1. (14 points) In section 2, the authors mention that they carried out their simulations using a code that solves Maxwell's equations, particularly Ampere's law. The differential form of the Ampere-Maxwell law is

$$\vec{\nabla} \times \vec{B} = \mu_0 \Big(\vec{J} + \epsilon_0 \frac{\partial \vec{E}}{\partial t} \Big)$$

Please, write down what each of the following terms represents: $\vec{\nabla} \times \vec{B}$, μ_0, $\vec{J}$, ϵ_0, $\frac{\partial \vec{E}}{\partial t}$ **(2 points each).**

Briefly explain what the Ampere-Maxwell law is. (2 points)

How does it apply to the work carried out by the authors? (2 points)

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Answer:

- $\vec{\nabla} \times \vec{B}$: curl of the magnetic field
- μ_0: magnetic permeability of free space
- $\vec{J}$: electric current density
- ϵ_0: electric permittivity of free space
- $\frac{\partial \vec{E}}{\partial t}$: rate of change of electric field with time

Briefly explain what the Ampere-Maxwell law is. (2 points)

Answer: The Ampere-Maxwell law relates the spatial variation of a magnetic field, to the accompanying electric current, and possibly a changing electric field (unless this change is negligibly small). If the latter is negligibly small, then it goes to zero and the equation reduces to $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$.

How does it apply to the work carried out by the authors? (2 points)

Answer: The authors are investigating the acceleration of electrons as a result of magnetic recconection. The $\vec{\nabla} \times \vec{B}$ term in the equation represents this change in the magnetic field, and the $\vec{J}$ term represents the induced current, or flow of charged particles (hence the movement and acceleration of electrons).