

## 2D particle-in-cell simulation in ESW

### Introduction

In space plasma, the electrostatic isolated structures are often observed by satellites in auroral region as a prevalent phenomenon, which is considered corresponding to electron phase-space holes, viz. BGK mode [Bernstein, et al., 1957; Berthomier, et al., 2003] by currently research. In these holes, the parallel cut of the parallel electric field exhibits bipolar structures. However, they only deem they are 1D structures. But in this paper, the 2D structures will be exhibited that the  $E_x$  is bipolar structures while the perpendicular electric field  $E_y$  is unipolar.

This paper is divided into four sections. Section One starts with background and status quo of the topic. The calculation model is presented in the second section, and in section three the results are educed. The conclusion is arranged in the last section.