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Monte-Carlo finite elements gyrokinetic simulations of Alfven modes in tokamaks ALBERTO BOTTINO, ALESSANDRO BIANCALANI, FRANCESCO PALERMO, NATALIA TRONKO, Max Planck Institute for Plasma Physics — The global gyrokinetic code ORB5 [S. Jolliet et al., Comp. Phys. Comm., 177, 409 (2007)] can simultaneously include electromagnetic perturbations, general ideal MHD axisymmetric equilibria, zonal-flow preserving sources, collisions, and the ability to solve the full core plasma including the magnetic axis. In this work, a Monte Carlo Particle In Cell Finite Element model, starting from a gyrokinetic discrete Lagrangian, is derived and implemented into the ORB5 code. The variations of the Lagrangian are used to obtain the time continuous equations of motion for the particles and the Finite Element approximation of the field equations. The Noether theorem for the semi-discretised system, implies a certain number of conservation properties for the final set of equation. Linear and nonlinear results, concerning Alfvén instabilities, in the presence of an energetic particle population, and microinstabilities, such as electromagnetic ion temperature gradient (ITG) driven modes and kinetic ballooning modes (KBM), will be presented and discussed. Due to losses of energetic particles, Alfvén instabilities can not only affect plasma stability and damage the walls, but also strongly impact the heating efficiency of a fusion reactor and ultimately the possibility of reaching ignition.

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