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Kinetic simulations of high-field fusion plasmas

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The ability to efficiently model highly magnetized plasmas is critical for the study of both astrophysical processes and magnetic fusion devices. However, resolving the high gyrofrequencies associated with these plasmas from first-principles is computationally demanding. In this work, we explore the use of a guiding center approximation (GCA) to relax the demanding resolutions required, allowing for more efficient simulations of high-field plasmas. We review the algorithms more commonly used in kinetic simulations of plasmas and compare them with those based on the GCA approach, that we intend to implement in the particle-in-cell code *OSIRIS* for applications in the study of magnetic mirror machines.

Our findings confirm the need to employ a very high resolution ($\Delta t \Omega < 0.2$) with current algorithms to reach reasonable accuracy and show good perspectives for significant computational gains by employing a CGA approach.

Primary author: CÂNDIDO, João (Instituto Superior Técnico)

Presenter: CÂNDIDO, João (Instituto Superior Técnico)