Contribution ID: **151** Type: **Student Poster**

A Toy Model of Numerical Cherenkov Radiation

Tuesday, 8 November 2022 17:00 (2h 30m)

The discretization of electromagnetic equations of motion can lead to changes in the dispersion relations such that particle velocities can meet or exceed the effective speed of light, even in vacuum. Numerical Cherenkov Radiation results from a resonance response between the electromagnetic potentials and superluminal charge. To assess the effects of numerical Cherenkov radiation on variational macro-particle models, we have developed a toy model. Analyzing this model of a single macro-particle moving through vacuum, we use Discrete Fourier Analysis to produce equations of motion consistent with a Lagrangian formulation in a discretized domain and show that the resonant behavior leads only to secular growth. We then claim that further complications to the toy model only serve to decrease the effect of Numerical Cherenkov Radiation on the growing solutions.

Acknowledgments

This work supported by NSF grant numbers PHY-1535678 and PHY-2108788.

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Session Classification: Poster Session and Reception

Track Classification: Poster Session: WG2 Poster: Computation for Accelerator Physics