"Spectral dynamics and Predator-Prey oscillations in turbulence in fusion plasmas", Ö. D. Gürcan, V. Berionni, P. Morel, LPP, Ecole Polytechnique, CNRS.

- The k-spectrum, *especially high-k* is very informative for nonlinear dynamics of a system.
- Studied in detail in neutral fluids. Shown regularly in fluid or MHD simulations.
- Its measurement is reasonable easy: boring steady L-mode plasmas.
- But it remains difficult to convince the gyrokinetic simulation people to look at it.
  - We can't reproduce the experimental k-spectrum well at high-k (i.e. $k_\perp \rho_i > 0.6$)?
- There is no universally accepted picture of "cascade" in plasma turbulence!?
- Instead there are speculations depending on who you ask:
  - Mixing length.
  - Classical 2D (Energy/Enstrophy) dual cascade (k^{-3} bur for what?)
  - Wave turbulence spectrum ala Zakharov-Kraichnan.
  - Scattering by zonal flows.
  - Damped modes.

Predator-Prey Oscillations

- The cascade model leads to real Predator-Prey like oscillations *[Berionni and Gürcan, PoP 2011]*.
- The "minimum" shell model with 2-shells + the large scale mode.
- In this case the shell model reduces to a coupled set of 3 ordinary differential equations:

$$\frac{\partial \Phi_1}{\partial t} + \overline{\alpha} q g k \frac{\left(1 + g^2 k^2 - q^2\right)}{\left(1 + k^2\right)} \overline{\Phi}^* \Phi_2 = \gamma \Phi_1$$

$$\frac{\partial \Phi_2}{\partial t} - \overline{\alpha} q g k \frac{\left(1 + k^2 - q^2\right)}{\left(1 + g^2 k^2\right)} \overline{\Phi} \Phi_1 = -\nu k^2 g^2 \Phi_2$$

$$\frac{\partial}{\partial t} q^2 \overline{\Phi} = \overline{\alpha} q k^3 g \left(g^2 - 1\right) \Phi_1^* \Phi_2 - \nu_F q^2 \overline{\Phi}$$