In recent work (Herreman & Lesaffre, JFM 679, 2011 - Vladimirov, JFM 698, 2012), it was found that fluctuation flows in highly conducting fluids can drive dynamos through their Stokes drift. We have linked this result to Braginsky's & Soward's model for dynamo in weakly asymmetric systems (Braginsky, Sov. Phys. JETP 20, 1964 - Soward, PTRSO A 272, 1972).

If no use is made of spatial averages, the leading order prediction of this model is that the Lagrangian mean flow controls the dynamo at high Rm. We test this idea on a pulsed Beltrami-wave dynamo, which confirms the validity but also reveals how critical layer problems, related to the appearance of Lagrangian chaos may prevent from using such Lagrangian averaged model. We apply the model to show that inertial waves or quasigeostrophic Rossby waves accompanied by mean flow do not drive a dynamo at lowest order.