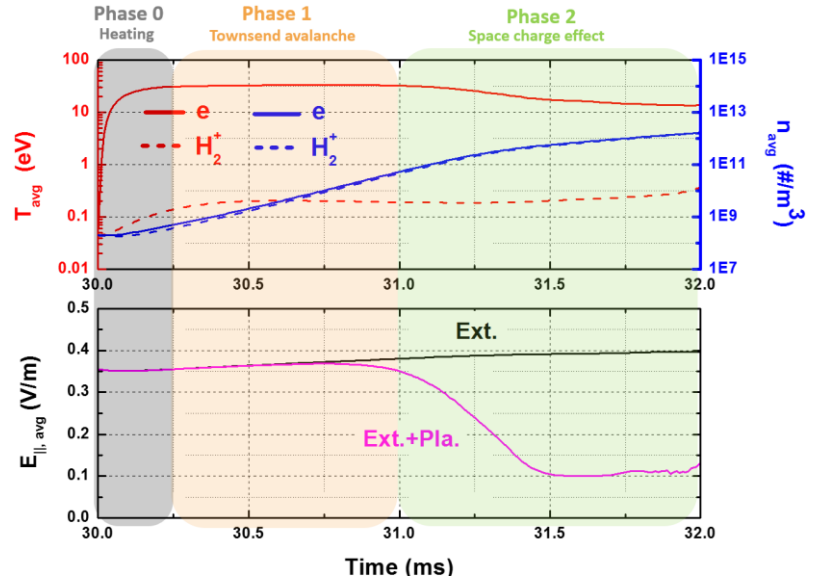


FIG. 1. Intuitive schematic diagram of the relation between electric fields and the space charge in the tokamak with the toroidal axisymmetric assumption.



- To understand the dynamic and complex ohmic breakdown phenomena in a tokamak, an **electrostatic direct-implicit PIC-MCC code** for **toroidally axisymmetric plasma model** is developed and applied.
- In the simulations, **crucial roles of the self-produced electric fields** by the **space charge** of the plasma are newly observed.
 - In the parallel direction, the **avalanche growth rate is reduced** by $|E_{tot,||}|$ reduction due to the space charge accumulated inside of the vessel.
 - In the perpendicular direction, **$E \times B$ drift** due to the self-produced perpendicular electric field results in new perpendicular transport especially for cold ions which can totally change the picture of the breakdown.
- These **space-charge effects** newly observed in this research could be important clues to a deeper understanding of unresolved issues of the ohmic breakdown in the tokamak.