Abstract Submitted
for the GEC20 Meeting of
The American Physical Society

Multi-scale two-domain numerical modeling of stationary positive DC corona discharge/drift-region coupling[1] NICOLAS MONROLIN, FRANCK PLOURABOU, Institute of Fluid Mechanics of Toulouse (IMFT), Toulouse University, CNRS, INPT, UPS, Toulouse, France., MIR COLLABORATION — We asymptotically derive a multi-scale/two-domain approach for corona discharge numerical modeling. We show how the initial non-linear, elliptic-hyperbolic non-local problem can be formulated into two coupled ones from a multipole expansion of the radiative photo-ionization source term resulting in truncating it to a local integral in corona discharge domain. The proposed approach is both monolithic and two-domain, producing two asymptotic regions, an inner-one associated with corona discharge, and an outer-one, the drift region. We provide the coupled conditions between the two domains, as well as thoughtfully analyze the electron flux feeding of the inner corona discharge created from photo-ionization in the drift region. This coupling is taken care of by Lagrange multipliers, within a variational formulation, leading to a hierarchy of non-linear coupled problems. Numerical convergence and validations of the finite element implementation of the approach are provided. Comparison with various experimental results convincingly demonstrate the applicability of the method, which avoid tuning parameters dedicated to each specific configuration, but, on the contrary, exclusively and robustly relies on known and measurable physical quantities.

[1]This work was supported by the CNES (research contract 5100015475) and the French Occitanie region.

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Date submitted: 08 Jun 2020 Electronic form version 1.4