NONINTERACTION THEOREM

Zonal-mean potential vorticity equation :

$$\frac{\partial \bar{q}}{\partial t} = -\frac{\partial}{\partial y}\overline{v'q'}, \quad \text{where } \overline{v'q'} = -\left[\frac{\partial}{\partial y}\overline{u'v'} + \frac{\partial}{\partial p}\left(\frac{f_0}{\sigma}\overline{v'\theta'}\right)\right]$$

Perturbation potential vorticity equation :

$$\frac{\partial q'}{\partial t} + \bar{u}\frac{\partial q'}{\partial x} + v'\frac{\partial \bar{q}}{\partial y} = N', \qquad \text{N : nonlinear effects}$$

Perturbation potential enstrophy equation:

$$\frac{\partial}{\partial t}\frac{1}{2}\overline{q'^2} + \overline{v'q'}\frac{\partial \bar{q}}{\partial y} = \overline{q'N'} \quad \Rightarrow \quad \overline{v'q'} = \frac{1}{\partial \bar{q}/\partial y}\left[\overline{q'N'} - \frac{\partial}{\partial t}\frac{1}{2}\overline{q'^2}\right]$$

potential enstrophy cascade
when negative

Assume $\frac{\partial \bar{q}}{\partial y} \neq 0$, $\frac{\partial}{\partial t}\frac{1}{2}\overline{q'^2} = 0$ (neutral wave) and $\overline{q'N'} = 0$ (no potential enstrophy cascade).
(This effectively excludes critical and wave-breaking levels.) Then

$$\overline{v'q'} = 0 \quad \Rightarrow \quad \frac{\partial \bar{q}}{\partial t} = 0$$

Noninteraction theorem of Charney and Drazin (1961)