Alfvén Waves in Gyrokinetic Plasmas and Transport Time Scale Simulations*

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We will report in this paper the properties of shear and compressional Alfvén waves in gyrokinetic plasmas.[1,2] One salient feature of these waves in comparison with their MHD counterparts is the role played by compressional Alfvén waves in magnetic field calculations. Specifically, we can eliminate these waves in gyrokinetic plasmas through frequency ordering while one needs further geometric simplifications or implicit numerical schemes in the MHD description for their suppression. We will focus on this unique property to design a scheme for simulating plasma turbulence and kinetic-MHD on the transport time scale using our global gyrokinetic particle simulation code (GTC) which has been utilized recently for turbulence simulations of reactor size plasmas.[3] The proposed scheme also depends critically on the concept of steady state turbulent transport using entropy production in the presence of collisionless and/or collisional dissipations as a measuring stick.[4,5] In this regard, we need simulation models that can properly take into account velocity space nonlinearities[6] and collisions that are momentum and energy conserving.[5,7] Both of these effects are already in place in the GTC code, where collisions are treated as subgrid phenomena using Monte-Carlo operations. The procedures for using GTC to simulate turbulence transport and kinetic-MHD physics, and to predict profile (density, current, pressure) evolution and to advance magnetic topology on the transport time scale will be discussed. The expected performance of such a code on MPP platforms, such as the cached-based Seaborg at NERSC and the vector-parallel Earth Simulator in Japan will be reported as well.

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(Oral Talk)