Particle-In-Cell code and the developments in the field of General Purpose Graphical Processing Units to investigate a fully kinetic approach to atmospheric plasma modeling. We present benchmark performances with respect to a classical CPU approach, demonstrating achievable improvements on a relatively inexpensive hardware setup, and validation of basic physics of the model implementation in anticipation of extending the existing code to allow for comparison of physical predictions with atmospheric fluid models.


* Work supported by IRCSET and SFI Grant no. 08/SRC/I1411