Abstract Submitted
for the GEC19 Meeting of
The American Physical Society

Implementing a shallow water mathematical modeling approach for simulating plasma interaction in multiphase configurations ALI CHARCHI AGHDAM, Department of Mechanical Engineering, University of South Carolina, ENRICA VIPARELLI, Department of Civil and Environmental Engineering, University of South Carolina, TANVIR FAROUK, Department of Mechanical Engineering, University of South Carolina — Numerous mathematical approaches have been proposed to resolve and simulate general multi-phase flow problems. Notable among them are the Volume of Fluid (VOF), the front tracking and the level-set methods. Each of these methods have their own strengths and drawbacks but they all suffer from extensive computational overhead which has limited their usage and utility in simulating plasma discharges in multiphase configuration. In this work, an attempt has been made to adopt the 1D shallow water (SW) approach; typically employed for modeling fluid flow in open channels, to model the gas liquid interface for a multiphase plasma process. The proposed model is adopted to simulate the classical cold plasma jet and its interaction with a liquid layer. A special boundary condition for the SW equations is developed from momentum balance for a selected region of the liquid which is directly affected by the jet. The SW equations are then solved for the rest of the domain to resolve the velocity and interface location. The SW method proved to be more affordable compared to the VOF methods while the results found to be in good agreement.

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Date submitted: 31 May 2019 Electronic form version 1.4