Abstract Submitted
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Role of phase locking in nonlinear dynamics of fishbones and EPMs[1] FULVIO ZONCA, ENEA, C.R. Frascati, LIU CHEN, UCI and IFTS, ZJU, ZHIYONG QIU, IFTS, ZJU — Fishbones [1] and, more generally, Energetic Particle Modes (EPM) [2], are discrete non-normal modes excited out of the shear Alfvén wave (SAW) continuous spectrum. Their frequency is the characteristic one of resonant EPs and maximizes wave-EP power exchange, exceeding SAW continuum damping. These properties are maintained during the nonlinear evolution of the system, due to the intrinsic non-perturbative response of EPs to the fluctuating SAW fields and their self-consistent interplay with the perturbed EP source. This dynamic behavior is given by "phase locking" between resonant EPs and SAW fluctuations, as demonstrated in this work; and can be generally described by a Dyson equation for the emission and reabsorption of SAW fluctuations by the EP population [3]. Here, we apply this theoretical framework to nonlinear fishbone and EPM dynamics in fusion plasmas; and discuss their description as complex Nonlinear Schrödinger Equation, for which we provide solutions in simple yet practically relevant limiting cases [3].

[1] L. Chen et al. Phys. Rev. Lett. **52**, 1122 (1984).
[2] L. Chen, Phys. Plasmas **1**, 1519 (1994).
[3] L. Chen and F. Zonca, submitted to Rev. Mod. Phys. (2014).

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